100% OPEN SOURCE

EU GDPR COMPLIANT

PEN Test Passed

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

SNAP4 Appliances and Dockers Installations

SNAP4CITY

KM4CITY

Be smart in a SNAP!



1st Day, General, Nov 2019, Florence

https://www.snap4city.org/501

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT

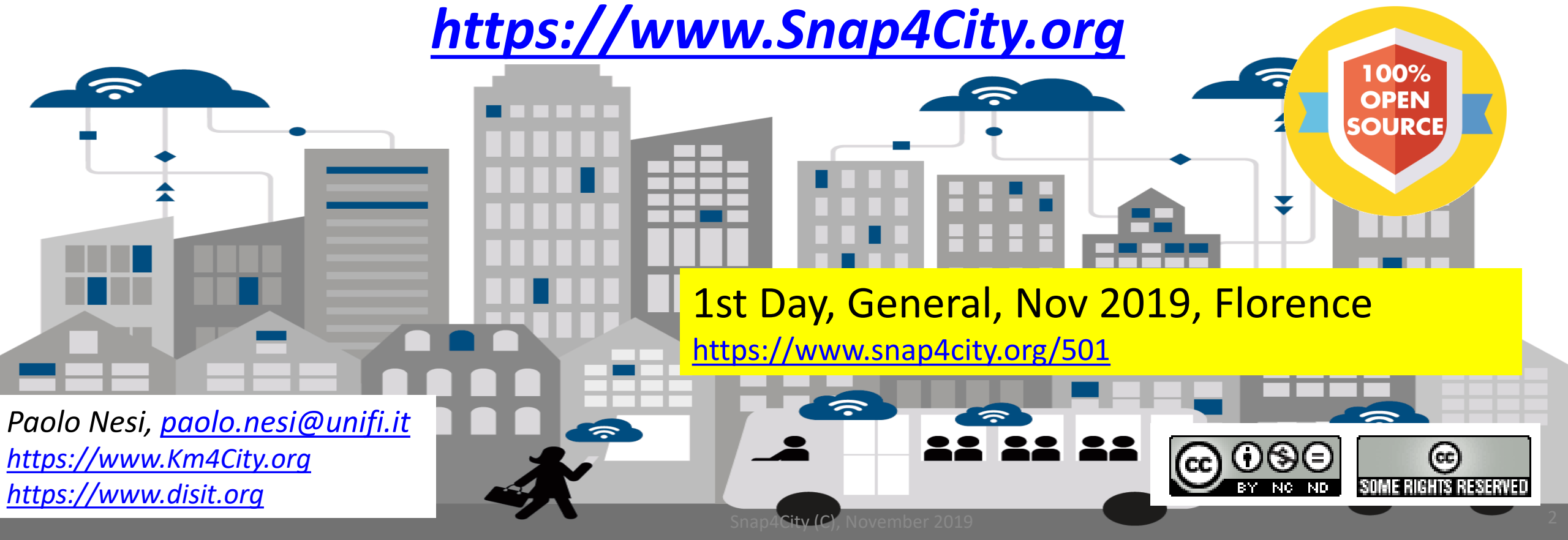
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

Powered by KM4CITY

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

https://www.Snap4City.org



1st Day, General, Nov 2019, Florence
https://www.snap4city.org/501

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

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General Overview of the full Course

- **1st Day:** *General overview (1 day, 6 hours)*
- ***2nd Day:*** *Dashboards, how to build and manage them (4 hours)*
- ***3rd Day:*** *IOT Applications development, IOT Devices, IOT Networks (4 hours)*
- ***4th Day:*** *Data Analytics, in R Studio, In Python, how to integrate with IOT Applications (4 hours)*
- ***5th Day:*** *Data Ingestion, Data Warehouse, ETL Development, Data Gate, IOT Device Data ingestion, etc.. (5 hours)*
- ***6th Day:*** *Snap4City Architecture, How To Install Snap4City (3 hours)*
- ***7th Day****: Smart city API (internal and external) Web and Mobile App development tool kit (4 hours)*

A number of the training sections include exercitations

Updated versions on: https://www.snap4city.org/501

Agenda

- GO • Overview
- GO • Urban Platform (main concepts vs Living Lab)
- GO • Snap4City Architecture
- GO • Dashboards: from City Dashboards to Applications
- GO • Data Gathering and City Data Knowledge Management
- GO • IOT Applications, Devices and Dashboards
- GO • Forging & Managing Flexible Mobile Apps, Web App, MicroApplications
- GO • Data Analytic, Big Data Science
- GO • Snap4City Living Lab for Collaborative Work
- GO • Snap4City and Km4City Projects
- GO • Acknowledgment

TOP



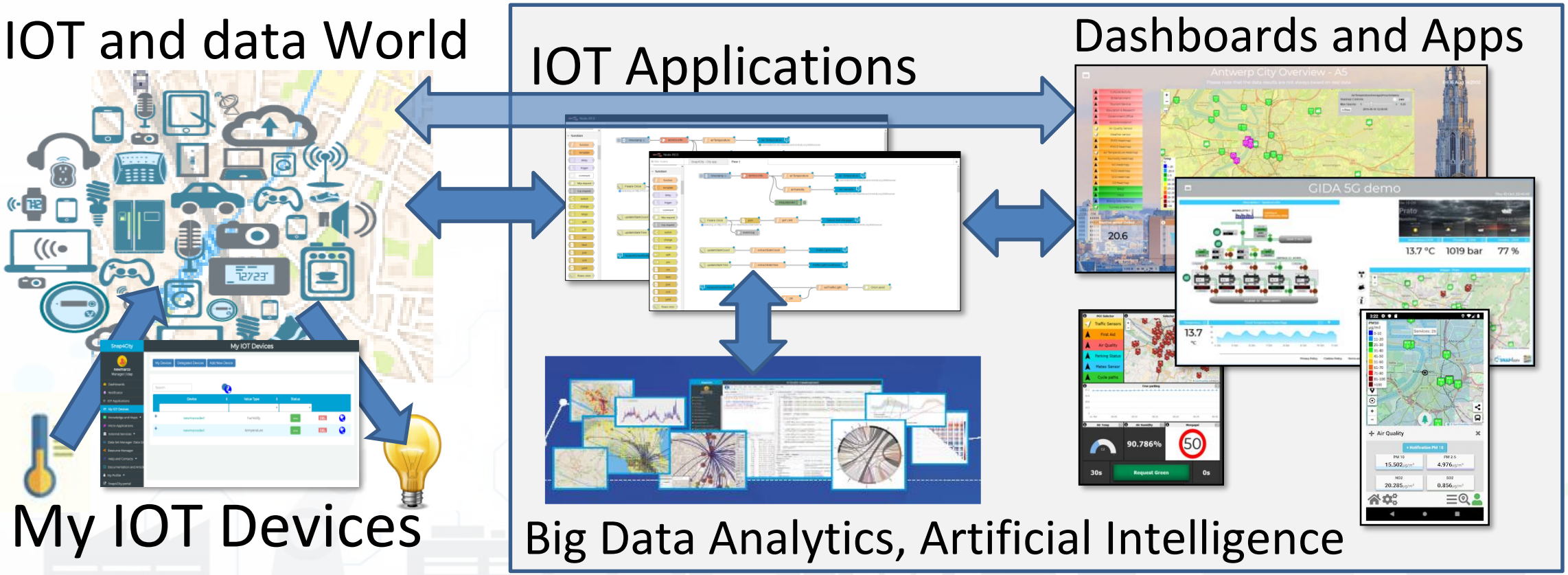
Overview

Scalable Sentient Cities Builder

SNAP4
Appliances and Dockers
Installations

Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence



SNAP4CITY

KM4CITY

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

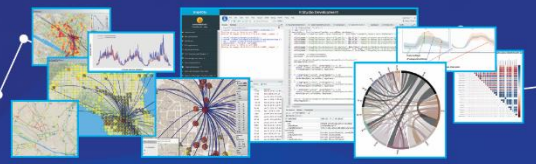
MICROSERVICES & ADVANCED SMART CITY API

LIVING LAB - DEV TOOLS - COWORKING

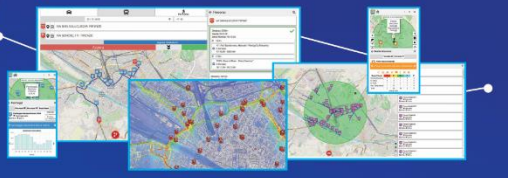


IOT DIRECTORY • SERVICE MAP • RESOURCE MANAGER • DATA GATE • R STUDIO • ETL

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

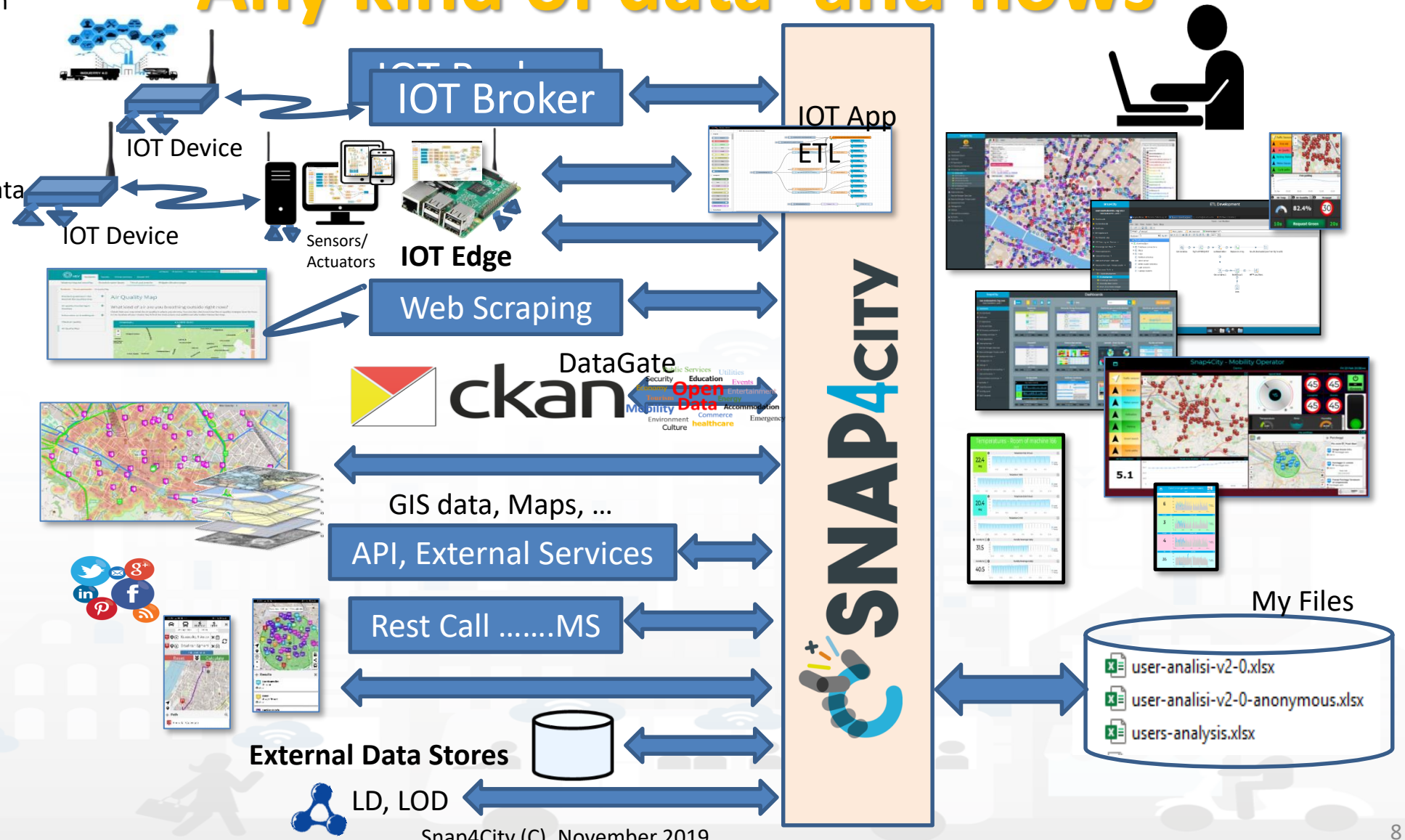
IOT MNG - DATA MNG - DATA INSPECTOR – PROCESS MNG – USER ENGAGEMENT – GDPR MNG ...

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



Any kind of data and flows

- **Open Data:**
  - Data gate, federation of Open Data Portals
  - ETL processes (PULL)
  - IOT Application processes
- **IOT Networks:**
  - IOT Application processes, data driven or PULL
  - IOT Brokers (Push) → IOT Shadow
- **Web Pages:**
  - Web scraping, crawling processes
- **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

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, etc.

Node-RED
JS Foundation
FI-WARE
E015 digital ecosystem
bee smart city
sigfox partner network
ckan
GJL
LABGEO
esri Italia THE SCIENCE OF WHERE
EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Florence





http://www.darionardella.it/il-sindaco-dario-nardella-in-missione-a-madrid-e-barcellona/

Firenze Oggi 2019

Fri 25 Oct 23:29:38

43666
Totale utenti WIFI

COLONNINE RICARICA
176 INSTALLATE
71 % ATTIVE
5.1 % IN USO

GENERAL | METEO

MINIMO	BASSO	MEDIO	ALTO

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

SITUAZIONE VIABILITA
0 INCIDENTI
0 CHIUSURE AL TRAFFICO (TOT)
0 CHIUSURE PER CANTIERI
0 PROGR. | 0 NON PROG.
0 LIMITAZIONI AL TRAFFICO (TOT)
0 LIMITAZIONI PER CANTIERI
0 NON PROG. | 0 PROGR.
0 TOT. EVENTI SULLA RETE

SMN	BINARIO16	FORTEZZA
28.7 % occupati su 607 posti	55.2 % occupati su 165 posti	27.8 % occupati su 521 posti
LEOPOLDA	**CALZA**	**S.AMBROGIO**
36 % occupati su 300 posti	70.3 % occupati su 148	99.7 % occupati su 379 posti
PARTERRE	**CAREGGI**	**BECCARIA**
34 % occupati su 656 posti	24.9 % occupati su 406 posti	98.1 % occupati su 210 posti

ANALYSIS
Energy | Environment | Mobility | Social | Resilience

FLUSSI INGRESSO CITTA
26 393.2 / 19 794.9 / 13 196.6 / 6598.3 / 0
12:00
Current / Previous

TOTALE
284094
VEICOLI

FLUSSI INGRESSO ZTL
5522 / 4141.5 / 2761 / 1380.5 / 0
12:00
Current / Previous

TOTALE ZTL
57499
VEICOLI

Nati Italiani	Nati stranieri	Deceduti	Matrimoni	Unioni Civili
163 ultimo mese consolidato	49 ultimo mese	395 ultimo mese	19 ultimi 7 giorni	0 ultimi 7 giorni

Segnalazioni ricevute in attesa	In Lavorazione	Risolte	Chiuse senza risoluzion...
1116 ultimo mese	524	305	285

Manutenzioni Stradali	Verde Pubbli...	Decoro Urbano	Relitti
54 oggi	4	6	3

Attesa media alla fermata

Linea 6	Linea 13
3 min	13 min
Linea 17	**Linea 23**
4 min	5 min
Linea 31	**Linea 36**
19 min	2 min

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

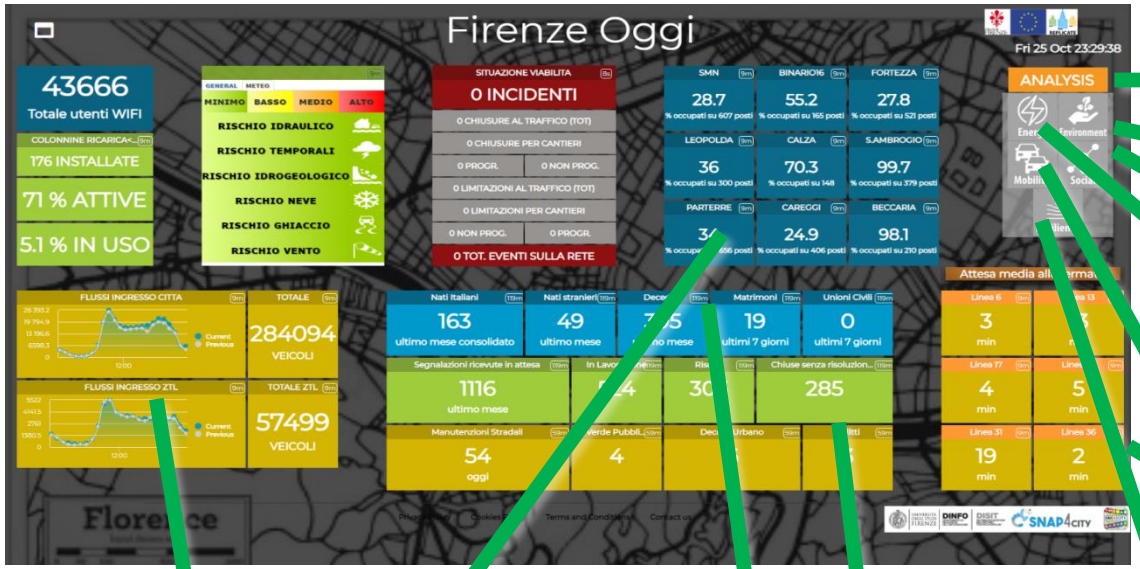
Smart City Control Room

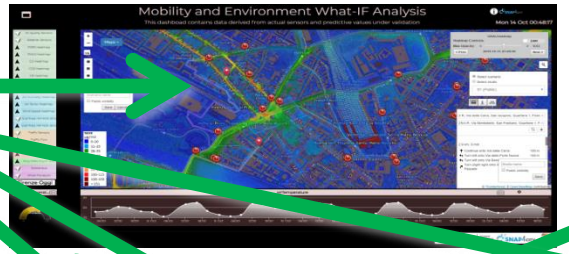
a set of dashboards and tools

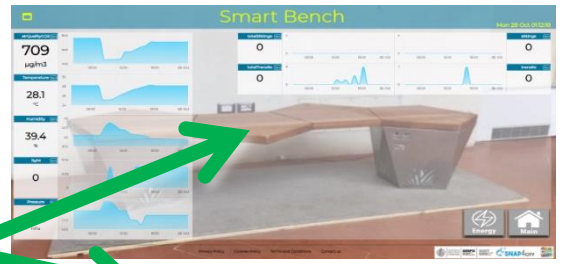
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement Nº 691735

REPLICATE

FIRENZE CITTÀ FARO



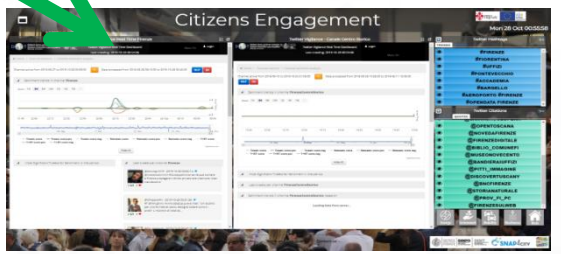


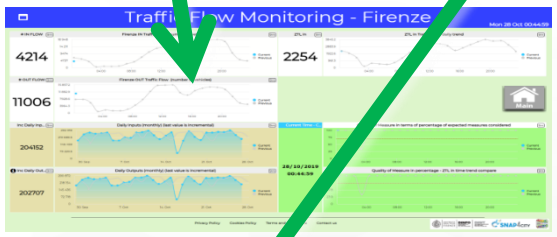




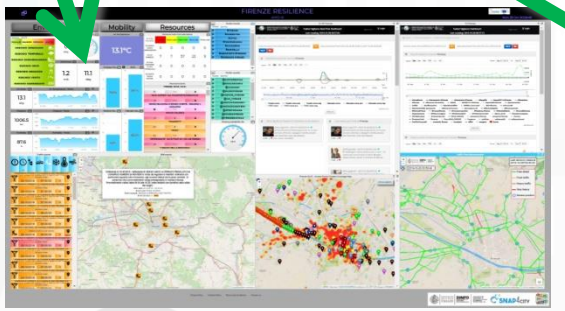


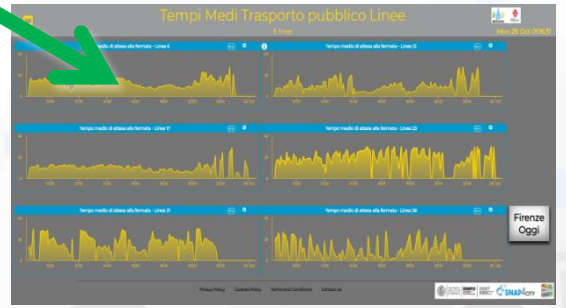
















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Mobility and Environment What-IF Analysis

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

Mon 14 Oct 00:48:17

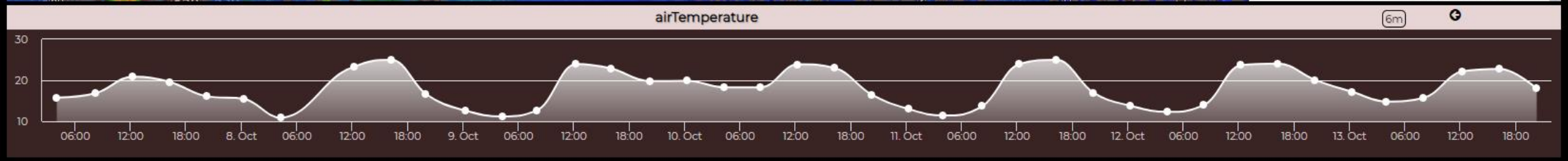
- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling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

Firenze Oggi

Air Temperat... 6m







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

Smart City Control Room (Data View)

REPLICATE
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement Nº 691735

FIRENZE CITTÀ FARO

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



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

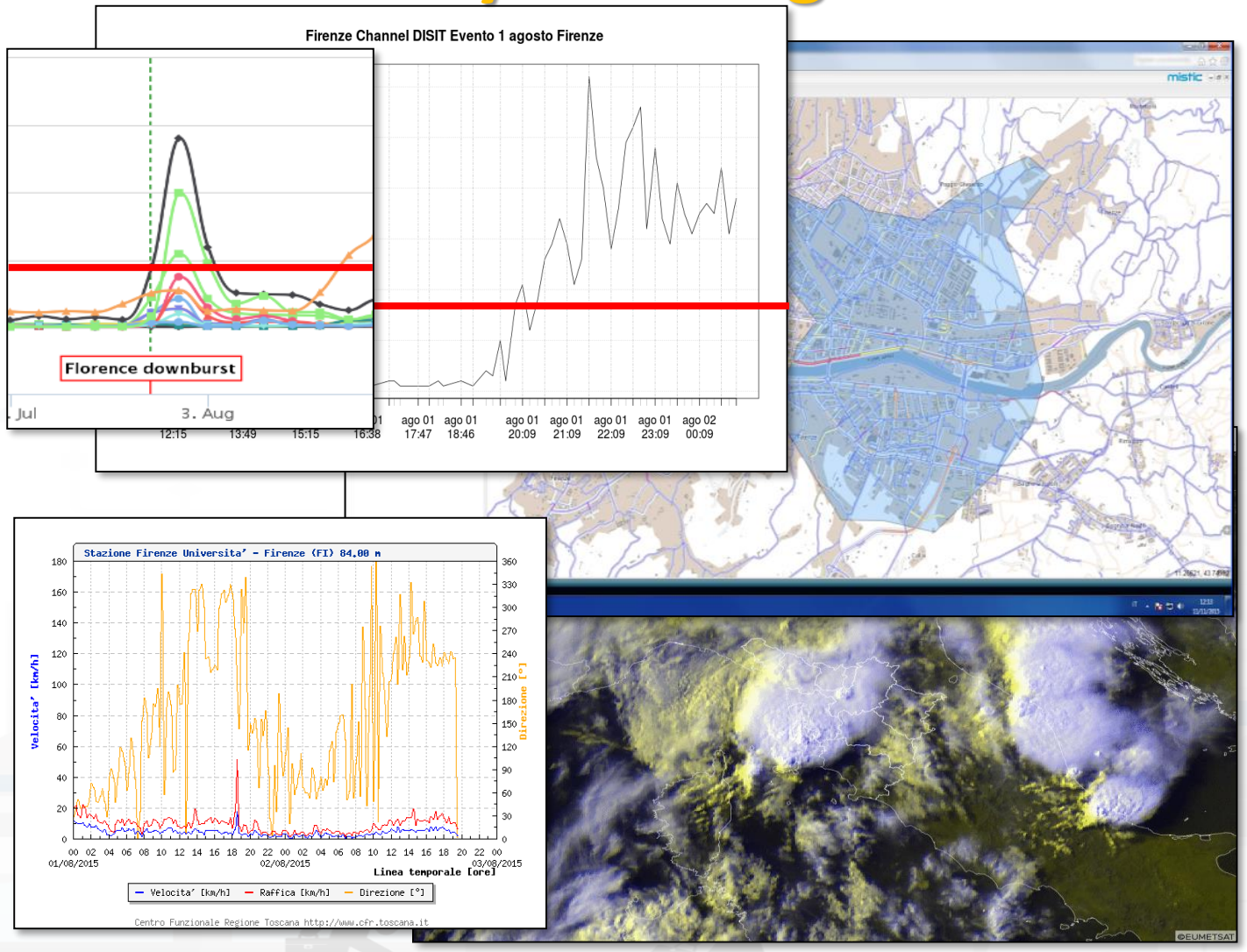


Analysis:

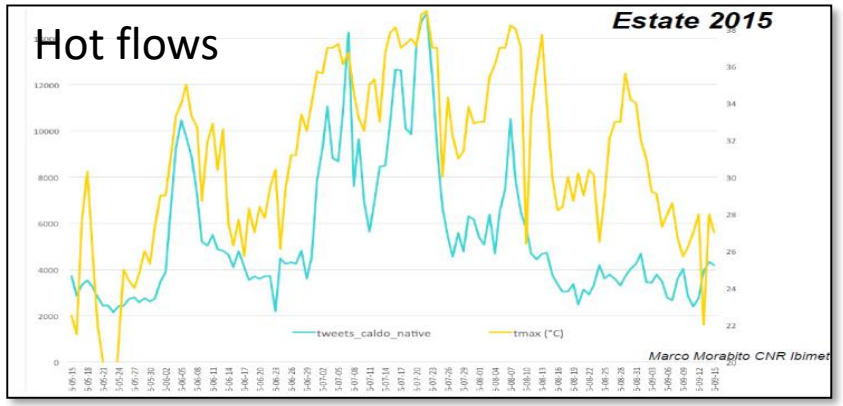
- what-if routing, scenarios,
- traffic flow, environmental predictions

Twitter Vigilance

Early Warning



Predictive models



Attendance at long lasting events: EXPO2015

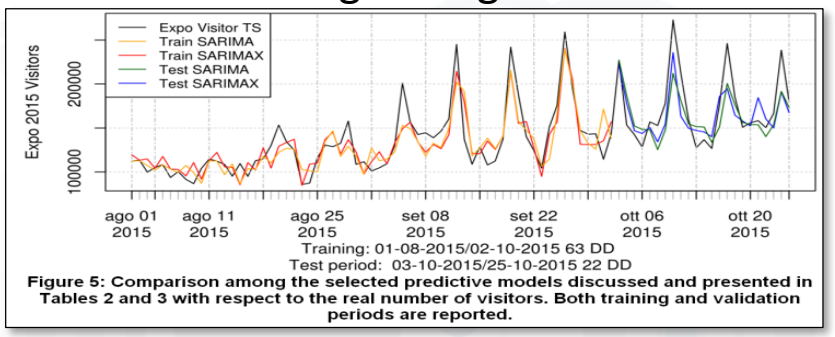
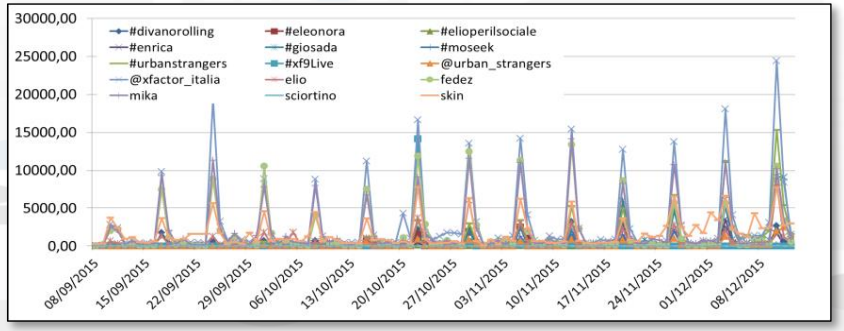


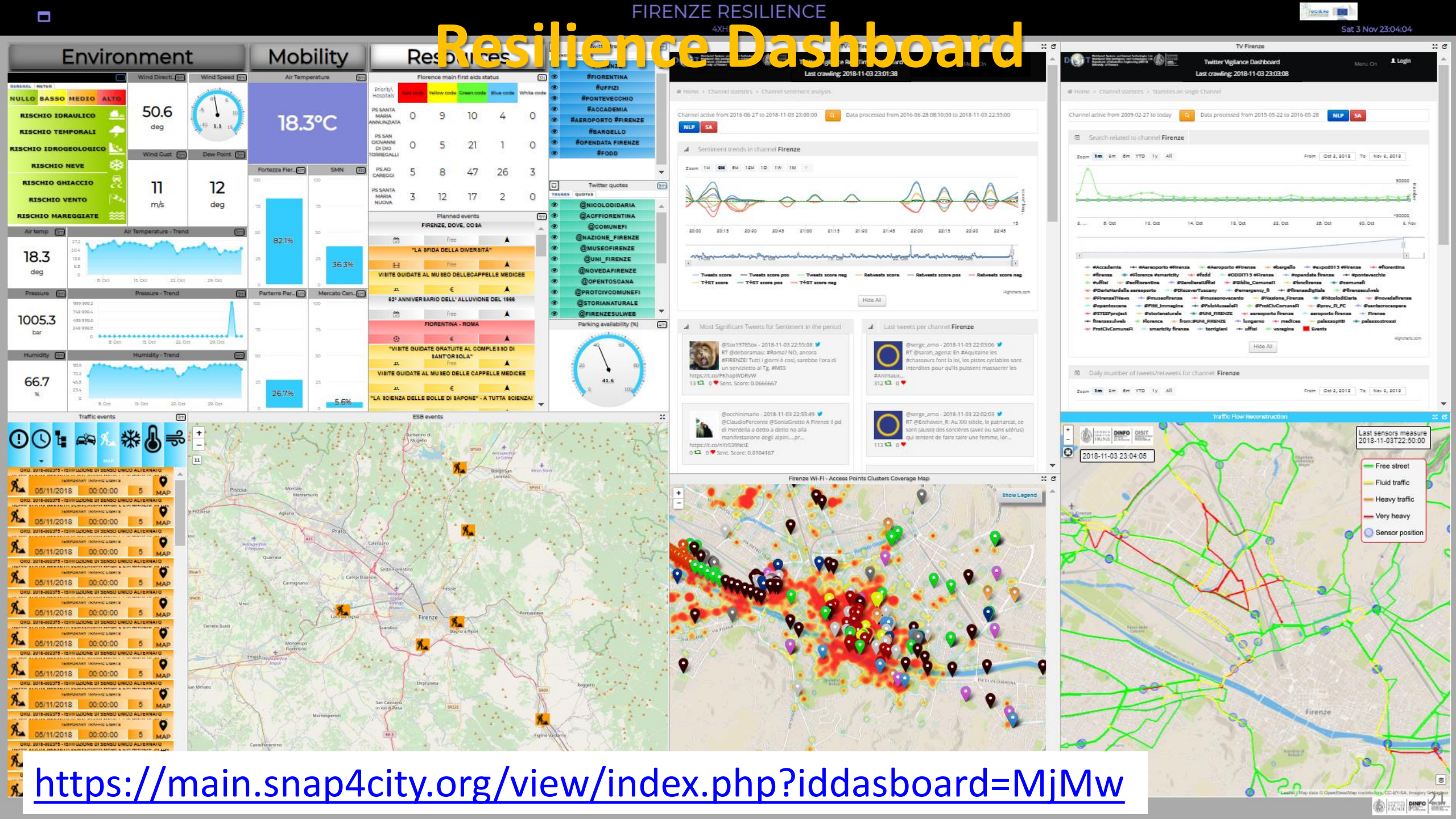
Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

Attendance at recurrent events: TV, footbal



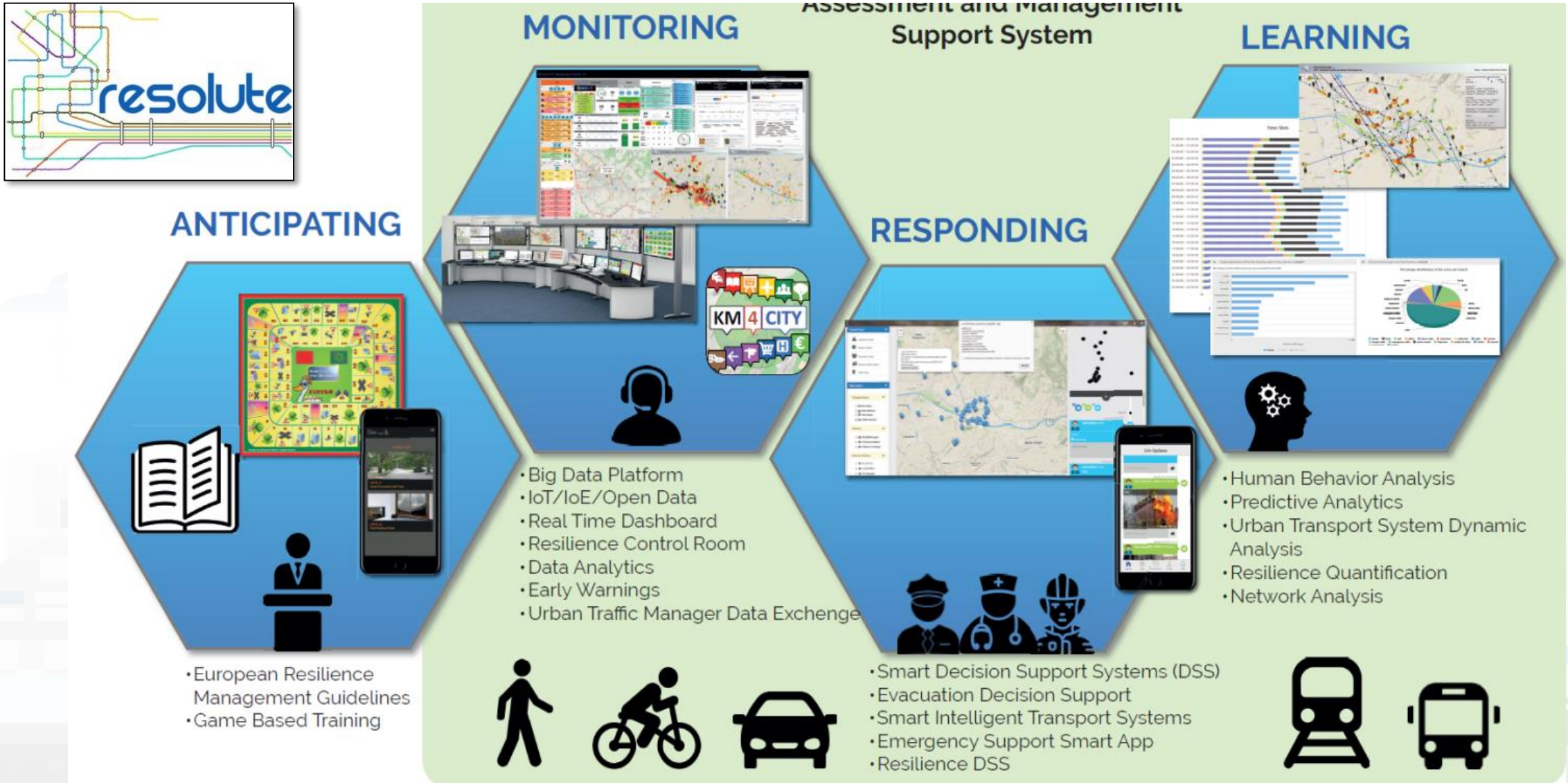

SIGNORVINO

Resilience Dashboard



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

ERMG: European Resilience Management Guide



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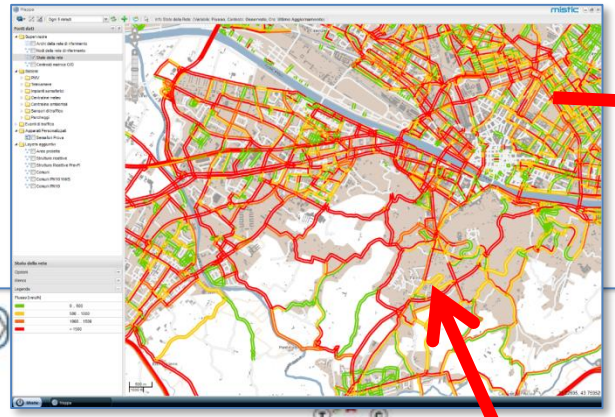
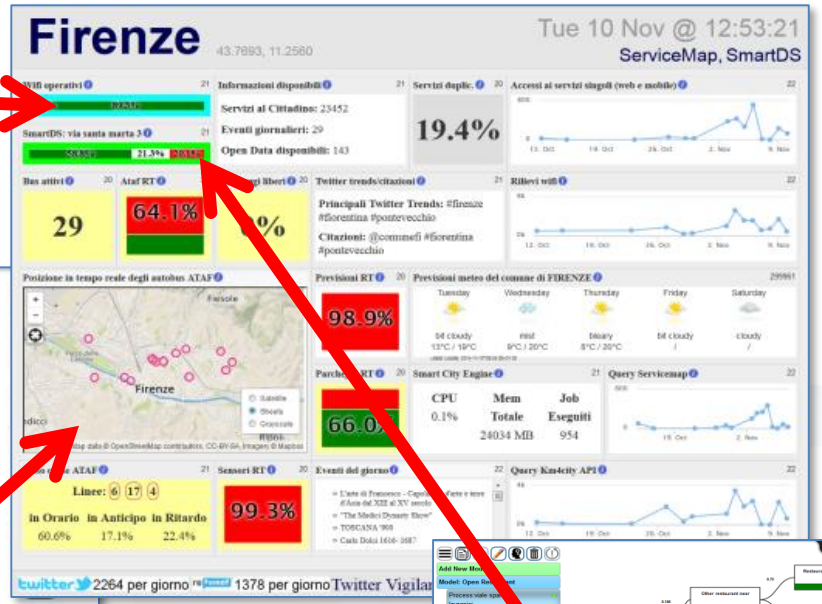
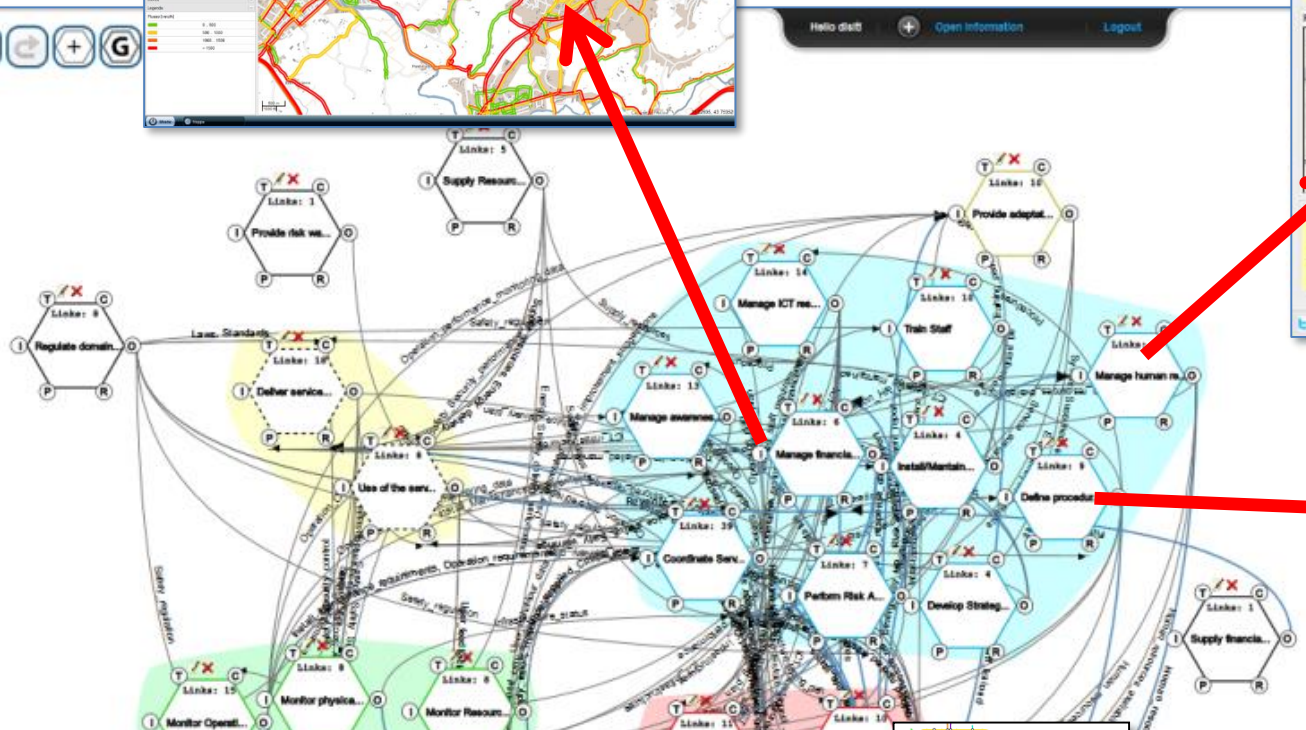
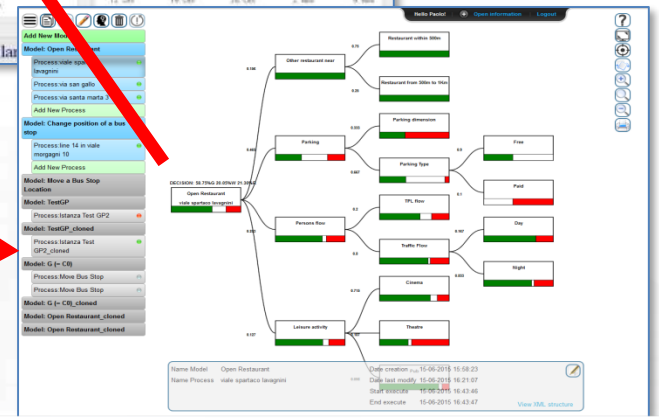
Dashboarding city resilience











Tuscany Region
Firenze, Pisa, Livorno, Prato, etc.



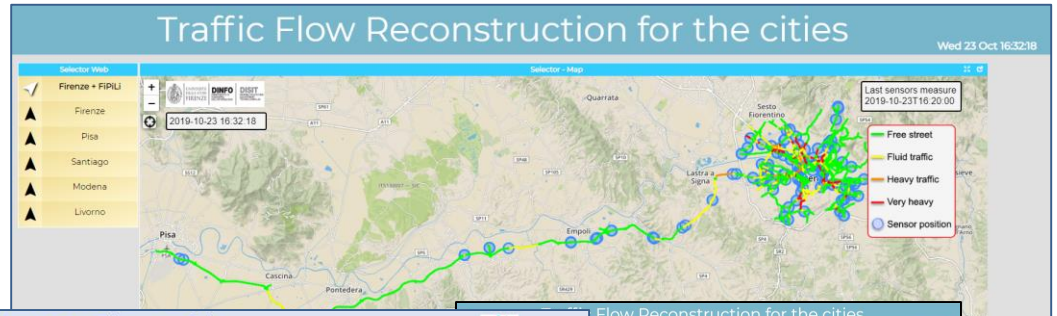


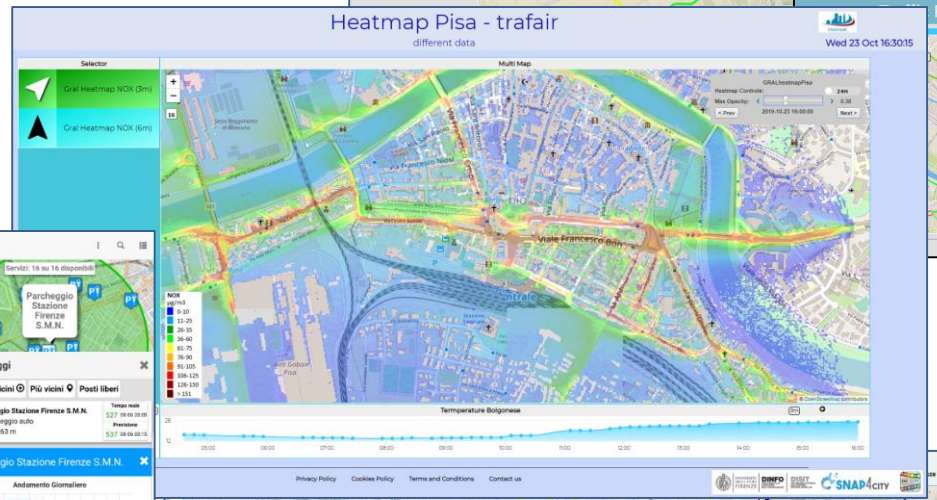


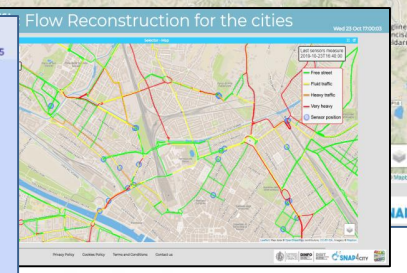


Tuscany Region

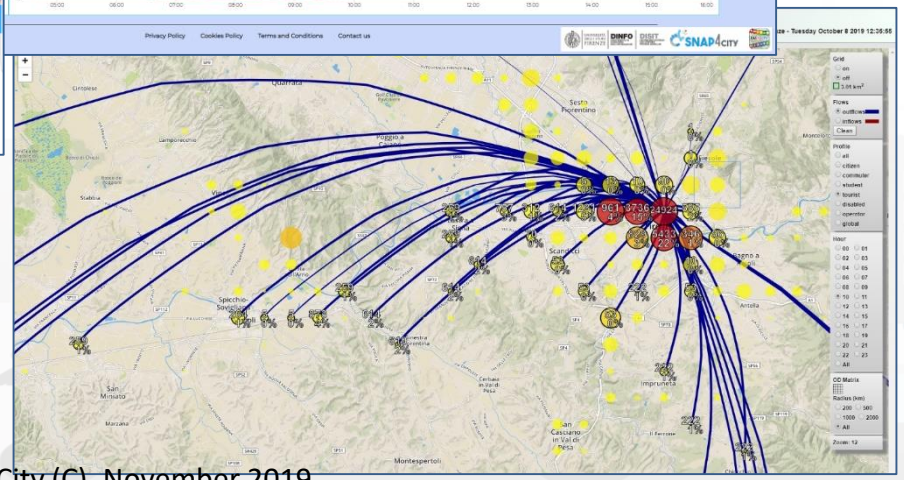
- **Dashboards & Services**:
  - **Mobility**: public transport operators schedule and paths, traffic Fi-Pi-Li main road, parking status and predictions, traffic sensors, Origin Destination matrix, routing, multimodal routing, etc.
  - **Social**: Hospitals and triage, etc.
  - **Environment**: sensors, heatmaps, alerting,
    - **Pollution** Forecast
    - **Weather** Forecast,
  - **Culture** and **Tourisms**
  - Etc.
- **Mobile App and MicroApplications:**
  - Tuscany in a Snap (all stores)
  - Tuscany where what… km4city (all stores)
- **Numbers**: 1.5 M complex events per day

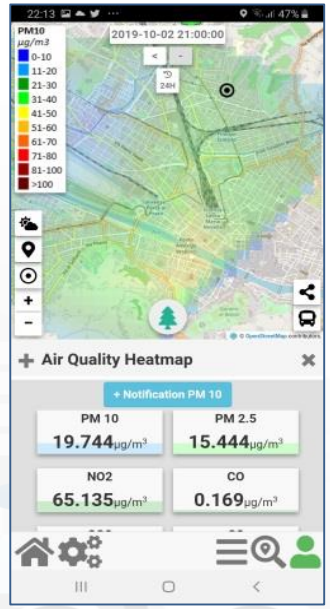












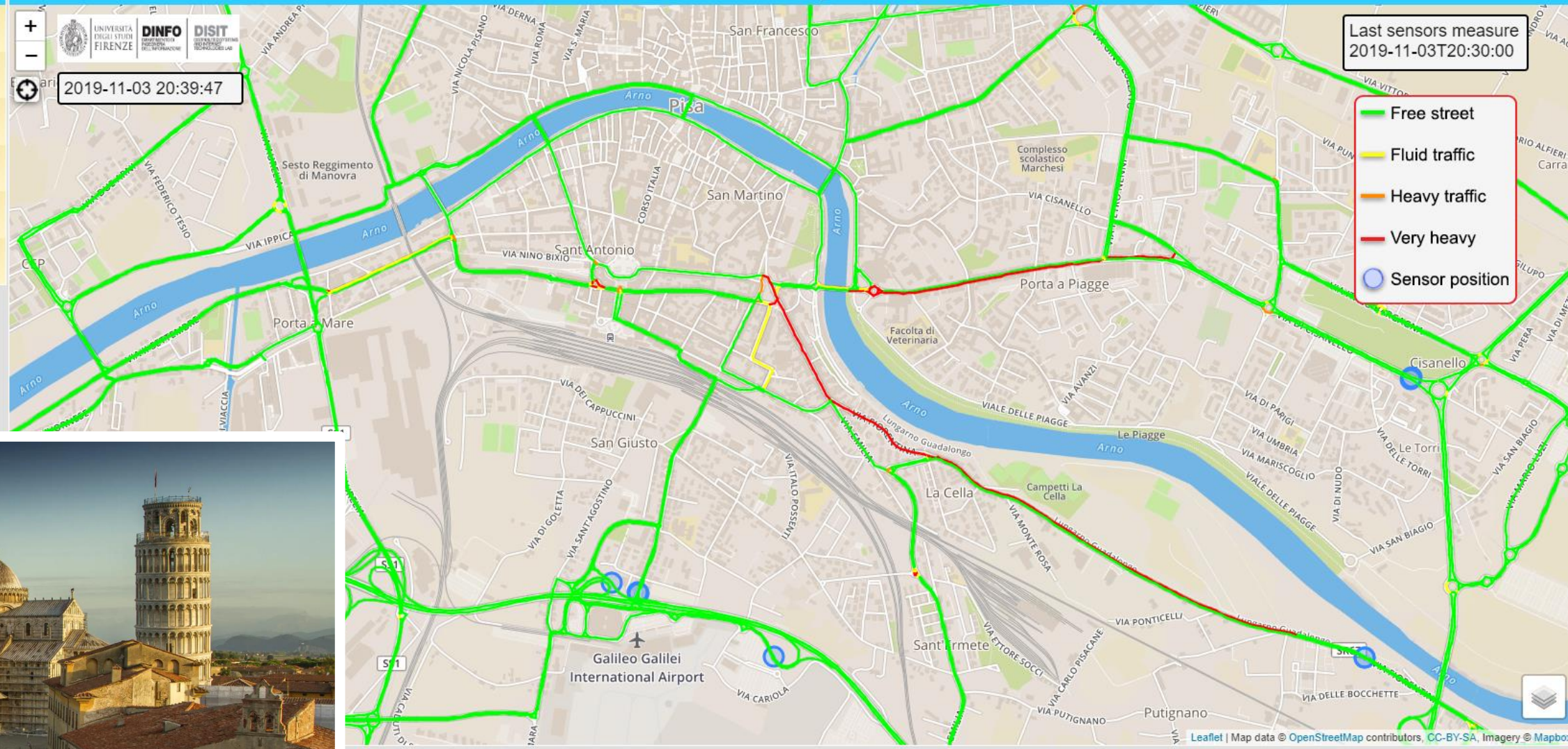
Traffic Flow Reconstruction for the cities

Sun 3 Nov 20:39:47

Selector Web

- Firenze + FiPiLi
- Firenze
- Pisa
- Santiago
- Modena
- Livorno

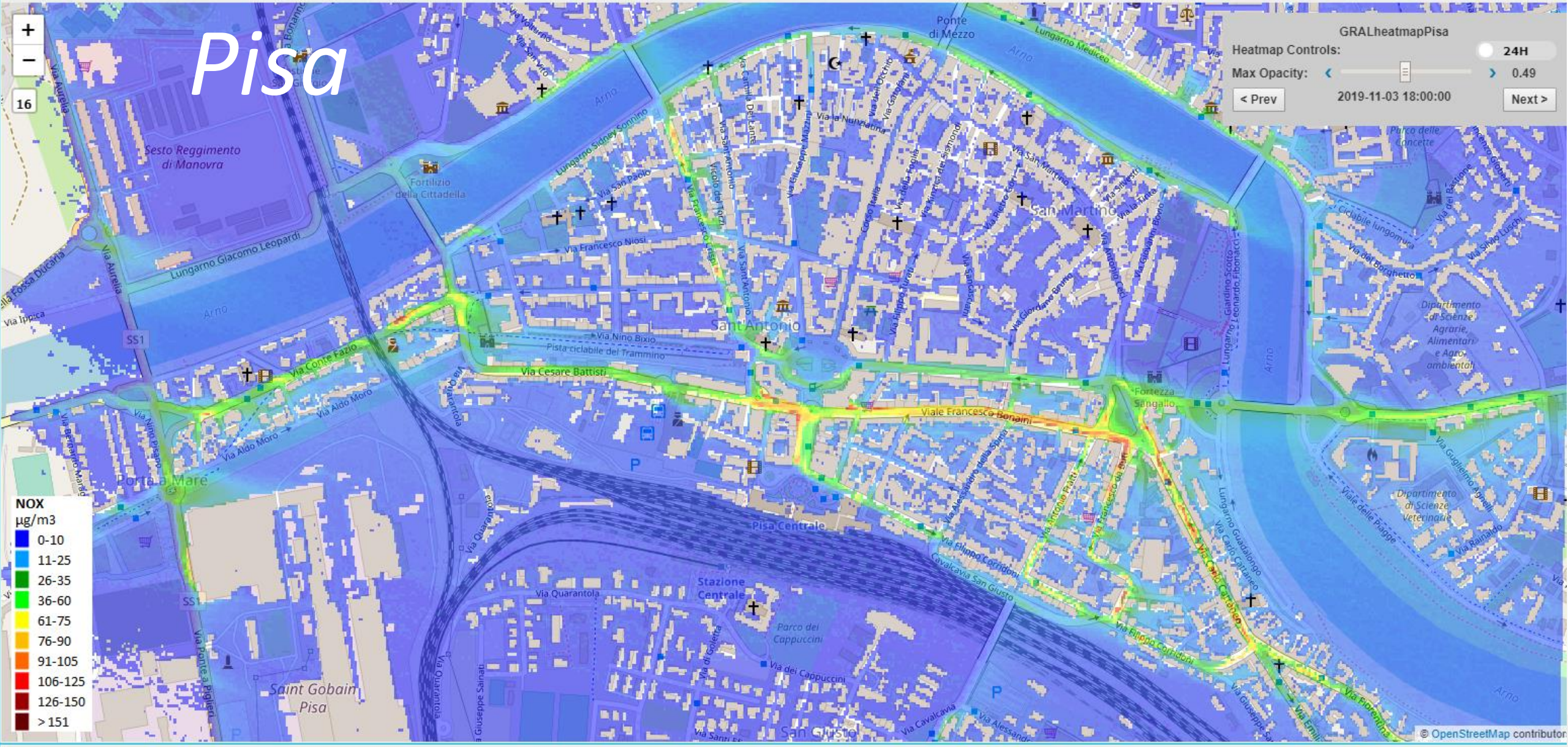
Selector - Map



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

SNAP4CITY | KM4CITY

Multi Map



Selector - Map

2019-11-03 20:44:08

Multi Map

15

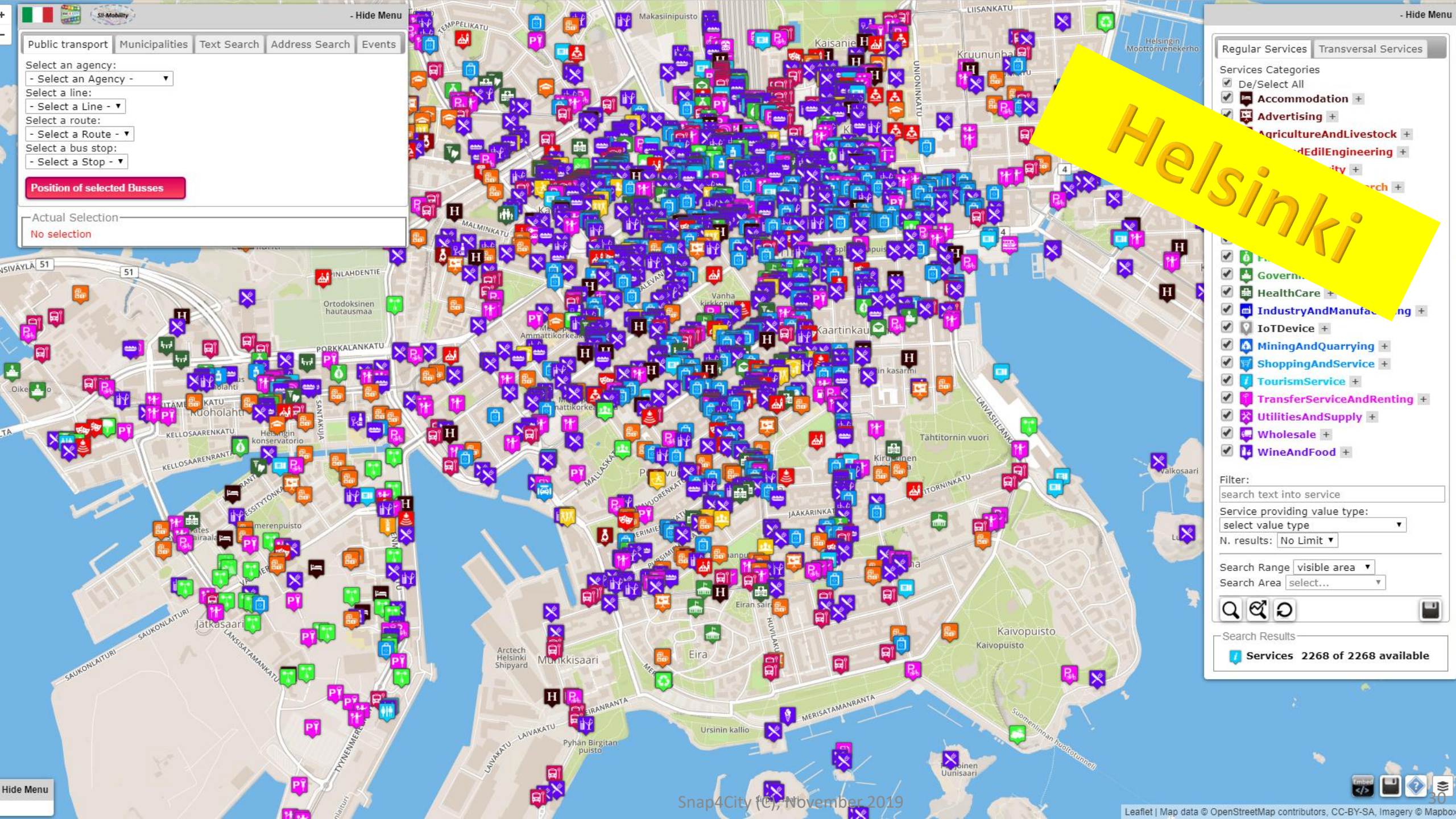
NOX
µg/m3
0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
>151



Livorno

Helsinki




- 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
Helsinki
- Hide Menu
Regular Services
Transversal Services
Services Categories
De/Select All
Accommodation
Advertising
HealthCare
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 2268 of 2268 available
Hide Menu
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

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)



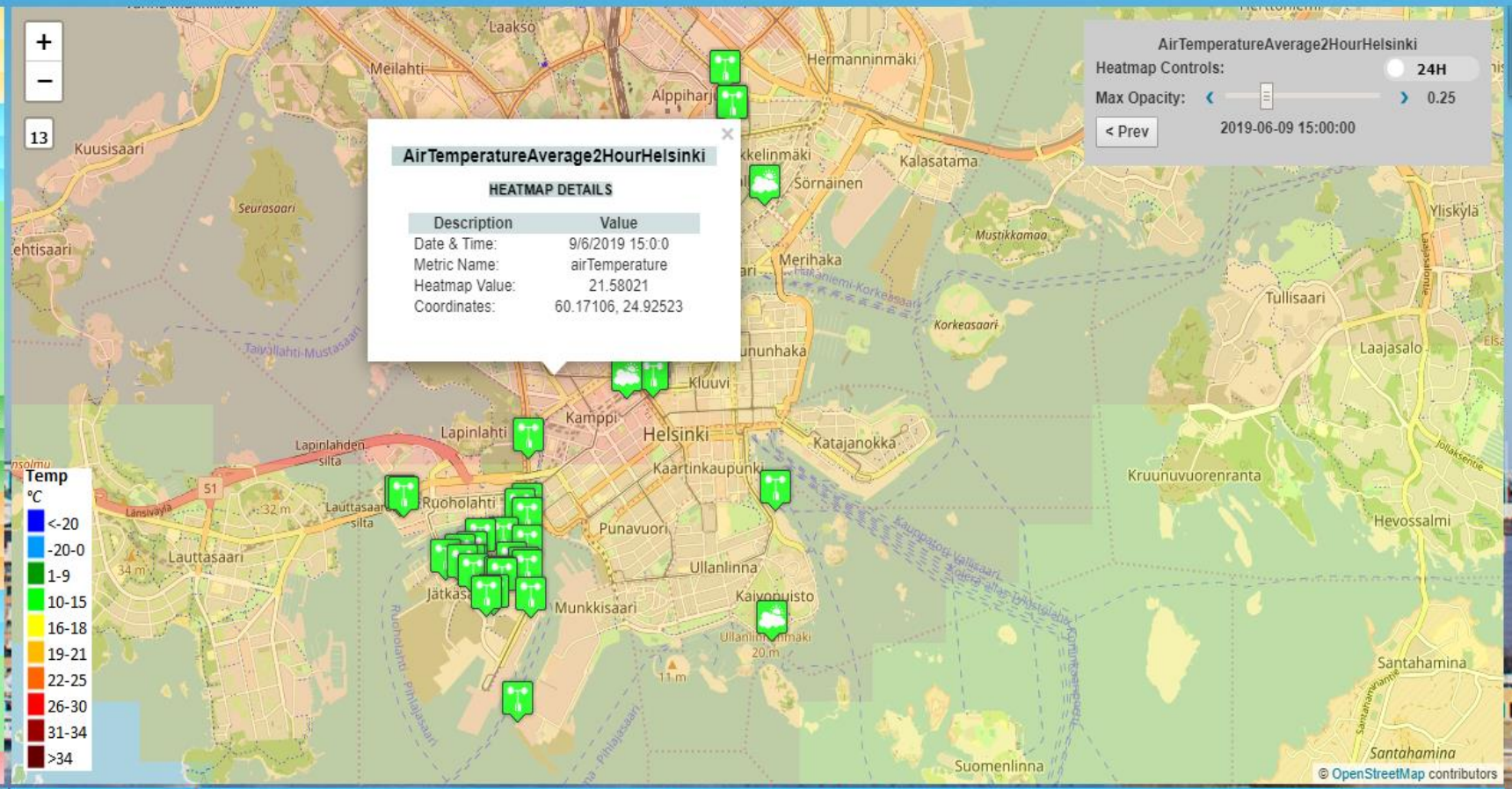
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

Helsinki City Overview (H5a)

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

Sun 9 Jun 17:07:25

- BusStop
- Ticket sale
- Traffic Sensor
- Weather sensor
- Air Temp heatmap
- Humidity Heatmap
- Air Quality Sensors
- Noise sensors
- Noise Heatmap
- PM10 heatmap
- PM2.5 Heatmap
- NO2 heatmap
- Air Quality Index heatmap
- EAQI
- CAQI
- Enfuser pred. AQI
- Enfuser pred. PM10
- Enfuser pred. PM2.5
- Gral pred. PM10
- Gral pred. PM10 (6m)
- PM10 Jatkasaari
- PM2.5 Jatkasaari
- EAQI Jatkasaari
- Appreciated POIs





Weather sen... 9m

20.5

Weather sensor Helsinki Kaisaniemi - airTemperature 9m



The Life of Helsinki

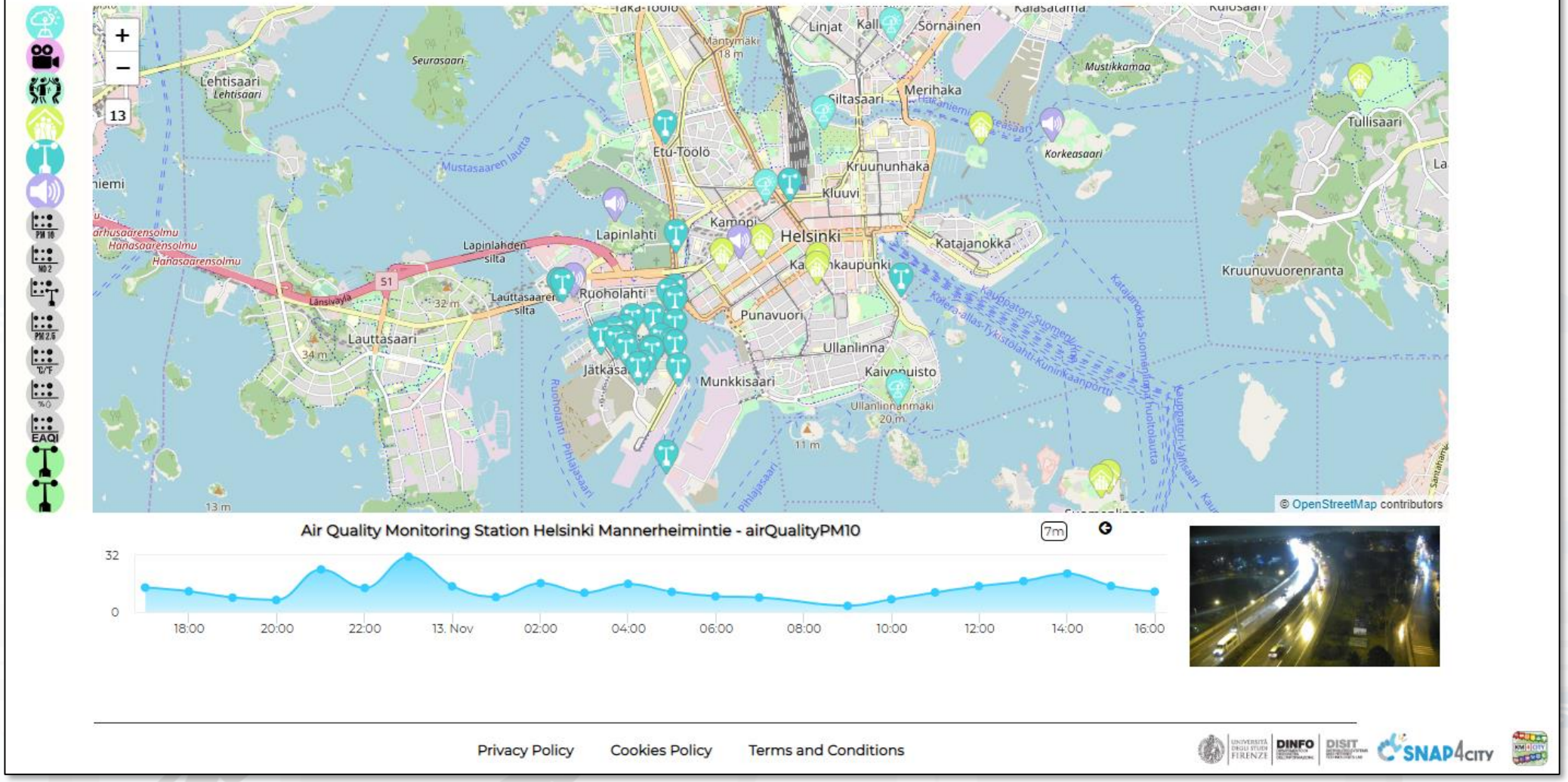
Documentation

Forum Discussion

Survey

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

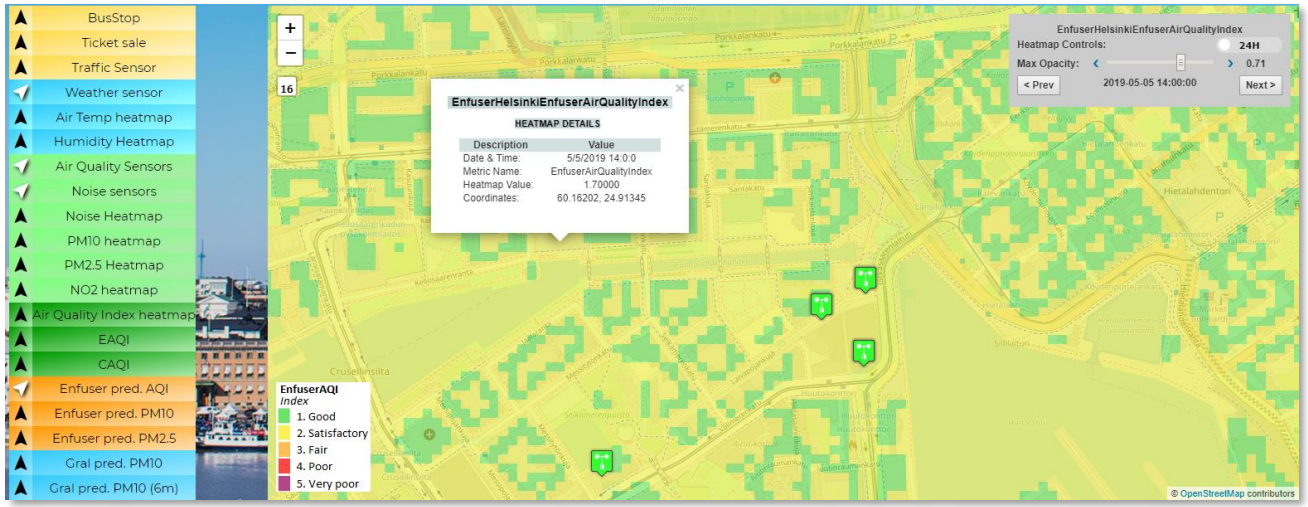
Helsinki icon

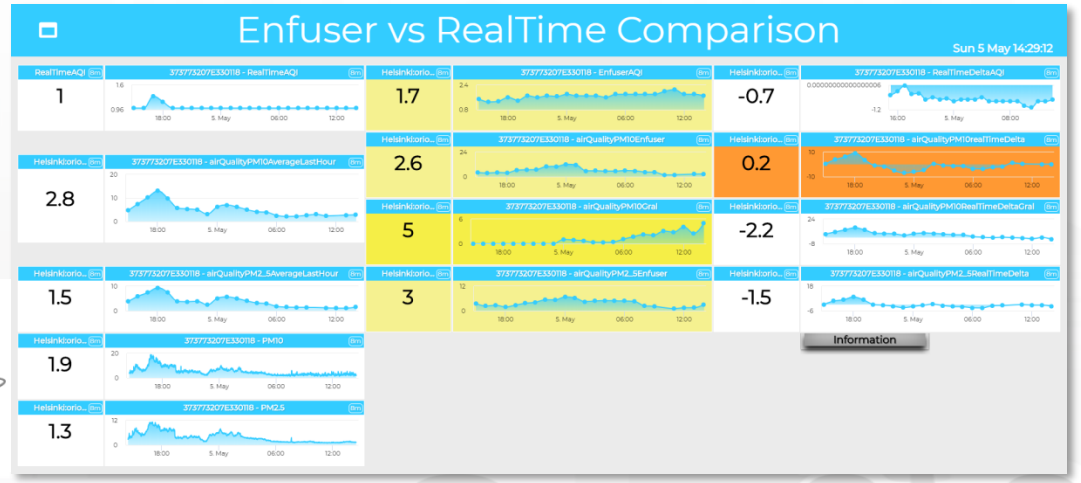


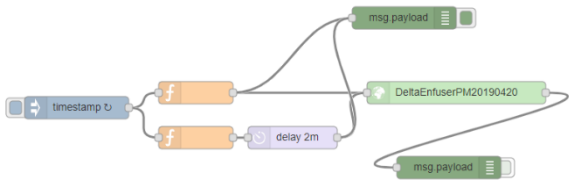
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM1NQ==

Data Analytics: Enfuser predictions

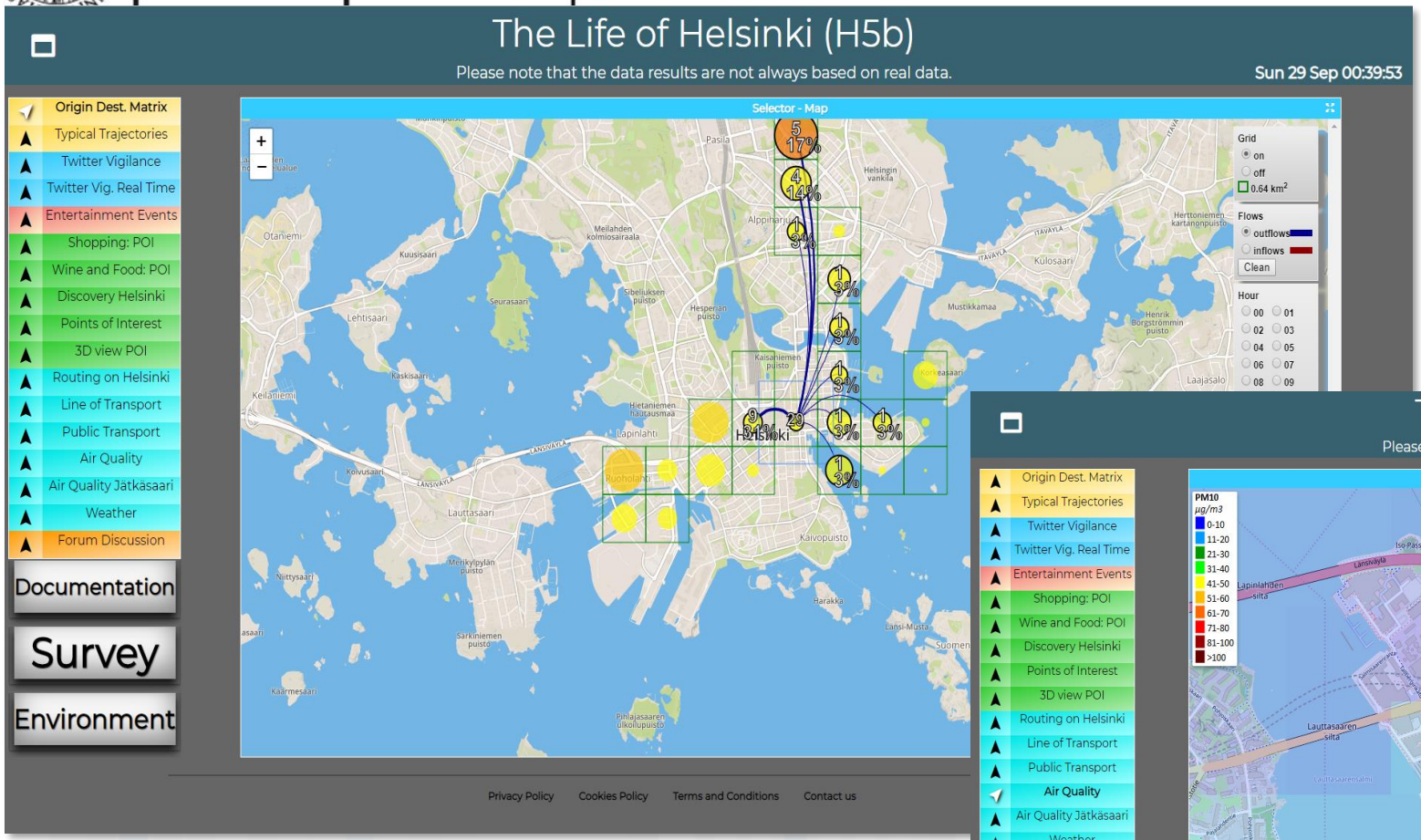
- **Enfuser predictions: AQI, PM10, PM2.5**
  - Data gathering, data processing for Piking
  - Delta Estimation Predictions vs Actual: on 12 points/sensors via R-Studio and IOT App
  - API for accessing data of Heatmaps in real time

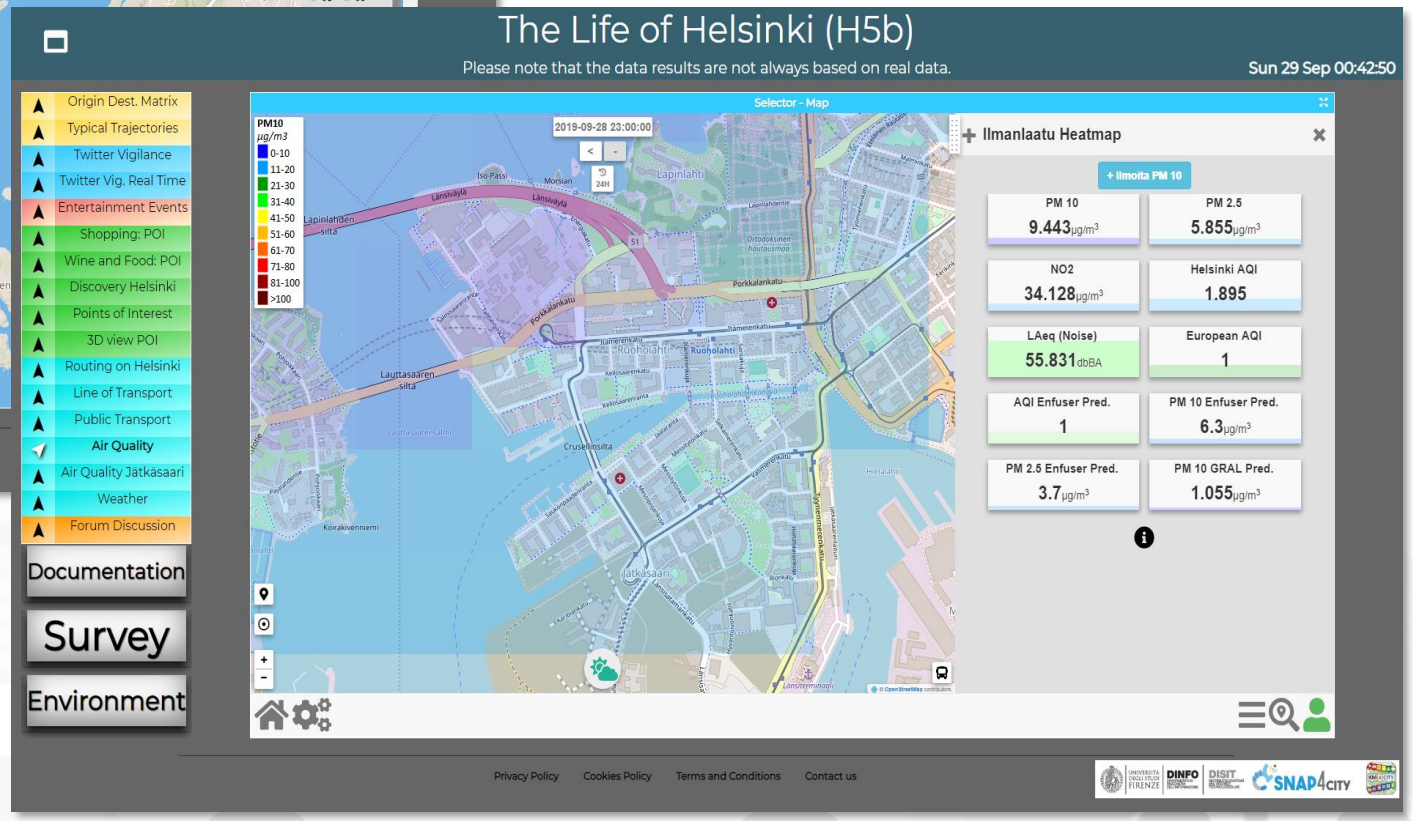






Helsinki





https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc1Mg==

Helsinki

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

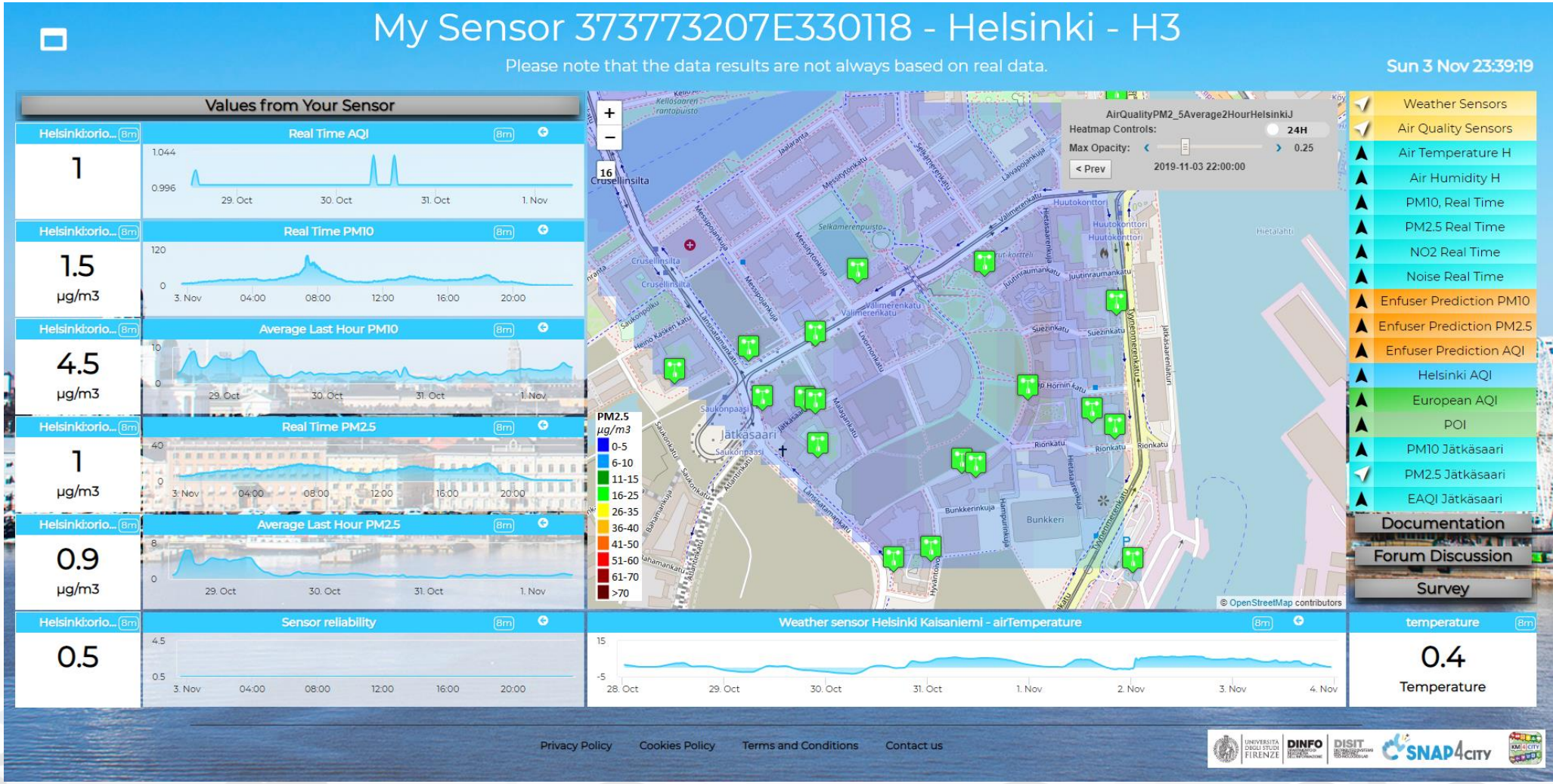


TRAFAIR

Environmental Devices hosted by Citizens







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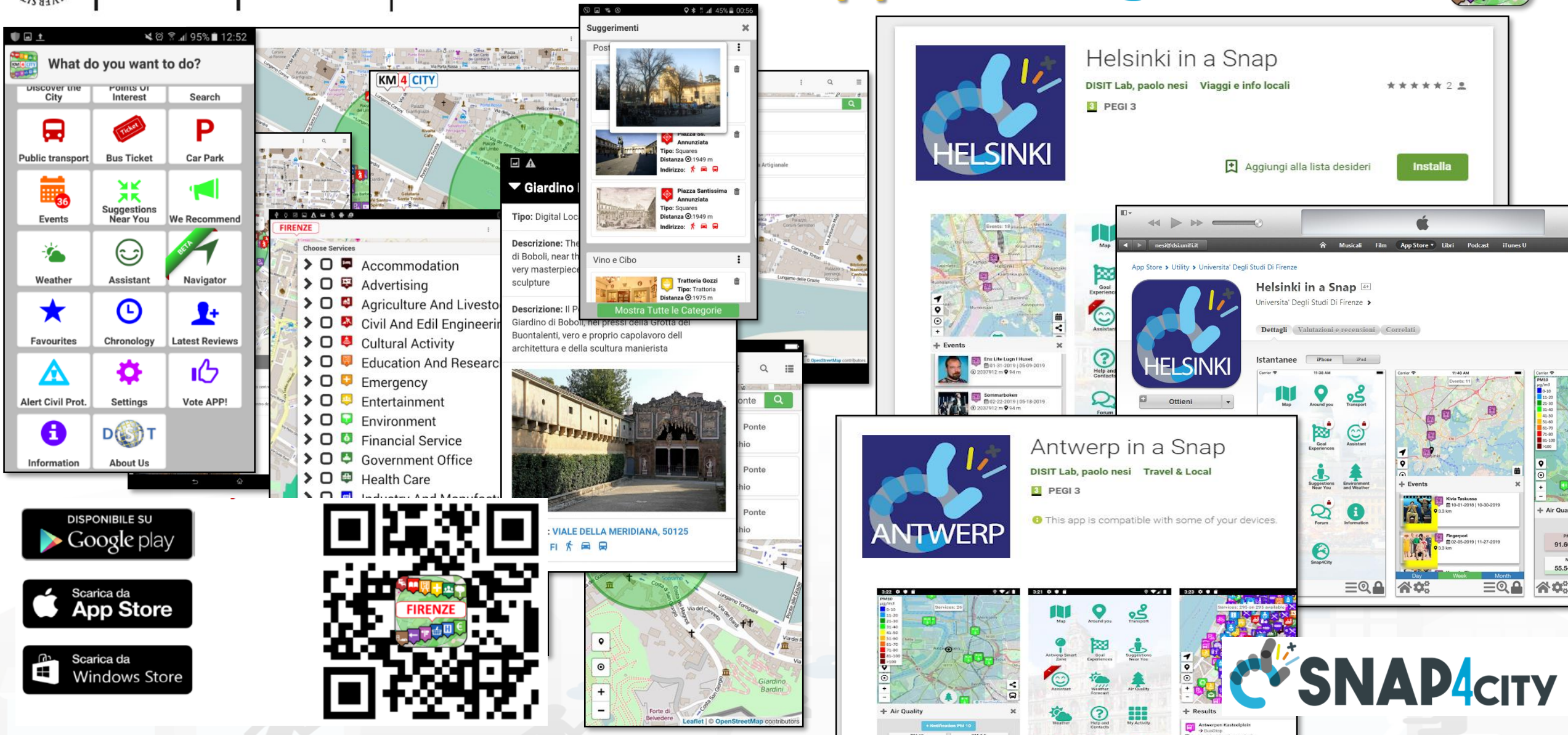
Mobile Apps

SNAP4CITY KM 4 CITY



DISPONIBILE SU Google play

Scarica da App Store

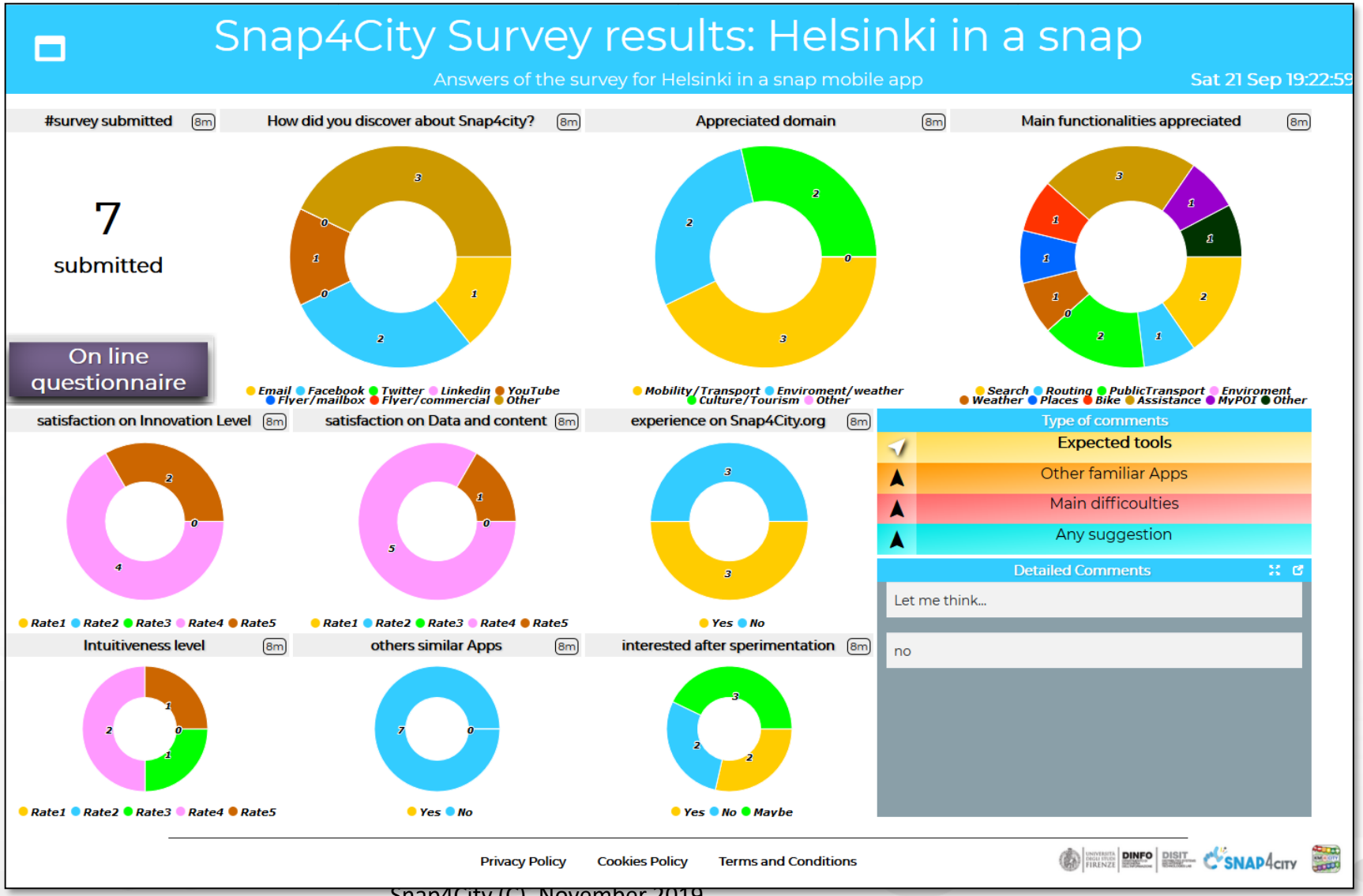
Scarica da Windows Store

SNAP4CITY

Helsinki

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc2OA==

Dashboard created to monitor in real time the answers to the survey provided on the Mobile App directly by the Engagement tool

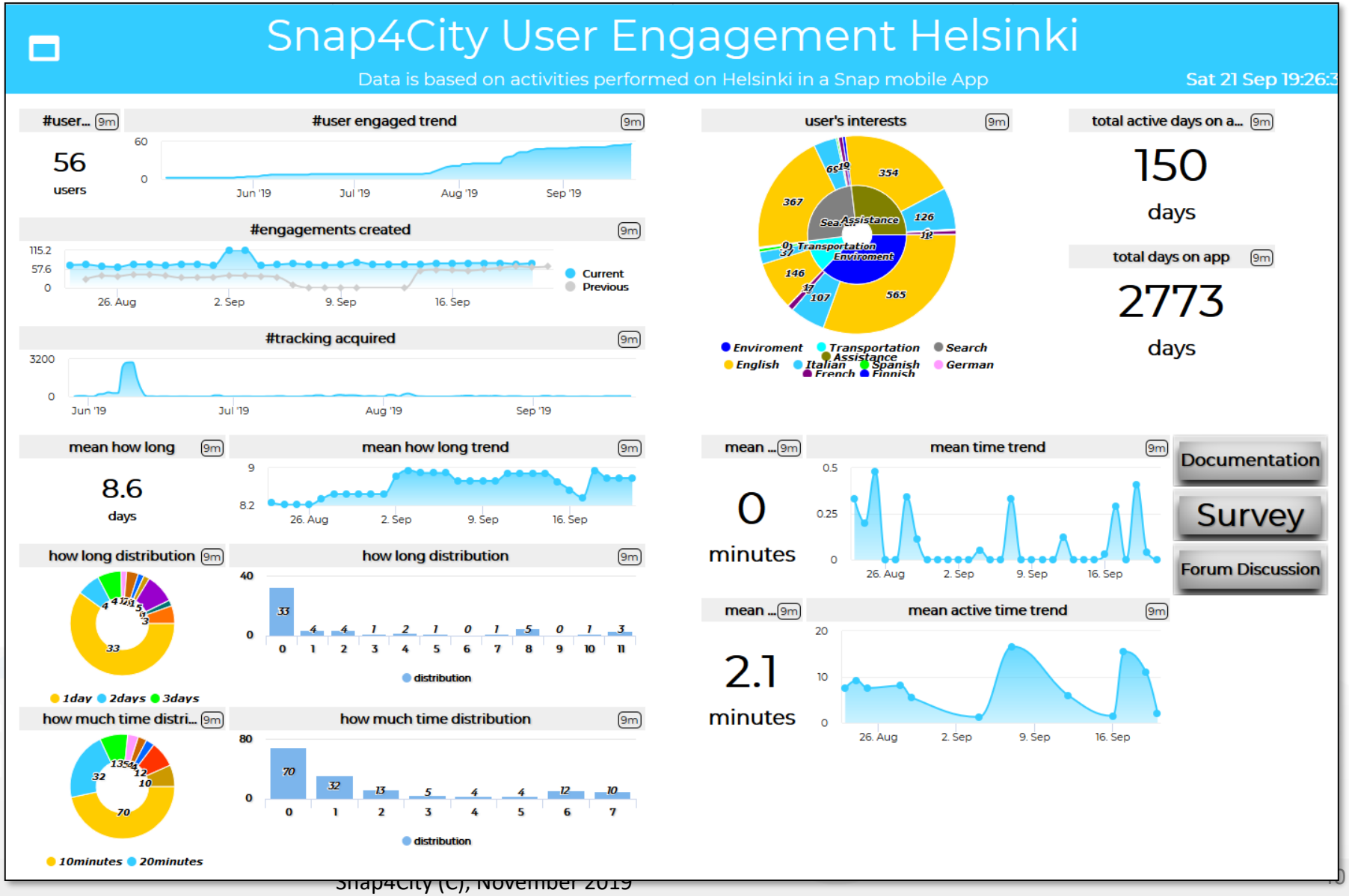


Helsinki

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc1OA==

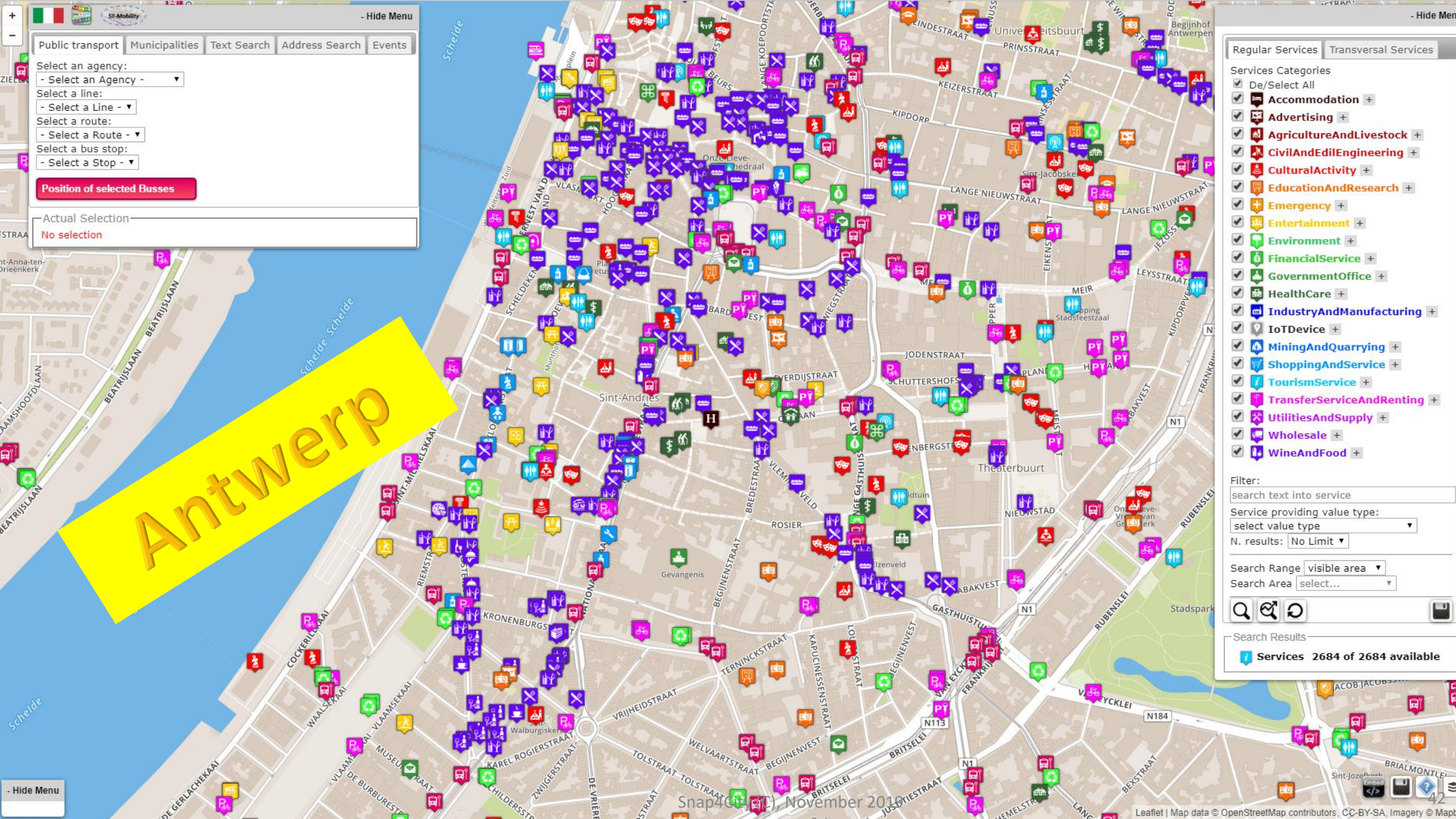
Dashboard monitoring the Mobile App:

- Collecting the clicks
- Describing the community of users in terms of the profile aspects
- Measuring the time spend, and topics of interest of the users, etc.



Antwerp




- 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
Schelde
Sint-Andries
Theaterbuurt
Gevangenis
ROSIER
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapb

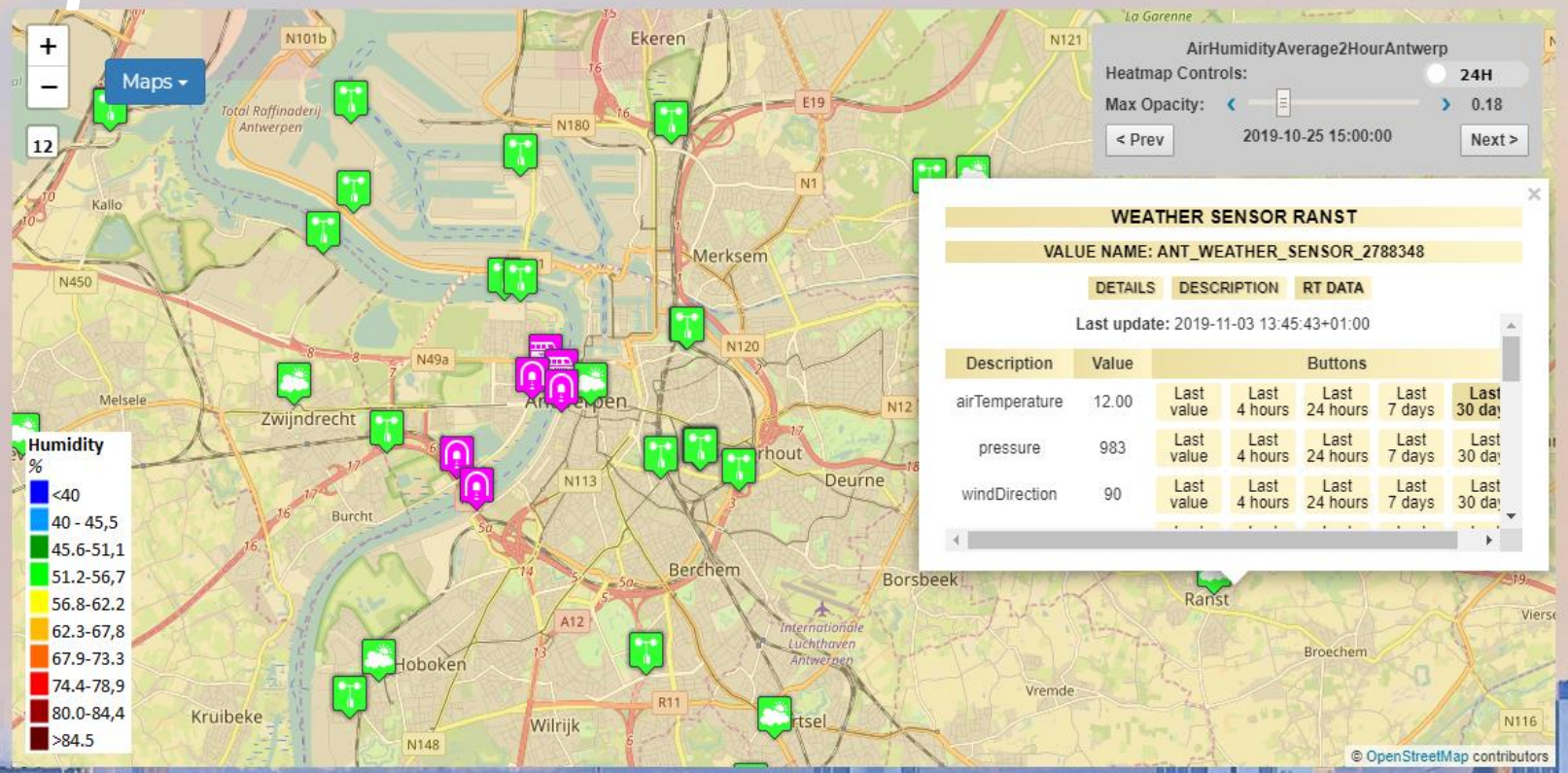
Antwerp

Antwerp City Overview - A5

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

Sun 3 Nov 14:09:43

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



Weather sensor Zwijndr... 8m

11.9



Forum Discussion

Documentation

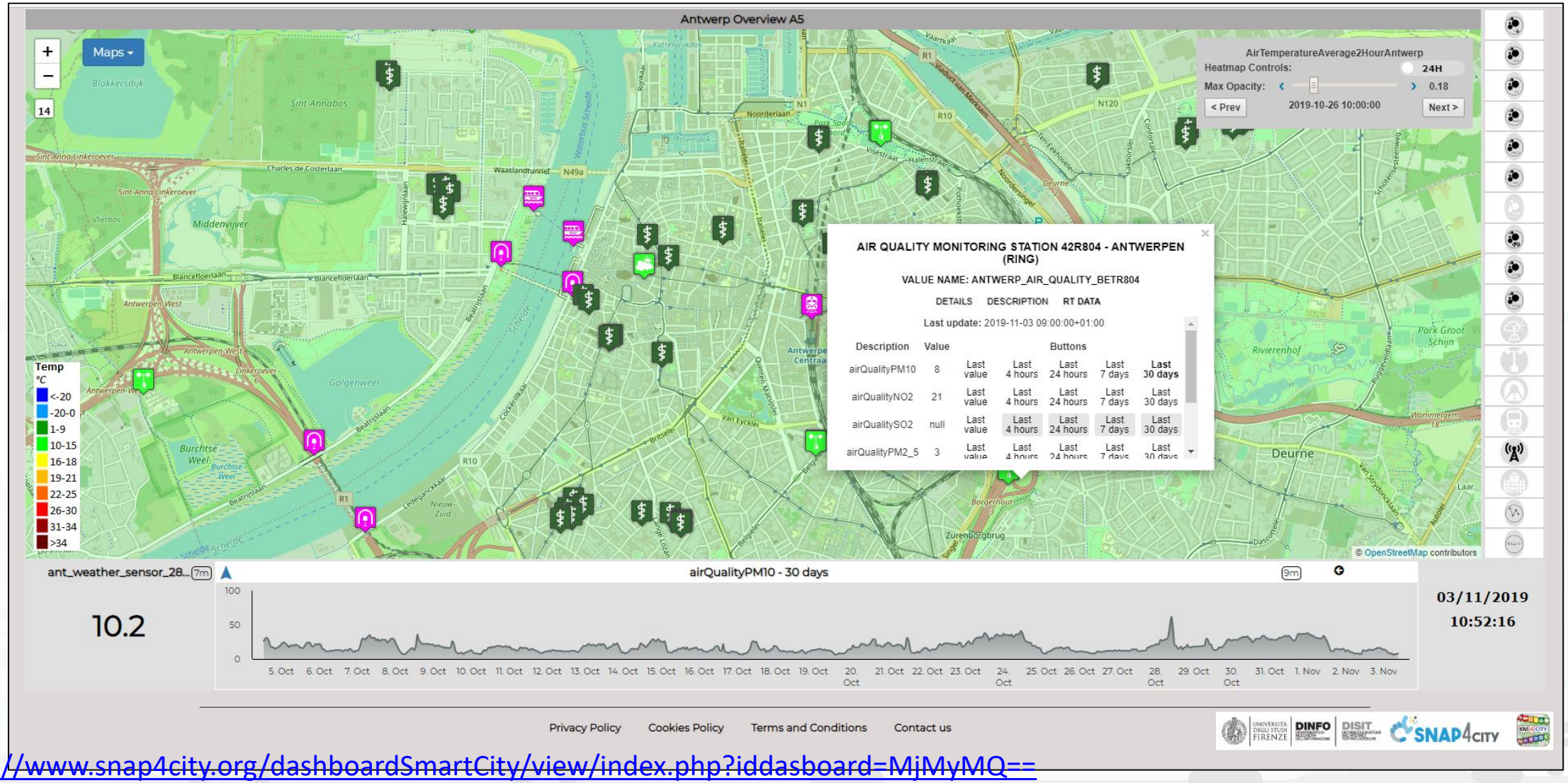
Survey

The Life of Antwerp

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

Antwerp

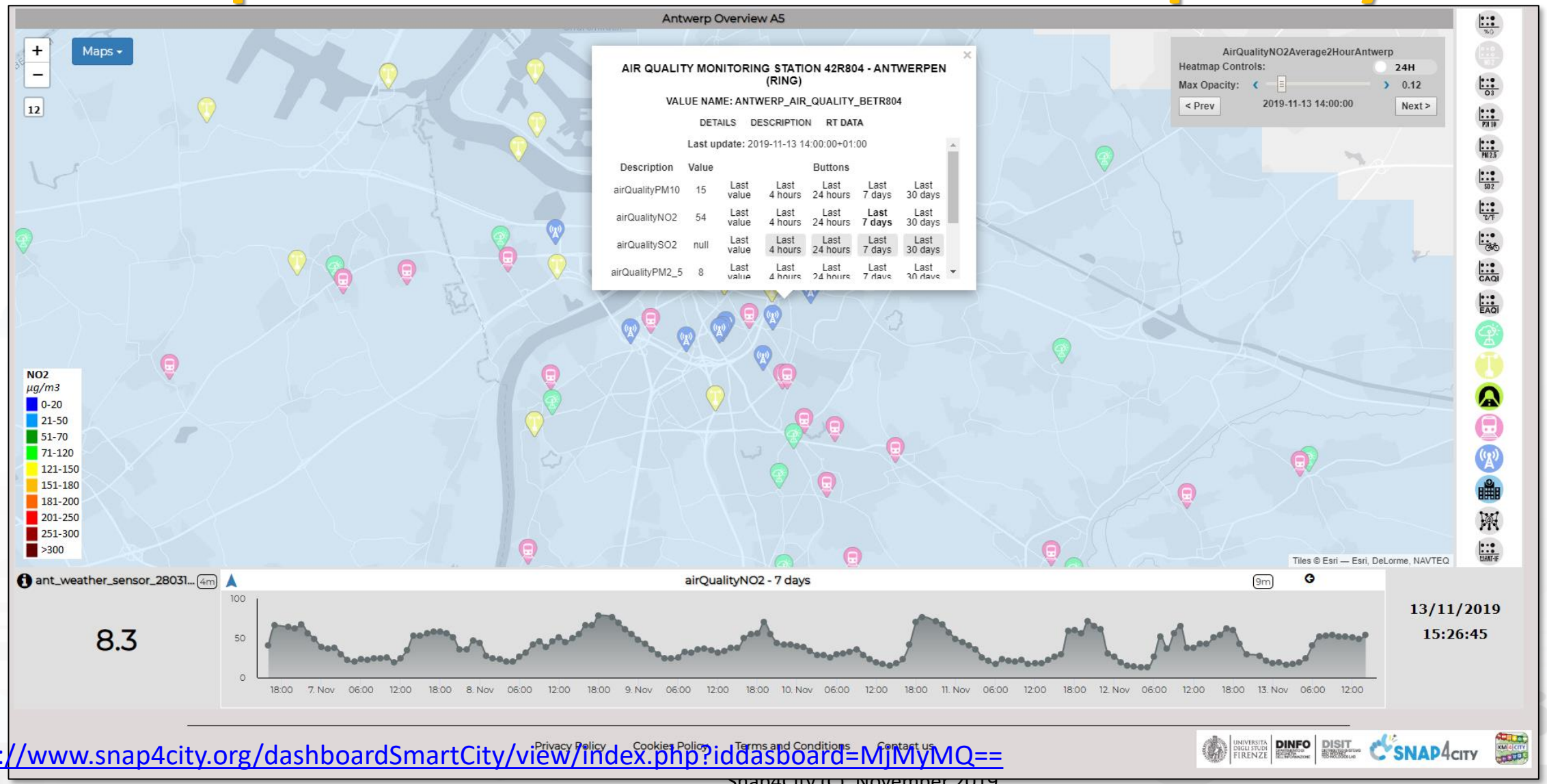
Unique Dashboard builder Multiple Styles



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

Antwerp

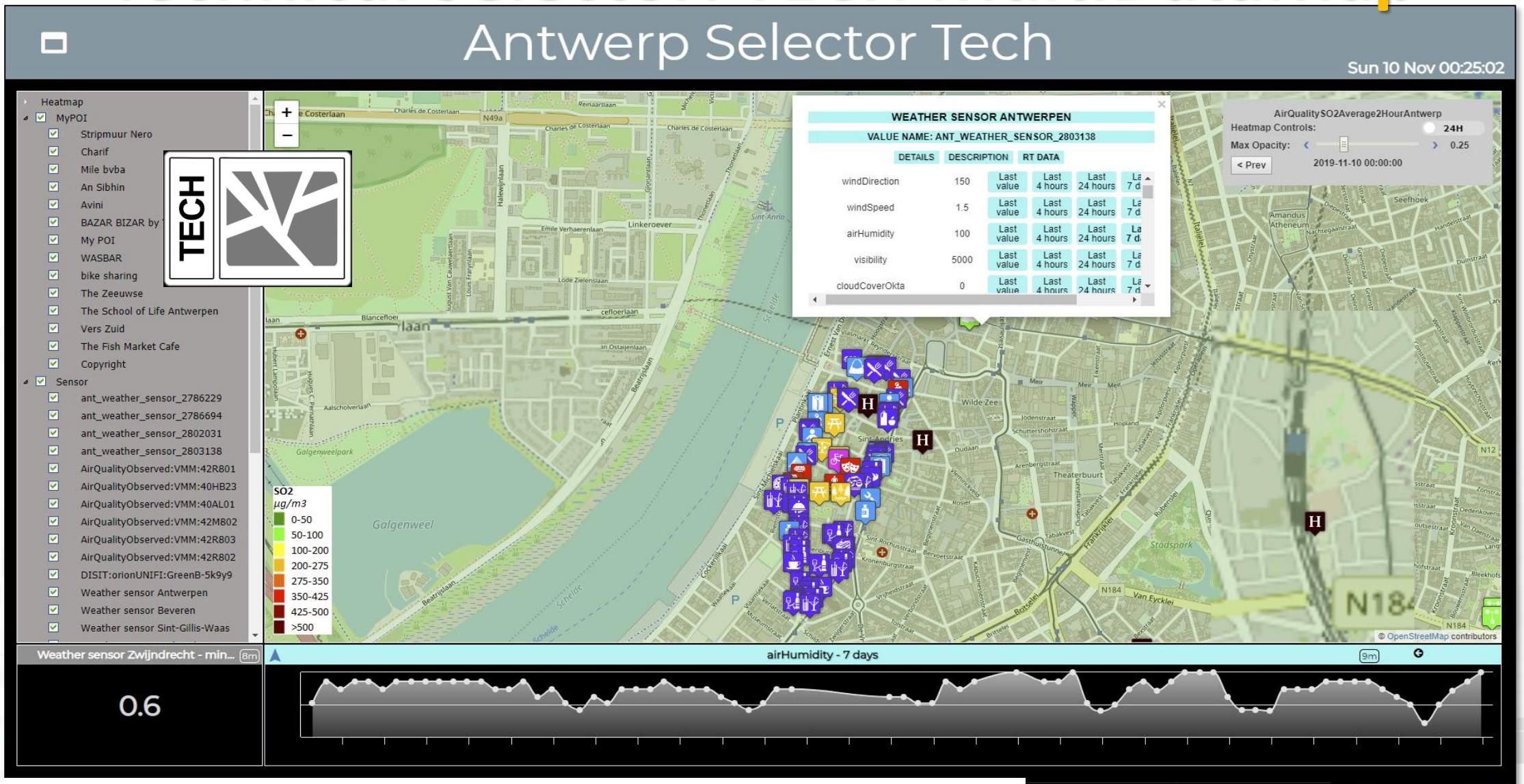
Unique Dashboard builder Multiple Styles



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

Antwerp

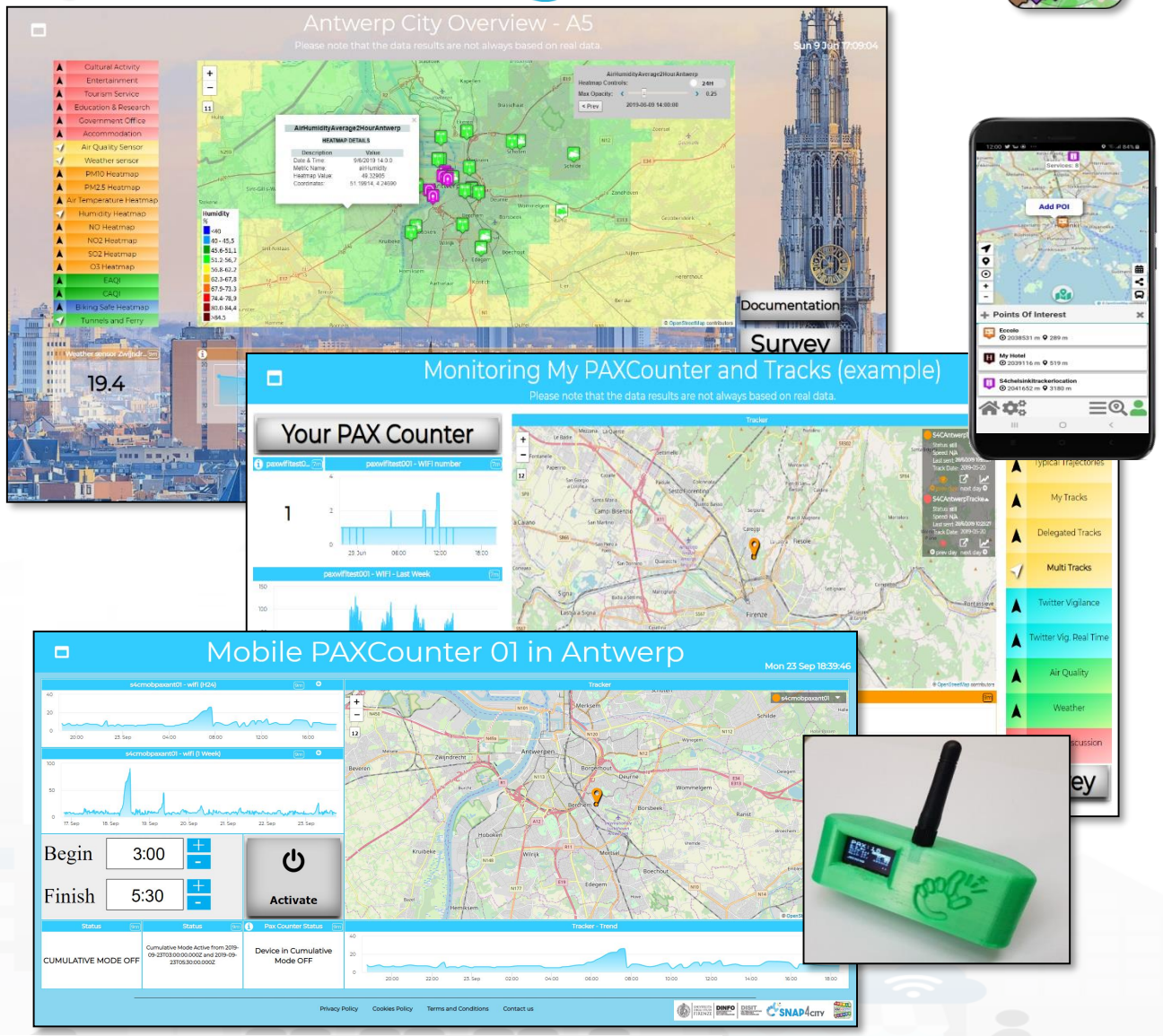
Technical Selector: TECH MultiDataMap



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

Antwerp Case

- **Dashboards & Services**:
  - **Environment** & **Weather**: PM10, PM2.5,NO, SO2, CO, etc.
    - Heatmap & **Alerts** on critical
  - **Mobility**: public transport Operators schedule and path, monitoring of river crossing, routing, what-if
  - **PAX Counters:** museum and public services, mobile PAX Counter for events
  - **Social**: Twitter Vigilance, early warning
  - **Life in Antwerp**: OD matrix people flow, Twitter Vigilance SA, hot places, ...
  - **Tourism and Culture**
- **Mobile App and MicroApplications:**
  - Antwerp in a Snap (all stores)



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

PaxCounter devices







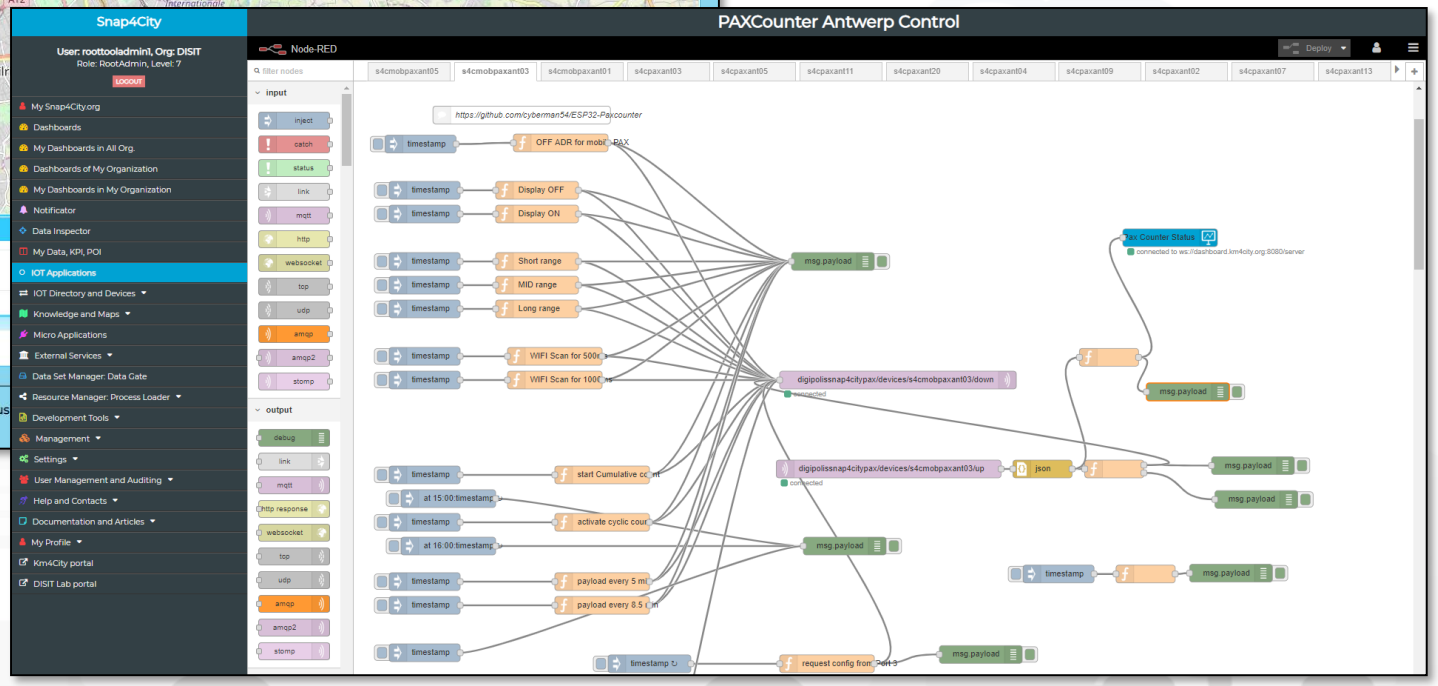
- Fixed PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Mobile PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Fixed PaxCounter(LoraWan+Wifi out)
  - Based on Wi-Fi- Bluetooth

LoRa® Wi Fi Bluetooth™

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

Programmable PAX counting

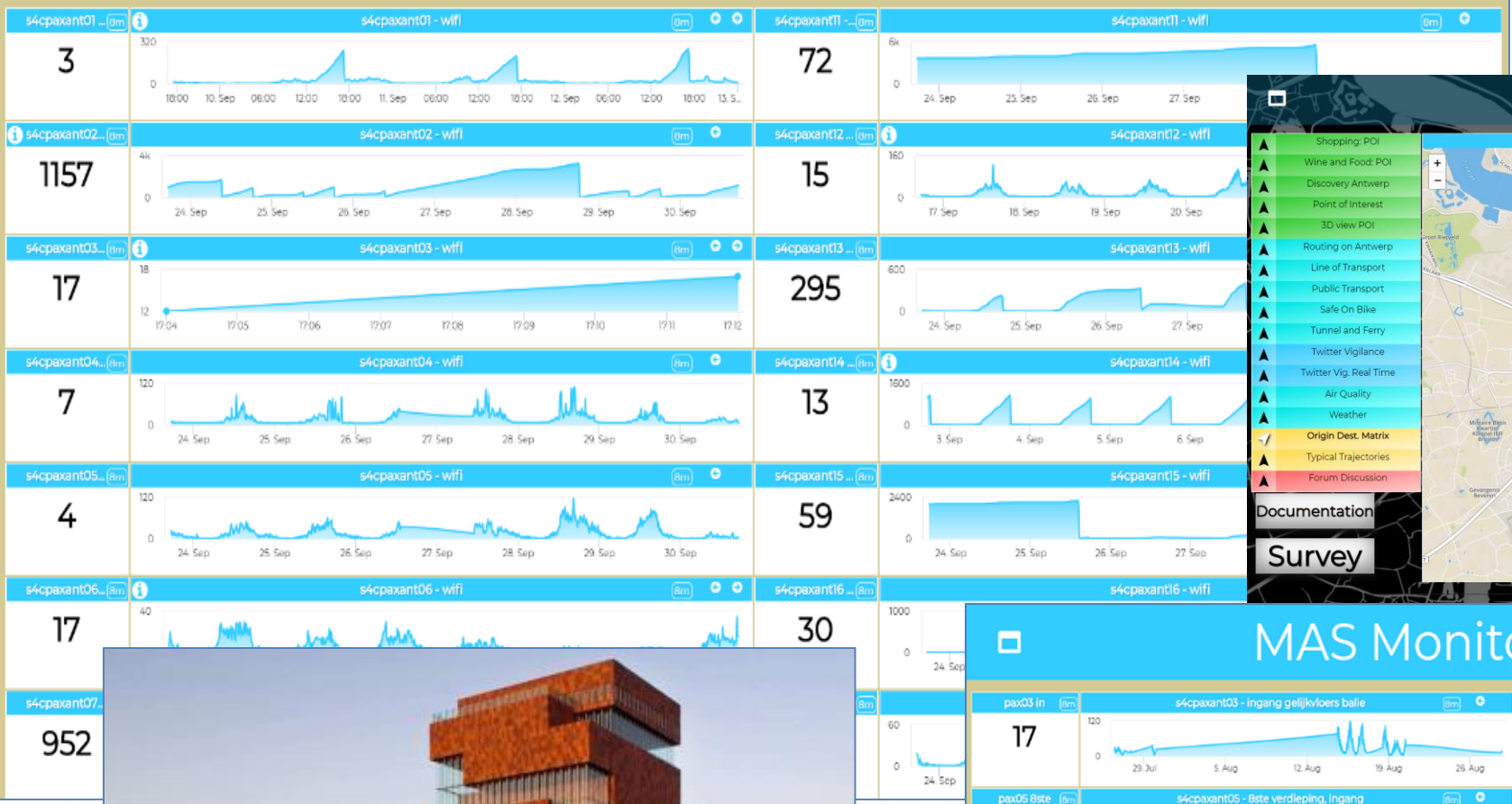




Antwerp

PAXCounter real time and trend

Mon 30 Sep 17:18:48







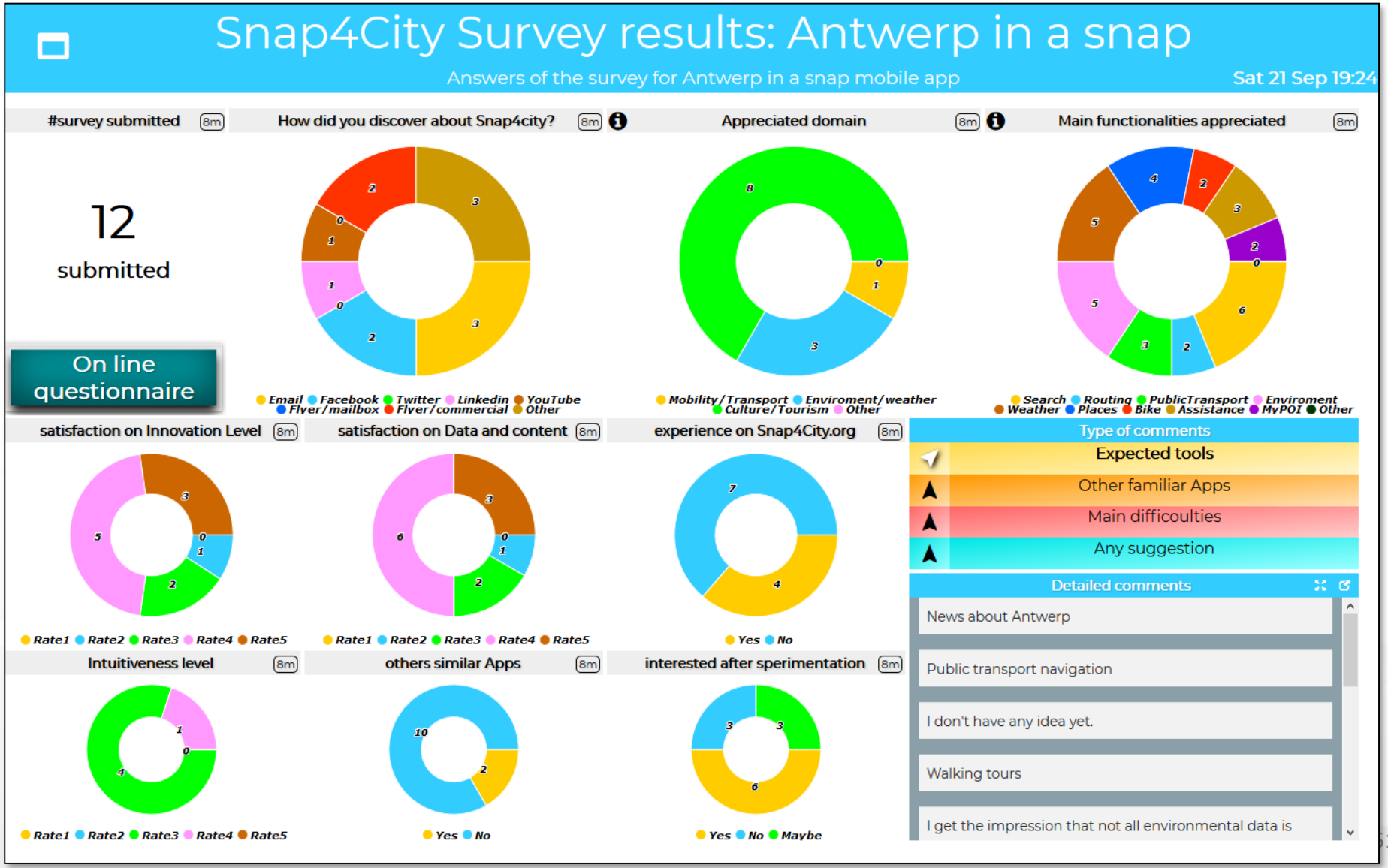
MAS Monitoring via PAXCounter

Mon 30 Sep 17:31:32



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc2OQ==

Dashboard created to monitor in real time the answers to the survey provided on the Mobile App directly by the Engagement tool



Antwerp

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc1OQ==

Dashboard monitoring the Mobile App:

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- Describing the community of users in terms of the profile aspects
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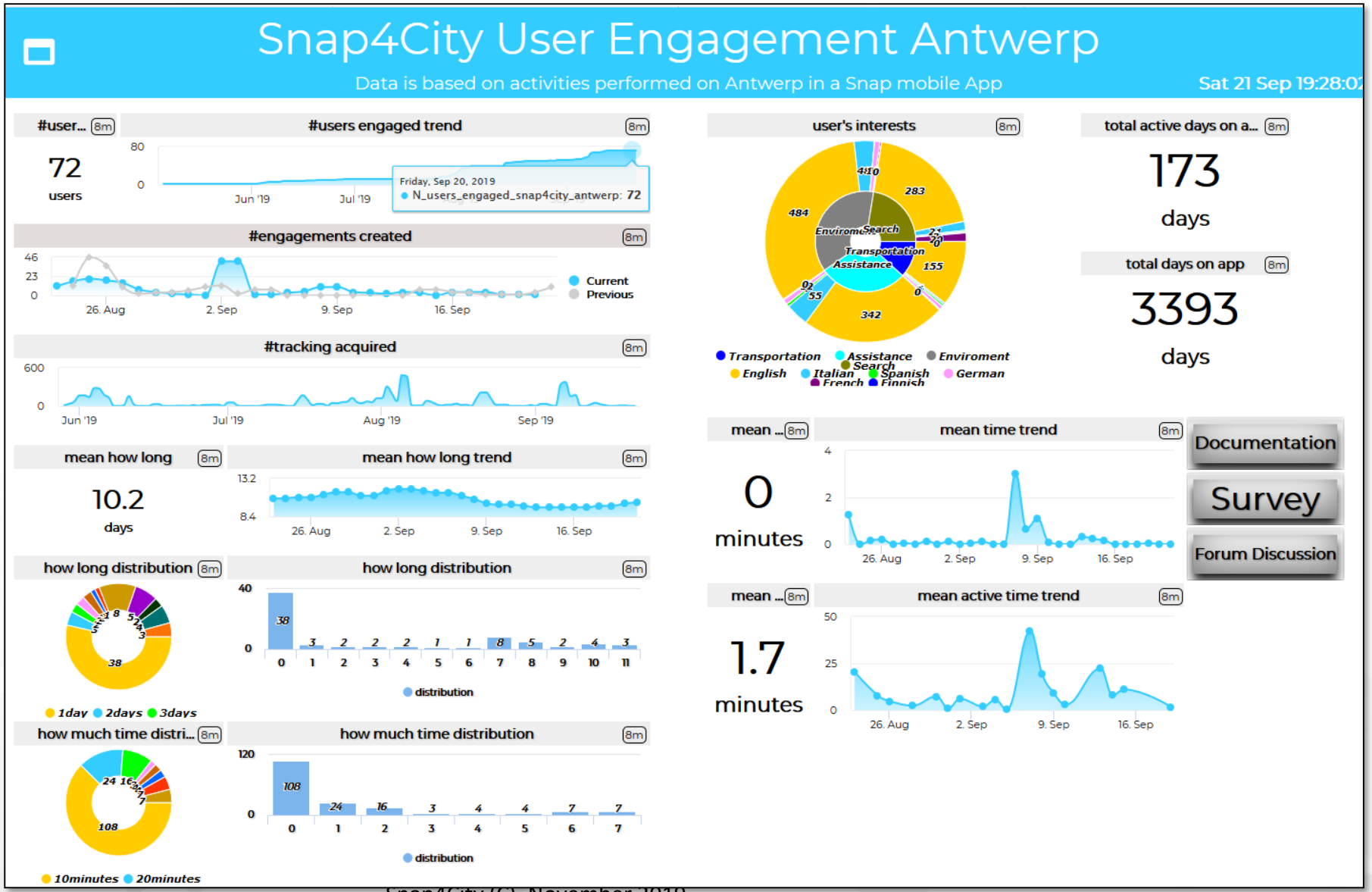


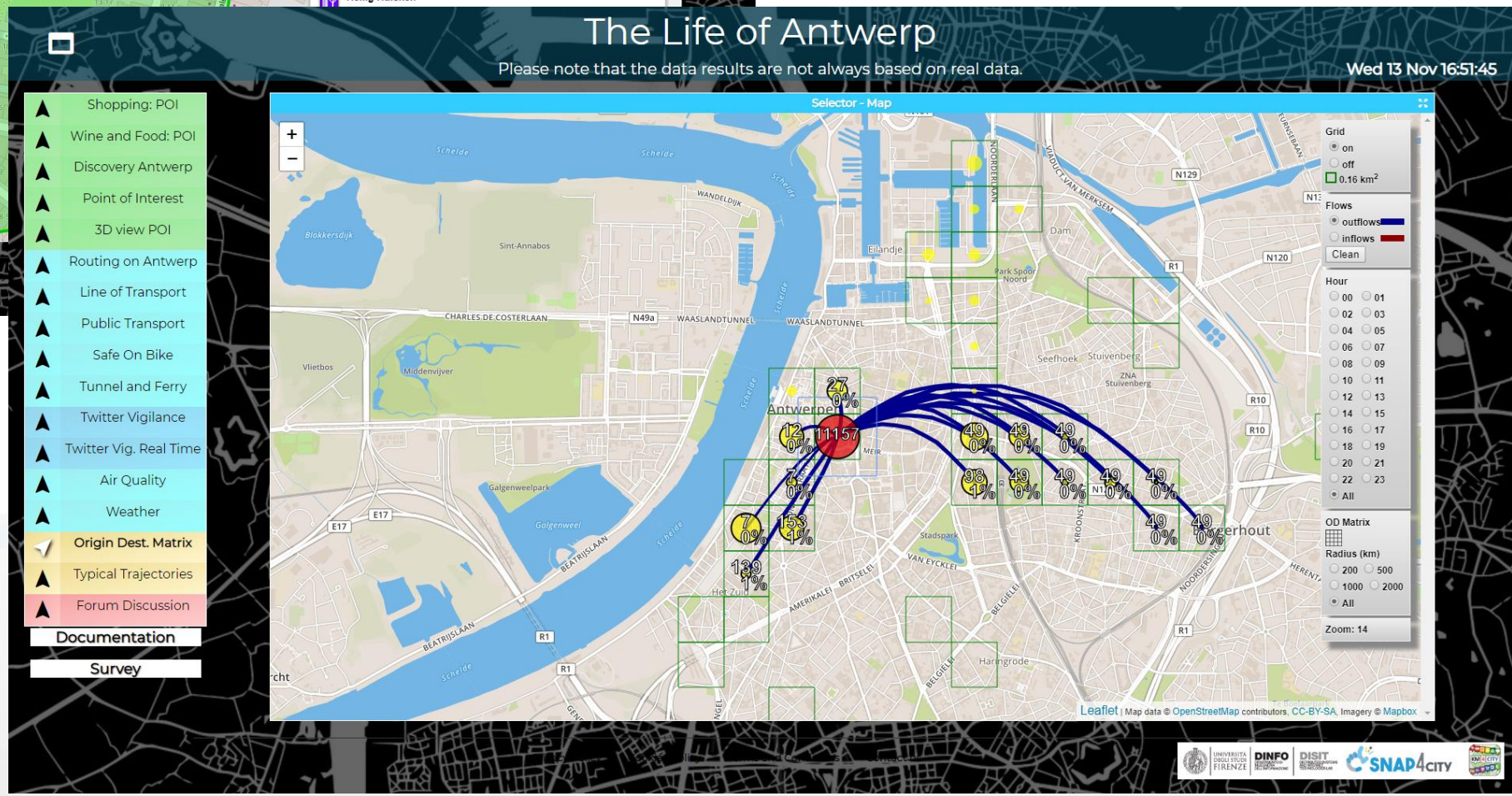
Antwerp



SNAP4CITY

KM4CITY

Antwerp



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



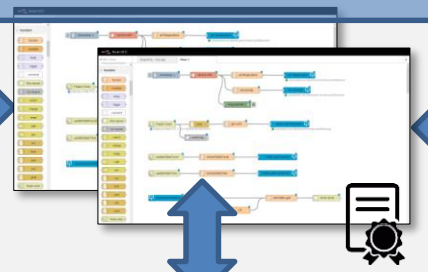
Prato
Smart City vs Industry 4.0

GIDA set up

Smart City data from many sources



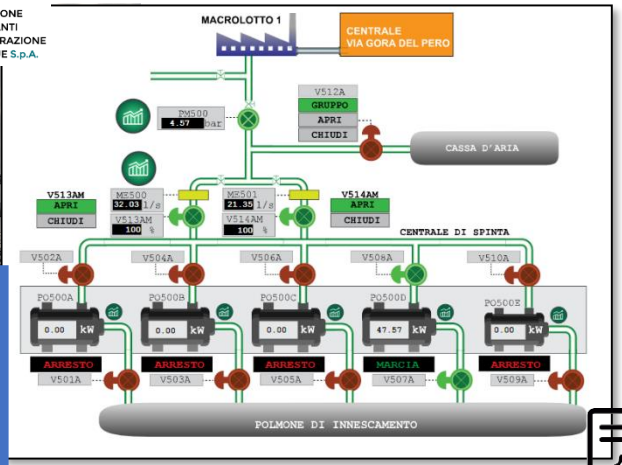
IOT Applications



Dashboards and Apps







IOT Data Shadow Snap4City

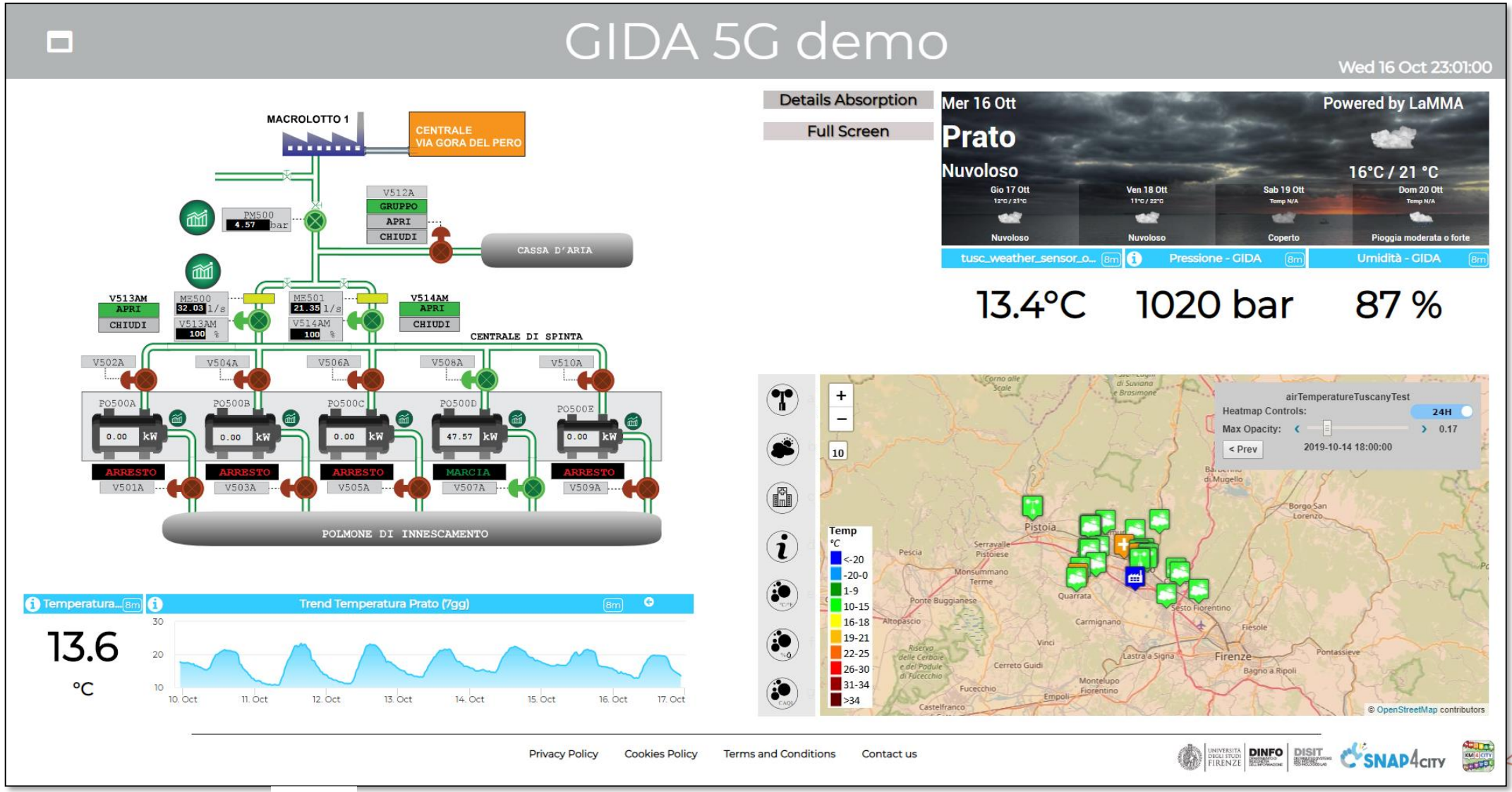
Big Data Analytics, Artificial Intelligence

ModBus to Snap4City Gateway Edge

5G network devices

Telemonitoring Telecontrol

Dashboards & Services:



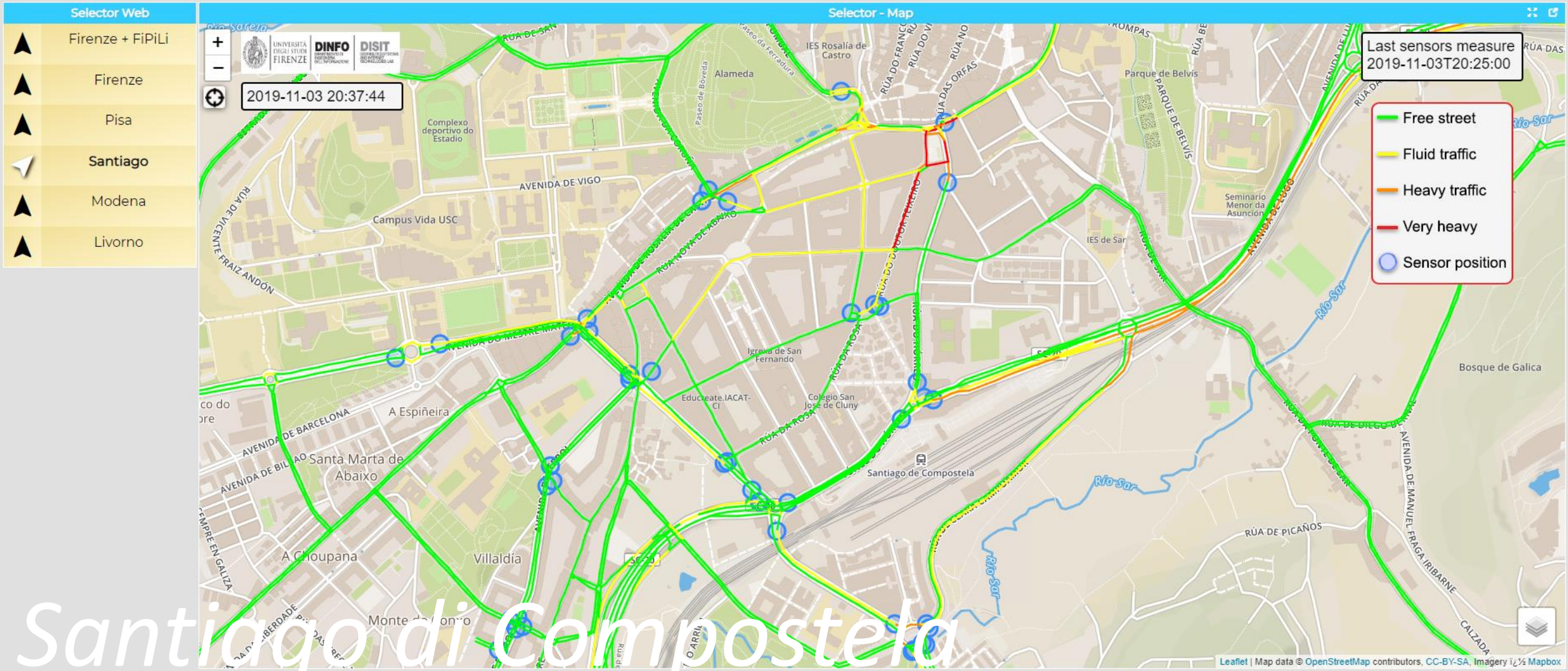
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==



Santiago di Compostela

Traffic Flow Reconstruction for the cities

Sun 3 Nov 20:37:43



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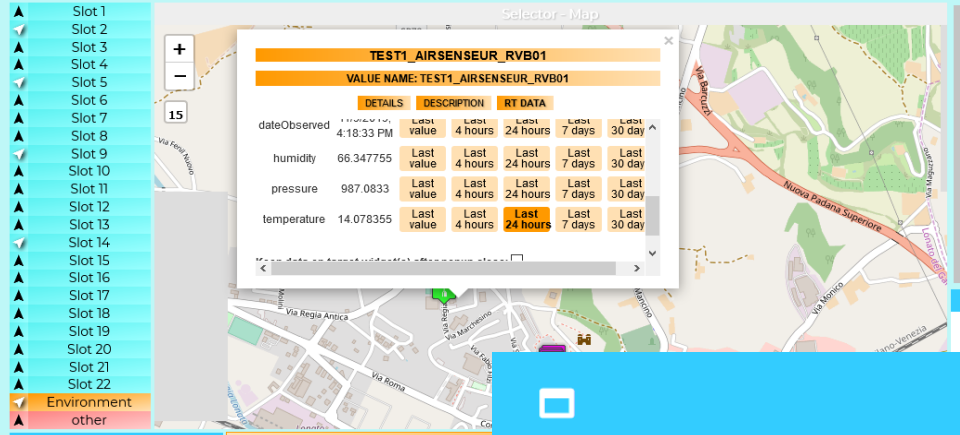
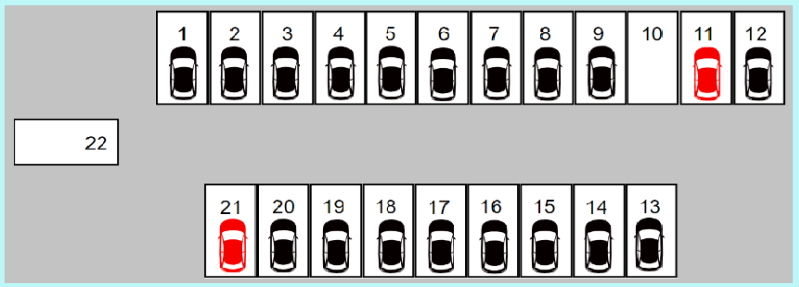
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

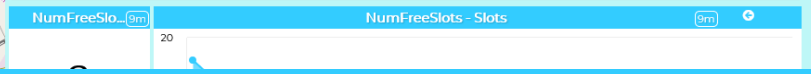

Lonato del Garda

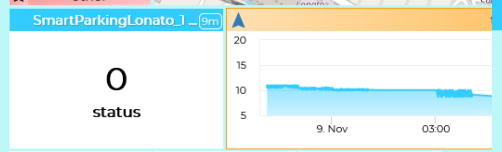
Smart Lonato del Garda

Sat 9 Nov 17:20:59





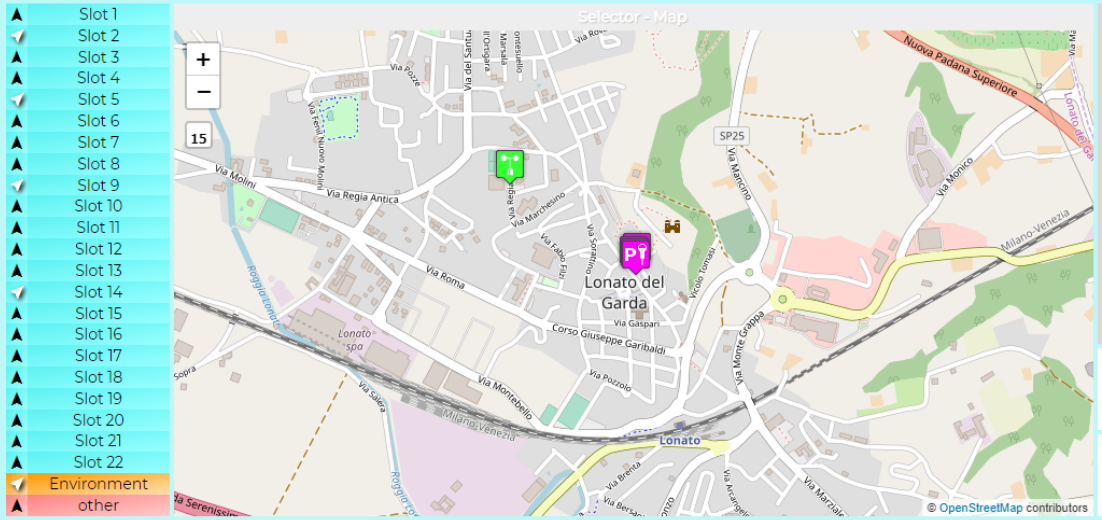


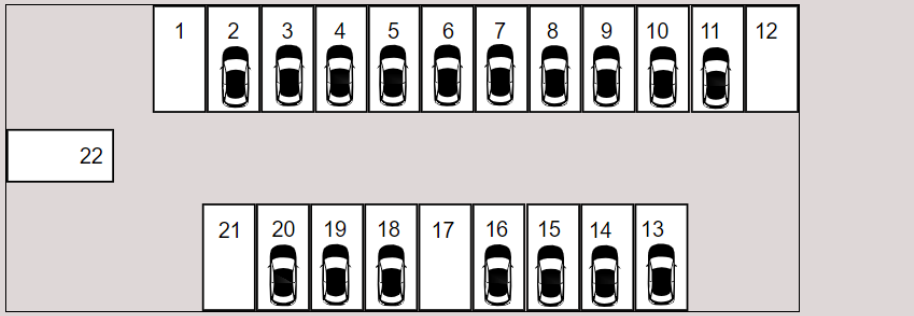


pressure 9m	humidity % 9m	temperature 9m
987.1 mm	66.3 %	14.1 C

Smart Lonato del Garda

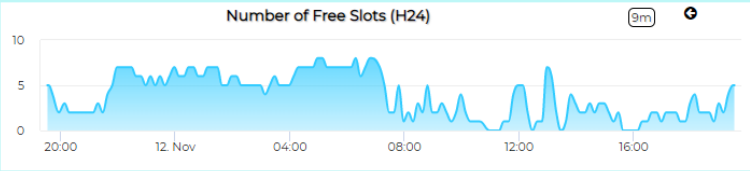
Tue 12 Nov 19:33:05

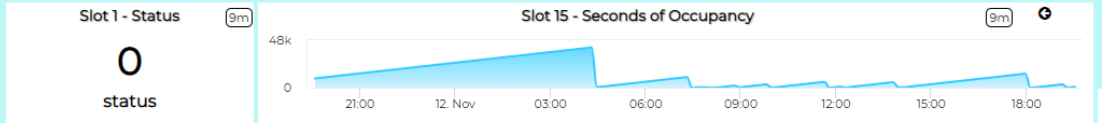




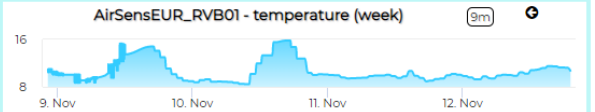
3 slot ID	Max Present Duration 9m	Median of Busy Slots 9m	AVG time of free slot 9m
	53 ore e 00 minuti	1 ora e 24 minuti	9 minuti

5 free slots	View Cam





pressure 9m	humidity % 9m	temperature 9m
976.2 mbar	82.7 %	10.7 °C

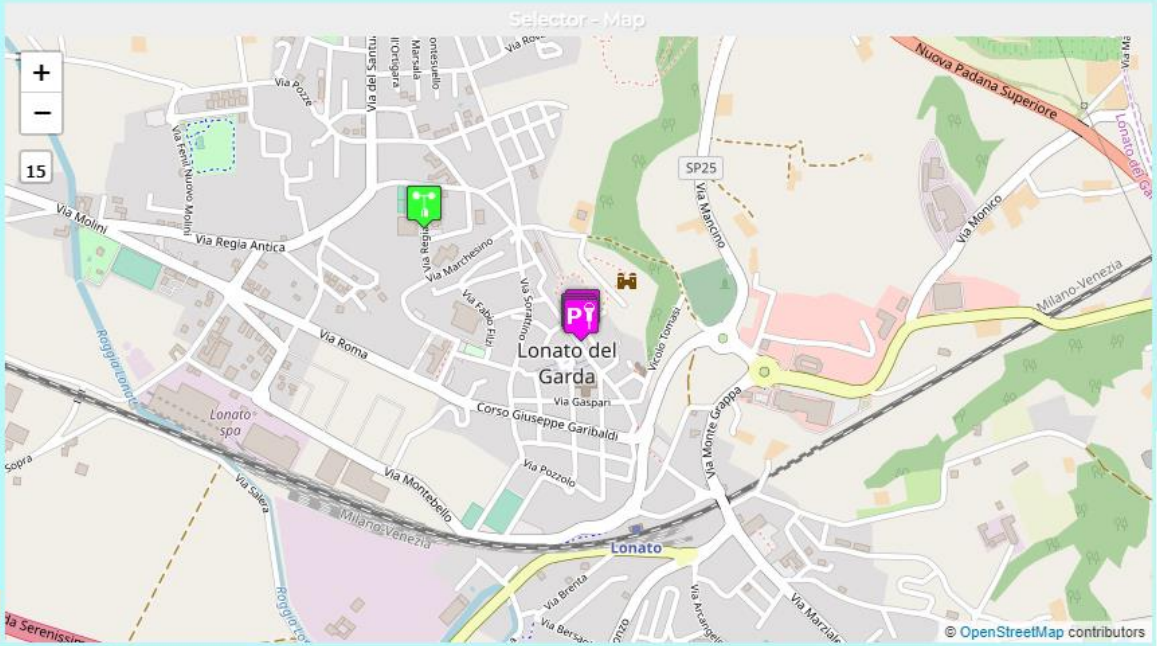


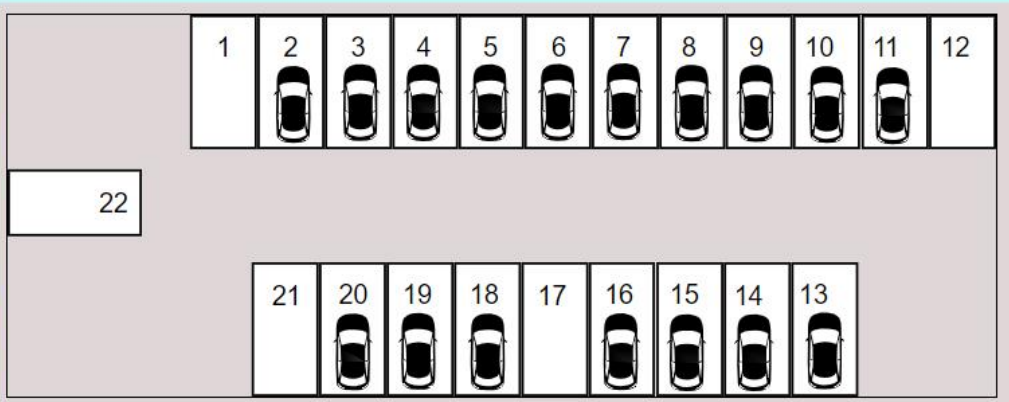


Smart Lonato del Garda - cam

Tue 12 Nov 19:31:54

- Slot 1
- Slot 2
- Slot 3
- Slot 4
- Slot 5
- Slot 6
- Slot 7
- Slot 8
- Slot 9
- Slot 10
- Slot 11
- Slot 12
- Slot 13
- Slot 14
- Slot 15
- Slot 16
- Slot 17
- Slot 18
- Slot 19
- Slot 20
- Slot 21
- Slot 22
- Environment
- other





view cam



AVG time of free slot 9m
08 minuti

5
free slots

Median of Busy Slots 9m
1 ora e 23 minuti

Max Present Duration 9m
53 ore e 01 minuto

View main

Slot 1 - Status 9m
0
status

Slot 15 - Seconds of Occupancy 9m



pressure 9m
976.2
mbar

humidity % 9m
82.7
%

temperature 9m
10.7
°C

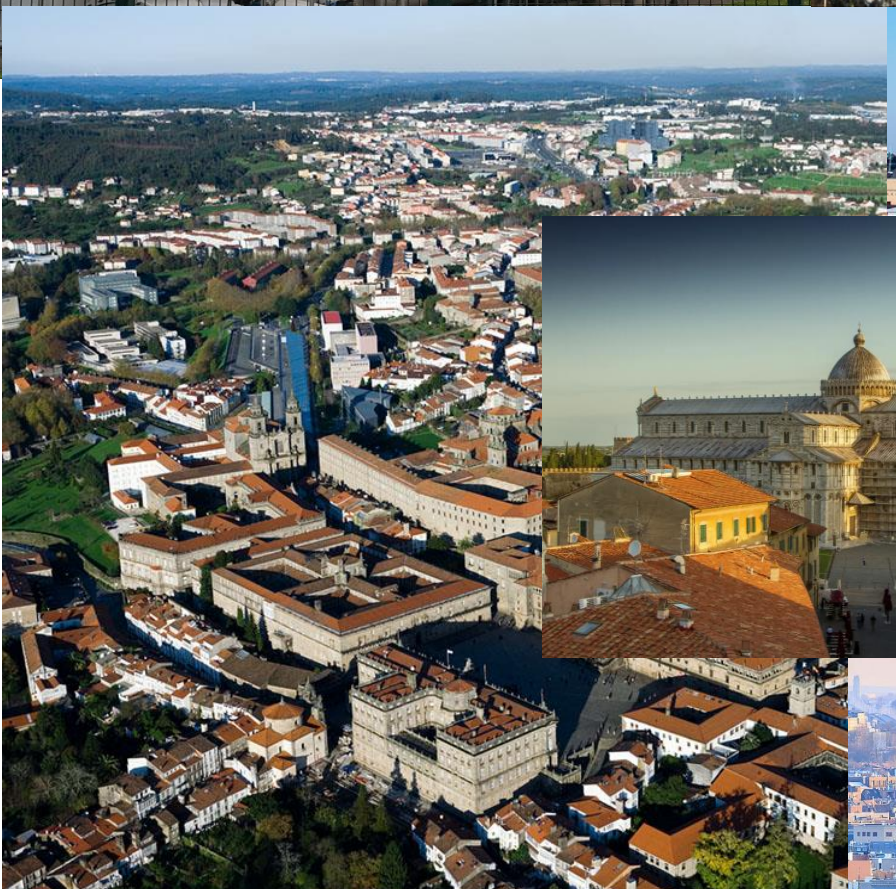
AirSensEUR_RVB01 - temperature (week) 9m

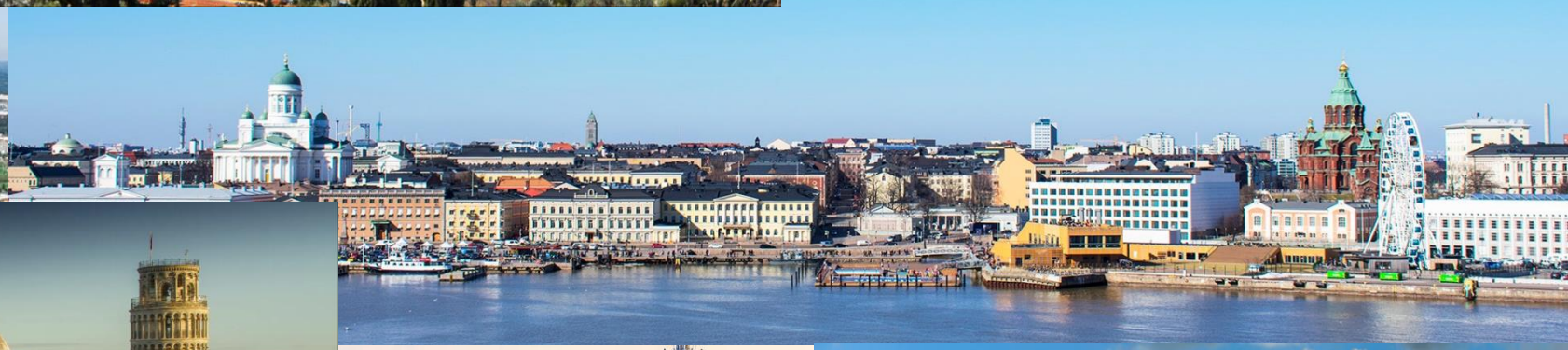







MOBY











A Larger set of Scenarious



- 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

MORE data in other locations that we manage

- **Mobility**:
  - Underpasses (real time)
  - Ferry and railways (real time)
  - tracking of busses (real time)
  - Delay at bus-stops (real time)
  - ODB2 monitoring vehicles data and trajectories (real time)
  - Mobile trajectories (real time)
  - Bike sharing (real time)
  - Connected Driving (real time)
  - Fuel station prices (real time)
- **Environment**:
  - Sensors: Noise, distance, water flow, gas, …
  - Heatmaps: Noise, ….
  - Mobile sensors: PAX, environment
  - FMI predictions: PM10, PM2.5, EAQI
  - Quality index: AQI, EAQI, CAQI, ..
- **Energy**:
  - **…..**
- **Weather**
  - Forecast and actual, several sources
- **Social**:
  - PAX Counters, Mobile PAX Counters
  - Engagement data collected from mobile Apps
  - Clicks on Mobile Applications
  - Ranking, comments and images, from Apps (web and mob)
  - Entertainment events: different kinds
- **People and People Flows**:
  - Mobile Applications
  - Origin destination matrices, people flow
- **Governmental and Communications**:
  - Emergency, risk analysis and resilience
  - Notification of events, CAP, ..
- **Tourism and Culture:**
  - POI, many many kinds

Many data analytics, for example:

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

SNAP4CITY

KM4CITY

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

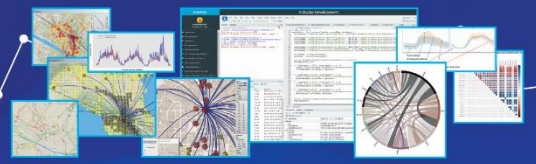
MICROSERVICES & ADVANCED SMART CITY API

LIVING LAB - DEV TOOLS - COWORKING

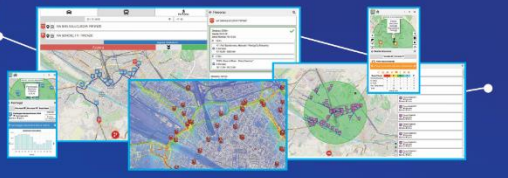


IOT DIRECTORY • SERVICE MAP • RESOURCE MANAGER • DATA GATE • R STUDIO • ETL

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, …



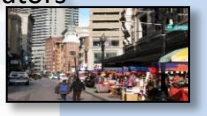
Sensors, IOT Cameras, Wi-Fi



Environment, Water, energy



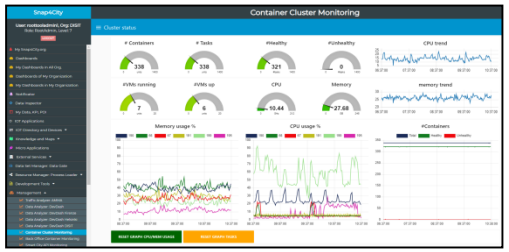
Shops, services, operators

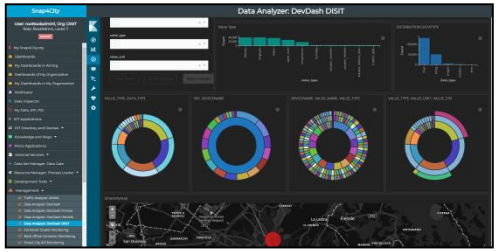


Social Media

Social Media Crawler and Manager







Data Sources PULL Data

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

Data Ingestion, aggregation, regularization, reconcile

ETL, NIFI, DISCES

Big Data Cluster
HDFS, Hbase, Phoenix

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search

Data Analytics
R, Tensor Flow, Python, MapReduce, …

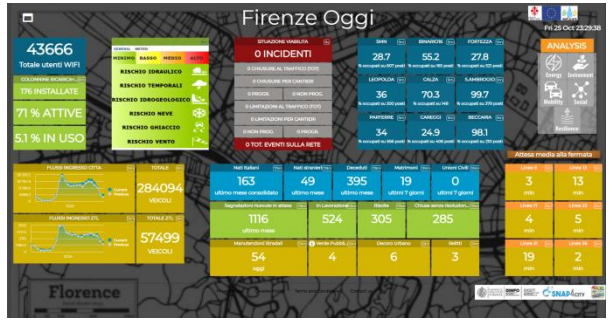
IOT Applications
Node-RED + Snap4City MicroSrvs

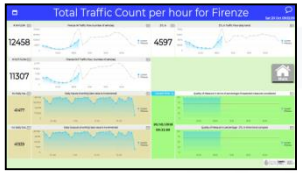
Search and Query, Smart City API
Facet, semantic search

Visual Analytics
Special dash/ tools

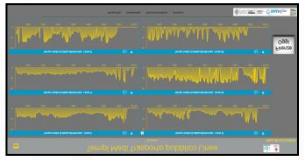
Rendering Acting, Widgets, MicroApps
User interface, Interactive Dashboard, Drill down, maps, heatmaps

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



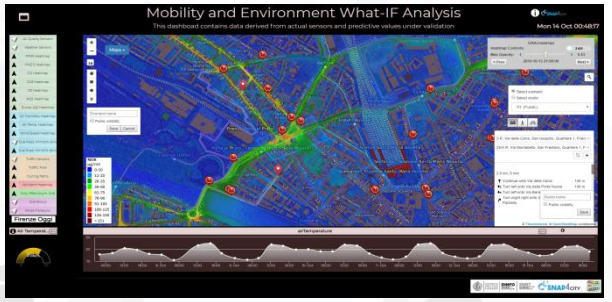












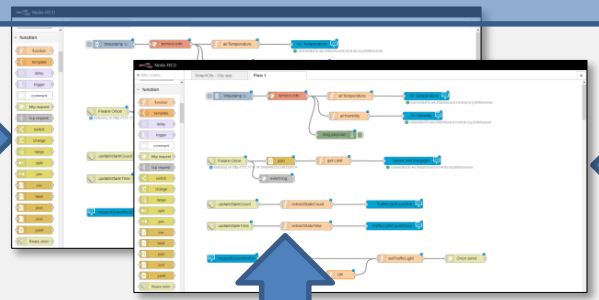
Snap4City: Builder of Sentient Cities Solutions

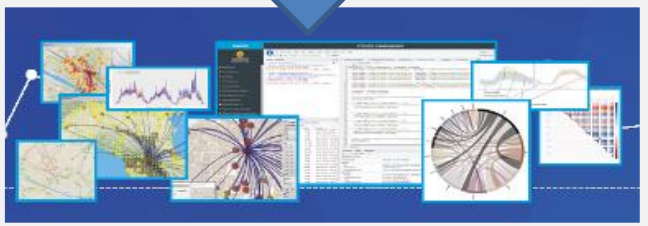
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

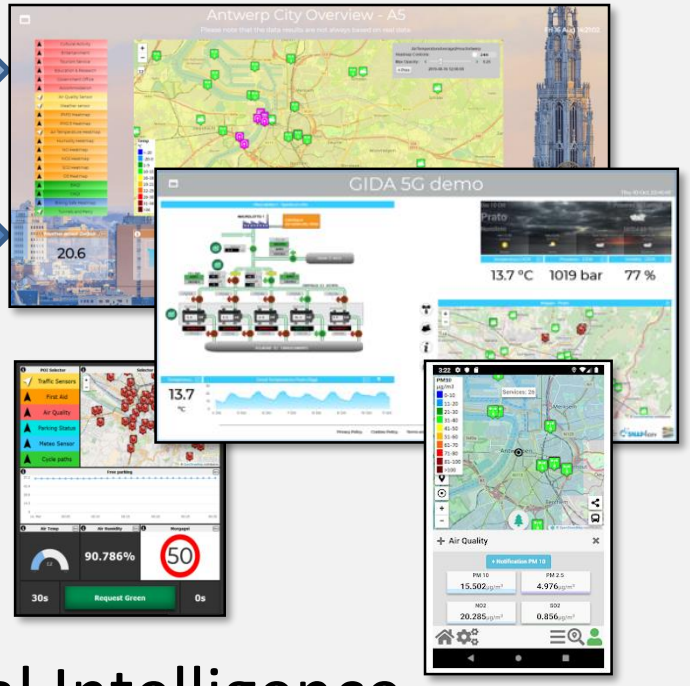


IOT Applications

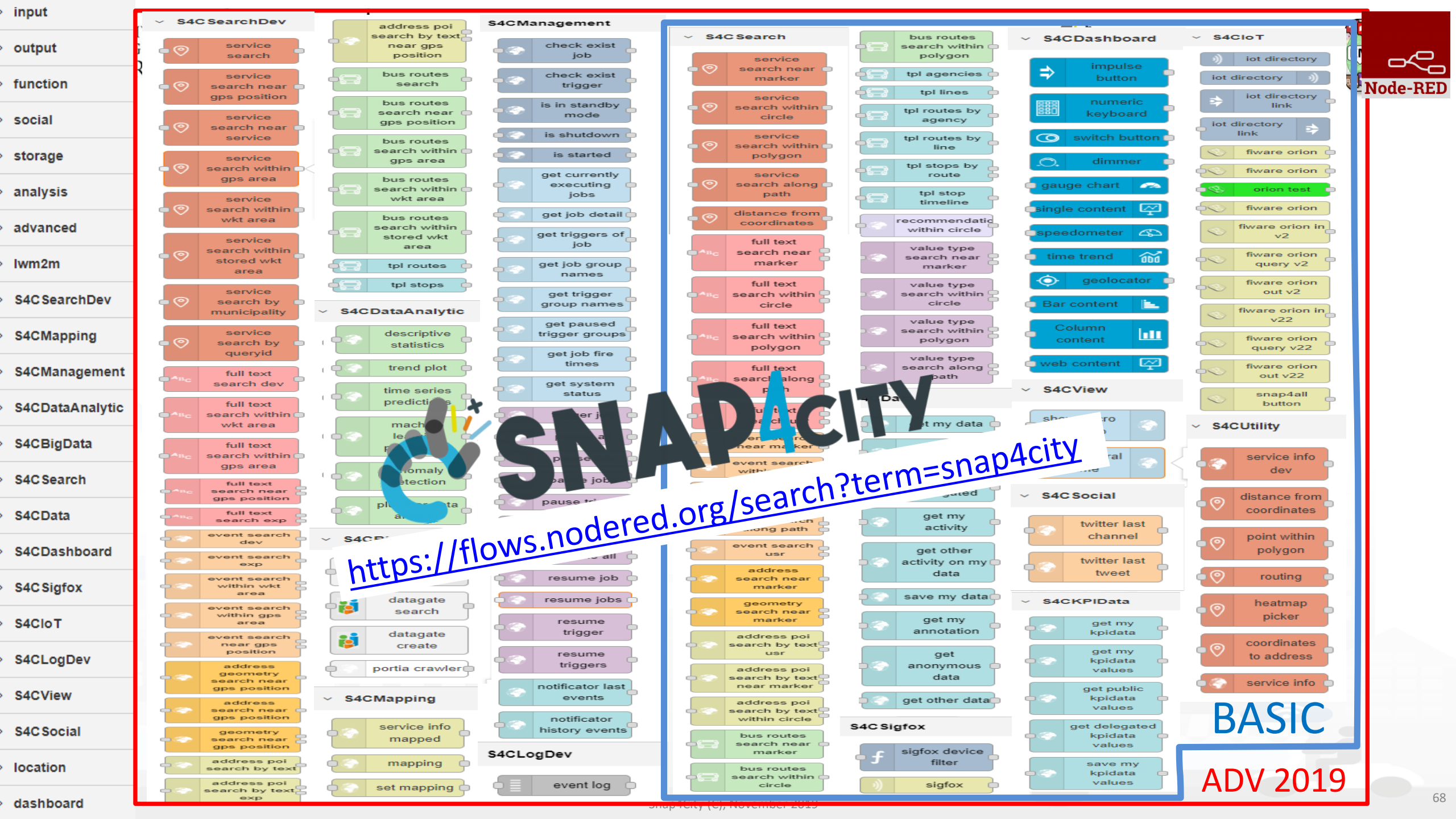




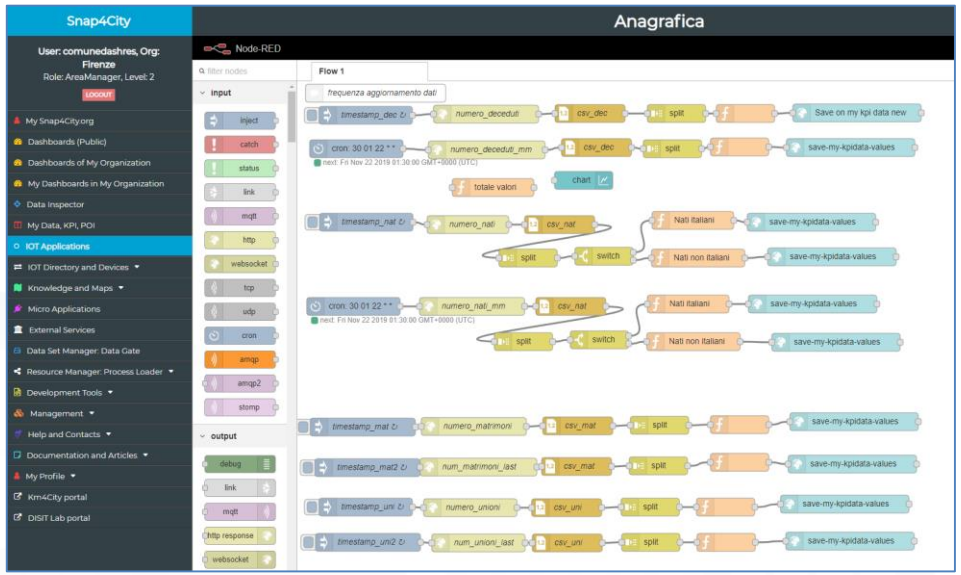
Dashboards and Apps

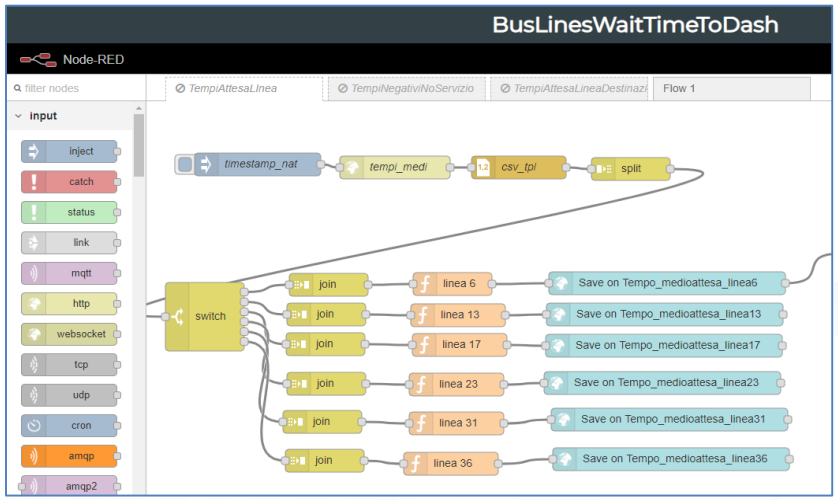


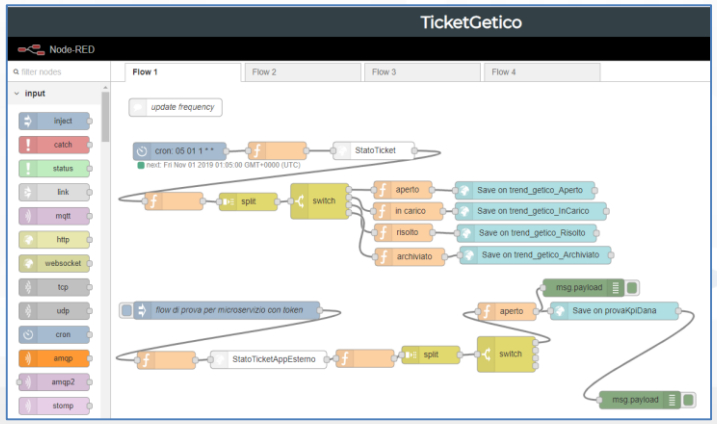
Big Data Analytics, Artificial Intelligence

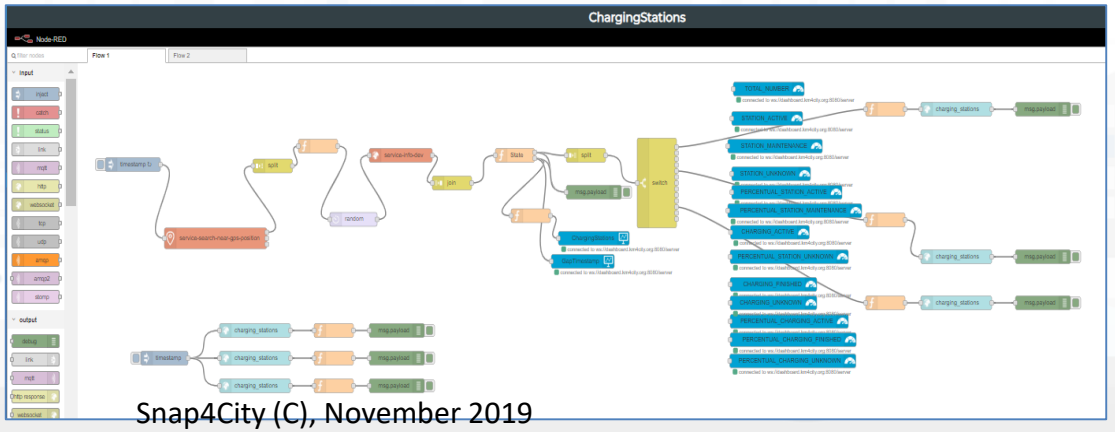

input
output
function
social
storage
analysis
advanced
lwm2m
S4CSearchDev
S4CMapping
S4CManagement
S4CDataAnalytic
S4CBigData
S4CSearch
S4CData
S4CDashboard
S4CSigfox
S4CIoT
S4CLogDev
S4CView
S4CSocial
location
dashboard
Node-RED
SNAP4CITY
https://flows.nodered.org/search?term=snap4city
BASIC
ADV 2019

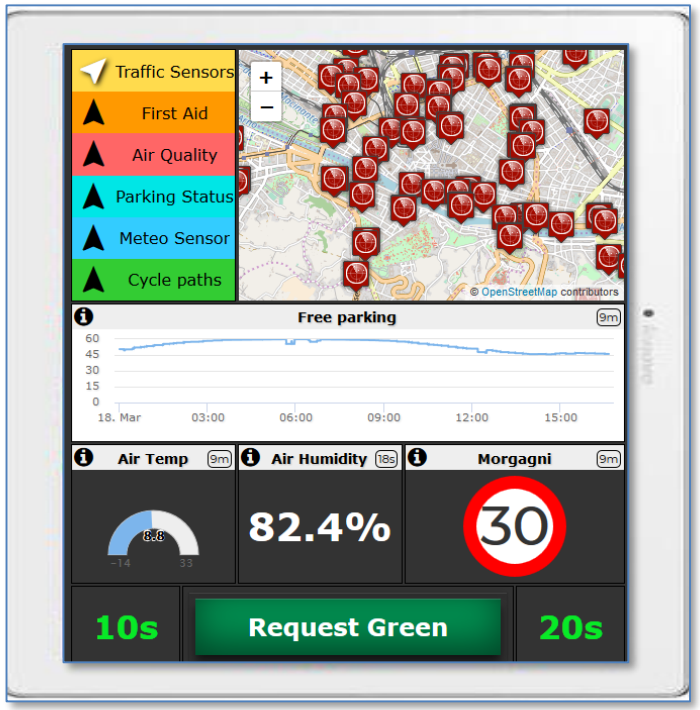
The Back-Office Data Flows (selection) Exploiting *the Snap4City Node-RED MicroServices*

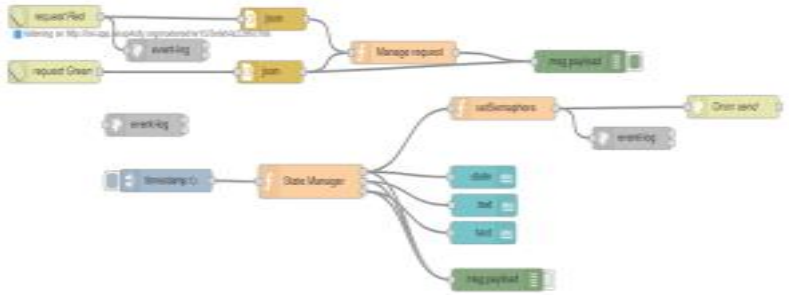









Traffic Sensors
First Aid
Air Quality
Parking Status
Meteo Sensor
Cycle paths
© OpenStreetMap contributors
Free parking
9m
60
45
30
15
0
18. Mar
03:00
06:00
09:00
12:00
15:00
Air Temp
9m
Air Humidity
18s
Morgagni
9m
82.4%
30
10s
Request Green
20s







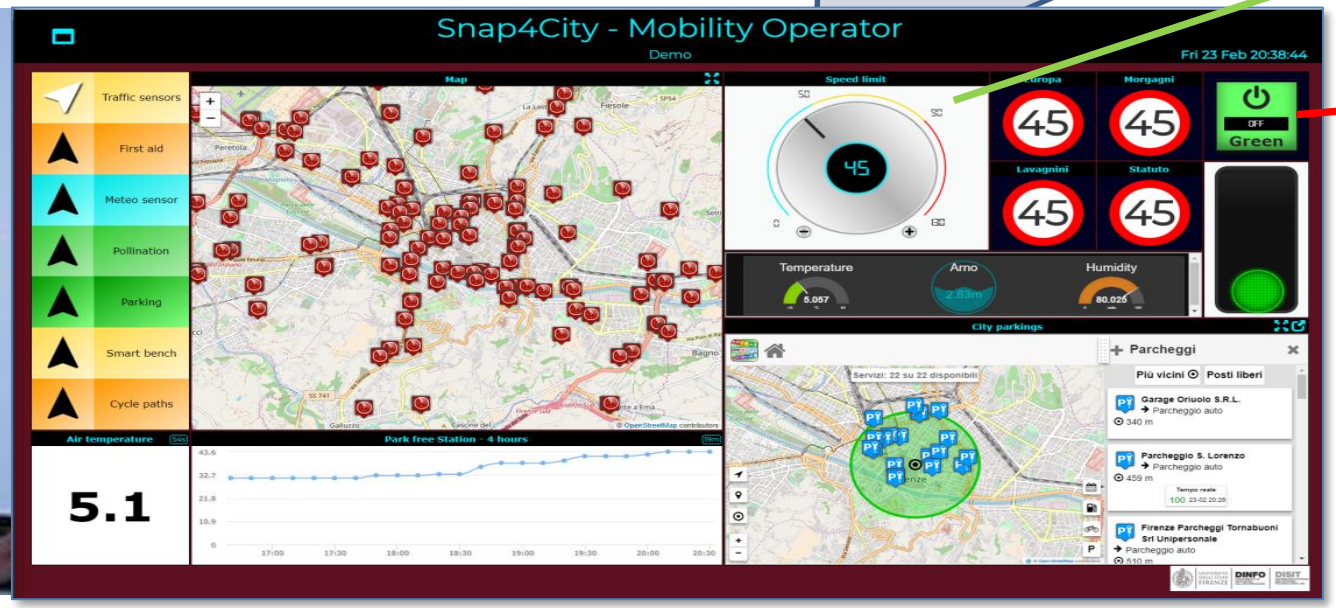


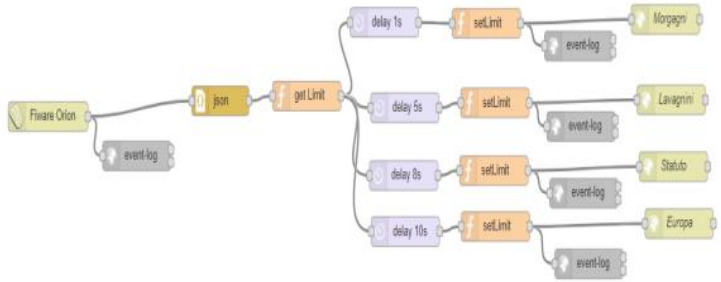









Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
Europa
Morgagni
Lavagnini
Statuto
45
OFF
Green
Temperature
Arno
Humidity
5.057
80.025
City parkings
Parcheggi
Più vicini
Posti liberi
Garage Oriuolo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


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

IOT Devices

Sensors/
Actuators

IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI

Arduino,
Wi-Fi, NGSI

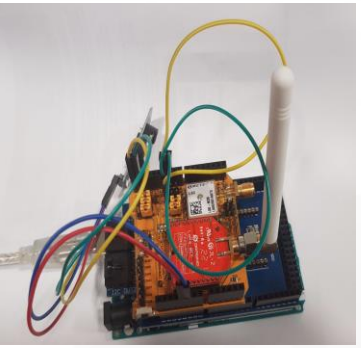
Snap4All
IOT Button
ESP, NGSI,
Wi-FI, BT

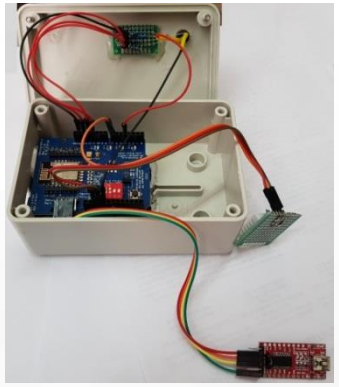
Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

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

IOT Edge
NodeRED:
Android, LINUX,
Windows, …

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



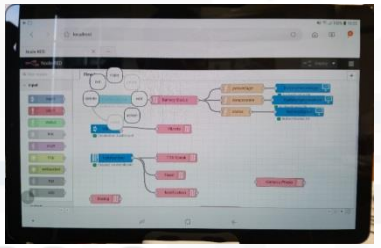








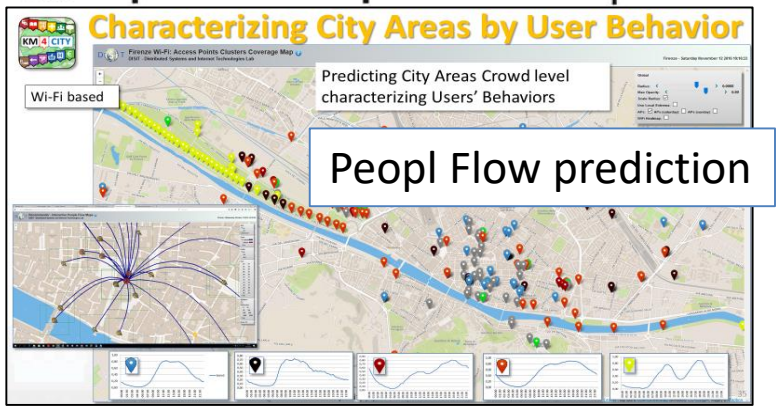




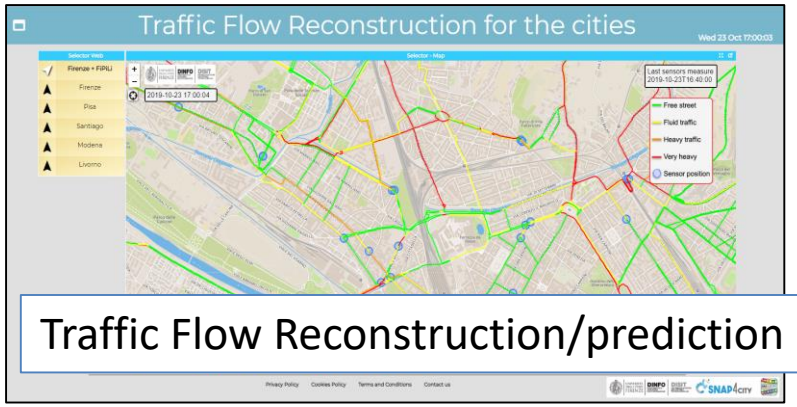


Any Sensor / Actuator
Open to other protocols

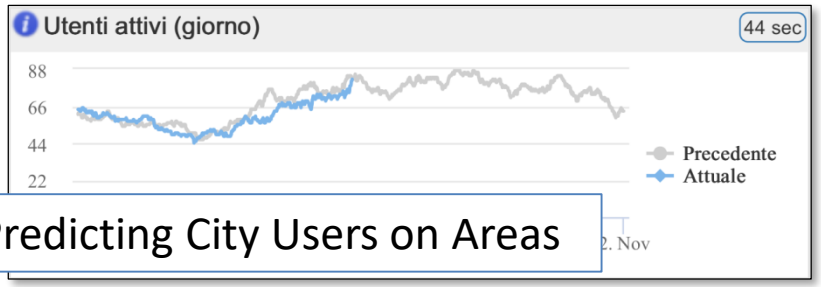
Data Analytics



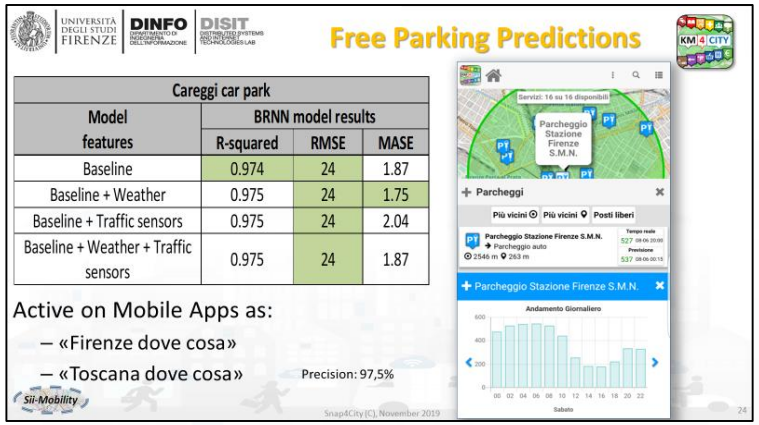
Peopl Flow prediction

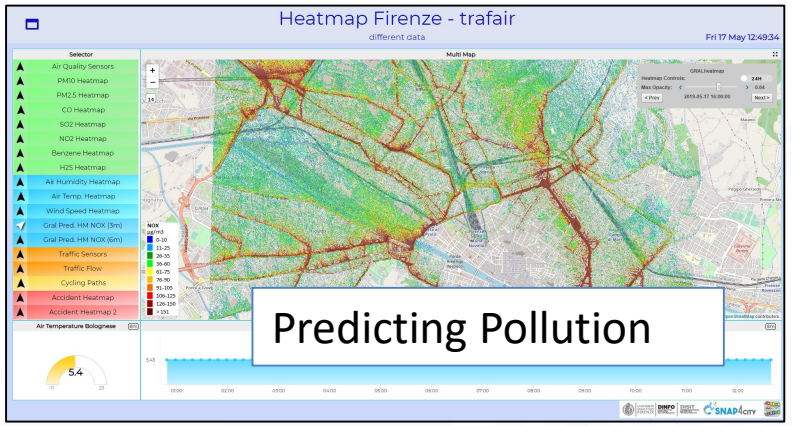


Traffic Flow Reconstruction/prediction

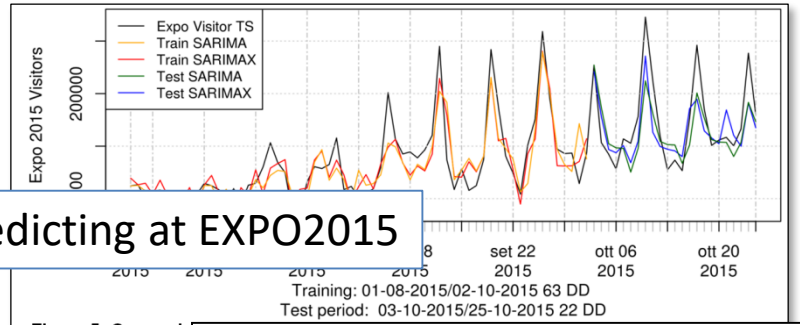


Predicting City Users on Areas

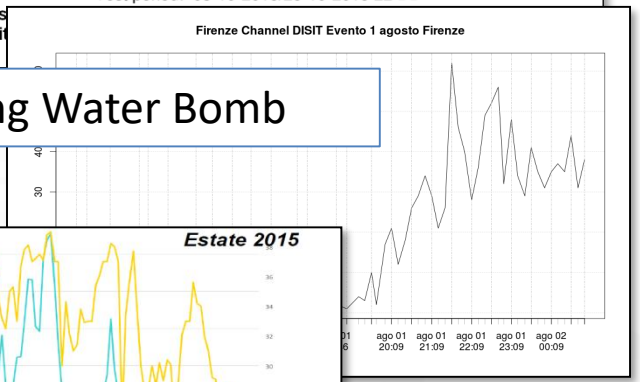




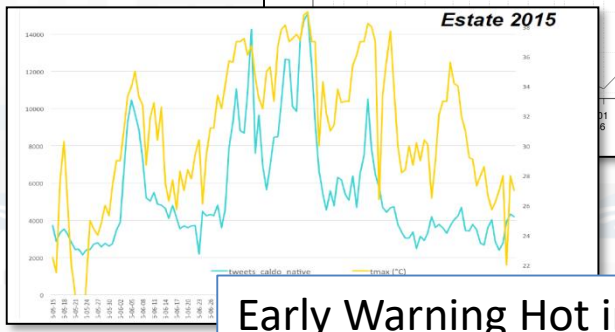
Predicting Pollution



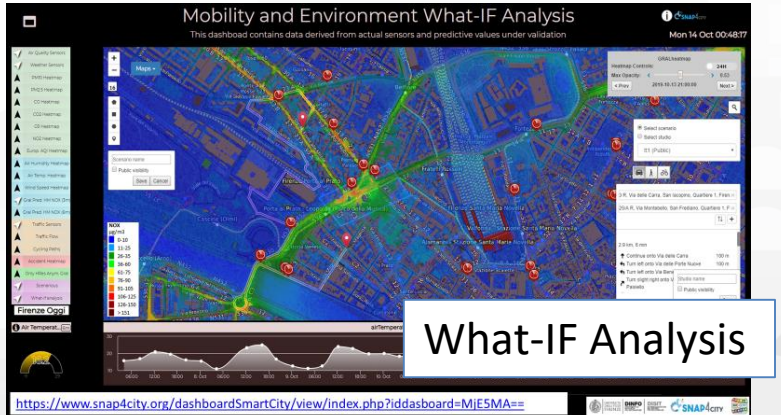
Predicting at EXPO2015



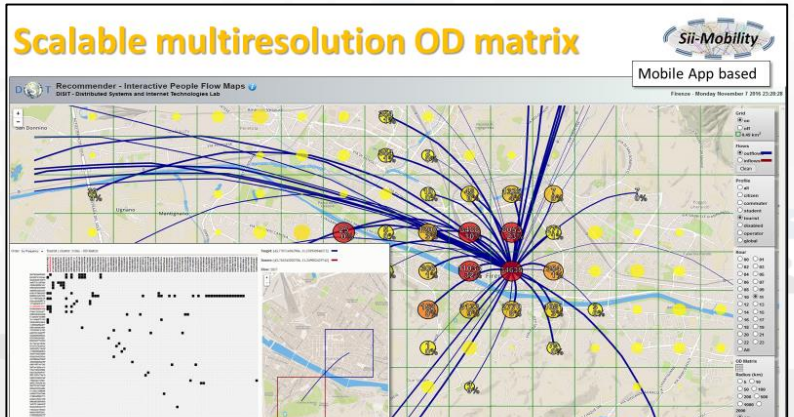
Early Warning Water Bomb



Early Warning Hot in Tuscany



What-IF Analysis



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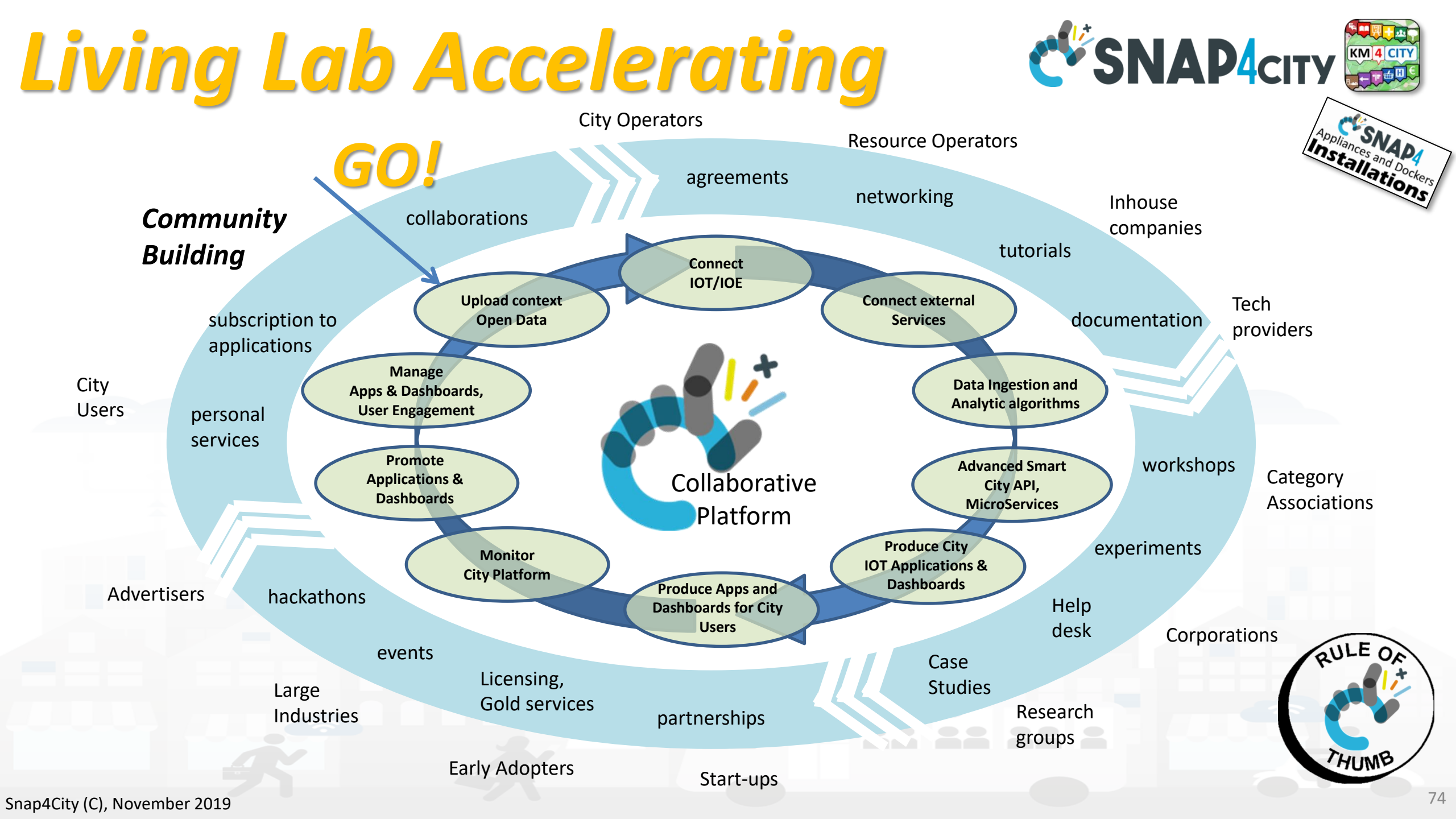
Disappearing Data Analytics

SNAP4CITY | KM 4 CITY

	Antwerp					Helsinki								Where				
SNAP4CITY	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	RULE OF THUMB 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
Engagement real time assessment	X	X	X			X	X	X									X	Snap4City Mobile App

Living Lab Accelerating





Dashboards (Public)
Knowledge and Maps
Service Map (Toscana)
Service Map 3D (Firenze)
Helsinki Service Map
Garda Lake Service Map
Cagliari Service Map
Service Map 3D (Helsinki)
Micro Applications
External Services
Data Set Manager: Data Gate
Resource Manager
Development Tools
Management
Help and Contacts
Documentation and Articles
Km4City portal
DISIT Lab portal

Snap4City - scalable Smart aNalytic APplication builder for sentient Cities



Tutorials Scenarious Innovations Interoperability Installations What People say

Mobile Apps IOT Devices IOT Applications Data Analytics Dashboards Living Lab Smart City API

Smart City Ontology Articles

SMARTCITY EXPO WORLD CONGRESS 19-21 Nov. 2019 *See you at Stand A118*

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

SNAP4CITY HACKATHON BUILD YOUR APP FOR A CONNECTED CITY

Smart Cities need to set up a flexible Living Lab to cope with the city evolution in terms of services and city users' needs and sustainability. Snap4City solution (https://www.snap4city.org) provides a flexible method and solution to quickly create a large range of smart city applications exploiting heterogeneous data and enabling services for stakeholders by IOT/IOE, data analytics and big data technologies. Snap4City applications may exploit multiple paradigms as data driven, stream and batch processing, putting co-creation tools in the hands of: (i) Smart Living Lab users and developers a plethora of solutions to develop applications without vendor lock-in nor technology lock-in, (ii) final users customizable / flexible mobile Apps and tools, (iii) city operators and decision makers specialized / sophisticated city dashboards and IOT/IOE applications for city status monitoring, control and decision support. Snap4City satisfies all the expected requirements of Select4Cities challenge PCP and much more, and it is 100% open source, scalable, robust, respects user needs and privacy; provides MicroServices and easily replaceable tools; compliant with GDPR; provides a set of tools for knowledge and living lab management, and it is compliant

Login

Registration

- New Registration
- Request a new password

Search

Search

-Any-

Training Snap4City from Data to Sentient Cities in a Snap
Program and Interactive Slides

Powered by www.km4city.org

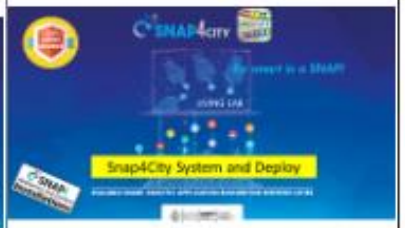
FI-WARE Node-RED

Virtual Assistant


SNAP4city
Be smart in a SNAP!
LIVING LAB
9 July 2019, 2° Training day of 3 Florence
Coll@bora
Welcome: how to start using Snap4City for beginners
We suggest you:
Search
Organization Groups
Recent content

https://www.snap4city.org/501

November 2019 Training for Barcelona Smart City World Expo Congress

	1st day	2nd day	3rd day	4th day	5th day	6th day
what	General	Dashboards	IOT App, App, Network	Data Analytics	DataWareHouse Data Ingestion	System and Installation
PDF						 Installations
Inter active						

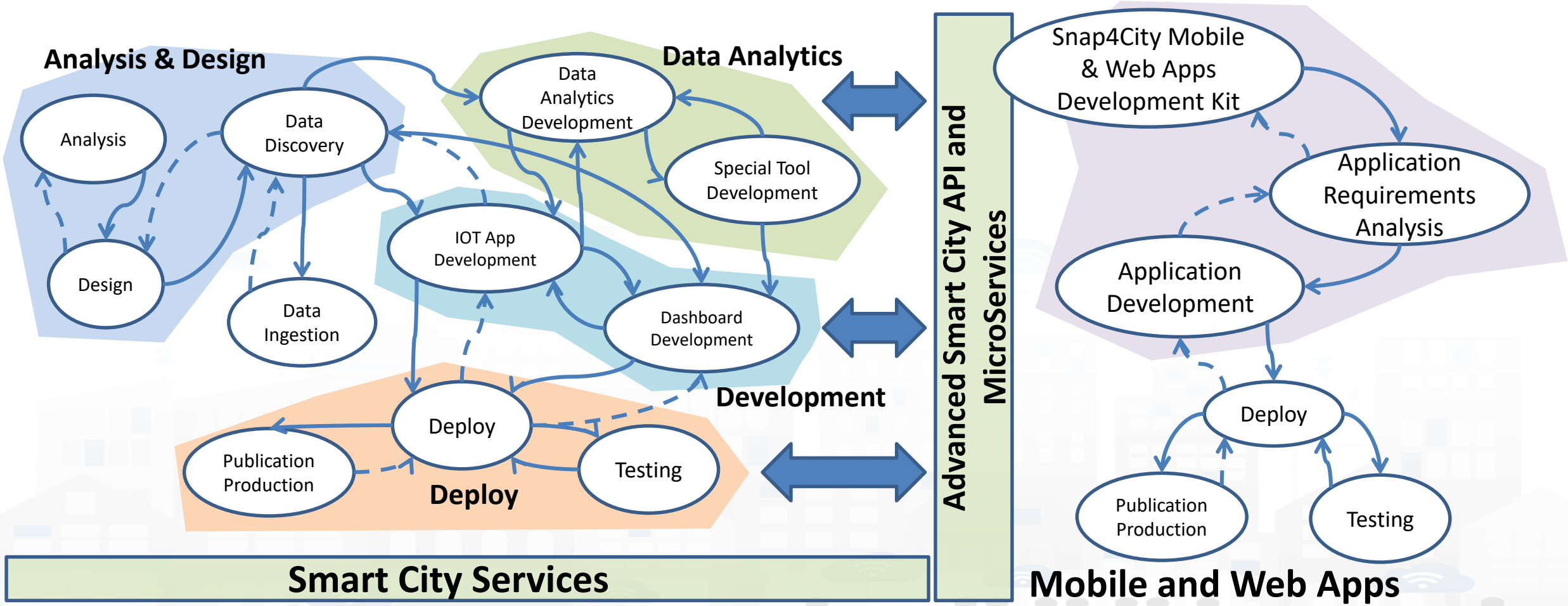
The updated Snap4City mobile development App Kit as open source for developing mobile and web App using Cordoba Apache is accessible on GitHUB from:

https://github.com/disit/snap4cityAppKit

Swagger documentation of Smart City API is on: https://www.km4city.org/swagger/external/index.html

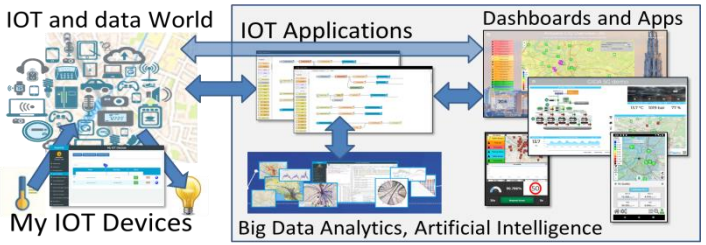
7th day, the Mobile App Development exploiting the Smart city API					
Slides ENG in PDF about the structure of the kit and main tools		interactive SLIDES ENG about the structure of the kit and main tools		video ENG on HOW to use the Dev Kit from zero	

Develop Mobile & Web Applications Exploiting Snap4City Smart City Services



How to adopt Snap4City

On your premise





Installation on your premise

- Virtual Machines or Dockers
- Different configurations
  - From small to scalable
  - Exploiting your legacy tools
  - Interoperable with any tool
- No vendor lock-in, No tech lock-in

Mixed solutions! For example:

- Start on Cloud as Smart City as a Service
  - Migrate on premise on the fly
- Start on Cloud into a sand box
  - Pass to install on premise what you need

Download and deploy

Https://www.snap4city.org



Smart City as a Service

- Supporting Org
- 100% Open Source Platform: Github
- Further developments
- Publishing Appliances and Dockers
- Training courses, docs
- Consulting
- Forums
- Etc.

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

DISIT lab roadmap vs model and tools' usage

2013 Km4City Ontology 1.1

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

2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- Events
- LOD

ckan

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015

- Sardinia Region Smart City Strategies and plan

FIWARE

SII-MOBILITY SCN (2016-19)

Km4City 1.5 (2016-21) H2020

resolute (2015-18) H2020

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

E015 digital ecosystem

2016

Km4City 1.6.2

- Infomobility
- Mobile App
- Routing
- Multimodality

- Smart Energy
- Sustainable Mobility
- Control Room Dashboard

REPLICATE

Km4City 1.6.4

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

GHOST SIR (2016-19)

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

GREEN IMPACT

POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

Km4City 1.6.6 IOT/IOE

Node-RED

SNAP4CITY

SELECT for Cities H2020 (2017-19)

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

2017

life weee (2017-20)

- Smart Waste

TRAFAIR CEF (2018-21)

2018

MOSAiC (2018-20)

- Mobility Demand / Offer Analytics and Strategy

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

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

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

2020

Reverberi Enetec Gruppo MPES

bee smart city

GREEN FIELD PEAS Soda4.0

SIRIUS

LAID Smart Bed

…2022

SNAP4CITY

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

Projects

Sii-Mobility · REPLICATE · resolute · GHOST · TRAFAIR · MOSAiC · life weee · smartGARDAlake · SELECT for Cities · SIRIUS · GREEN IMPACT C.A.P.A.C.I.T.Y. · GREEN FIELD PEAS Soda4.0 · LAID Smart Bed

Co-founding institutions on projects

EUROPEAN COMMISSION · MIUR MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA · POR CreO · Regione Toscana

Qualified Partners

COMUNE DI FIRENZE · CITTÀ METROPOLITANA DI FIRENZE · comune di PRATO · Comune di LIVORNO · Comune di Modena · COMUNE DI CAGLIARI · CITTÀ METROPOLITANA DI CAGLIARI · REGIONE AUTÒNOMA DE SARDIGNA REGIONE AUTONOMA DELLA SARDEGNA

ALSTOM mobility by nature · SESA · ALTAIR CHIMICA · swarco SWARCO MIZAR S.r.l. · DIPARTIMENTO DI INFORMATICA · anci toscana · USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

estra · Reverberi Enetec Gruppo MPES · FORUM VIRIUM HELSINKI · National Research Council of Italy

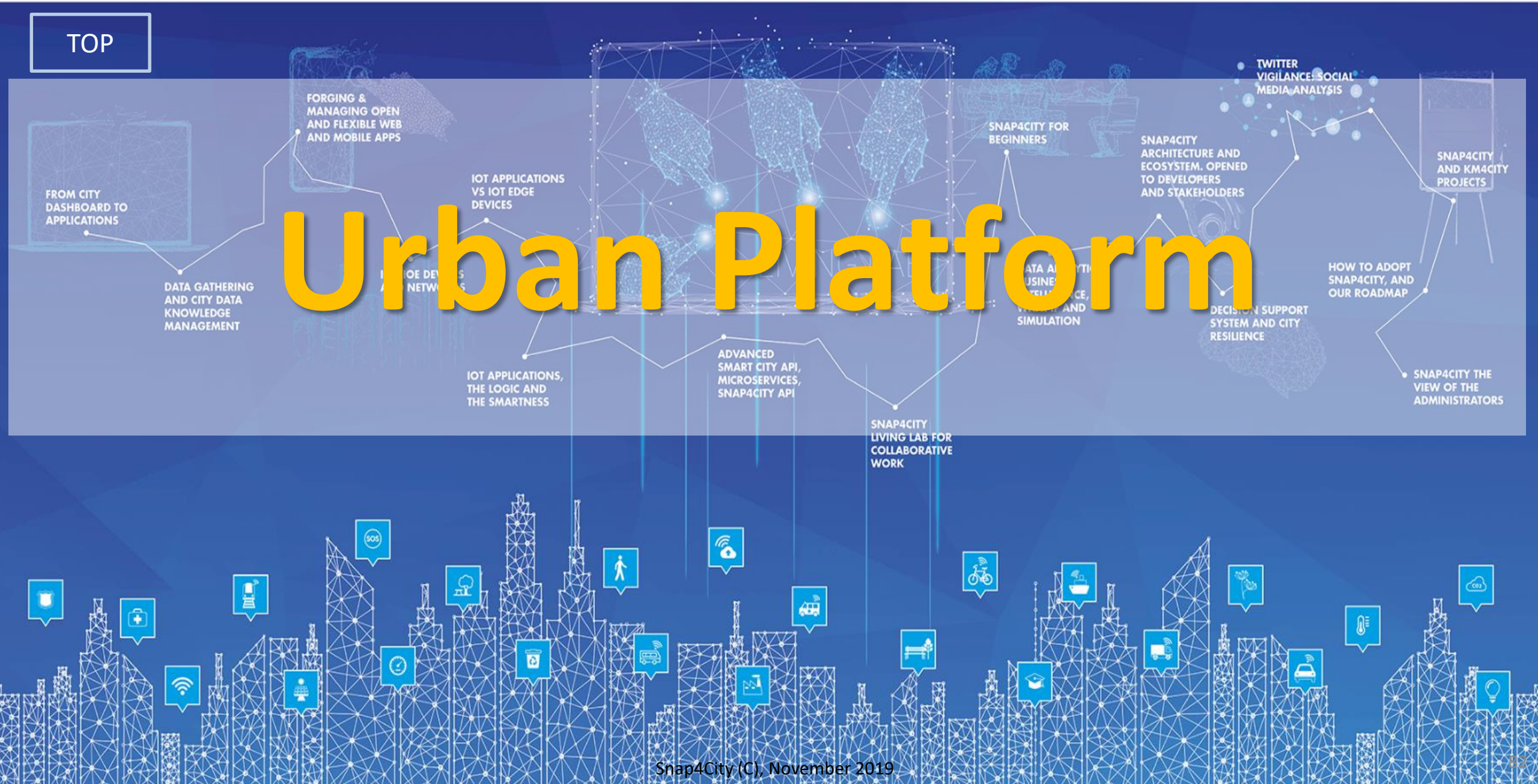
Technical Partnerships

Powered by FIWARE · sigfox partner network · ckan · GJL · LABGEO · esri Italia THE SCIENCE OF WHERE · With the support of NVIDIA

Marketplaces

Node-RED · JS Foundation · FIWARE · bee smart city · EUROPEAN OPEN SCIENCE CLOUD · EØ15 digital ecosystem Powered by EXPO MILANO 2015

TOP

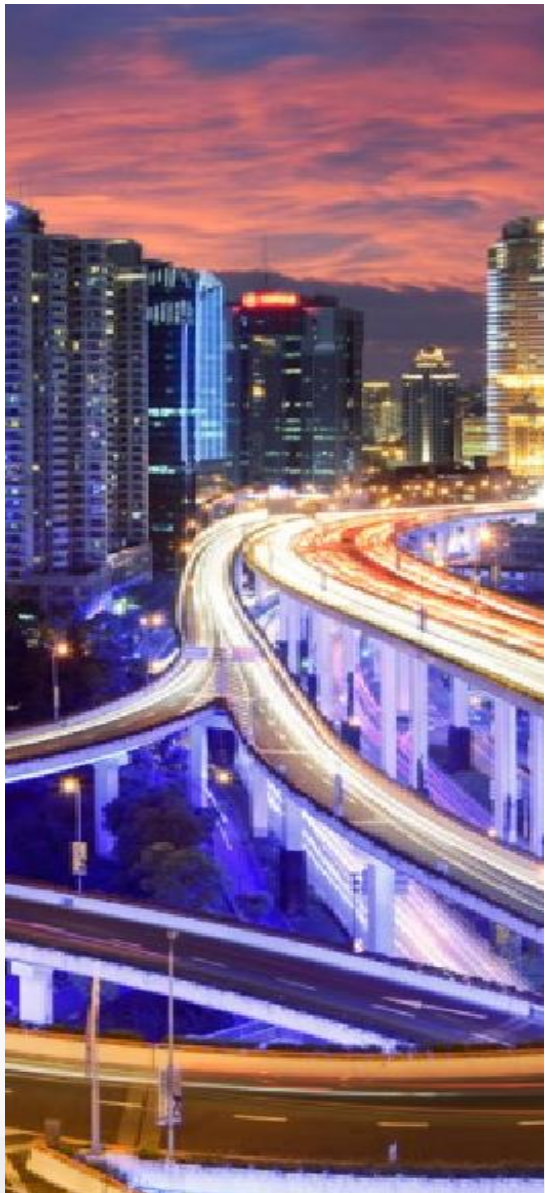


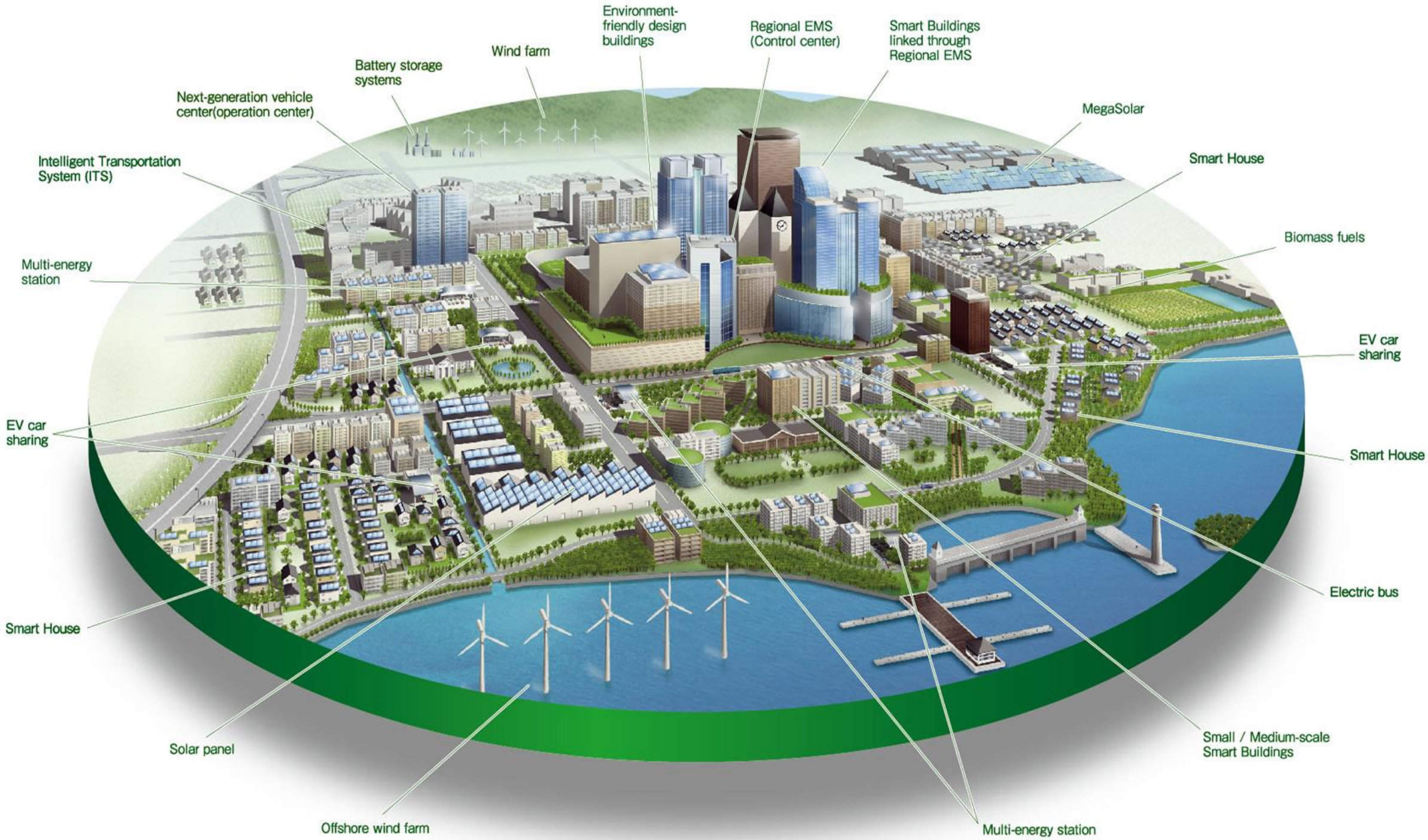
Urban Platform



Motivations of the Smart City

- Migration towards cities: in the 2050 more than the 75% of population will live in the cities.
  - More opportunities, higher salaries, etc.
- Cities have to cope with the increment of citizens providing higher quality of services & efficiency:
  - To this end, they have to conquer a high level of
    - control on: expenses, quality of services,….
    - quality of services, new services, etc.
    - sustainability of services …



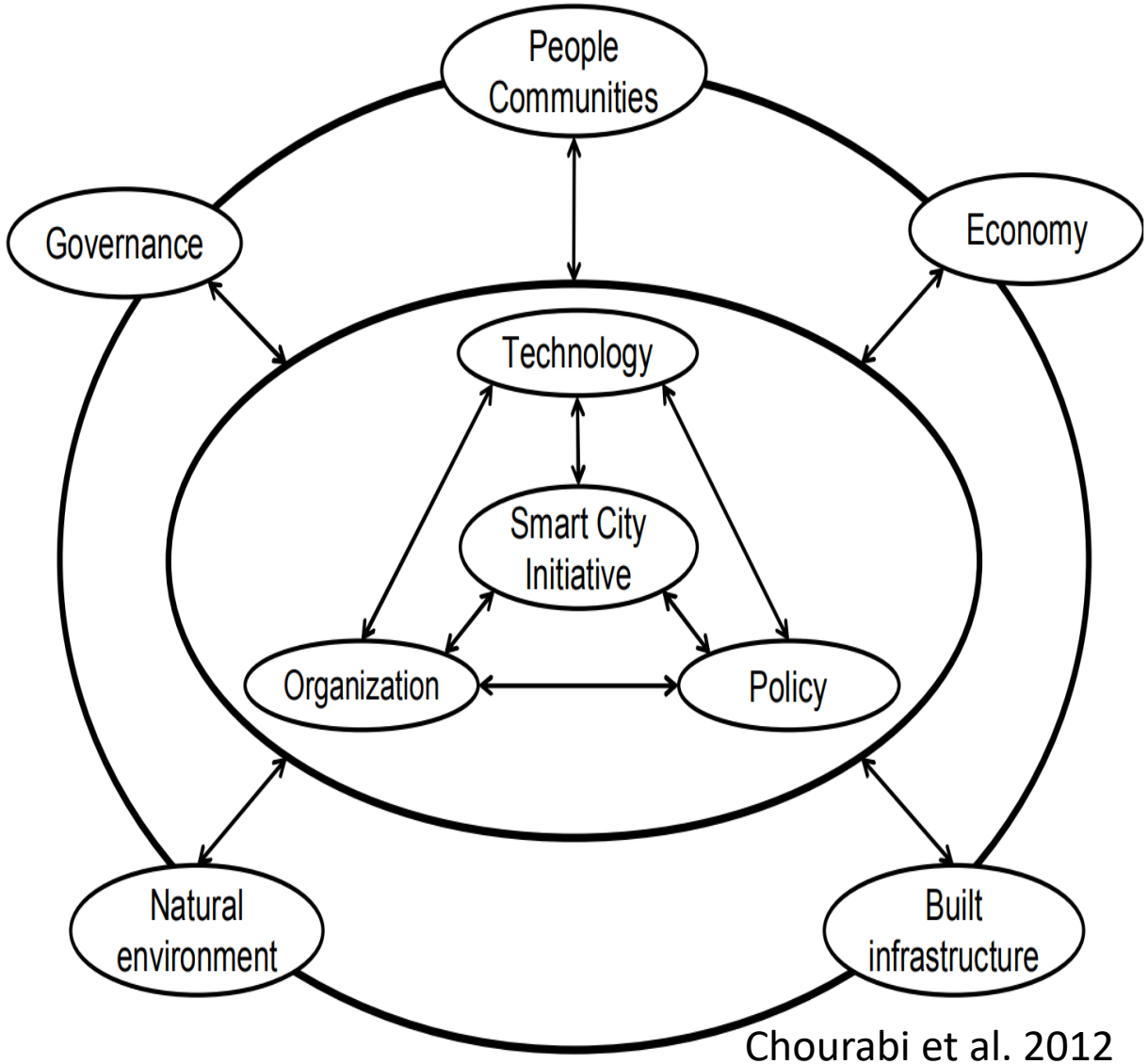

Environment-friendly design buildings
Regional EMS (Control center)
Smart Buildings linked through Regional EMS
Wind farm
Battery storage systems
Next-generation vehicle center(operation center)
MegaSolar
Intelligent Transportation System (ITS)
Smart House
Biomass fuels
Multi-energy station
EV car sharing
EV car sharing
Smart House
Electric bus
Smart House
Small / Medium-scale Smart Buildings
Solar panel
Offshore wind farm
Multi-energy station

Smart City Process

- Many aspects should be taken into account for a successful Smart City transformation

- → *The influence of each of them depends on context, attitude of the institutions, internal structure, etc.*
  - *Parallel actions can conflict, compete …*
  - *Spreading of efforts may distance the goals*
  - *……*

- → *The process may become sustainable, harmonized and faster with a Living Lab Strategy and Support*



Chourabi et al. 2012

Smart City Domains

- Health
- Education
- Economy & commercial
- Energy
- Environment
- Mobility & Transport
- People & Living
- Governmental
  - Risk management, Resilience
- …










Sustainability of the Growth

- To be **planned and managed** with respect to increment of population and their needs
  - Increment of quality of life, more services or more efficient services
  - provisioning of new services in place of older services
  - Decision support for strategic aspects:
    - Corrections, prediction, new services, etc.
- **Towards citizens**
  - Informing citizens on the new adaptations, making them aware about that
  - Forming citizens to adopt virtuous behaviour in the usage of services and resources
  - Collecting their feedback continuosly via a multichannel

Challenges: Requests and Deductions

Public Admin.



Pub. Admin: detection of critical conditions, improving services

Mobility Operators





Tune the service, reselling data and services , prediction







Commercial: customers prediction and profiles, promotions via ads

Tourism Museums



Tune the service, prediction

API for SME

Smart City Engine

Services & Suggestions
Transport, Mobility, Commercial (retail), Tourism, Cultural



Personal Time Assistant
dynamic ticketing, whispers to save time and money, geoloc information, offers, etc.







User profiling
Collective profiles
User segmentation

User Behavior Crowd Sources



Data: Public and Private, Static and Real Time

Private: user movements, social media, crowd sources, commercial (retail)
Public: infomobility, traffic flow, TV cameras, flows, ambient, weather, statistic, accesses to LTZ, services, museums, point of interests, …

Snap4City has been Created to satisfy requirements of:

European Network of Living Labs

- **ENOLL**: https://www.openlivinglabs.eu/
  - European Network of Living Labs

EIP-SCC

- **EIP-SCC**: European Innovation Partnership on Smart Cities and Communities
  - https://eu-smartcities.eu/

SELECT for Cities

- **Select4Cities**: Pre-Commercial Procurement Project to develop a data-driven, Internet-of-Everything (IoE) platform for large-scale urban co-creation
  - https://www.select4cities.eu/

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.
- 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, coworking; collaborative work; sharing: data, processes, dashboard, experiences, solutions, ….
- Experimented on **large scale cases**

Non functional requirements

- **Open Source** and based on Open Source Tools and OS
- Open **Standard** for communication and API for In/Out
- **Scalable, Robust, Distributed** and Decoupled, modular, Service Oriented, open to external services and data sets
- **Data driven**, for reading and data analytic
- **Heterogeneous**: any device, private and public, custom and..
- **Interoperability**: protocols, internal API, Smart City API, capable to integrate with legacy conditions in place, modular, reusable,…
- Communication with things: any protocol, any format, …
- **Security** by Design: HTTPS, TLS, …
- **User Centric** Design: privacy by Design (and **GDPR**), personalized, personal data management, ...

Security/Privacy Requirements

- **Managing** private data together with public data
- **Private data management** according to GDPR
  - Browsing, downloading, controlling rights, delegating access, revoking accesses, etc.
  - Keep them safe
- Secure enough to delegate management of data regarding public security:
  - Data that could be used against us by some terrorist, or anyway by someone with some bad intention, for example to access in our home when we are far away, etc.

Data Driven Decision Support

- Decision Support system
- Assessment / Strategies
- Data Rendering, visual analytics
- Data Processing
- Data aggregation, Storage, indexing
- Data Ingestion



Data Collection, ingestion (processes)

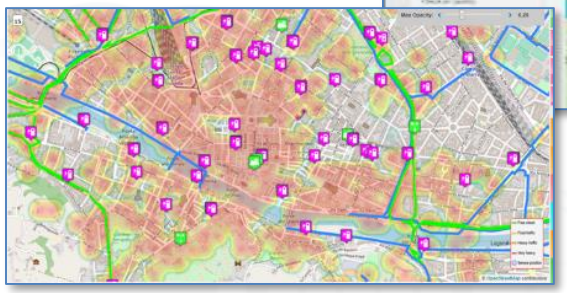
- **Data**
  - Open and private: Open Data: CKAN
    - licensing, private, GDPR
  - Static vs Real time
  - Any protocol, any standard: Push and Pull
  - Any format
- From **observations and milestones**:
  - sensors, database, KPI, etc.
- From **legacy services** of in-place operators
  - External Services: call of any kind
  - MicroServices, MicroApplications
  - Local databases
- From **citizens, city users, tourists, operators, ..**:
  - participated processes, feedback, Apps, etc.
  - Crawling web pages, etc.

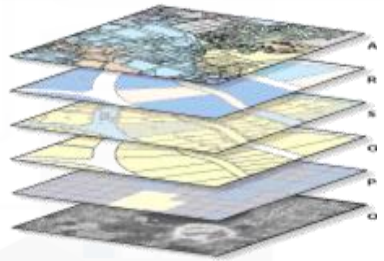




ckan

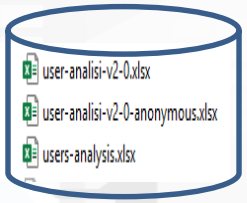












Private and static

- Fiscal Code, SSN
- Non shared pictures
- Level aspects
- Patient health record
- ..

- Personal movements
- GPS traces
- Relationships among people

- User Behaviour
- social media
- Contributions
- Consumption of energy, gas
- banking

Real time private

- Personal traffic
- Position of cars
- Position of taxi
- Position of CarSharing ...

Static Public (open data)

statistics: accidents, census, votations

- # Accesses to RTZ ZTL
- Data from Public GOV

- Position of commercial activities, POI

- Museums
- City services data, almost
- Active services

- TV cameras

Real time public (open data)

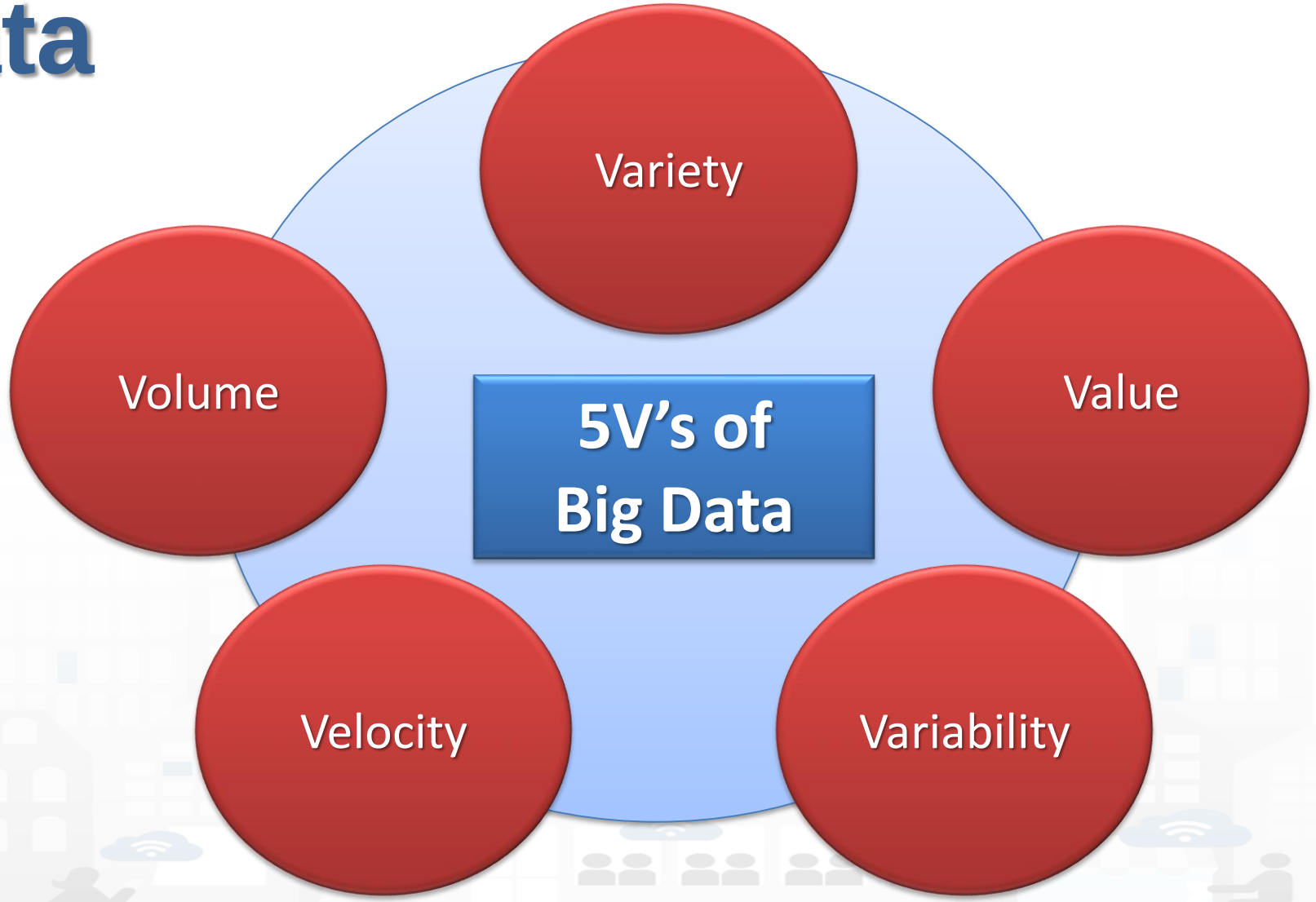
- Info traffico
- video camere
- Info weather
- Info environment
- Status of the queue at Museums
- earthquake data
- parking

- Stato accessi alla ZTL
- Stato dei servizi

5V of Big Data

When data are BIG data?

The excel file size?

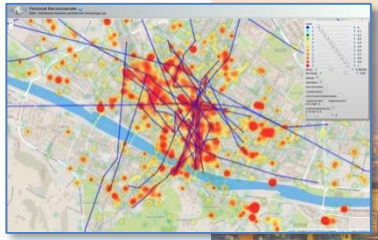


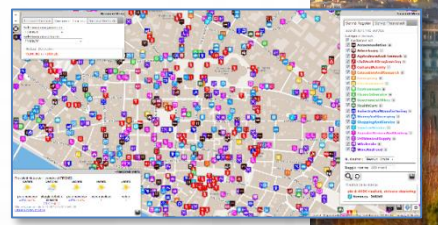
Other Vs have been also proposed…

Integrated Urban Platform

- **Produce value from data supporting Living lab**
  - Stimulate virtuous behavior, influence City Users!
  - Put in action CITY Strategies
- **Data Exploitation performing**
  - predictions, reasoning, business intelligence, ..
  - users behavior analysis, decision support system, ..
  - Control Room, Real Time Monitoring tools, ….
- **Aggregate & integrate data**
  - Multiple protocols from urban operators, ...
  - open data, IOT, sensors, internet of everything, cloud, mobile devices, Wi-Fi, social media, ...







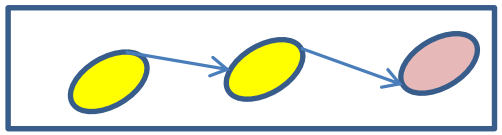


Data Indexing & Semantic Data Indexing

- **Textual**, multilingual, NLP (Natural Language Processing)
  - For social media data, but also for metadata, descriptions
- **Spatial**, **geographical**, georeversing → Knowledge Base, Km4City
  - Around a point, along a line/path, near a path, into a polyline, etc.
- **Temporal** → Historical data
- **Semantic:** relationships among city entities.
- **Data Value** different data type (Data Lake/normalization), data unit, etc. → the so called IOT shadowing of Azure, AWS
  - Relating to Knowledge Base reciprocally

- ***Traffic** / volume of Data (KBps) → Network Analysis, monitoring*

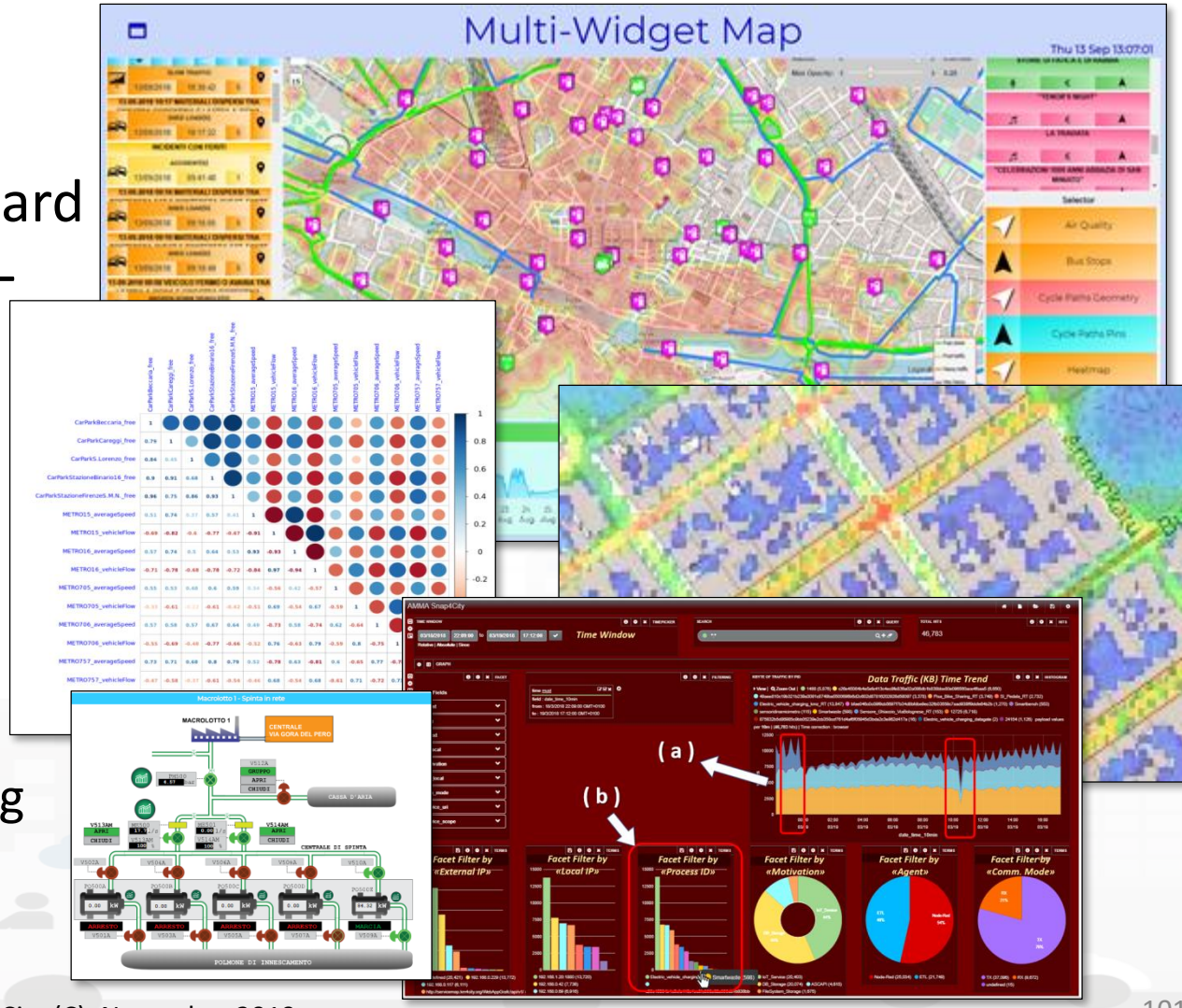
Data processing



- **Data analytics**
  - Periodic or event driven
    - On demand
  - Data transformation
    - ETL: extract transform load
  - Control Flow, data transform
    - Node-RED: Node.JS
- **For example**:
  - Assessment/monitoring
  - Predictions
  - Anomaly detection
  - Simulations
  - Etc.

Data Rendering vs Control Room Dashboards

- **GIS** rendering by layers
- **Business intelligence** mainly focused on making statistics from tabular: no layer, hard relationships, ... Exploit Data Analytic, ETL
- **Visual Analytics**, data understanding
  - Rendering and drill down
  - Faceting/grouping (Elastic Search/SOLR)
  - Cross filtering (Kibana, Grafana, Banana)
  - Interactive, Cross Widgeting
- **Control Room Dashboards:**
  - Need: Visual Analytics, Data Analytic, geospatial reasoning, data driven processing
  - H24, alerting, Flexible rendering, custom widgets, interactive dashboards

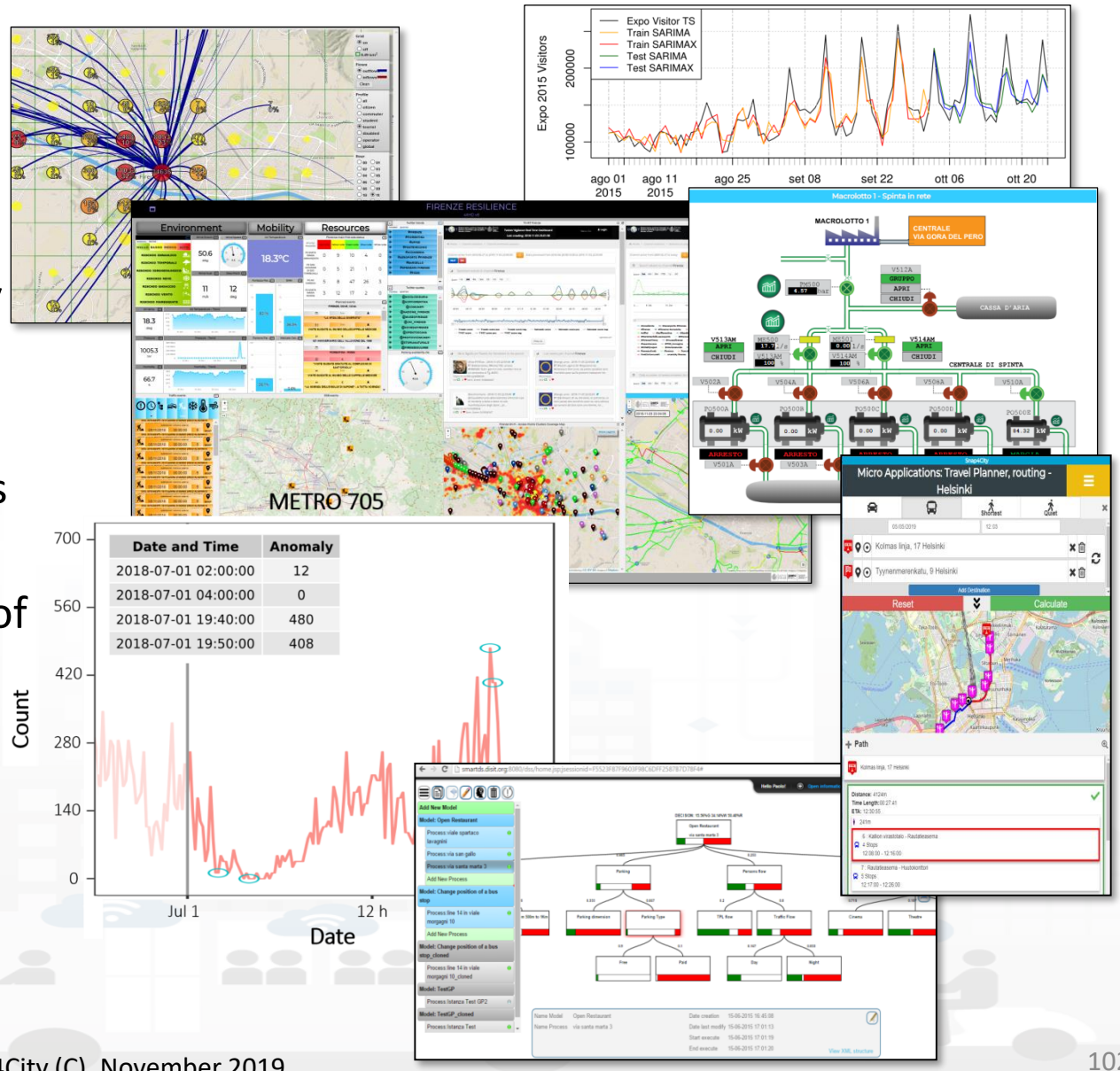


Decision Support, Act!

Smart City Control Room, SCCR, SCR

- Not only a collection of verticals

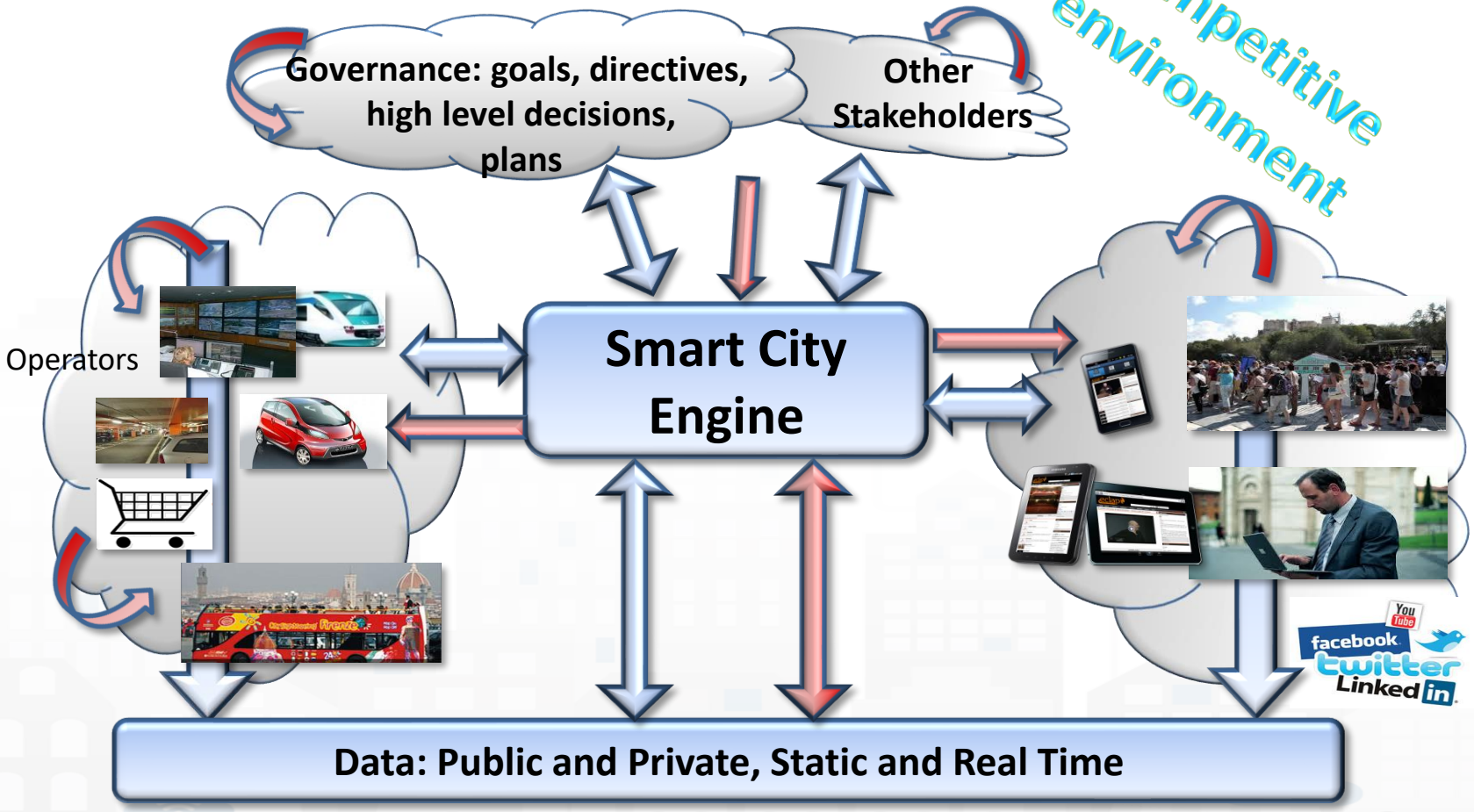
- **Exploiting analytics**: prediction, simulations, anomaly detection. ..
  - Big data approach to Data Analytics
- **Connecting Heterogeneous data** to defined strategies and alerting
- **Connected interactive dashboards** for different kind of decision makers: operators and majors
- **What-if Analysis taking into account multiple data sources**



From strategies to Actions

From Strategies to (re-)Actions

- Informing
- Suggesting
- Engaging
- Alerting, Early Warning
- Making Decision active
- New Plan

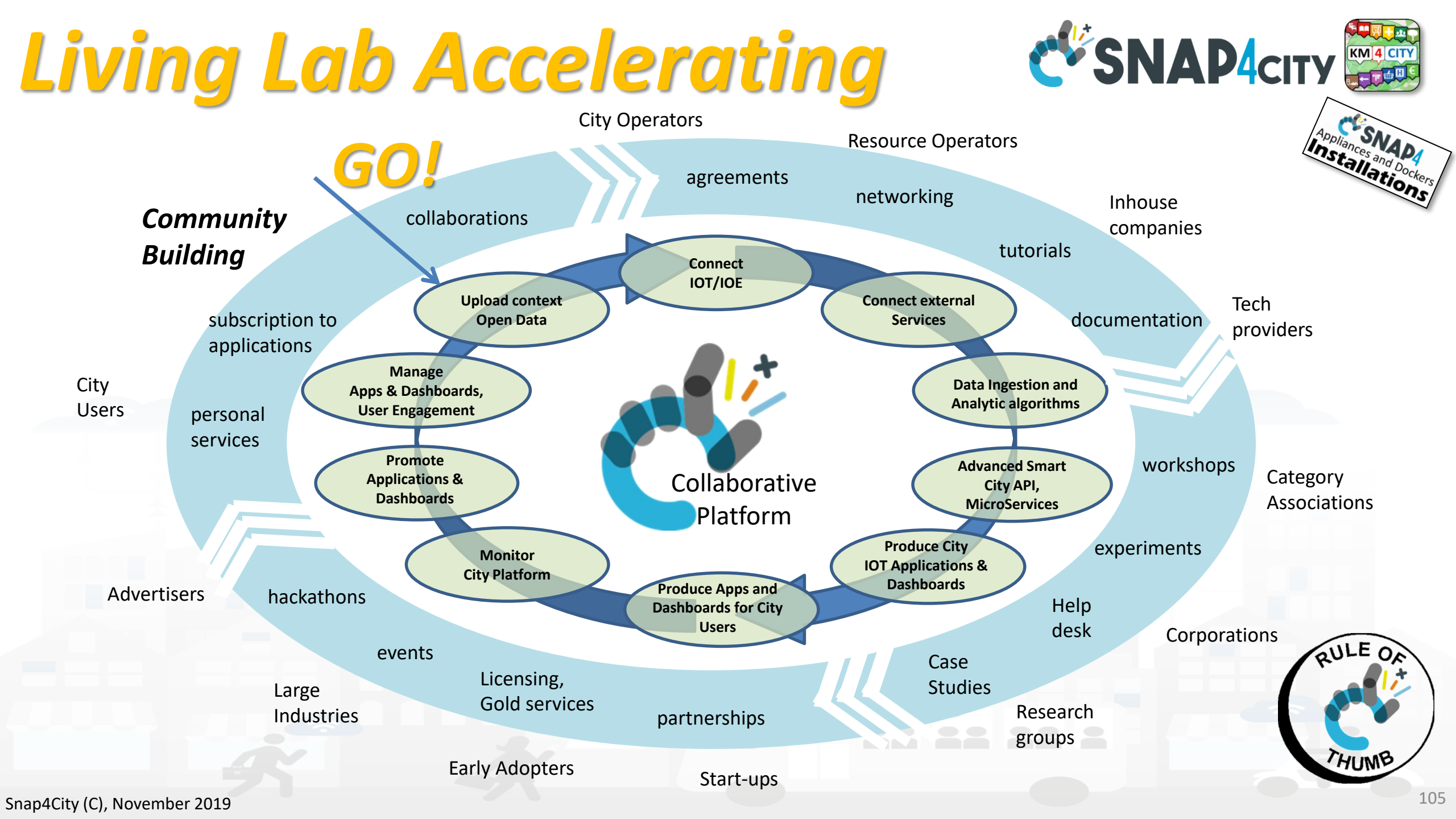


Living Lab Flexibility

Snap4City Satisfies all Requirements of ENOLL Select4Cities and EIP-SCC

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

Living Lab Accelerating



Snap4City

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

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

Your Level

All Tools

Snap4City

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

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

Welcome: how to start using Snap4City for beginners

Personalized Suggestions

Snap4City developers suggest you reading:

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

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

See this test case to experiment some of the above possibilities:

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

Exercises

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

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

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

SLIDES





NEWS

News

Flyer

VIDEOS

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

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

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

Username: adifino

Powered by www.km4city.org

Full Search

Search

Search

Organization Groups

DISIT

- Operativo

Your Org

Recent comments

- 1 month 6 days ago

Recent content

Last Art.

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

Benvenuto al nostro Sindaco ed al suo Team new roottooladmin1

We sugges to Antwerp Developers: How to manange my Dashboards

How to adopt Snap4City

Https://www.snap4city.org



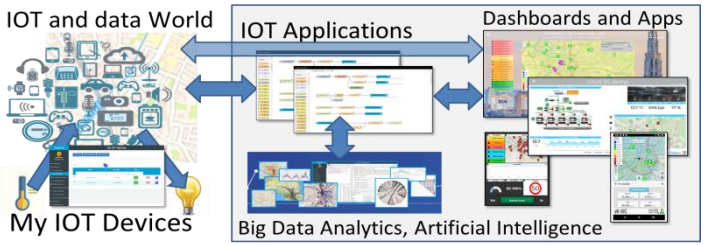
Smart City as a Service

- Supporting Org
- 100% Open Source Platform: Github
- Further developments
- Publishing Appliances and Dockers
- Training courses, docs
- Consulting
- Forums
- Etc.

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Download and deploy

On your premise





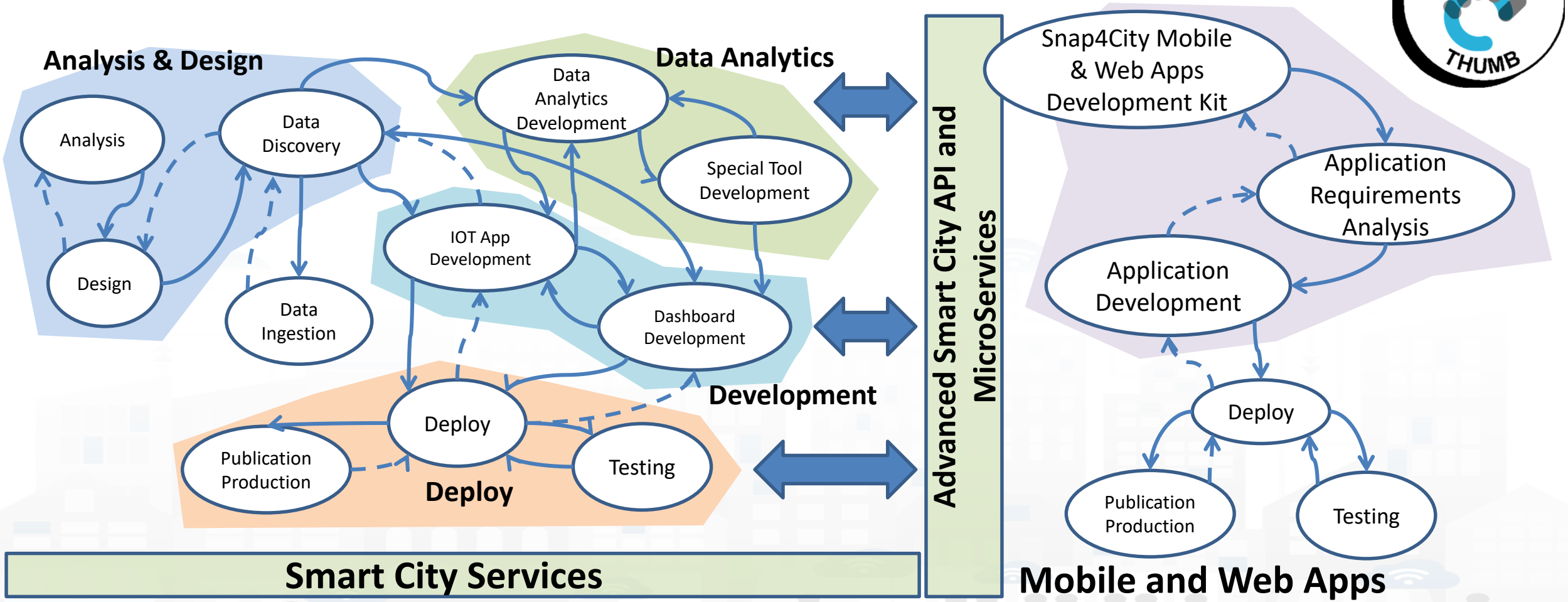
Installation on your premise

- Virtual Machines or Dockers
- Different configurations
  - From small to scalable
  - Exploiting your legacy tools
  - Interoperable with any tool
- No vendor lock-in, No tech lock-in

Mixed solutions! For example:

- Start on Cloud as Smart City as a Service
  - Migrate on premise on the fly
- Start on Cloud into a sand box
  - Pass to install on premise what you need

Develop Mobile & Web Applications Exploiting Snap4City Smart City Services

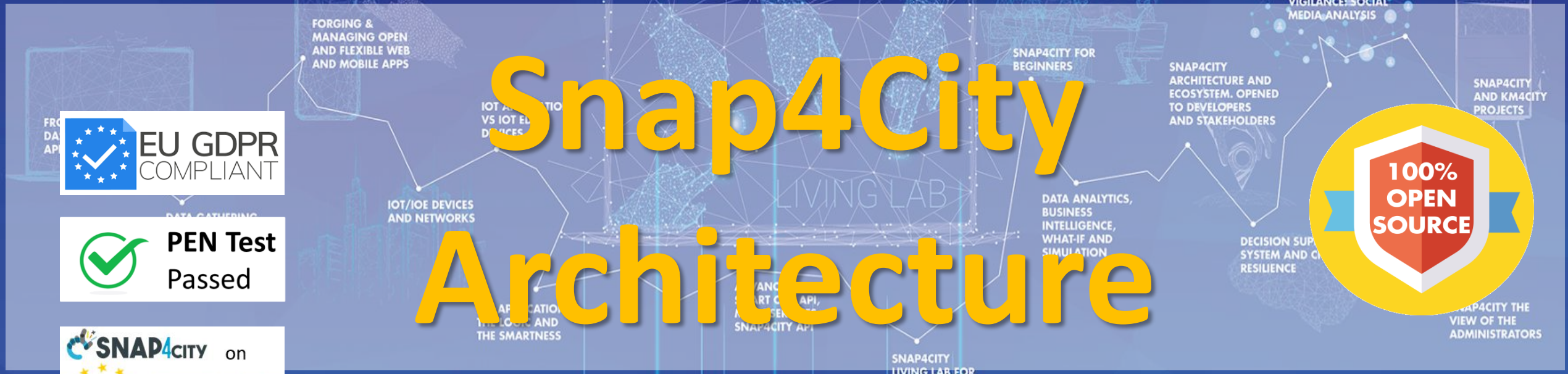


Documentation on Https://www.snap4city.org

- **We suggest you to start:**
  - HOW TO: create a Dashboard in Snap4City
  - HOW TO: add a device to the Snap4City Platform
  - HOW TO: add data sources to the Snap4City Platform
  - HOW TO: define privacy rules for personal data, produced by the end-users own device
- **Plus, more than**
  - 150 Test Cases for training, with training sources for IOT Applications, ETL, Data Analytics on the Resource Manager
  - 40 Video of training
  - 30 articles
- **Please follow the personalized suggestions** Snap4City proposes you!
- **A course in Italiano: https://www.snap4city.org/drupal/node/485**

TOP

Snap4City Architecture



EU GDPR COMPLIANT

PEN Test Passed

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

100% OPEN SOURCE

SNAP4 Appliances and Dockers Installations

DISIT lab roadmap vs model and tools' usage

2013 Km4City Ontology 1.1

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

2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- Events
- LOD

ckan

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015

- Sardinia Region Smart City Strategies and plan

FIWARE

SII-MOBILITY SCN (2016-19)

Km4City 1.5 (2016-21) H2020

resolute (2015-18) H2020

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

E015 digital ecosystem

2016

Km4City 1.6.2

- Infomobility
- Mobile App
- Routing
- Multimodality

- Smart Energy
- Sustainable Mobility
- Control Room Dashboard

REPLICATE

Km4City 1.6.4

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

GHOST SIR (2016-19)

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

Km4City 1.6.6 IOT/IOE

Node-RED

SNAP4CITY

SELECT for Cities H2020 (2017-19)

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

life weee (2017-20)

- Smart Waste

2017

TRAFAIR CEF (2018-21)

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

2018

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

MOSAiC (2018-20)

- Mobility Demand / Offer Analytics and Strategy

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

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

2020

…2022

Reverberi Enetec
Gruppo MPES

bee smart city

GREEN FIELD PEAS
Soda4.0

SIRIUS

LAID Smart Bed

SNAP4CITY

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

Projects

Sii-Mobility · REPLICATE · resolute · GHOST · TRAFAIR · MOSAiC · life weee · smartGARDAlake · SELECT for Cities · SIRIUS · GREEN IMPACT C.A.P.A.C.I.T.Y. · GREEN FIELD PEAS Soda4.0 · LAID Smart Bed

Co-founding institutions on projects

EUROPEAN COMMISSION · MIUR MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA · POR CreO · GREEN IMPACT C.A.P.A.C.I.T.Y. Regione Toscana

Qualified Partners

COMUNE DI FIRENZE · CITTÀ METROPOLITANA DI FIRENZE · comune di PRATO · Comune di LIVORNO · Comune di Modena · COMUNE DI CAGLIARI · CITTÀ METROPOLITANA DI CAGLIARI · REGIONE AUTÒNOMA DE SARDIGNA REGIONE AUTONOMA DELLA SARDEGNA

ALSTOM mobility by nature · SeSa · ALTAIR CHIMICA · swarco SWARCO MIZAR S.r.l. · DIPARTIMENTO DI INFORMATICA · anci toscana · USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

estra · Reverberi Enetec Gruppo MPES · FORUM VIRIUM HELSINKI · National Research Council of Italy

Technical Partnerships

Powered by FIWARE · sigfox partner network · ckan · GJL · LABGEO · esri Italia THE SCIENCE OF WHERE · With the support of NVIDIA

Marketplaces

Node-RED · JS Foundation · FIWARE · bee smart city · EUROPEAN OPEN SCIENCE CLOUD · EØ15 digital ecosystem Powered by EXPO MILANO 2015

SNAP4CITY

KM4CITY

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

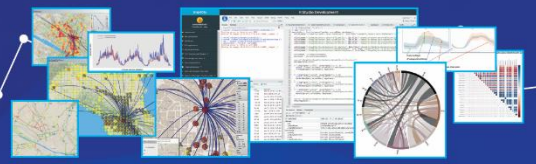
MICROSERVICES & ADVANCED SMART CITY API

LIVING LAB - DEV TOOLS - COWORKING

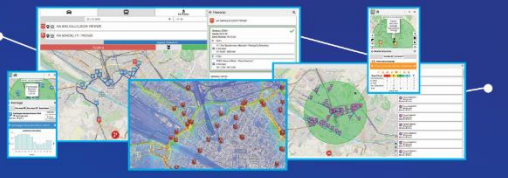


IOT DIRECTORY • SERVICE MAP • RESOURCE MANAGER • DATA GATE • R STUDIO • ETL

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

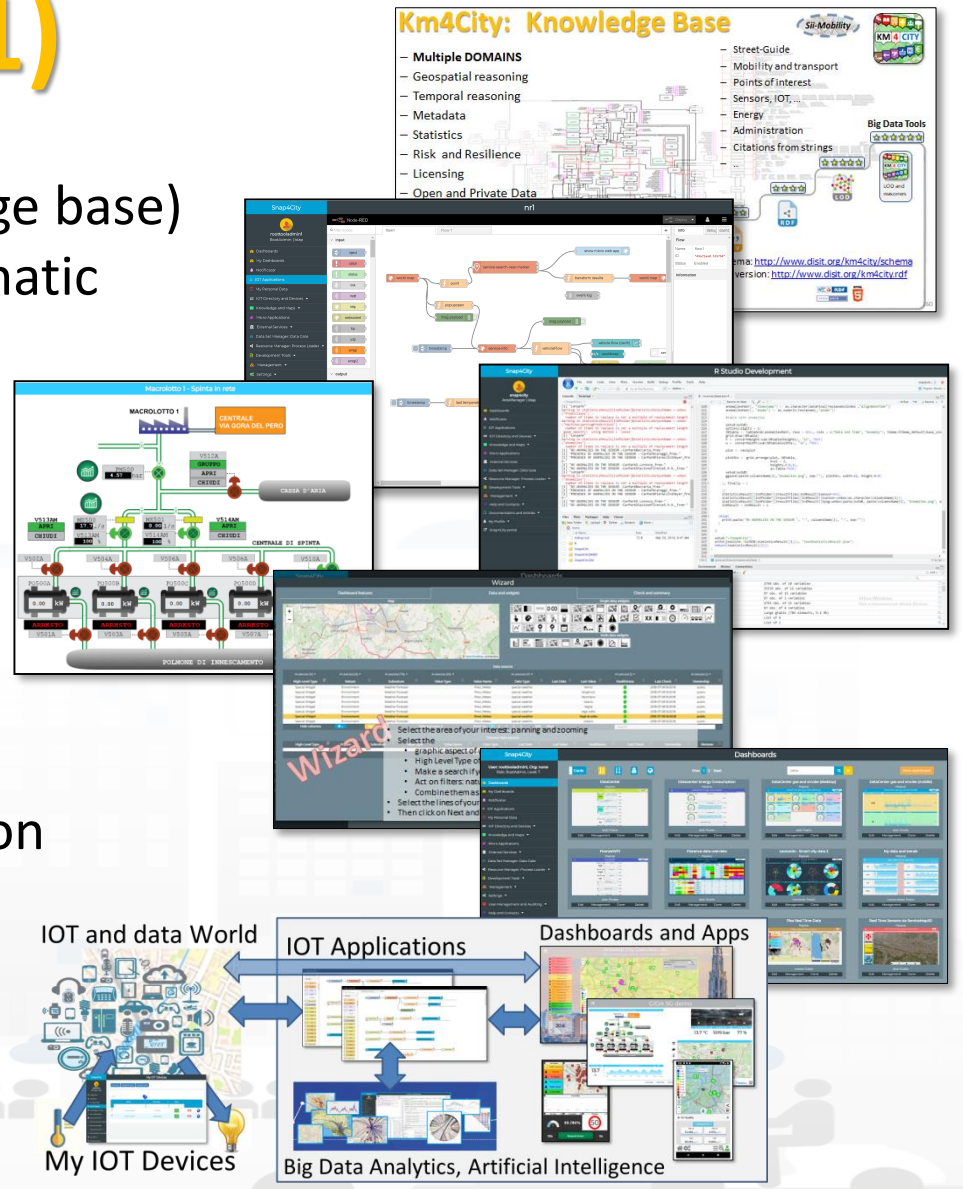
IOT MNG - DATA MNG - DATA INSPECTOR – PROCESS MNG – USER ENGAGEMENT – GDPR MNG ...

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



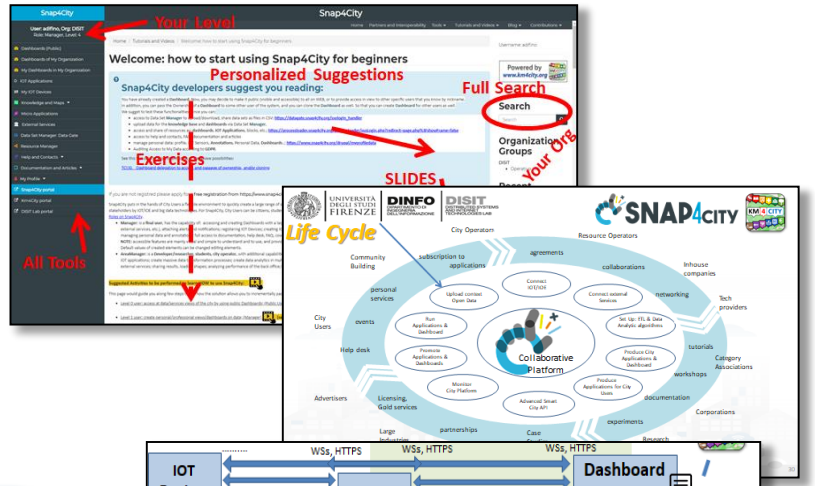
Unique of Snap4City Platform (1)

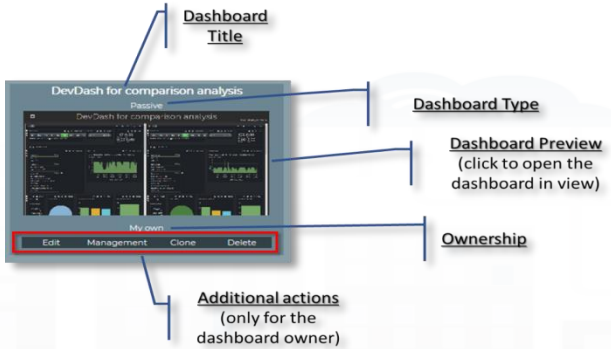
- Data ingestion and model
  - **Unified data model** (exploited in the Wizard and Knowledge base)
  - **Semantic Reasoner** modelling city entities, supporting sematic search, expert system, digital Twin, etc.
  - **IOT Directory abstracting complexity of IOT Devices, Edge, Brokers**, protocols and data formats
- Data Analytics and Data Processes
  - **Flexible and extensible IOT Applications**
  - **Data Analytic:** multiple programming languages,
- Visual Analytics, dashboarding, Apps
  - **Wizard: expert system** for immediate dashboard production matching data vs graphics representation
  - **Dashboards specialized** multidomain for Smart Cities
  - **Custom Widgets and Synoptics**
  - **Ready to use Mobile App, instant App, MicroApplication**
  - **Strategies** formalization supports

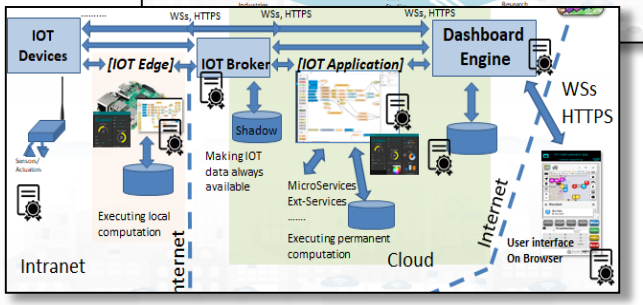


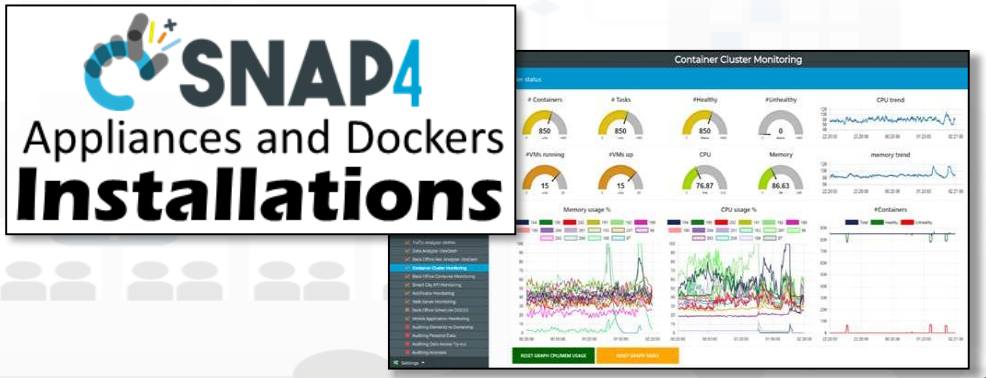
Unique of Snap4City Platform (2)

- Openness to any developers
  - **Living Lab support for coworking, sharing, and delegating**
  - **Advanced Smart City APIs and MicroServices**
  - **100% Open Source, Open hardware**
- Security and Privacy
  - **End-2-end encrypted communication**, on devices, platform, ... dashboards
  - **GDPR compliant** privacy/security
- Non functional
  - **on cloud and on premise,** your private installation
  - **Ready to use Appliance** Virtual Machines and/or Containers for a modules and tools.
  - **Flexible, Modular, Elastic, scalable and robust**









Smart City Functional Architecture

Transport systems
Mobility, parking



Public Services,
Govern, events, …



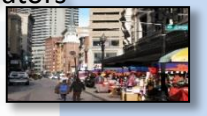
Sensors, IOT Cameras,
Wi-Fi



Environment, Water,
energy



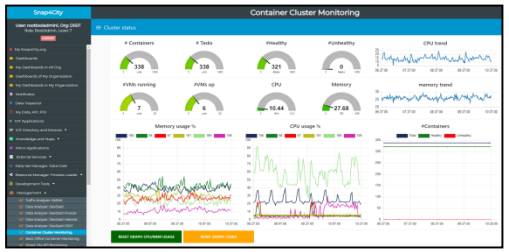
Shops, services,
operators

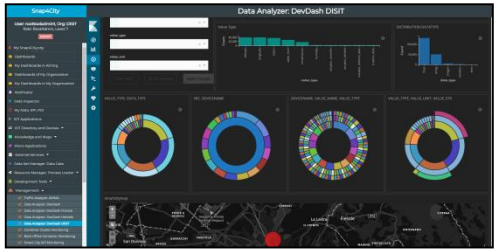


Social Media

Social Media Crawler and Manager







Data Sources PULL Data

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

Data Ingestion, aggregation, regularization, reconcile

ETL, NIFI, DISCES

Big Data Cluster
HDFS, Hbase, Phoenix

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search

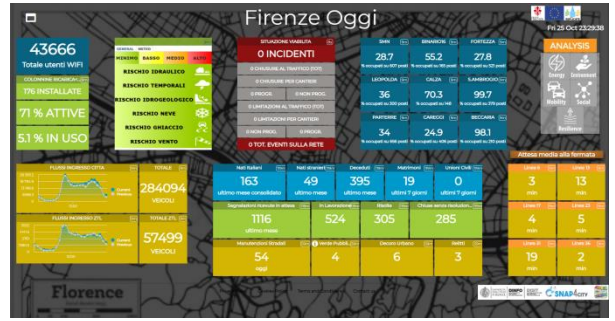
Data Analytics
R, Tensor Flow, Python, MapReduce, …

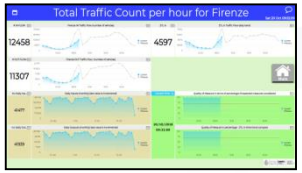
IOT Applications
Node-RED + Snap4City MicroSrvs

Search and Query, Smart City API
Facet, semantic search

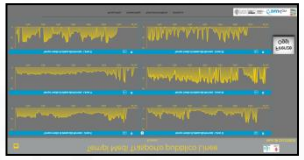
Visual Analytics
Special dash/ tools

Rendering Acting, Widgets, MicroApps
User interface, Interactive Dashboard, Drill down, maps, heatmaps



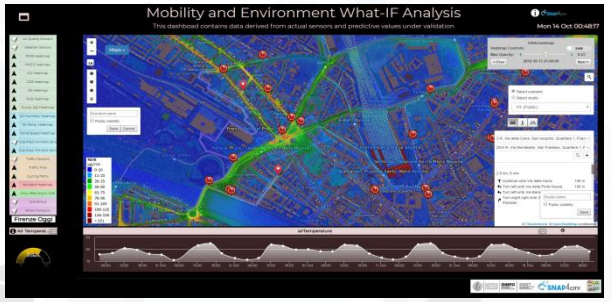












Inform, announce, Act!, warning, alarms, What-IF, ..



Dashboards (Public)
Knowledge and Maps
Service Map (Toscana)
Service Map 3D (Firenze)
Helsinki Service Map
Garda Lake Service Map
Cagliari Service Map
Service Map 3D (Helsinki)
Micro Applications
External Services
Data Set Manager: Data Gate
Resource Manager
Development Tools
Management
Help and Contacts
Documentation and Articles
Km4City portal
DISIT Lab portal

Snap4City - scalable Smart aNalytic APplication builder for sentient Cities



Tutorials Scenarious Innovations Interoperability Installations What People say

Mobile Apps IOT Devices IOT Applications Data Analytics Dashboards Living Lab Smart City API

Smart City Ontology Articles

SMARTCITY EXPO WORLD CONGRESS 19-21 Nov. 2019 *See you at Stand A118*

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

SNAP4CITY HACKATHON BUILD YOUR APP FOR A CONNECTED CITY

Smart Cities need to set up a flexible Living Lab to cope with the city evolution in terms of services and city users' needs and sustainability. Snap4City solution (https://www.snap4city.org) provides a flexible method and solution to quickly create a large range of smart city applications exploiting heterogeneous data and enabling services for stakeholders by IOT/IOE, data analytics and big data technologies. Snap4City applications may exploit multiple paradigms as data driven, stream and batch processing, putting co-creation tools in the hands of: (i) Smart Living Lab users and developers a plethora of solutions to develop applications without vendor lock-in nor technology lock-in, (ii) final users customizable / flexible mobile Apps and tools, (iii) city operators and decision makers specialized / sophisticated city dashboards and IOT/IOE applications for city status monitoring, control and decision support. Snap4City satisfies all the expected requirements of Select4Cities challenge PCP and much more, and it is 100% open source, scalable, robust, respects user needs and privacy; provides MicroServices and easily replaceable tools; compliant with GDPR; provides a set of tools for knowledge and living lab management, and it is compliant

Login

Registration

- New Registration
- Request a new password

Search

Search

-Any-

Training Snap4City from Data to Sentient Cities in a Snap
Program and Interactive Slides

Powered by www.km4city.org

FI-WARE Node-RED

Virtual Assistant

TOP

DASHBOARDS: FROM CITY DASHBOARD TO APPLICATIONS



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

https://www.snap4City.org , KM4CITY

Public Dashboards for your perusal

Snap4City

LOGIN

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

Dashboards (Public by (ORG))

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

Filter by dashboard title

ServiceMap for data comparison
Passive


Public (DISIT)

Servizi agli utenti
Passive


Public (DISIT)

Smart City Control Room Console
Passive


Public (DISIT)

Smart City Control Room Console - new
Passive

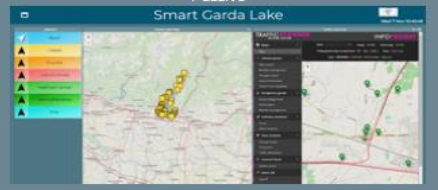

Public (DISIT)

Smart City Data Overview
Passive


Public (DISIT)

Smart City Data Overview 2
Passive


Public (DISIT)

Smart Garda Lake
Passive


Public (DISIT)

SmartCity processes
Passive

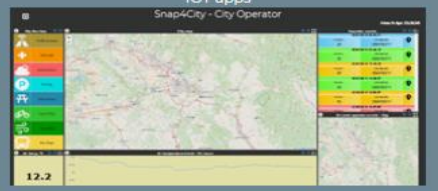

Public (DISIT)

Snap4City - App dashboard
IOT apps

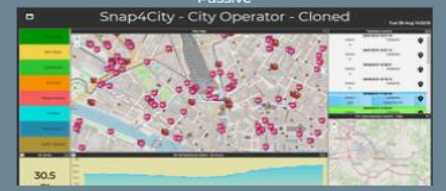

Public (DISIT)

Snap4City - Buttons with images
Passive


Public (DISIT)

Snap4City - City Operator
IOT apps


Public (DISIT)

Snap4City - City Operator - Cloned
Passive


Public (DISIT)



REPLICATE

We expect you at Stand 120, Hall P2 , Level 0, Street A
Smart City Expo World Congress 2018
13-15 Novembre 2018, Barcelona, Gran Via Venue

SMARTCITY EXPO WORLD CONGRESS

http://www.darionardella.it/il-sindaco-dario-nardella-in-missione-a-madrid-e-barcellona/

Firenze Oggi

Fri 25 Oct 23:29:38

43666
Totale utenti WIFI

COLONNINE RICARICA<... 9m
176 INSTALLATE
71 % ATTIVE
5.1 % IN USO

GENERAL | METEO 9m

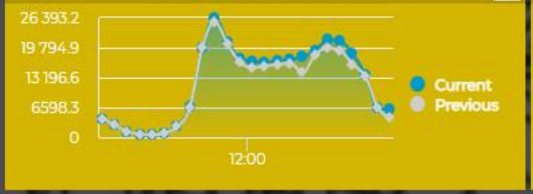
MINIMO	BASSO	MEDIO	ALTO

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

SITUAZIONE VIABILITA 8s
0 INCIDENTI
0 CHIUSURE AL TRAFFICO (TOT)
0 CHIUSURE PER CANTIERI
0 PROGR. | 0 NON PROG.
0 LIMITAZIONI AL TRAFFICO (TOT)
0 LIMITAZIONI PER CANTIERI
0 NON PROG. | 0 PROGR.
0 TOT. EVENTI SULLA RETE

SMN 9m	BINARIO16 9m	FORTEZZA 9m
28.7 % occupati su 607 posti	55.2 % occupati su 165 posti	27.8 % occupati su 521 posti
LEOPOLDA 9m	**CALZA 9m**	**S.AMBROGIO 9m**
36 % occupati su 300 posti	70.3 % occupati su 148	99.7 % occupati su 379 posti
PARTERRE 9m	**CAREGGI 9m**	**BECCARIA 9m**
34 % occupati su 656 posti	24.9 % occupati su 406 posti	98.1 % occupati su 210 posti

ANALYSIS
Energy
Environment
Mobility
Social
Resilience

FLUSSI INGRESSO CITTA 9m


TOTALE 9m
284094
VEICOLI

FLUSSI INGRESSO ZTL 9m


TOTALE ZTL 9m
57499
VEICOLI

Nati Italiani 119m	Nati stranieri 119m	Deceduti 119m	Matrimoni 119m	Unioni Civili 119m
163 ultimo mese consolidato	49 ultimo mese	395 ultimo mese	19 ultimi 7 giorni	0 ultimi 7 giorni

Segnalazioni ricevute in attesa 119m	In Lavorazione 119m	Risolte 119m	Chiuse senza risoluzion... 119m
1116 ultimo mese	524	305	285

Manutenzioni Stradali 59m	Verde Pubbli... 59m	Decoro Urbano 59m	Relitti 59m
54 oggi	4	6	3

Attesa media alla fermata

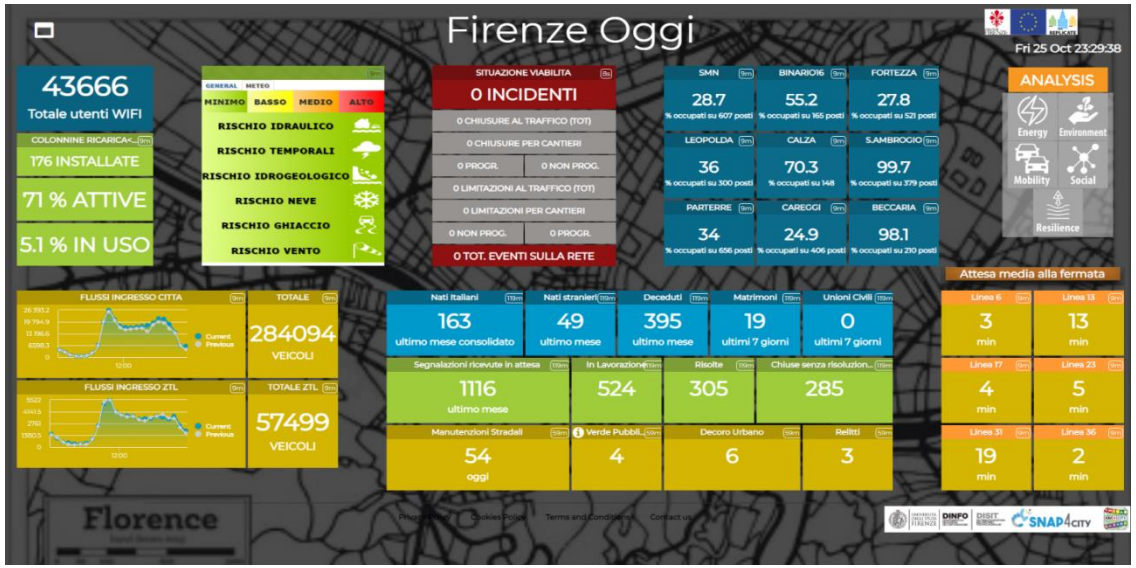
Linea 6 9m	Linea 13 9m	Linea 17 9m	Linea 23 9m	Linea 31 9m	Linea 36 9m
3 min	13 min	4 min	5 min	19 min	2 min

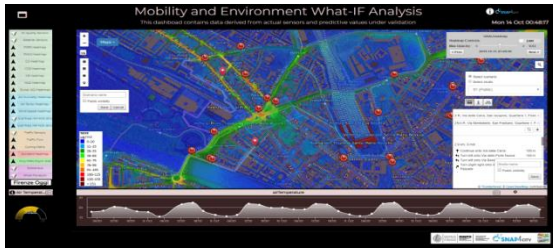
Smart City Control Room

a set of dashboards and tools

REPLICATE

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement Nº 691735



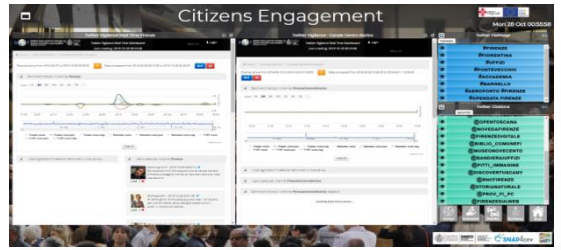


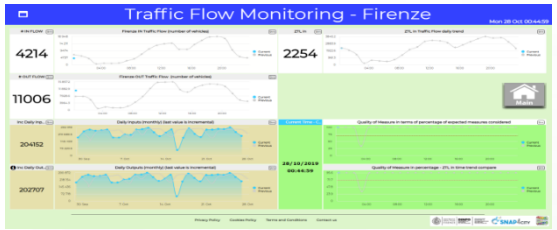




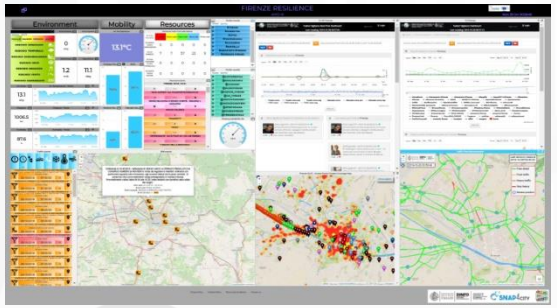


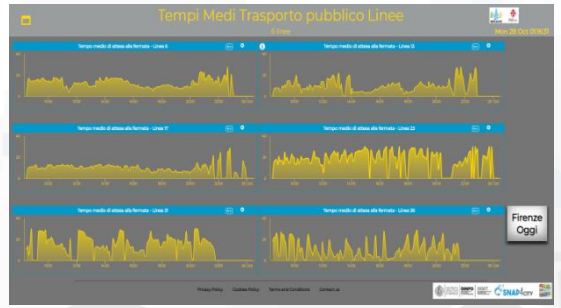




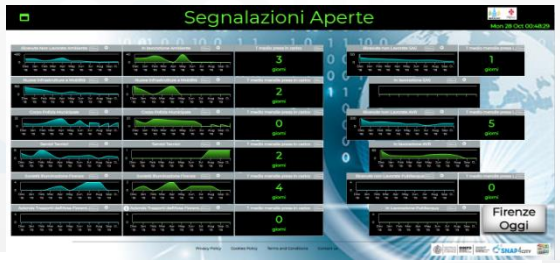












FIRENZE CITTÀ FARO

Smart City Control Room

a set of dashboards and tools

REPLICATE

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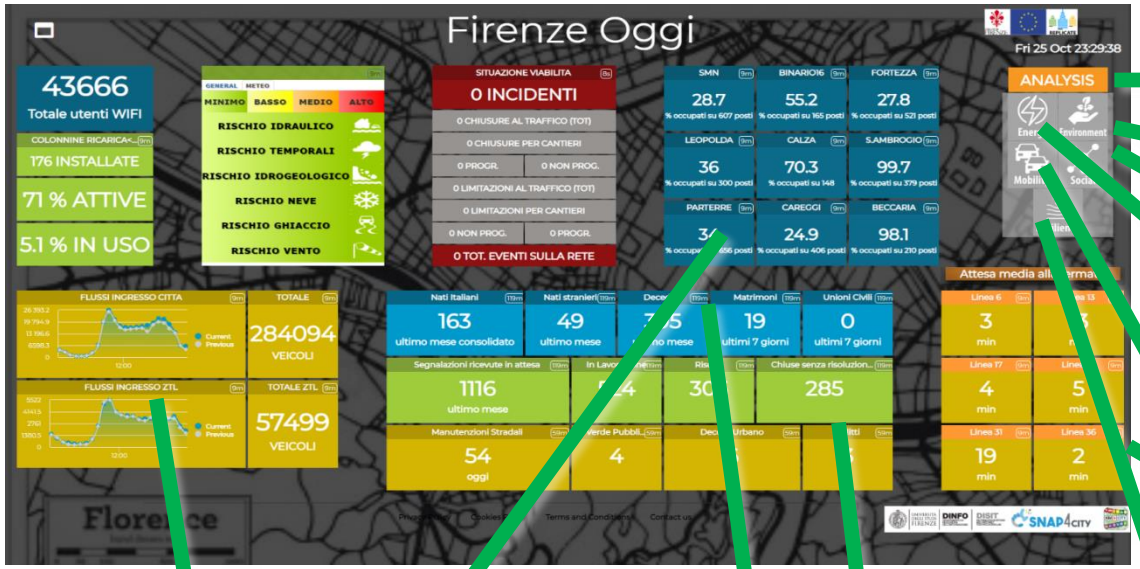
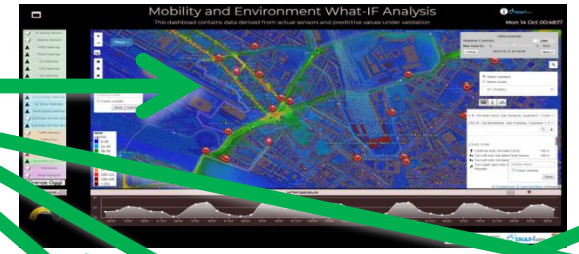
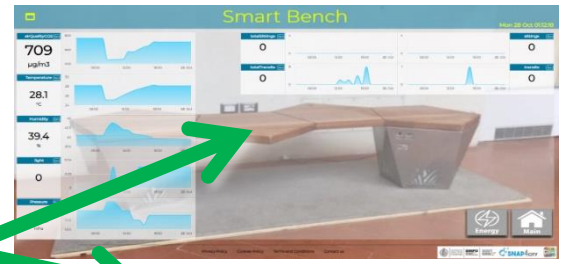
FIRENZE CITTÀ FARO



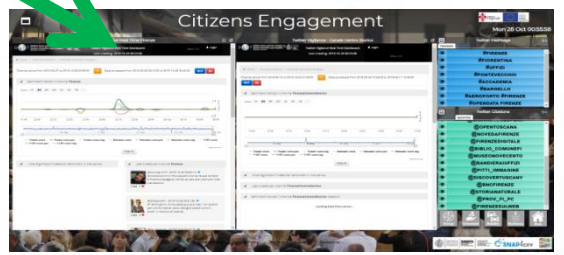


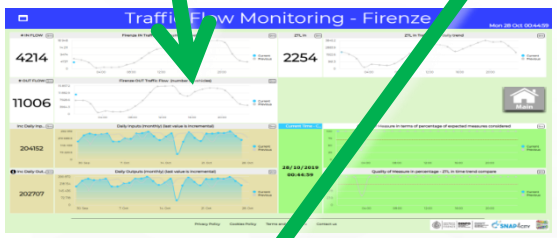






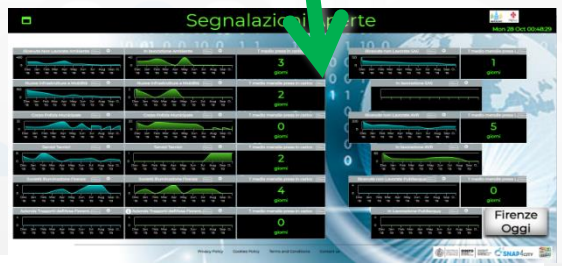


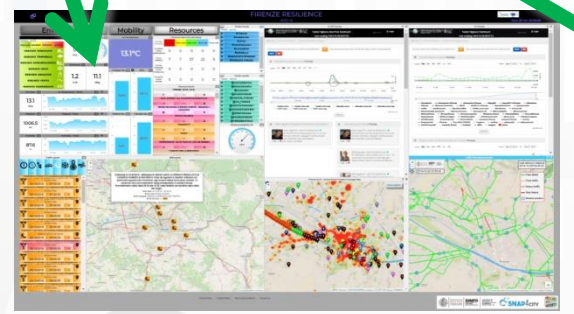


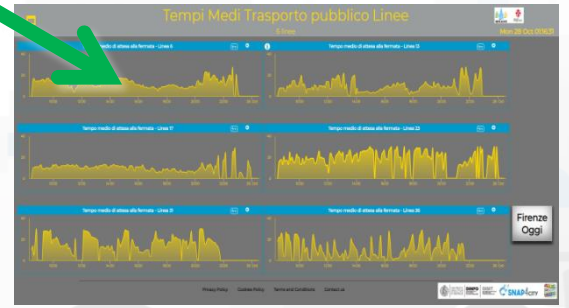












Mobility and Environment What-IF Analysis

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

Mon 14 Oct 00:48:17

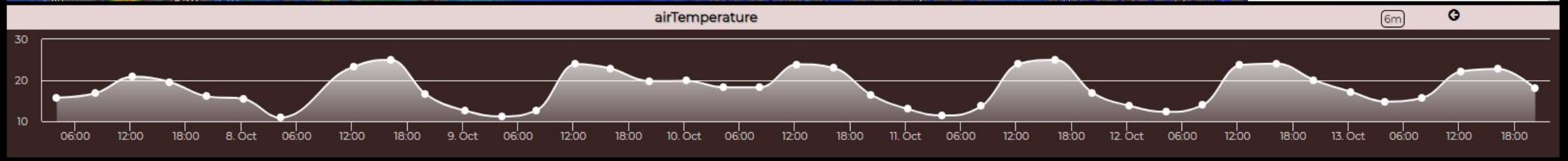
- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling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

Firenze Oggi

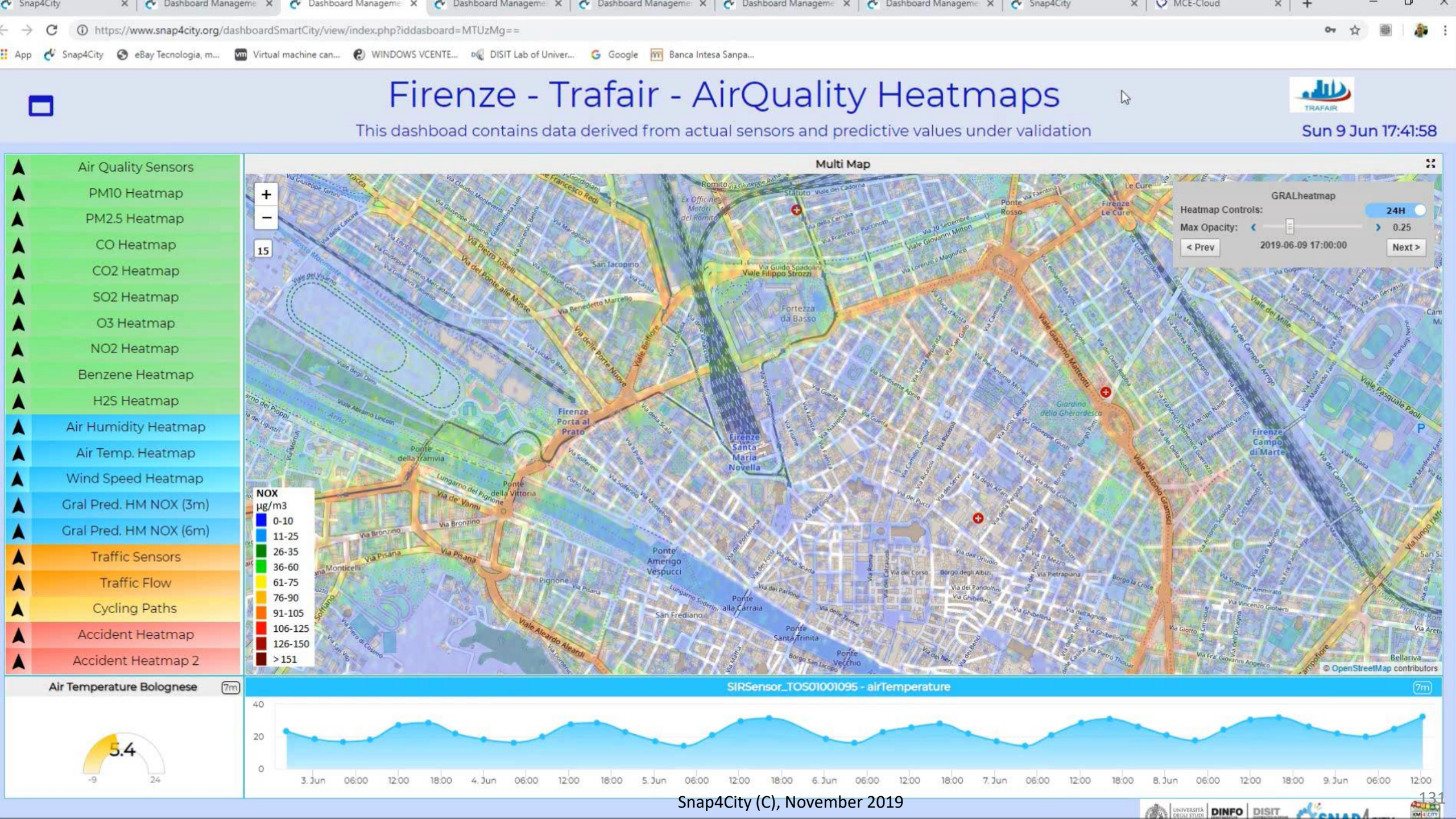
Air Temperat... 6m







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



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTUzMg==
Firenze - Trafair - AirQuality Heatmaps
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 9 Jun 17:41:58
Air Quality Sensors
PM10 Heatmap
PM2.5 Heatmap
CO Heatmap
CO2 Heatmap
SO2 Heatmap
O3 Heatmap
NO2 Heatmap
Benzene Heatmap
H2S Heatmap
Air Humidity Heatmap
Air Temp. Heatmap
Wind Speed Heatmap
Gral Pred. HM NOX (3m)
Gral Pred. HM NOX (6m)
Traffic Sensors
Traffic Flow
Cycling Paths
Accident Heatmap
Accident Heatmap 2
Multi Map
GRALheatmap
Heatmap Controls:
24H
Max Opacity:
0.25
< Prev
2019-06-09 17:00:00
Next >
NOX
µg/m3
0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
> 151
© OpenStreetMap contributors
Air Temperature Bolognese
5.4
SIRSensor_TOS01001095 - airTemperature

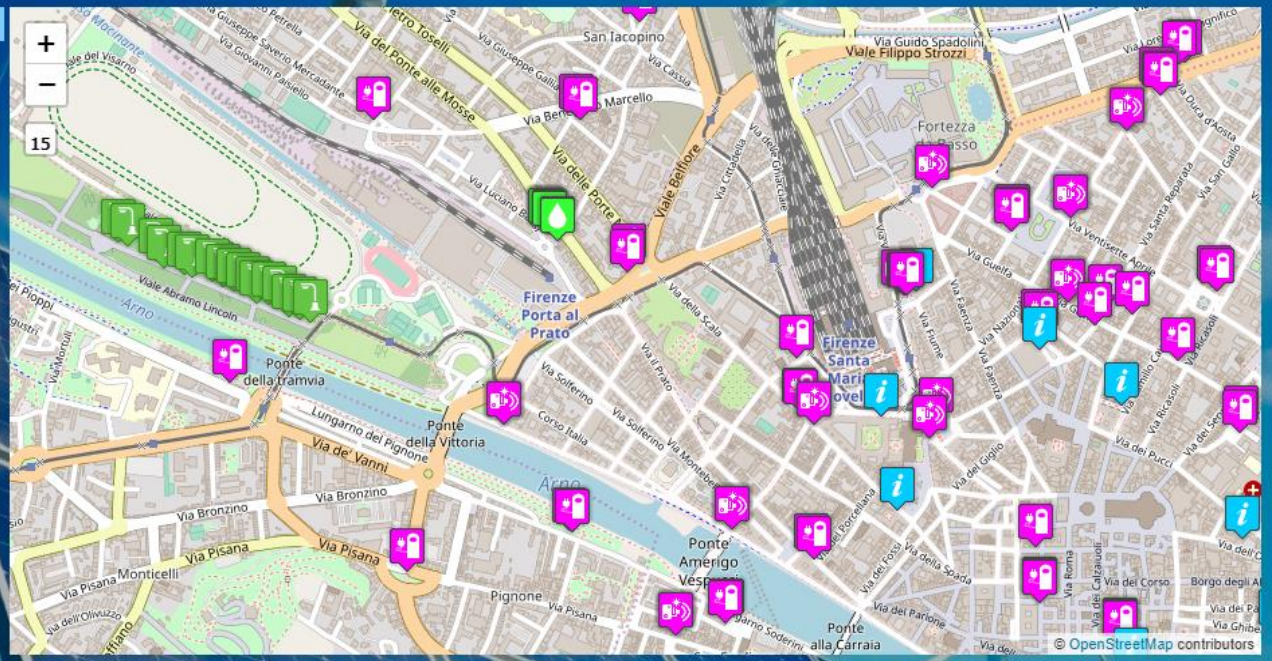
- Energy -

Sun 3 Nov 22:44:41

Environment | Mobility | Social | Resilience | Main

Selector - Click the icon

- Fast recharging stations
- Normal recharging stations
- ZTL gate
- Smart waste
- Florence WiFi POI
- Digital Signage
- Smart Irrigator
- Smart Light
- Smart Bench


Via del Ponte alle Mosse
Viale Belfiore
Via delle Porte
Firenze Porta al Prato
Firenze Santa Maria Novella
Viale Abramo Lincoln
Ponte della tramvia
Lungarno del Pignone
Ponte della Vittoria
Via de' Vanni
Via Bronzino
Via Pisana
Via Pisana Monticelli
Corso Italia
Via Solferino
Via Montebello
Via del Parione
Ponte Amerigo Vespucci
Ponte alla Carraia
Pignone
Via Guido Spadolini
Viale Filippo Strozzi
Fortezza da Basso
San Iacopino
Via Cassia
Marcello
Via Guelfa
Via Faenza
Via Fiume
Via Nazionale
Via Ricasoli
Via del Giglio
Via del Corso
Via Roma
Via dei Cerretani
Via dei Pucci
Via del Porcellana
Via della Spada
Via dei Fossi
Via della Scala
Via il Prato
Via Ventisette Aprile
Via Santa Reparata
Via San Gallo
Via Duca d'Aosta
Via Cavour
Via Ghibellina
Via dei Pandolfini
Via dei Servi
Via dei Ginori
Via dei Tornabuoni
Via Vigna Nuova
Via Strozzi
Via Tornabuoni
Via Porta Rossa
Via Calimala
Via Lambertesca
Via Orsanmichele
Via Arte della Lana
Via Por Santa Maria
Via Lamarmora
Via Ghibellina
Via Giuseppe Giusti
Via Giovanni Pascoli
Via Giuseppe Saverio Mercadante
Via Luciano Bausi
Via Mozzante
Via del Visarno
Via dei Pioppi
Via Mortuli
Via dell'Oliviuzzo
Via Pisana
Via Bronzino
Via de' Vanni
Via Solferino
Via Montebello
Via del Parione

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

SNAP4CITY | KM4CITY

- Mobility -

Tue 5 Nov 17:47:56

Traffic Events in Firenze

05/11/2019	16:00:45	5	MAP

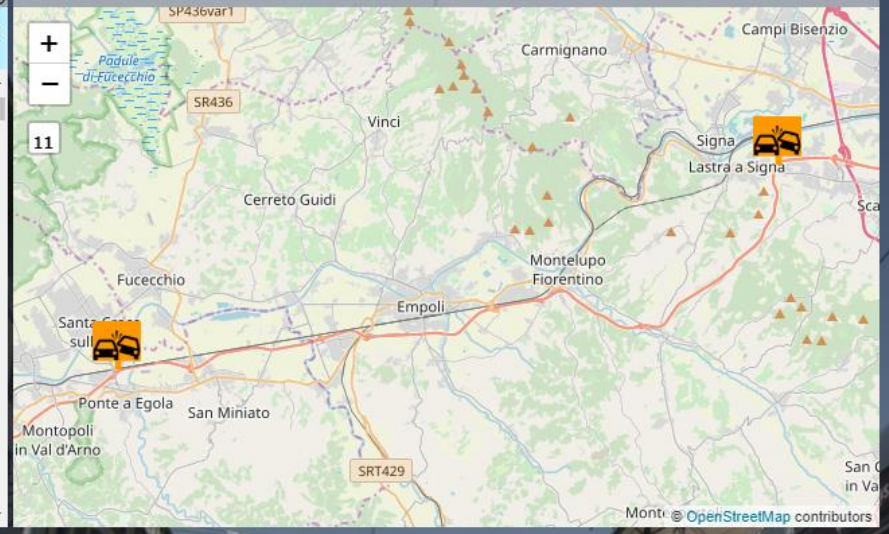
05-11-2019 17:13 VEICOLO FERMO O AVARIA
BROKEN DOWN VEHICLE(S) — 05/11/2019 — 17:13:07 — 5

05-11-2019 16:55 VEICOLO FERMO O AVARIA
BROKEN DOWN VEHICLE(S) — 05/11/2019 — 16:55:45 — 5

05-11-2019 17:12 TRAFFICO RALLENTATO
SLOW TRAFFIC — 05/11/2019 — 17:12:17 — 5

05-11-2019 16:40 CODA IN USCITA A LASTRA
QUEUING TRAFFIC — 05/11/2019 — 16:40:32 — 5

Traffic Events - Firenze



Traffic Daily Inflow trend



N. veicoli totali Inflow

144137 n.

Traffic Daily Outflow trend



N. veicoli totali Outflow

132220 n.

SMN

411 free

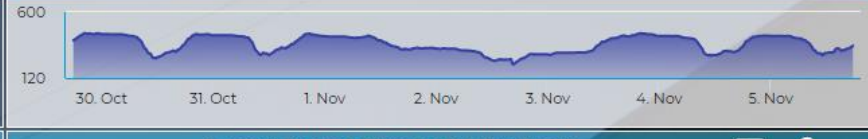
Stazione S.M.N. Parking Slots Availability Trend



Parterre

355 free

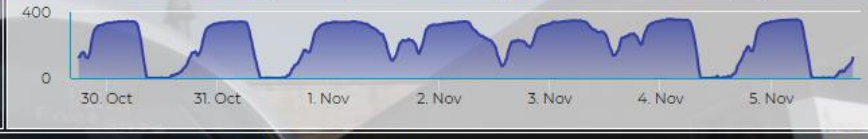
Parterre Parking Slots Availability Trend



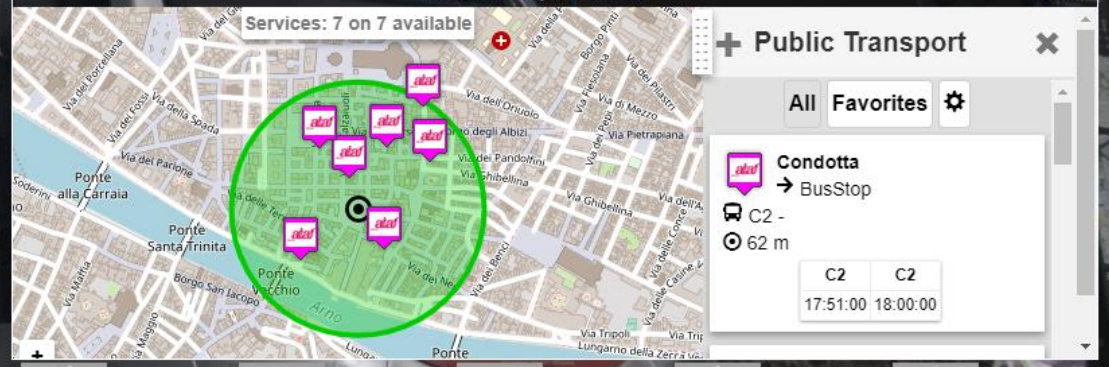
Careggi

123 free

Careggi Parking Slots Availability Trend



Public Transport Search



Energy | Environment | Social | Resilience | Main

Valutazione Trasporto Pubblico

Firenze - 6 linee

Tue 5 Nov 17:49:00

Linea 13

395

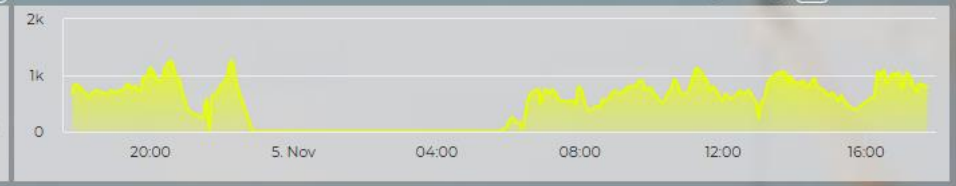
Ritardo medio corse attive nei 5min in sec



Linea 31

793

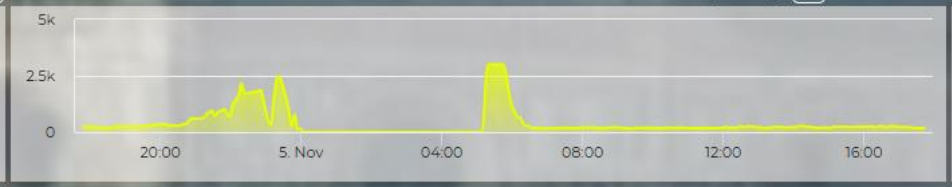
Ritardo medio corse attive nei 5min in sec



Linea 17

182

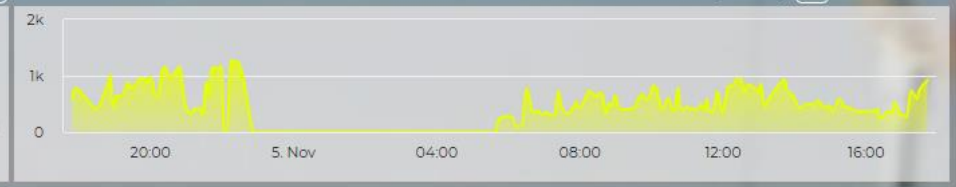
Ritardo medio corse attive nei 5min in sec



Linea 36

923

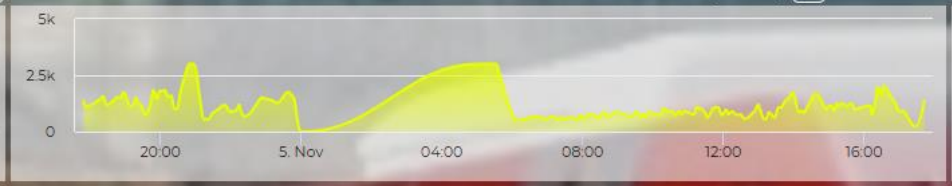
Ritardo medio corse attive nei 5min in sec



Linea 23

1369

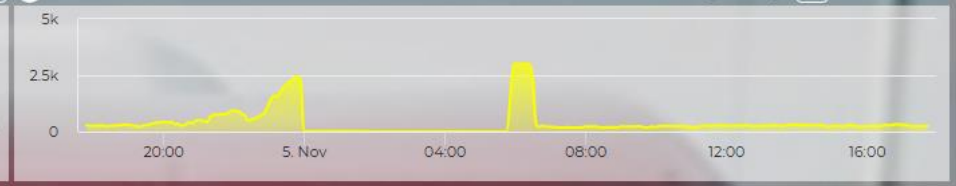
Ritardo medio corse attive nei 5min in sec



Linea 6

254

Ritardo medio corse attive nei 5min in sec















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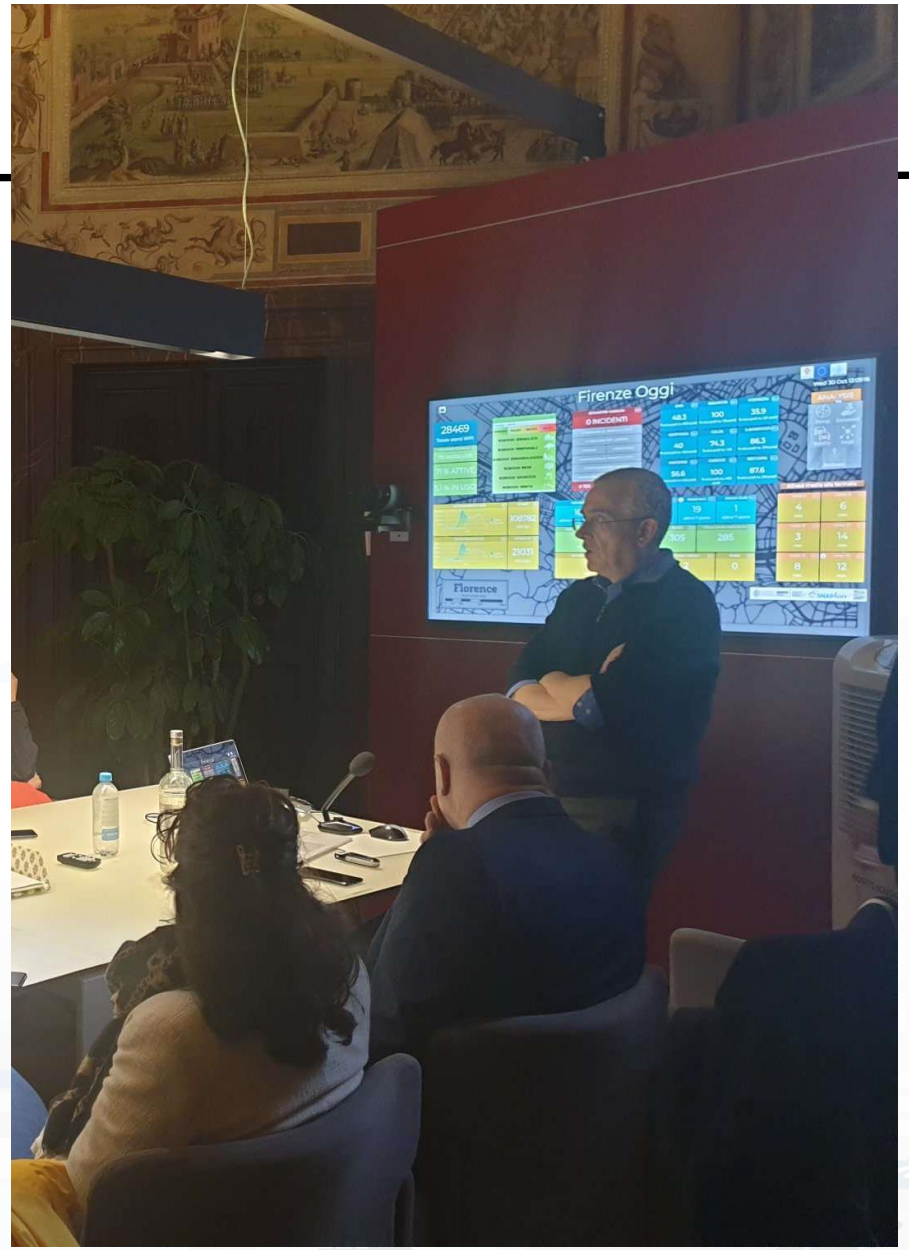




g from
2020
ramme
691735

FIRENZE
CITTÀ FARO

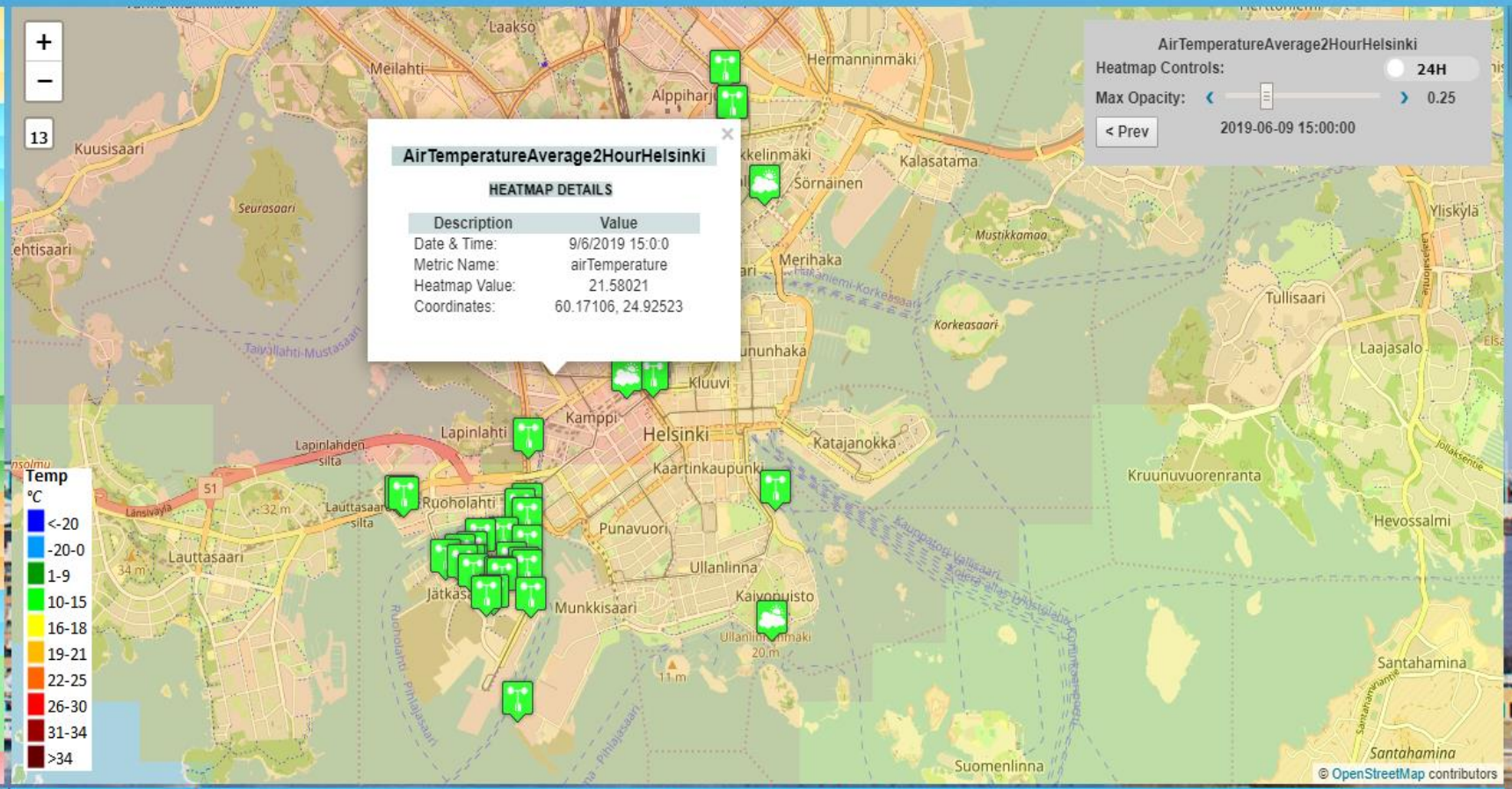


Helsinki City Overview (H5a)

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

Sun 9 Jun 17:07:25

- BusStop
- Ticket sale
- Traffic Sensor
- Weather sensor
- Air Temp heatmap
- Humidity Heatmap
- Air Quality Sensors
- Noise sensors
- Noise Heatmap
- PM10 heatmap
- PM2.5 Heatmap
- NO2 heatmap
- Air Quality Index heatmap
- EAQI
- CAQI
- Enfuser pred. AQI
- Enfuser pred. PM10
- Enfuser pred. PM2.5
- Gral pred. PM10
- Gral pred. PM10 (6m)
- PM10 Jatkasaari
- PM2.5 Jatkasaari
- EAQI Jatkasaari
- Appreciated POIs





Weather sen... 9m

20.5

Weather sensor Helsinki Kaisaniemi - airTemperature 9m



The Life of Helsinki

Documentation

Forum Discussion

Survey

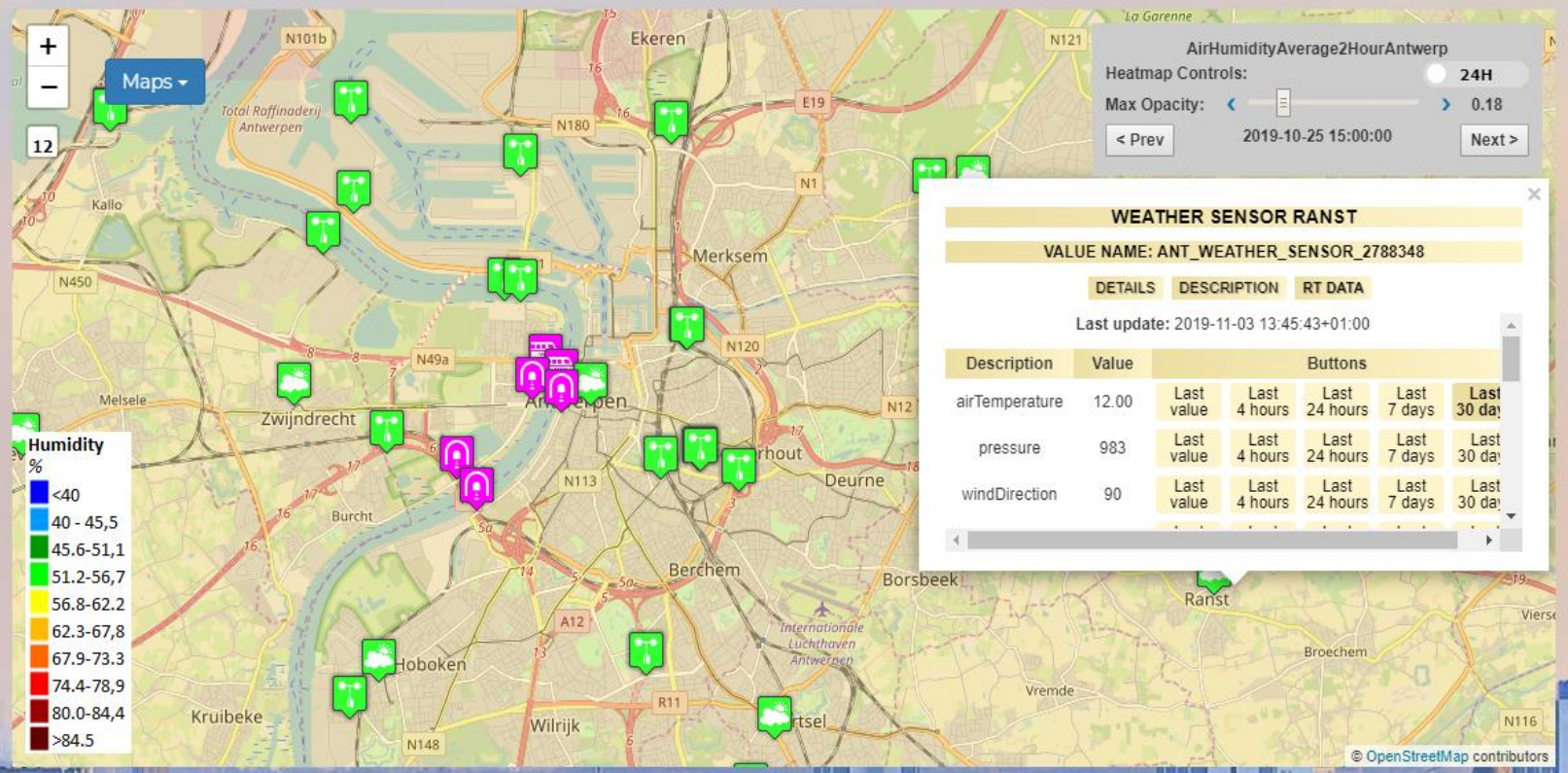
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

Antwerp City Overview - A5

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

Sun 3 Nov 14:09:43

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



Weather sensor Zwijndr... 8m

11.9



Forum Discussion

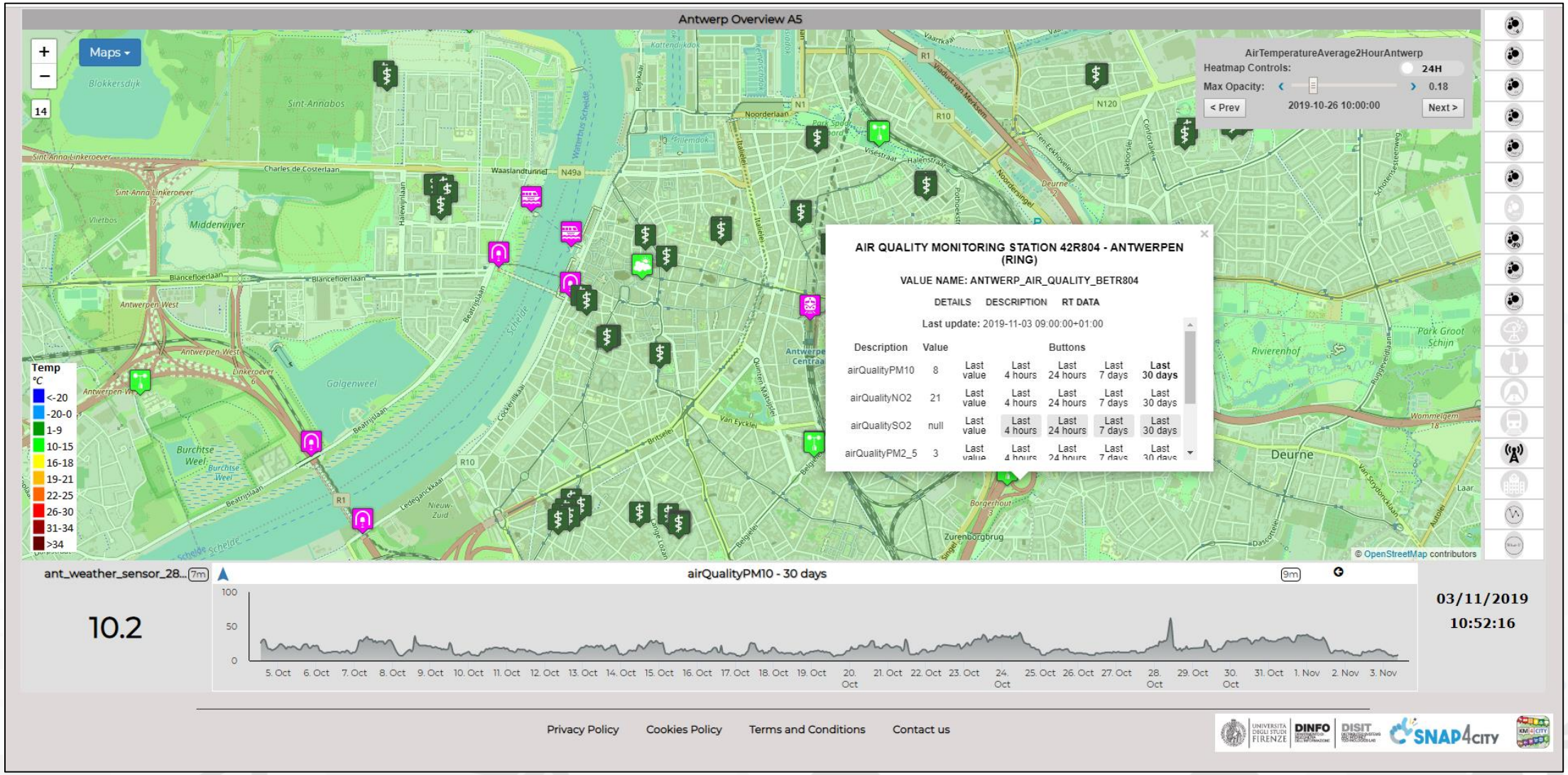
Documentation

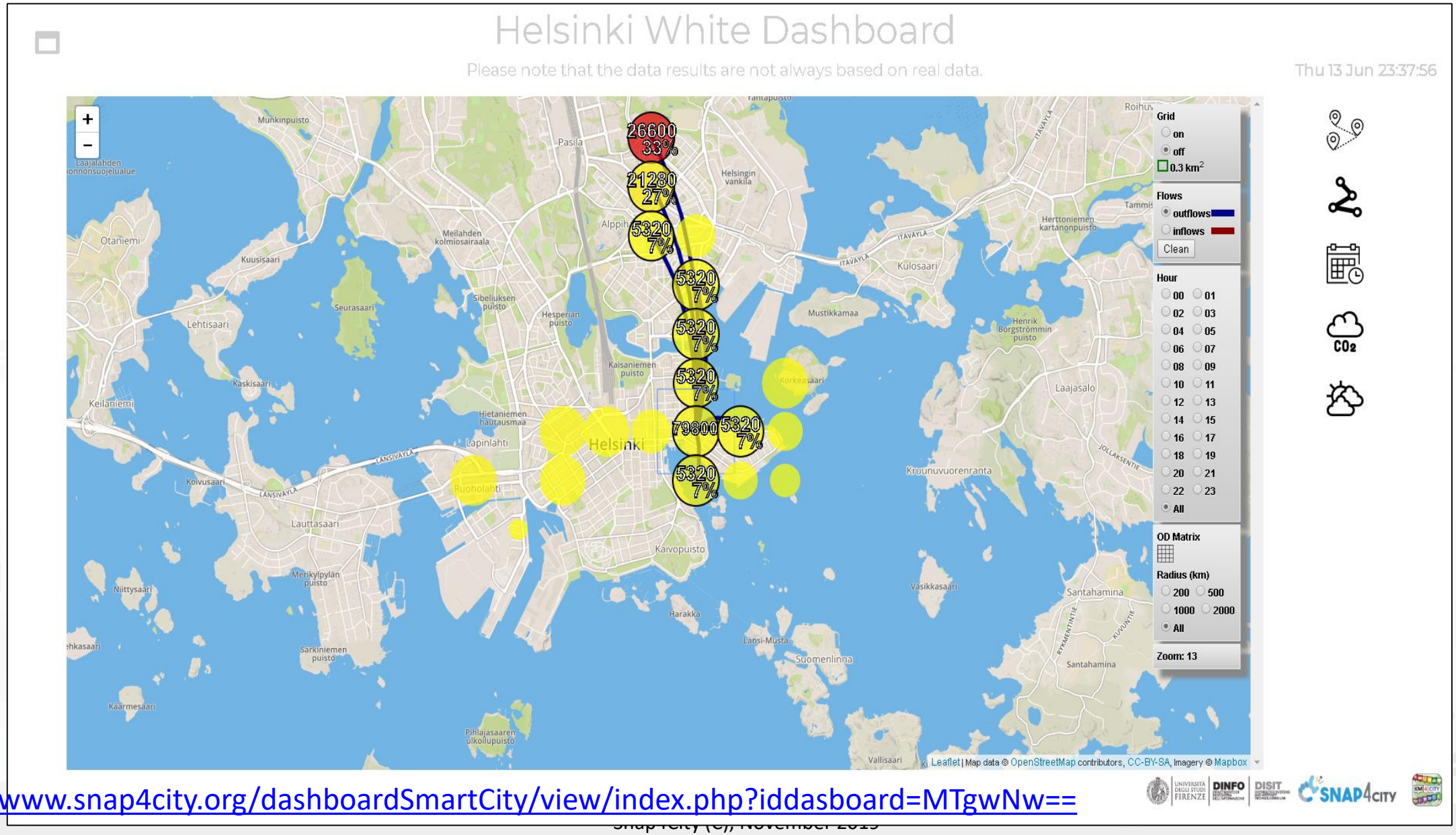
Survey

The Life of Antwerp

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

Unique Dashboard builder Multiple Styles

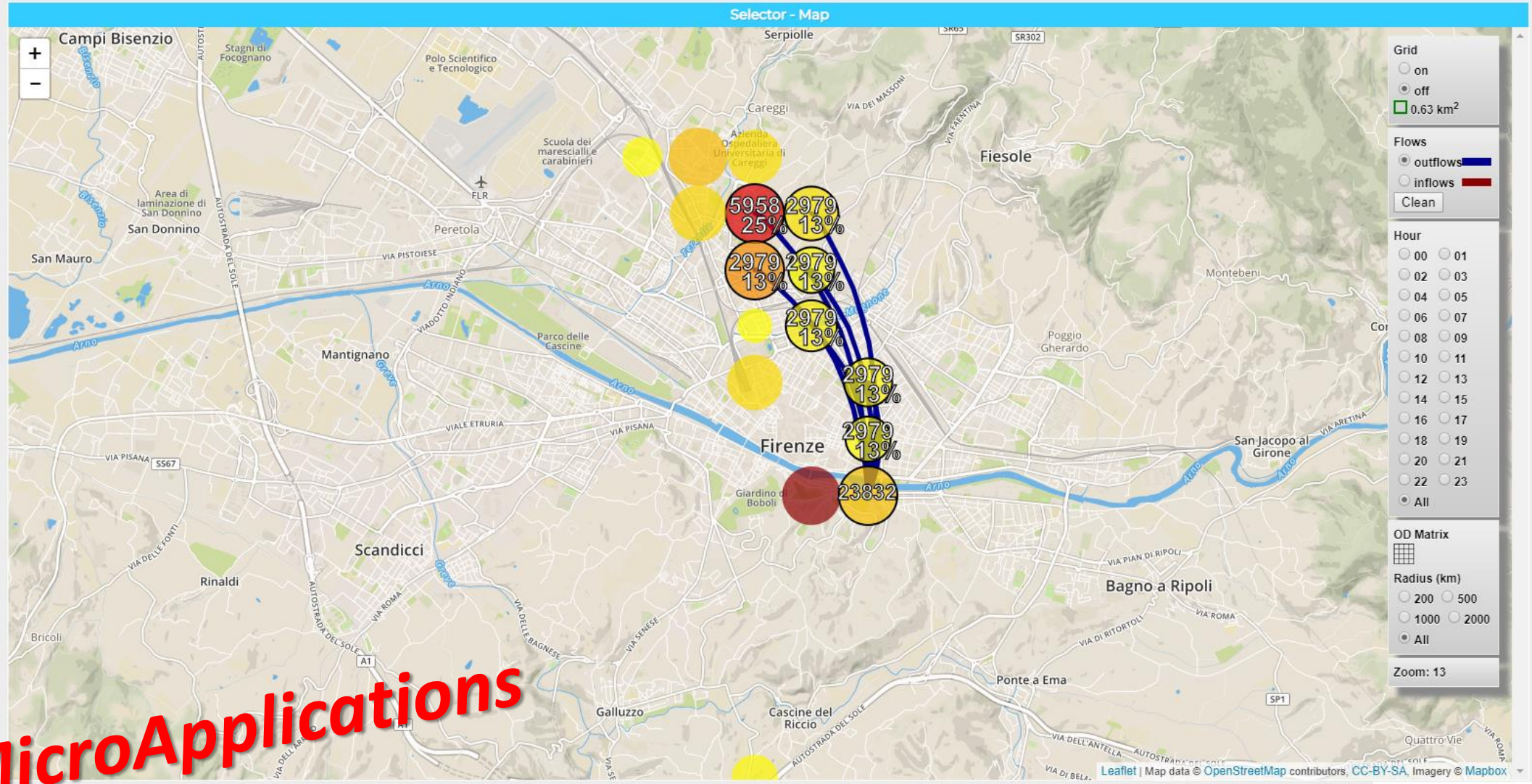




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTgwNw==

Life in Toscana: Dashboard

Mon 24 Jun 09:19:20

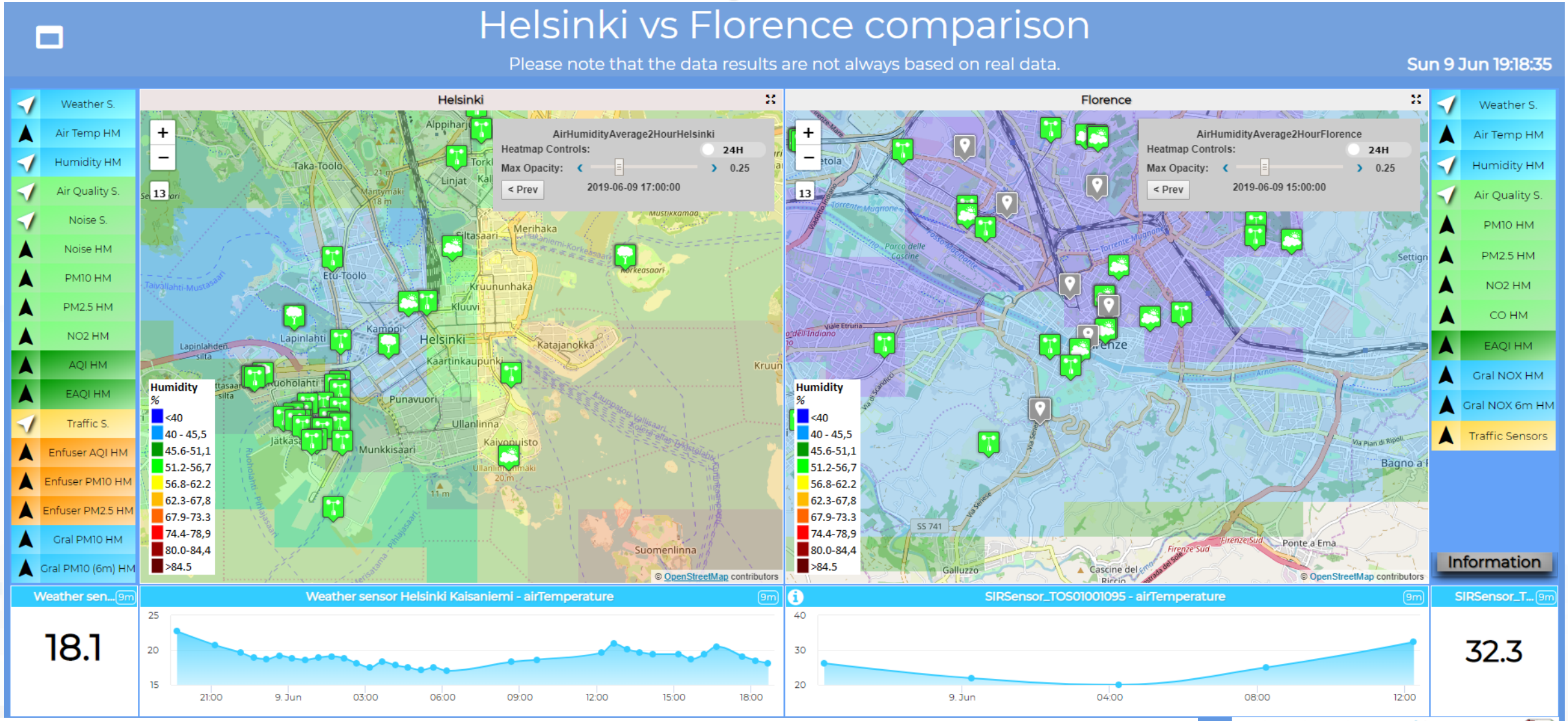


Line of Transport
Public Transport
Travel Plan
Air Quality
Weather
Origin Dest. Matrix
Typical Trajectories
Cultural Activities
Forum Discussion

MicroApplications

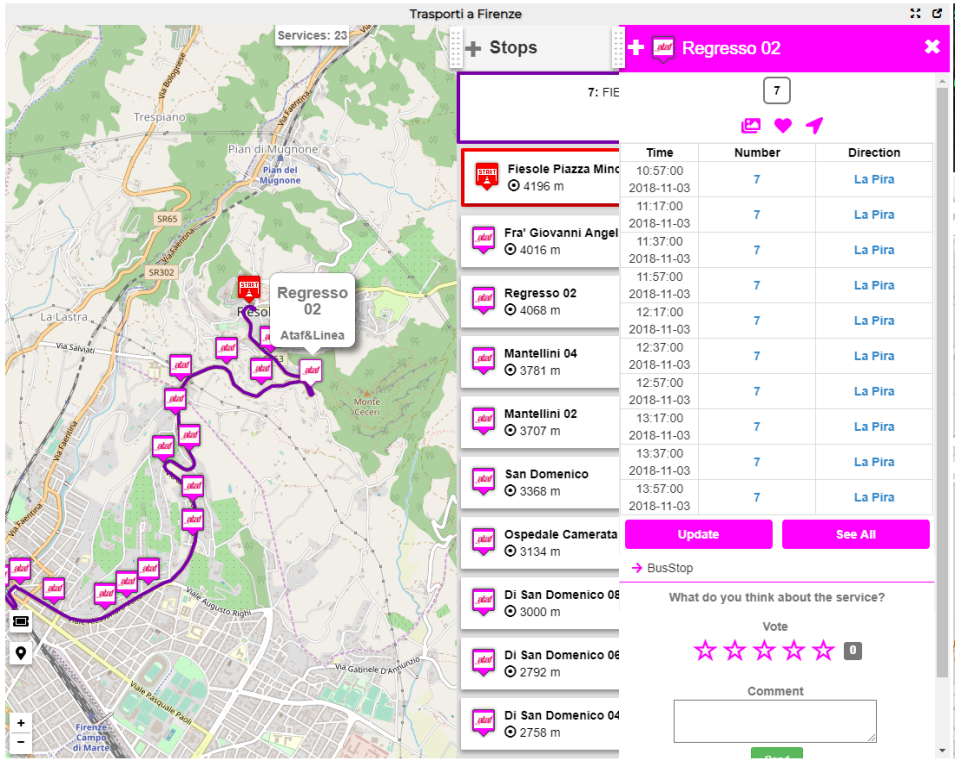
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==

Helsinki vs Florence comparison



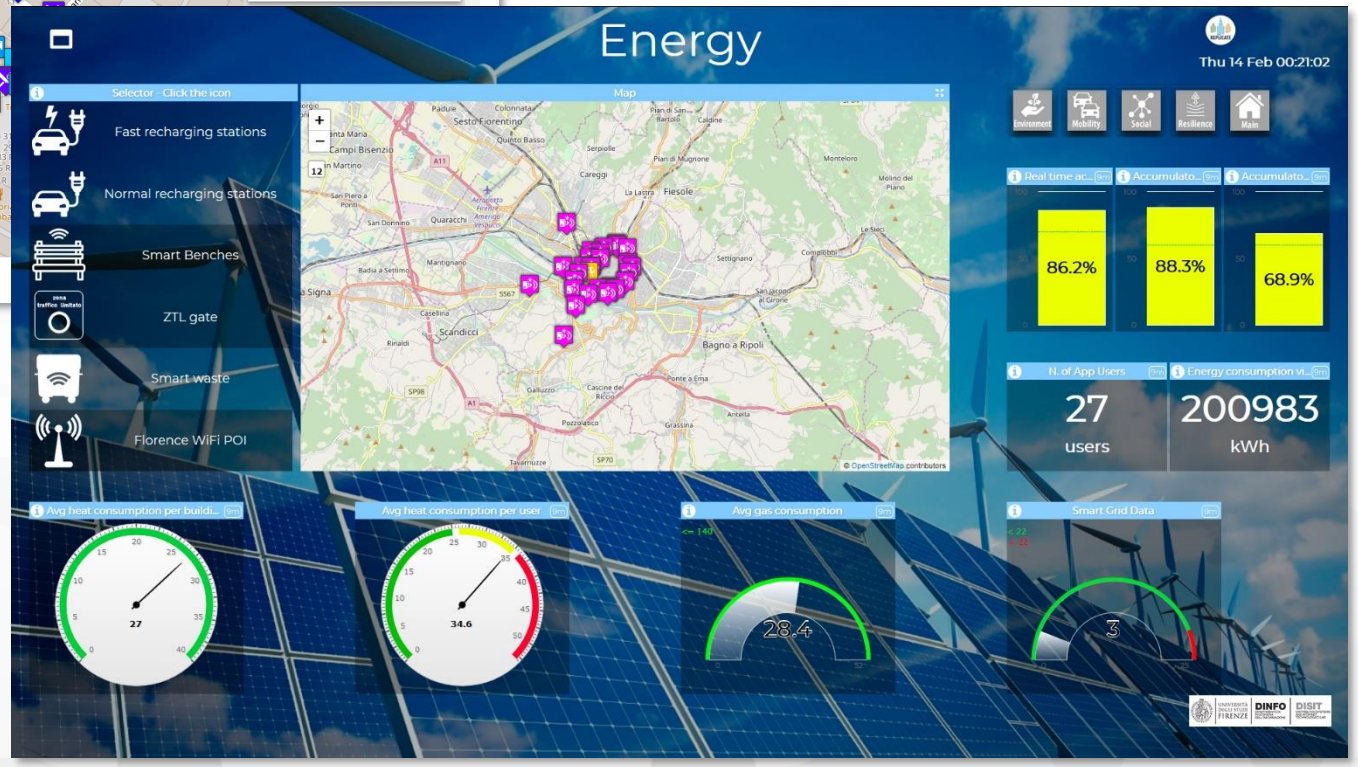
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0MQ==

Infomobility Dashboard MicroApplications





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



https://main.snap4city.org/view/index.php?iddasboard=MjE0

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

Real Time Sensors via ServiceMap3D

3D data rendering

Sat 1 Dec 16:57:33

Firenze

Airport

Empoli

Airport

+ Show Menu

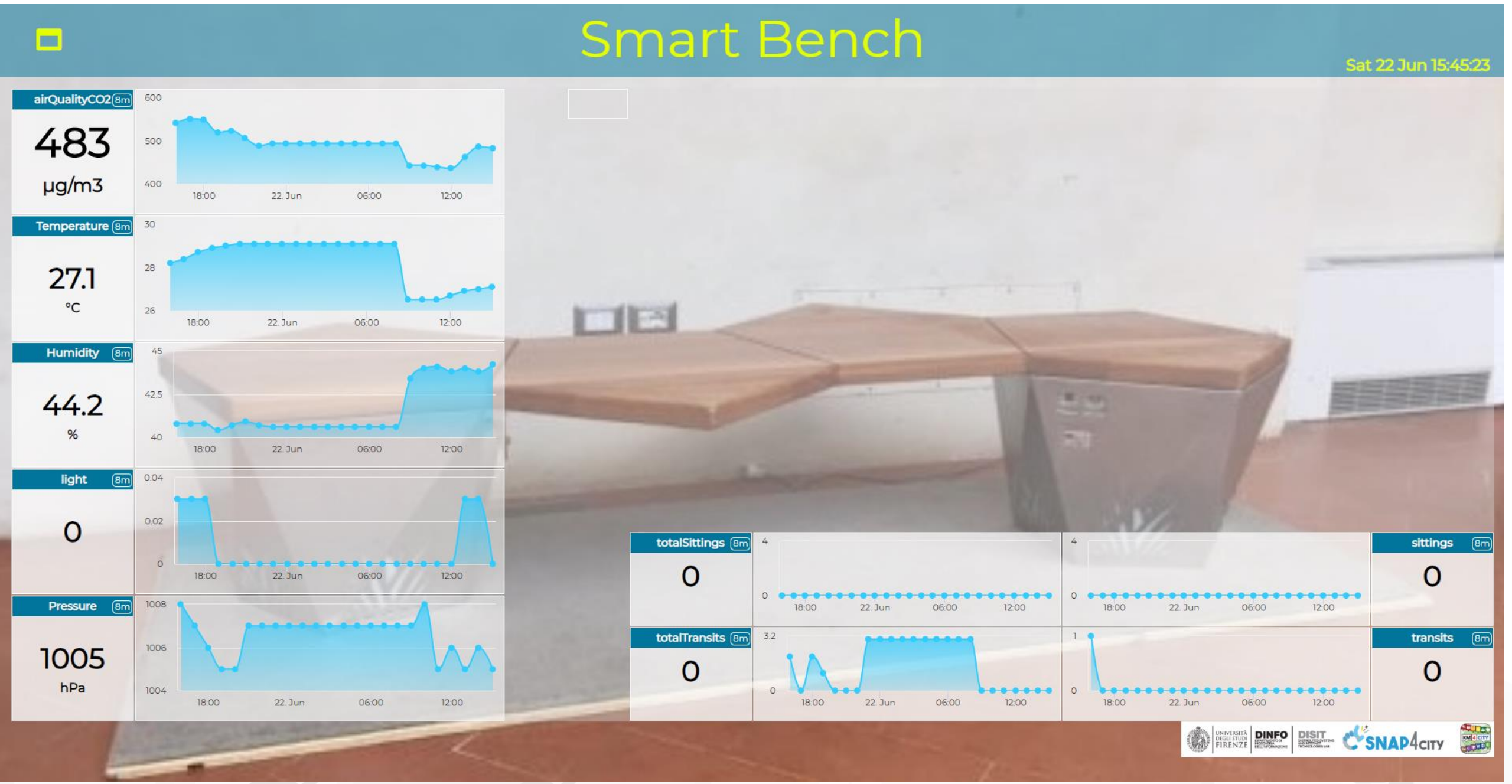
- Hide Menu

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

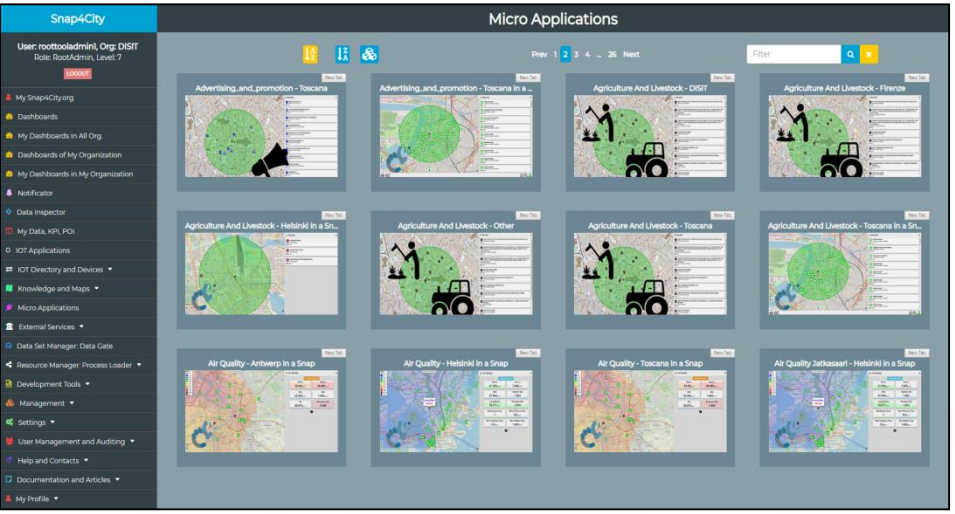
CESIUM bing © 2018 Microsoft Corporation - © 2018 HERE - © 2018 DigitalG

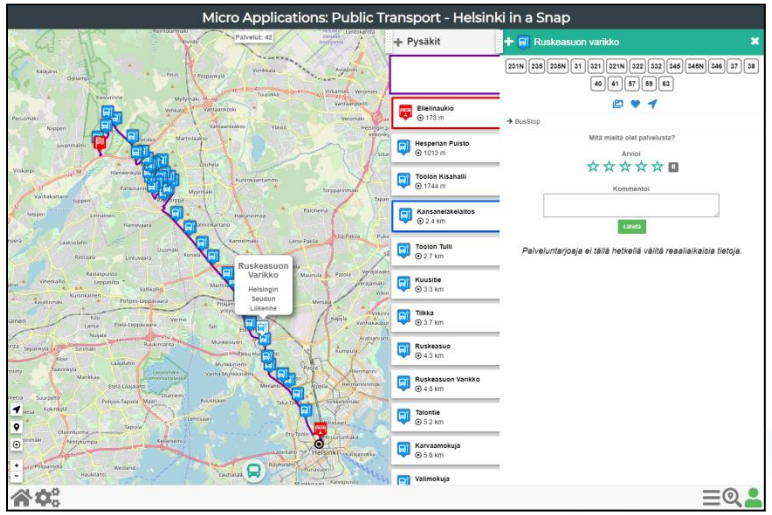
Smart Bench

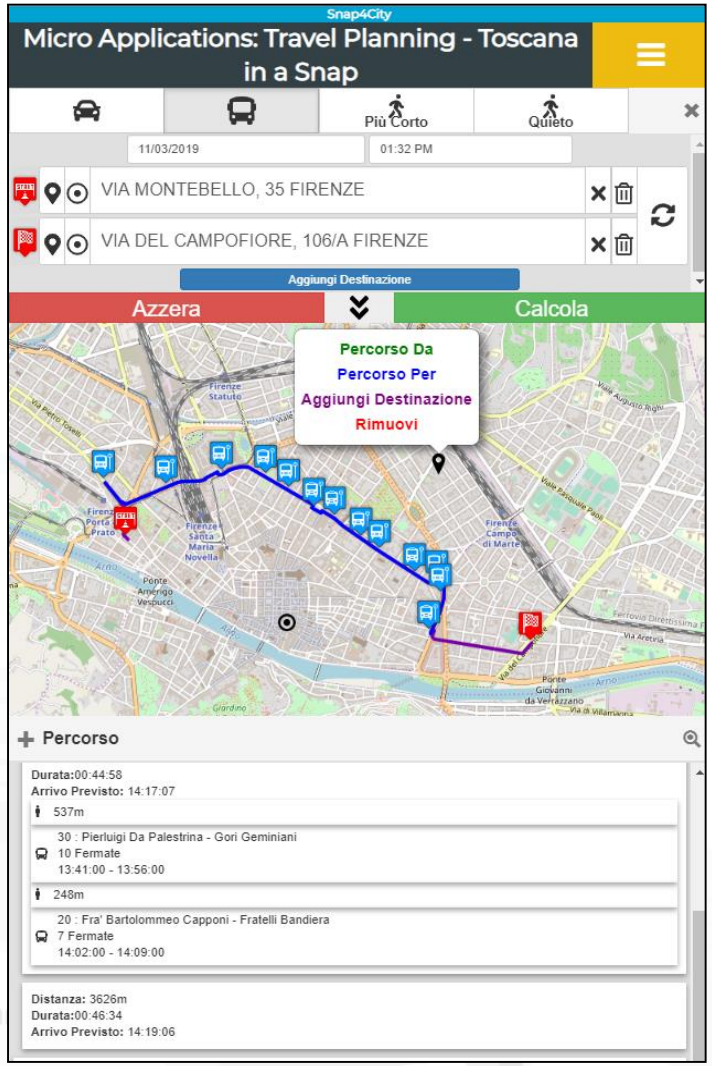
Sat 22 Jun 15:45:23

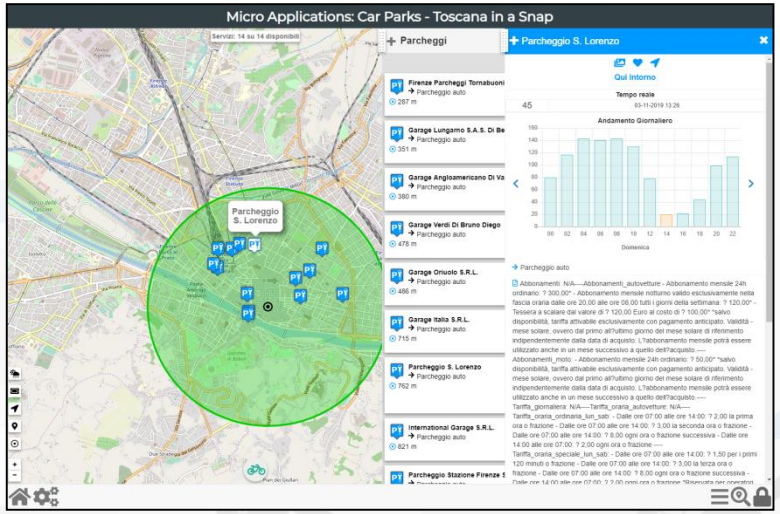


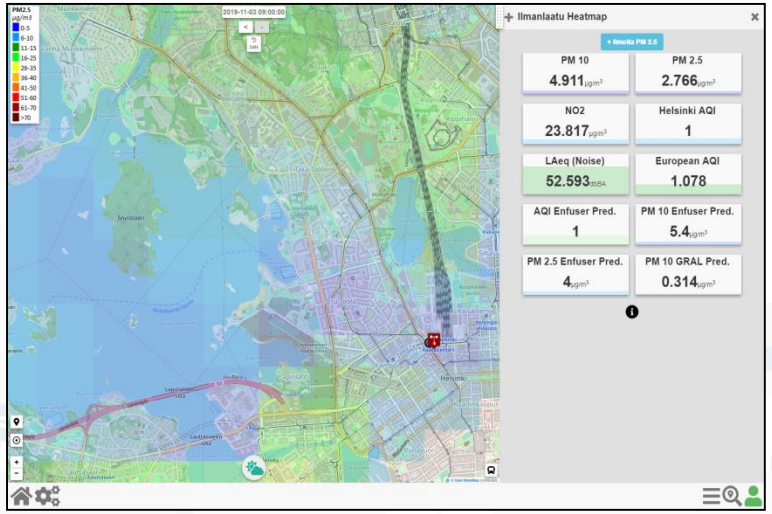
MIcroApplications for Dashboards





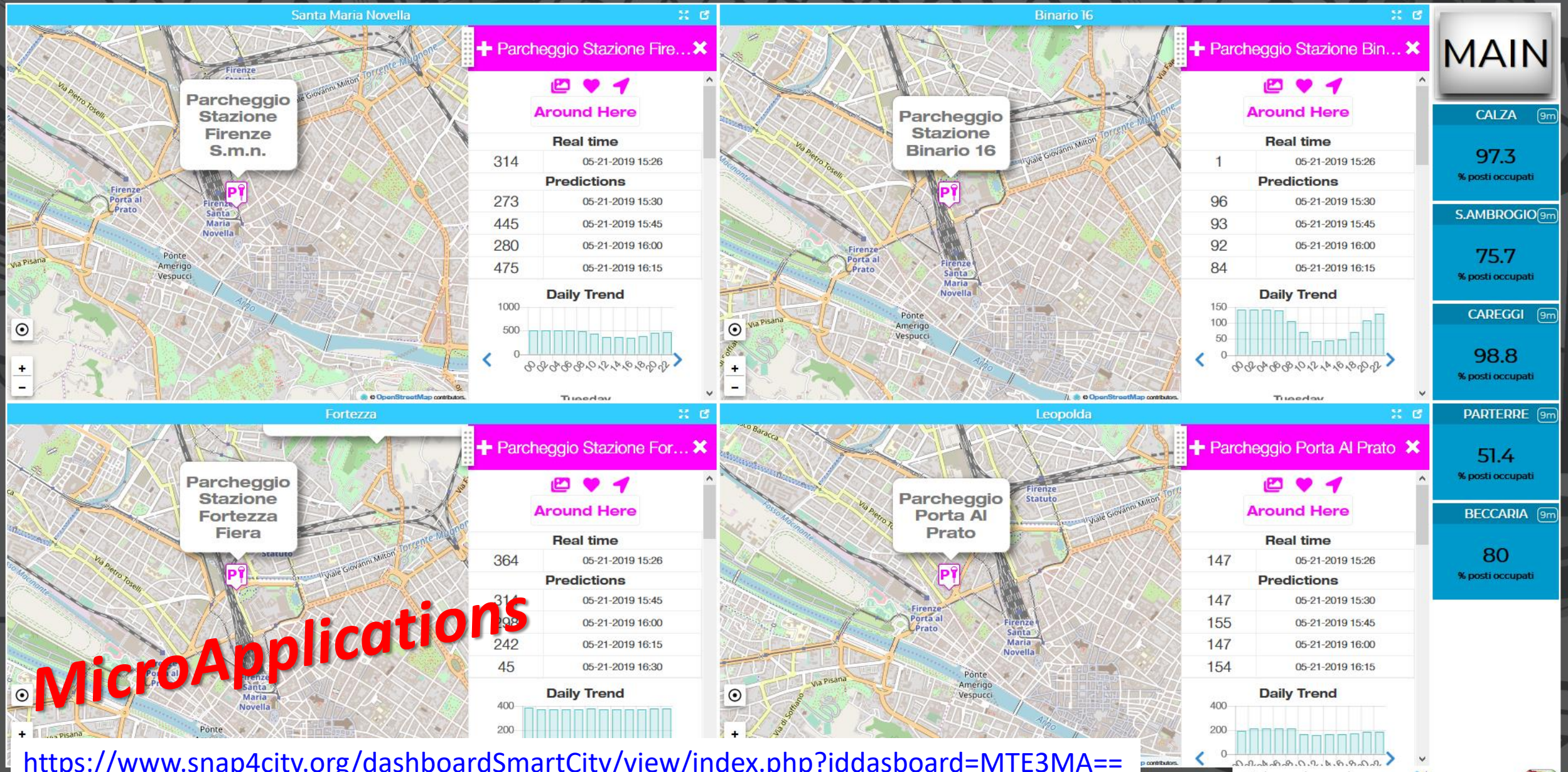






Parking Monitoring Firenze

Tue 21 May 15:23:09



MicroApplications

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

Operator Dashboards at different levels




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



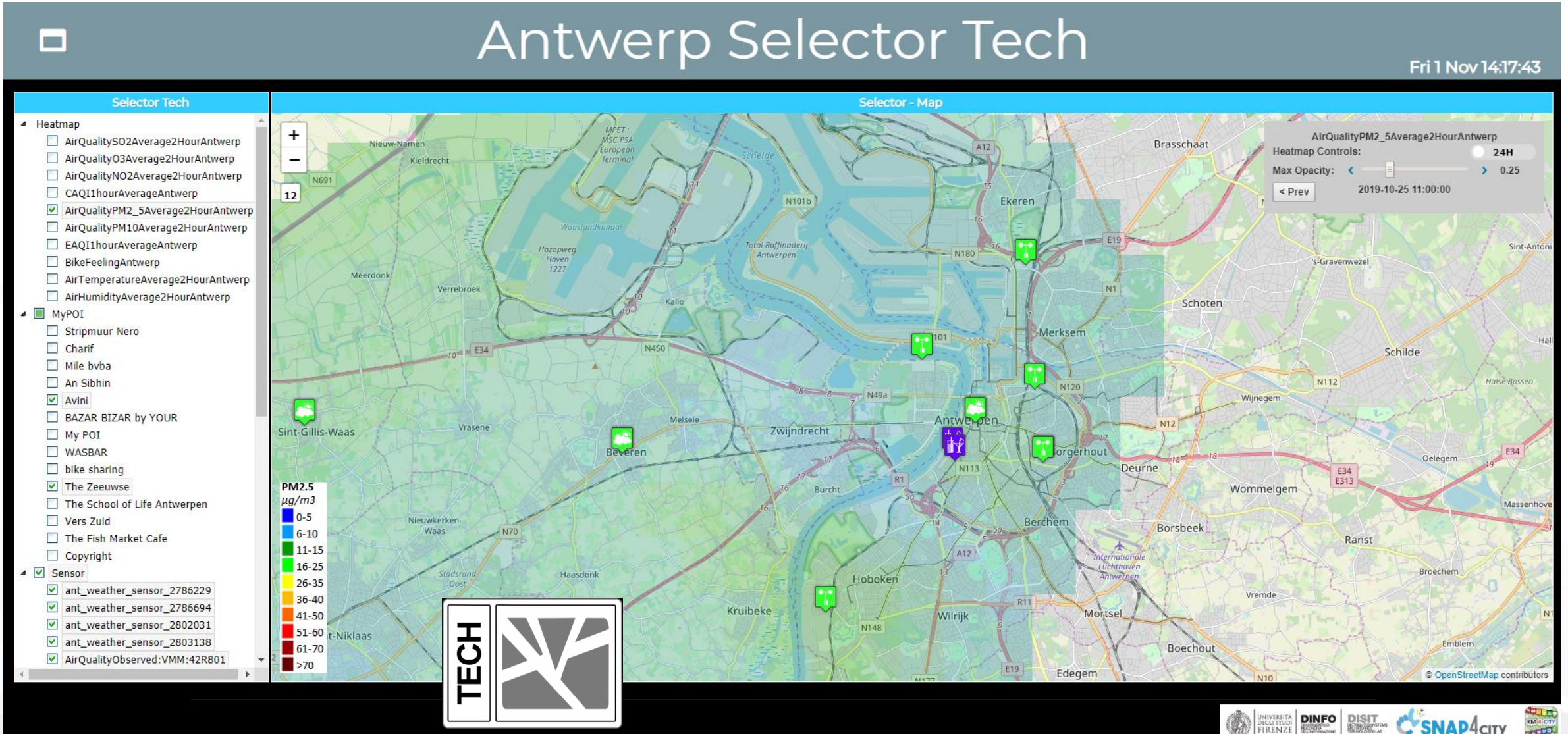


Chemical Plant Dashboard Green Impact Capacity (GIC)

Altair Control room



Technical Selector: TECH MultiDataMap

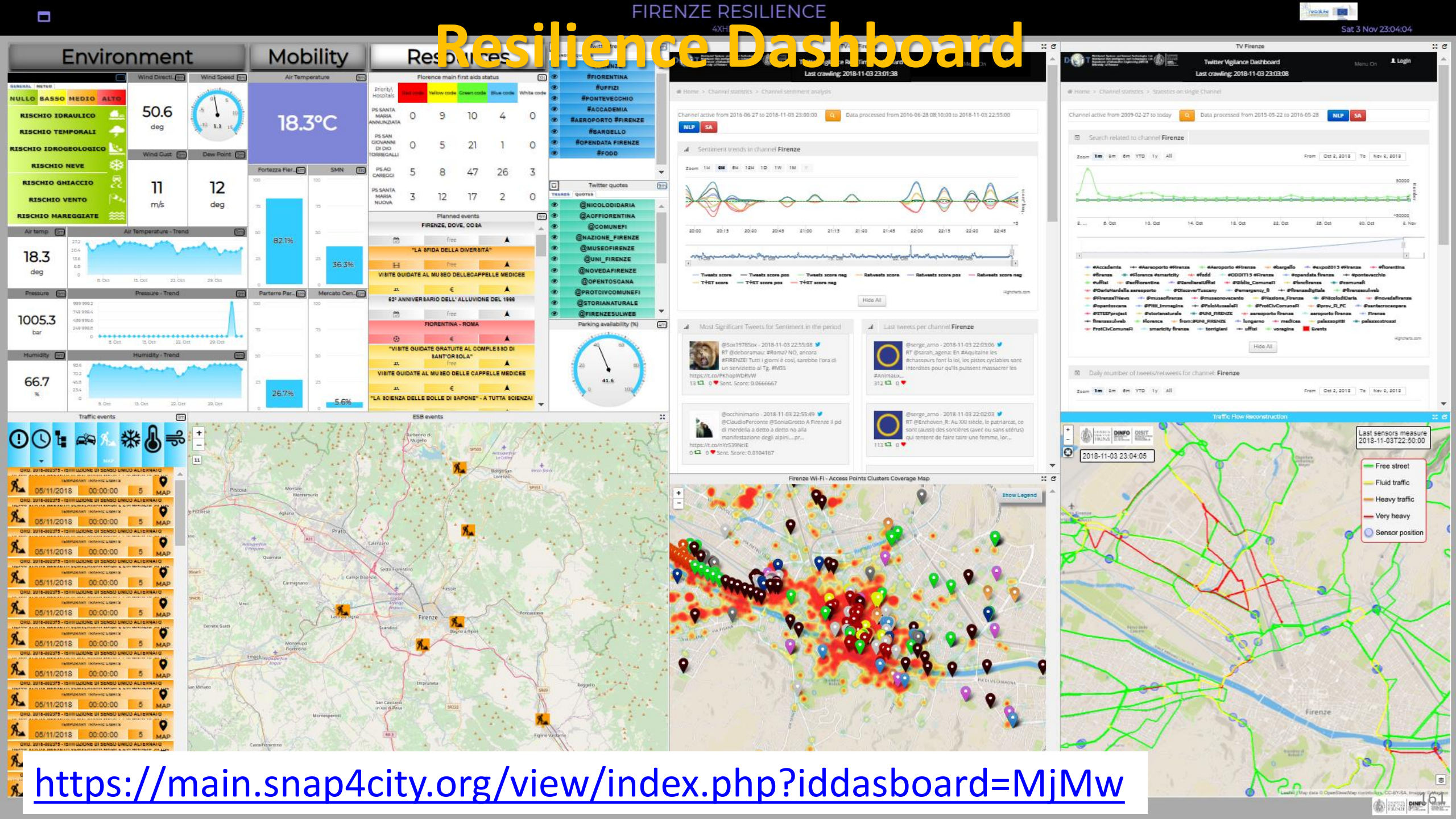


Multi-Widget Map



https://main.snap4city.org/view/index.php?iddasboard=OTc2

Resilience Dashboard



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

First aids overview - Tuscany

Service status of main first aids

Thu 25 May @ 11:00:34

Careggi hospital (Florence) - Details

9m

Priority\Status	Red code	Yellow code	Green code	Blue code	White code
Addressed	1	4	3	0	0
Waiting	0	2	9	2	0
In visit	1	9	18	3	0
In observation	4	19	2	0	0
Totals	6	34	32	5	0

Santa Chiara hospital (Pisa) - Details

9m

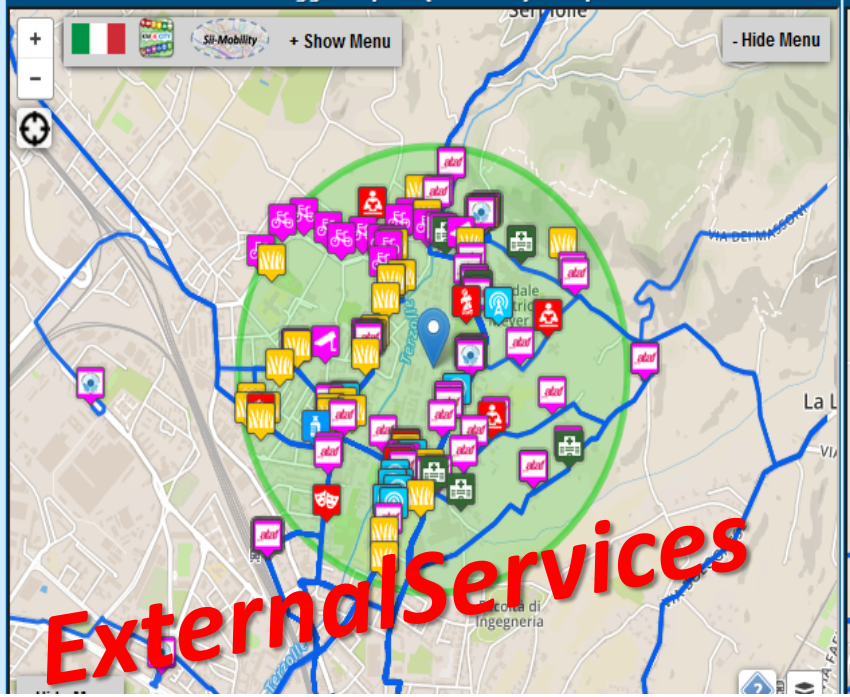
Priority\Status	Red code	Yellow code	Green code	Blue code	White code
Waiting	0	1	7	9	3
In visit	0	7	1	1	6
Totals	0	8	8	10	9

Other hospitals - Summary

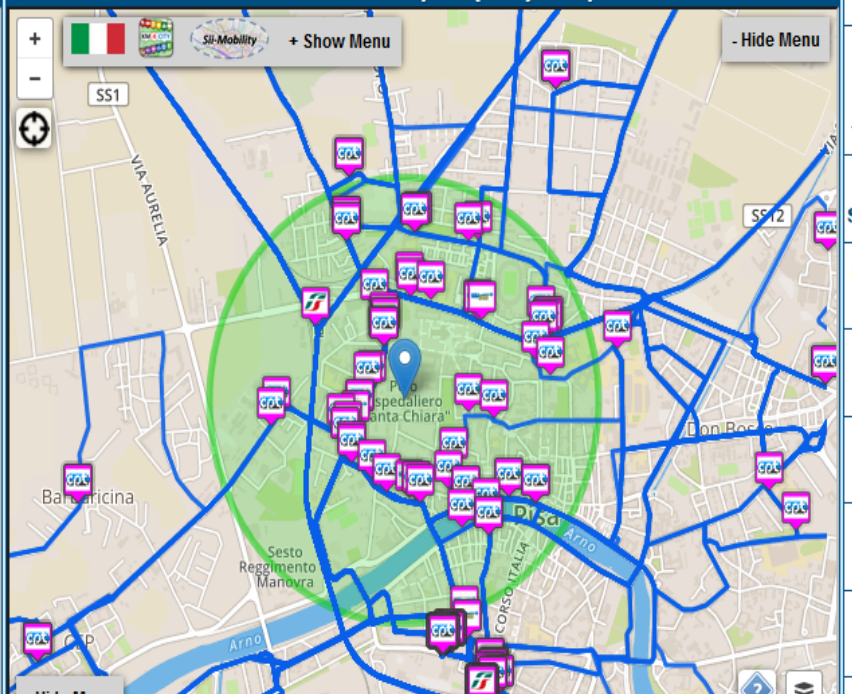
9m

Priority\Hospitals	Red code	Yellow code	Green code	Blue code	White code
PS SAN GIOVANNI DI DIO TORREGALLI	1	16	20	1	0
PS SANTA MARIA NUOVA	1	14	12	3	0
PS AO CAREGGI	6	34	32	5	0
PS SANTA MARIA ANNUNZIATA	1	8	11	1	0
PS BORGO SAN LORENZO	0				0
PS OSPEDALI RIUNITI	3				1
PS CASENTINO					
PS SANTA CROCE					
PI PO CORTONA					
PS CIVILE PIOMBINO					

Careggi hospital (Florence) - Map



Santa Chiara hospital (Pisa) - Map



ExternalServices

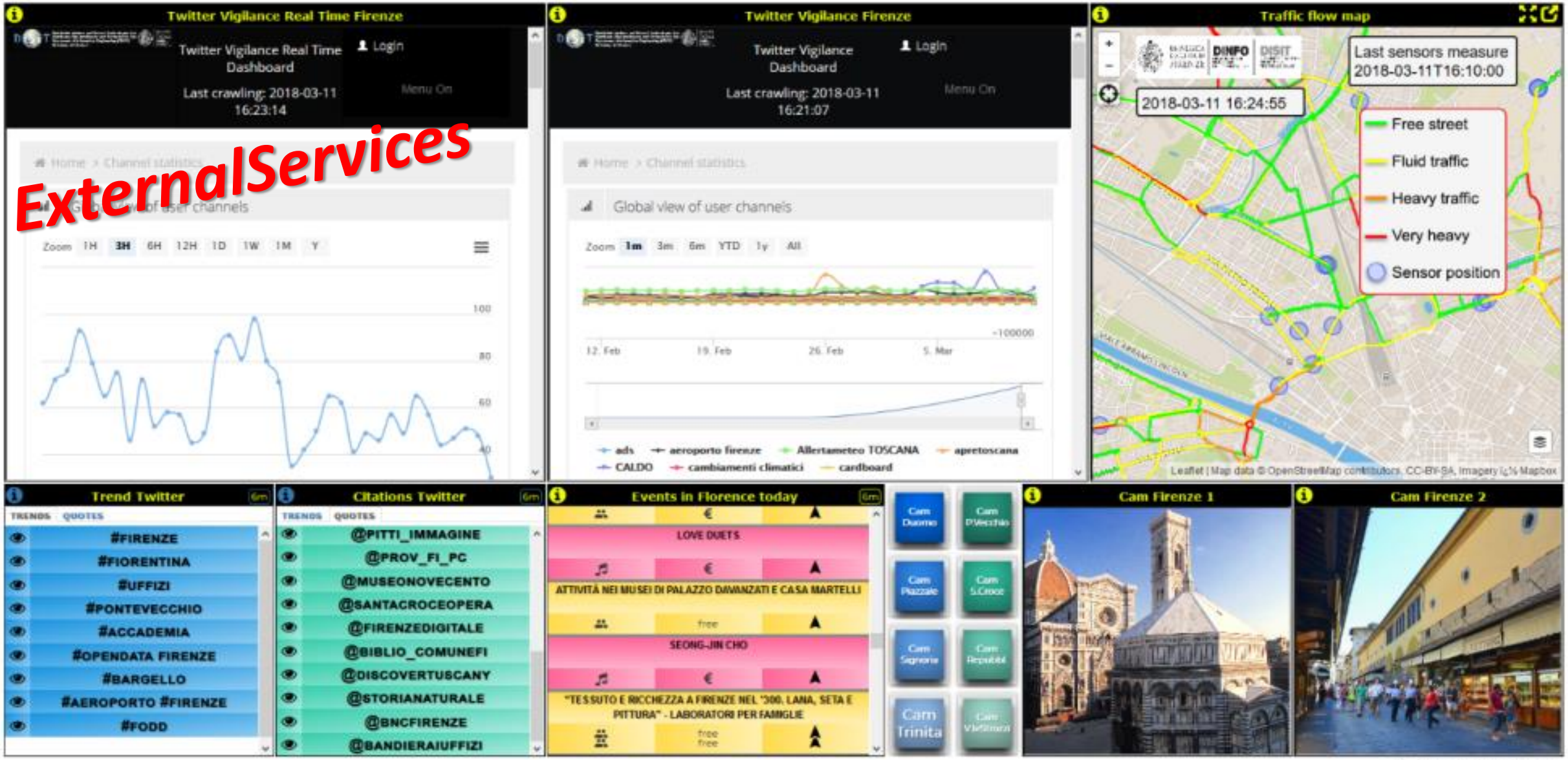


https://main.snap4city.org/view/index.php?iddasboard=MTIy

Firenze Social and Social Media new

Demo cams

Sun 11 Mar 16:24:55



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

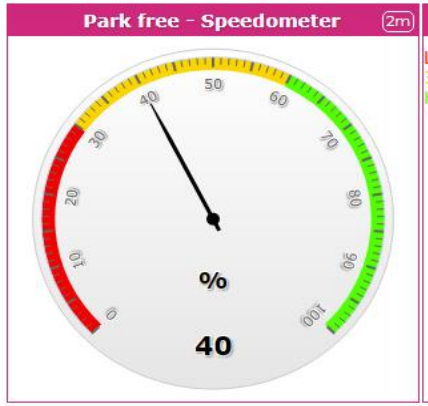
Cross widget interaction 2

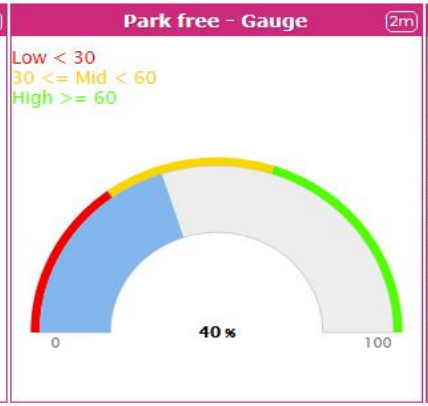
E Experimental

Mon 15 Jan 15:16:37

Any data
Real time updated
Flexible design
Easy to produce
Highly interactive

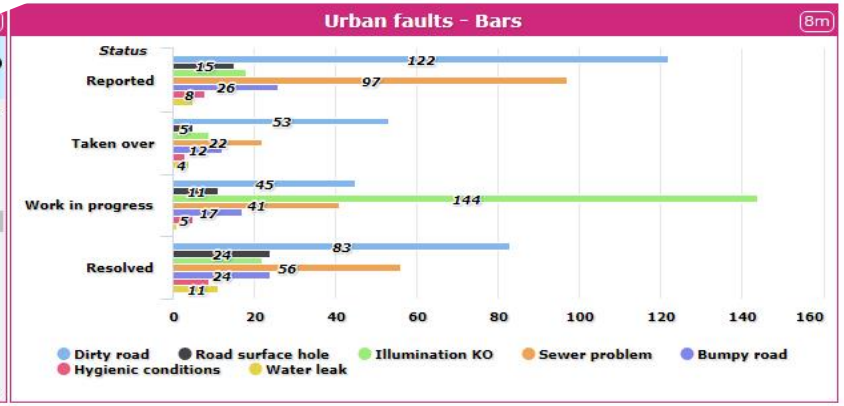




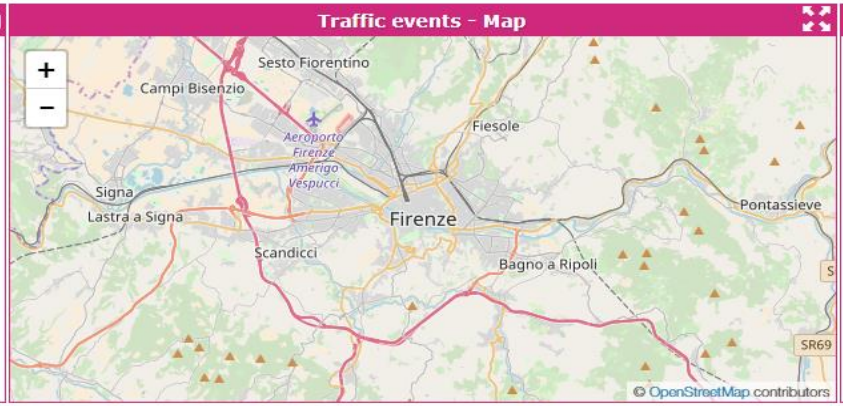


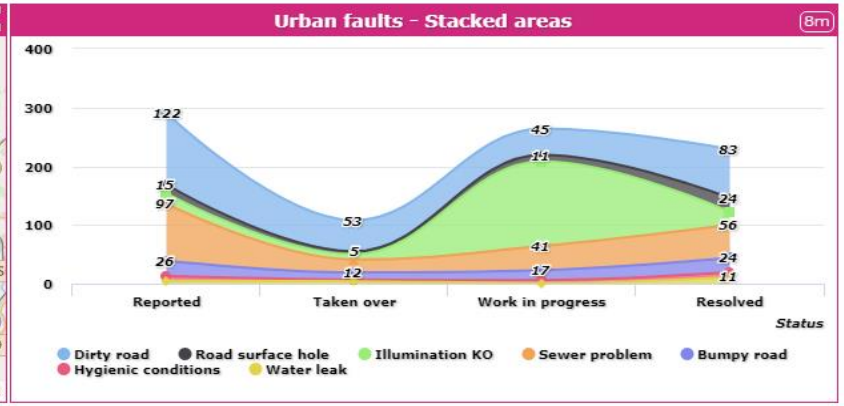












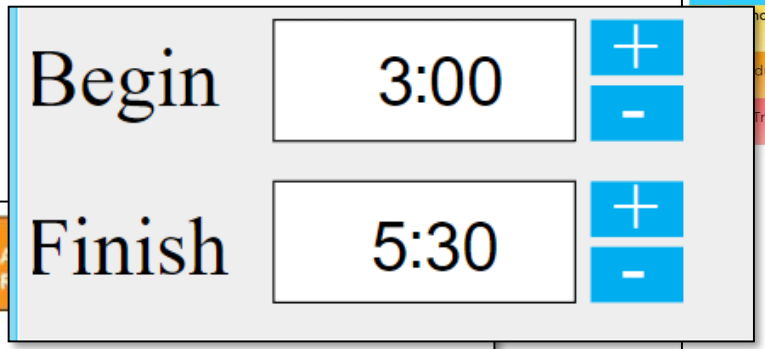
https://main.snap4city.org/view/index.php?iddasboard=MTU1

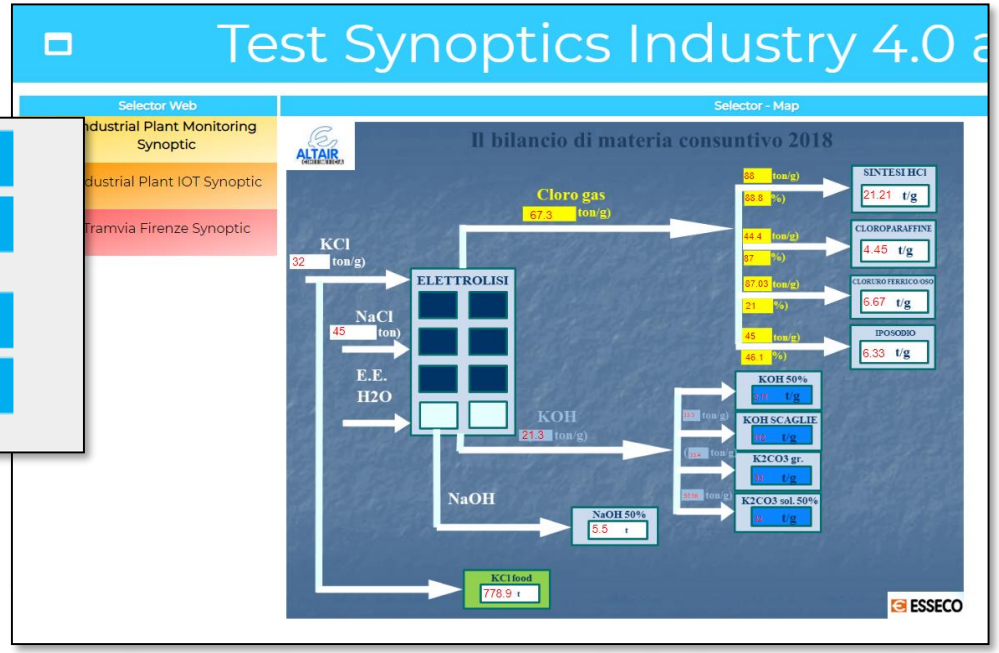
Custom Widgets

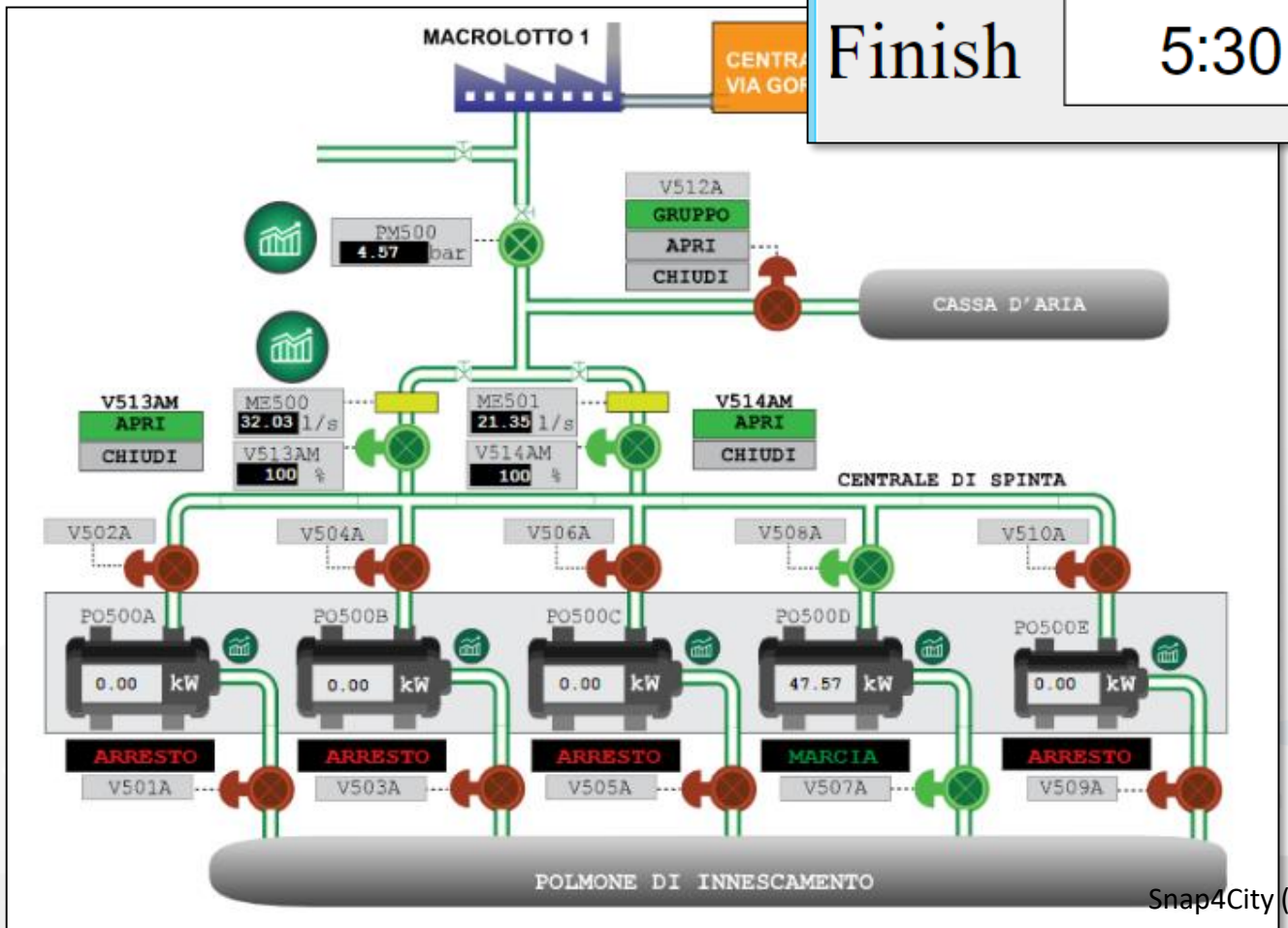
Custom Dashboards and Widgets (interactive, Animations, etc.)

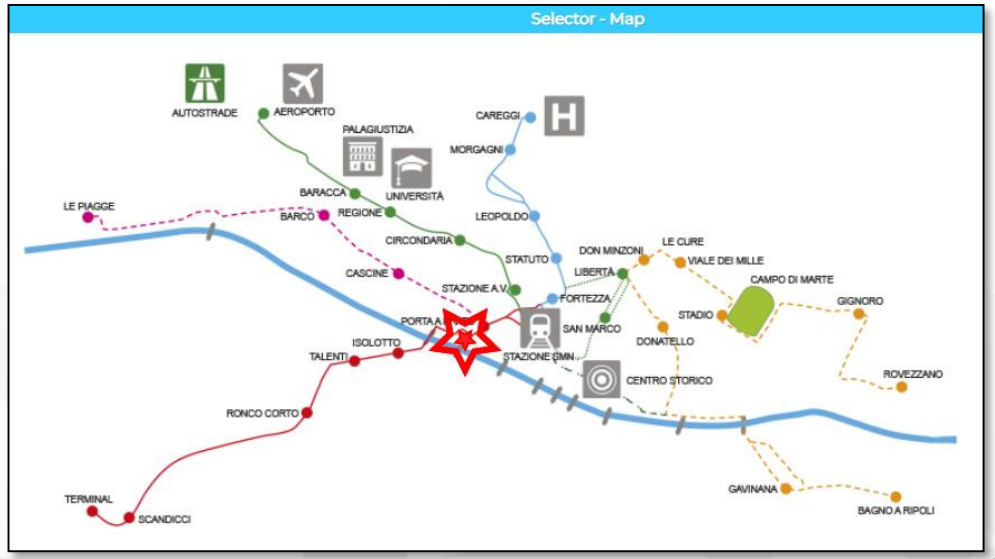
-- SVG for graphic design

-- MyKPI for collecting data

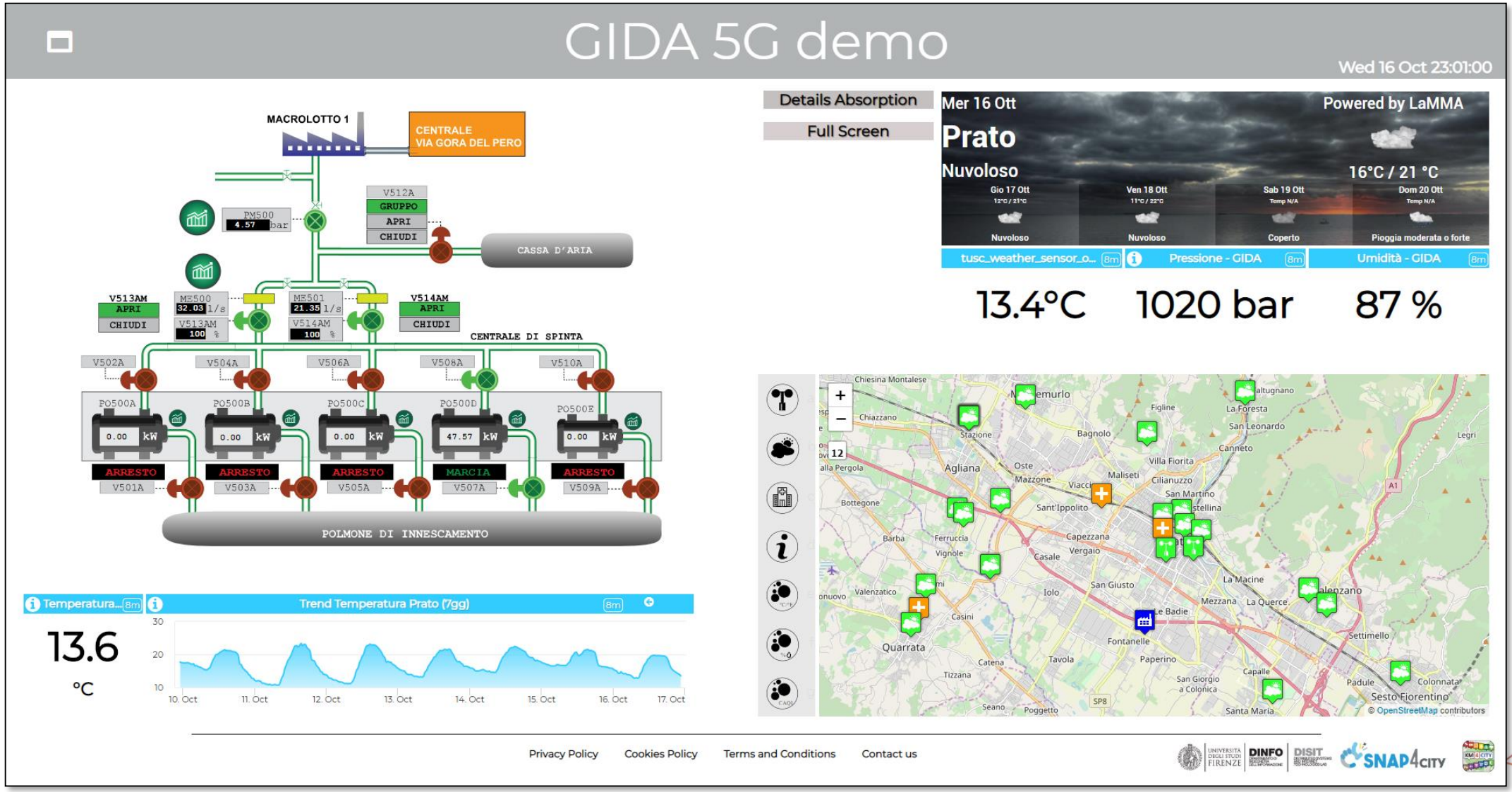








Demo UC5 GIDA



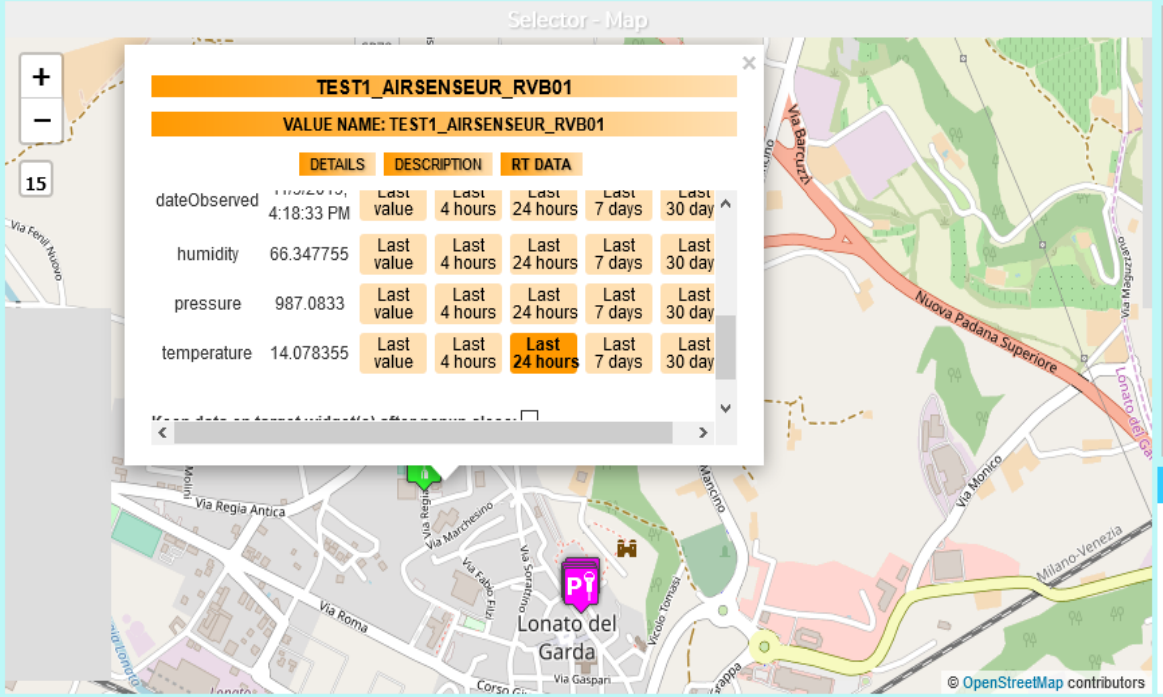
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==

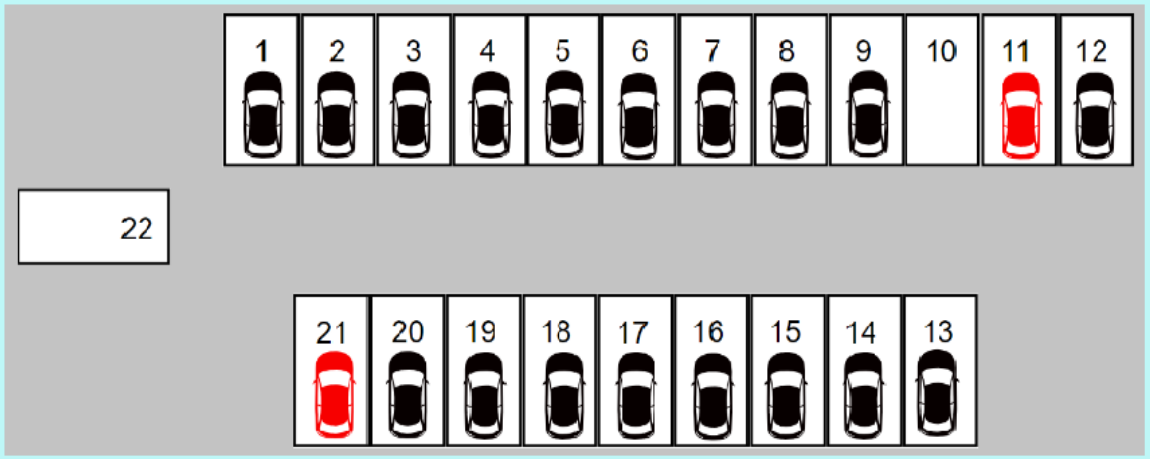
Smart Lonato del Garda

Sat 9 Nov 17:20:59

Slot 1
Slot 2
Slot 3
Slot 4
Slot 5
Slot 6
Slot 7
Slot 8
Slot 9
Slot 10
Slot 11
Slot 12
Slot 13
Slot 14
Slot 15
Slot 16
Slot 17
Slot 18
Slot 19
Slot 20
Slot 21
Slot 22
Environment
other

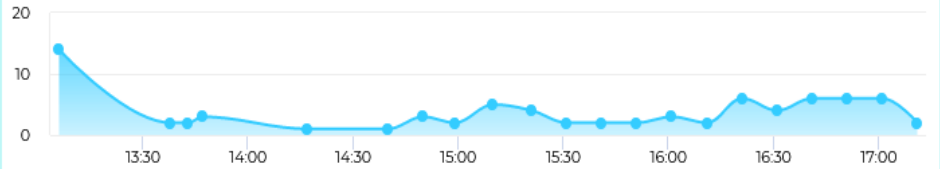
Selector - Map





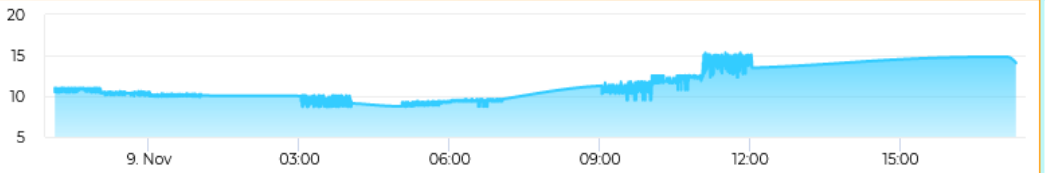
NumFreeSlo... 9m
2
free slots

NumFreeSlots - Slots 9m

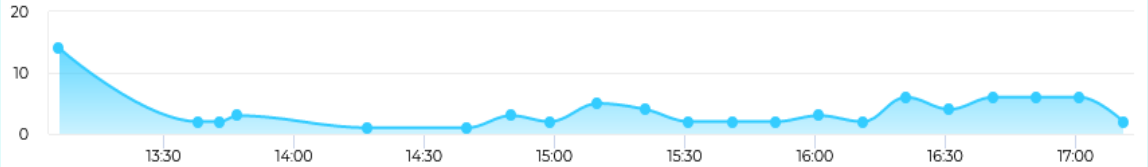


SmartParkingLonato_1 ... 9m
0
status

temperature - Day 9m



NumFreeSlots - Slots 9m



pressure 9m
987.1
mm

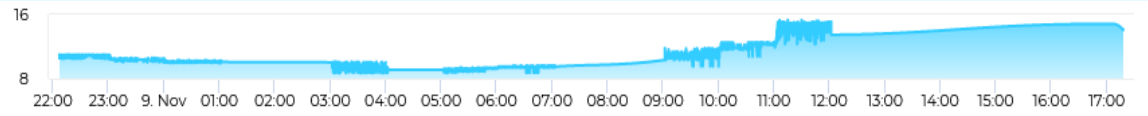
humidity % 9m
66.3
%

temperature 9m
14.1
C

Slot ID 9m
14
slot ID

Max Present Duration 9m
19 ore e 11 minuti

TEST1_AirSensEUR_RVB01 - temperature 9m



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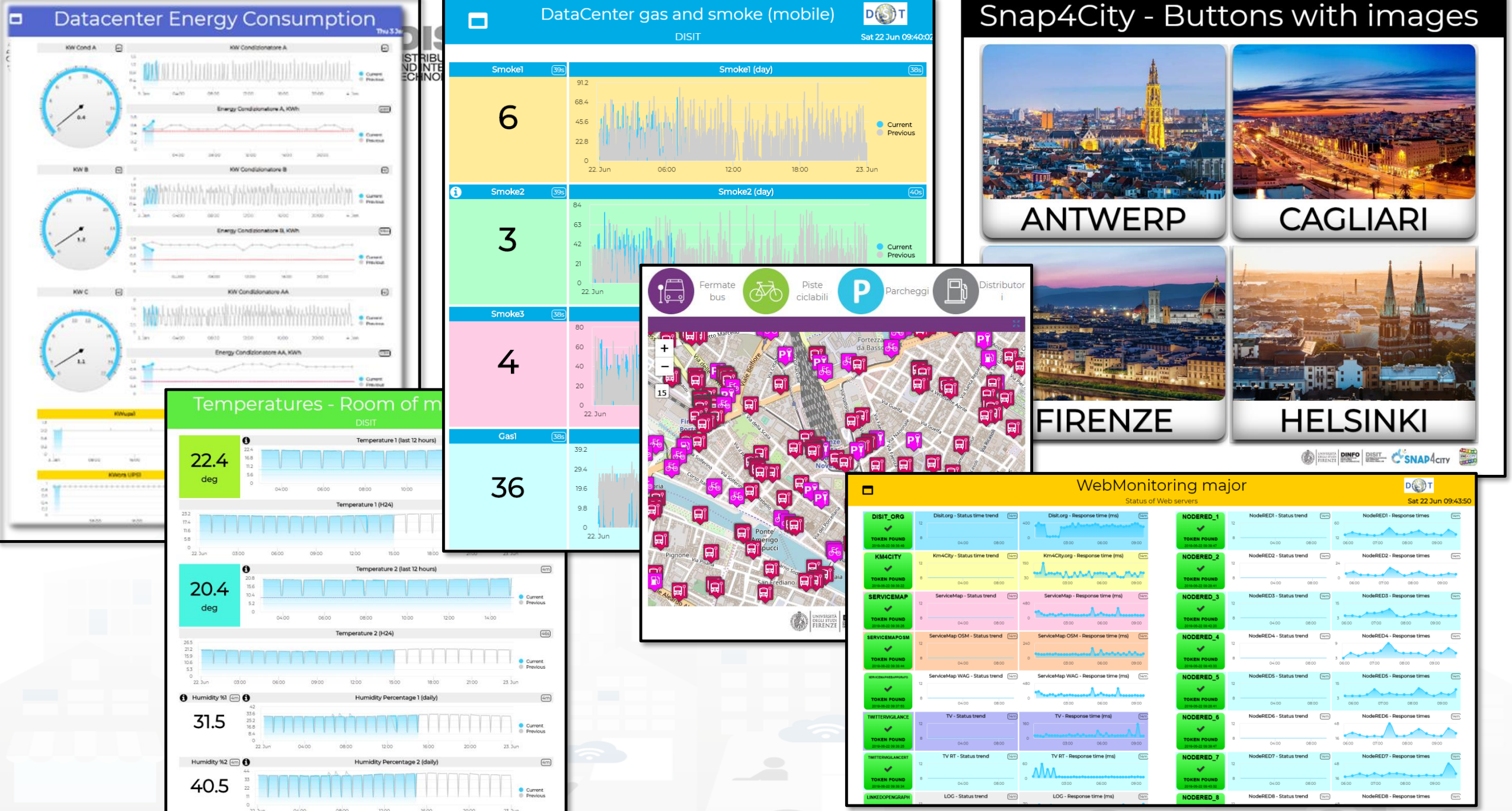
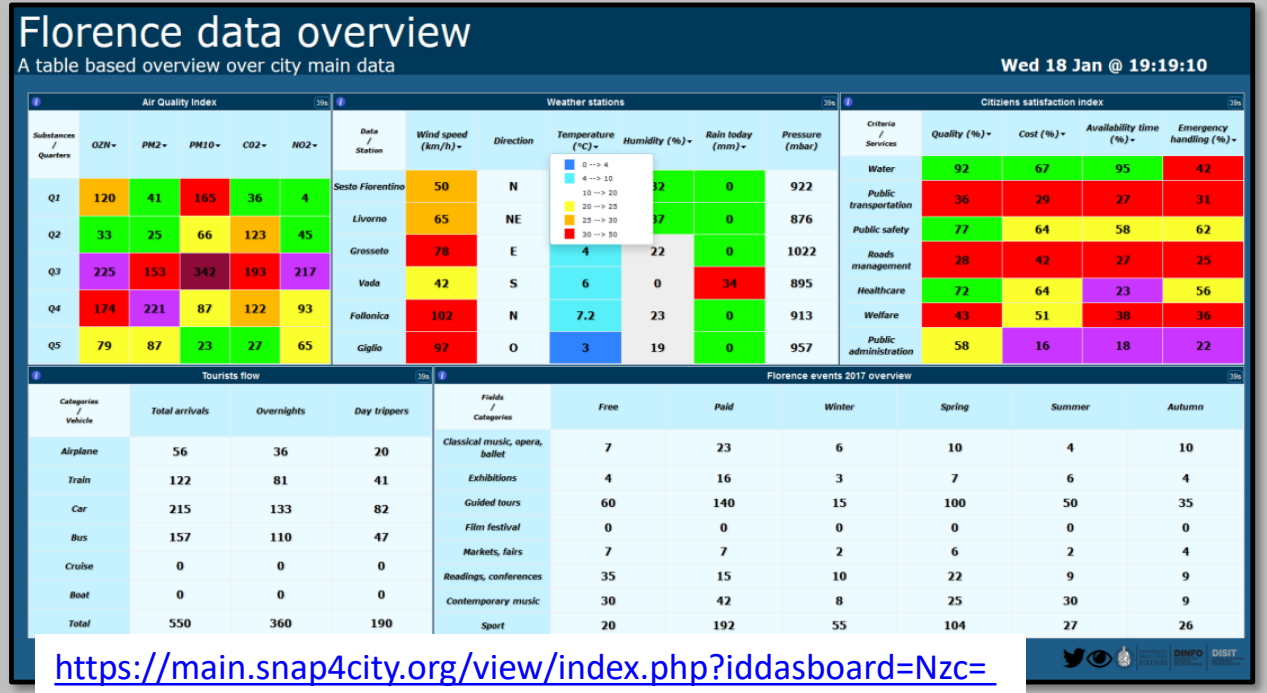

Datacenter Energy Consumption
DataCenter gas and smoke (mobile)
DISIT
Sat 22 Jun 09:40:02
Smoke1
6
Smoke1 (day)
Smoke2
3
Smoke2 (day)
Smoke3
4
Gas1
36
Snap4City - Buttons with images
ANTWERP
CAGLIARI
FIRENZE
HELSINKI
Fermate bus
Piste ciclabili
Parcheggi
Distributori
Temperatures - Room of m
DISIT
22.4
deg
Temperature 1 (last 12 hours)
Temperature 1 (H24)
20.4
deg
Temperature 2 (last 12 hours)
Temperature 2 (H24)
Humidity %1
31.5
Humidity Percentage 1 (daily)
Humidity %2
40.5
Humidity Percentage 2 (daily)
WebMonitoring major
Status of Web servers
Sat 22 Jun 09:43:50



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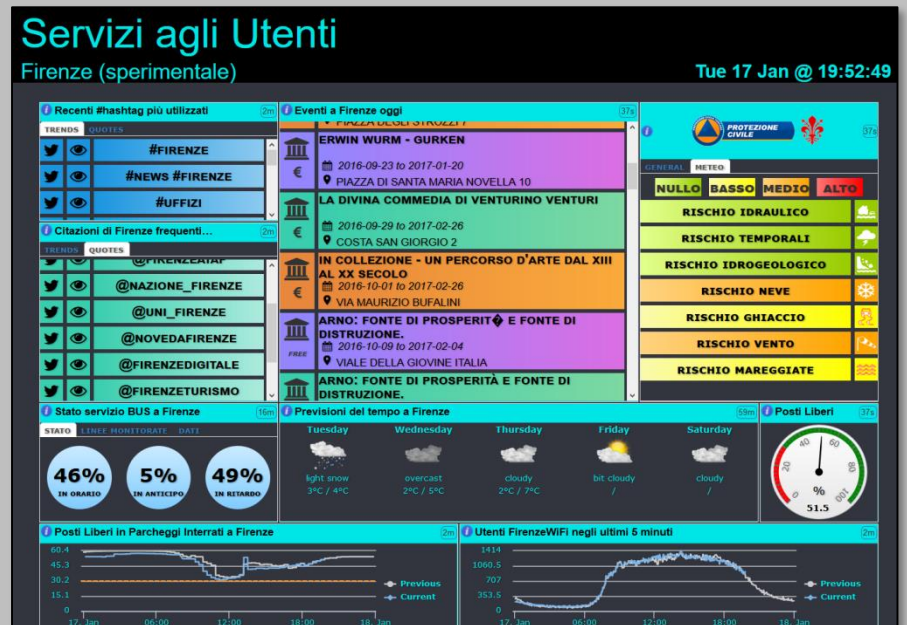

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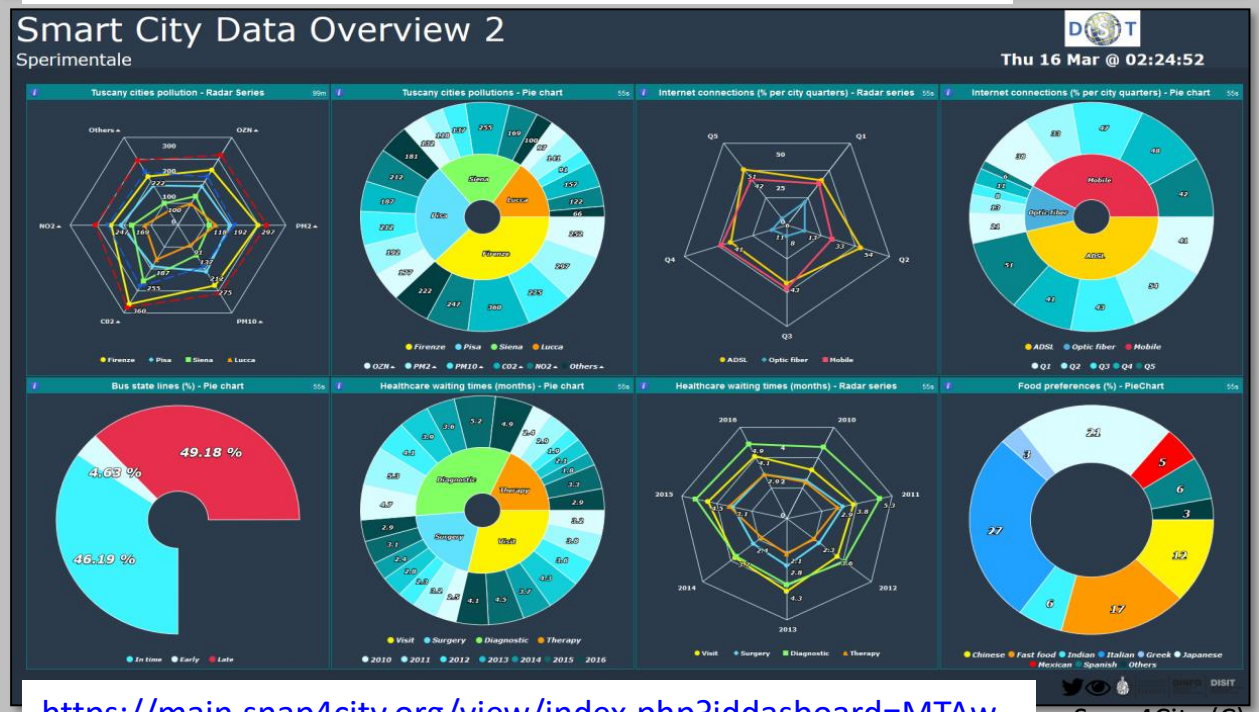

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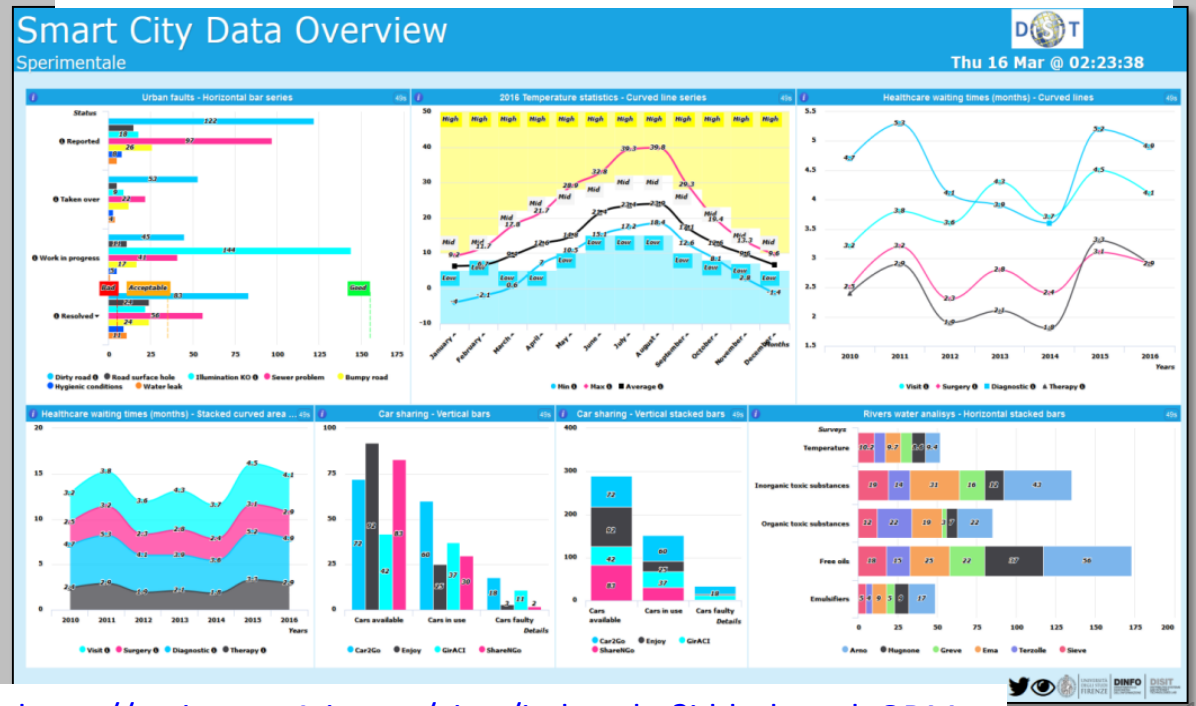

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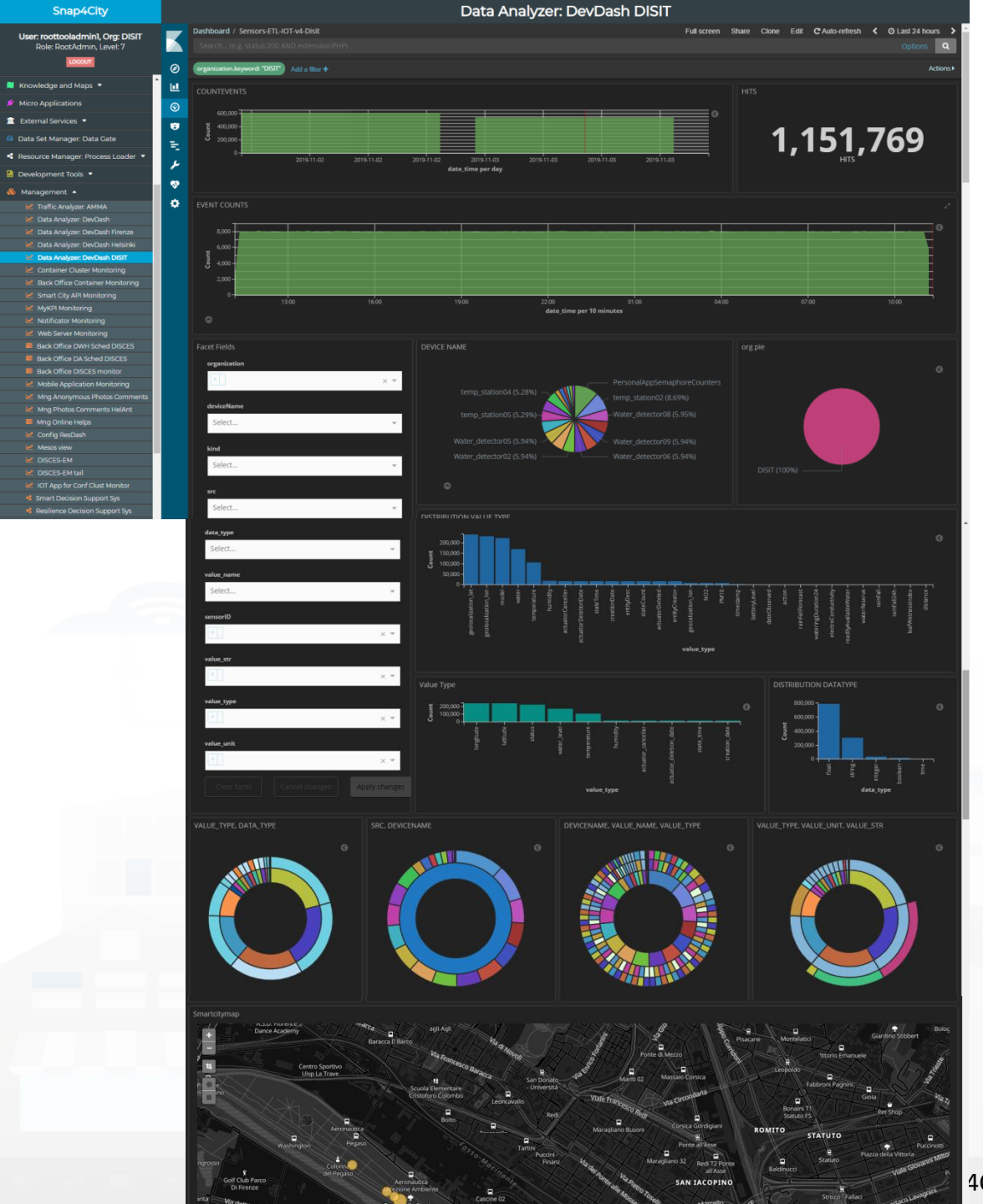


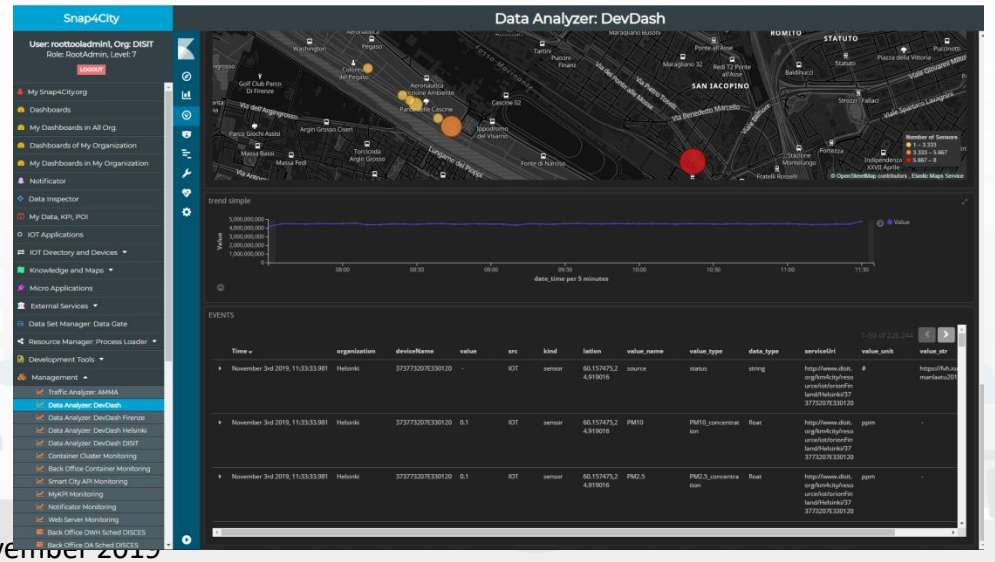
kibana

SNAP4CITY

KM4CITY

Operator Business Analysis Dashboards: DevDash, AMMA

- Dynamic Filtering, Adaptable, …
- Full data details, drill down,…
- Synergic with **Data Inspector** which addresses data relationships, processing and information



Data Analyzer: DevDash

Snap4City

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

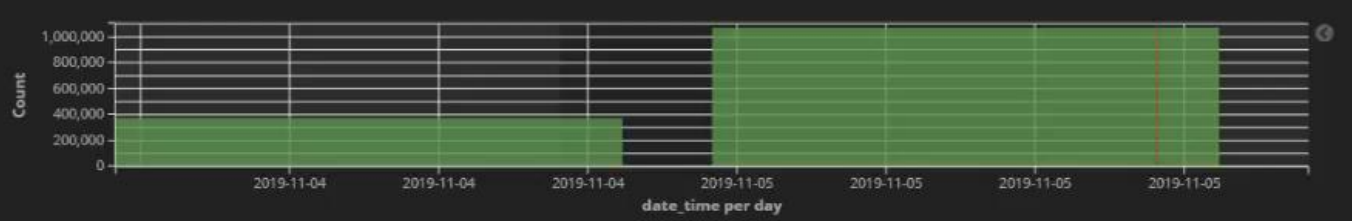
- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
  - Traffic Analyzer: AMMA
  - Data Analyzer: DevDash
  - Data Analyzer: DevDash Firenze
  - Data Analyzer: DevDash Helsinki
  - Data Analyzer: DevDash DISIT
  - Container Cluster Monitoring
  - Back Office Container Monitoring
  - Smart City API Monitoring
  - MyKPI Monitoring
  - Notificator Monitoring
  - Web Server Monitoring
  - Back Office DWH Sched DISCES

Dashboard / Sensors-ETL-IOT-v4 Full screen Share Clone Edit Auto-refresh Last 24 hours

Search... (e.g. status:200 AND extension:PHP) Options

Add a filter +

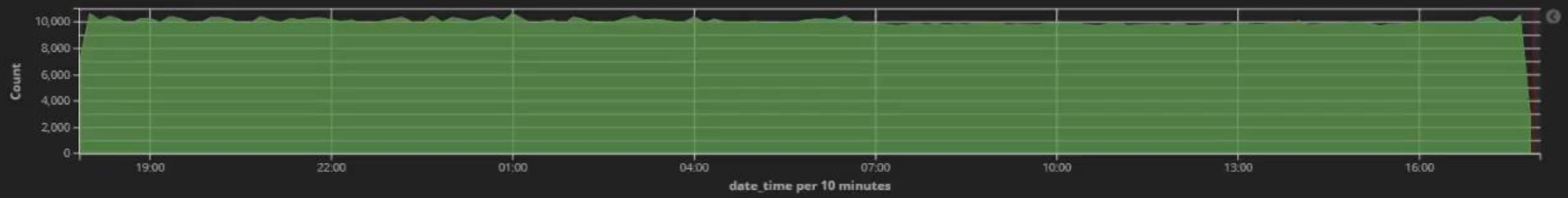
COUNTEVENTS



HITS

1,444,442
HITS

EVENT COUNTS



Facet Fields

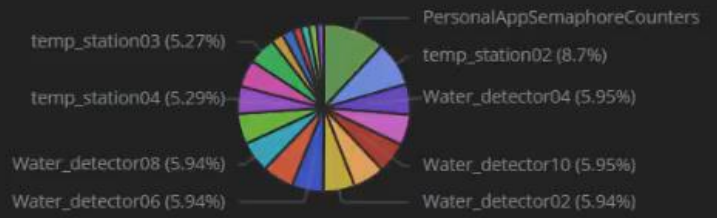
organization

deviceName
Select...

kind
Select...

src
Select...

DEVICE NAME



org pie

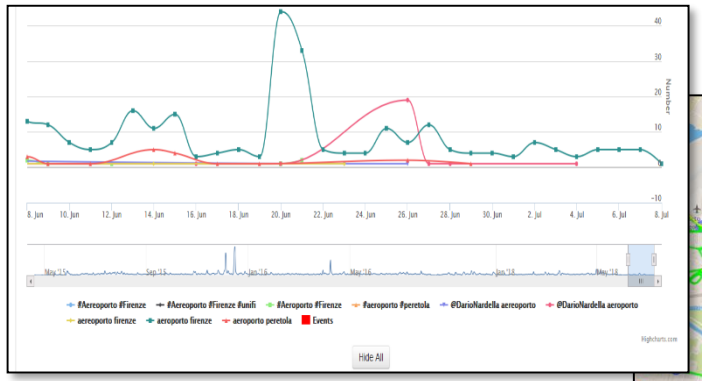


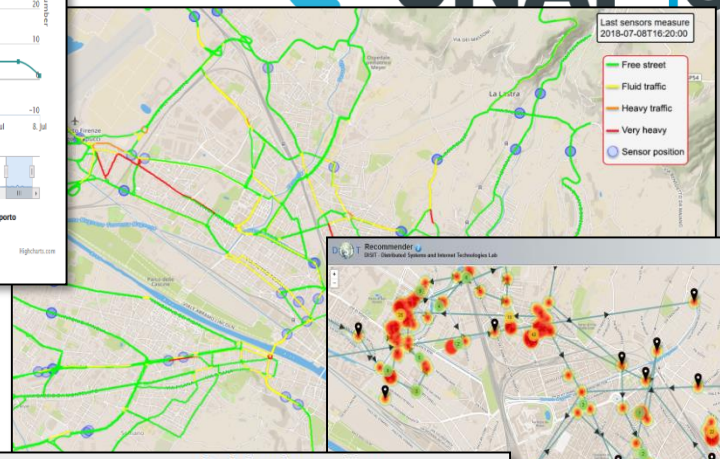
DISTRIBUTION VALUE TYPE

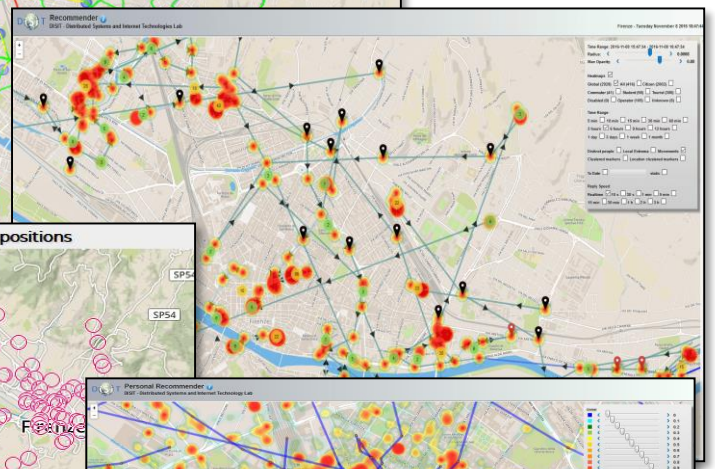
External Services

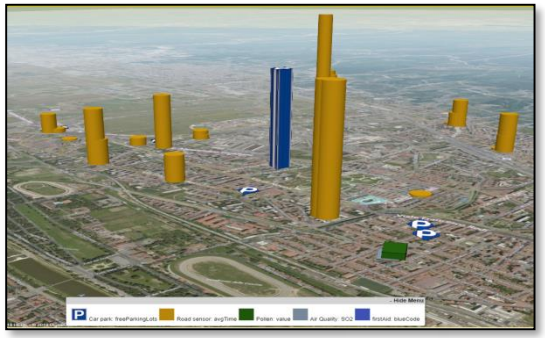
Nature

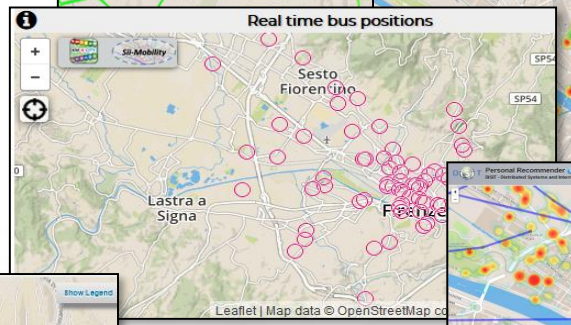
- Twitter Vigilance:
  - Daily and real time
  - Volume and sentiment analysis
- Services on Maps, GIS, ArcGIS
- Real time sensors on 3D
- Web HTML5 Applications
- Origin Destination Matrix
- Real Time fleets
- Routing, Multimodal tools
- IPCAM connector
- Synoptics
- **Third party tools!**
- **…..**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

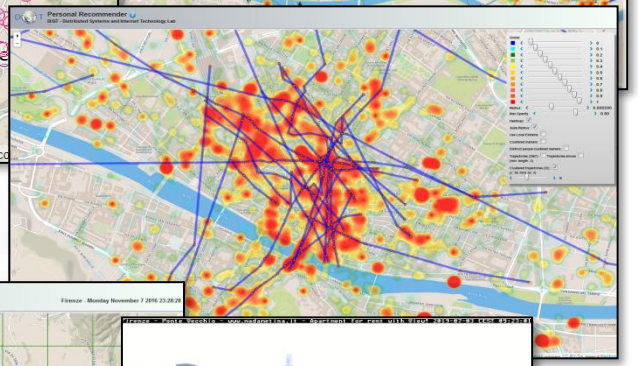


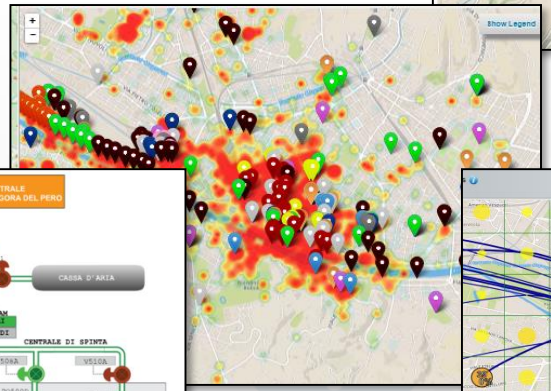


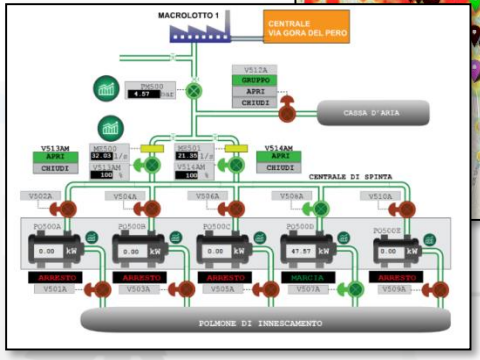


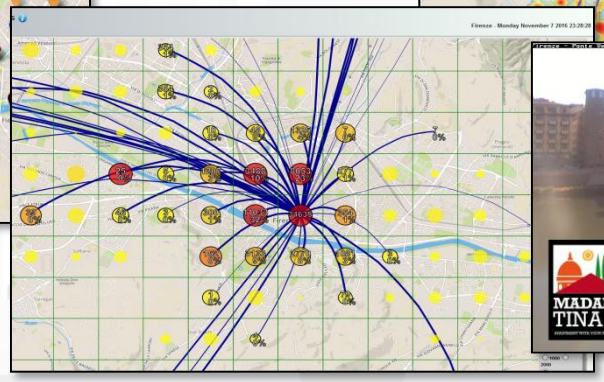














Trajectories and Real Time Tracking



MyKPI: Tracking of Devices and Mobiles

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



Mobile
PAX Counter



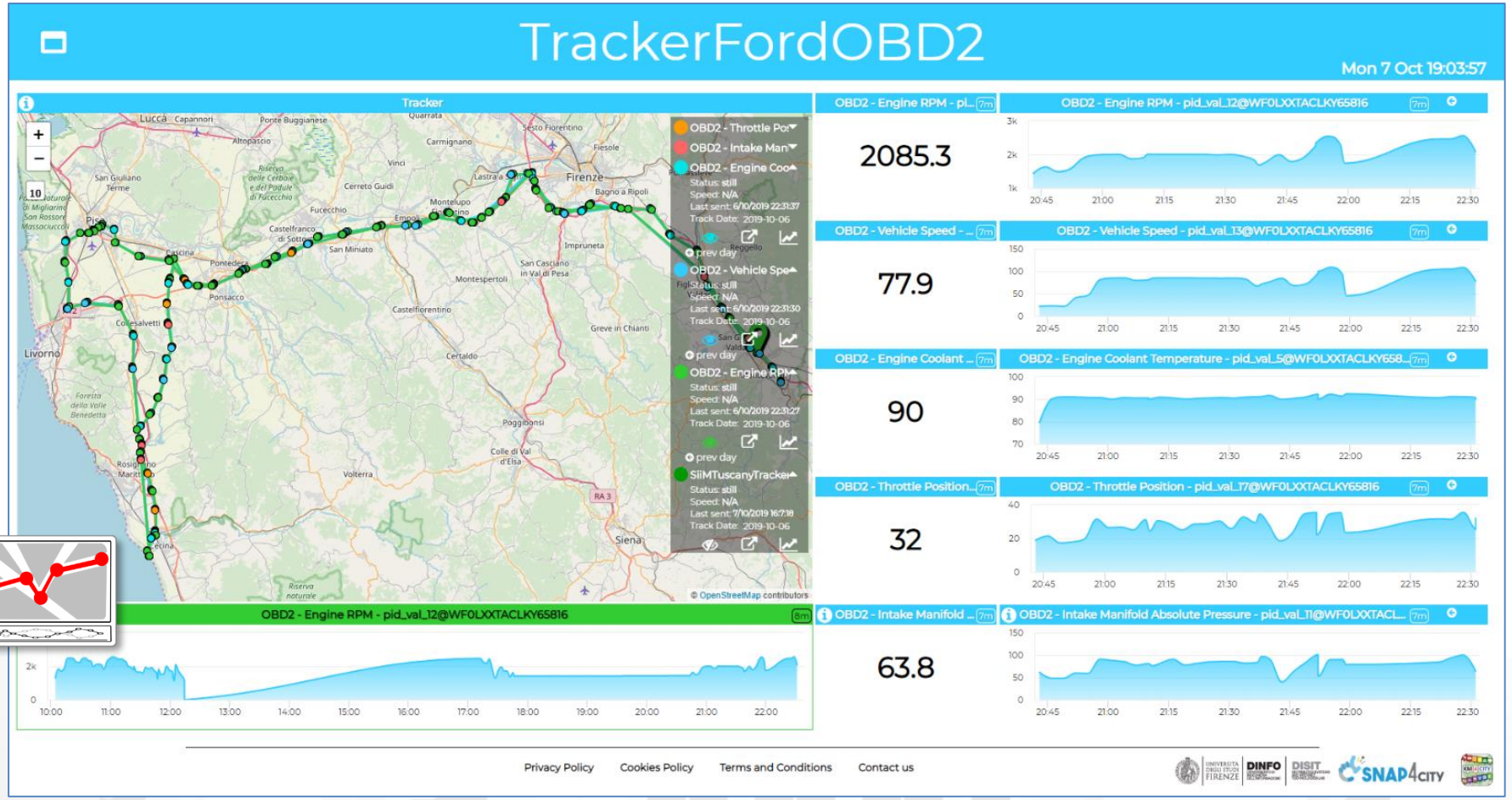
Apps



OBD2



OBU



Real Time Tracking

From mobile app:

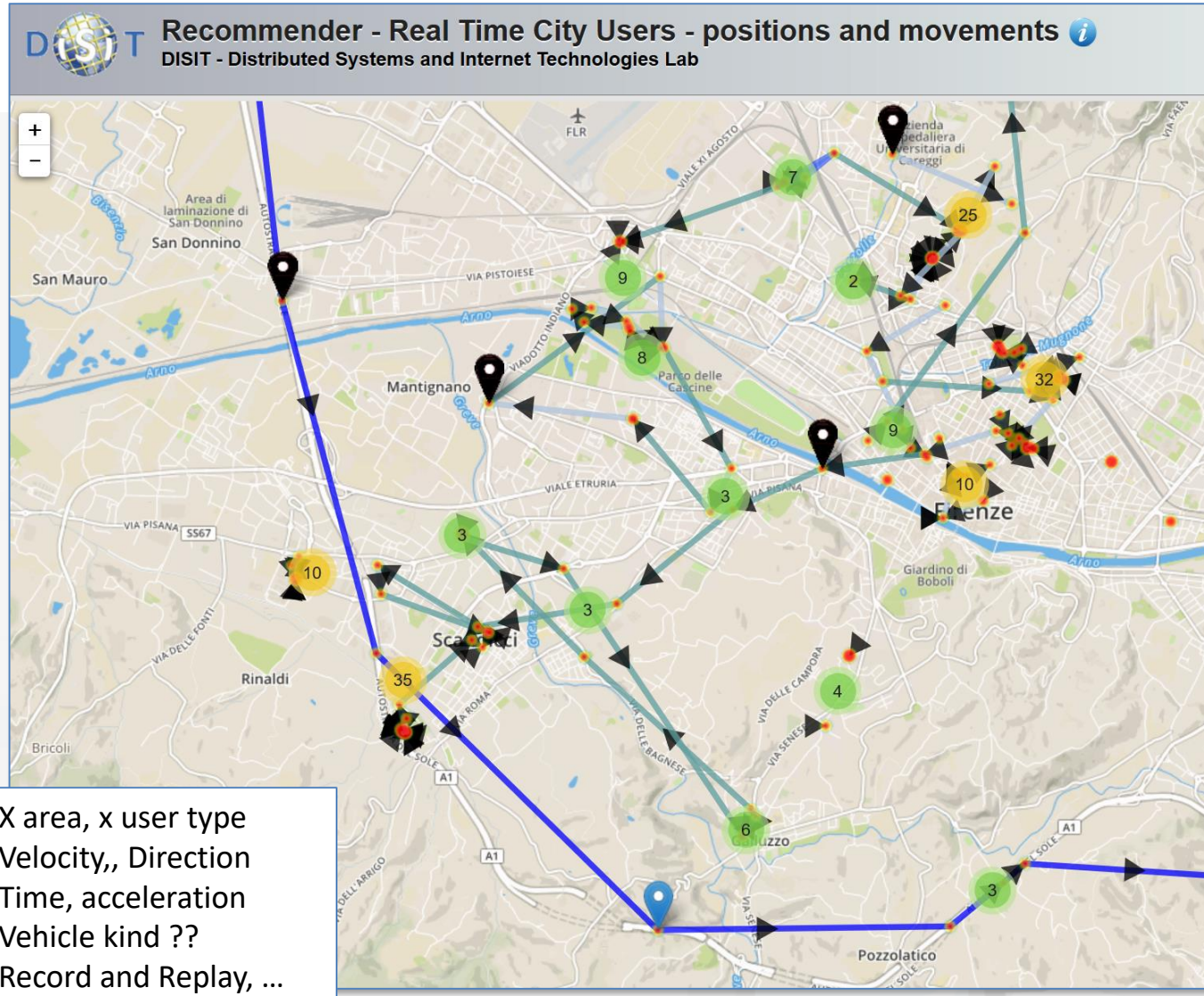
- Resolving GPS location: GPS, cells, wifi-network, … mixt
- Noisy, different kind of devices, …
- Smart algorithm on devices for location acquisition
- Anonymized data, terms of use on mobile

Filtering:

- GPS Accuracy, kind of measure (GPS, mixt)
- Jump in time, space, velocity
- General noise (diff. devices)
- Knowledge of precision map

Clustering:

- time, space, user kind, etc.



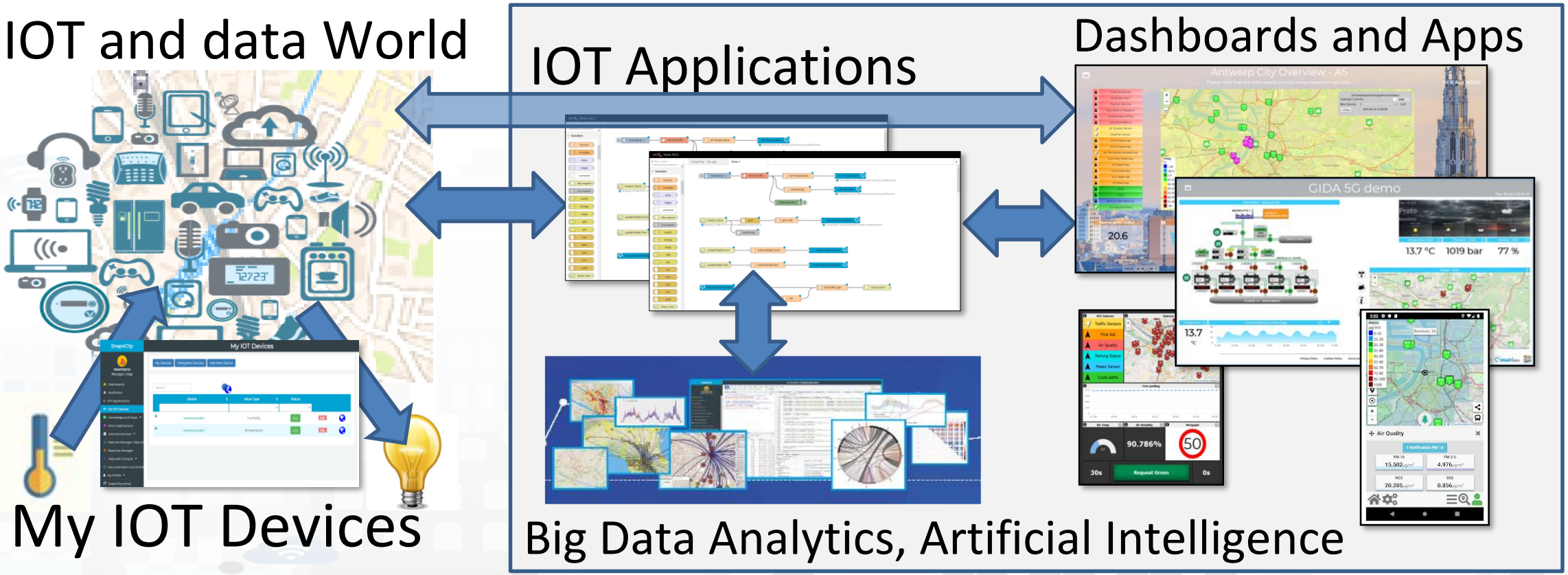
- X area, x user type
- Velocity,, Direction
- Time, acceleration
- Vehicle kind ??
- Record and Replay, …

Dashboards' Intelligence on Web and Mobile Devices



Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

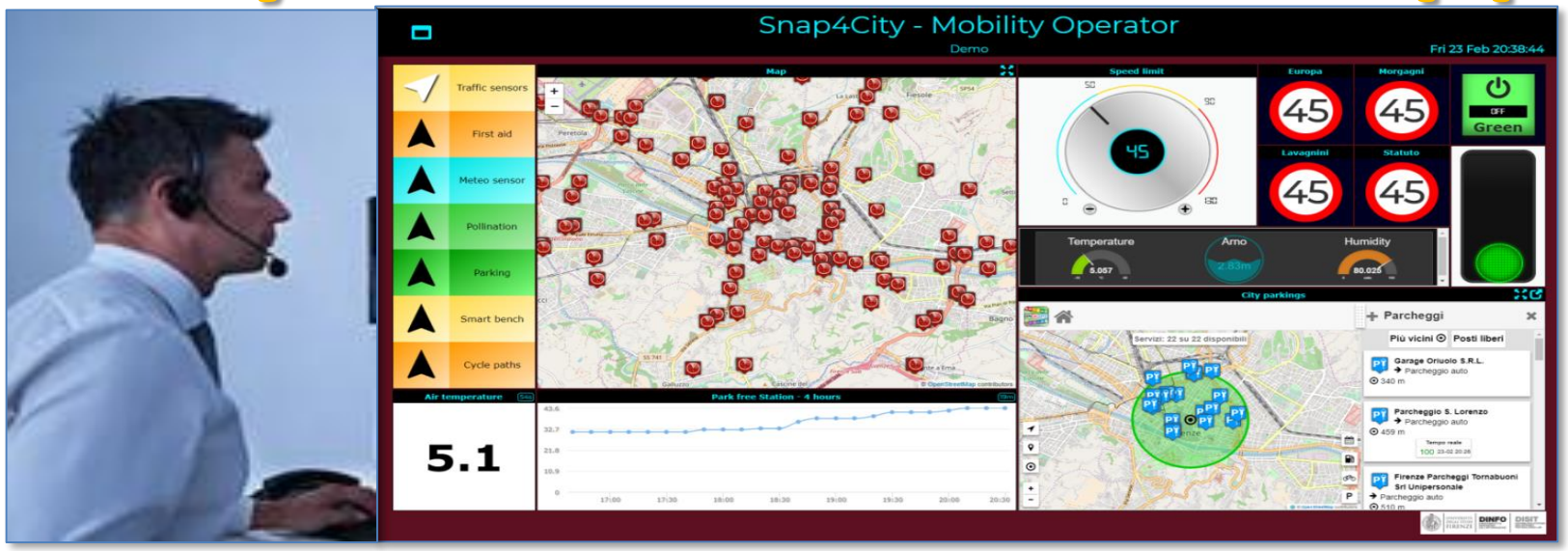


City Dashboard + IOT App

Control Room Operator

Would like to:

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

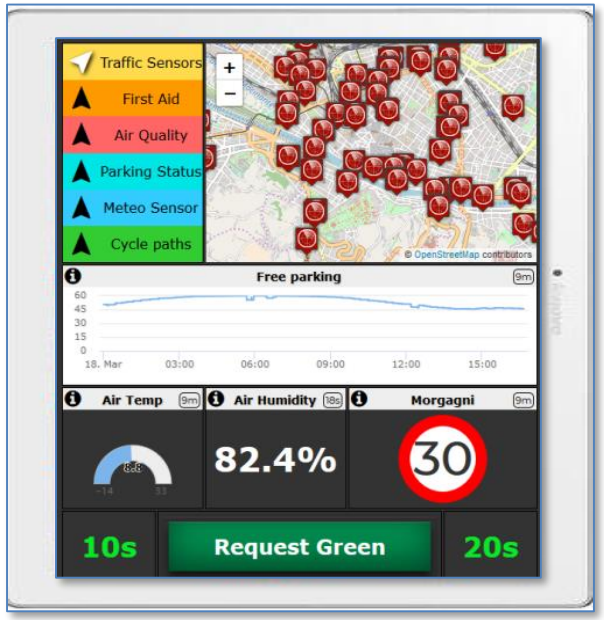


Driver, Policeman

Would like to:

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

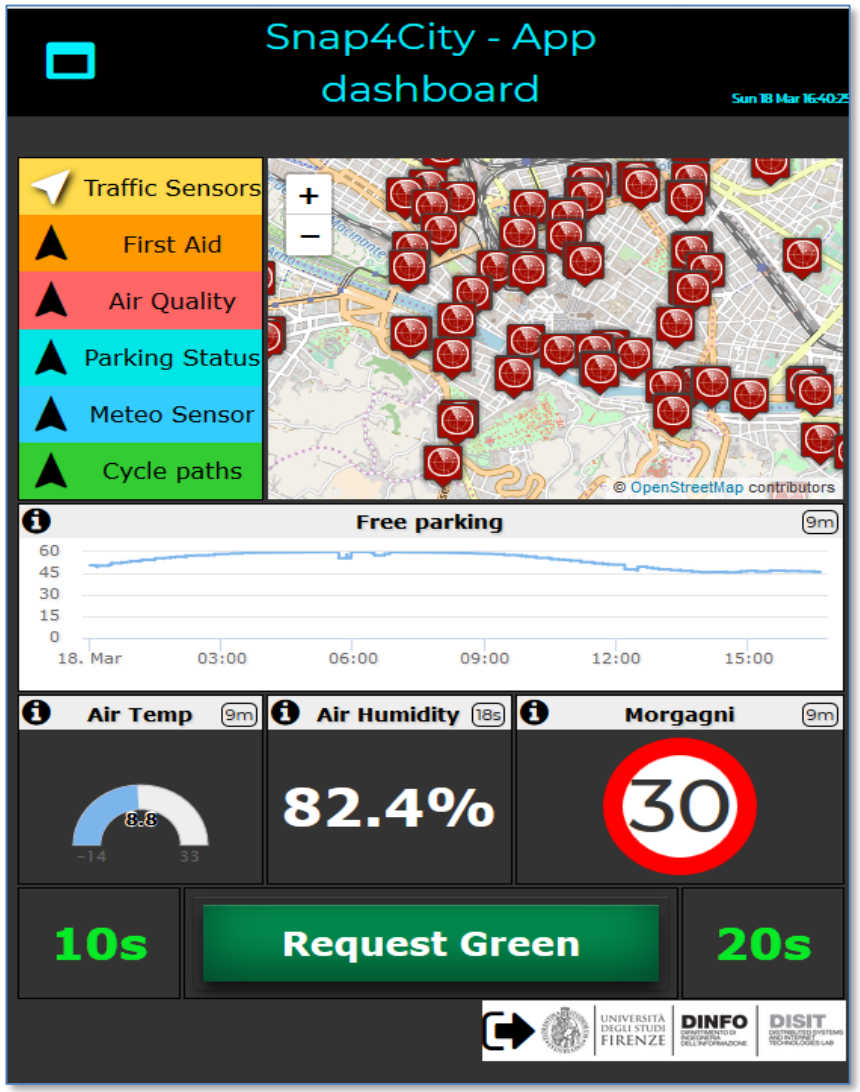


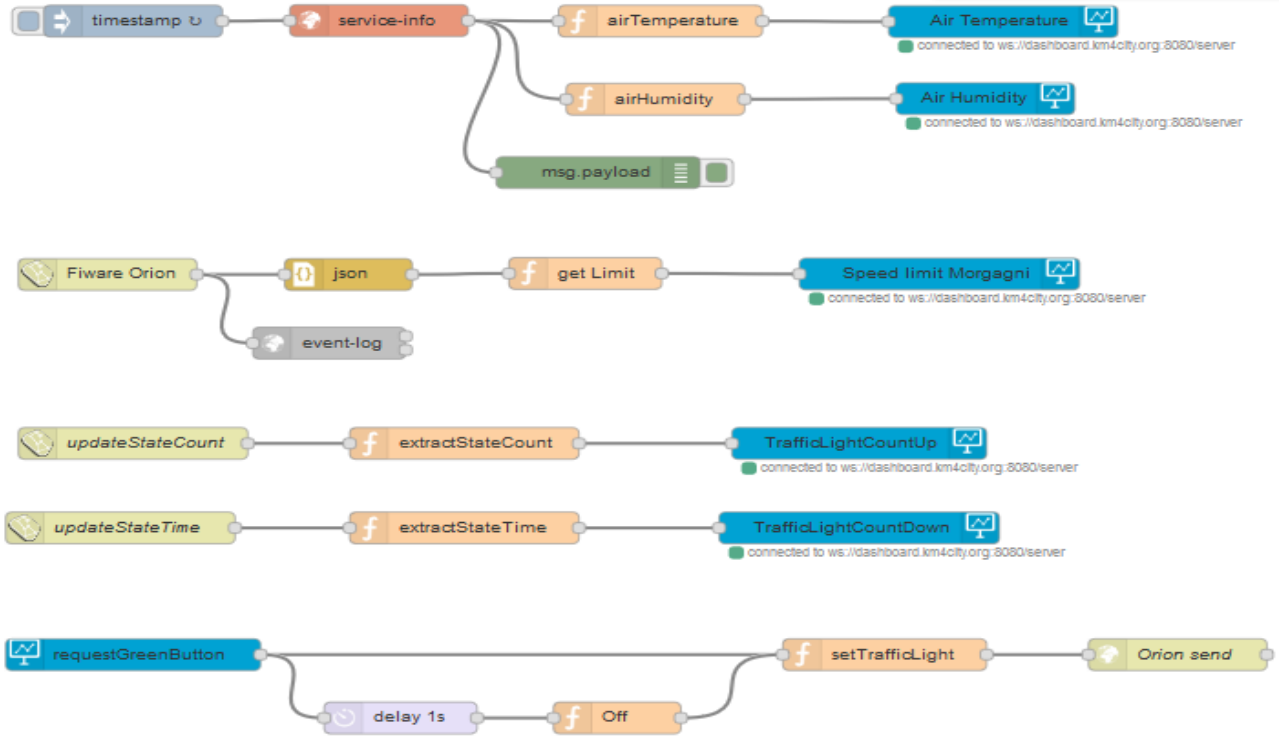



RADIO
MEDIA
TEL
MY CAR
SOUND
AUTO
AC
OK
MENU
TUNE
EXIT

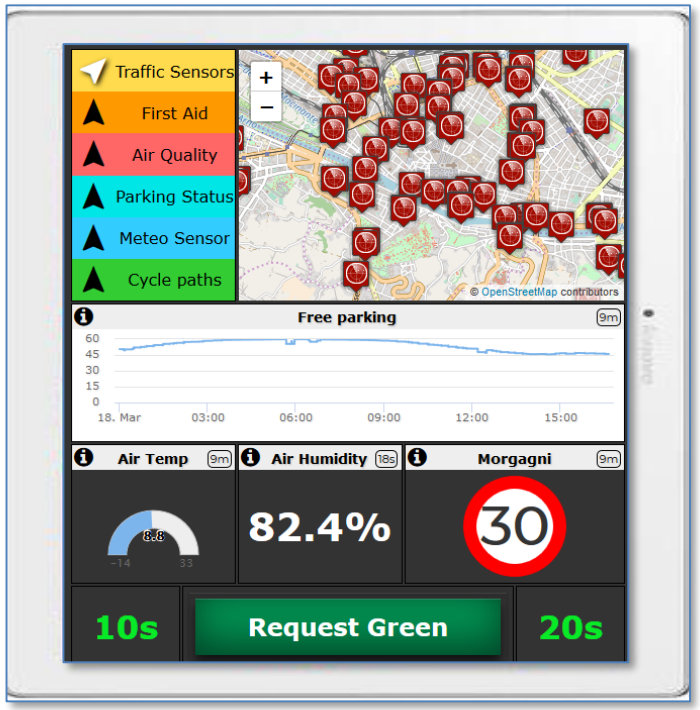
IOT Application with City Dashboard Simple development

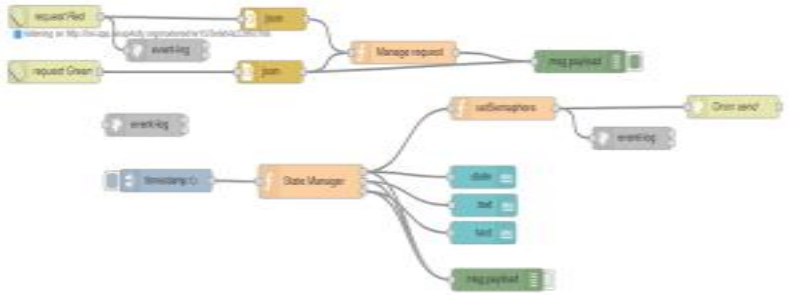






-Virtual Sensors and Virtual Actuators
-From Dashboard to IOT App and viceversa
-From Dashboard to IOT Brokers/Devices and viceversa


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







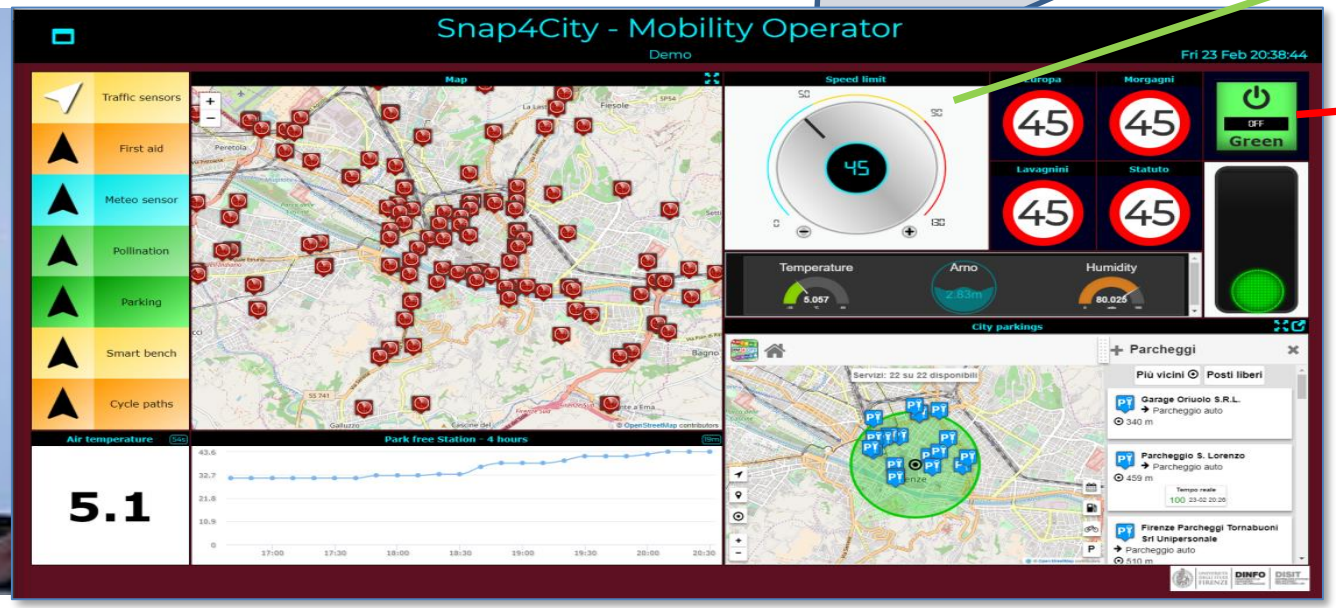


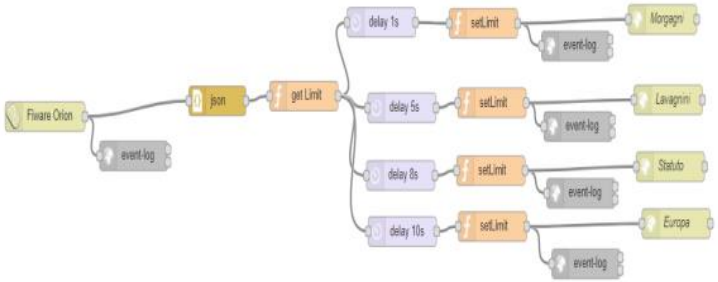









Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
Europa
Morgagni
Lavagnini
Statuto
45
OFF
Green
Temperature
Arno
Humidity
5.057
80.025
City parkings
Parcheggi
Più vicini
Posti liberi
Garage Oriuolo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


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

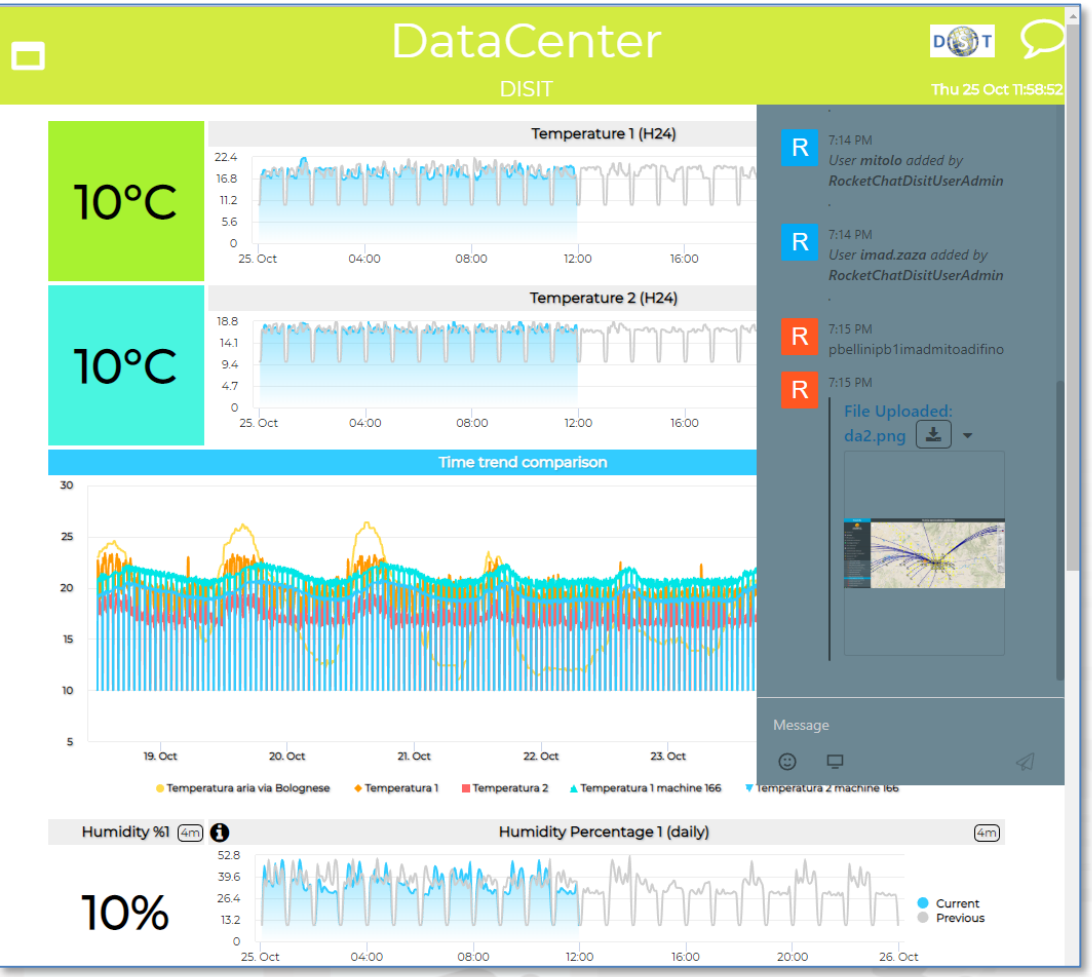
IOT Applications vs Dashboards

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

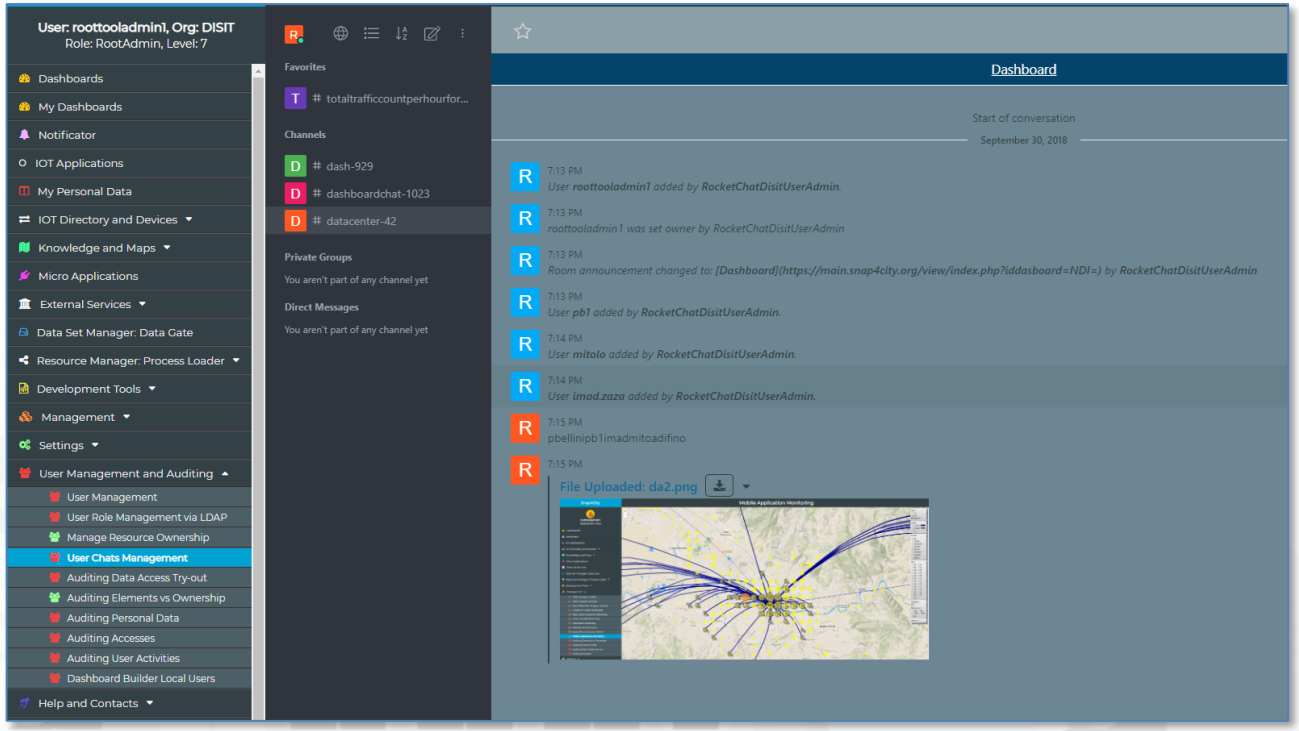
Dashboard Chatroom and Notifications



ChatRoom Per Dashboard

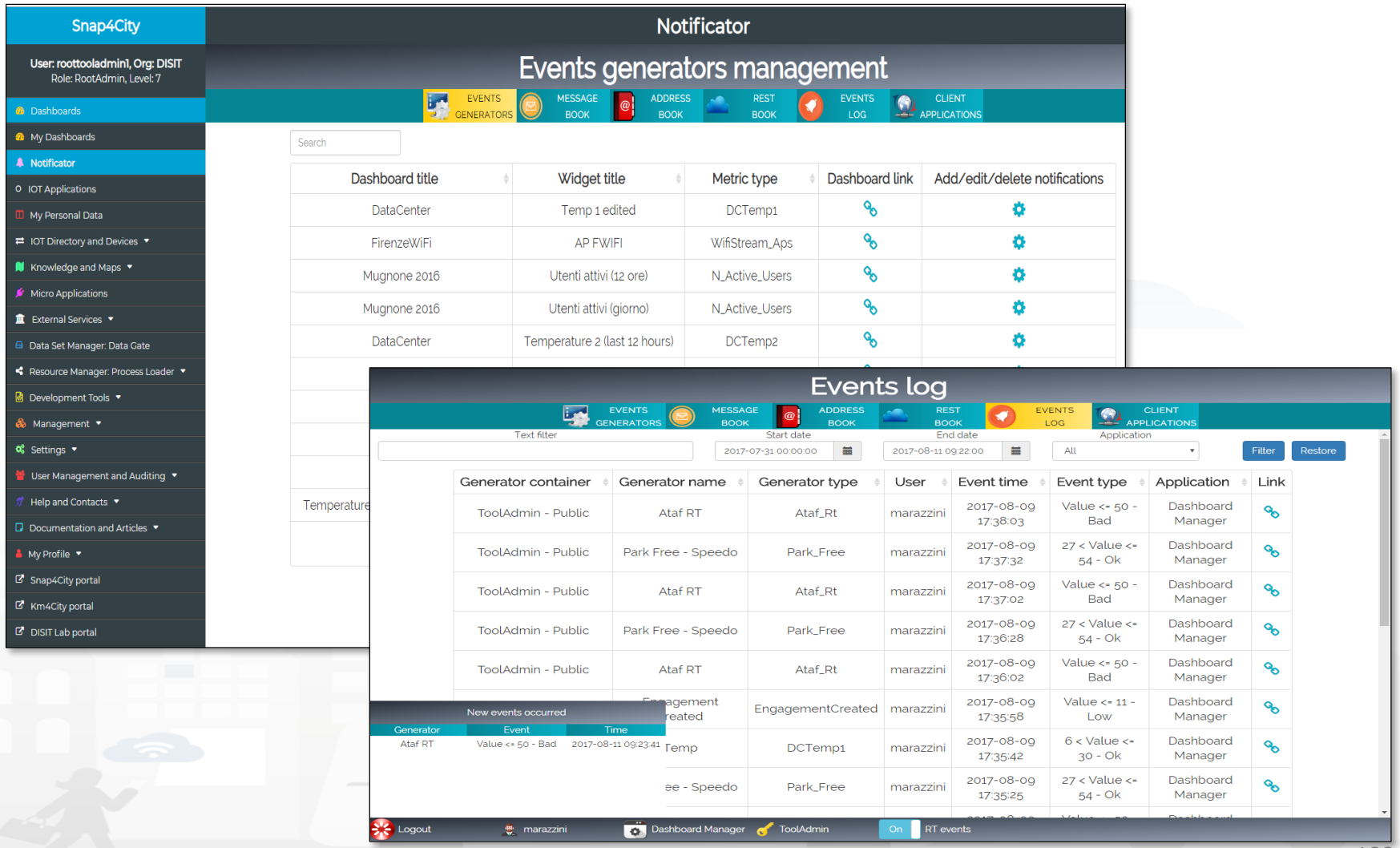


Chat Management



Smart City Monitoring: Notificator

- Notifications may arrive via Facebook, Telegram, SMS, email, etc., by exploiting IOT App behind the dashboard
- Integration with workflow management system for ticketing



Smart City Control Room





REPLICATE

We expect you at Stand 120, Hall P2 , Level 0, Street A
Smart City Expo World Congress 2018
13-15 Novembre 2018, Barcelona, Gran Via Venue

SMARTCITY EXPO WORLD CONGRESS

http://www.darionardella.it/il-sindaco-dario-nardella-in-missione-a-madrid-e-barcellona/

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

SNAP4CITY | KM4CITY

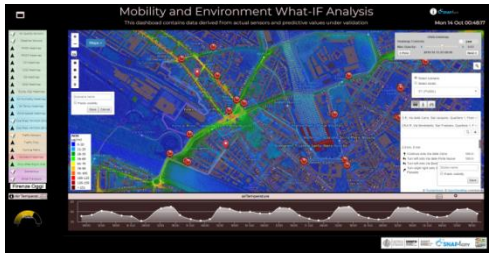
Smart City Control Room

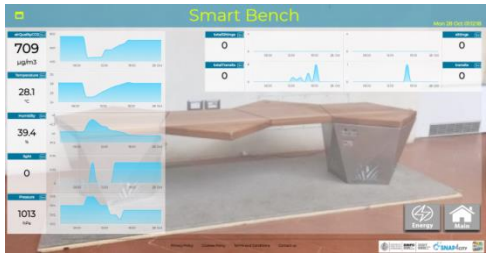
a set of dashboards and tools

FIRENZE CITTÀ FARO

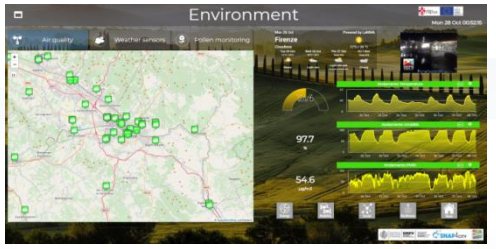
REPLICATE



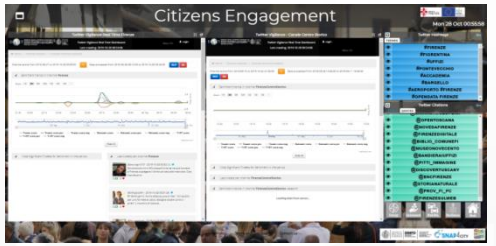


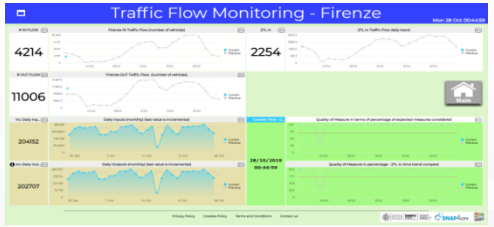








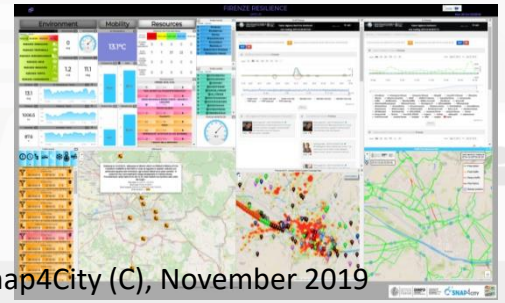


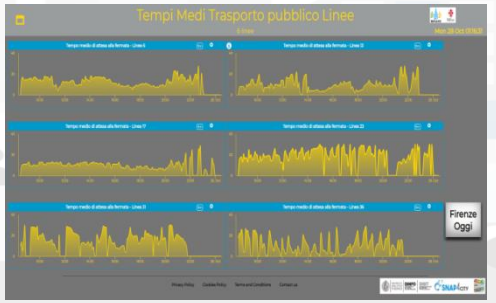






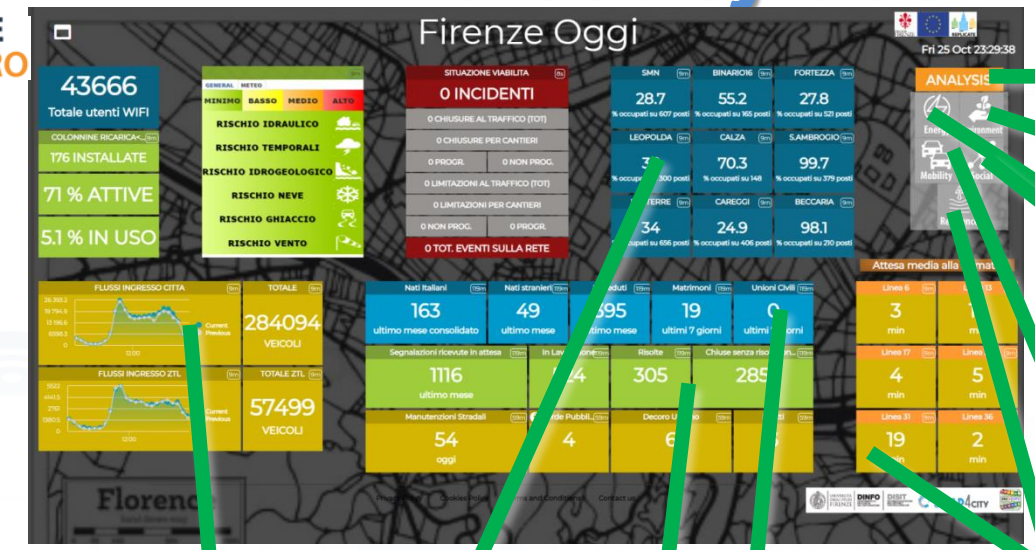




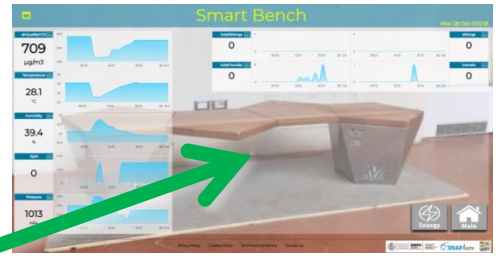


Smart City Control Room

a set of dashboards and tools



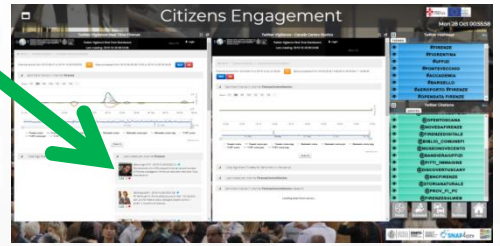


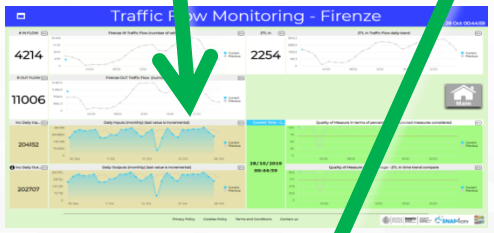








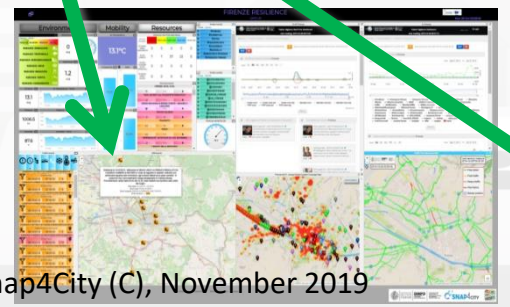


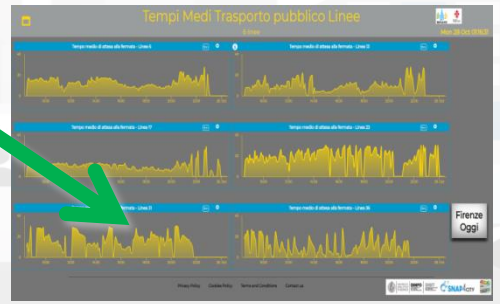




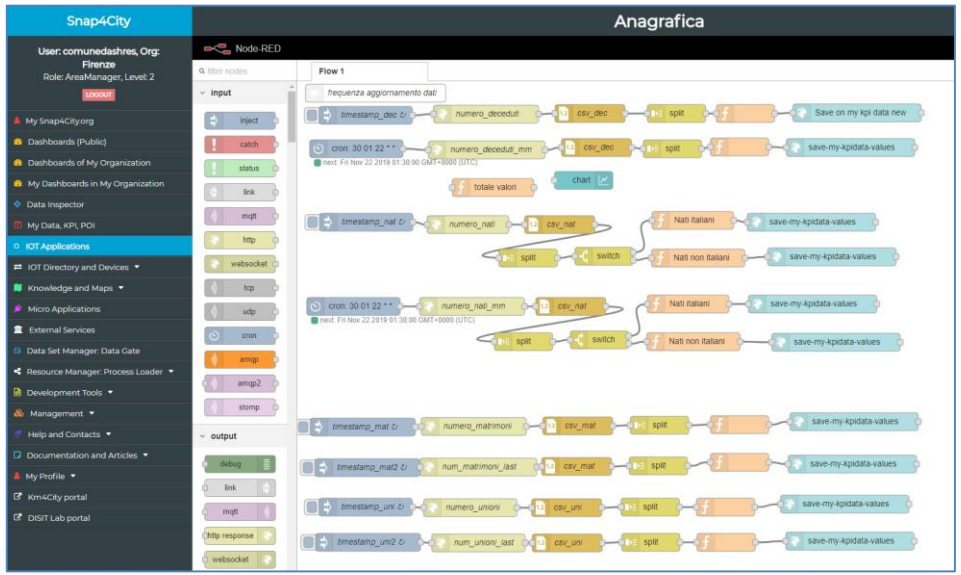


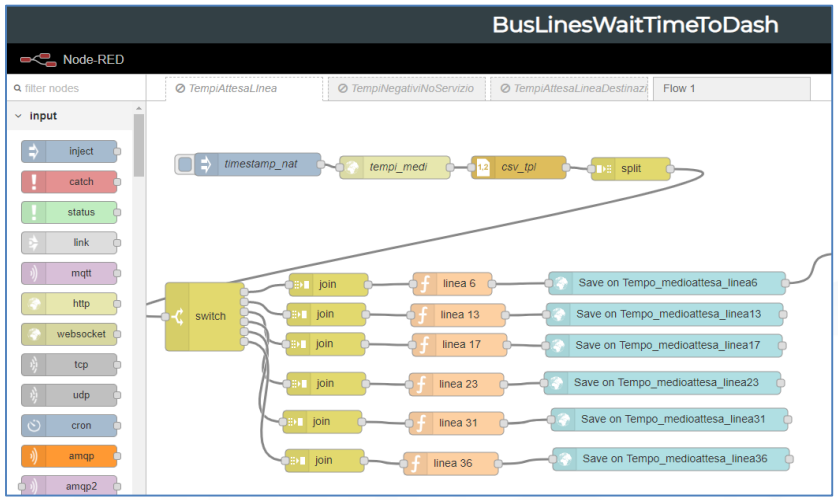


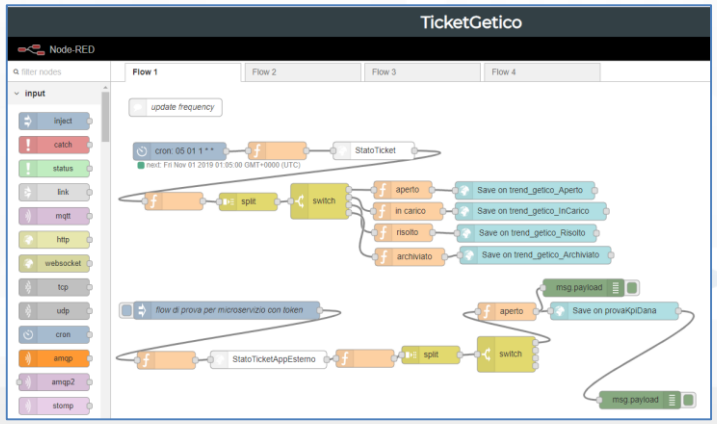


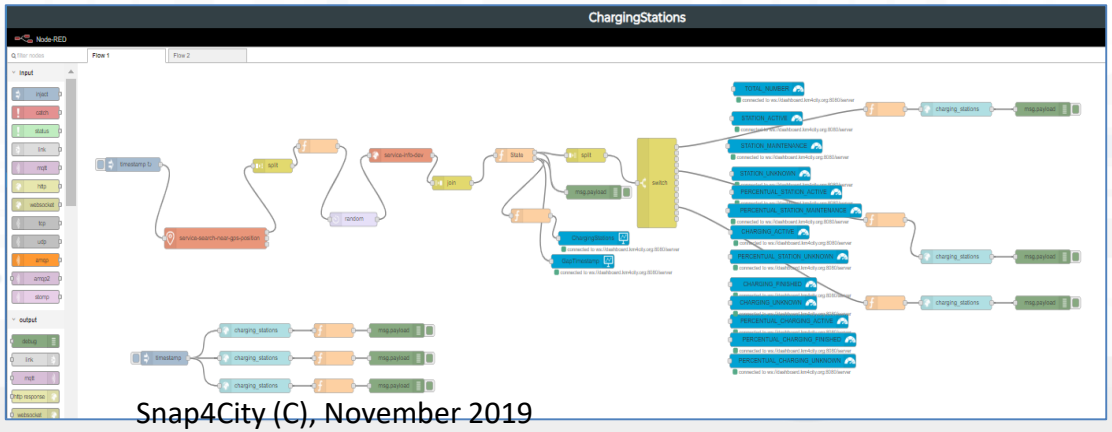


The Back-Office Data Flows (selection) Exploiting *the Snap4City Node-RED MicroServices*










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



https://www.snap4city.org/511

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

KM4CITY





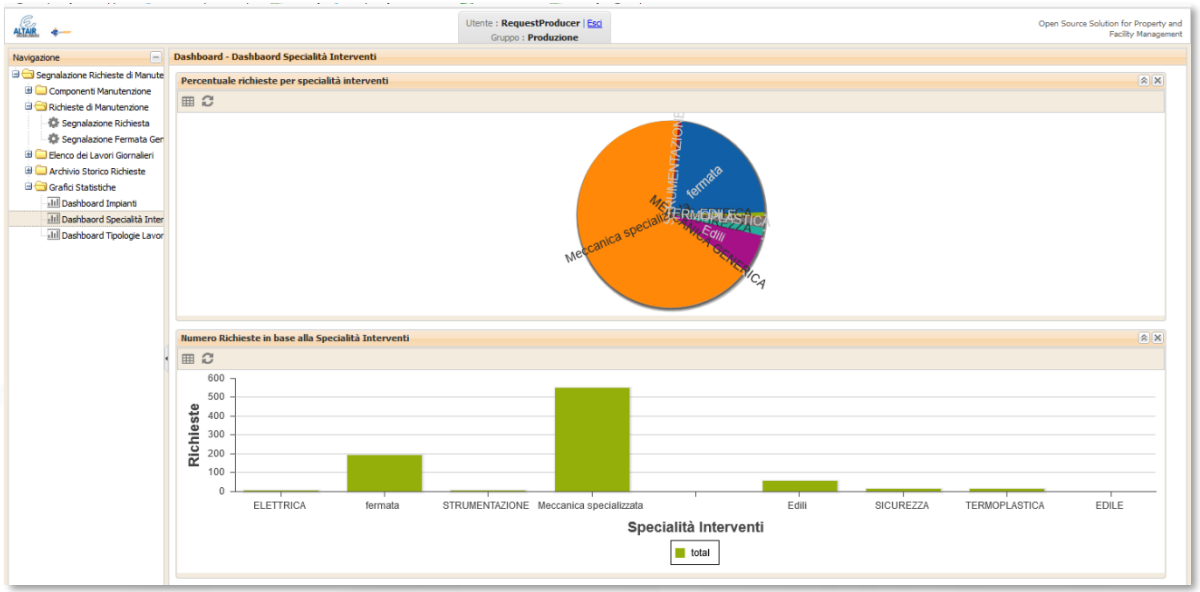


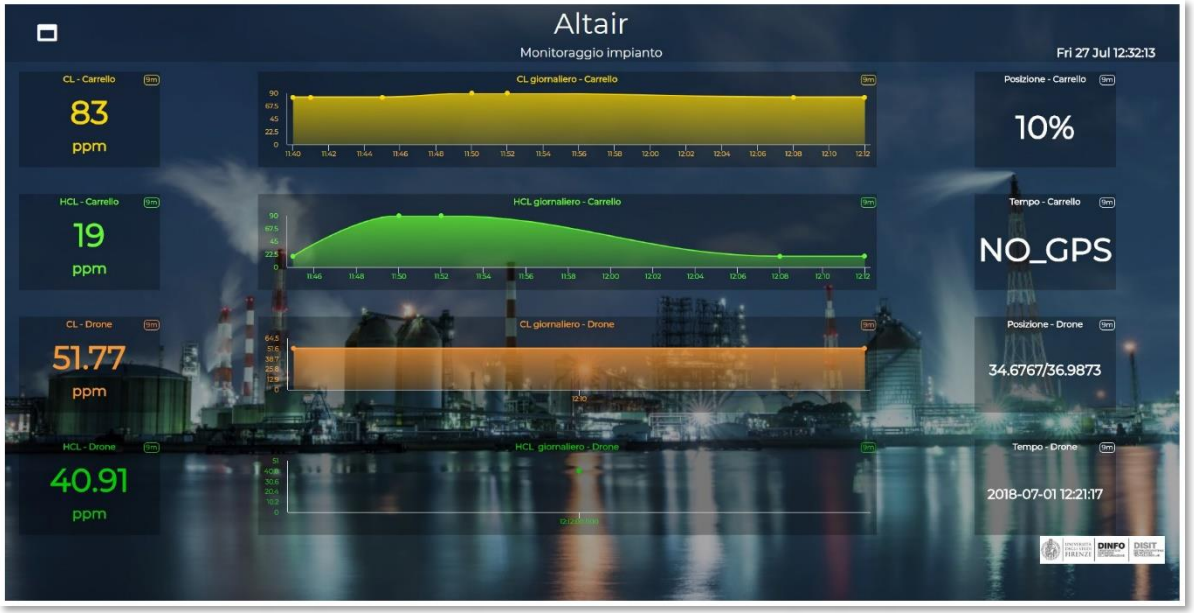
Chemical Plant Dashboard Green Impact Capacity (GIC)

Altair Control room

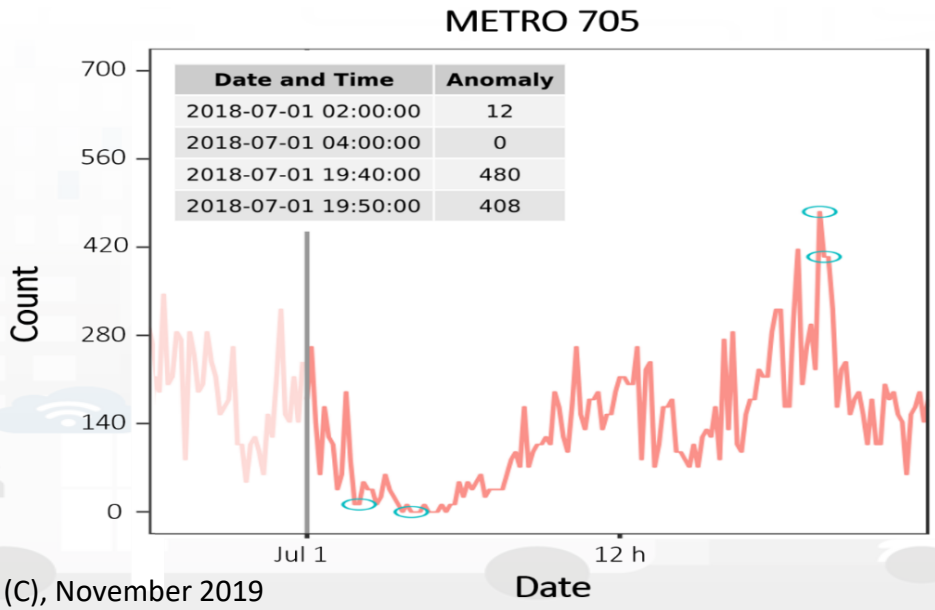


Reports and Dashboards

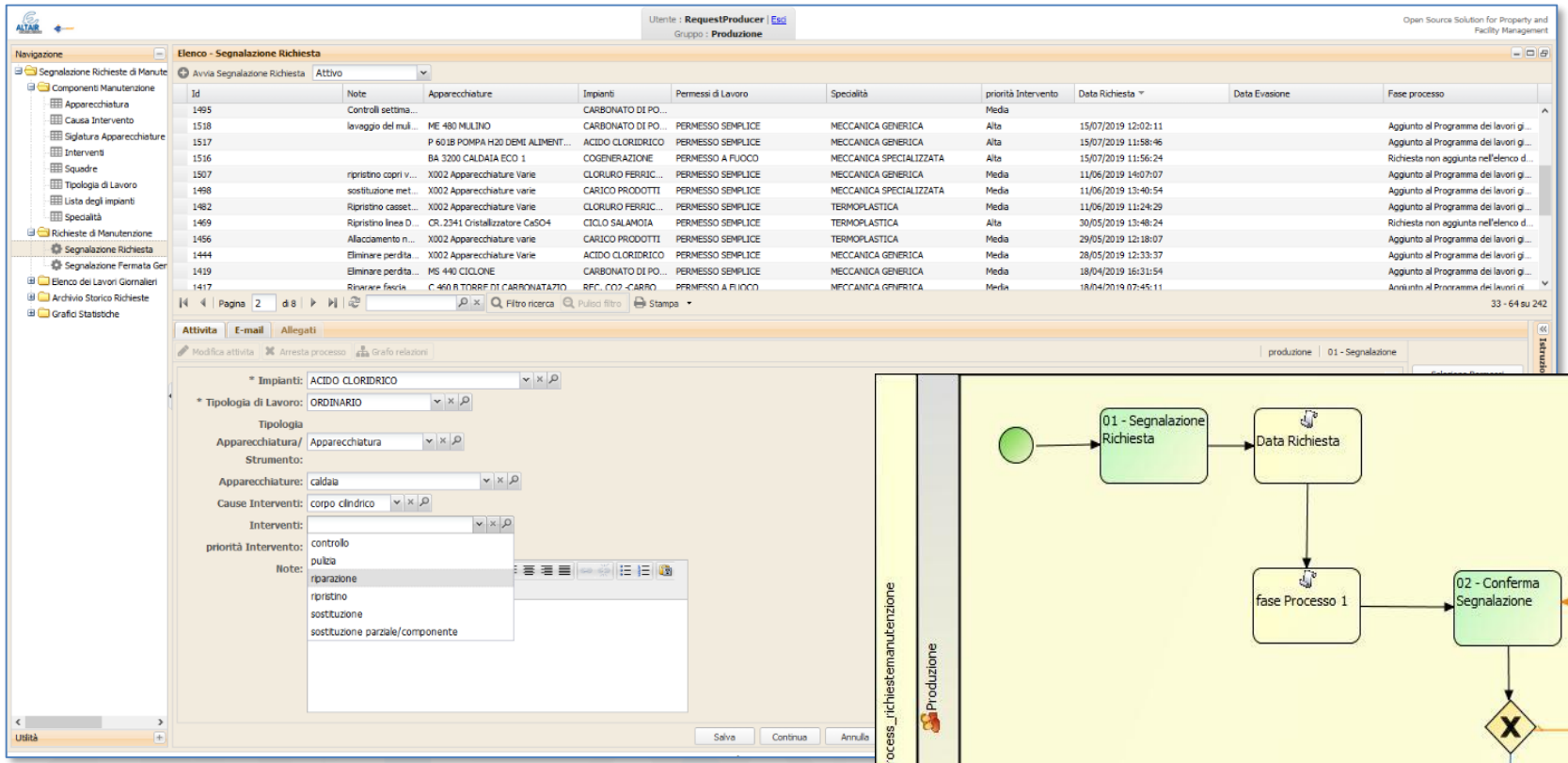




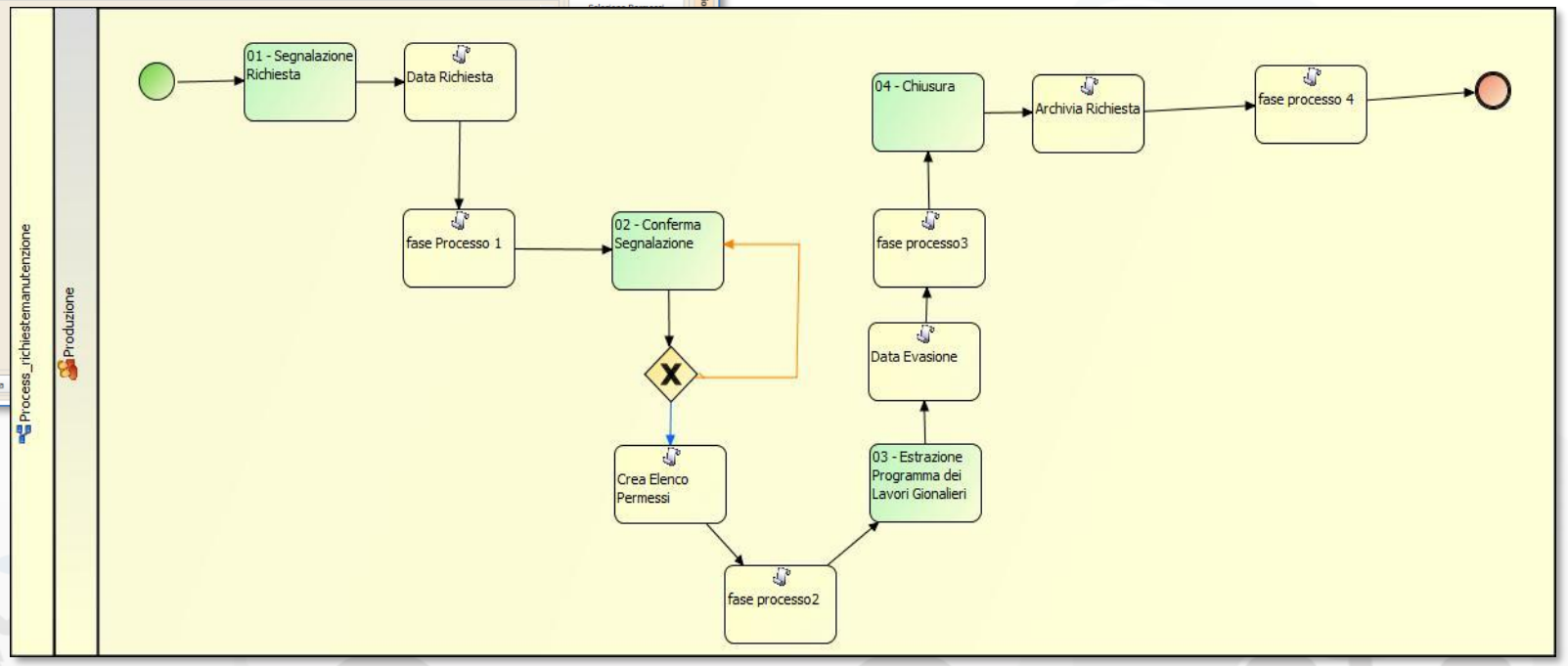
Anomaly detection Early Warning



Critical Events: ticket management



Personalised Workflows



Dashboards Production



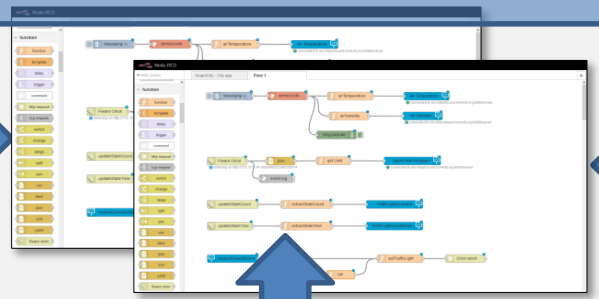
Snap4City: Builder of Sentient Cities Solutions

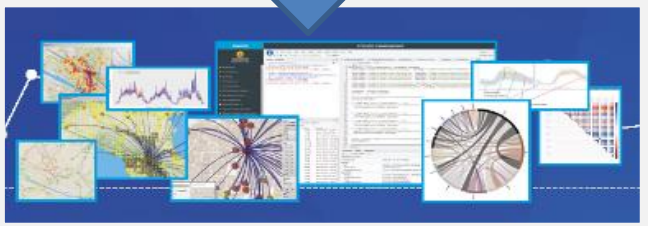
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

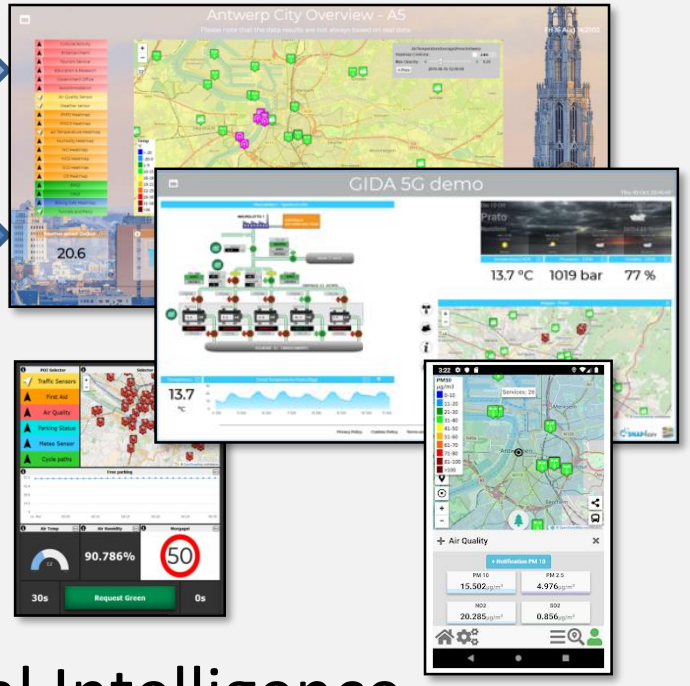


IOT Applications



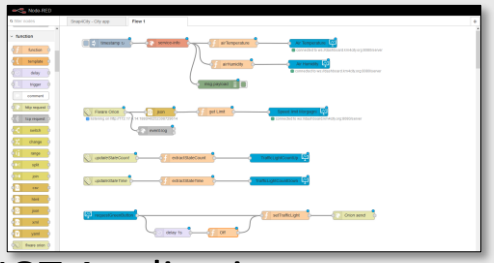


Dashboards and Apps



Big Data Analytics, Artificial Intelligence

Dashboard Development



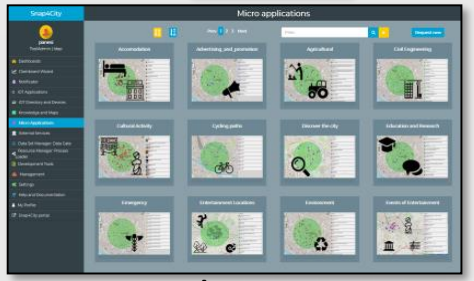
IOT Applications



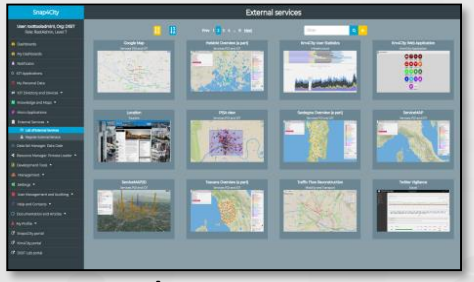
Knowledge and Storage
Data from the Field and City

Widget Collection



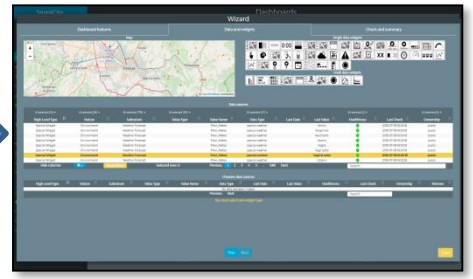


MicroApplications



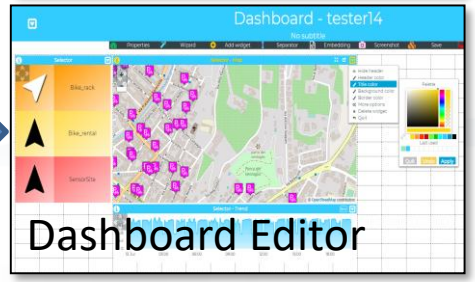
External Services

Dashboard Wizard



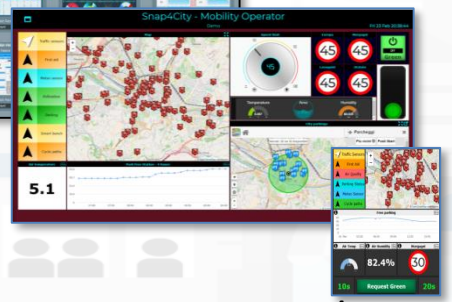
Create, save, load, delegate, grant access





Dashboard Editor



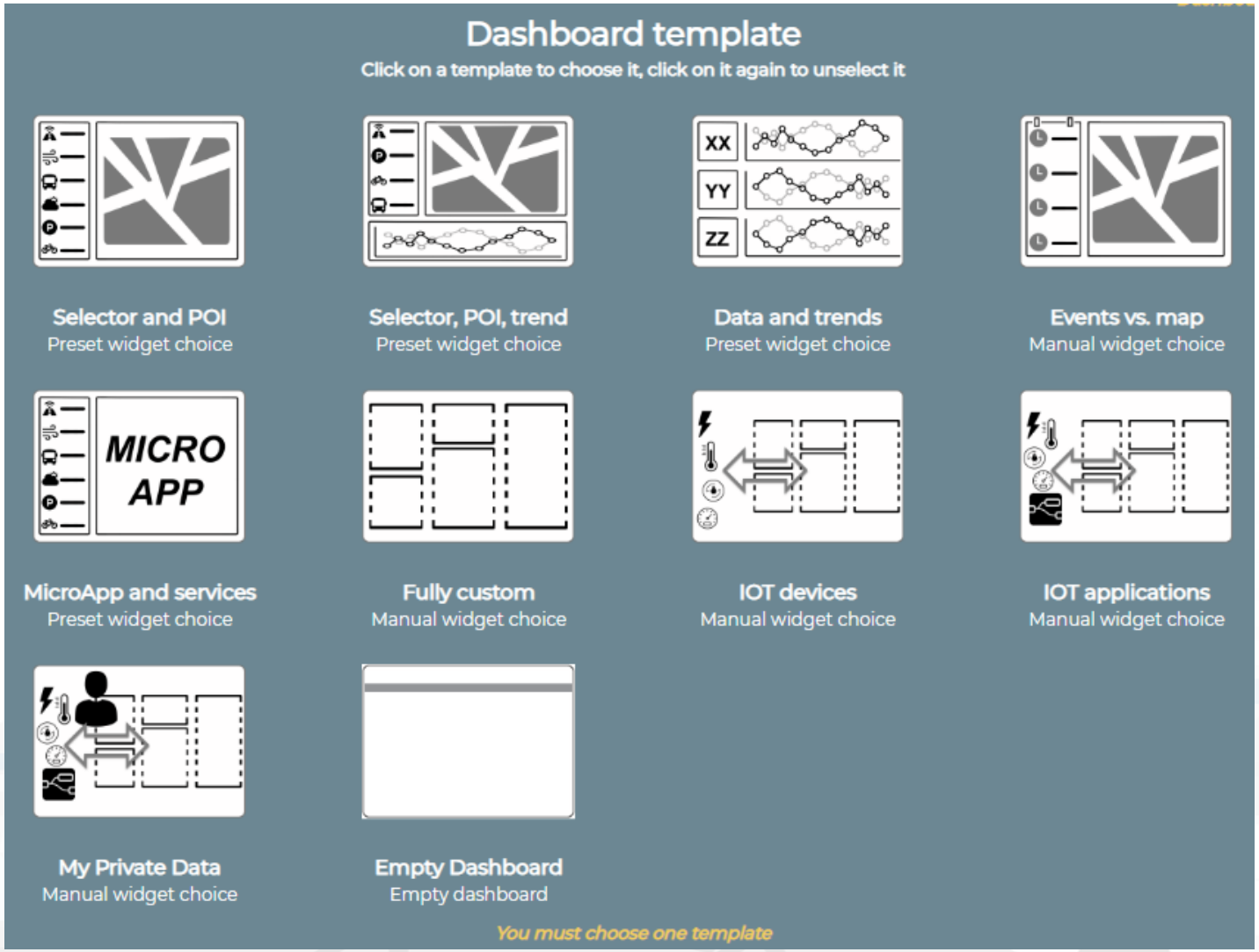


Public Dashboard Collection

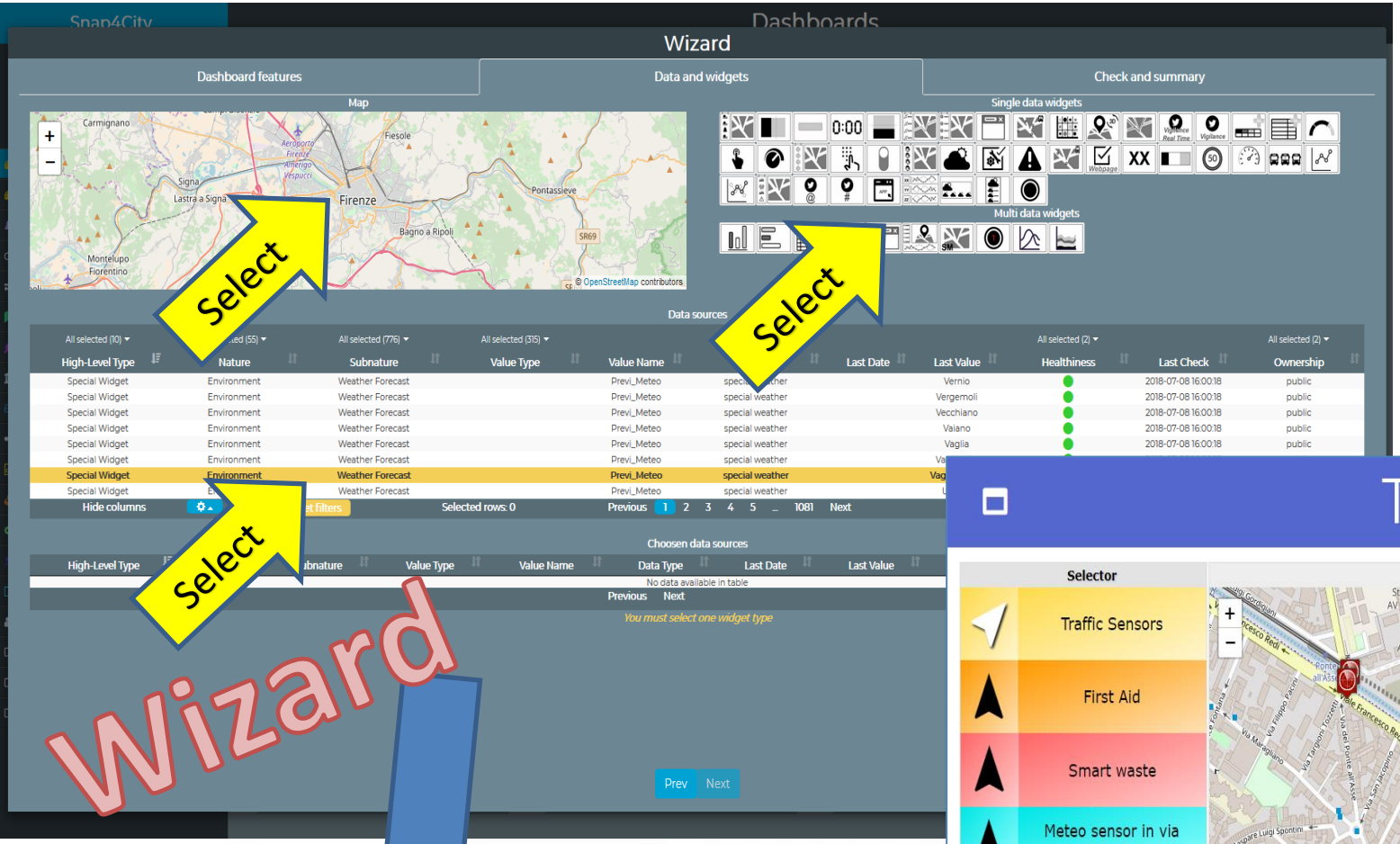


My Own Dash/App

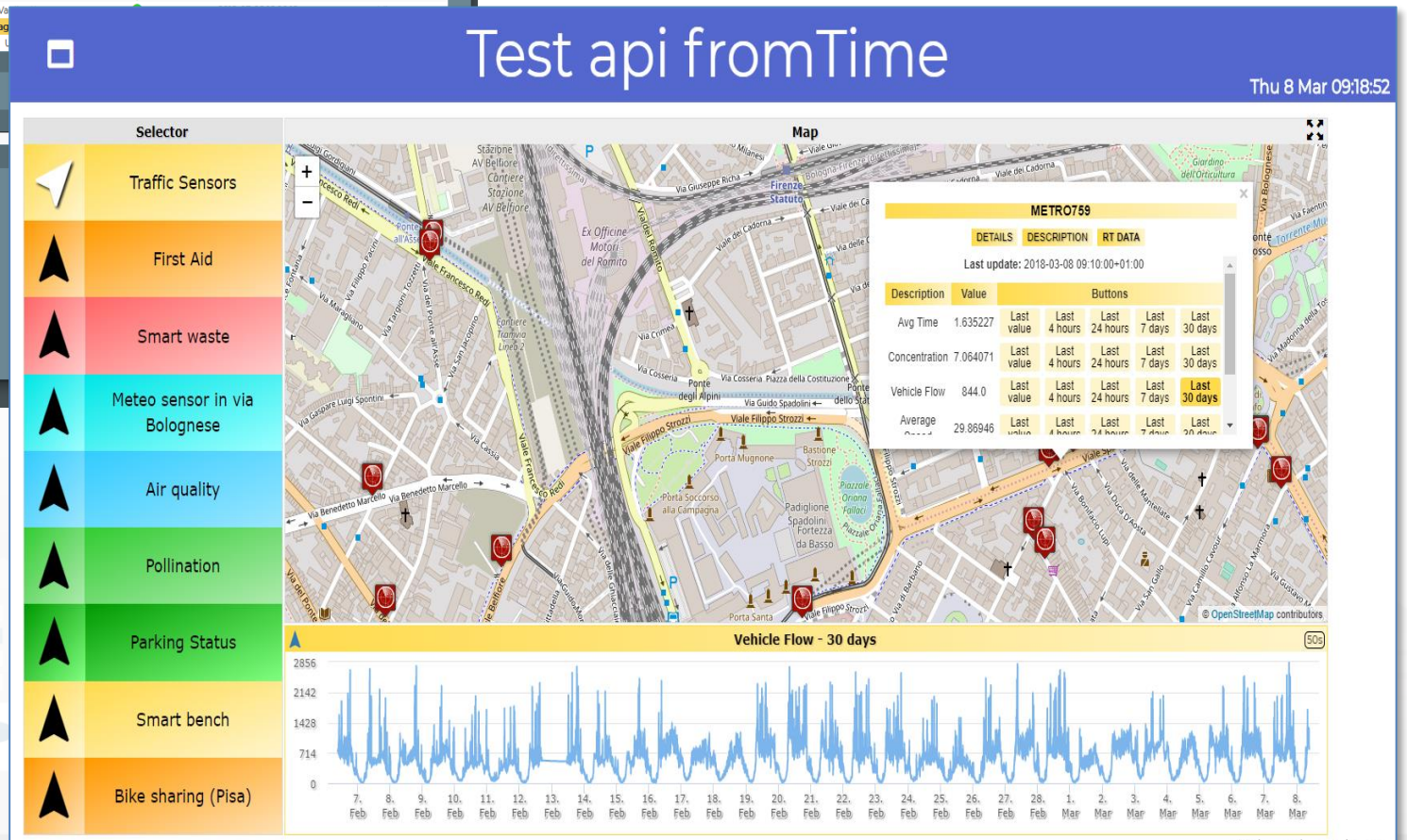
From Templates to Wizard and Dashboards



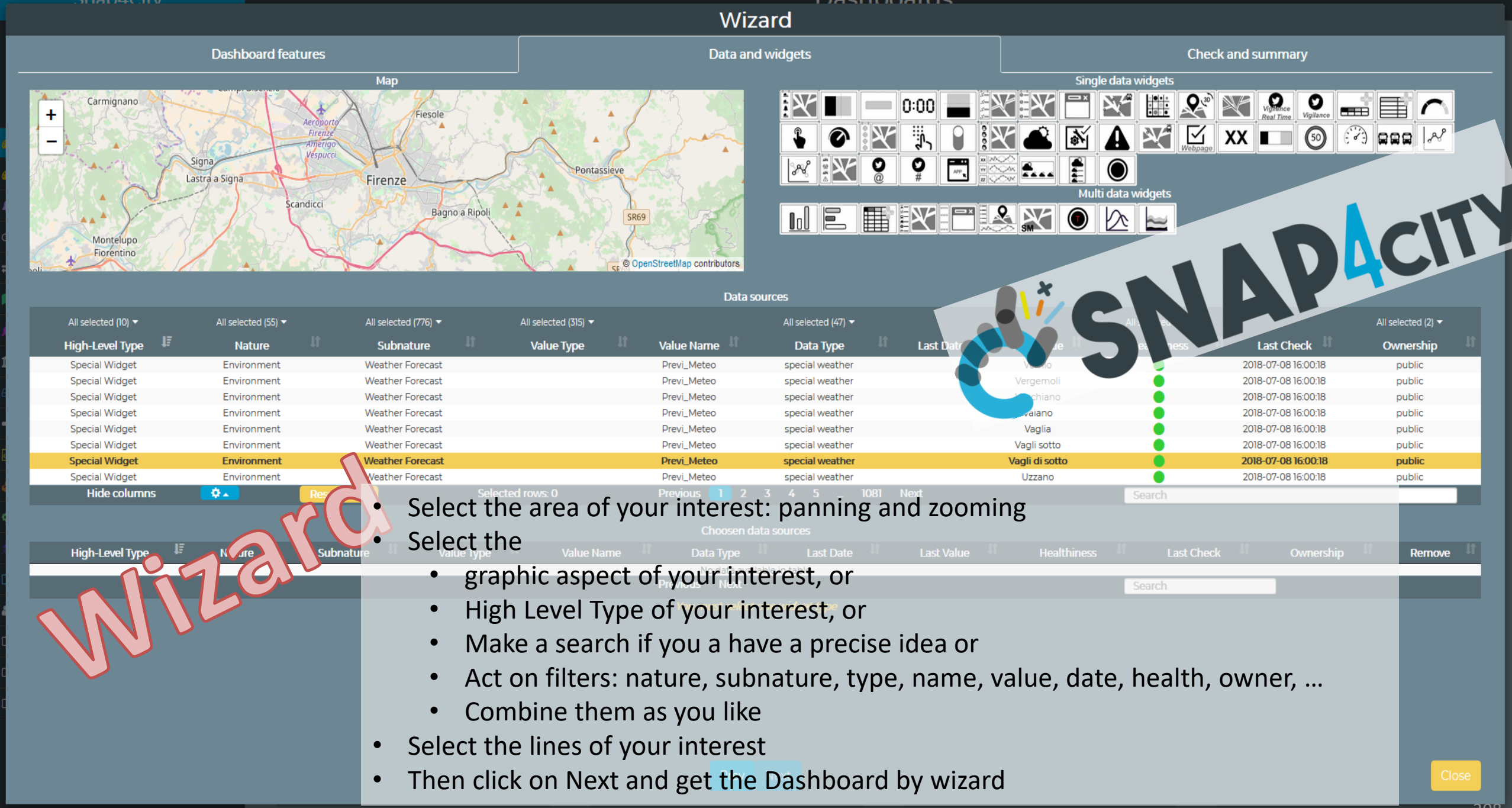
- to create a new Dashboard
- to add widgets and/or groups of them on any Dashboard



Dashboard Wizard



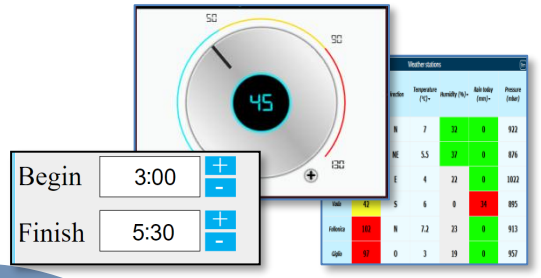
The Wizard help you in selecting only possible combination of data vs graphic representation



- 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



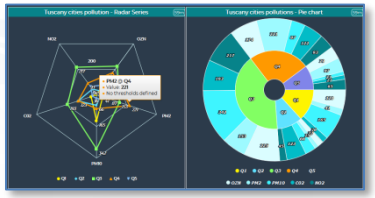


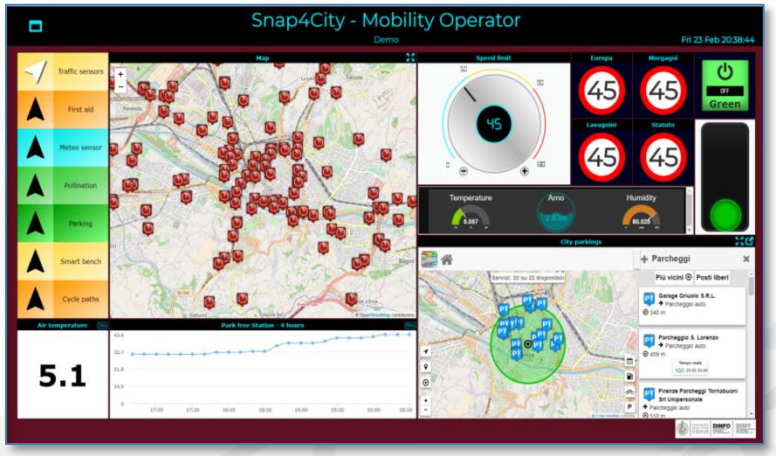




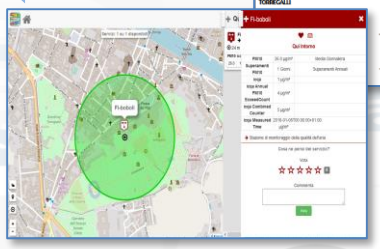




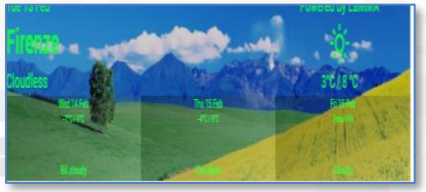


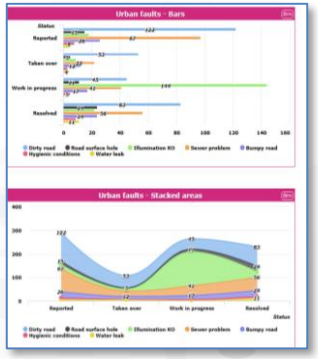












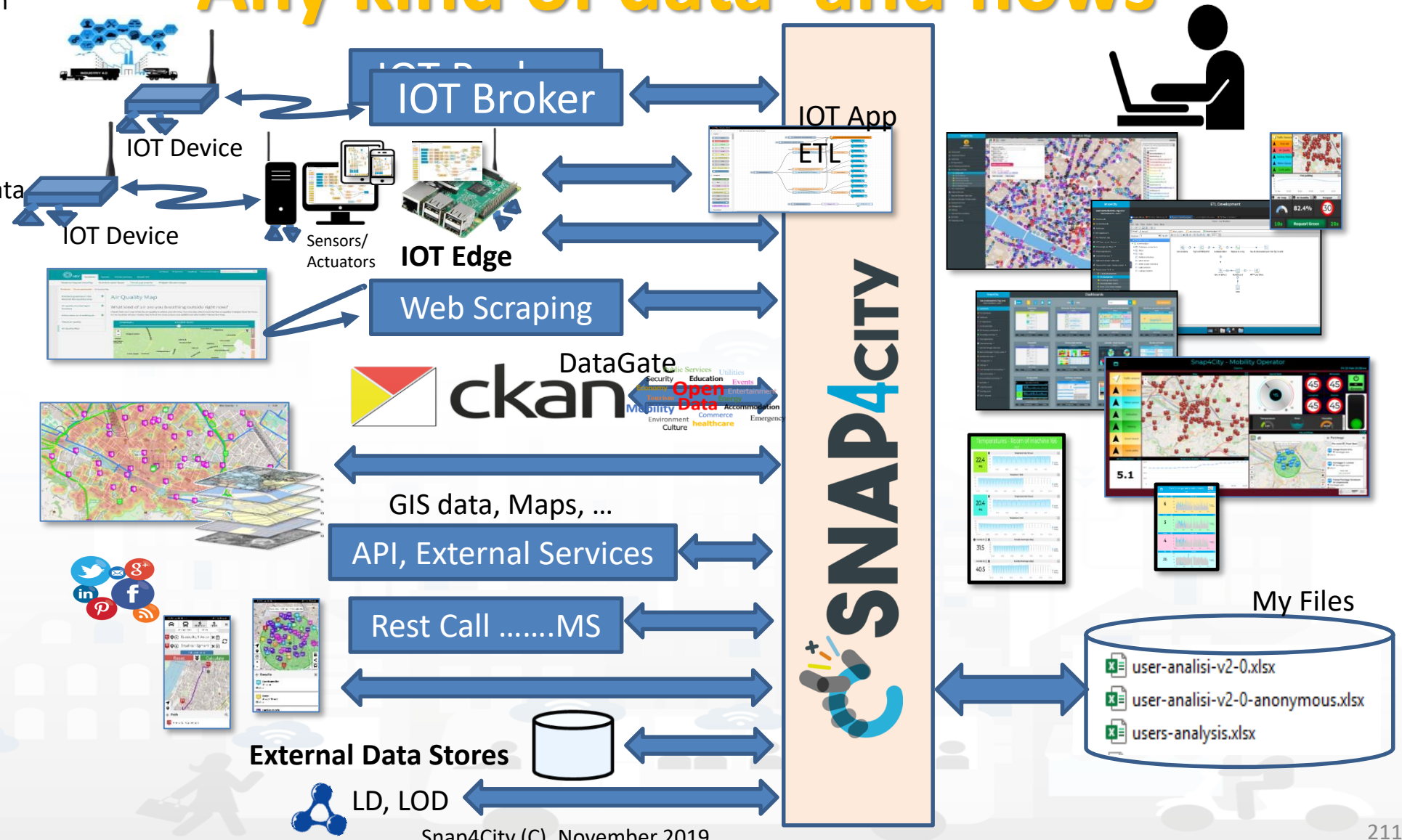
TOP

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT



Any kind of data and flows

- **Open Data:**
  - Data gate, federation of Open Data Portals
  - ETL processes (PULL)
  - IOT Application processes
- **IOT Networks:**
  - IOT Application processes, data driven or PULL
  - IOT Brokers (Push) → IOT Shadow
- **Web Pages:**
  - Web scraping, crawling processes
- **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



Smart City Functional Architecture

Transport systems Mobility, parking



Public Services, Govern, events, …



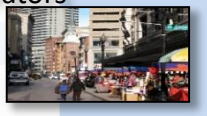
Sensors, IOT Cameras, Wi-Fi



Environment, Water, energy



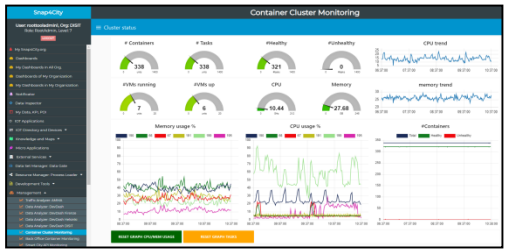
Shops, services, operators

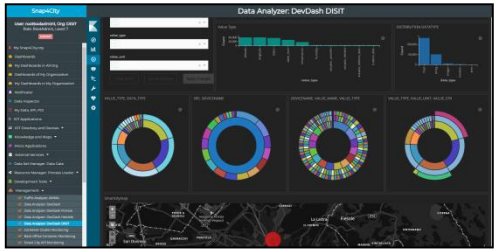


Social Media

Social Media Crawler and Manager







Data Sources PULL Data

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

Data Ingestion, aggregation, regularization, reconcile

ETL, NIFI, DISCES

Big Data Cluster
HDFS, Hbase, Phoenix

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search

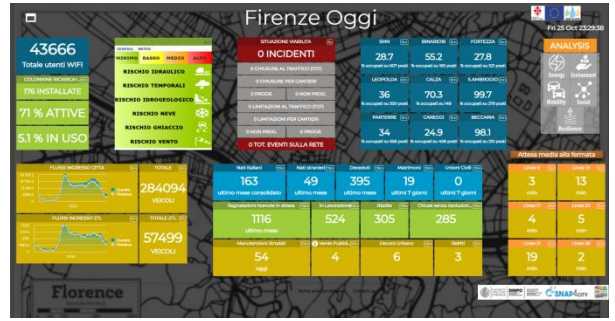
Data Analytics
R, Tensor Flow, Python, MapReduce, …

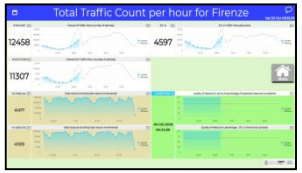
IOT Applications
Node-RED + Snap4City MicroSrvs

Search and Query, Smart City API
Facet, semantic search

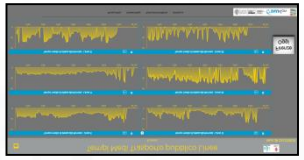
Visual Analytics
Special dash/ tools

Rendering Acting, Widgets, MicroApps
User interface, Interactive Dashboard, Drill down, maps, heatmaps



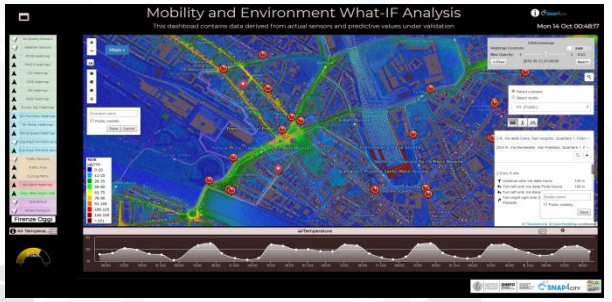






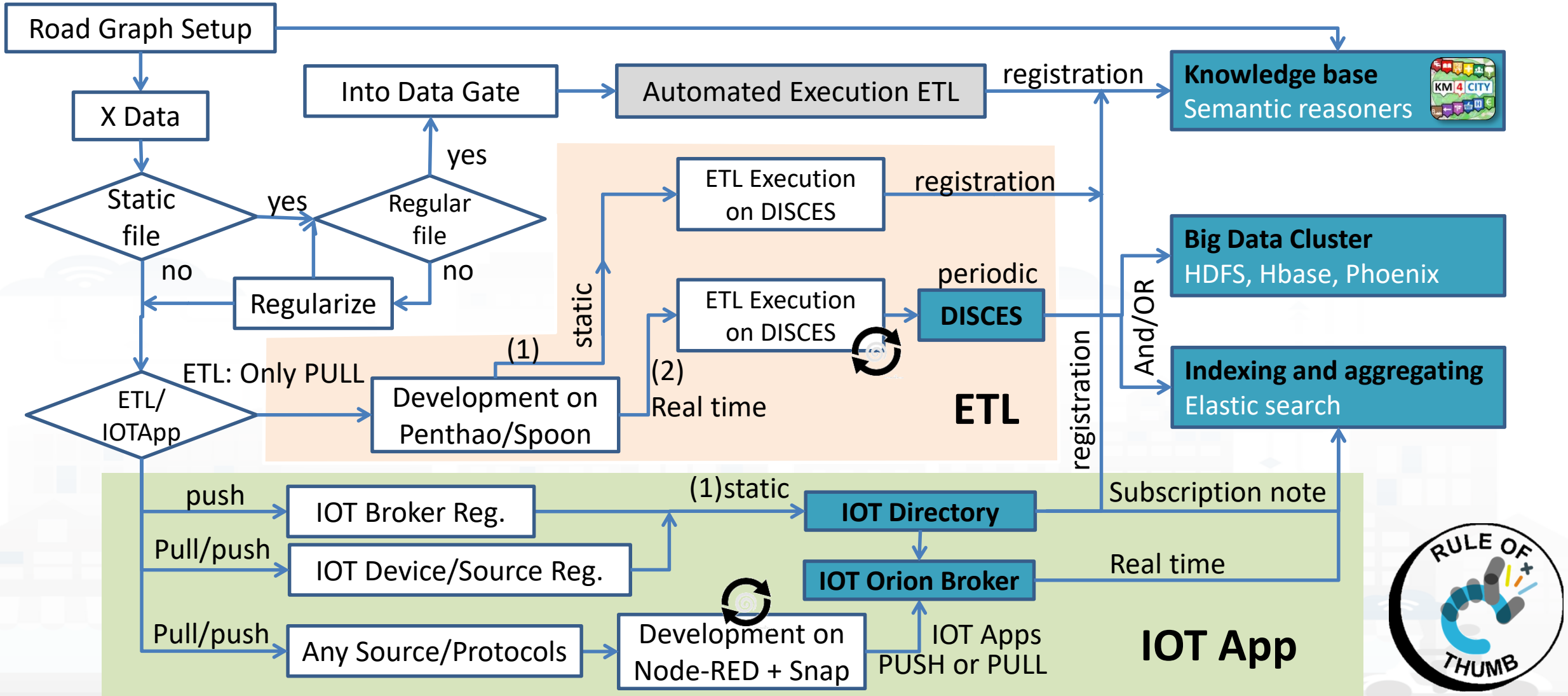


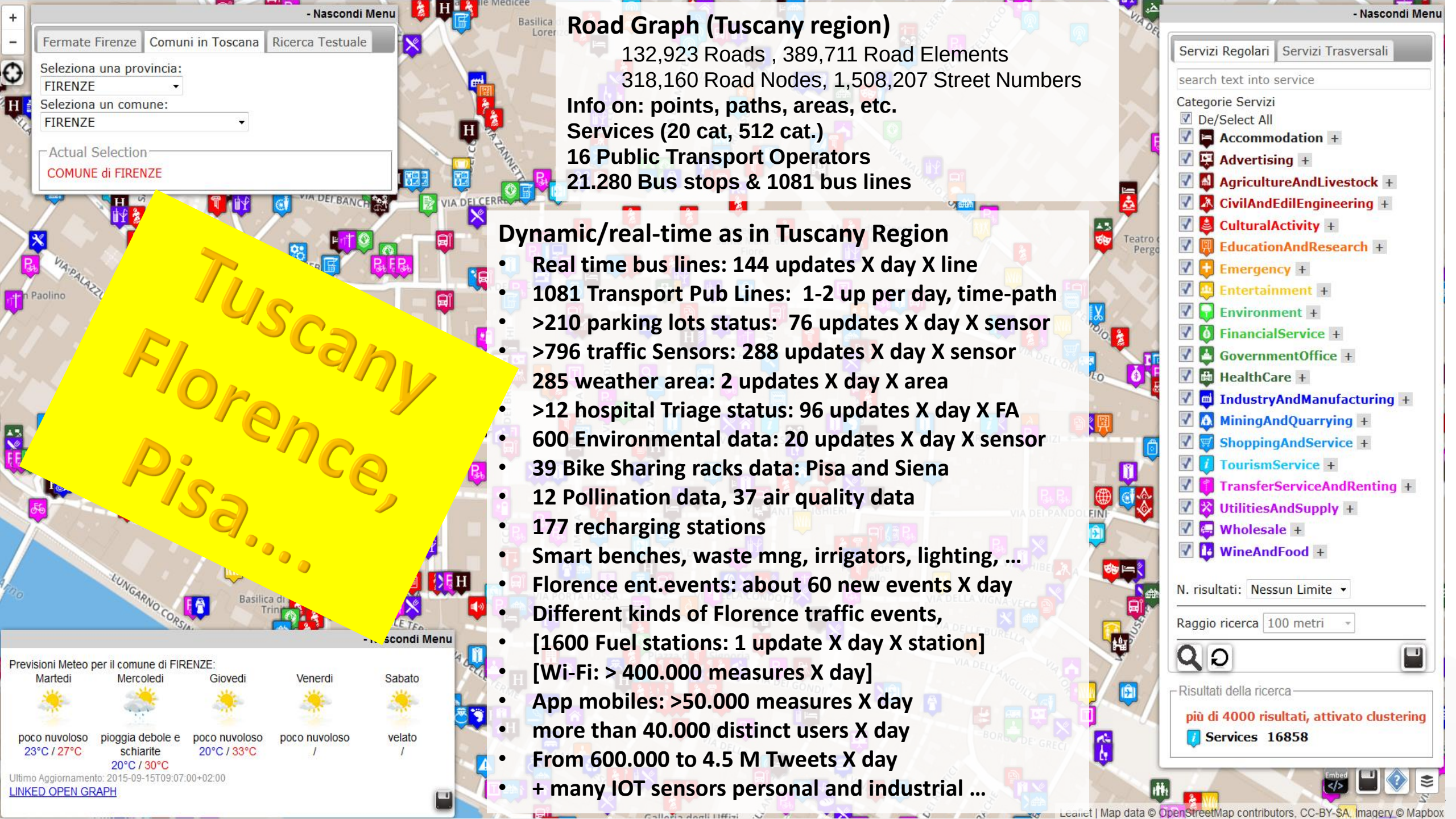




Inform, announce, Act!, warning, alarms, What-IF, ..

Data Ingestion Flow Guideline, thumb rules

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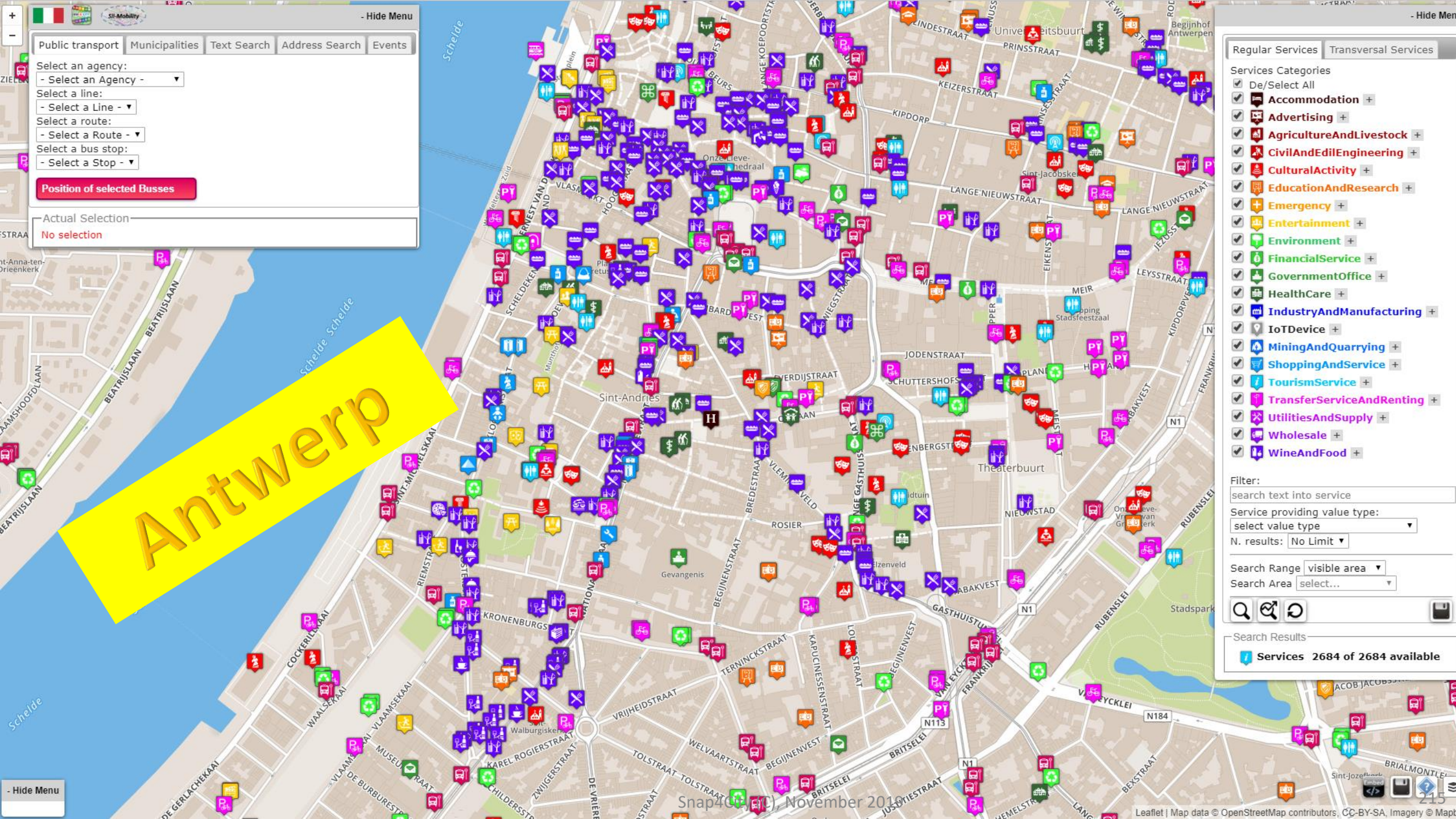
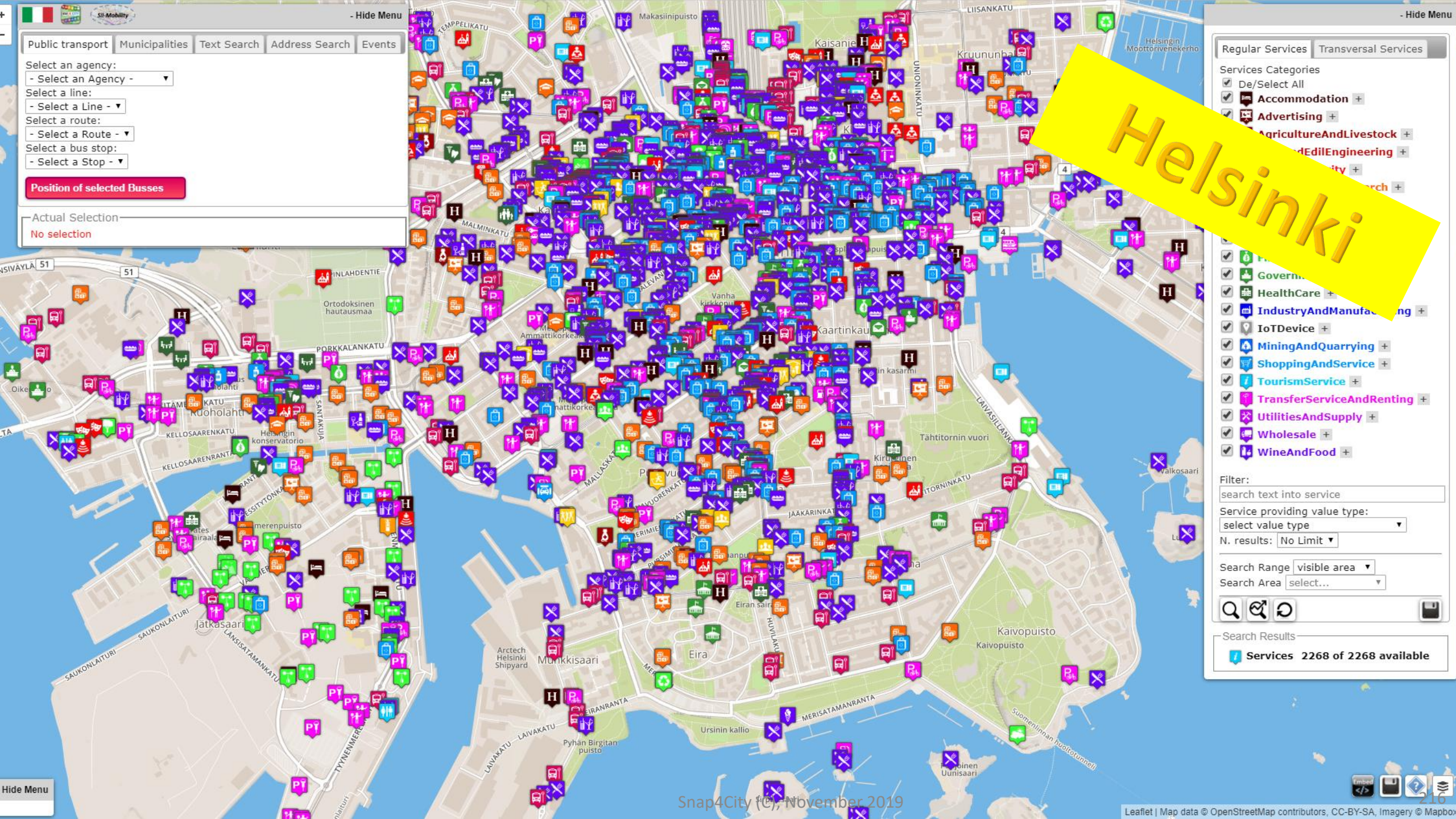
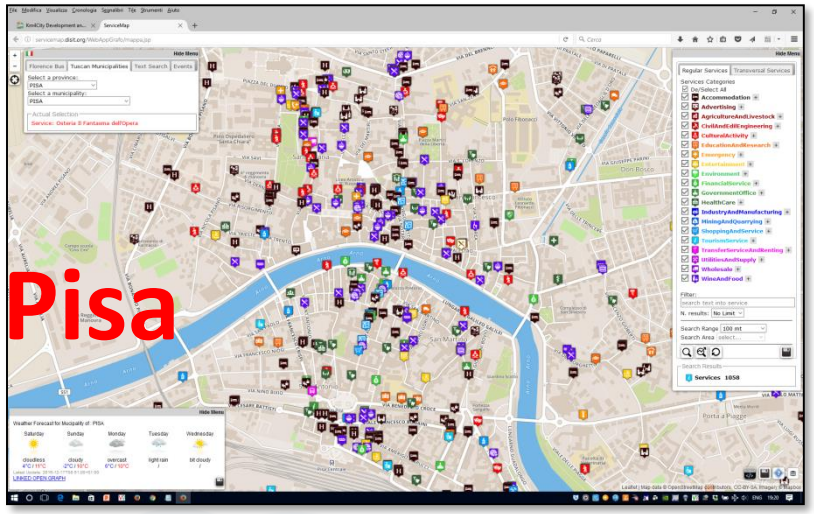
Fermate Firenze
Comuni in Toscana
Ricerca Testuale
Seleziona una provincia:
FIRENZE
Seleziona un comune:
FIRENZE
Actual Selection
COMUNE di FIRENZE
Tuscany
Florence,
Pisa....
Road Graph (Tuscany region)
132,923 Roads , 389,711 Road Elements
318,160 Road Nodes, 1,508,207 Street Numbers
Info on: points, 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

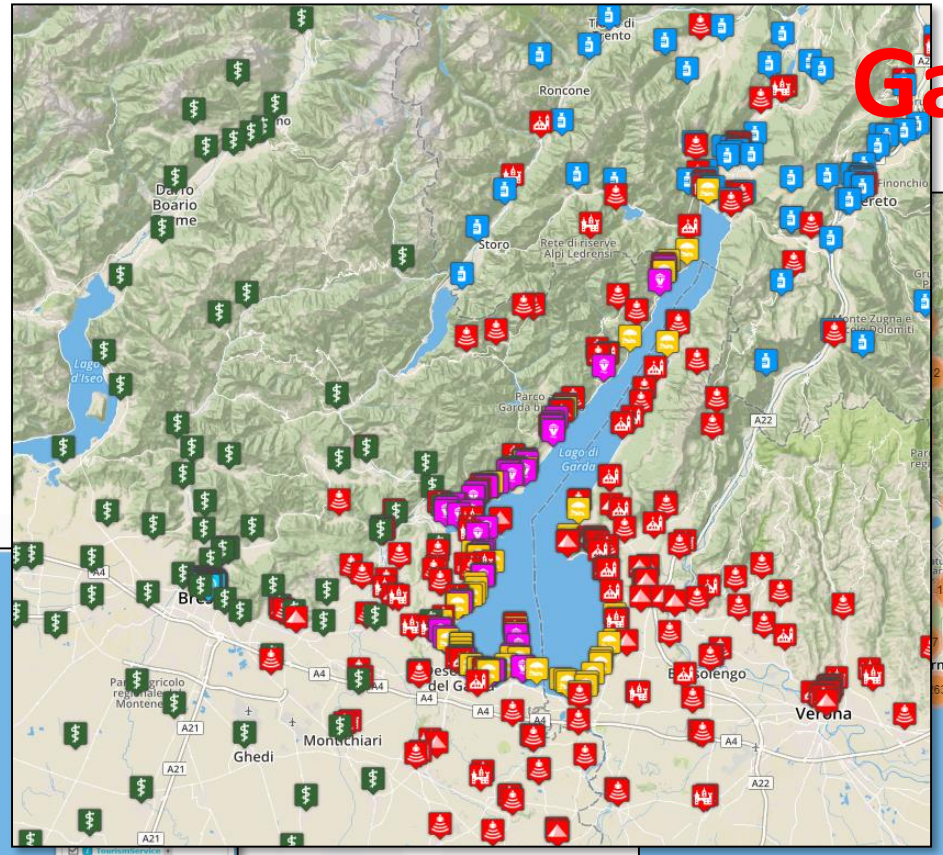

- Hide Menu
Public transport
Municipalities
Text Search
Address Search
Events
Select an agency:
- Select an Agency -
Select a line:
- Select a Line -
Select a route:
- Select a Route -
Select a bus stop:
- Select a Stop -
Position of selected Busses
Actual Selection
No selection
Antwerp
- Hide Menu
Regular 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
Schelde
Sint-Andries
Gevangenis
Theaterbuurt
Nieuwstad
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapb


- 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
Helsinki
- Hide Menu
Regular Services
Transversal Services
Services Categories
De/Select All
Accommodation
Advertising
HealthCare
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 2268 of 2268 available
Hide Menu
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

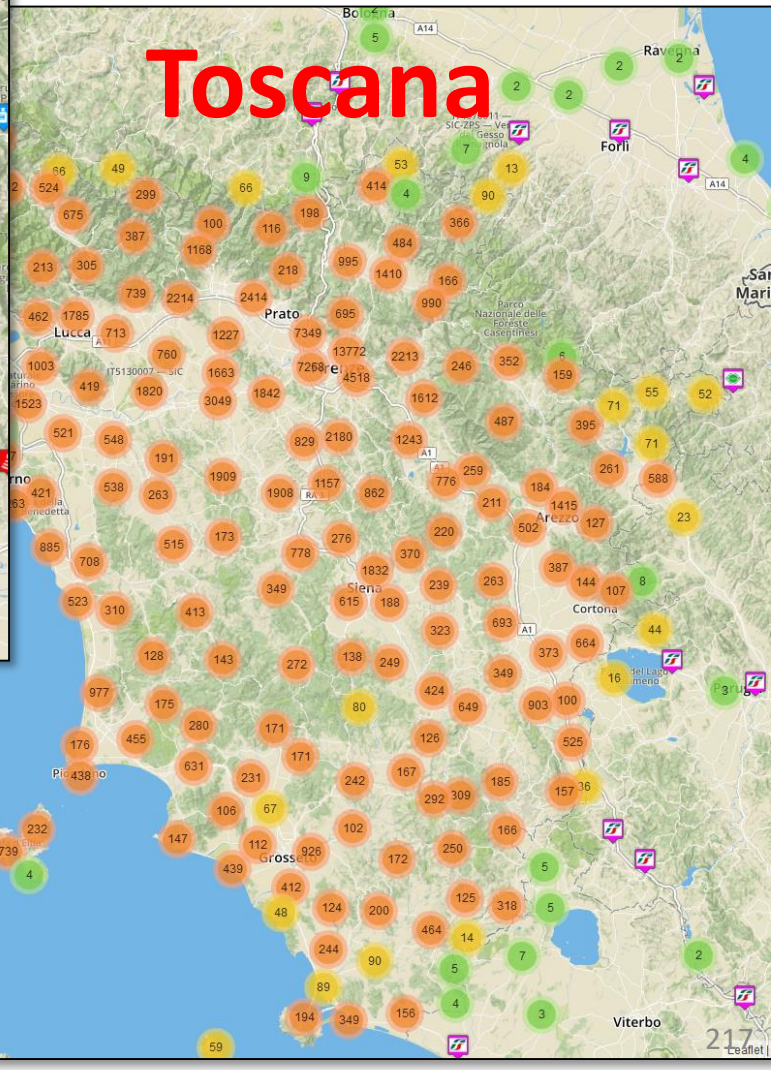
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

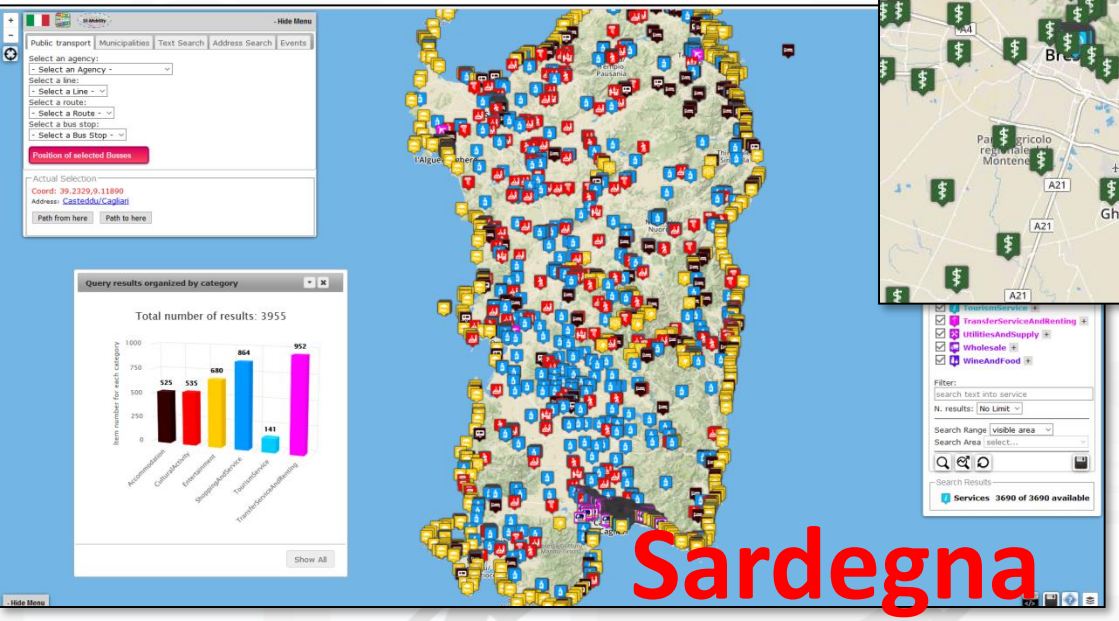
Km4City in SNAP4CITY





Sii-Mobility





Search all services in the area

Data vs Smart Services enabling on Snap4City

- **Public Transportation and mobility activated services in some where with Snap4City**
  - **Smart parking** (parking locations and real time parking data) … predictions
  - **Smart Fuel pricing** (fuel station locations and real time prices)
  - **Routing** (detailed GIS information, text indexing of streets, POI, etc.)
    - **Quite routing, perfect shopping, etc. etc**. (more data in needed….)
  - **multimodal routing** (detailed GIS information, Public transport time schedule)
  - **Info traffic** (traffic flow sensors, real time Traffic events, their localization, etc.)
  - **Dense info traffic** (traffic flow sensors and traffic flow reconstruction algorithm)
  - **Car/Bike/Scooter Sharing** (position and availability of Cars/Bikes, Scooters) … predictions
  - **Smart Biking** (cycling paths, environmental data) … predictions
  - **E-vehicles** (position, status of recharging stations,. …) … predictions vs booking
  - **Smart river crossing** (position and status of Underpass, Ferry) … prediction
  - **Quality of Public Transport** (actual time of arrival at the bus stops, wrt planned time schedule**)**
  - **Early Warning vs Resilience** (combination of several data including mobility, events, Social to perform early warning…)

Data vs Smart Services enabling on Snap4City

- **Social and Users Behaviour**
  - **Smart First Aid** (Location of First AID, real time status of triage)
  - **search for POI and public transport services** (POI geolocalized, spatial queries, along paths)
  - **Social Media Monitoring and acting** (Identif. of dysfunction, quality of service perceived)
  - **Information to Tourists** (Entertainment Events)
  - **Early Warning, prediction of audience** (Twitter data, social media)
  - **Improvement of services for Tourists** (people flow, usage of services)
    (Origin Destination Matrices, trajectories, heatmaps)
    (People Monitoring, via App, Wifi, PAX Counter)
    (Twitter Data, social mea,….)
- **Weather and environment, quality of life**
  - **Weather forecast/condition** (Weather forecast)
  - **Air quality Pollution** (pollution sensors, PM10, PM2.5, NOX, etc.)
  - **Pollination** (Pollination sensors)
  - **Alerting on Air quality for multiple parameters** (Prediction of parameters time slots, notification)
  - **Information Heatmaps for weather and air quality** (air quality sensors, heatmaps, prediction)
  - **Air quality indexes, and forecast** (…….

Interoperability Protocols vs Data



Integration with Legacy platforms and applications

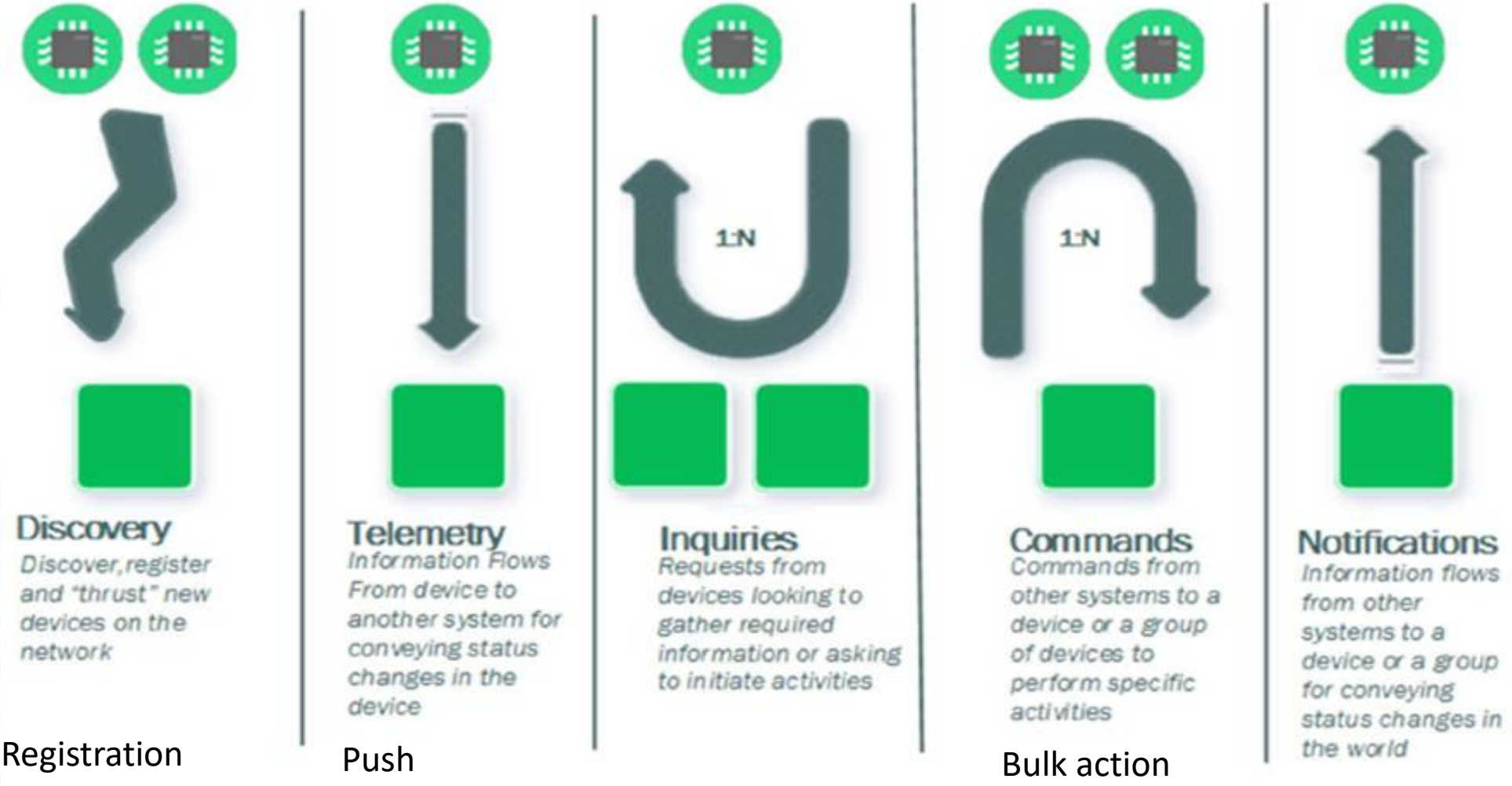
- ***Interoperability at multiple levels***
  - **Protocols**: data ingestion and Communication https://www.snap4city.org/drupal/node/65
  - **Formats**: Data Ingestion and production
  - **Dashboards**:
    - (i) embedding External Services web pages in widgets,
    - (ii) authorize dashboards to be embedded from third party portals, web pages
  - Creating **MicroServices** for IOT App from REST Call of third parties Ext. Service.
  - Different kinds of **IOT Brokers** and Secure authentication, authorization models
  - **Web Scraping** of Third-party Web portals, data ingestion in pull
  - **IOT Applications**: exploiting protocols and formats, direct connections, pull/push
  - **ETL:** exploiting protocols and formats, direct connections in pull
  - **Federated CKAN** Open Data Portal via Harvesting protocol, back and forward
  - **GIS systems** via: WFS, WMS, Dashboard, Smart City API/WFS, heatmaps/Orthomaps

Standards and Interoperability

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoraWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, etc.

IOT/IOE Protocols

Communication Patterns



Registration

Push

Bulk action

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

Exposing Services

- **Advanced Smart City API which can be confined into a single Smart City installation or Federated as well as for Super Service Map**
  - https://www.km4city.org/swagger/external/index.html
- **Federated Multiple Snap4City** Knowledge Bases. This allows the creation of mobile applications that may move from multiple cities and area accessing data and making queries transparently. This solution is presently in place among the Knowledge Bases of: Antwerp/Helsinki, Tuscany/Firenze, Sardegna, etc. The resulting Service is called Super Service Map and it is integrated in the Smart City API. For example, via:
  - https://www.disit.org/superservicemap/api/v1
- **Federated Open Data Portals** via DataGate/CKAN that presently presents now more than 13800 data sets linked for the cities of Helsinki and Antwerp.
  - https://datagate.snap4city.org/organization
  - Federation, Harvesting interface is: https://datagate.snap4city.org/harvest
- **WFS service of Snap4City** on top of Federated Smart City API or simple Smart City API of a single ServiceMap (smart City installation). This solution permits to GIS applications and platforms (such as ArcGIS OnLine ESRI, ArcGIS Enterprise ESRI, ArcGIS Map/pro Desktop, QGIS, GeoServer, etc.) to access at Snap4City data. For Example, via:
  - https://www.disit.org/superservicemap/api/v1/wfs
  - https://www.disit.org/superservicemap/api/v1/wfs?service=WFS&request=GetCapabilities&version=2.0.0
- **WMS service of Snap4City** for publishing **maps and heatmaps**, provided by an installed GeoServer third party open source tool. For example, via:
  - https://wmsserver.snap4city.org/geoserver/Snap4City/wms
  - https://www.km4city.org/swagger/external/index.html?urls.primaryName=Heatmap%20API

Snap4City vs Formats

- Snap4City is capable to ingest and work with any format:
  - Data **exchange**: JSON, GeoJSON, XML, HTML, HTML5, DATEX, GTFS, binary, etc.
  - **Table**: CSV, XLSX, XLS, database, …
  - Any **archive** file format: zip, rar, 7z, tgz, …
  - Any **image** format: png, gif, tiff, ico, jpg, …
  - Any **video** format: mp4, avi, mov, …
- Search the format you need to cope on the search box of Snap4City portal!

Snap4City vs protocols/formats

- Snap4City supports a large range of protocols for communicating with servers, services, IOT devices, legacy systems, GIS, etc., and format
- See also
  - Supported Protocols
  - High Levels IOT Protocols
  - TC9.2 - Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards
  - US9. Creating Snap4City IOT Applications, different formats, protocols, brokers, communications
  - TC2.14 - IOT Applications using multiple protocols, and formats for files Creating IOT Applications coping with heterogeneous data

Data Gathering Processes



Modalities and Strategies for data ingestion

- **Road Graphs**: from GIS, and/or OSM (see Snap4City tool for that), …
- **Data** of any format via any protocol
- **Structured and non-structured** data (tables and free text, mixt)
- **Static data** and metadata descriptions:
  - typically ingested with DataGate for automated ingestion and you find it on the menu on left of Snap4City environment.
    - DataGate is a module of CKAN, it can be installed on any CKAN also.
  - ingested producing a process visually: ETL, Node-RED, NIFI, etc.
- **Real Time data** can be ingested by using:
  - Node-RED, NIFI, ETL, WebScraping, etc.
- **Event Driven** → Node-RED, NodeJS

Developers of ETL, Data Manager

kettle™ pentaho data integration

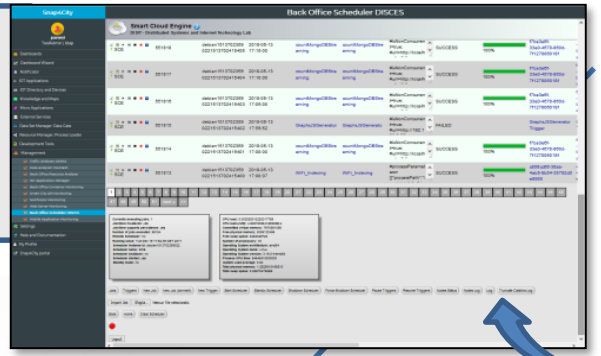
Distributed Back Office

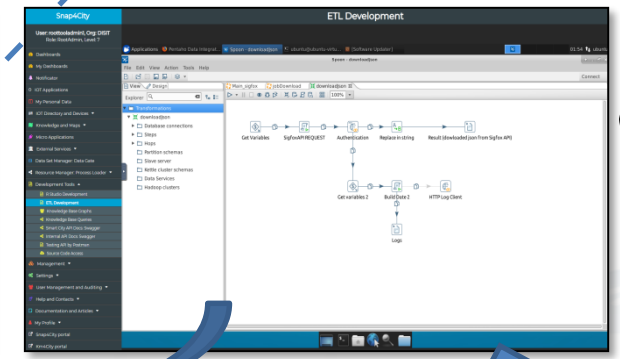
DISCES scheduler production

ETL Development Environment

Data sources

ETL Process







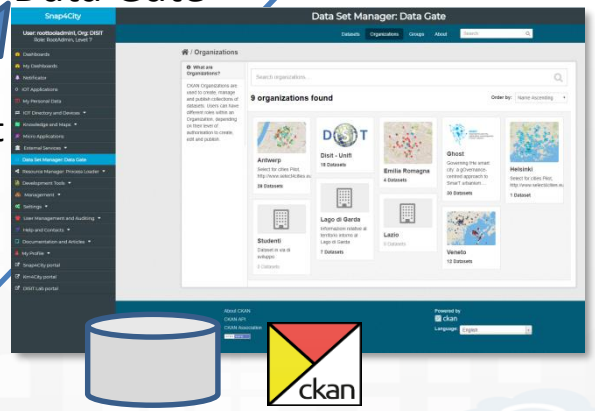
Data Gate

Knowledge Base, Km4City



Knowledge and Storage Data from the Field and City

Data Set Saving / Sharing



Data Set Loading/ Downloading

Saving / Sharing reusing



Resource Manager

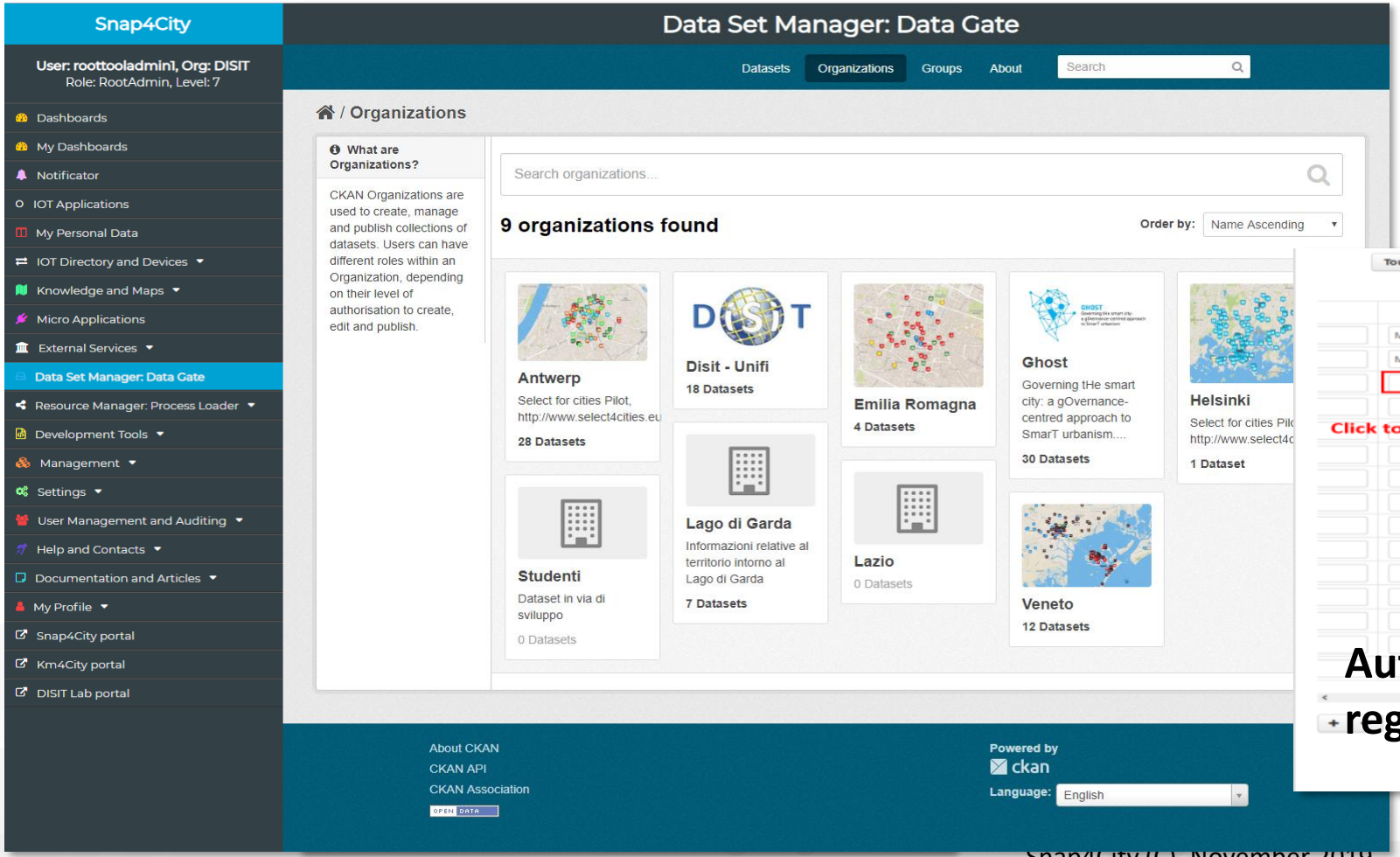
Schedule Execute

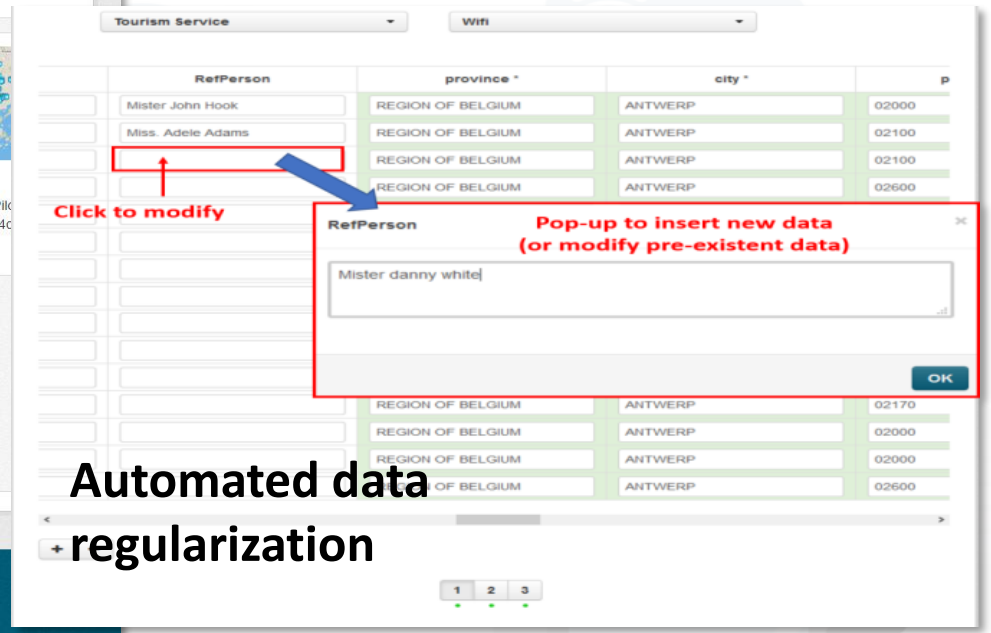
Load data or prepare for data ingestion

Integrated DataGate/CKAN
Static open data ingestion

Federated Crawling
Federated Distribution

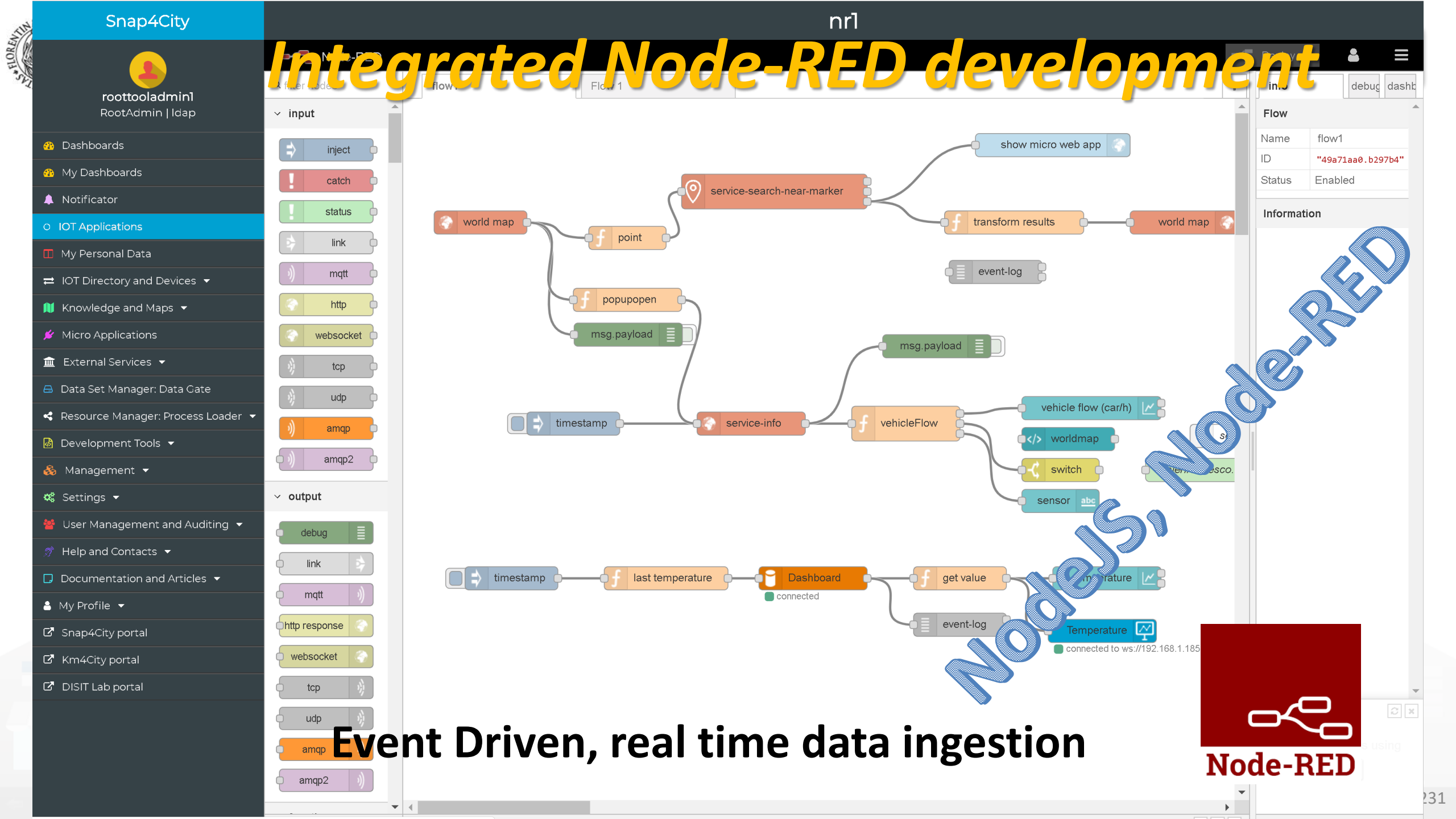
Data Set:
- Search
- Loading
- Download
- Share
- Publish
- Also automated





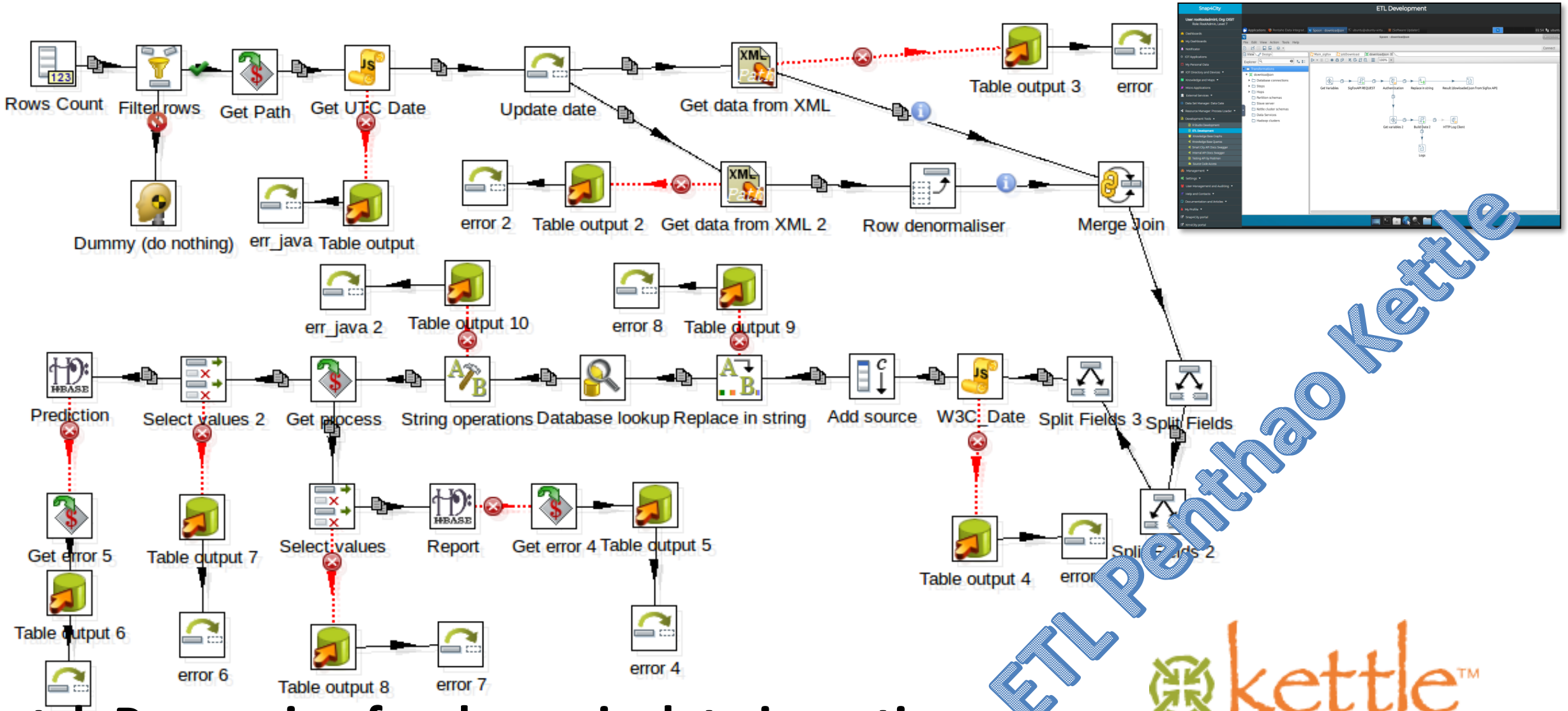
Automated data regularization

Integrated Node-RED development



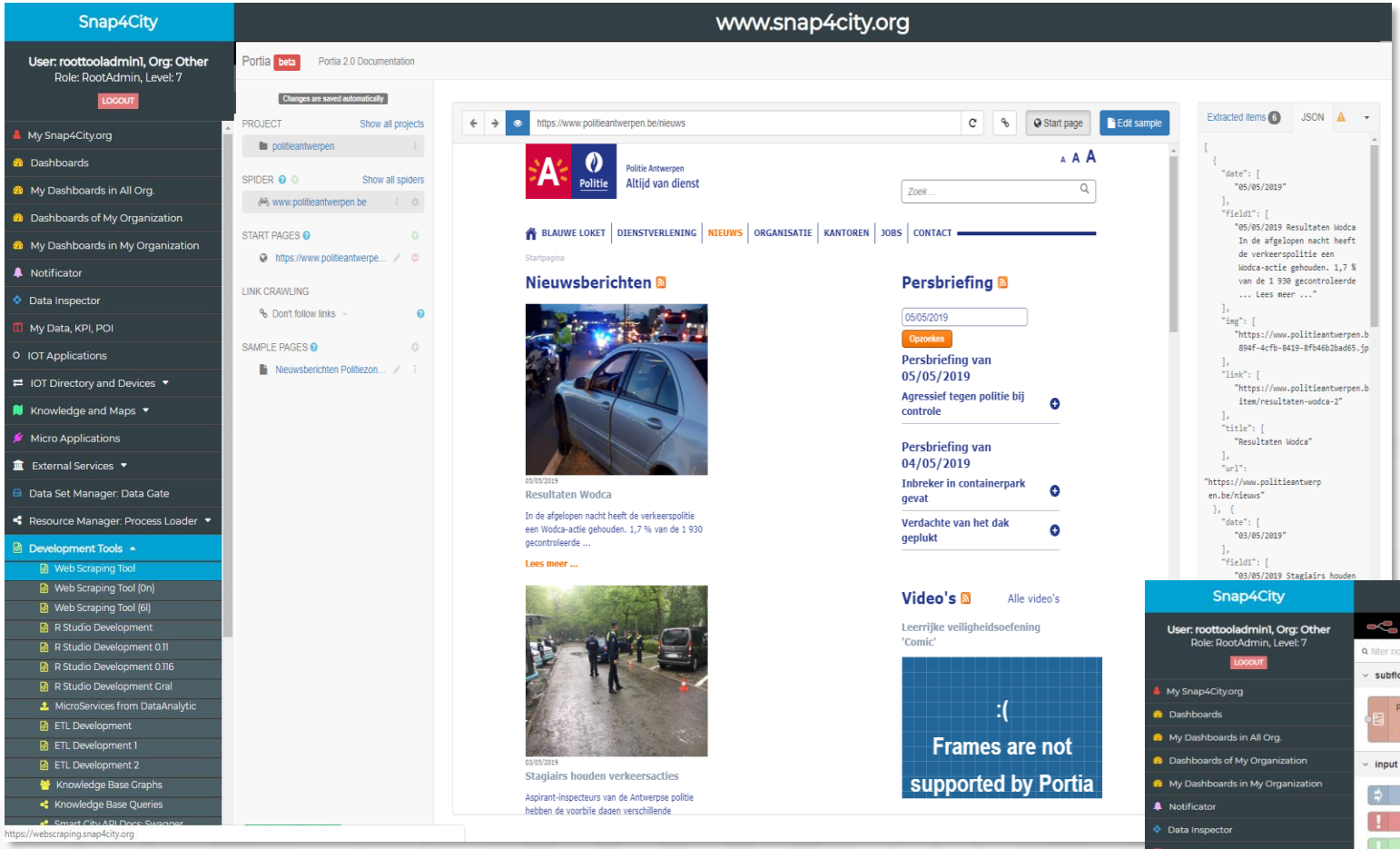
Event Driven, real time data ingestion

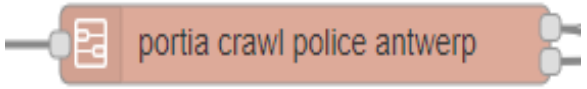
Integrated ETL development

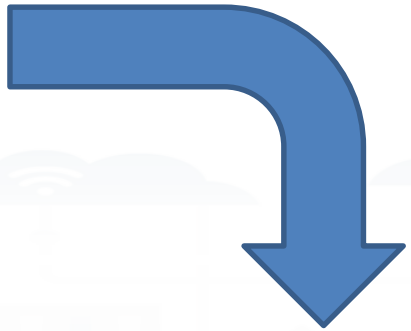


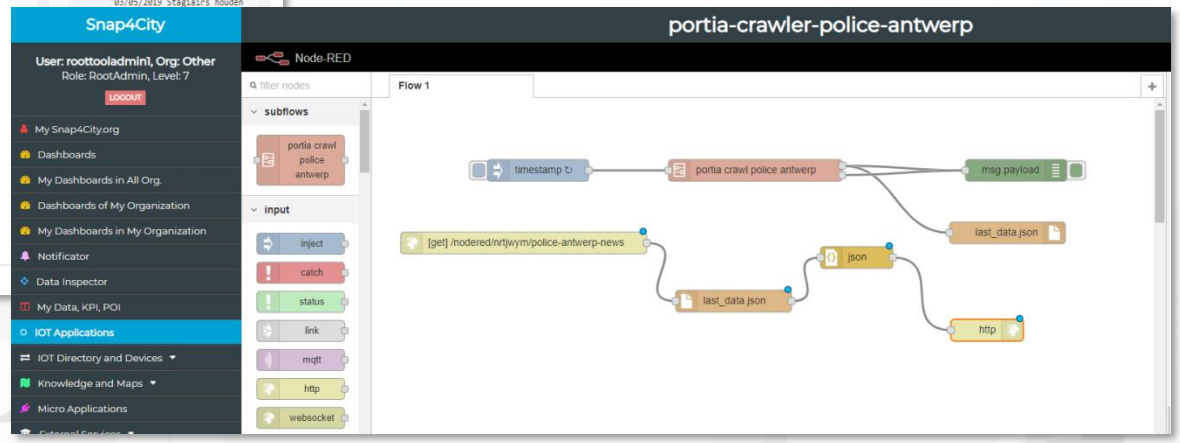
Batch Processing for dynamic data ingestion

Web Scraping









Data Gathering and Knowledge Management

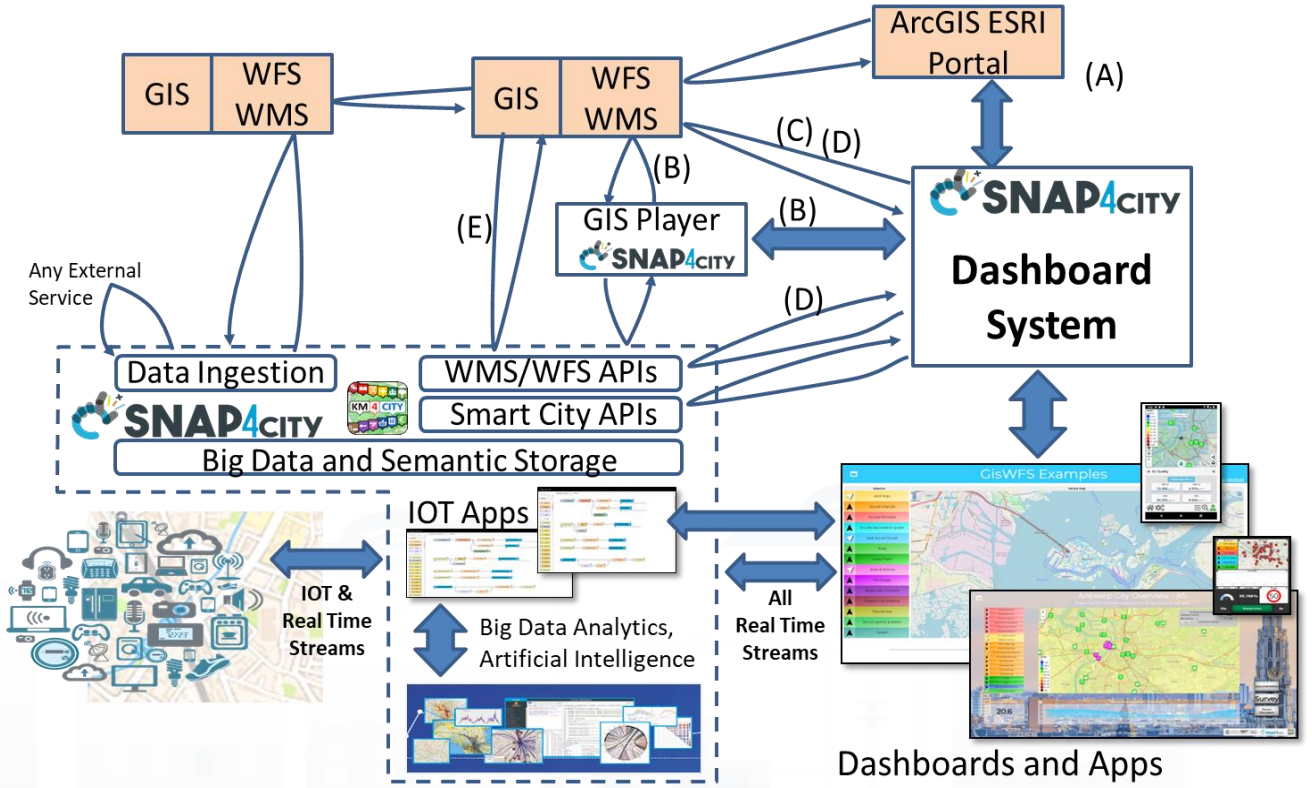
- Data ingestion can be performed by using multiple tools:
  - ETL processes, IOT Applications, Data Gate, WebScraping. We suggest:
    - ETL for static / periodic data in PULL
    - IOT App for real time data and flow, from IOT Brokers/Devices
    - DataGate for Static Data, upload them as files, or collected from other CKAN
    - WebScraper for scraping data from Web Pages, when authorized!
- See how to test cases:
  - **HOW TO: add data sources to the Snap4City Platform**
  - **HOW TO: define privacy rules for personal data, produced by the end-users own device**
  - **US6. Developing and using processes for data transformation**
  - **TC6.1 - Managing DataSets via DataGate: ingest, search, download, upload, annotate, share**
  - **TC6.3 - Creating ETL processes for automated data ingestion and data transformation**
  - **TC6.5 - Managing Heterogeneous File Ingestion via ETL processes**
  - **TC6.9 - ETL processes for multiprotocol and format data ingestion, see on GITHUB for library**
  - **TC9.2 - Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards**

GIS Data Import, Export and Exploitation



Interoperability ESRI

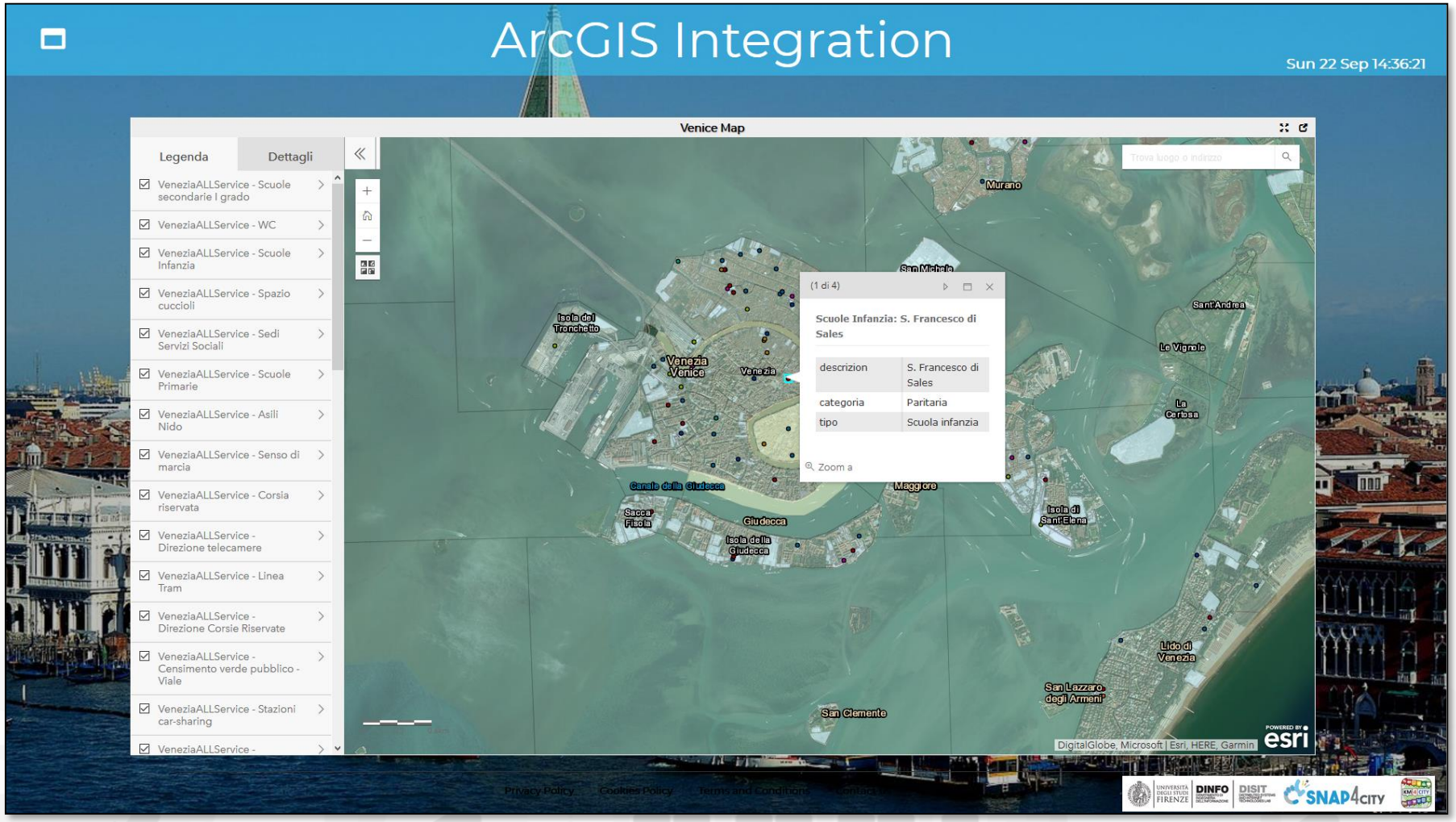
- **Snap4City is interoperable with**
  - ESRI ArcGIS Enterprise, Portal, Pro/MAP, ...
  - other GIS tools supporting WFS, WMS, GeoJSON, GML
- **Snap4City is interoperable since:**
  - **Provides** info/data in WFS, WMS
  - **Exploits** data/info from WFS, WMS
  - **Import** data/info from WFS/WMS



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

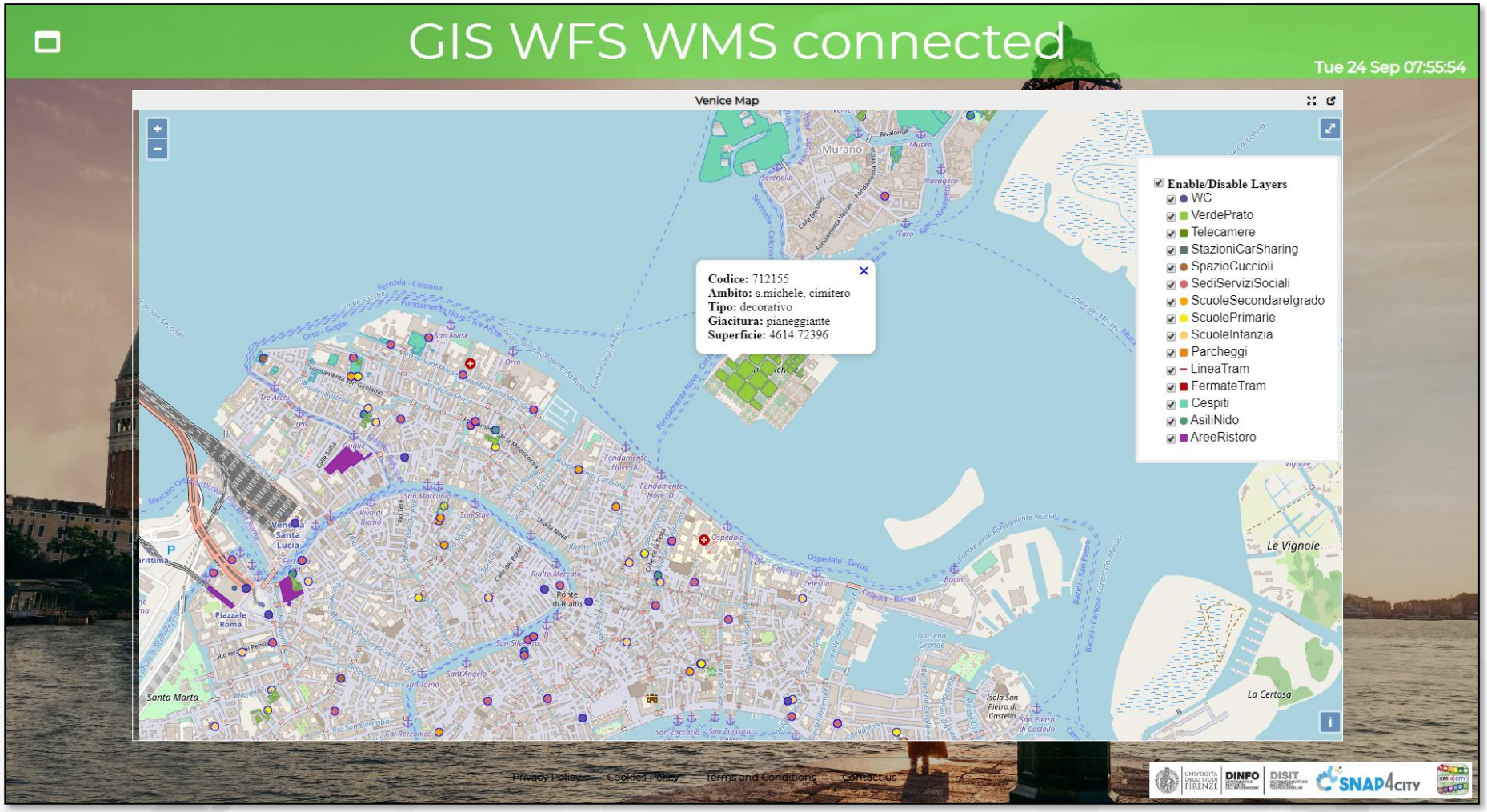
(A) ArcGIS ESRI as External Service

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



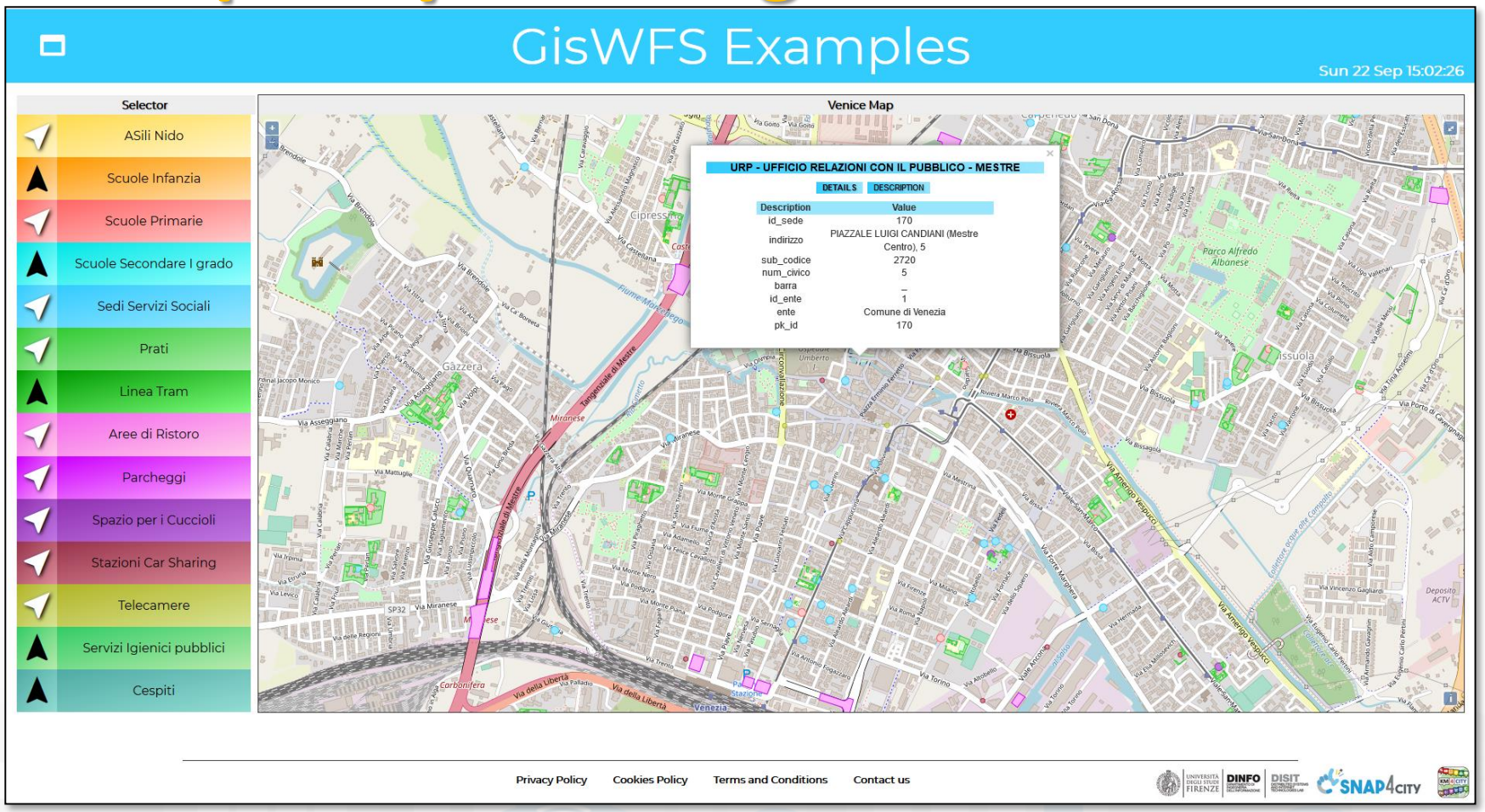
(B) GIS data on Dashboard via Snap4City GIS Player

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



(C) Dash with Snap4City GIS widget and Selector

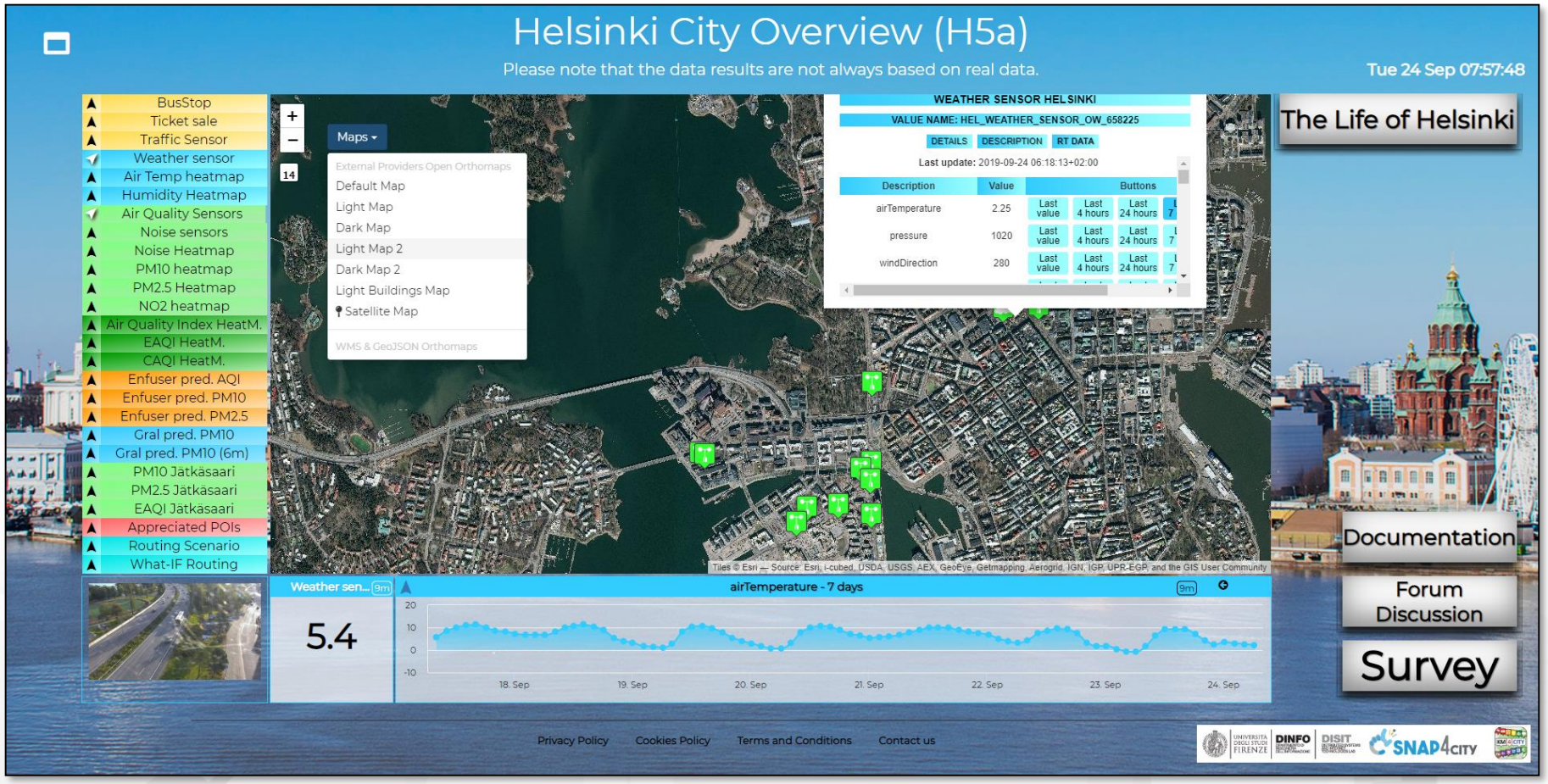
- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- Snap4City has its WFS / WMS widget / Player
- Snap4City Dashboard shows WFS/WMS data via Special GIS Widget Map:
  - https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwMw==
- Snap4City can use **Selector** to select WFS /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



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

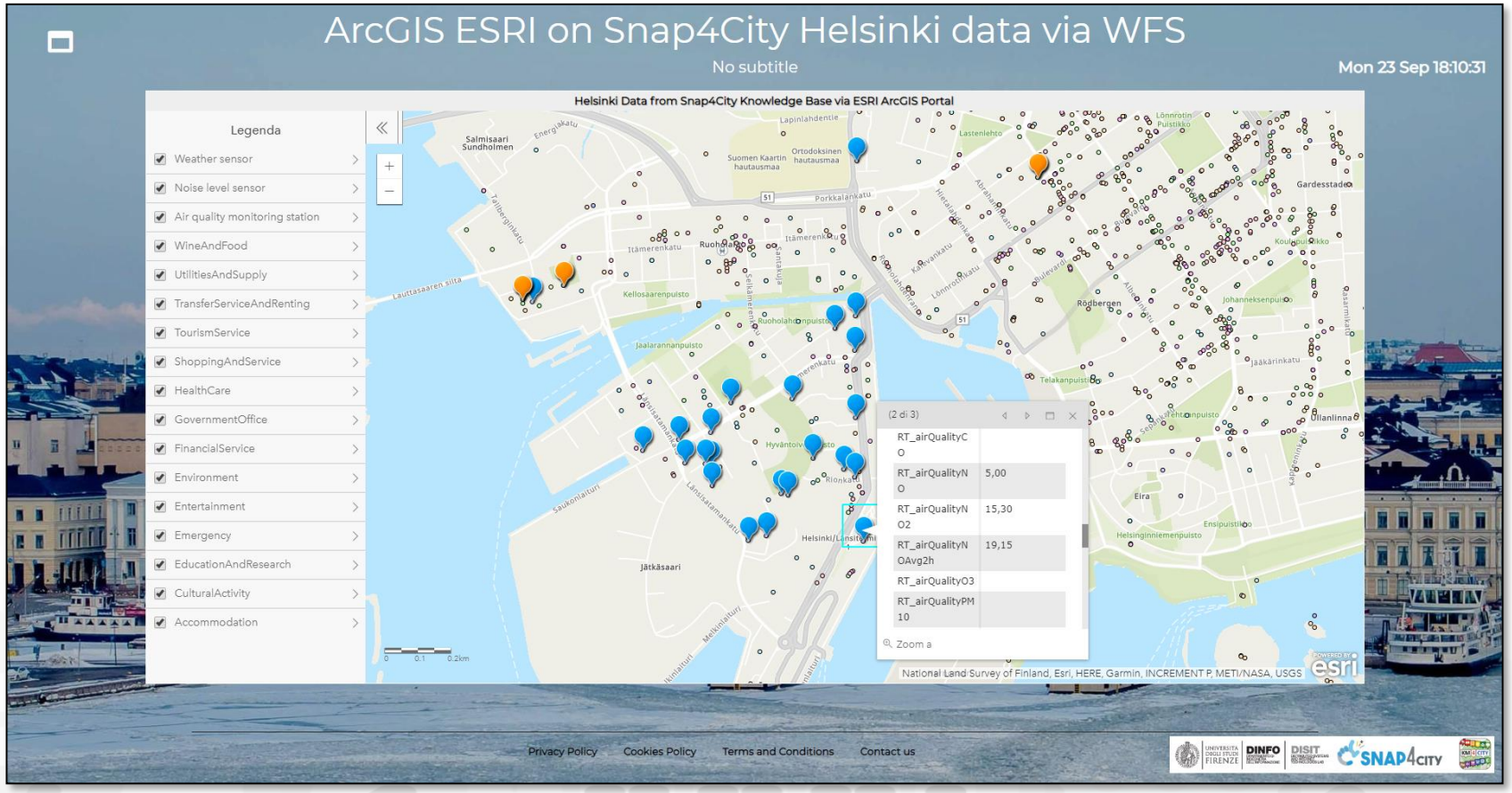
(D) Dashboard with Orthomaps and shapes layers based on WMS, GeoJSON

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



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

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



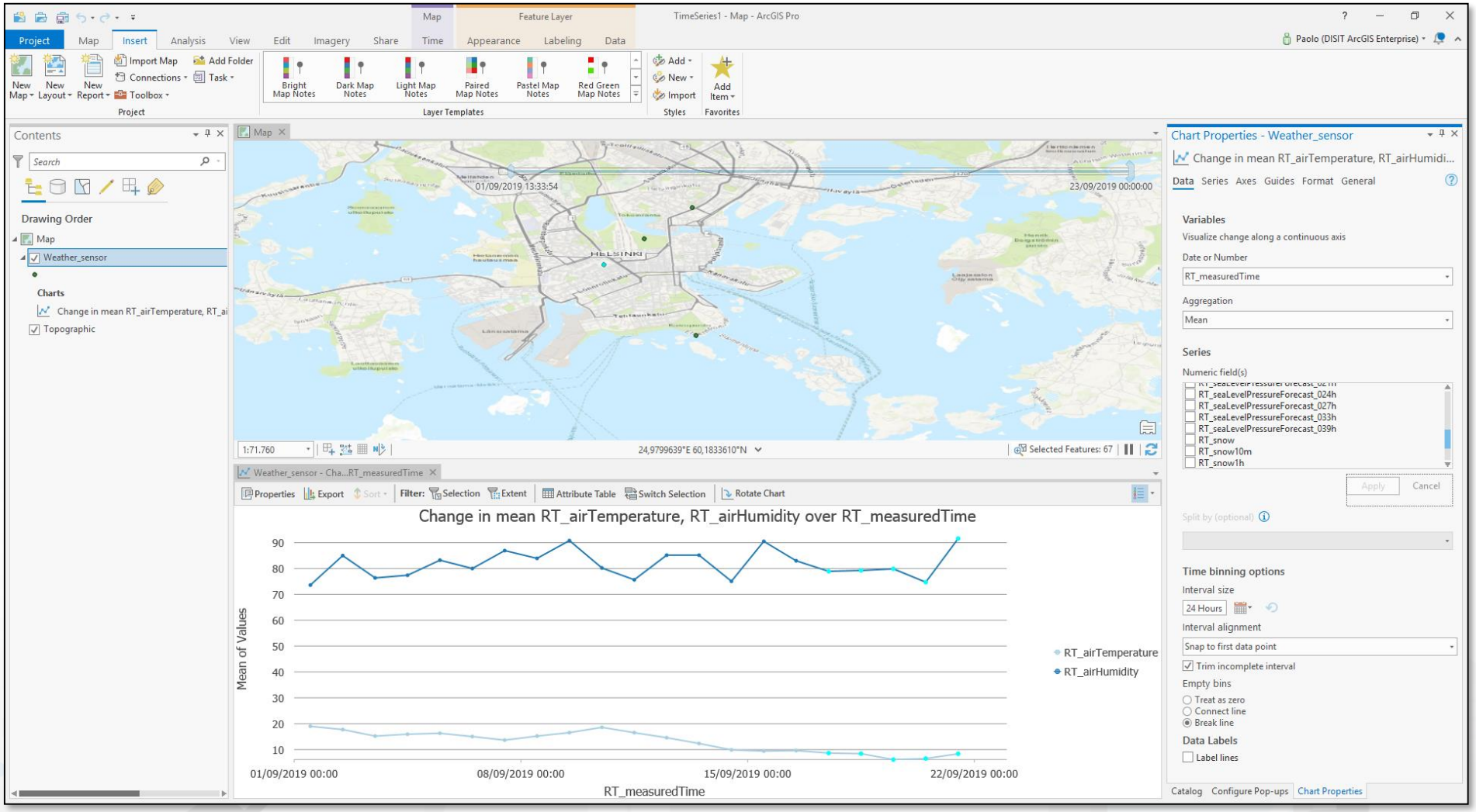
(EA) ArcGIS ESRI Pro as GIS / WFS play

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

On PC:

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

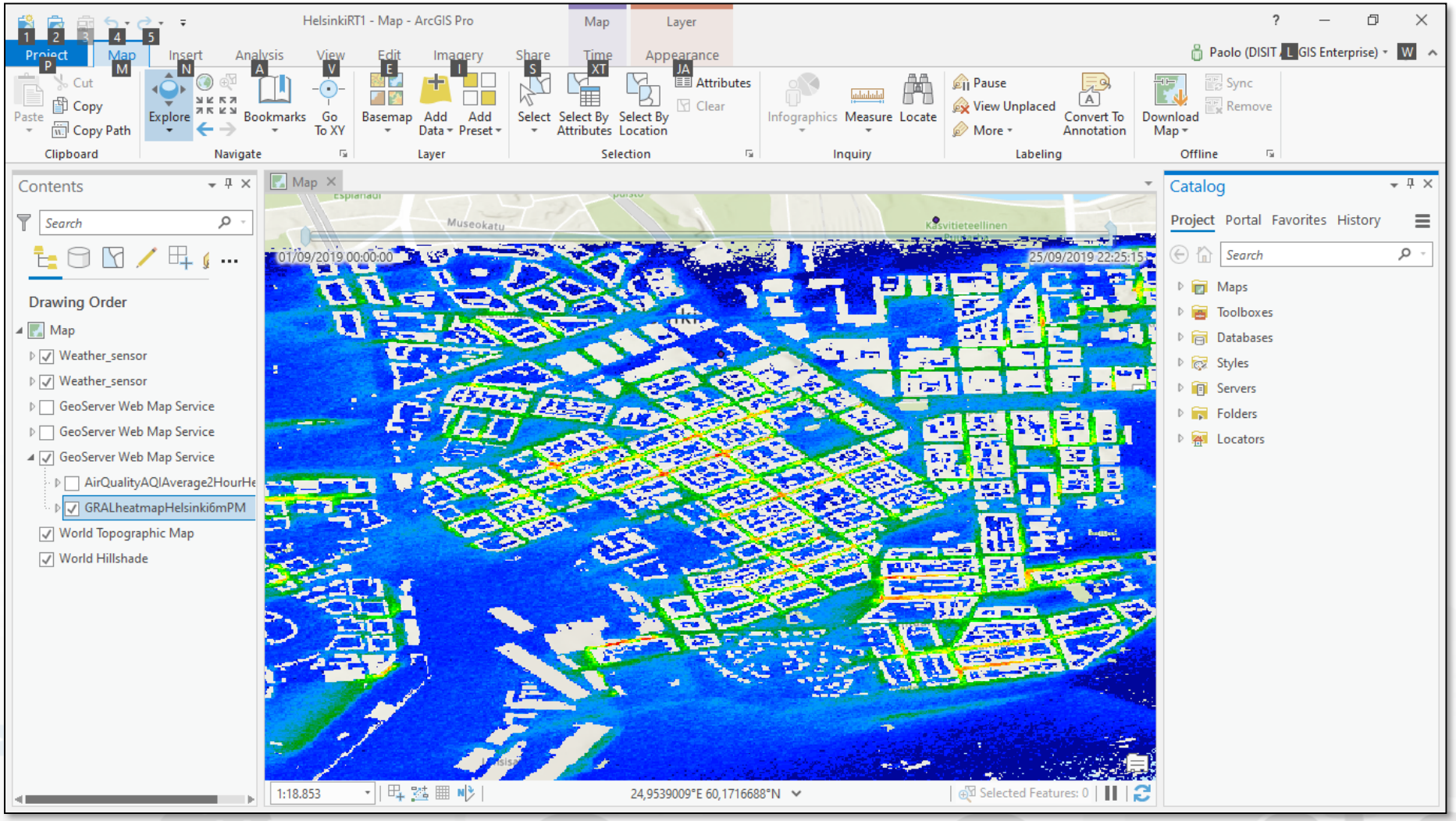
(ii) Download data via WFS … from…



(EA) ArcGIS ESRI Pro as GIS / WMS play

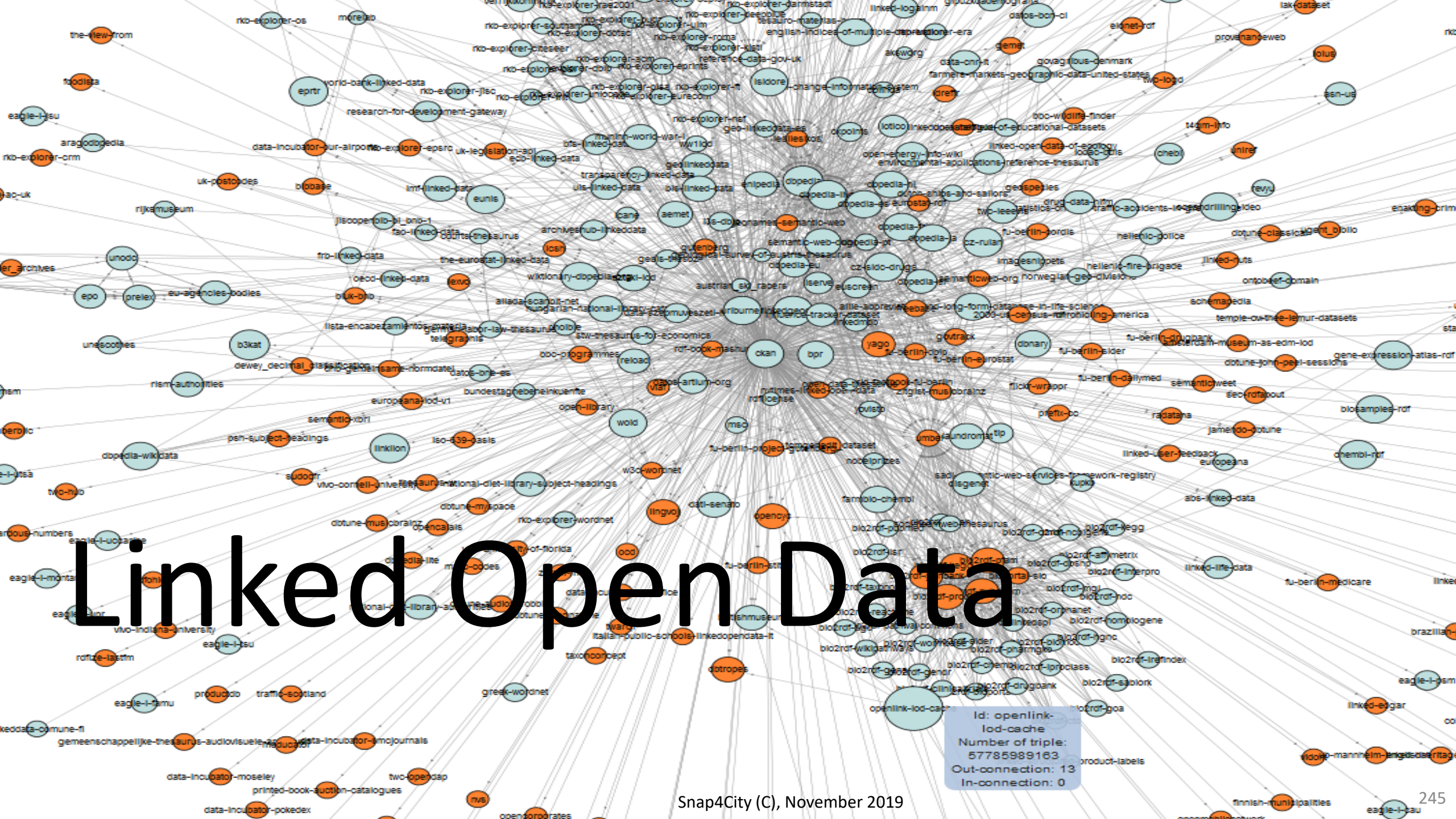
To test it you need to have installed ArcGIS pro on your pc and connect with our WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

Heatmap taken from Snap4City GeoServer via WMS protocol



Semantic Modeling and City Knowledge Base, Km4City

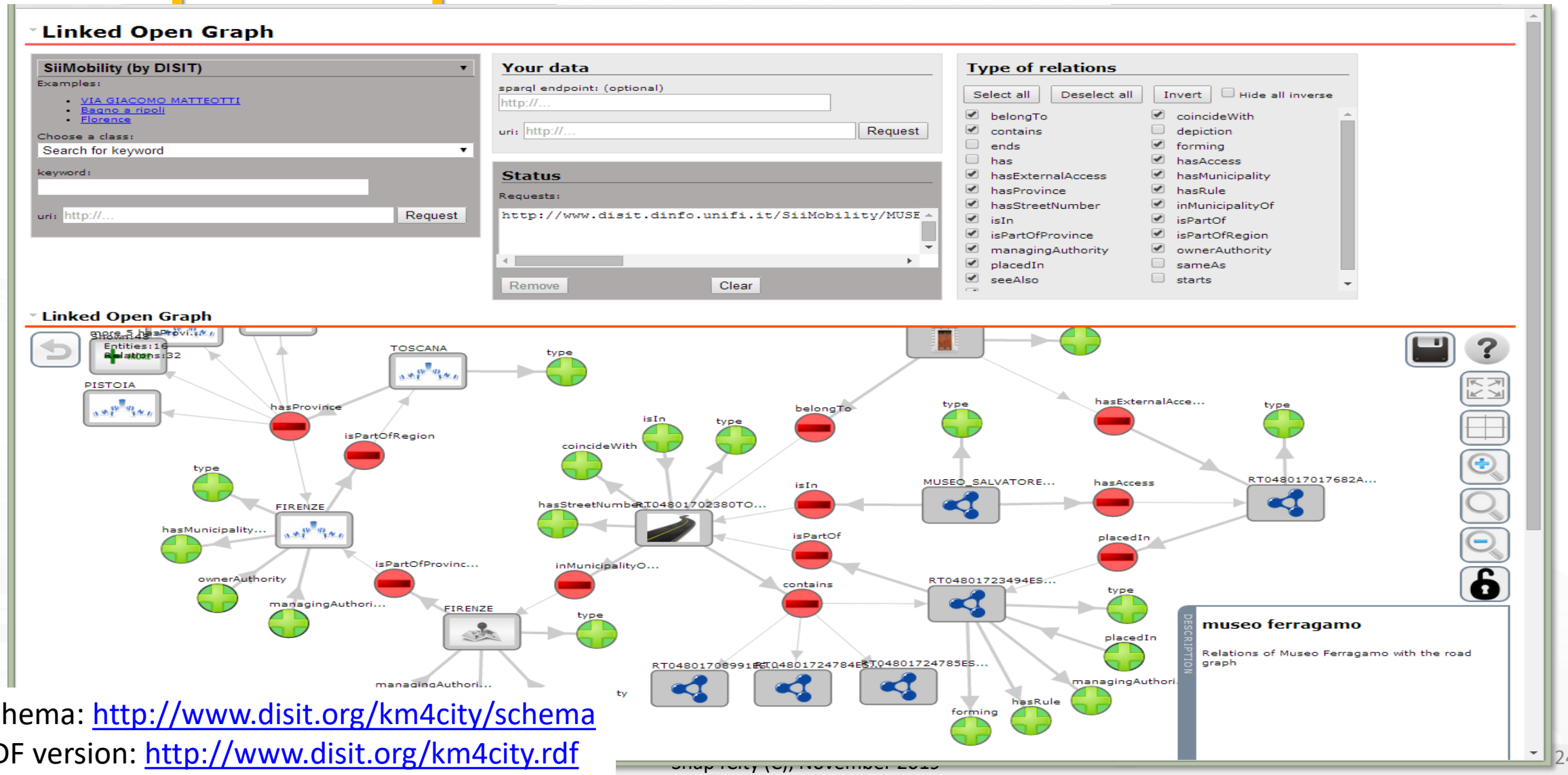



Linked Open Data
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

Linked Open Data

Linked Open Graph

LOG: https://log.disit.org



Schema: http://www.disit.org/km4city/schema

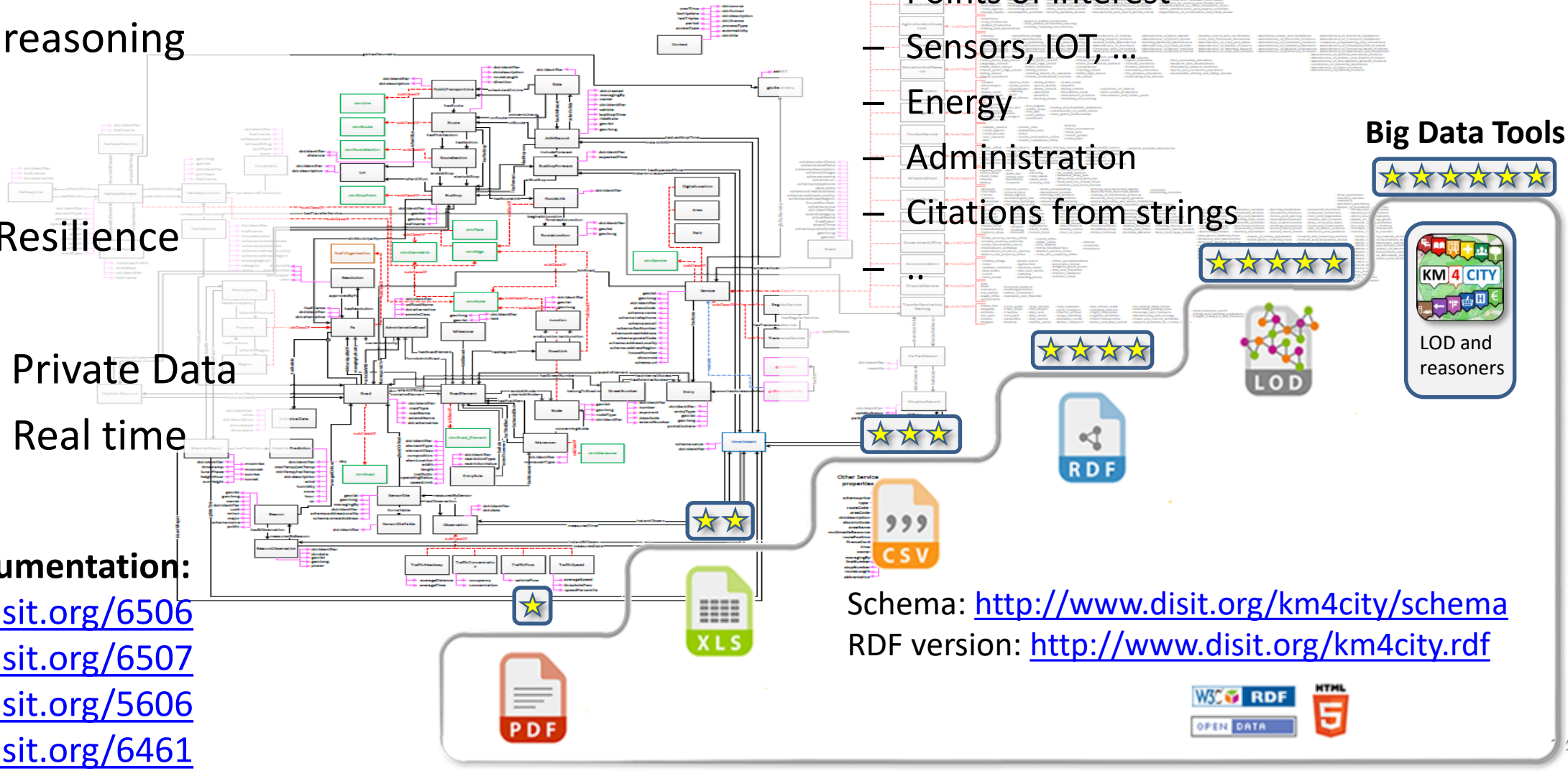
RDF version: http://www.disit.org/km4city.rdf

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

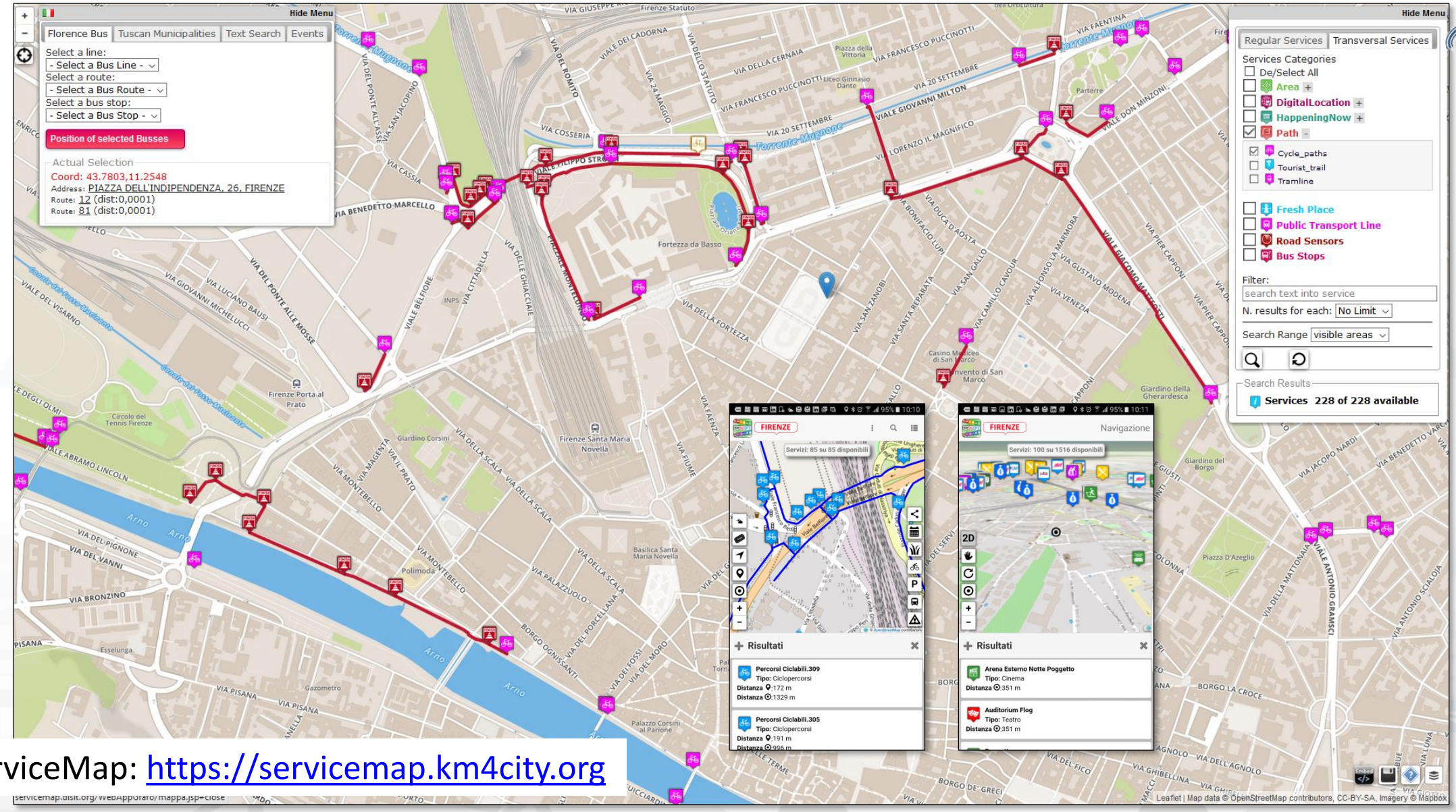
Ontology Documentation:
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

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



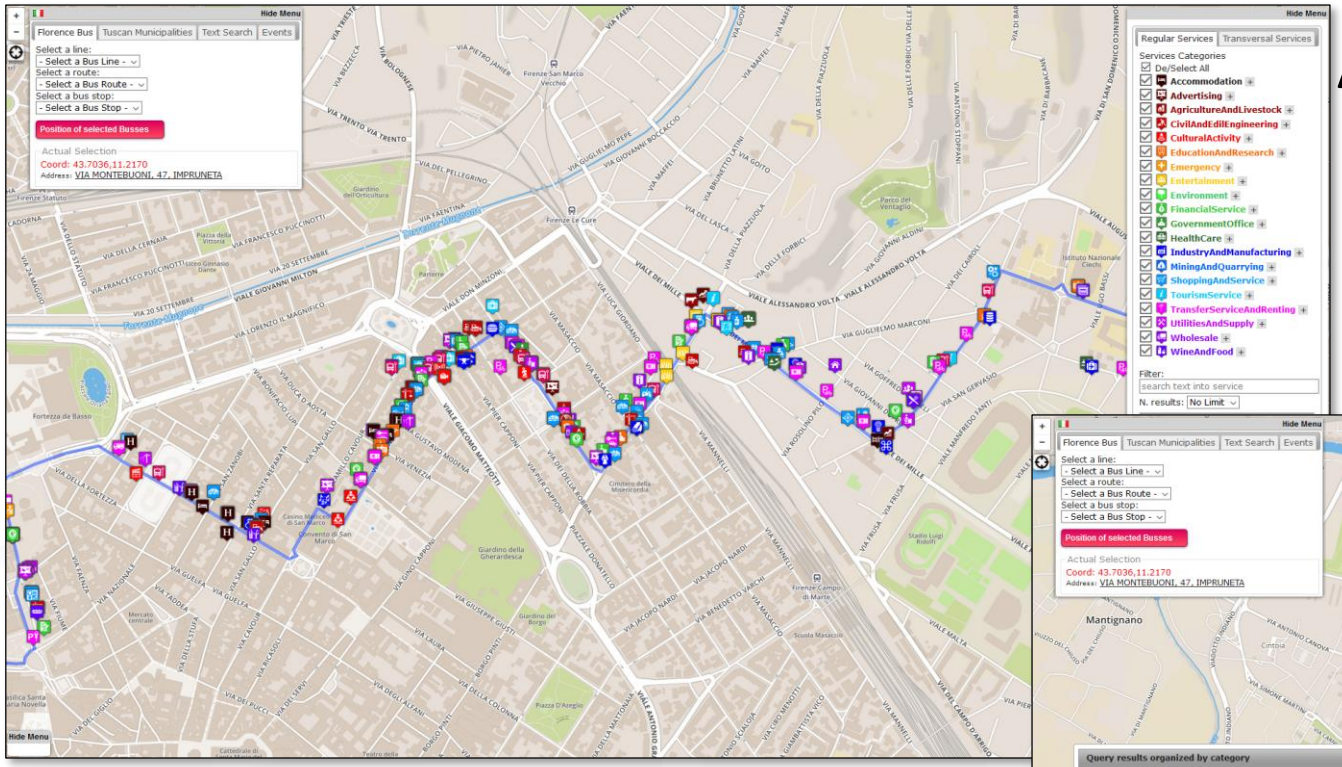
Schema: http://www.disit.org/km4city/schema
RDF version: http://www.disit.org/km4city.rdf

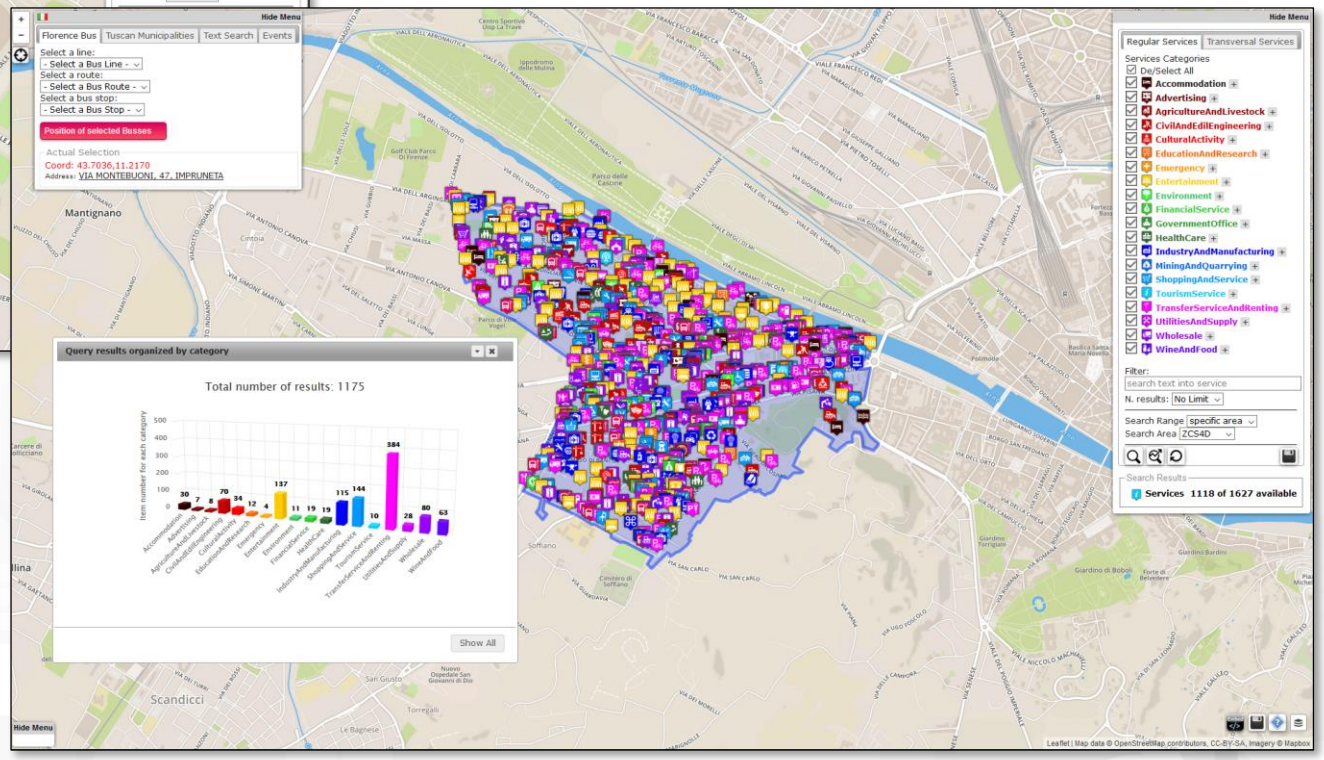
Cycling Paths



ServiceMap: https://servicemap.km4city.org

Along a path





Inside an area

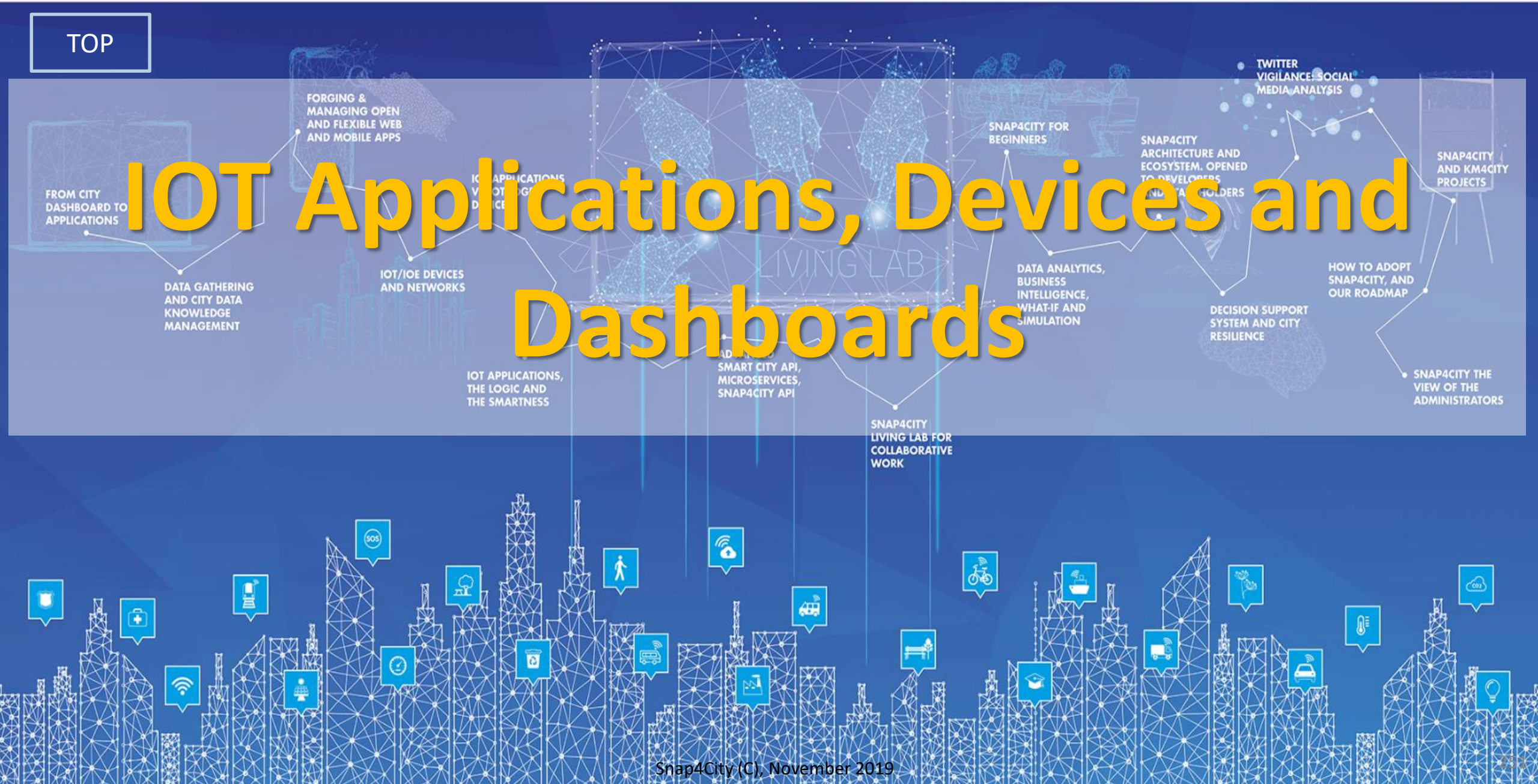
ServiceMap: https://servicemap.km4city.org

Semantic modeling

- **Km4City is the reference ontology for Snap4City,** It allows to:
  - keep connected city entities each other:
    - Semantic Index, reticular
    - Perform spatial, geo graphic, and temporal reasoning
  - Discover city entities and their relationships,
    - IOT devices, IOT sensors, city elements, etc.
  - Provide access via Advanced Smart City API
  - Federate other Km4City Knowledge Bases, the approach allows to scale geographically and create redundancies, improving performances
- Documentation
  - **TC5.15 - Snap4City Smart City API Collection and overview, real time**
  - **ServiceMap and ServiceMap3D, Knowledge Model, Km4City Ontology**
  - **Knowledge Base Graphs and Queries: browsing and queries into the KB**

TOP

IOT Applications, Devices and Dashboards



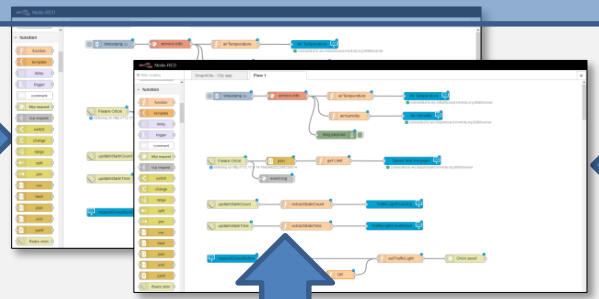
Snap4City: Builder of Sentient Cities Solutions

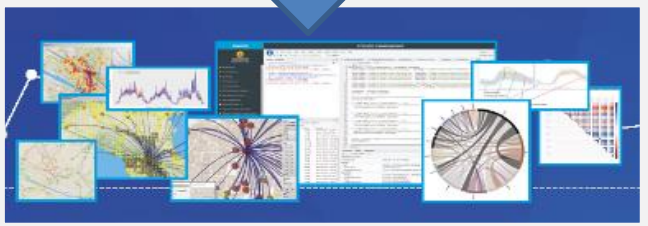
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

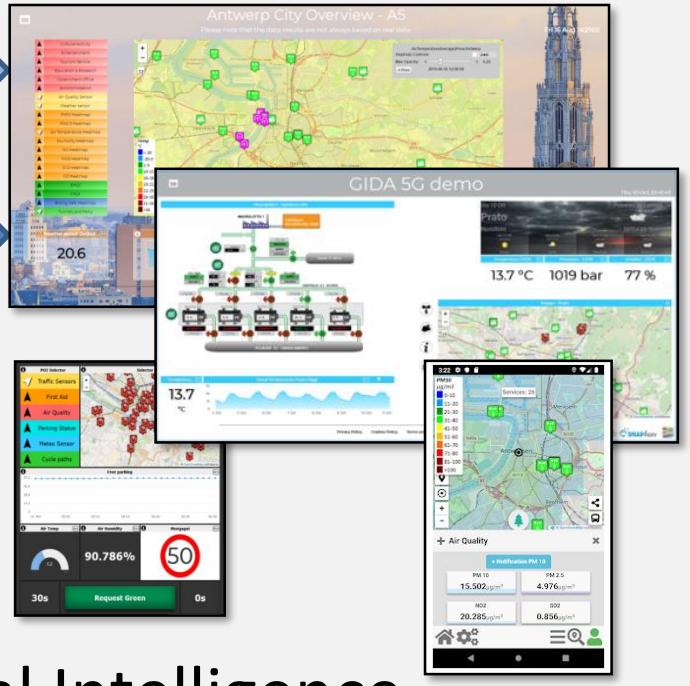


IOT Applications



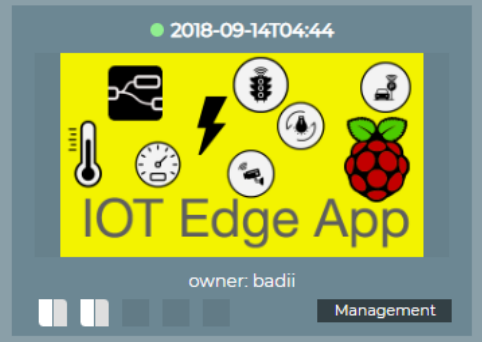


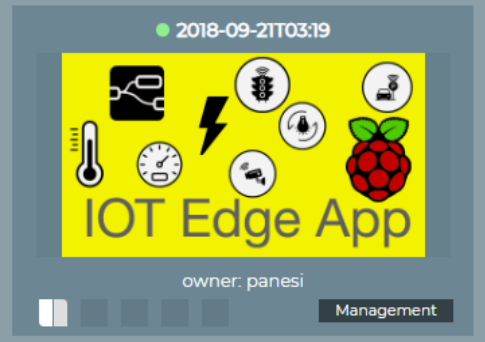
Dashboards and Apps

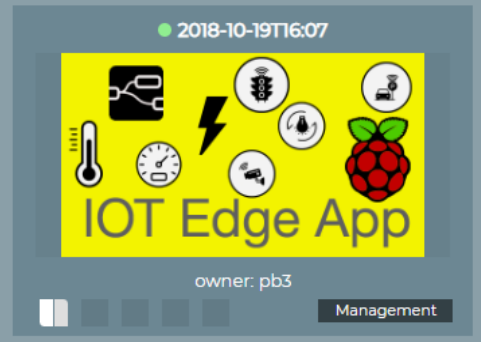


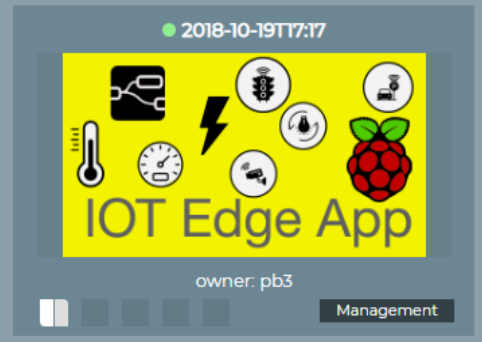
Big Data Analytics, Artificial Intelligence

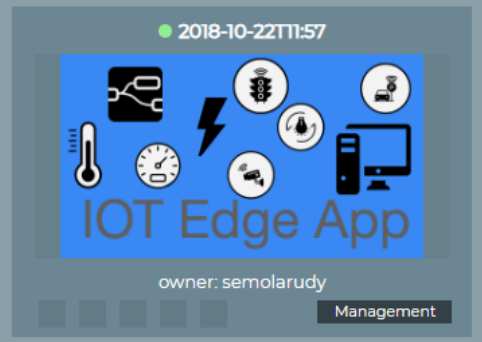
IOT Applications

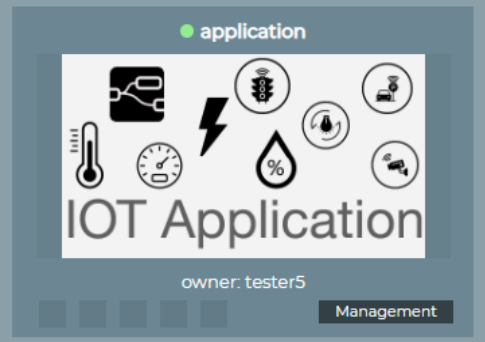


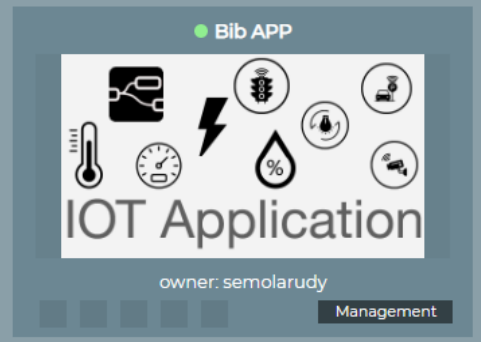


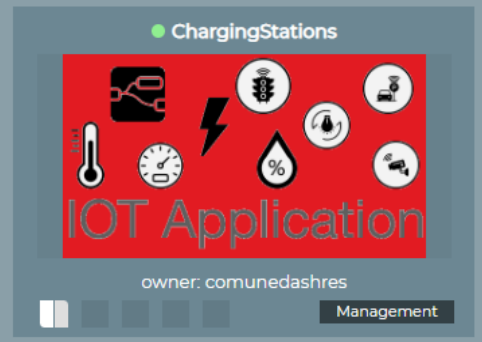


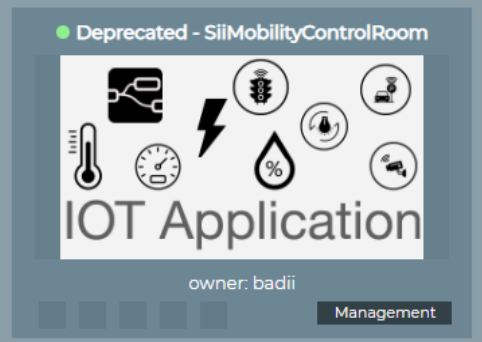


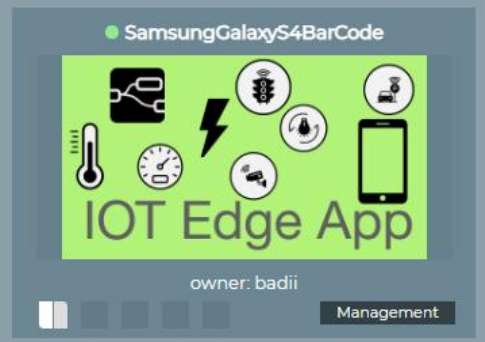




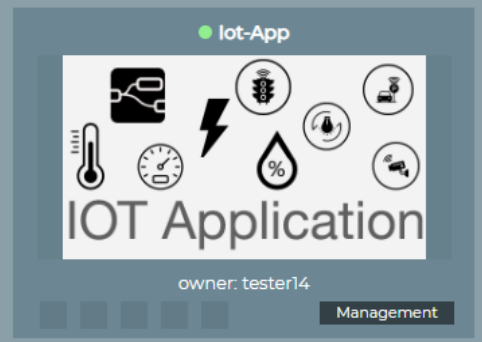






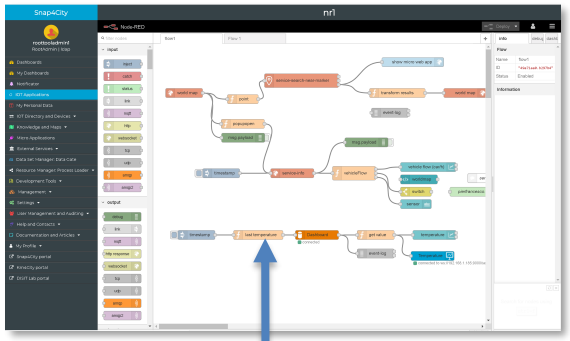




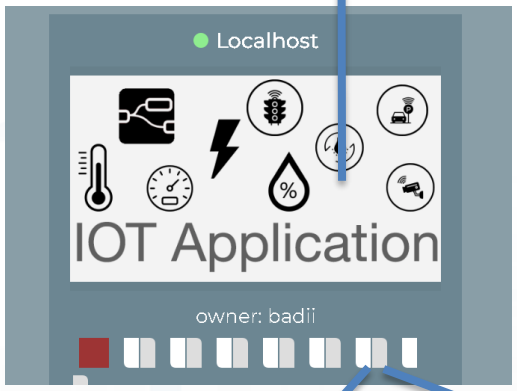


IOT Applications

- Basic / Advanced
- On IOT Edge Raspberry Pi
- On IOT Edge Android
- On IOT Edge Win/Linux



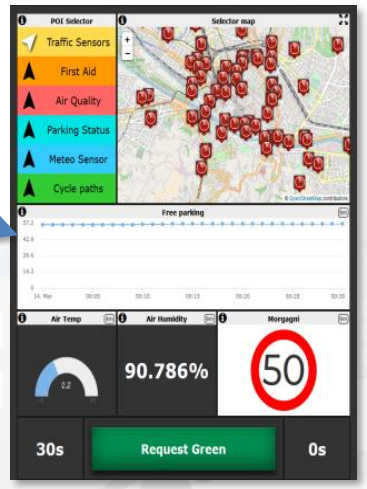
EDIT IOT APP



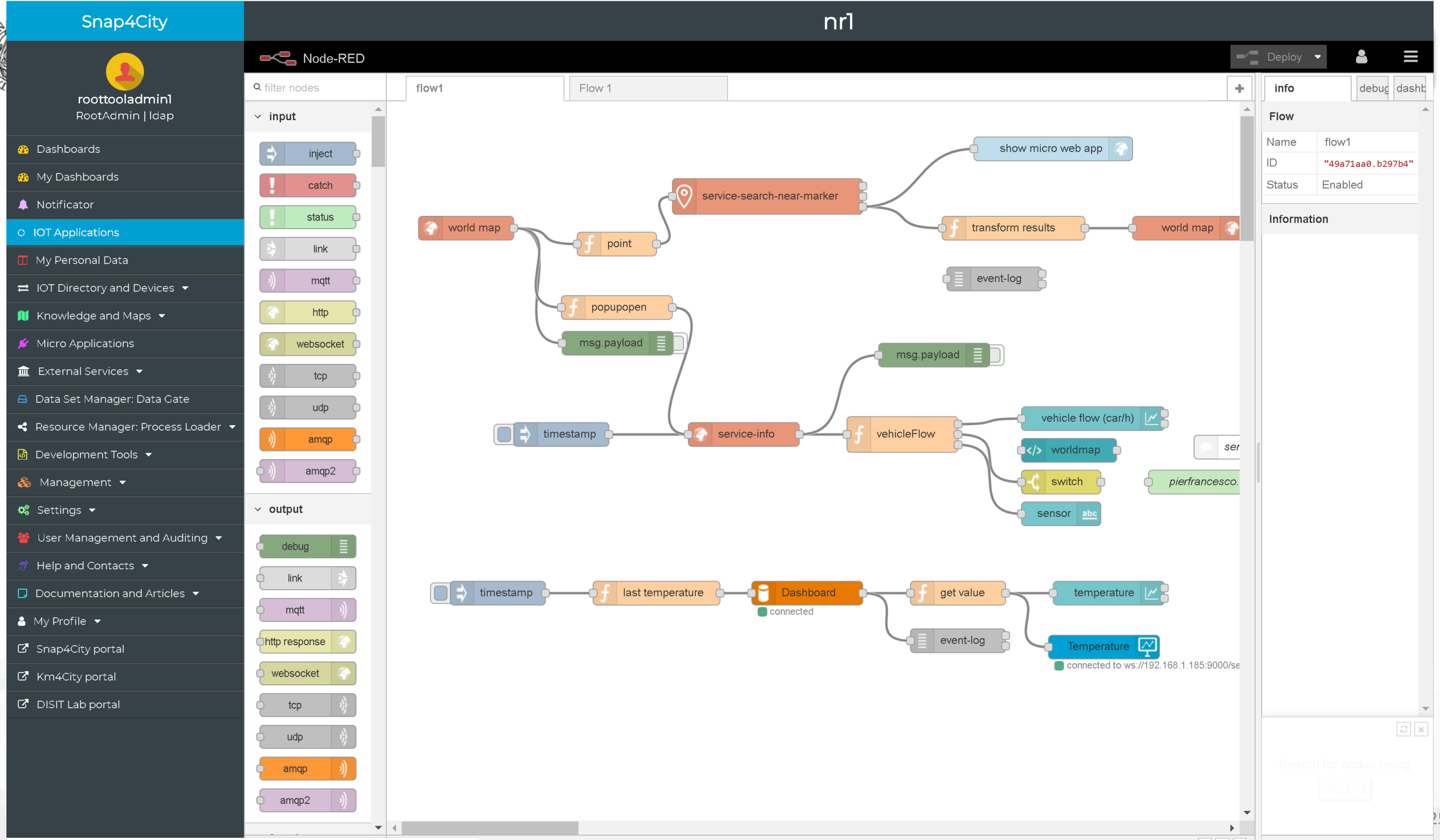
VIEW

EDIT








Snap4City
nr1
roottooladmin1
RootAdmin | ldap
Dashboards
My Dashboards
Notificator
IOT Applications
My Personal Data
IOT Directory and Devices
Knowledge and Maps
Micro Applications
External Services
Data Set Manager: Data Gate
Resource Manager: Process Loader
Development Tools
Management
Settings
User Management and Auditing
Help and Contacts
Documentation and Articles
My Profile
Snap4City portal
Km4City portal
DISIT Lab portal
Node-RED
Deploy
filter nodes
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
flow1
Flow 1
world map
point
service-search-near-marker
show micro web app
transform results
world map
event-log
popupopen
msg.payload
msg.payload
timestamp
service-info
vehicleFlow
vehicle flow (car/h)
worldmap
switch
sensor
timestamp
last temperature
Dashboard
connected
get value
temperature
event-log
Temperature
connected to ws://192.168.1.185:9000/se
info
debug
dashb
Flow
Name
flow1
ID
"49a71aa0.b297b4"
Status
Enabled
Information

Dashboards with city data and your data/actuators

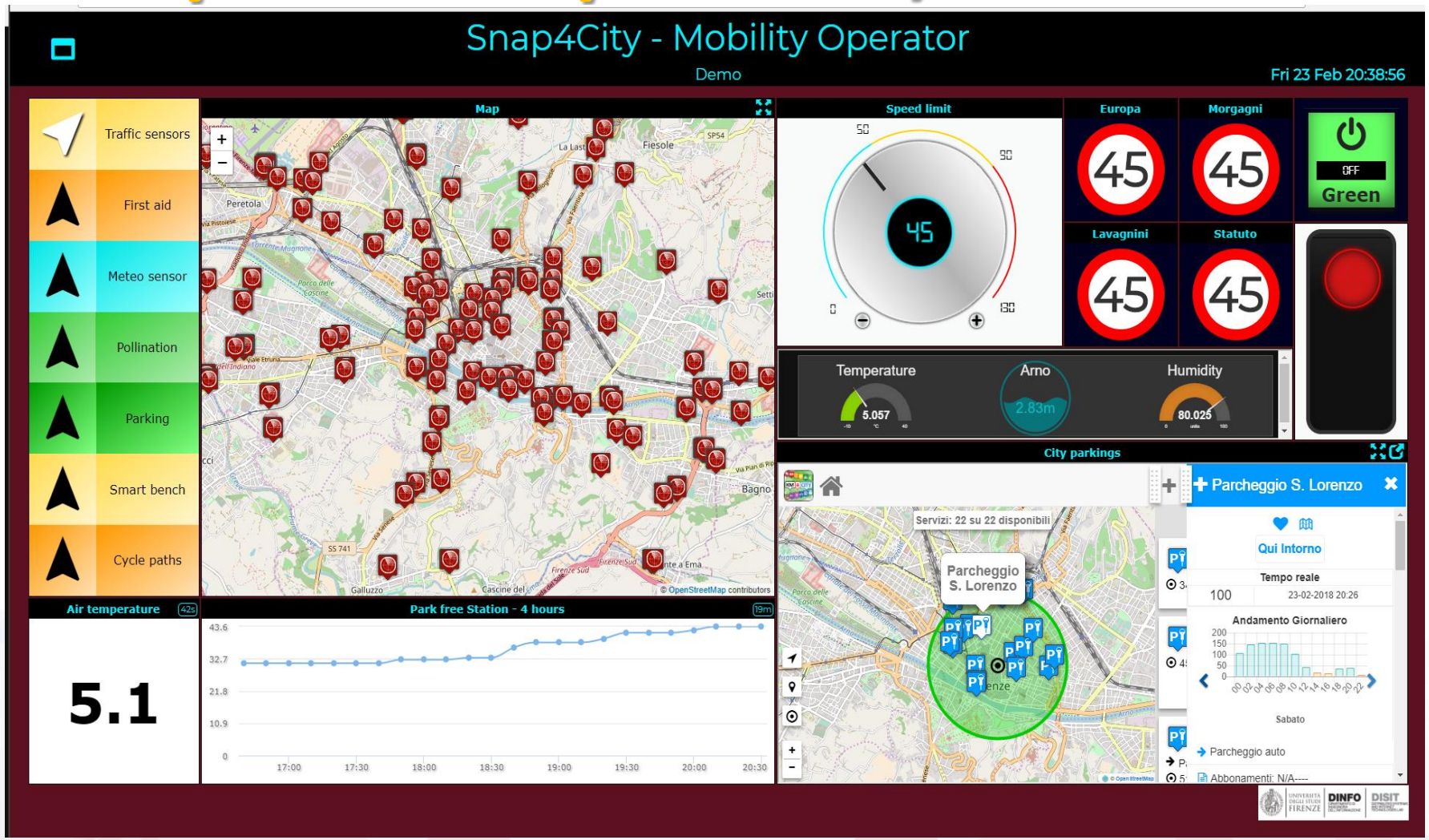
Sensors:

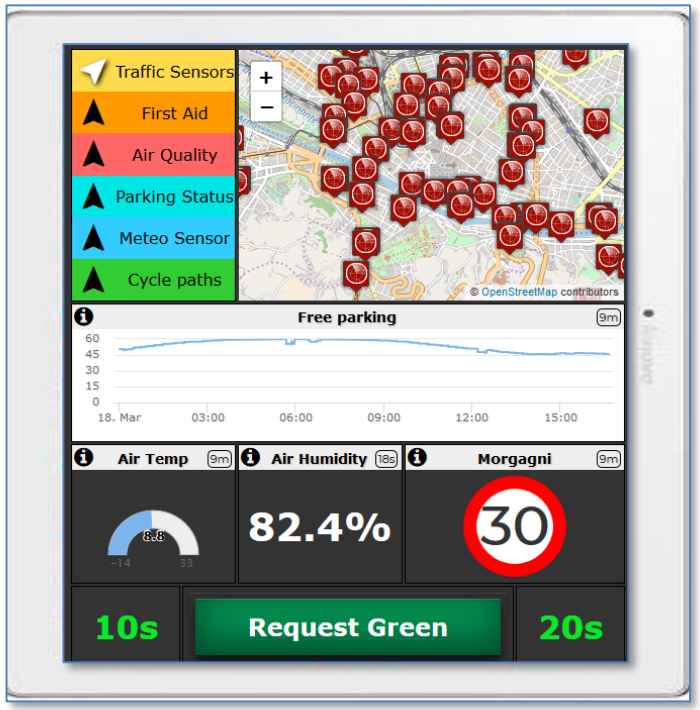
- Values
- Status

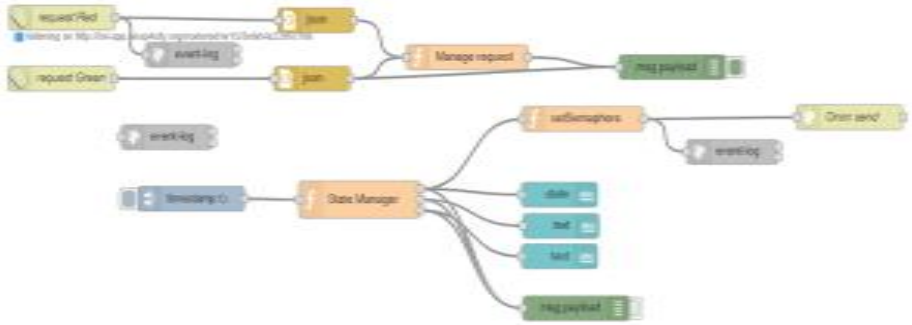
Actuators:

- Buttons
- Dimers
- Etc.

Virtual Sensors and Actuators




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







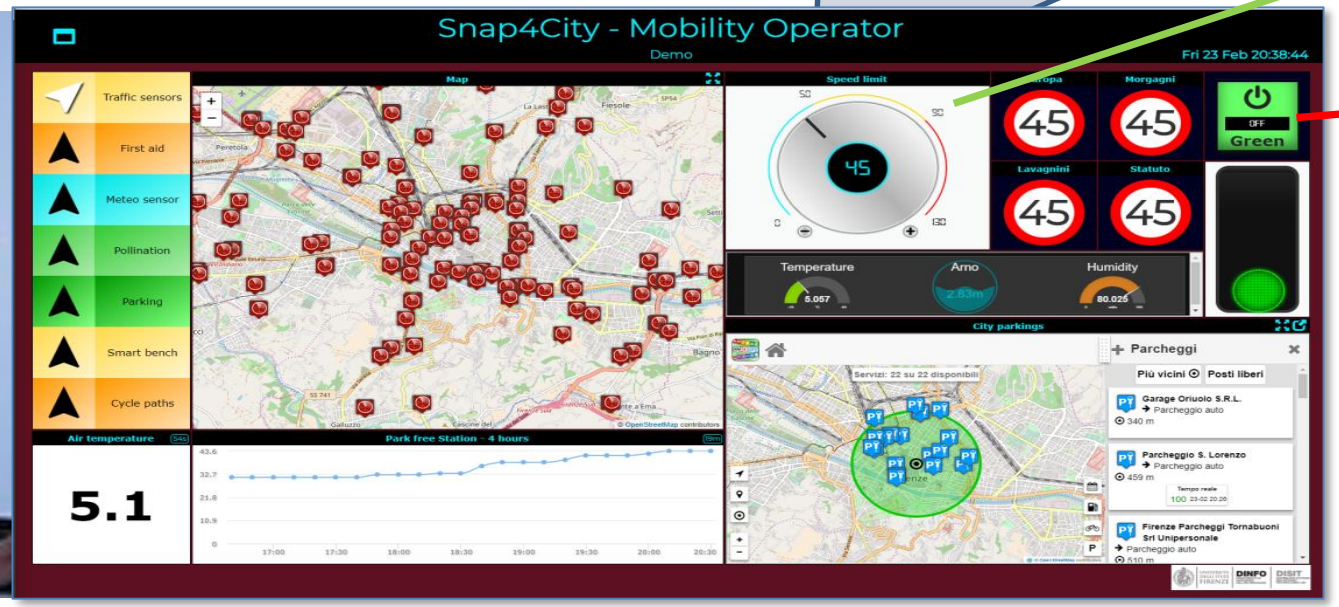


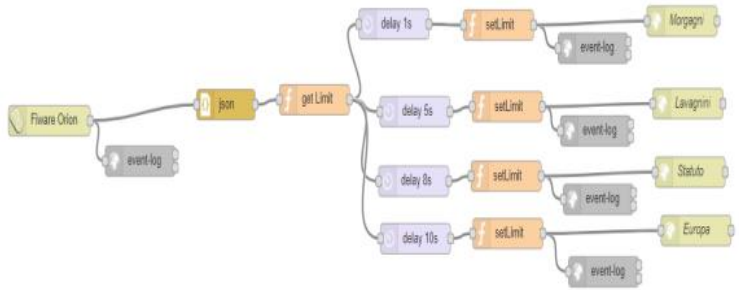




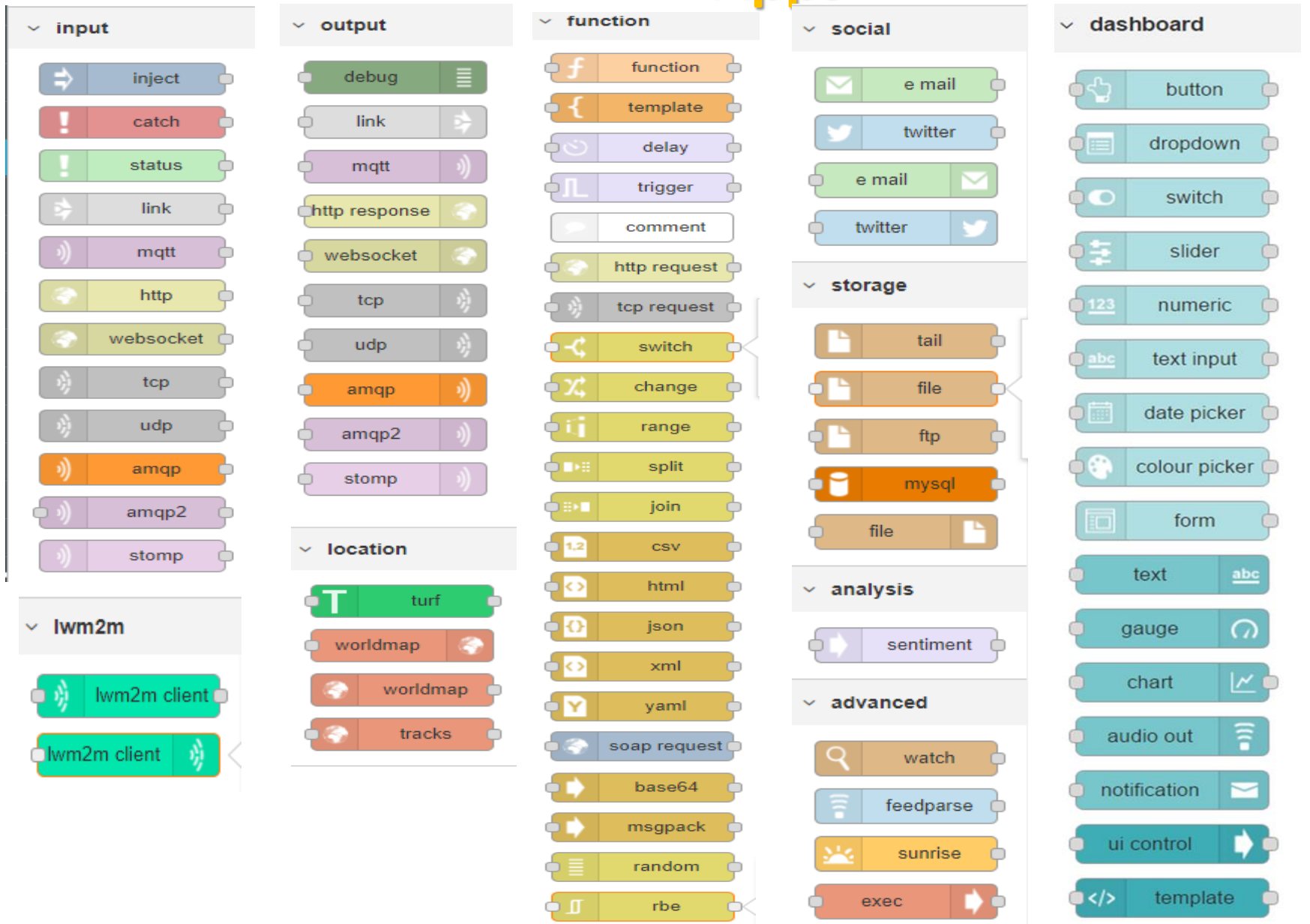




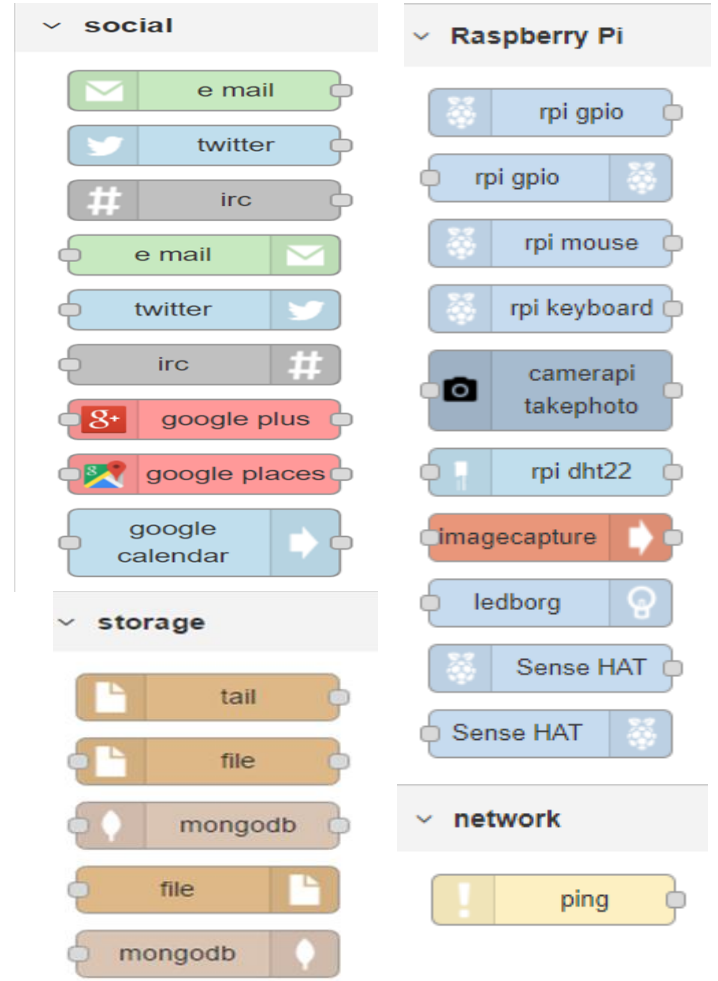

Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
45
Europa
45
Morgagni
45
Lavagnini
45
Statuto
45
OFF
Green
Temperature
Arno
Humidity
City parkings
Parcheggi
Air temperature
5.1
Park free Station - 4 hours

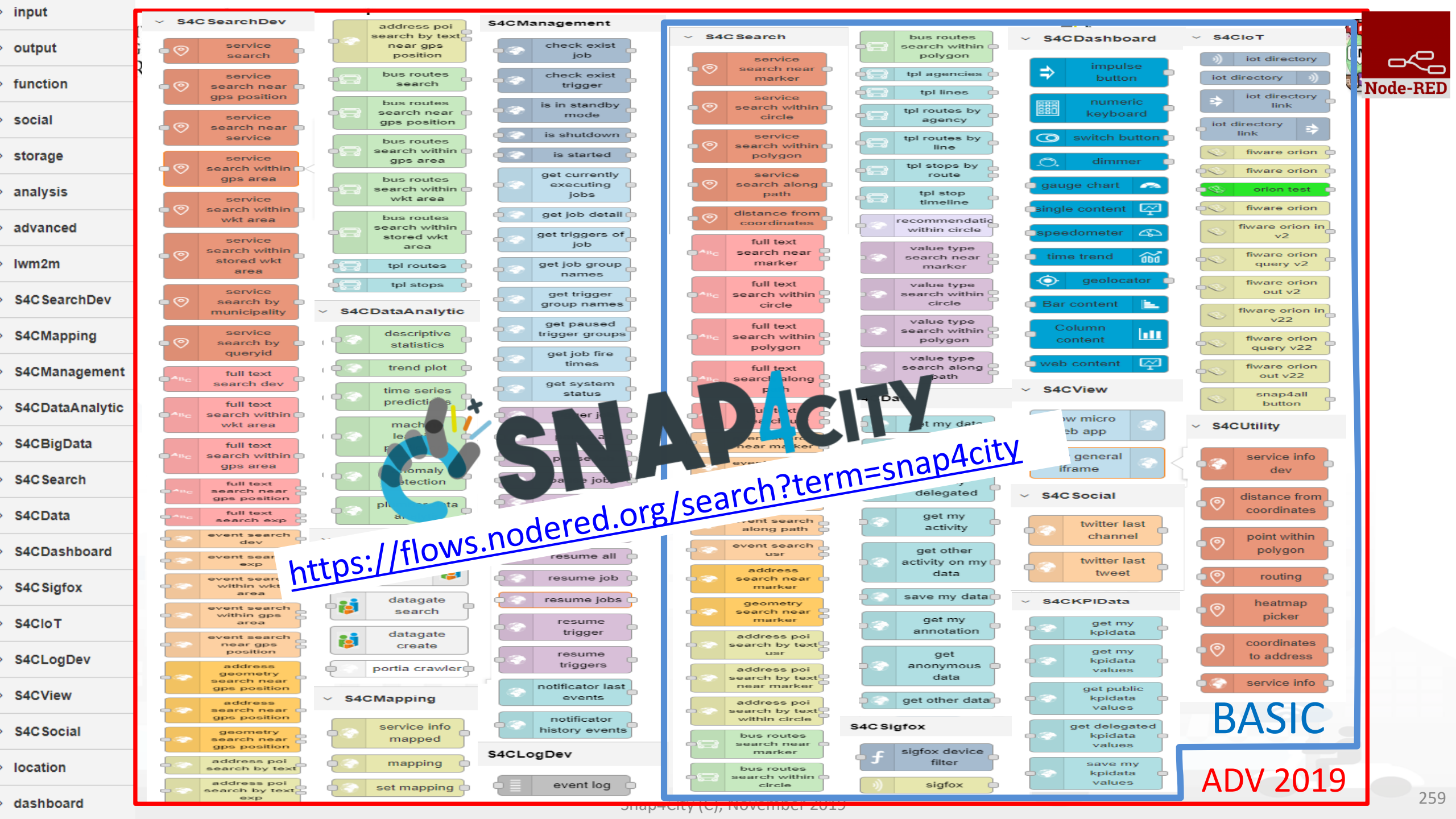

Fiware Orion
event-log
json
get Limit
delay 1s
delay 5s
delay 8s
delay 10s
setLimit
setLimit
setLimit
setLimit
event-log
event-log
event-log
event-log
Morgagni
Lavagnini
Statuto
Europa

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



+ on IOT Edge Raspberry




input
output
function
social
storage
analysis
advanced
lwm2m
S4CSearchDev
S4CMapping
S4CManagement
S4CDataAnalytic
S4CBigData
S4CSearch
S4CData
S4CDashboard
S4CSigfox
S4CIoT
S4CLogDev
S4CView
S4CSocial
location
dashboard
Node-RED
SNAP4CITY
https://flows.nodered.org/search?term=snap4city
BASIC
ADV 2019

IOT Applications vs Dashboards

- IOT Applications, realized by using Snap4City Node-RED and integrated with Snap4City Nodes/MicroServices block, can be behind dashboards to get data from them with Virtual Sensors and Actuators.
  - Dashboards may be connected to multiple IOT Applications and IOT devices
  - IOT Applications may be connected with multiple Dashboards and IOT devices
- A network of Dashboards, IOT Apps and IOT Dev and data is easily realized exchanging data via secure connections.
- see the following Training Cases
  - **US2. Using and Creating Snap4City Applications with Dashboards**
  - **TC2.3 - List of MicroServices and the Help, for Final Users and Developers**
  - **TC2.4 - The daisy of MicroServices for Snap4City Dashboard and IOT App**
  - **TC2.28 - Snap4City MicroServices for Snap4City platform management from IOT Applications, feature of reflection**

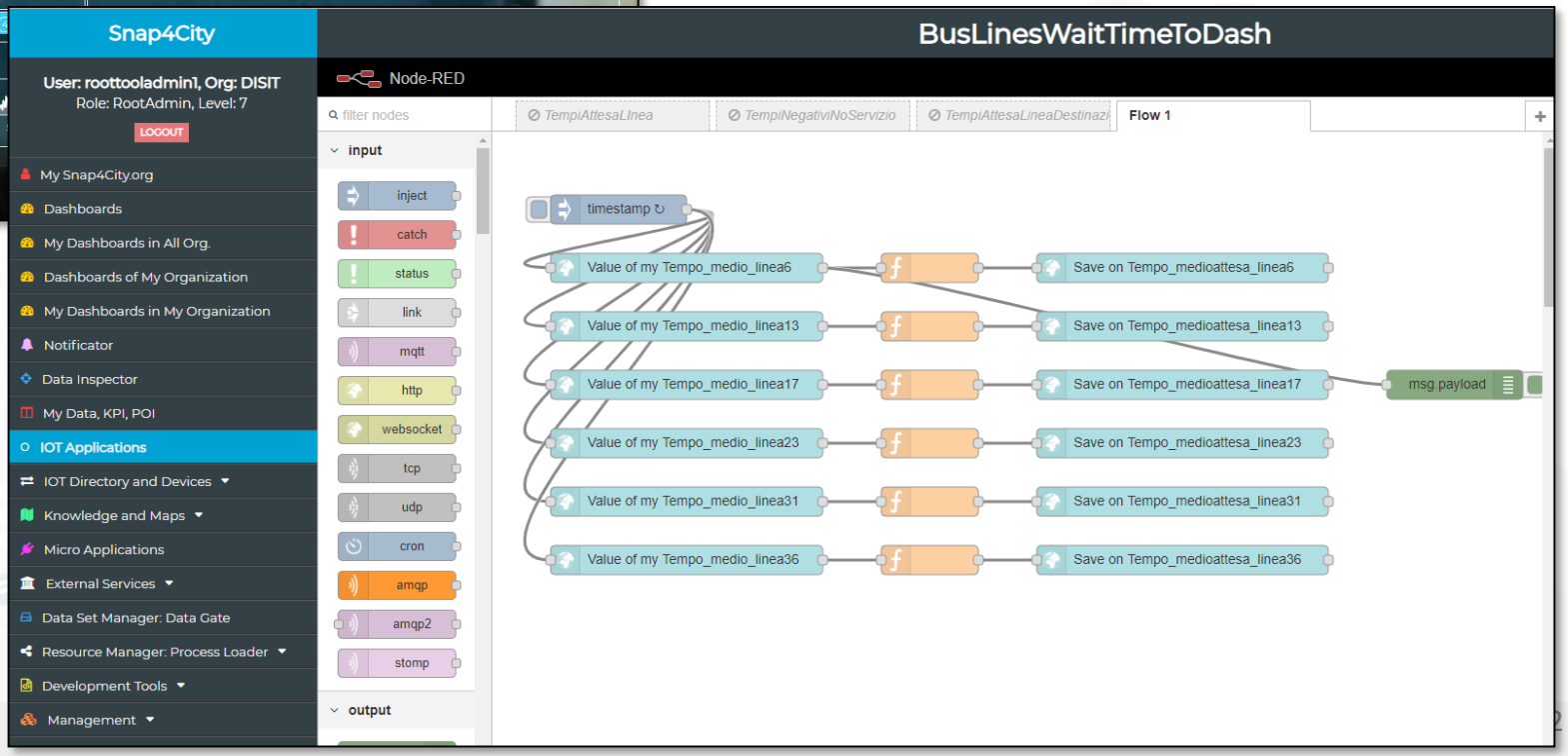
Florence







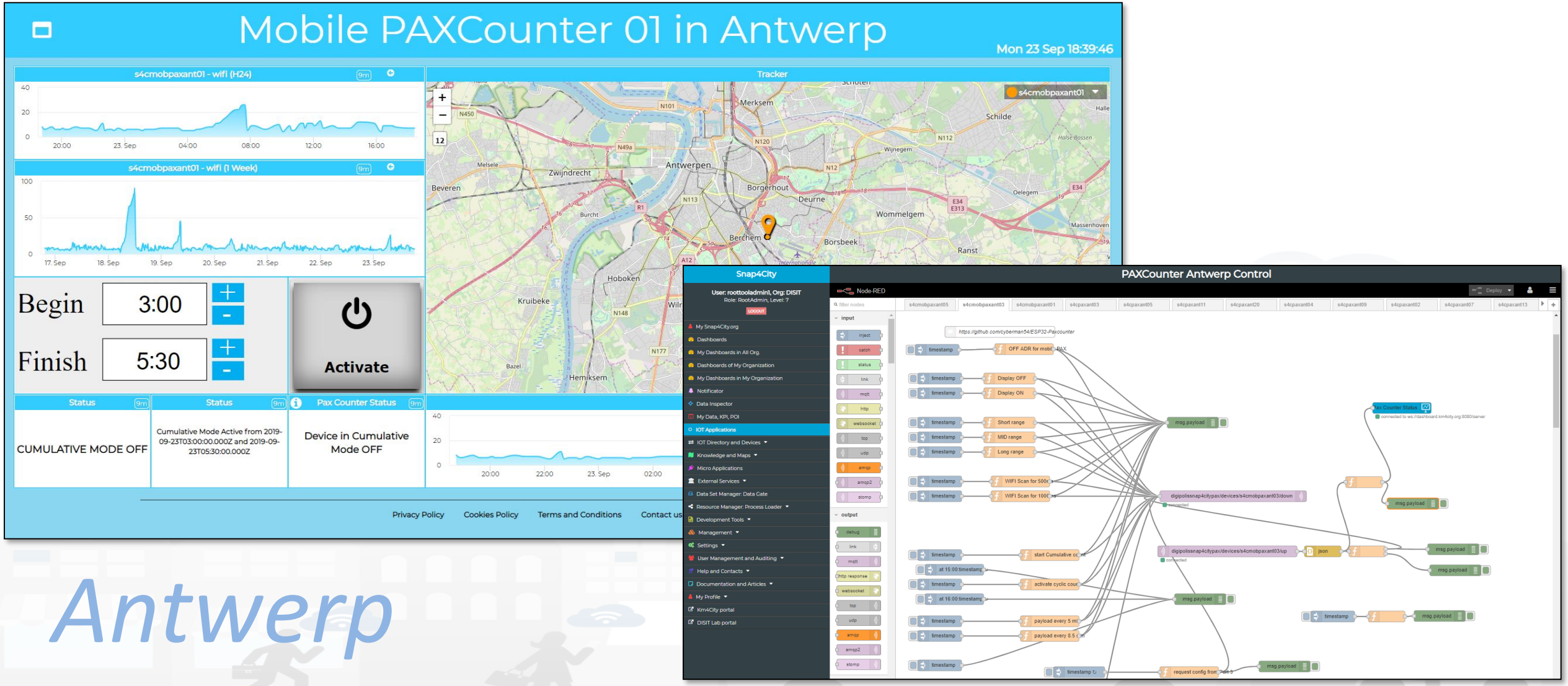
Estimation of the mean waiting time at bus stops



Antwerp



Programmable PAX counting



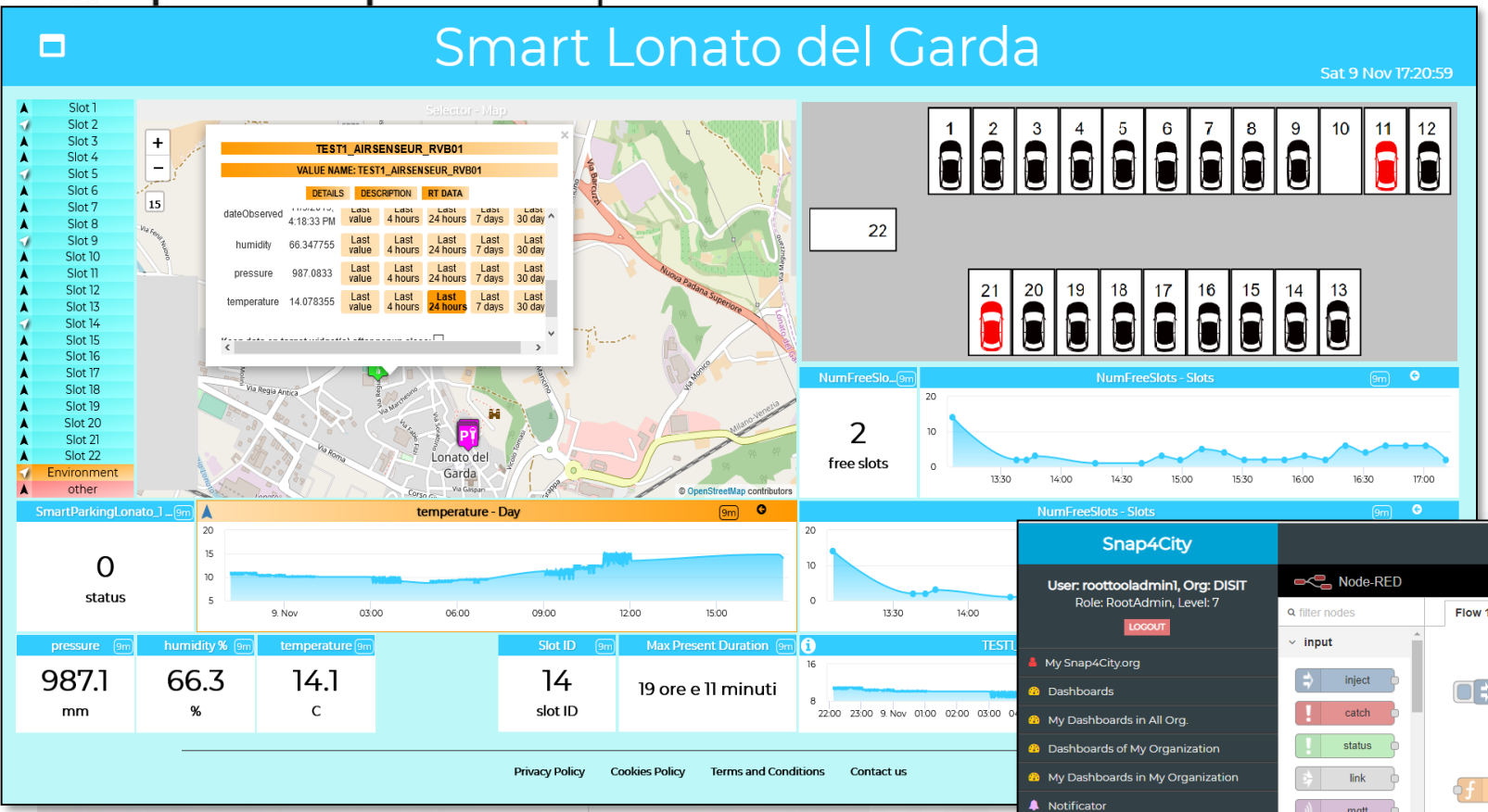
Antwerp

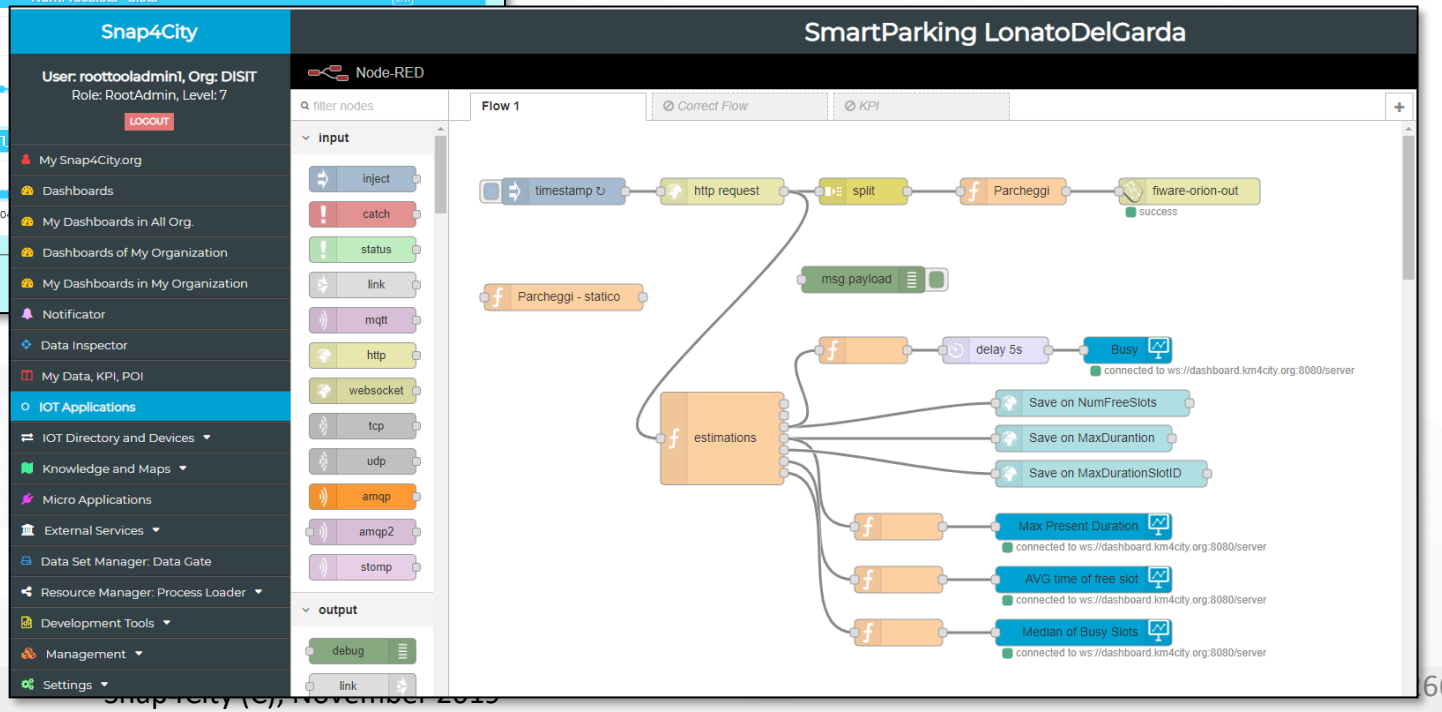

Lonato del Garda

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

SNAP4CITY KM4CITY

Smart Parking Monitoring







IOT Devices



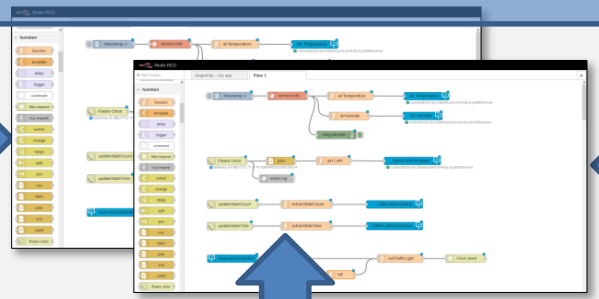
Snap4City: Builder of Sentient Cities Solutions

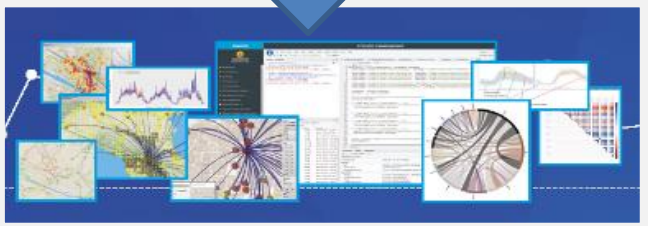
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

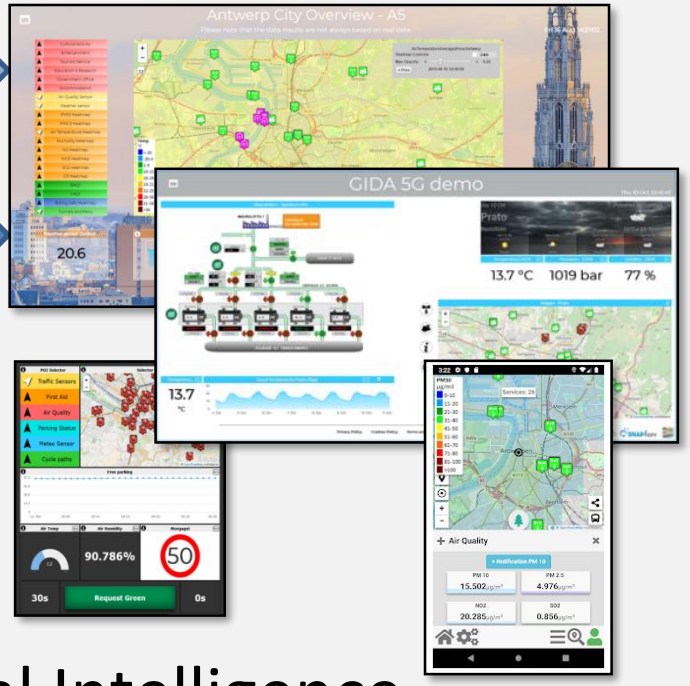


IOT Applications





Dashboards and Apps



Big Data Analytics, Artificial Intelligence

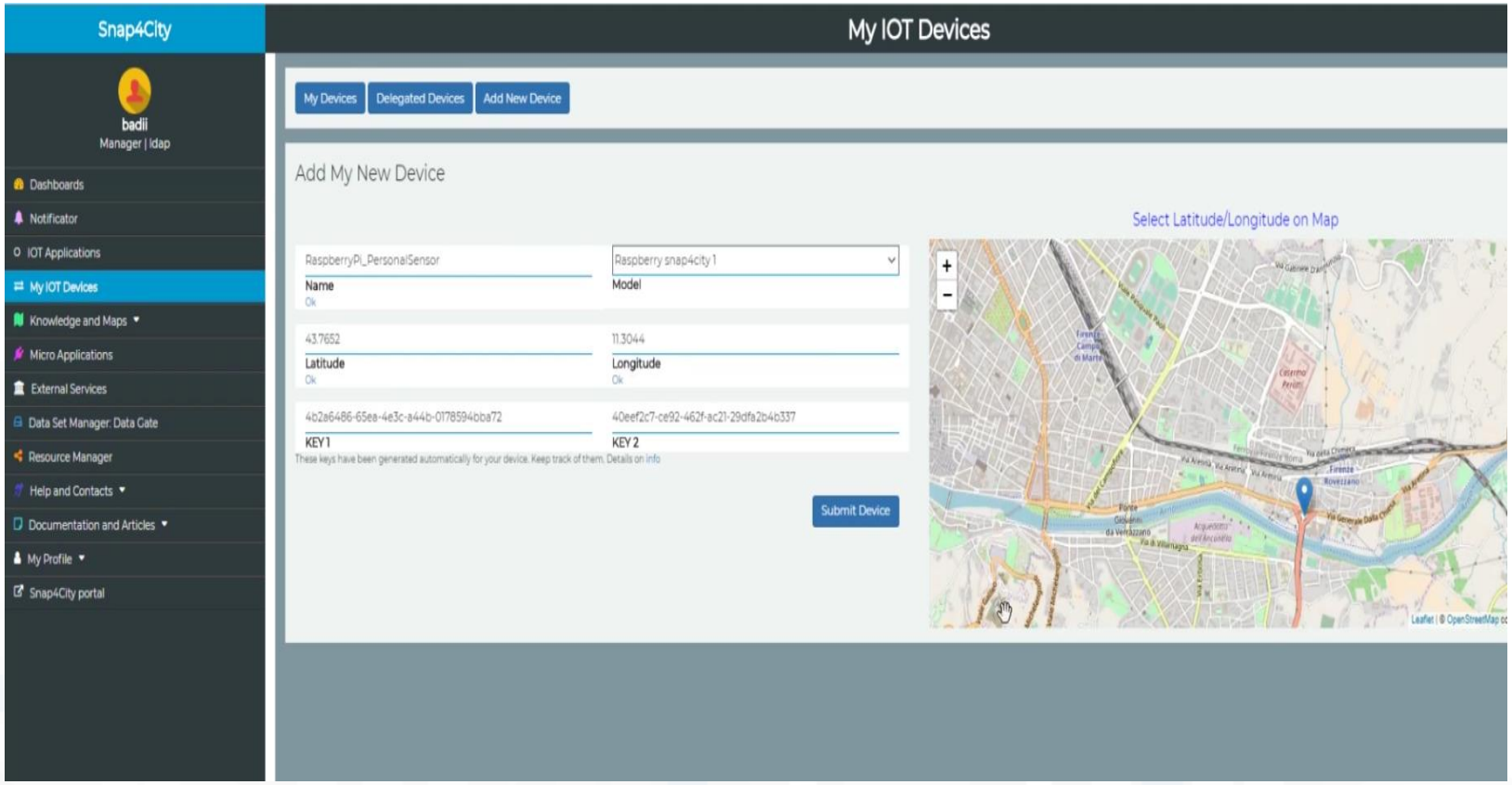
Add IOT/IOE Devices

Just Buy an IOT Device and register: SigFOX, MQTT, NGSI (FiWare), …

- Attach them by
  - Models
- A range of protocols, formats, approaches

Create your own devices:

- Arduino,
- Raspberry,
- Android,
- LoraWAN + Arduino,
- etc.

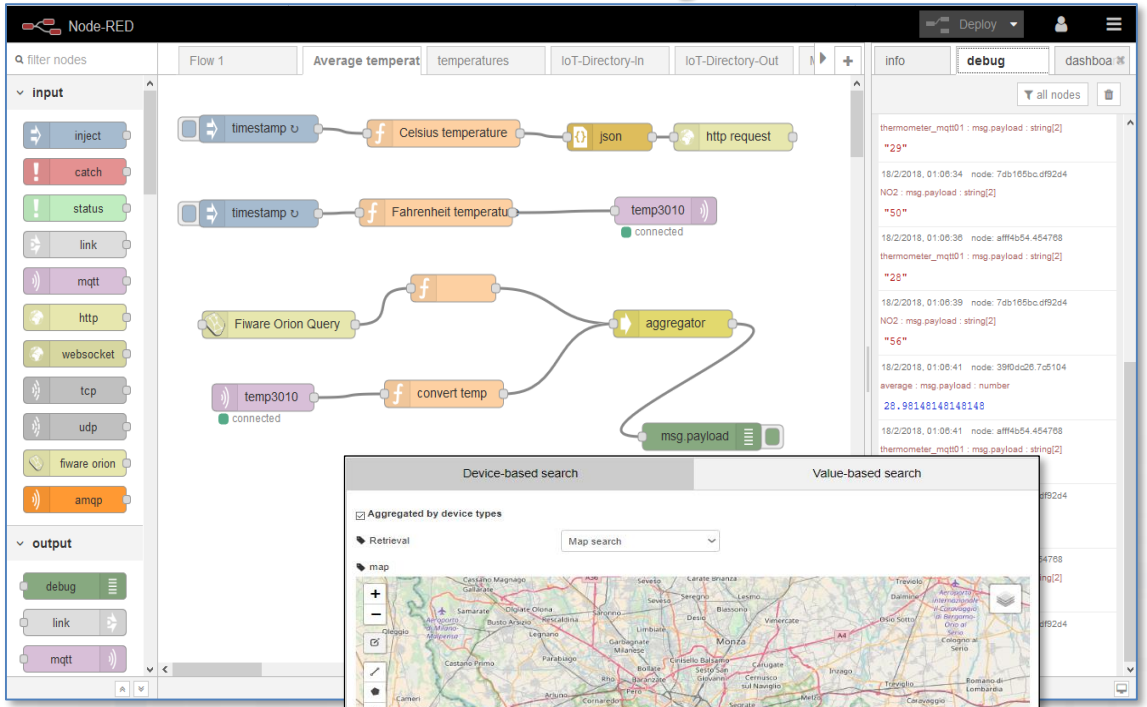


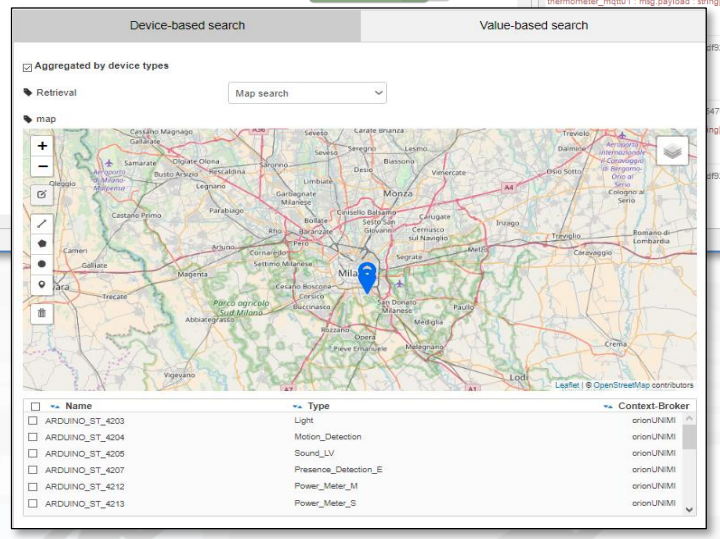
Secure Communication: HTTPS, TLS (K1, K2), Certificates

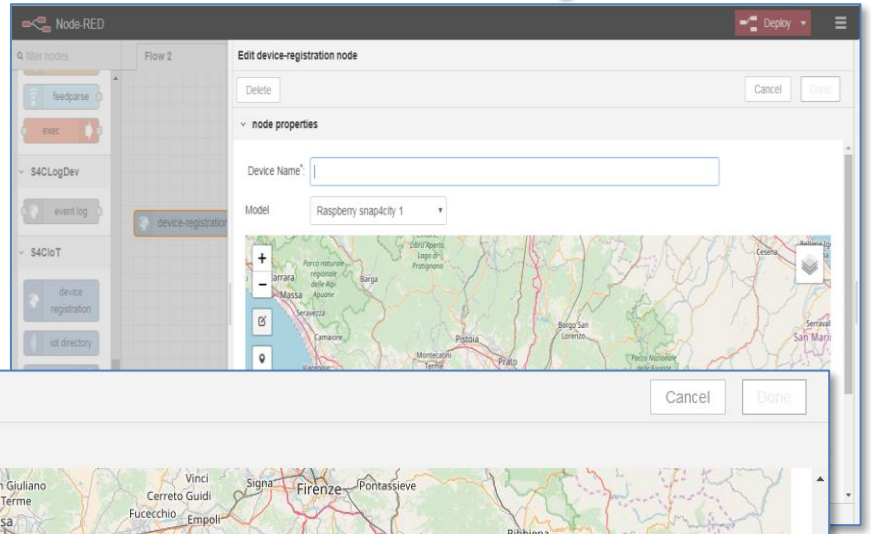
Standards and Interoperability

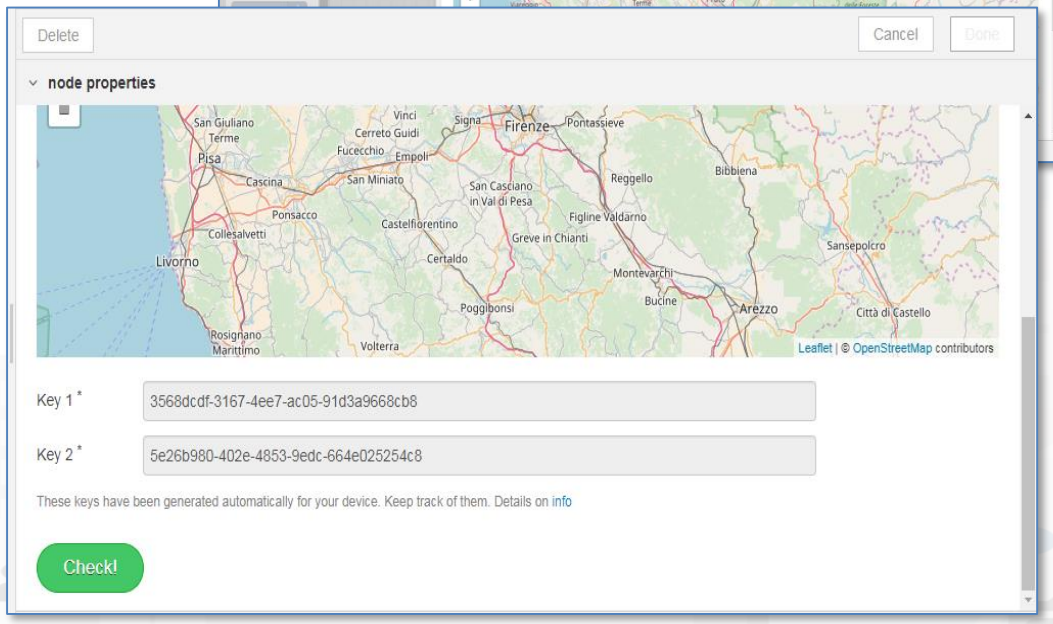
Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, etc.

IOT Discovery on IOT Application Development









IOT Devices Registration

- IOT device registration can be performed by all kind of users.
- Higher level users can register large sets of IOT devices, reg. in Bulk
- Suggested training:
  - HOW TO: add a device to the Snap4City Platform
  - Snap4City IOT Devices Registration
  - TC2.15 - IOT device registration
  - TC2.11 - Search on IOT Directory for Devices and Sensors, IOT Device Registration
  - TC2.30 - Bulk Load for IoT Devices Registration
  - TC10.9 - IOT Directory and Multiple Brokers

IOT Devices

Sensors/
Actuators

IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI

Arduino,
Wi-Fi, NGSI

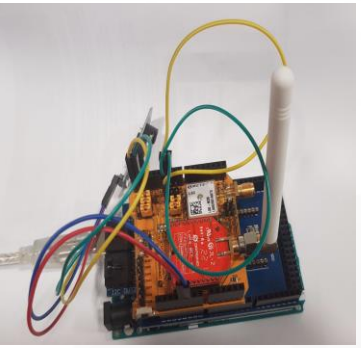
Snap4All
IOT Button
ESP, NGSI,
Wi-FI, BT

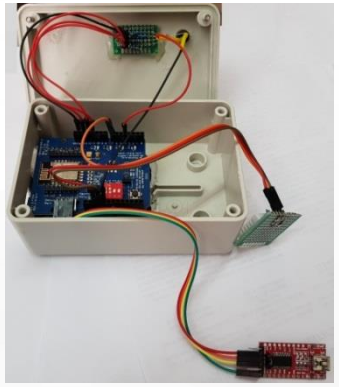
Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

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

IOT Edge
NodeRED:
Android, LINUX,
Windows, …

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



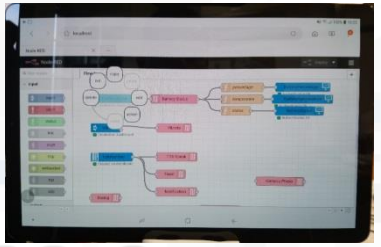














Any Sensor / Actuator
Open to other protocols

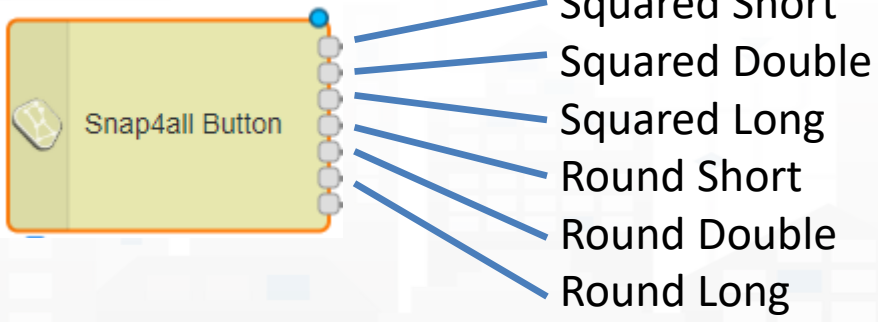
Snap4All IOT Button

- Multi Wi-Fi
- Ready to use BLE
- ESP based, cheap & easy
  - low/no energy consumption/ standby
- Mutual Authentication with certificates, or K1,K2,sha
- secure encrypted connection, NGSI
- Open Source, Fully Customizable
- HW extensible to sensors

version: 3



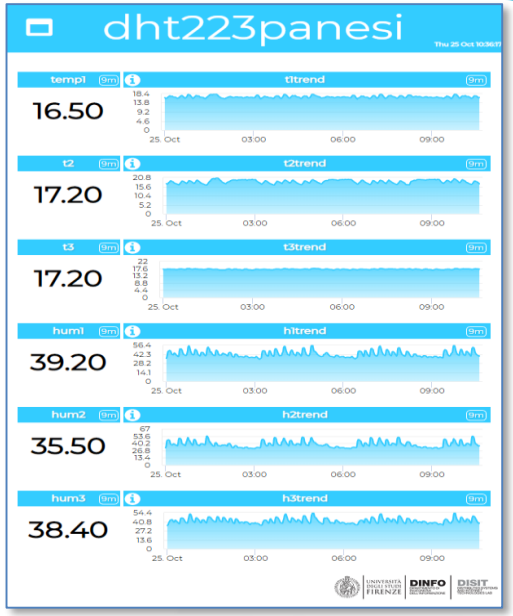




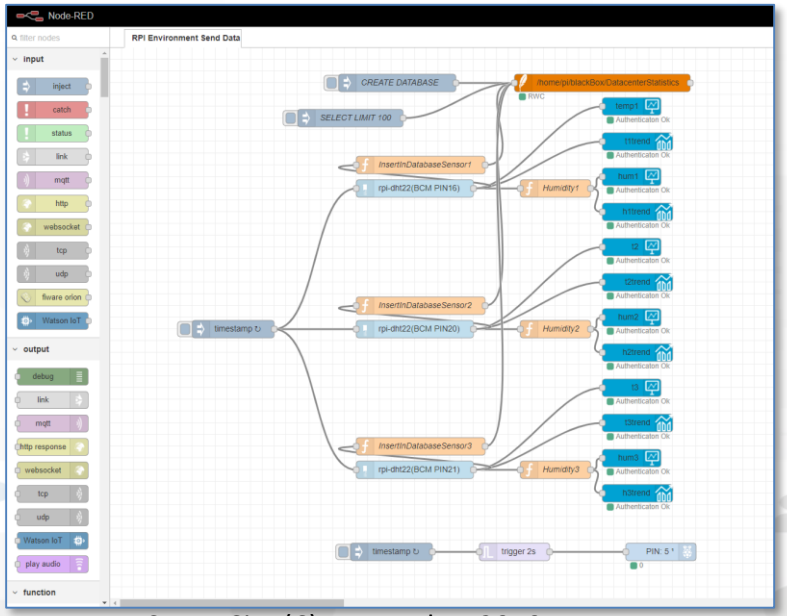
https://www.snap4city.org/drupal/node/276
https://www.snap4city.org/drupal/node/297 help config

IOT Edge on Raspberry Pi

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





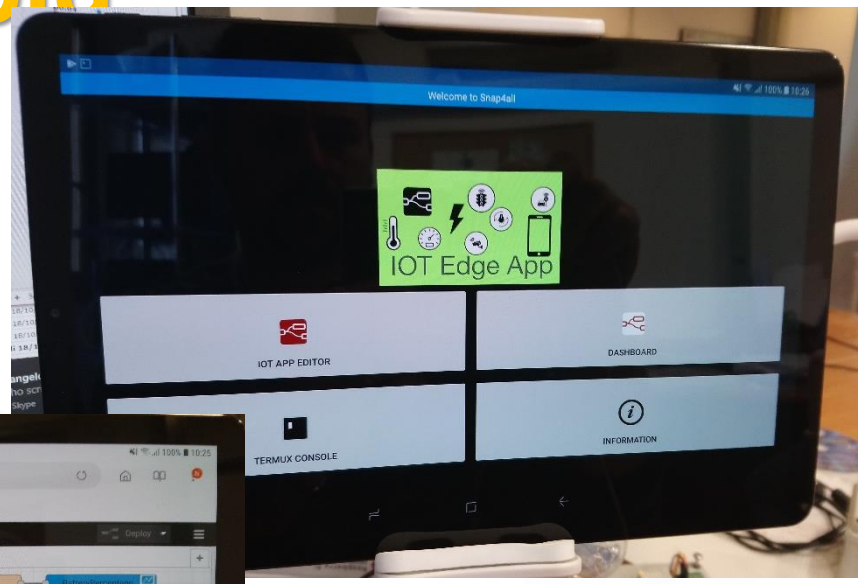


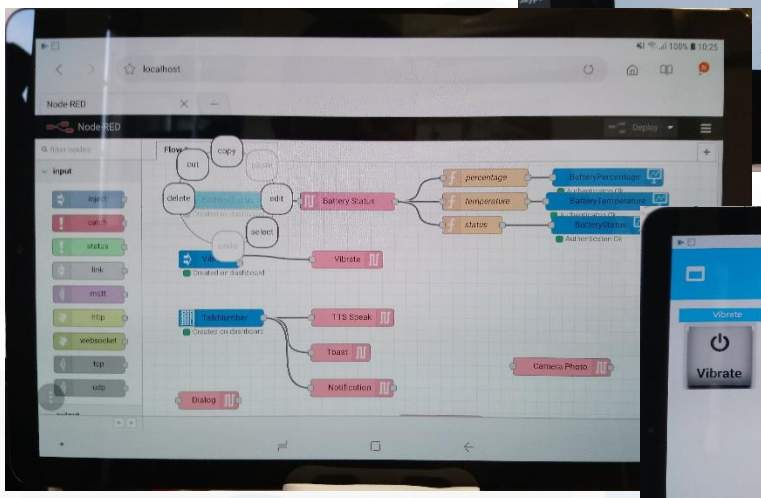


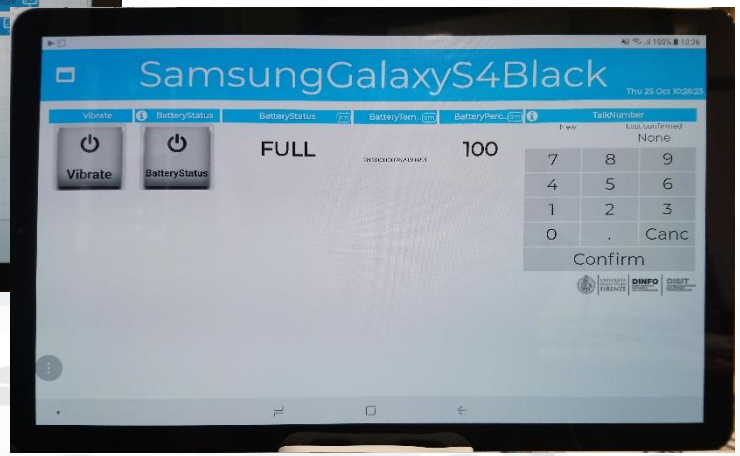
MicroServices:
- DHT
- ModBus
- any shield
- etc....

IOT Edge Snap4All App for Android

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







PaxCounter devices





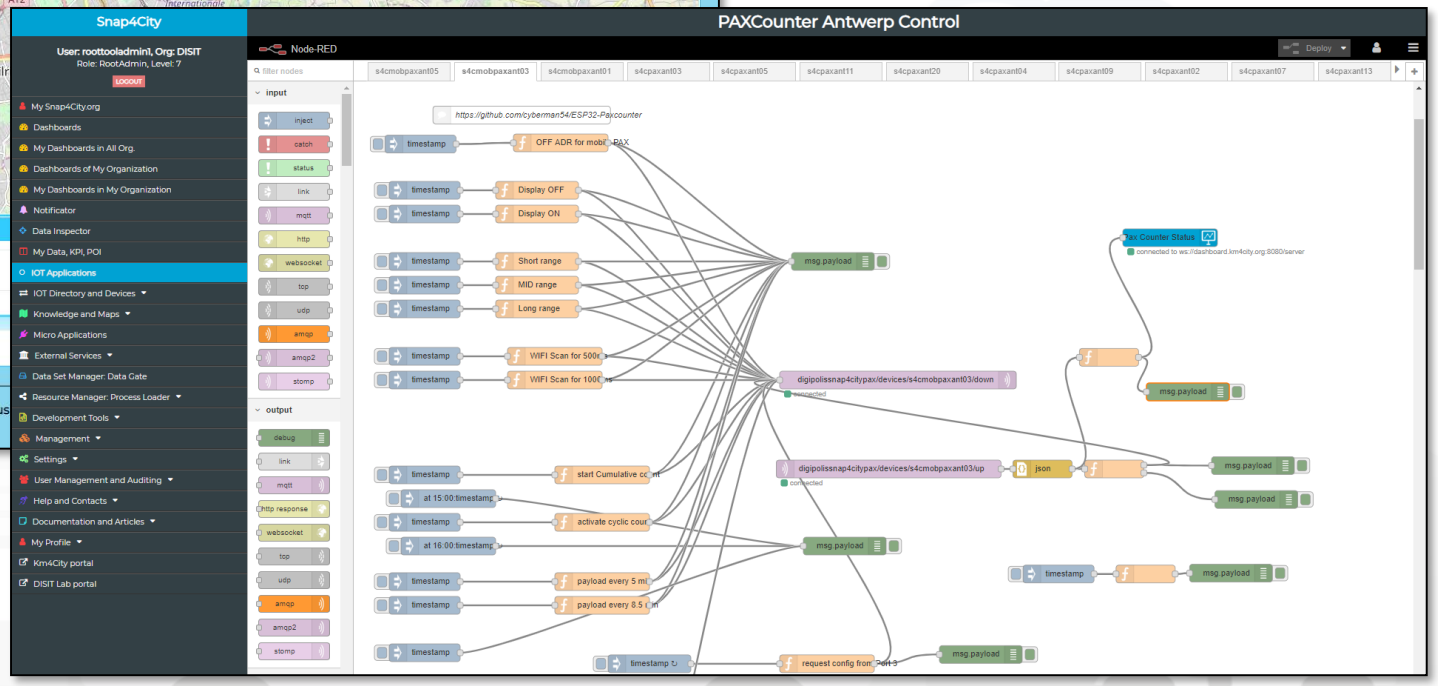


- Fixed PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Mobile PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Fixed PaxCounter(LoraWan+Wifi out)
  - Based on Wi-Fi- Bluetooth

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

Programmable PAX counting

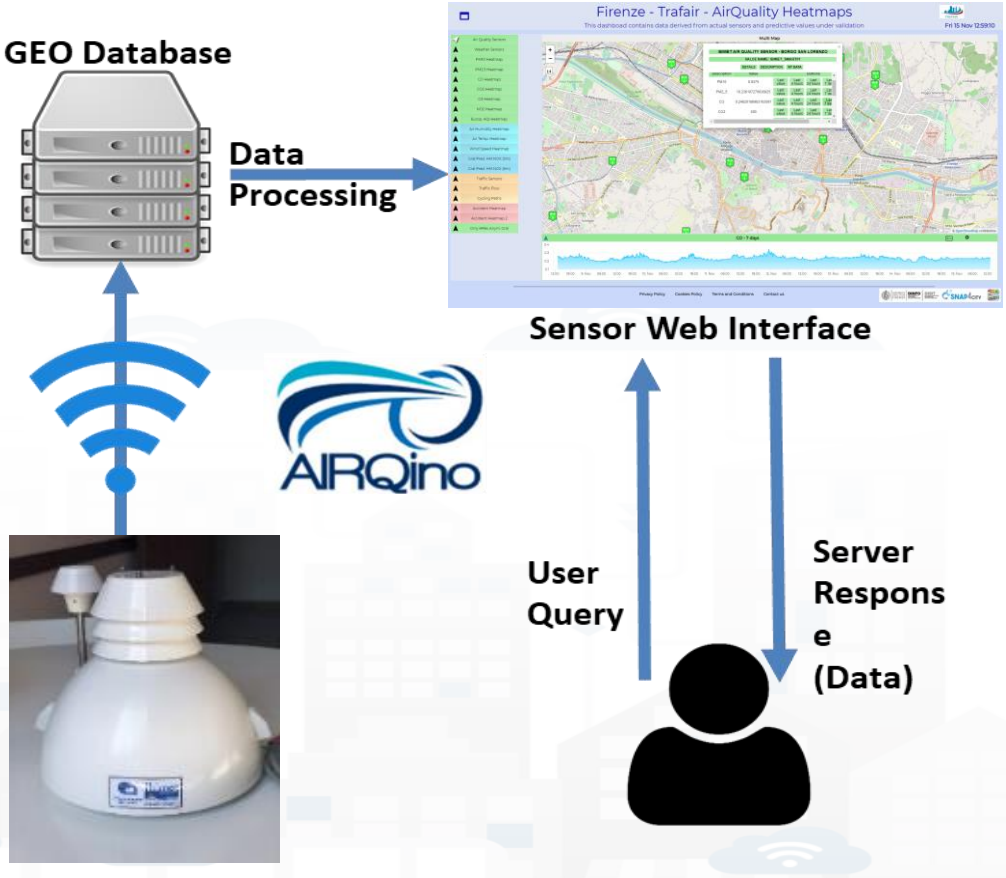




Antwerp

AIRQino Low cost air quality monitor





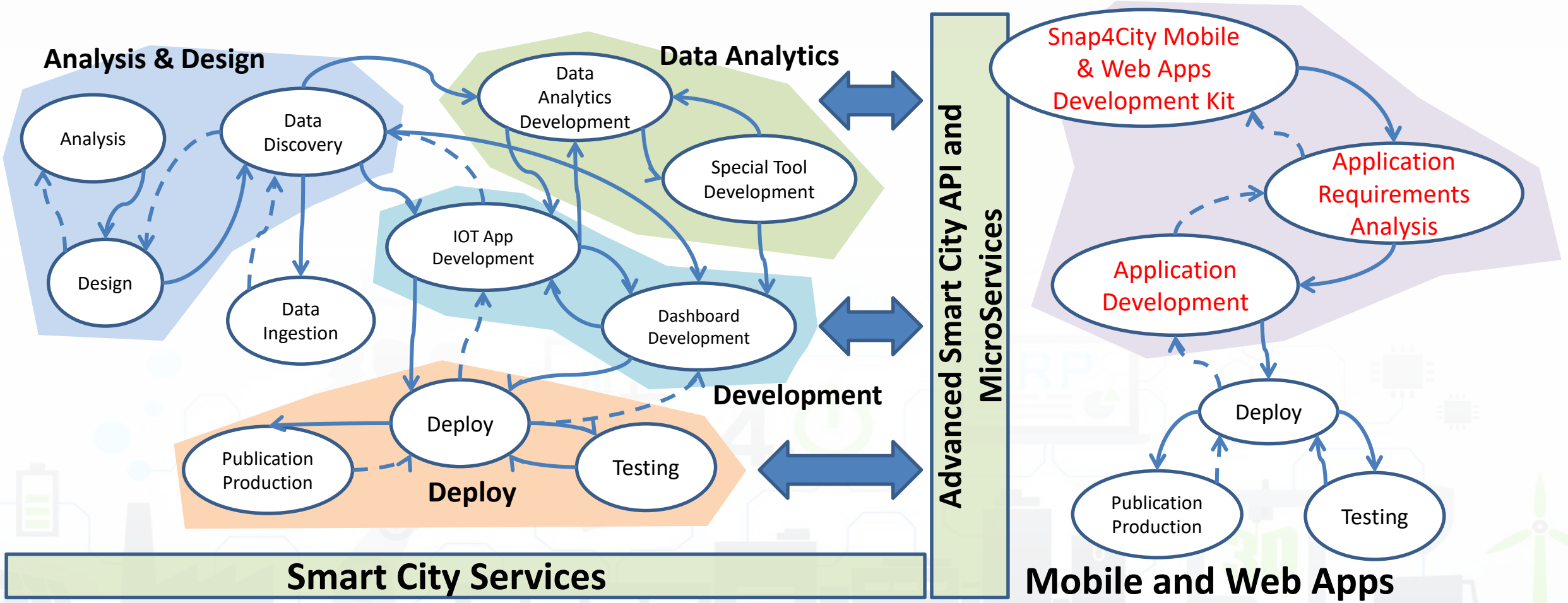
Humidity, Temperature, CO, CO2, O3, NO2, VOC, PM2.5, PM10) in urban environment

TOP

FORGING & MANAGING FLEXIBLE MOBILE APPS, Web Apps and MicroApplications

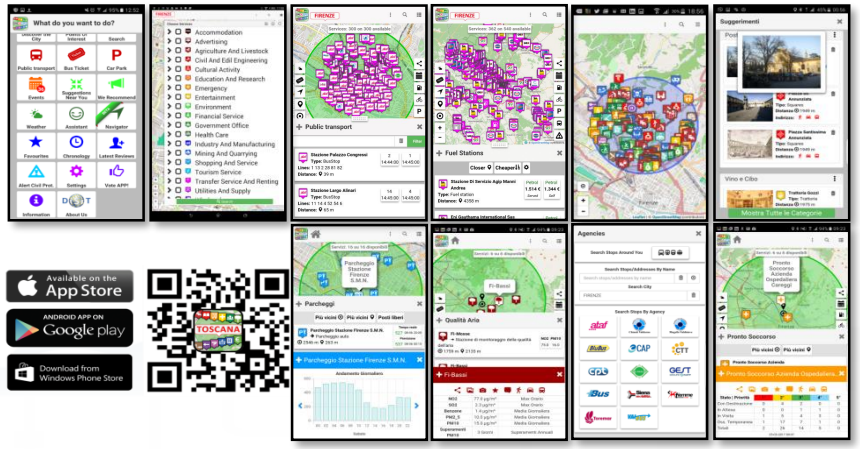


Develop Mobile & Web Applications Exploiting Snap4City Smart City Services



Web and Mobile App Developers, to generate

Mobile Apps



Web App HTML5



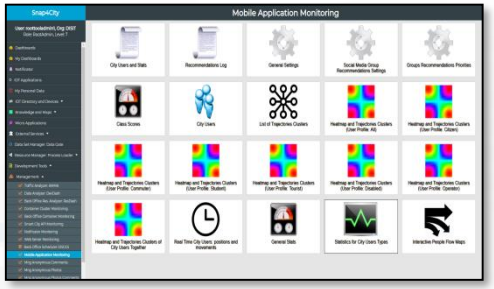
Embed into Web pages



City User



Advanced Smart City API



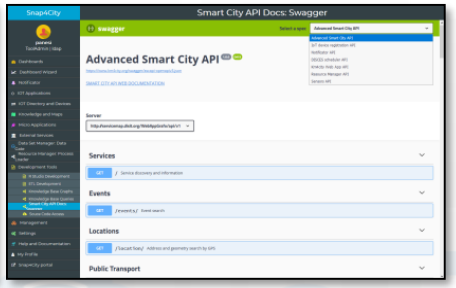
Mobile Application Monitoring Administrator



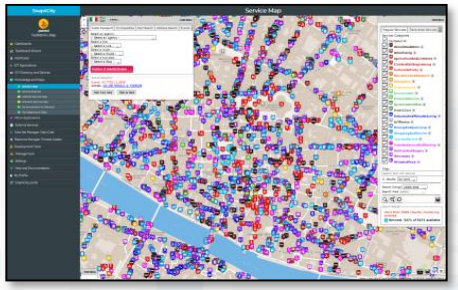
Knowledge Base, Km4City



Km4City Open Source examples dev. tool kit



Swagger



ServiceMap

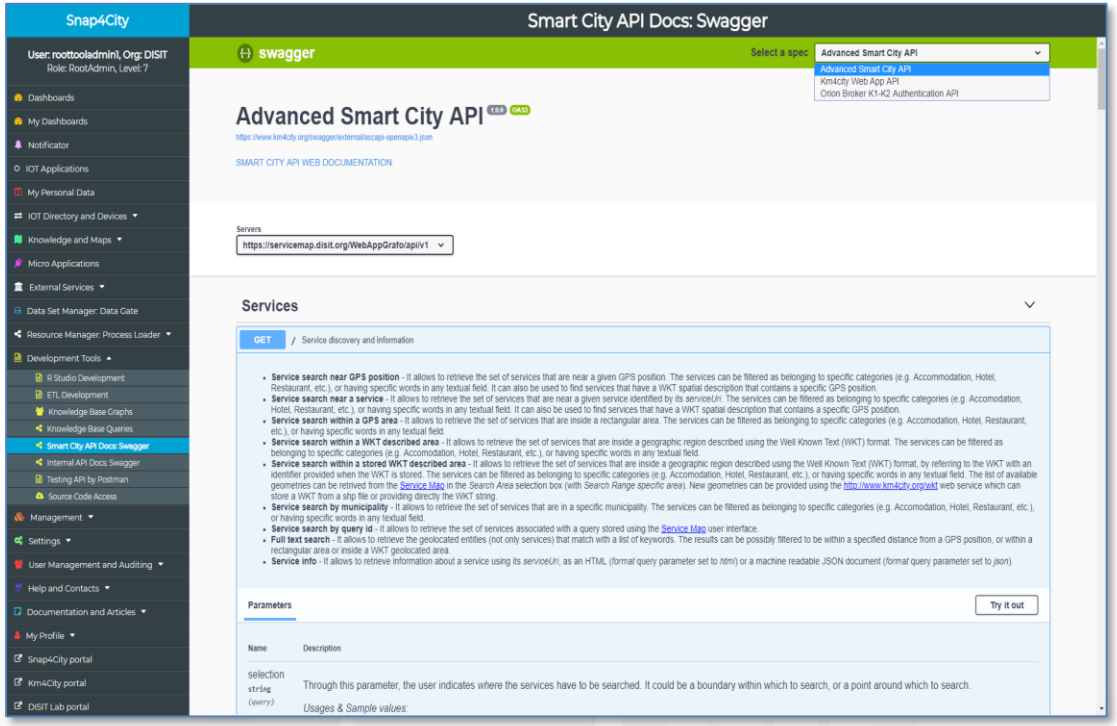
Developer



Advanced SmartCity API

- Search data: by text, near, along, etc.
  - Resolving text to GPS and formal city nodes model
- Empowering city users: contributions, suggestions, forum discussions, etc.
- Events: Entertainment, critical and mobility
- Public and Private Mobility & Transport, and predictions
- POIs, Cultural and Touristic info
- Health services and predictions
- Environmental information, heatmaps; values
- Profiled Suggestions to City Users
- Traffic flow reconstruction
- Personal Assistant: PAVAL
- User Engagement: goal experiences, and assessment
- *Sharing knowledge among cities → see Knowledge base Management*

Swagger

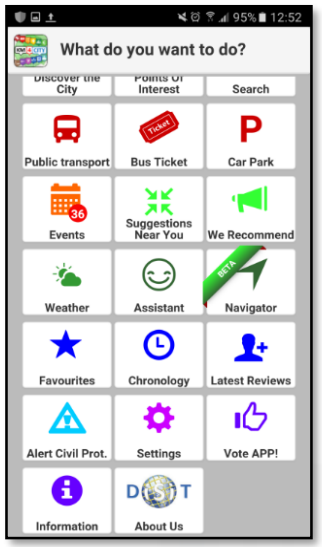


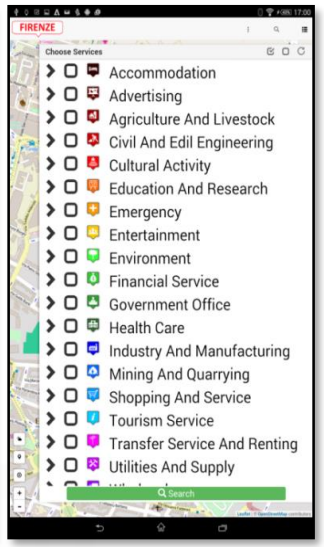
Web and Mobile App with Open Development Kit



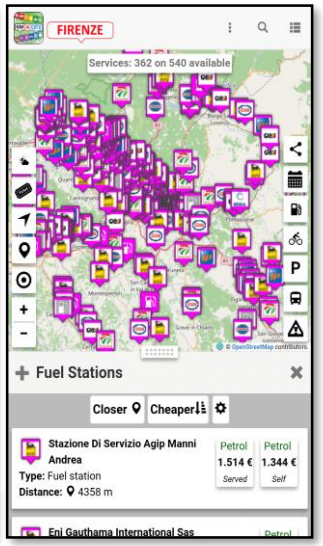
Km4City APP

- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart Public Transportation in Tuscany
- Smart Fuel pricing in Tuscany
- Bike Sharing in Pisa
- Weather condition in Tuscany
- Environmental data
- Pollution and Pollination in Tuscany
- Traffic Sensors in Tuscany
- Smart Routing in Tuscany
- Smart Transportation in Florence
  - Events, traffic, …
- Entertainment Events in Florence

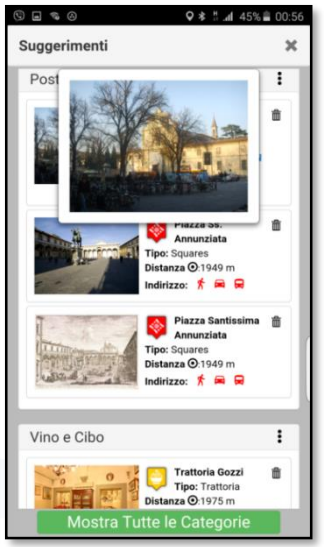


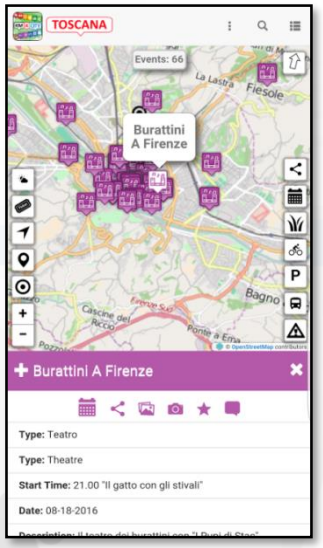




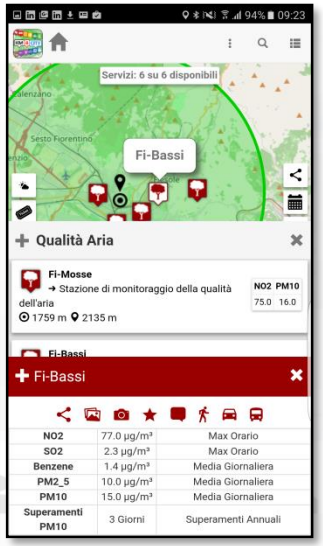


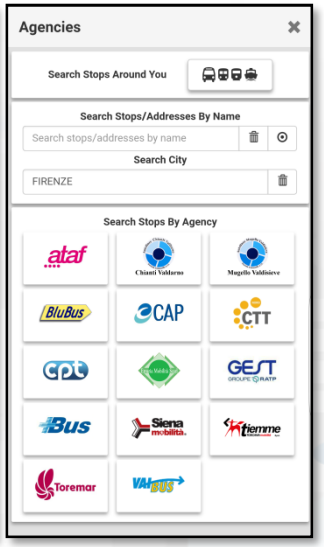










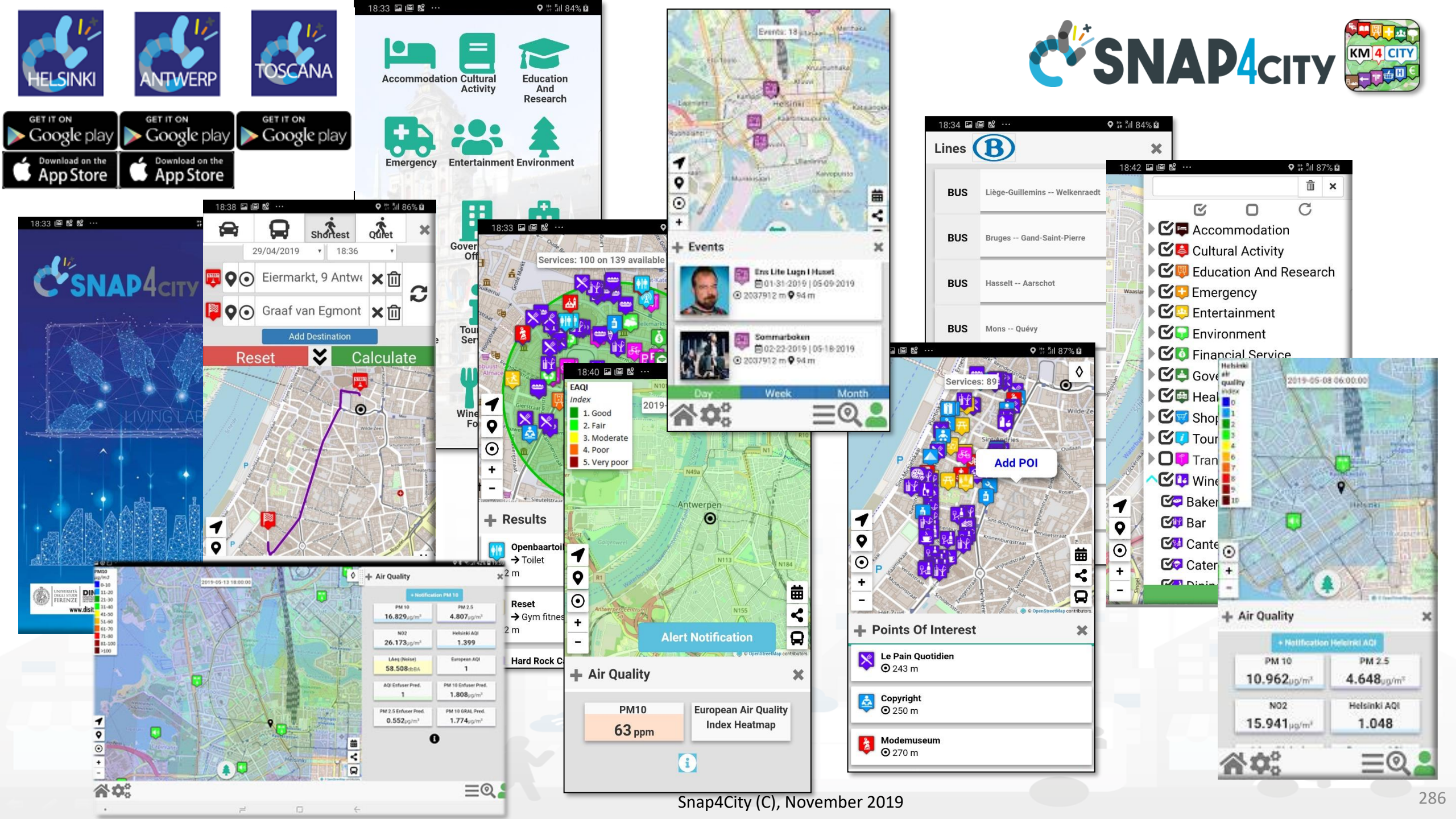




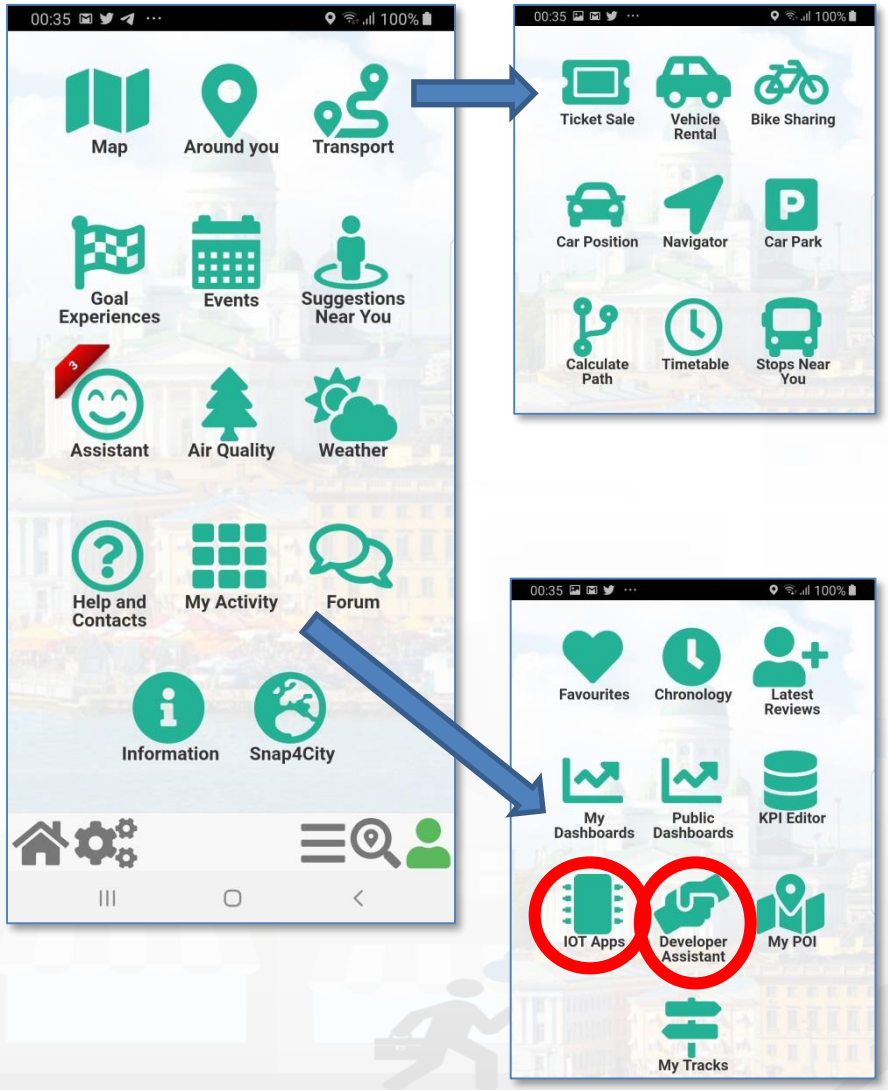
Available on the App Store

ANDROID APP ON Google play

Download from Windows Phone Store


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
Air Quality
PM10
63 ppm
European Air Quality Index Heatmap
Alert Notification
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
Financial Service
Bar
Air Quality
PM 10
10.962
PM 2.5
4.648
NO2
15.941
Helsinki AQI
1.048

Mobile App Features

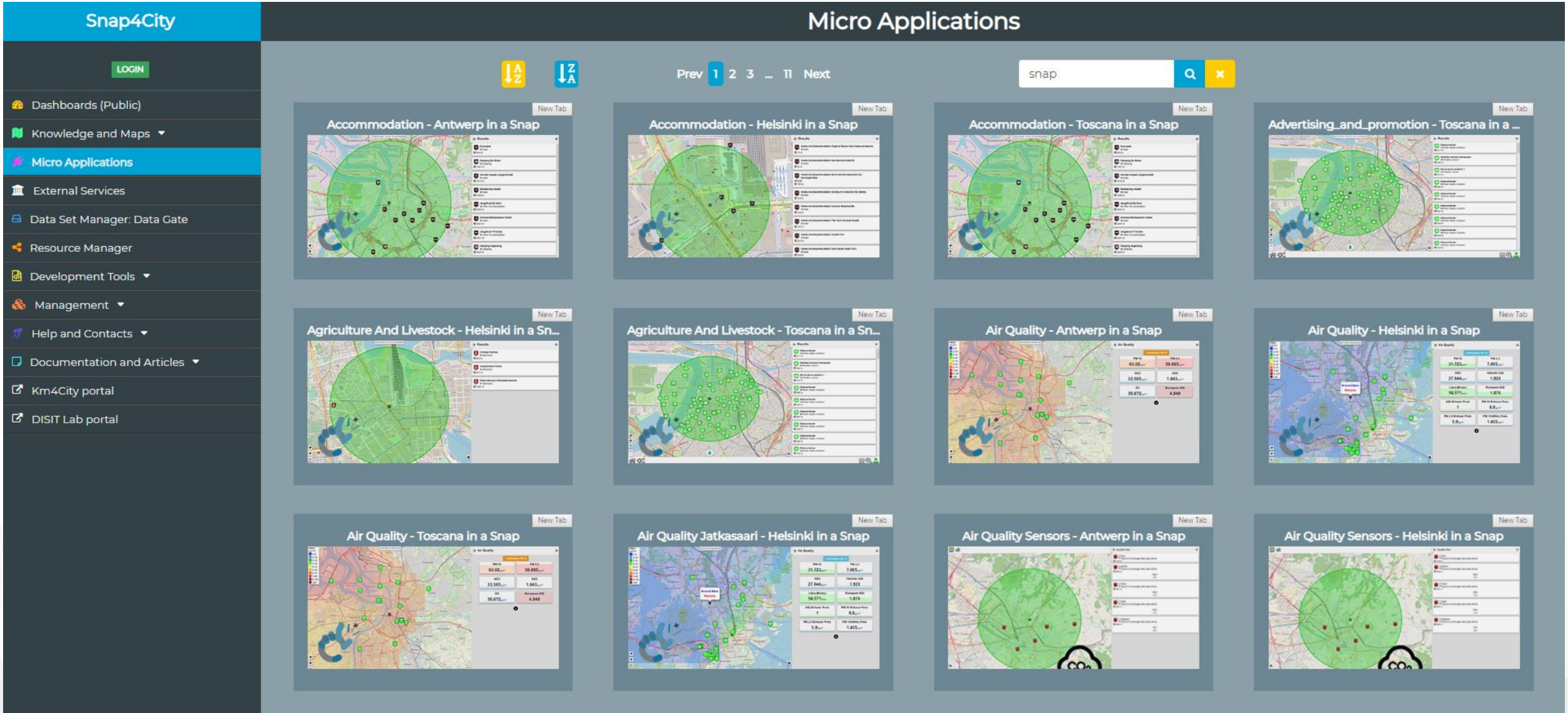


- **Discovery** POI/services
- **Search**: POI, streets, suggestions
- **Mobility and transport**: Pub/priv, routing, car position, time table, park, sharing, tickets, etc.
- **Environment and Weather**: values, sensors, heatmaps, notifications
- **Assistant, Forum, Developer Assistant**
- **Goal Experiences** (Engagement)
- **Personal** data, activities, POI, tracking, IOT App, Dashboards, etc.
- **Events**: entertainment, critical
- **Sharing** position and trajectories with friends
- **Monitoring** city and personal Dashboards
- **Personalized for Operators and Developers full control of their applications on cloud**

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

SNAP4CITY | KM4CITY

MicroApplications



Understanding how City Users are using the City Services



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 ?
- …



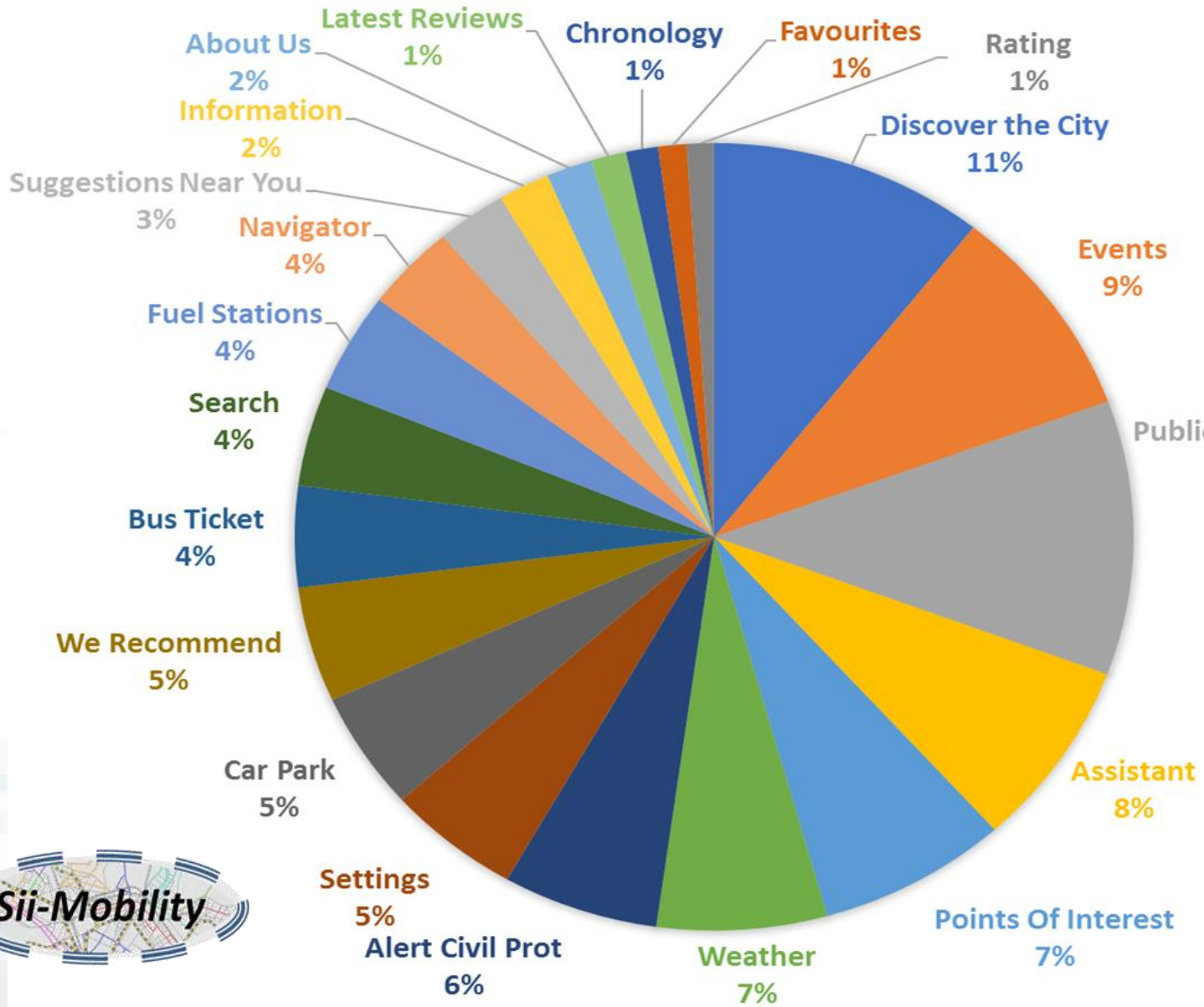
Derived information

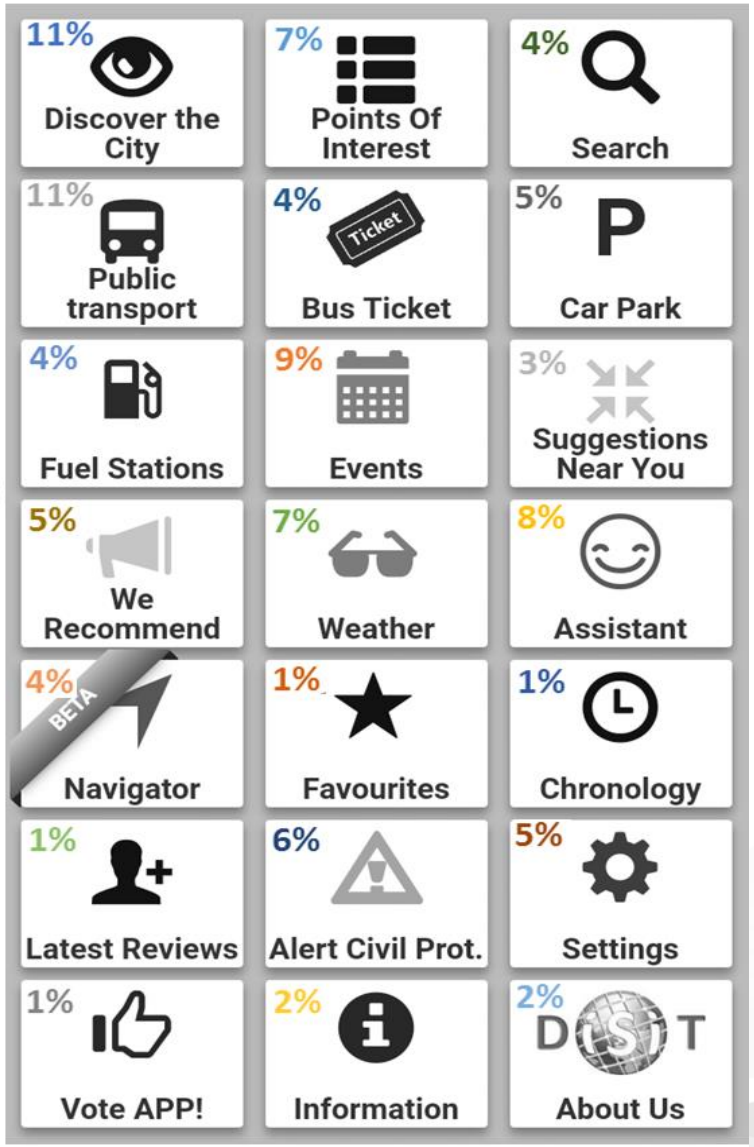
- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- Requested information
- Routing performed
- …..

Produced information

- Suggestions
- Engagements
- Notifications
- …

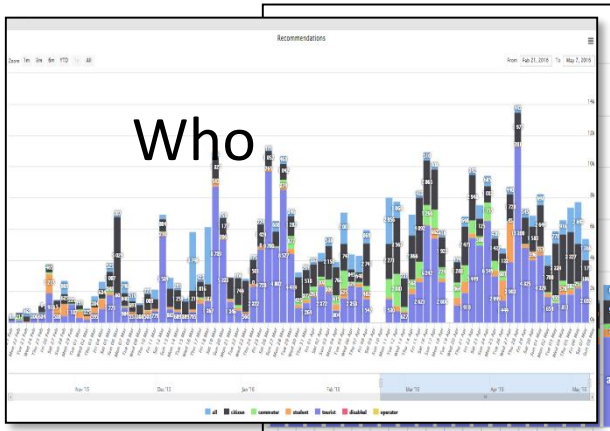
Users' preferences

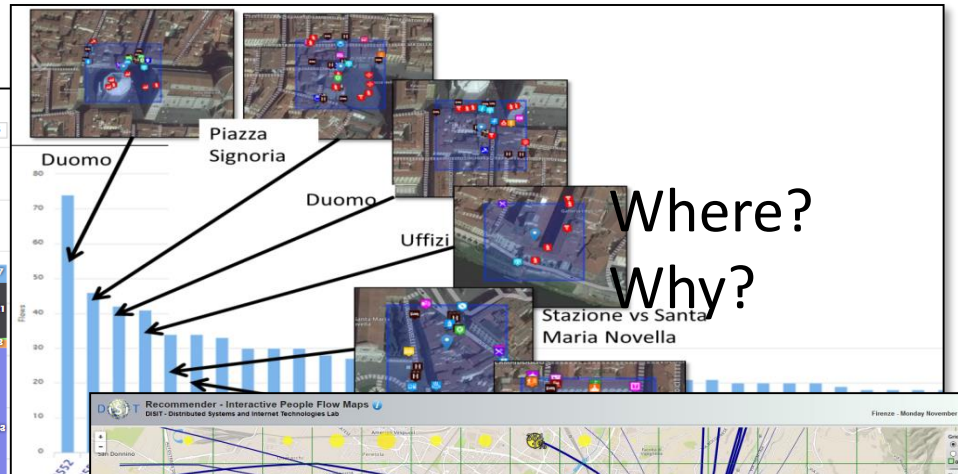


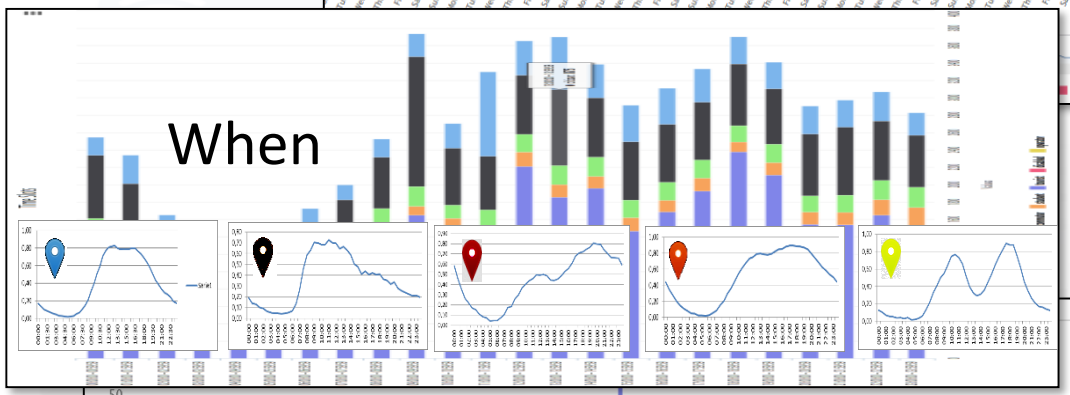


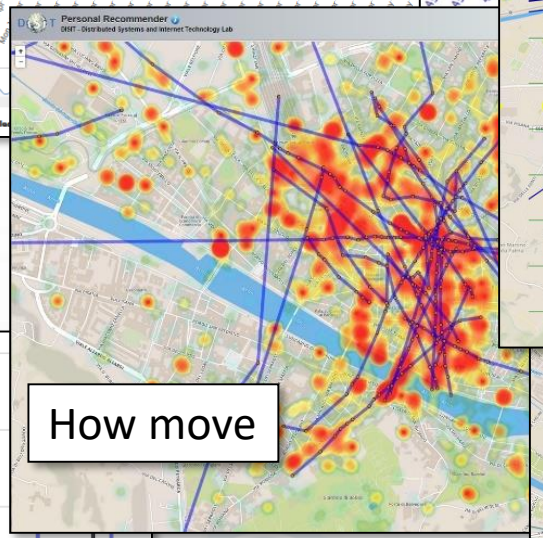
Sii-Mobility

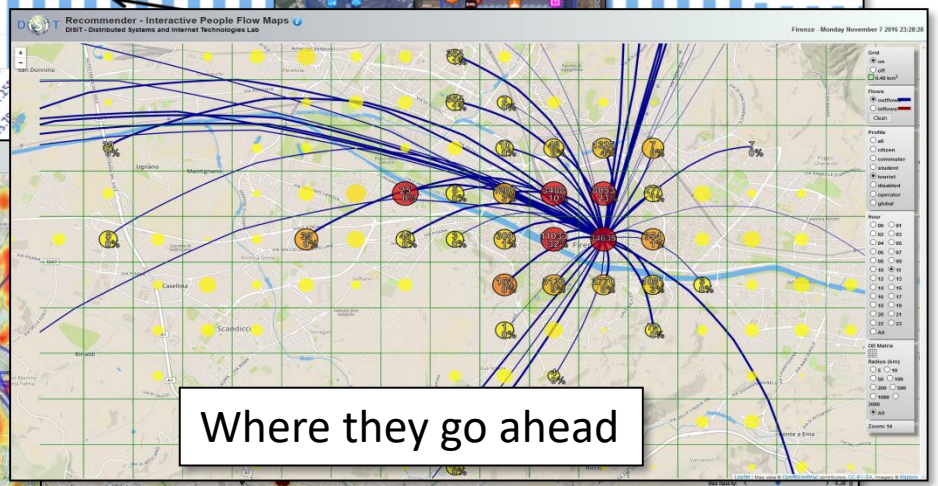
User Behavior Analyser for Collective Profiling

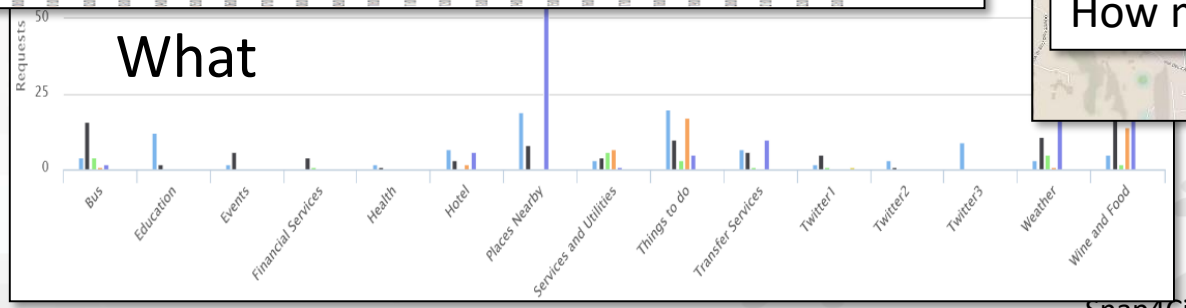


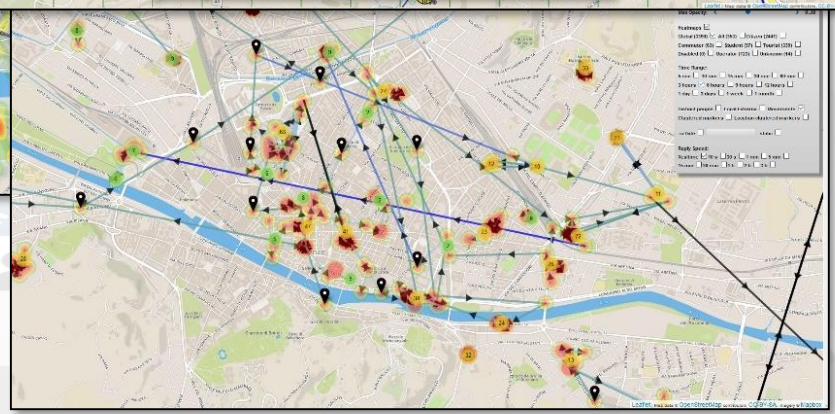




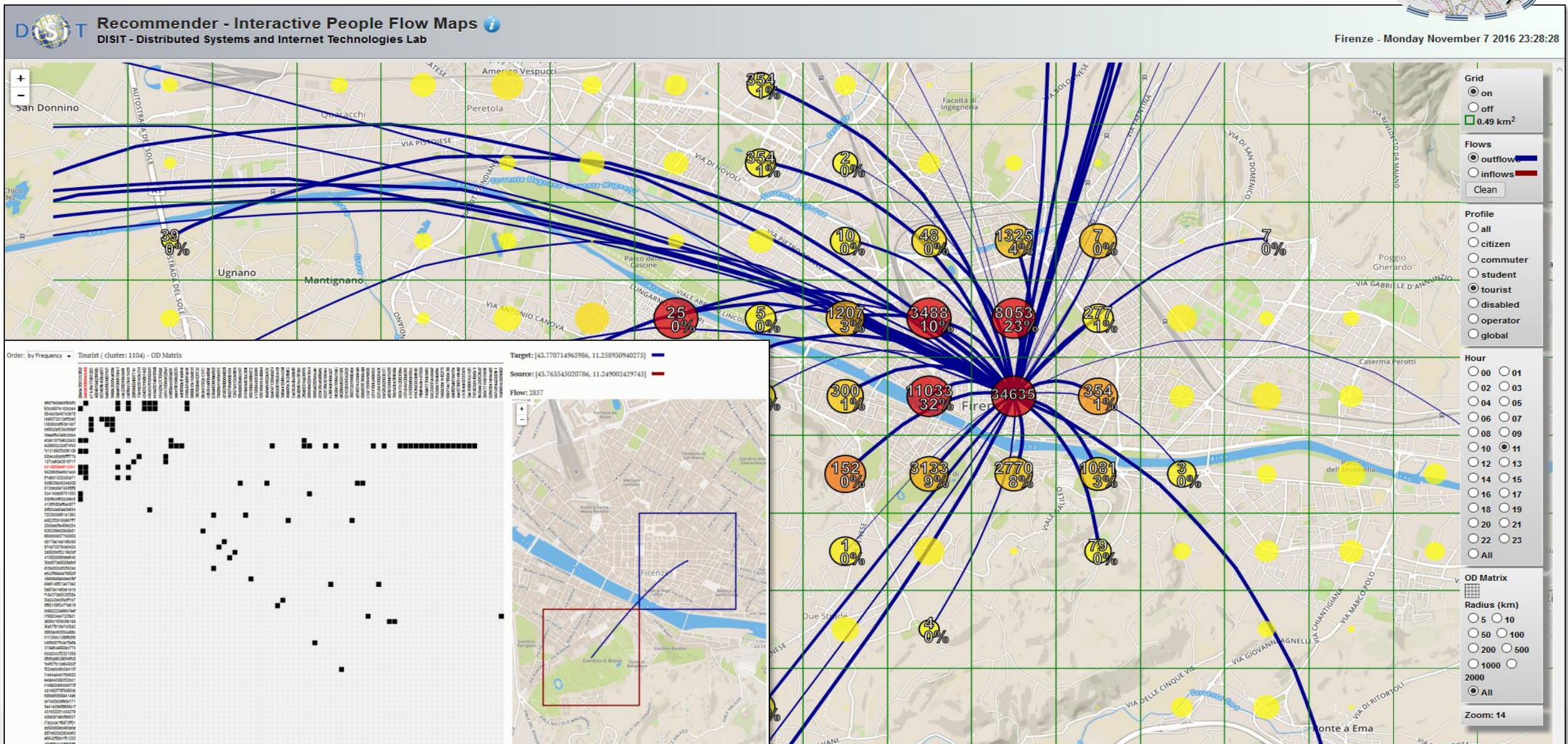






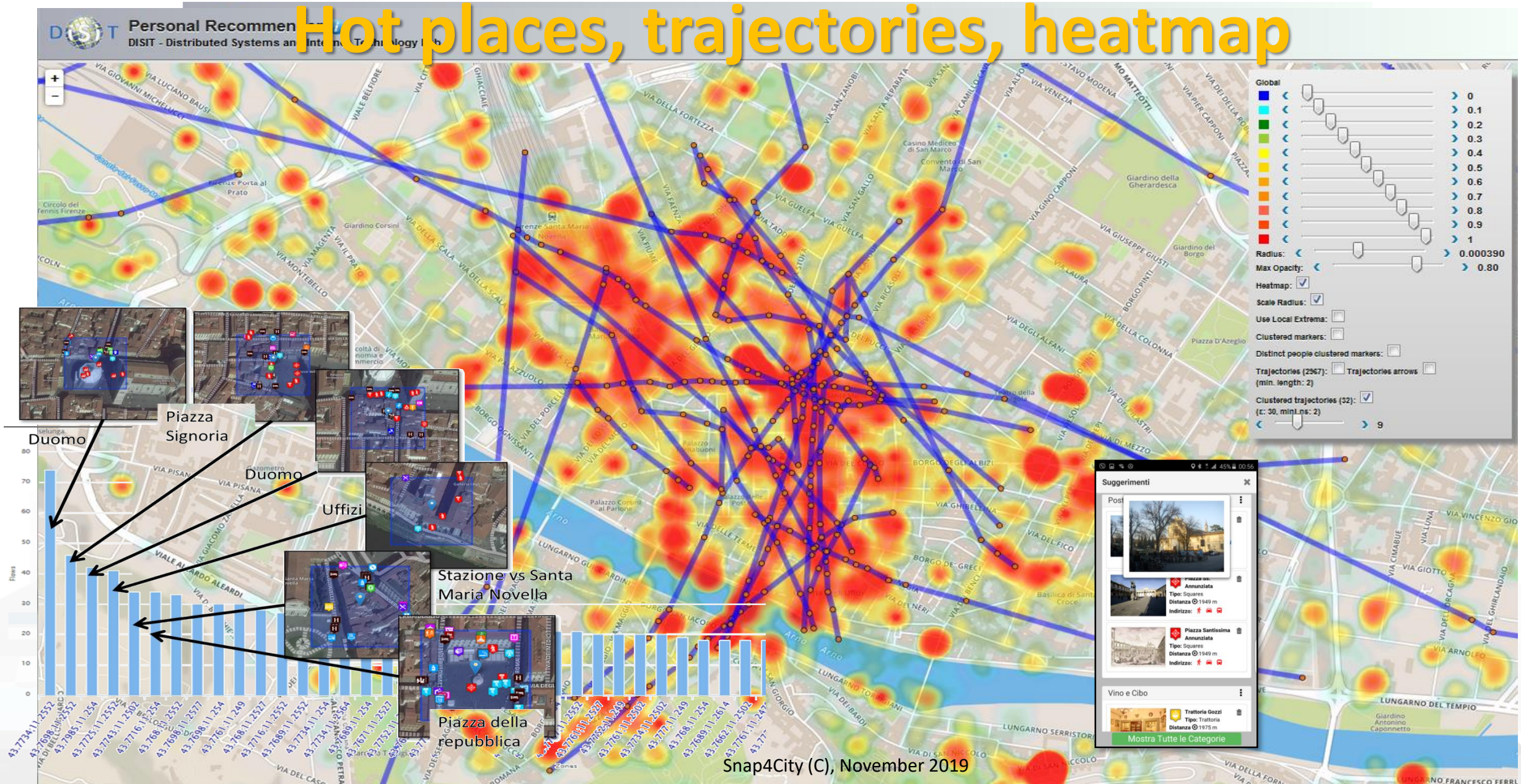


Scalable OD Matrix



User Behaviour Analyser

Hot places, trajectories, heatmap



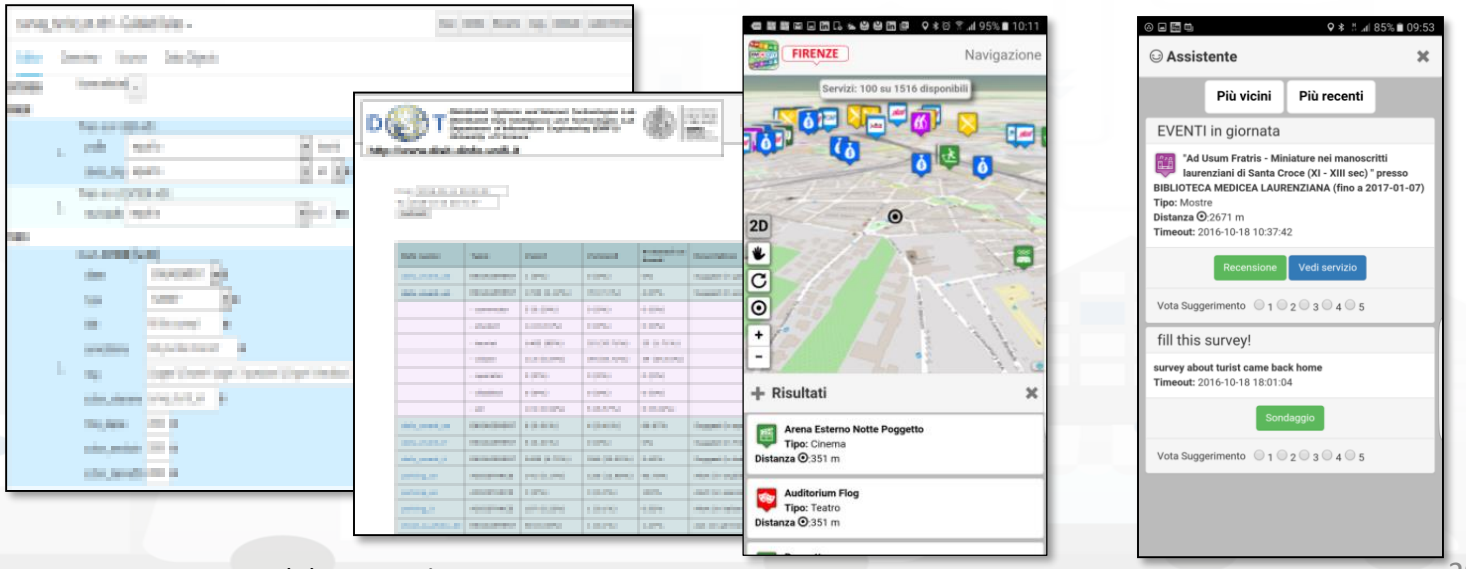
Engaging City Users Towards Virtuous Behaviours (real time)



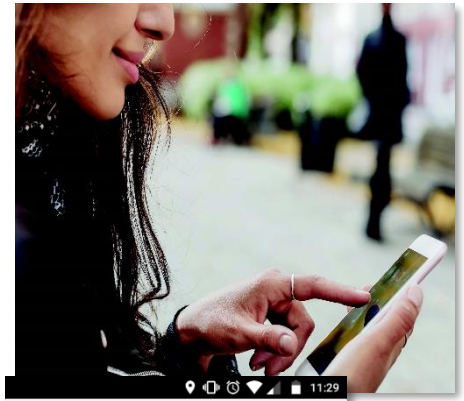
Profiled Engagements to City Users

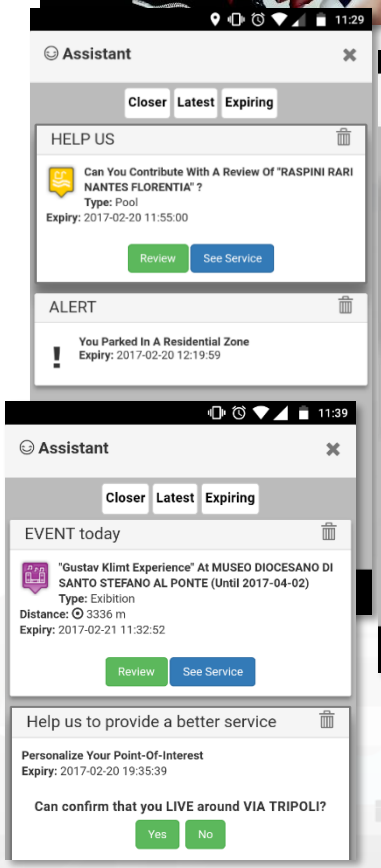
- The users are profiled to learn habits:
  - Personal POI, paths, Mobility habits
- Information and engagements sent to the users are programmed according to the context and user behavior to:
  - Stimulate virtuous habits
  - More sustainable habits
  - More healthy habits, etc.
  - Get feedbacks
  - Provide bonus and prices, …..
  - Send alerts, ….

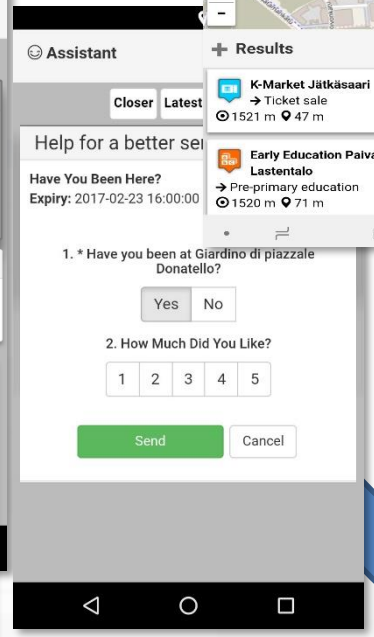


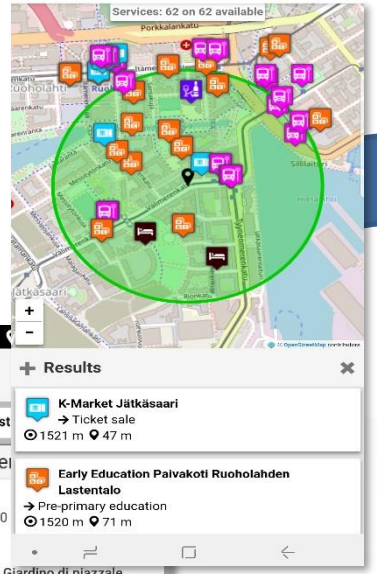


Users' Engagement

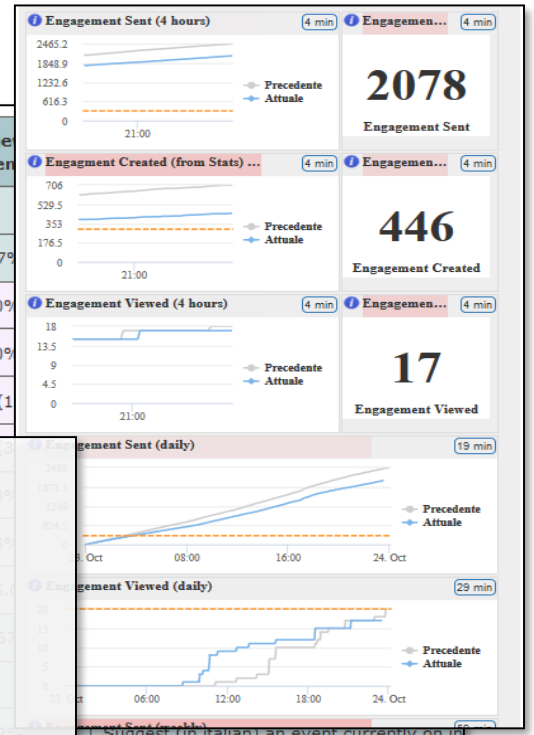


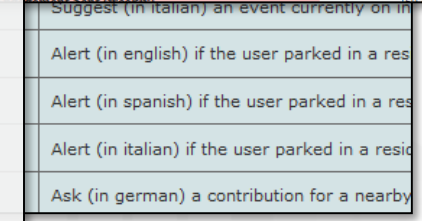






Rule name	Type	#sent	#viewed	#vie #sen
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%
	- commuter	5 (0.29%)	0 (0%)	0 (0%
	- student	14 (0.81%)	0 (0%)	0 (0%
	- tourist	1462 (85%)	25 (35.71%)	25 (1





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

User context

Rules

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
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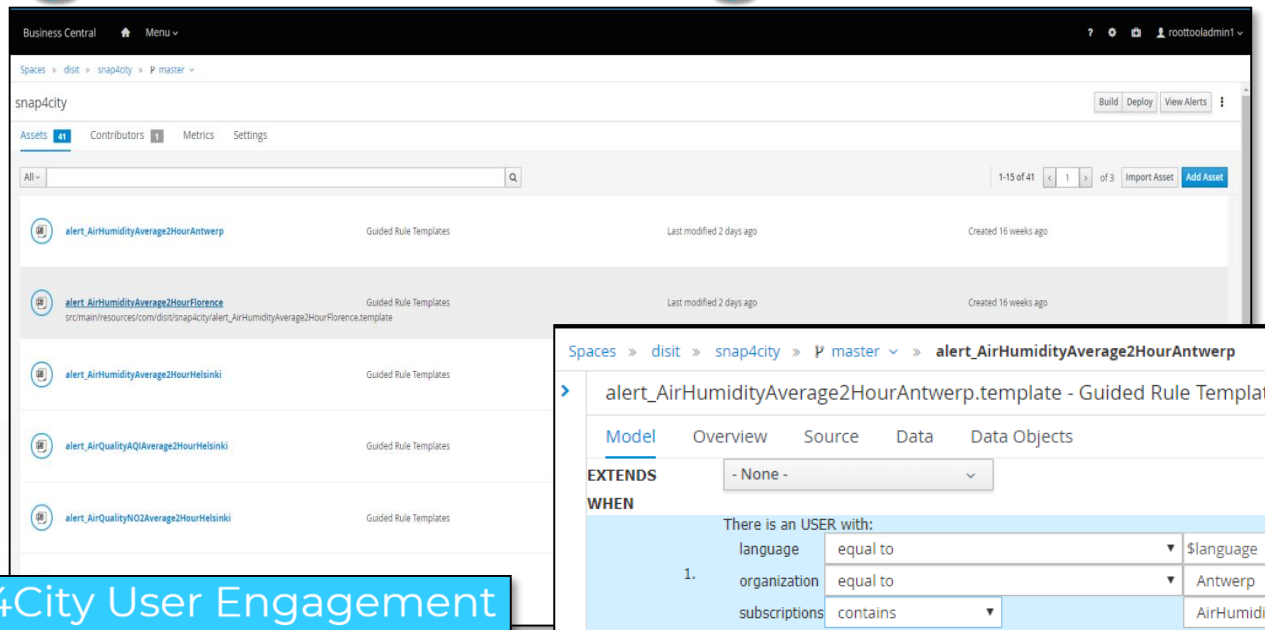
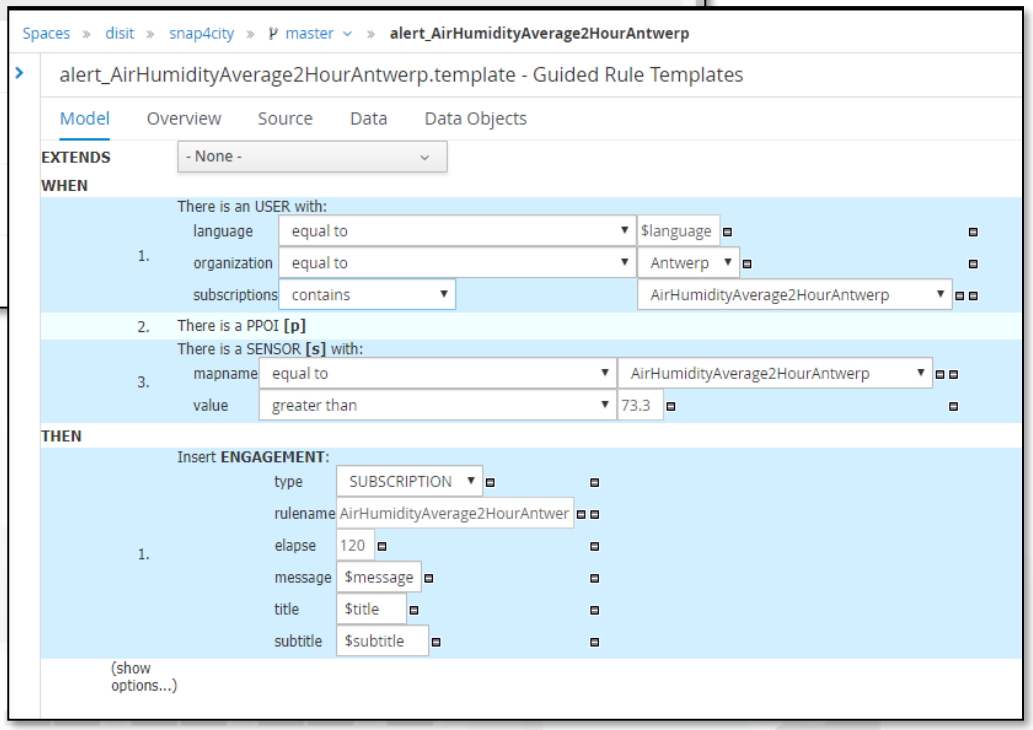
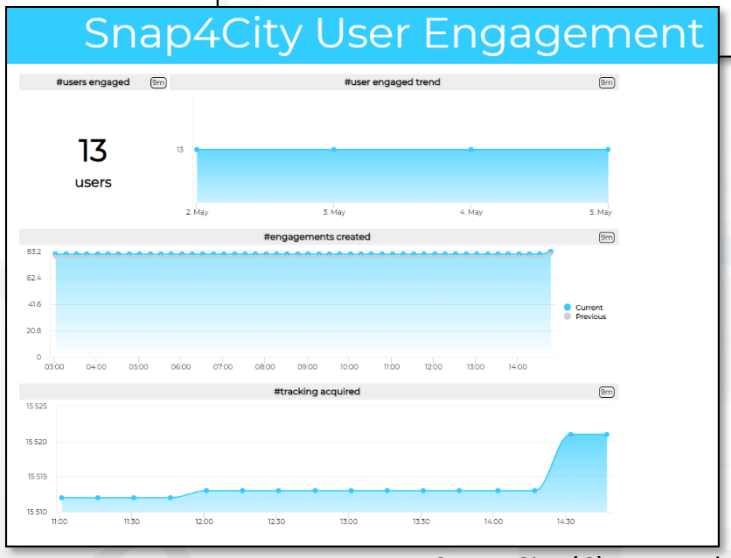
DISIT

Engagement Manager

- Definition of Rules for campaigns
- Monitoring and follow-up for each City
- Segmented for user kind and interest

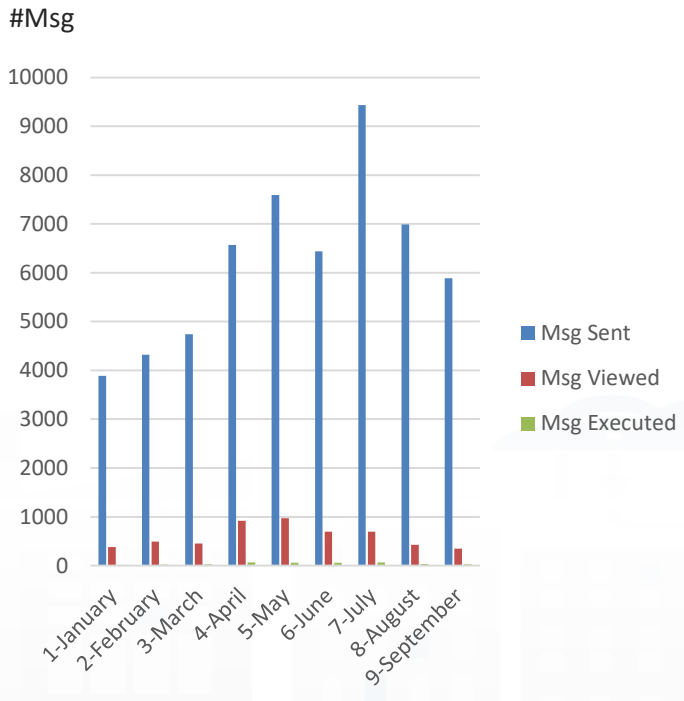


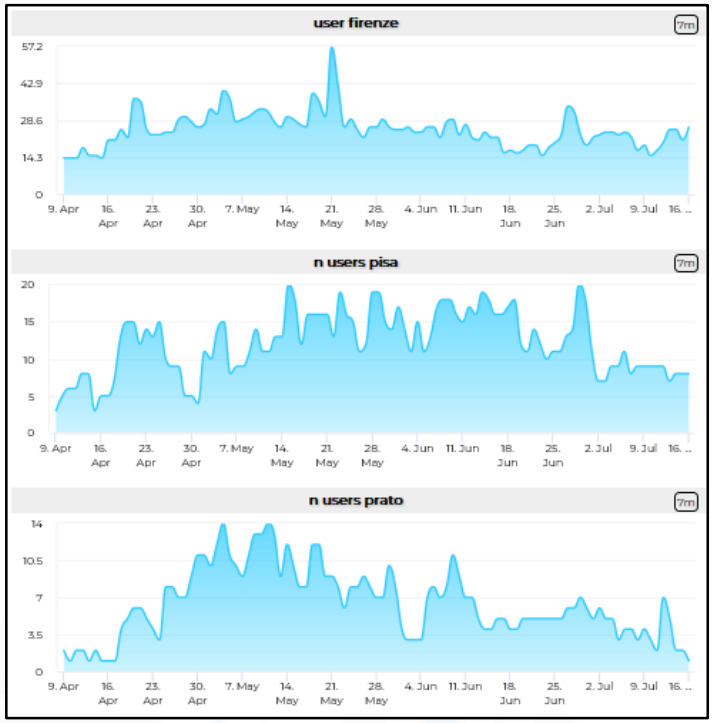


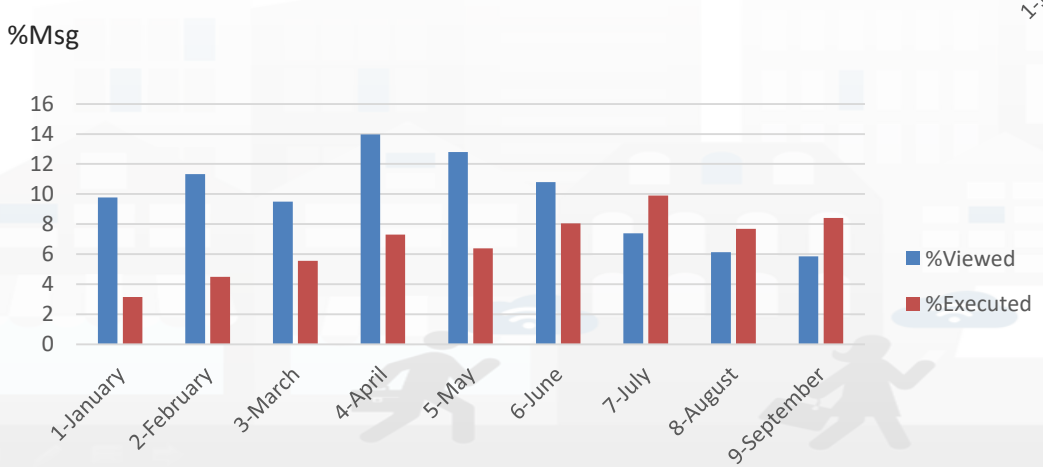


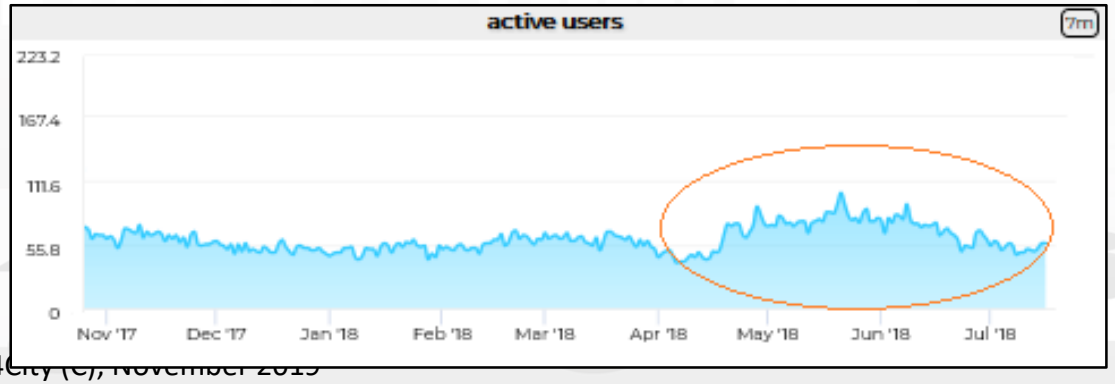
Validation of user Engagement

Months	Msg Sent	Msg Viewed	Msg Executed
1-January	3888	380	12
2-February	4319	489	22
3-March	4739	450	25
4-April	6567	918	67
5-May	7594	972	61
6-June	6437	695	55
7-July	9432	697	69
8-August	6988	429	73
9-September	5885	345	49
Total	55849	5375	433







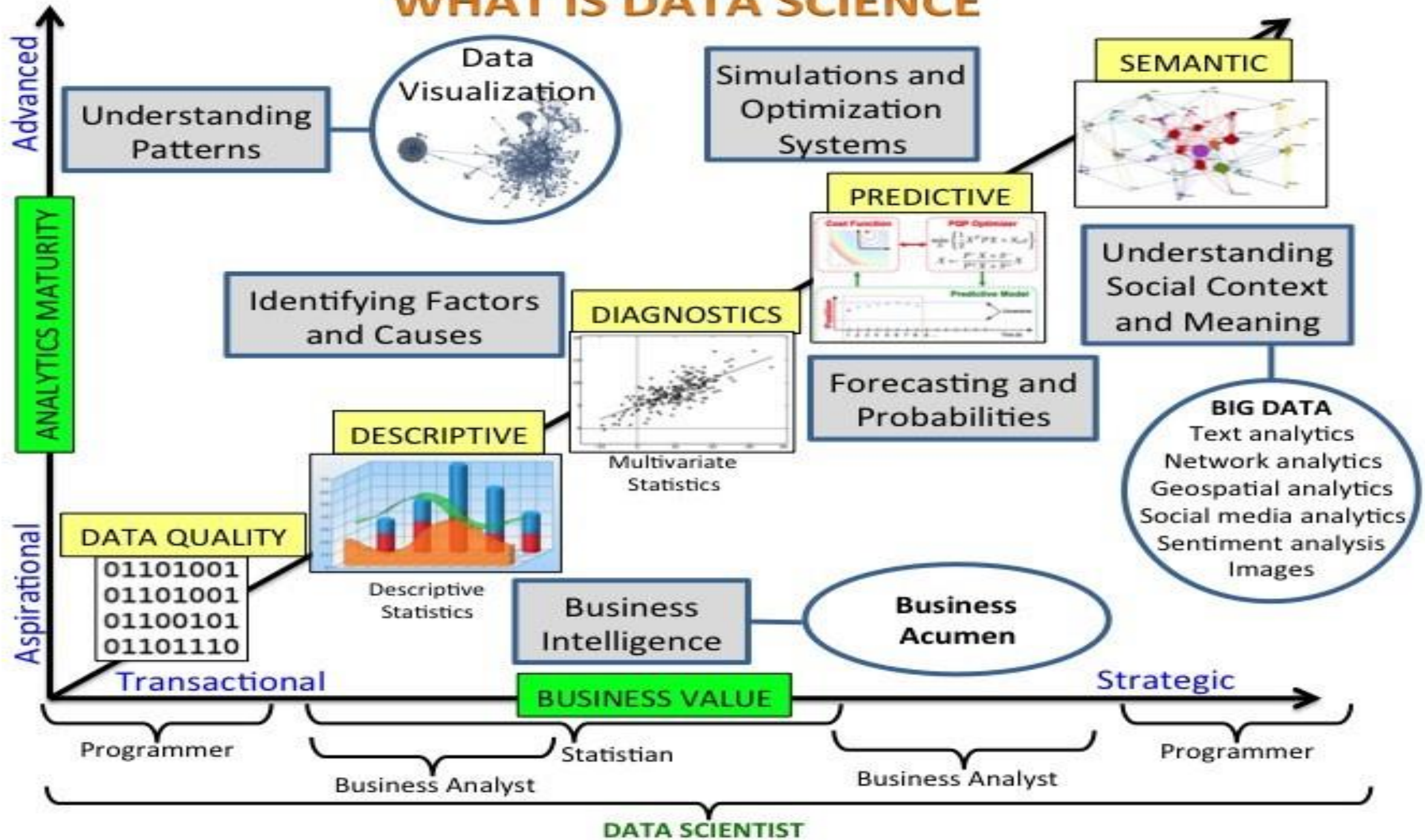


TOP

DATA ANALYTICS, Big Data Science



WHAT IS DATA SCIENCE



DATA ANALYTICS

- Traffic flow reconstruction from sensors and other sources: parking predictions: wi-fi people flow prediction and reconstruction
- What-if analysis, dynamic routing, origin destination matrices production from a large range of sources
- Analysis of the demand vs offer of mobility according to public transportation and multiple data sources
- Resilience and risk analysis
- Early warning computation
- Accidents heatmaps
- Traffic flow predictions
- NOX pollution prediction on the basis of traffic flow, 48 hours see
- Pollution prediction at 48 hours, every hour
- User engagement for sustainable mobility
- User's behaviour analysis, data reconstruction and calibration
- Tracking fleets, people, devicesOBD2 support
- People flow analysis from PAX Counters
- Social media analysis on specific channel, specific keywords: see Twitter Vigilance, for NLP and Sentiment Analysis, SA
- Data quality assessment, prediction, anomaly detection
- Maintenance prediction and costs predictions
- ReTweet proneness, retweet-ability of tweets
- Audience prediction to TV channels and physical events

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Disappearing Data Analytics

SNAP4CITY | KM4CITY

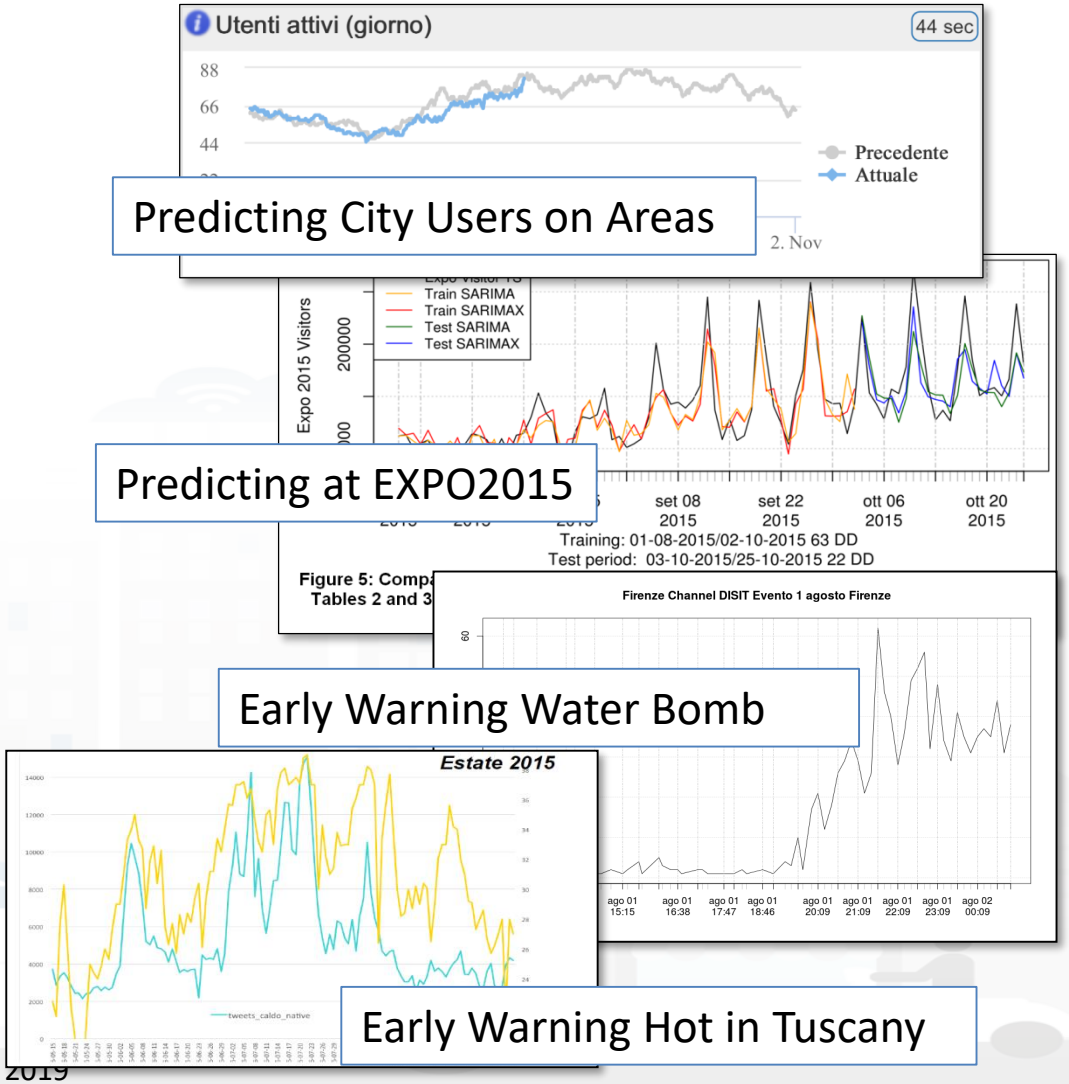
	Antwerp					Helsinki								Where				
SNAP4CITY	City official	ICT official	Developer	Citizen, tourist, visitor	Business owner	City officials	City officials Domain experts	City officials City developers	Third party developers	Citizen	Citizens with respiratory problems	Tourists	Business owners	Mobile	MIcroApplication	Tool, via Portal (ICT Developers)	Dashboards	RULE OF THUMB 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

Data Analytics: Predictions



Predicting Models for Administrators & City Users

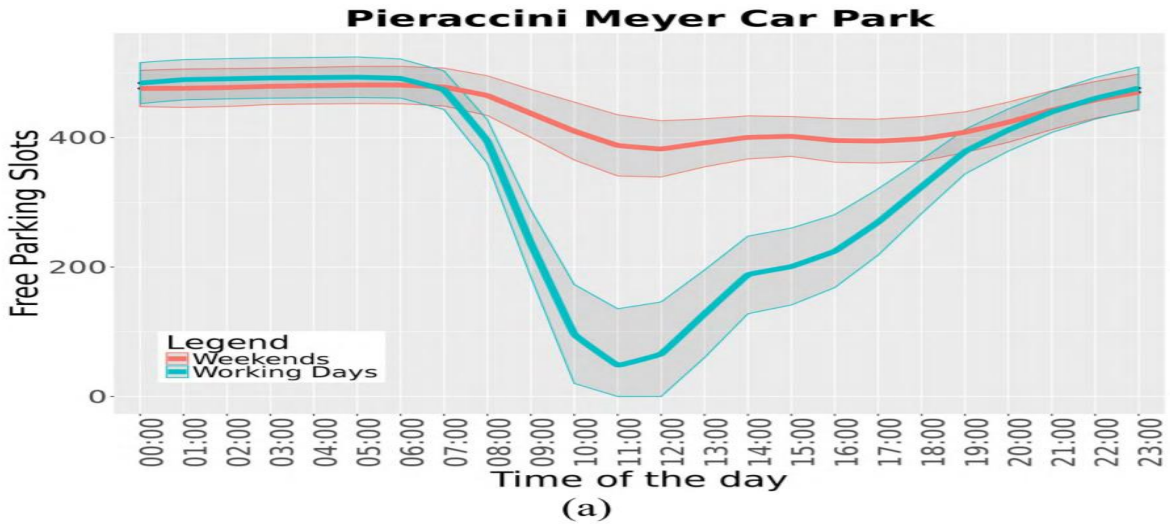
- **Aiming at improving**
  - quality of service, distributing workload
  - early warning
- **Predictions**: **Short** (15 min, 30 Min) and mid Term (1 week)
- **Data Analytics**: ML, NLP/SA, Clust., …
  - Traffic Flows → multi-flow reconstruction
  - Parking Status → free slots
  - Environmental Alarms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

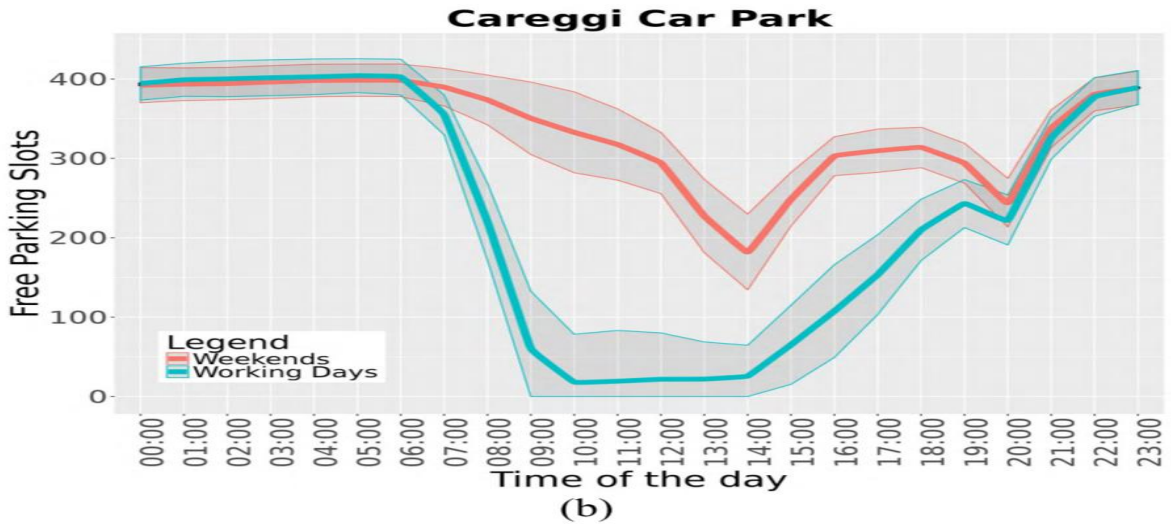


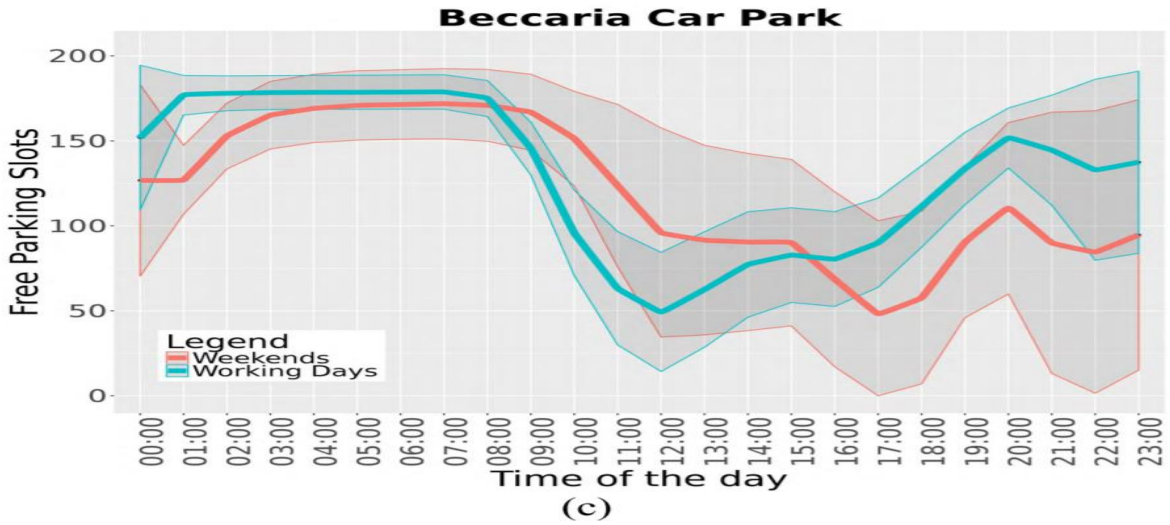
Smart Parking: predictions

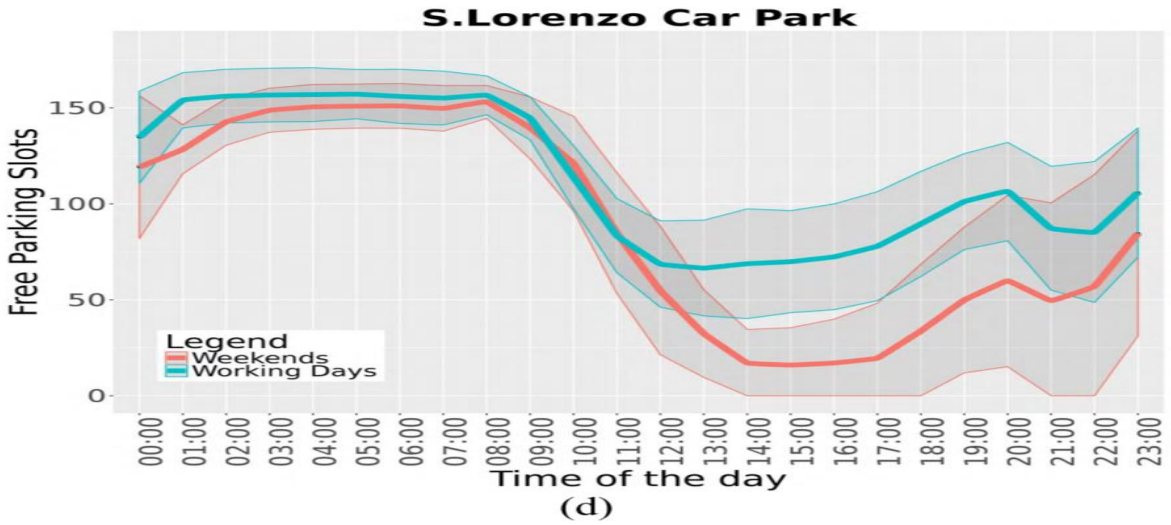


Free Parking space trends









12 parking areas in Florence

Free Parking Predictions

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



Active on Mobile Apps as:

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

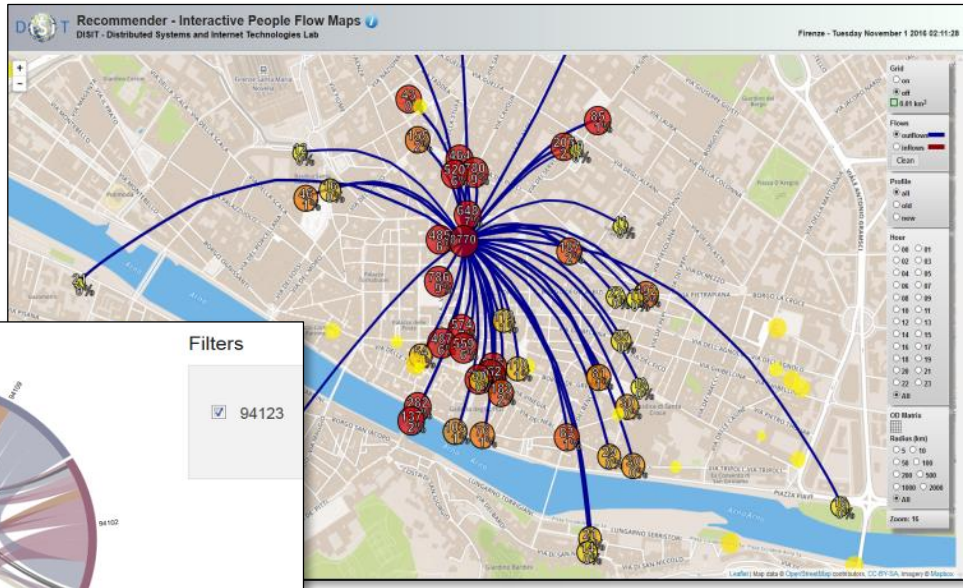
Precision: 97,5%

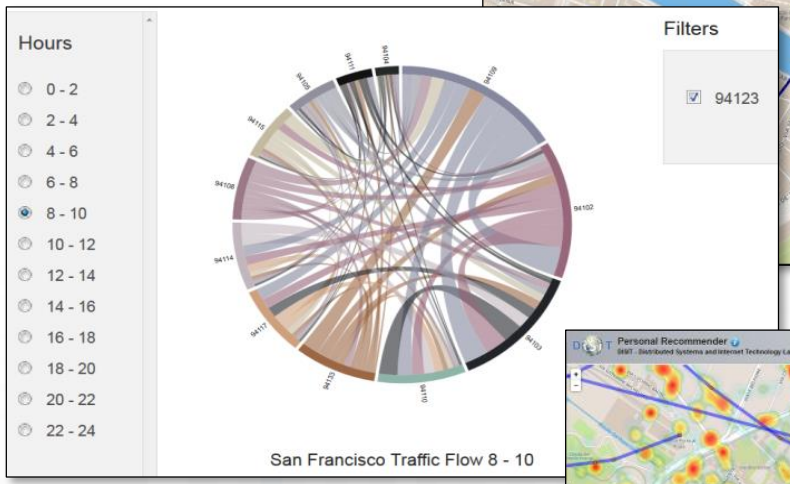
User Behaviour Analysis via Wi-Fi, OD Matrices, Trajectories

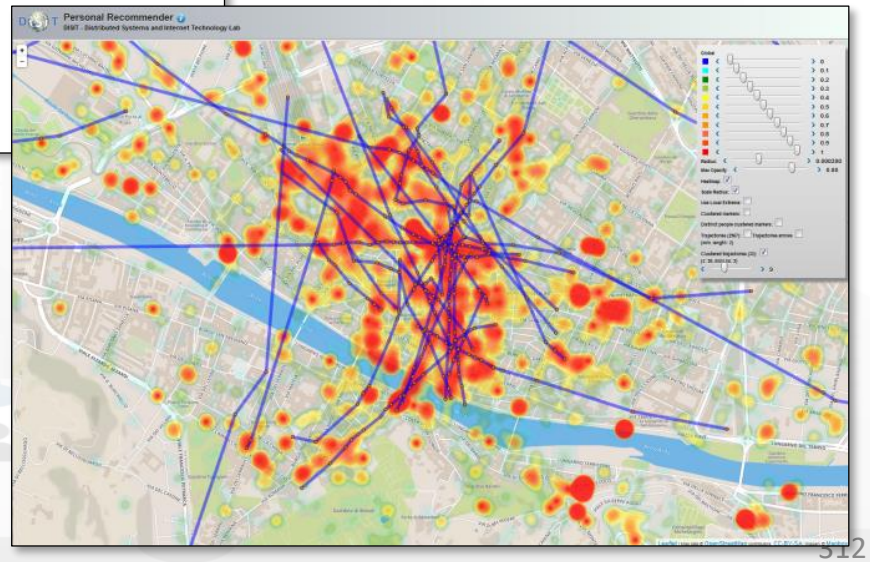


User Behaviour Analysis

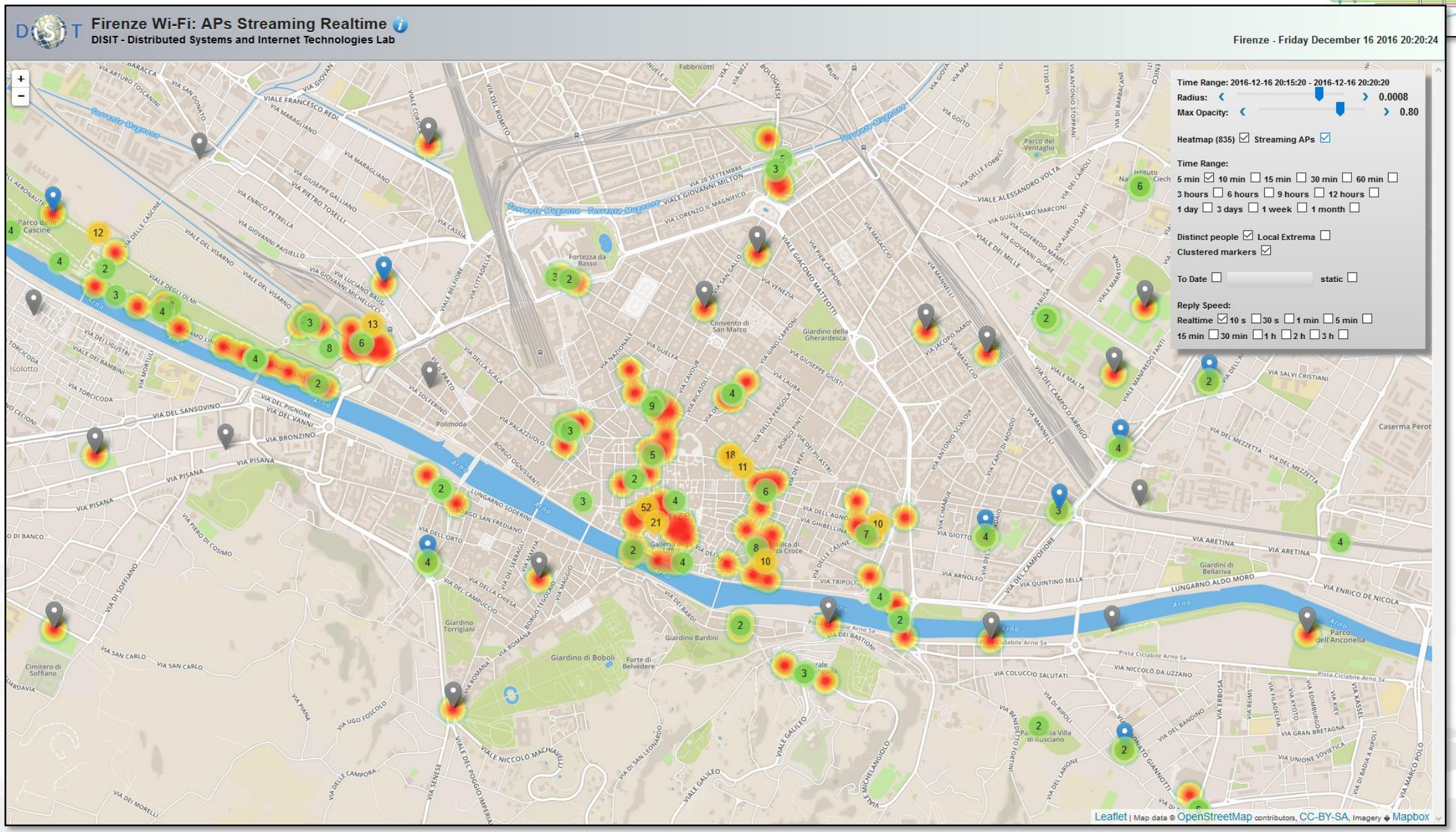
- **Monitoring movements by traffic flow sensors**
  - Spires and virtual spires
- **Monitoring movements from Mobile Cells**
  - Unsuitable for precise tracking and OD production
- **Monitoring movements from Wi-Fi**
- **Monitoring movements** and much more from mobile Apps



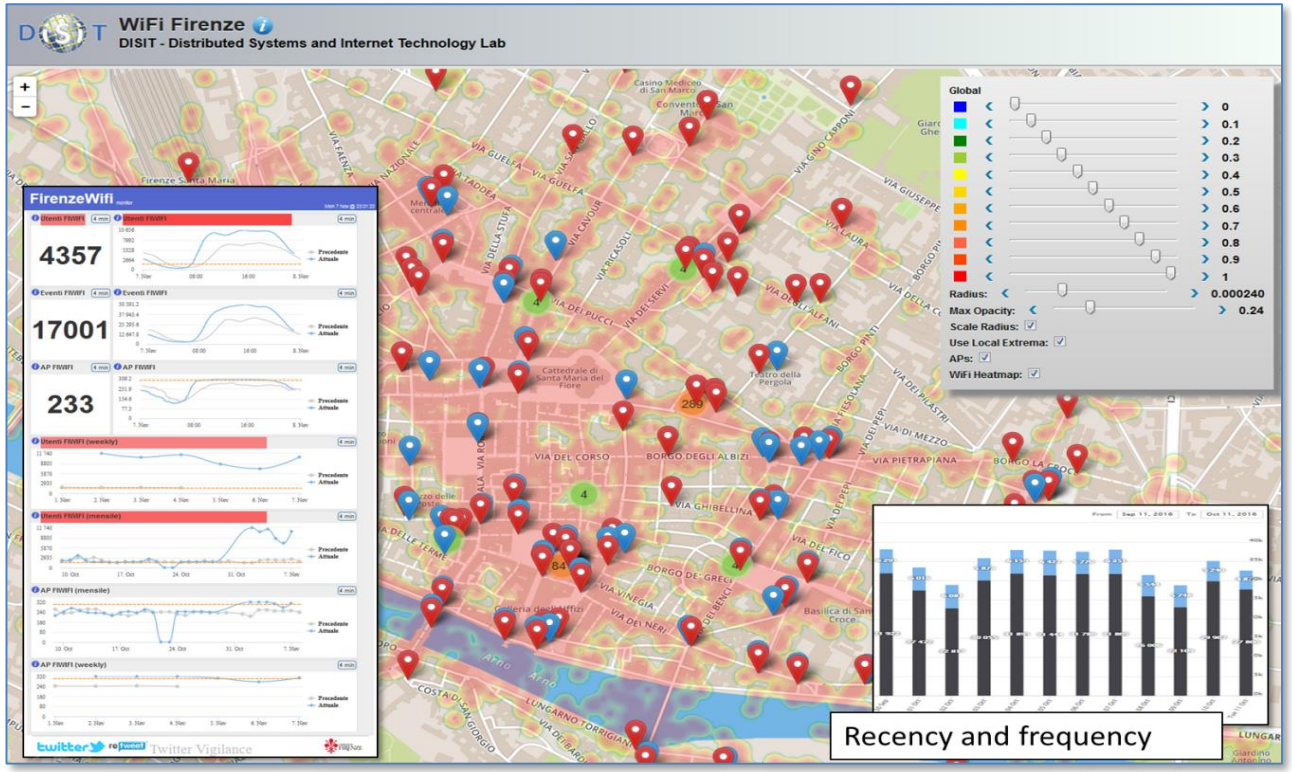


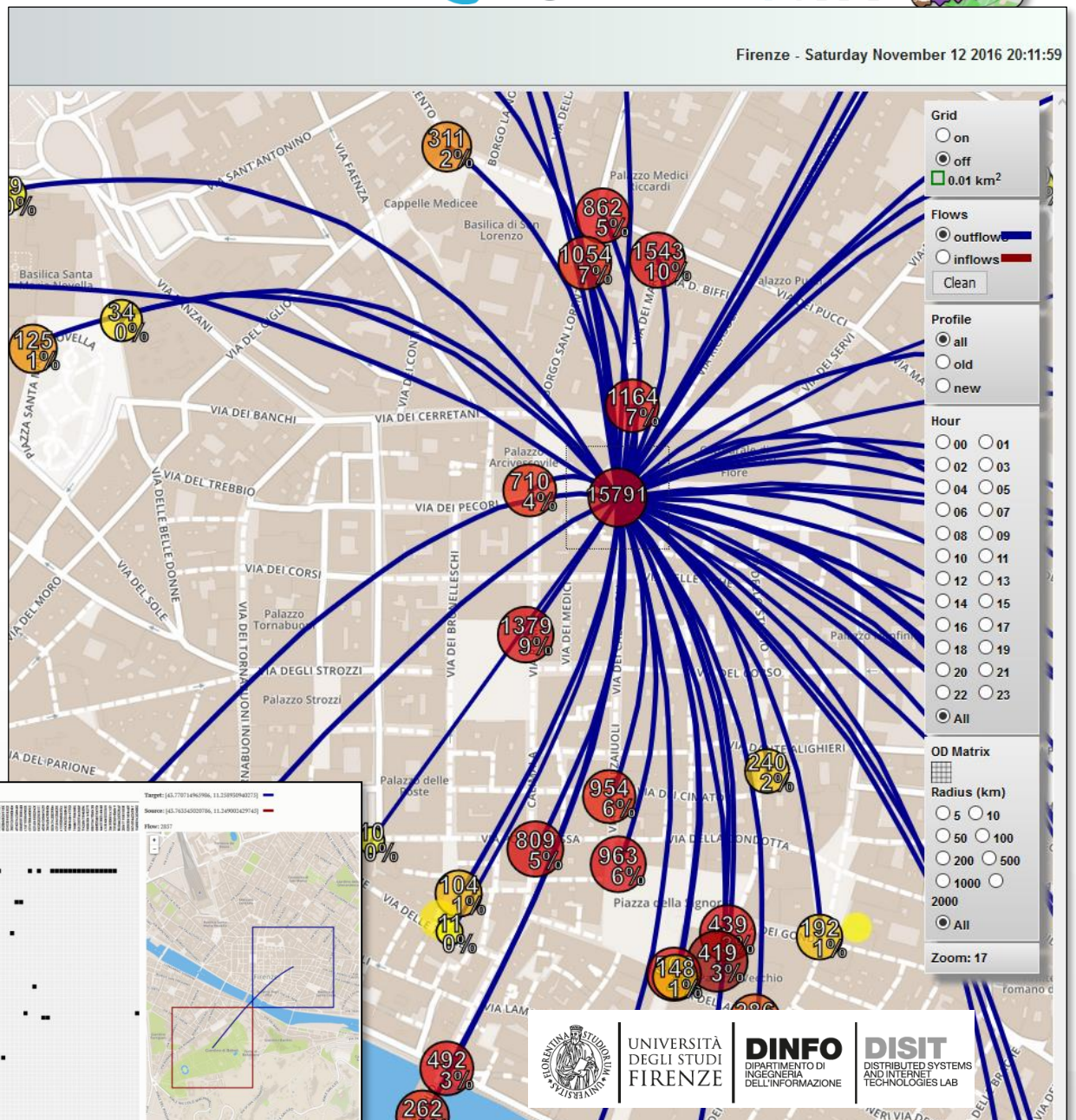


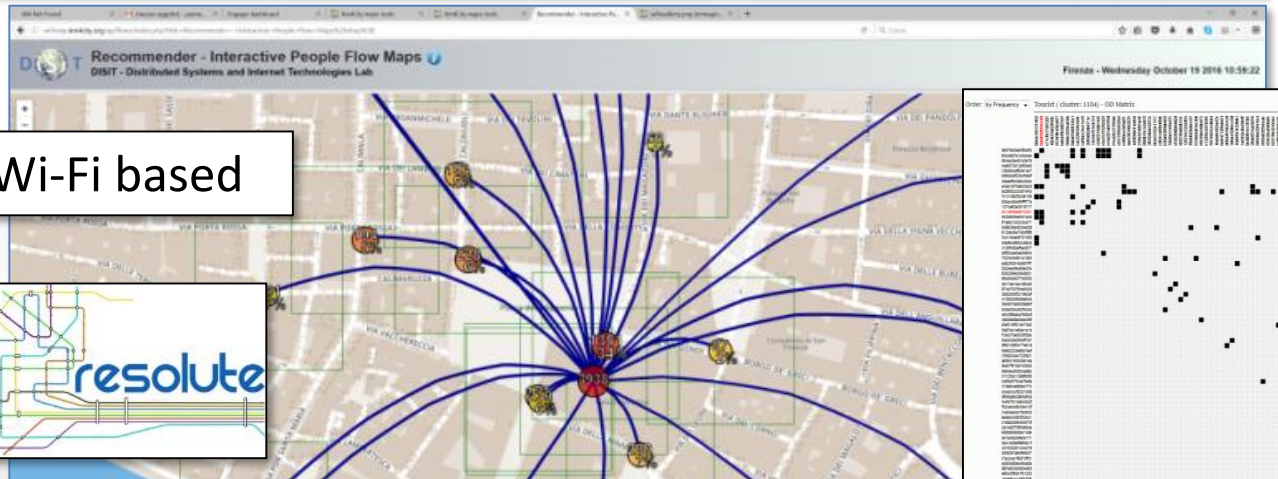
Real Time Monitoring of Wi-Fi network

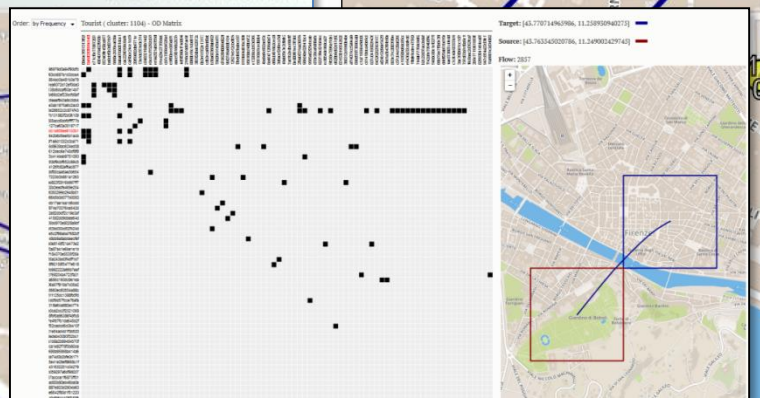


Origin Destination Matrix Estimation









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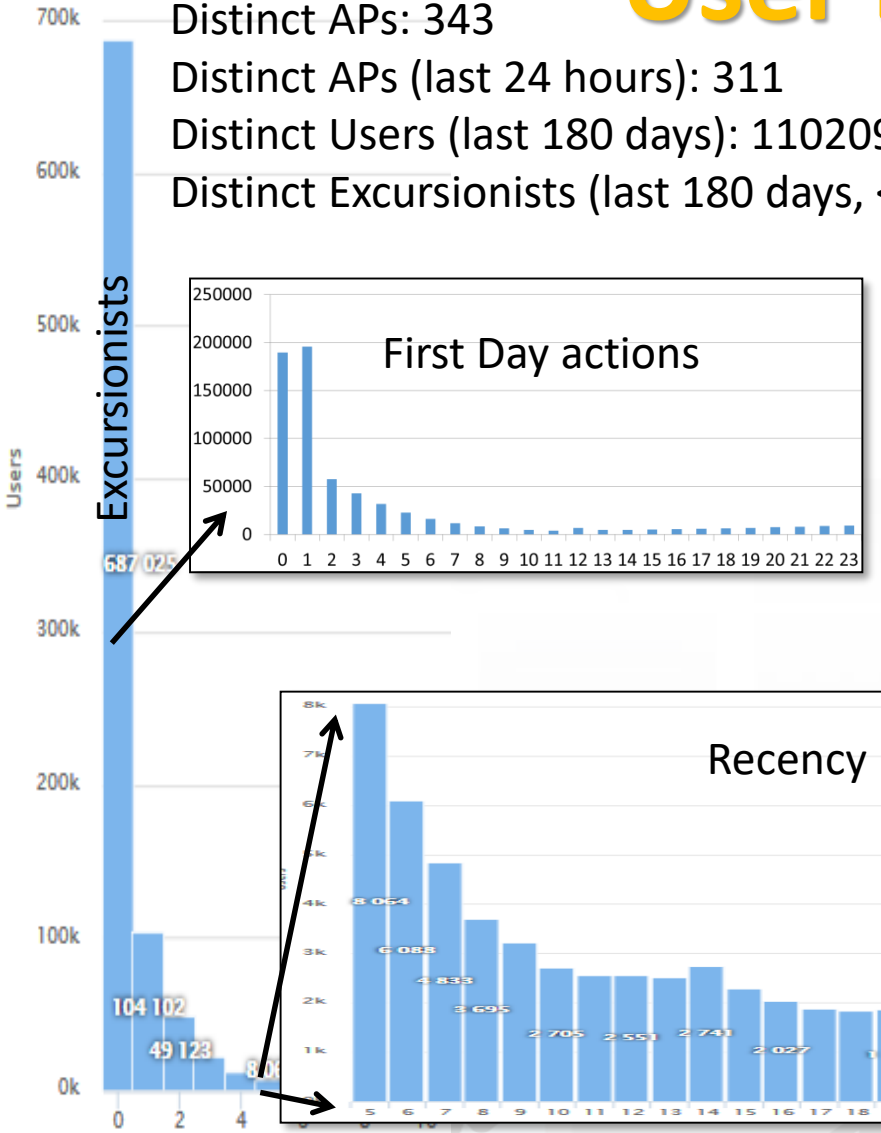
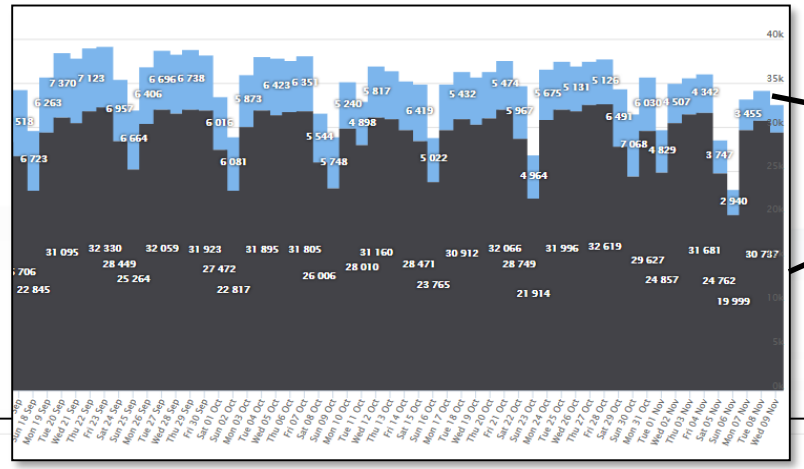
User Behaviour Analysis

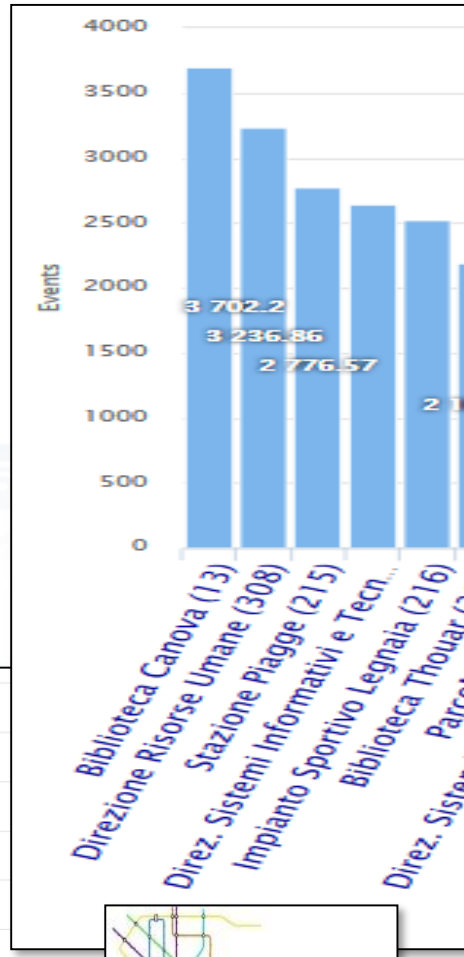
Distinct APs: 343
Distinct APs (last 24 hours): 311
Distinct Users (last 180 days): 1102098
Distinct Excursionists (last 180 days, < 24 h): 687025



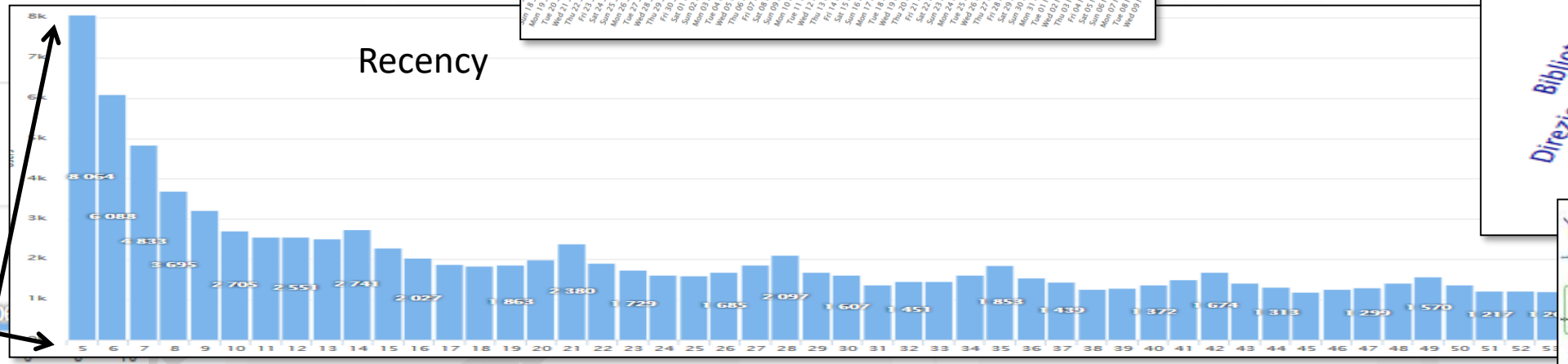


New City Users
VS
Returning

Where



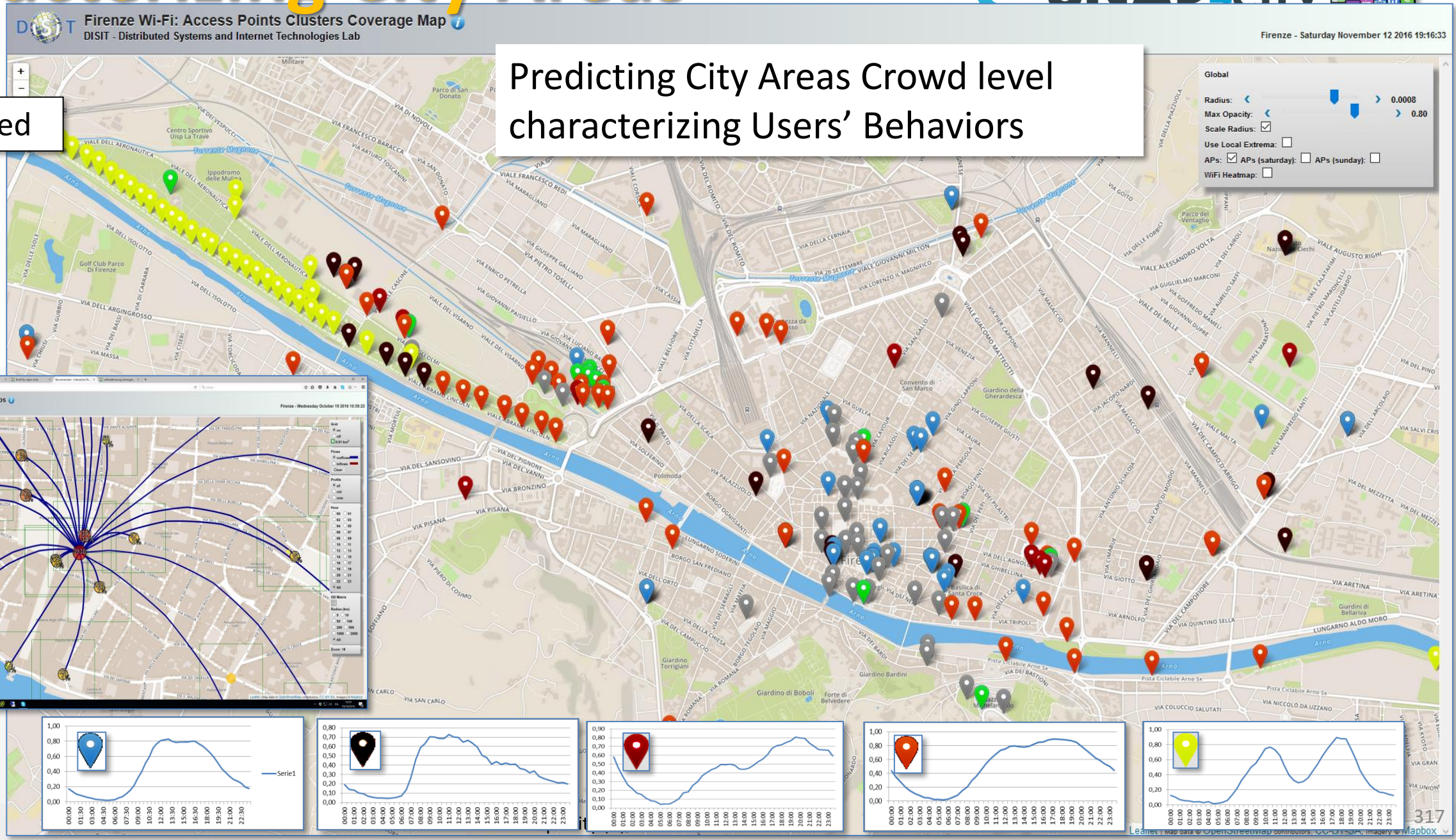
Recency



Characterizing City Areas

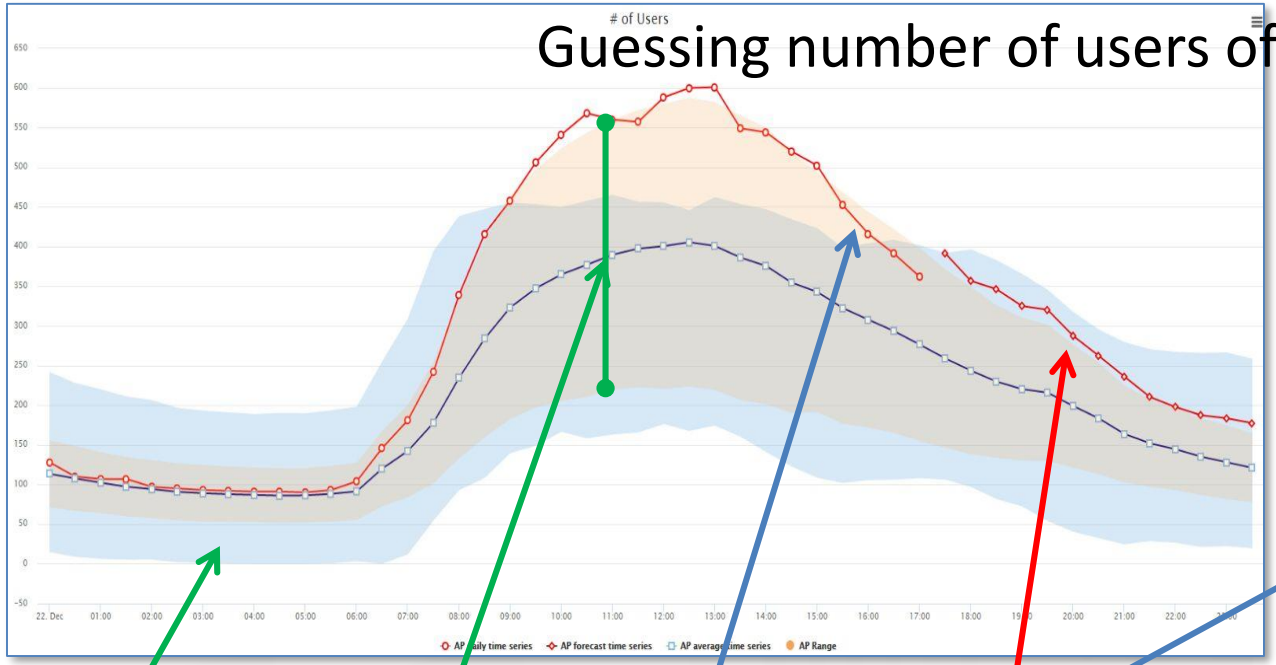
Wi-Fi based

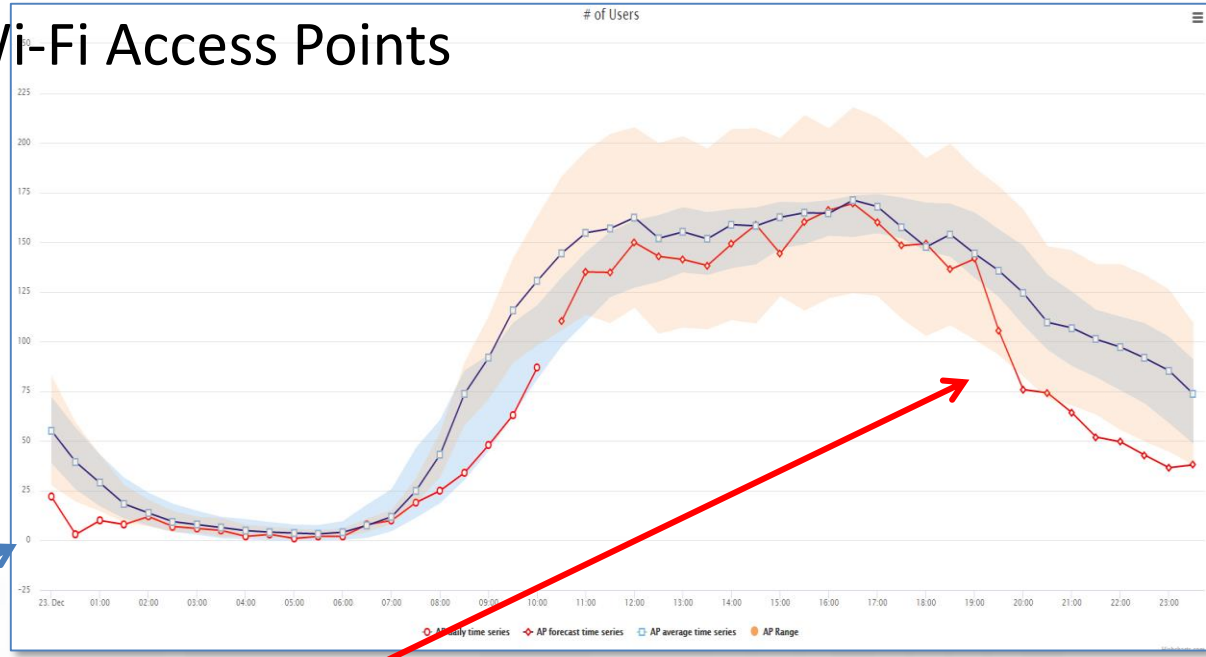
Predicting City Areas Crowd level characterizing Users' Behaviors



Prediction and Identification of Anomalies

Guessing number of users of Wi-Fi Access Points





Cluster confidence

AP average and confidence

Actual AP trend for today

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

Predictive precision of the 95%

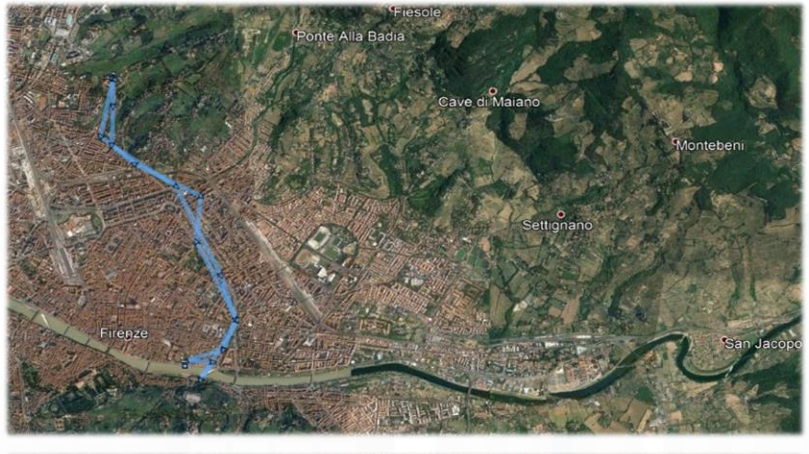
Recognition of Used Transportation means



Automated Classification of Users' Transportation Modality in Real Conditions

Variables taken into account:

- ***Day/Time Baseline and GPS***:
- ***Accelerometer***
- ***Proximity***
- ***Temporal window***



Dataset:

- 30K observations
- 25 variables
- 38 different users
- 30 different kinds of devices
- 4 classes (Stationary, Walking, Private Transport, Public Transport)

Four combinations of the different categories of data:

1. Baseline features and distance feature
2. Baseline, distance feature and accelerometer features
3. Baseline, distance feature and temporal window features
4. Baseline, distance, accelerometer, temporal features together

Note that, *each user have used the mean of transport of his/her own preference*.
When the mode of transport is changed, the user was asked to notify the change to the App for creating the learning set and for validation.

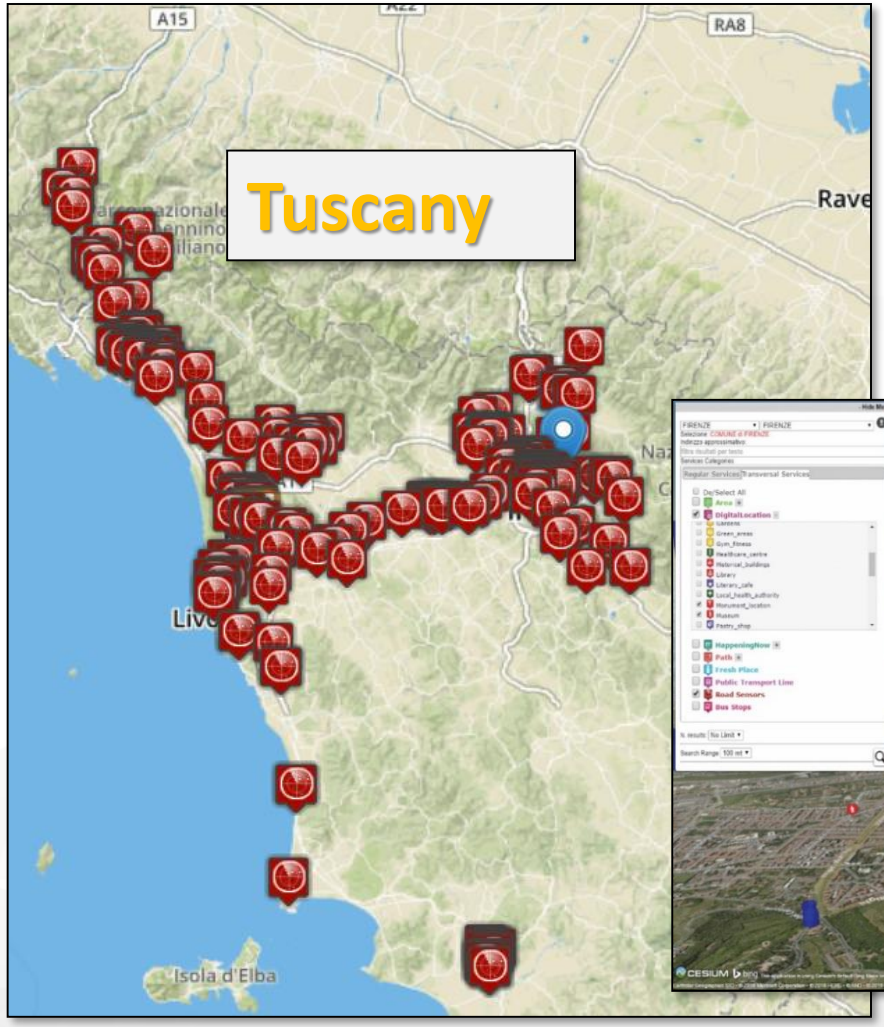
Traffic Flow Reconstruction from Traffic Sensors Data

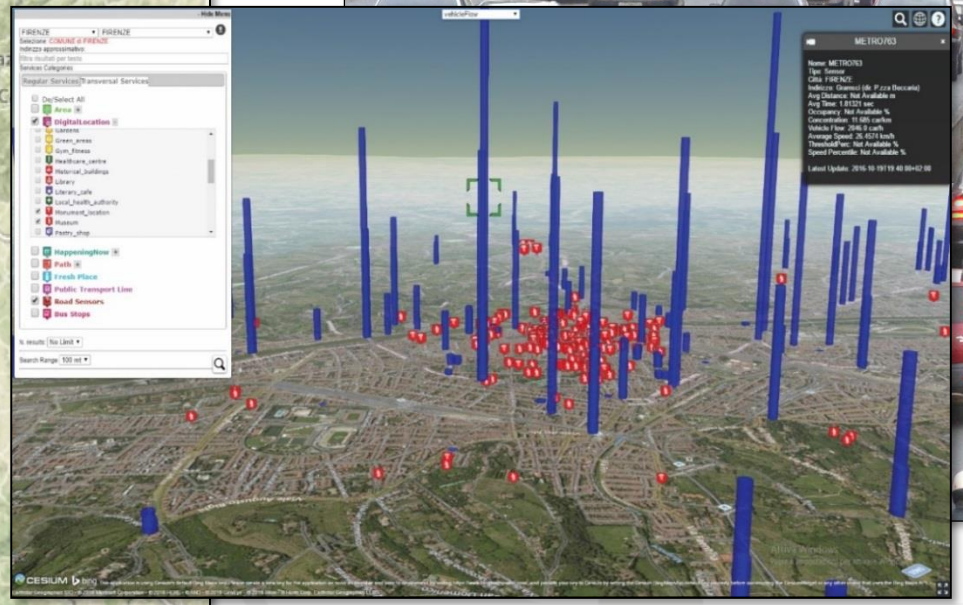


Traffic Flow Tools

Spire and Virtual Spires (cameras), Bluetooth, ...

Specifically located: along, around, on gates, on x...





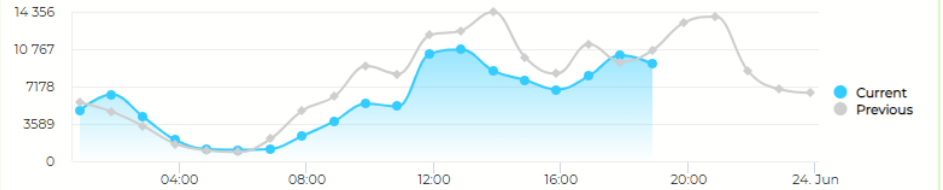
Traffic Flow Monitoring - Firenze - Cloned

Sun 23 Jun 19:38:15

 # IN FLOW 9m

9350

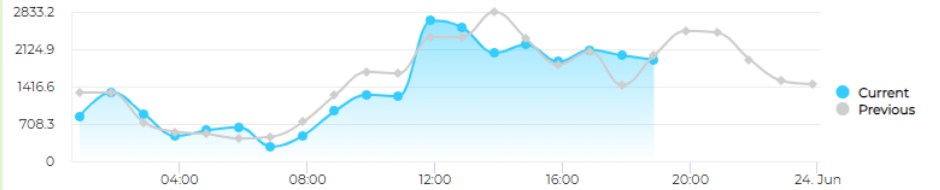
Firenze IN Traffic Flow (number of vehicles) 9m



ZTL in 9m

1925

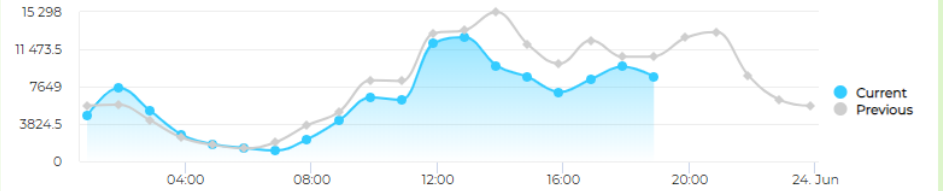
ZTL in Traffic Flow daily trend 9m



 # OUT FLOW 9m

8684

Firenze OUT Traffic Flow (number of vehicles) 9m



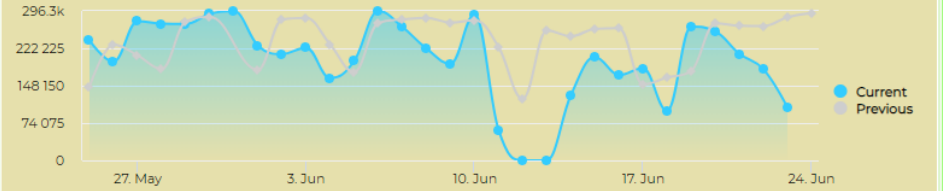
status comments 4m

All OK

Inc Daily Inp... 9m

105354

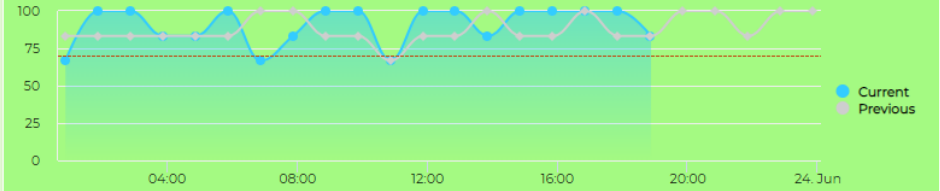
Daily Inputs (monthly) (last value is incremental) 9m



Current Time - C...

23/06/2019
19:38:15

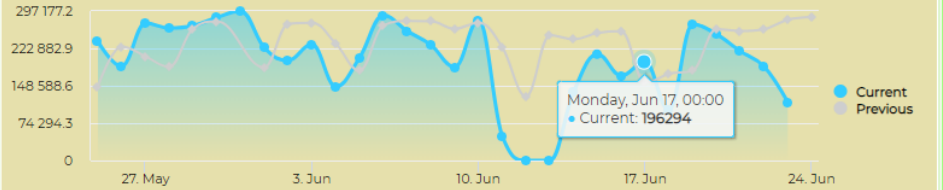
Quality of Measure in terms of percentage of expected measures considered 9m



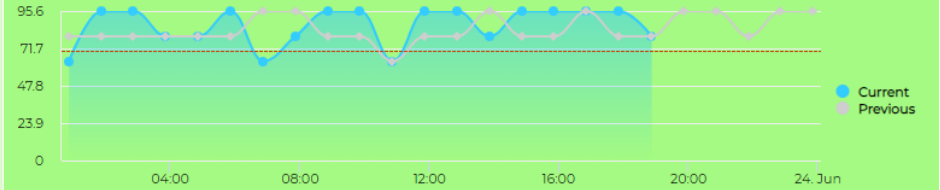
Inc Daily Out... 9m

116029

Daily Outputs (monthly) (last value is incremental) 9m



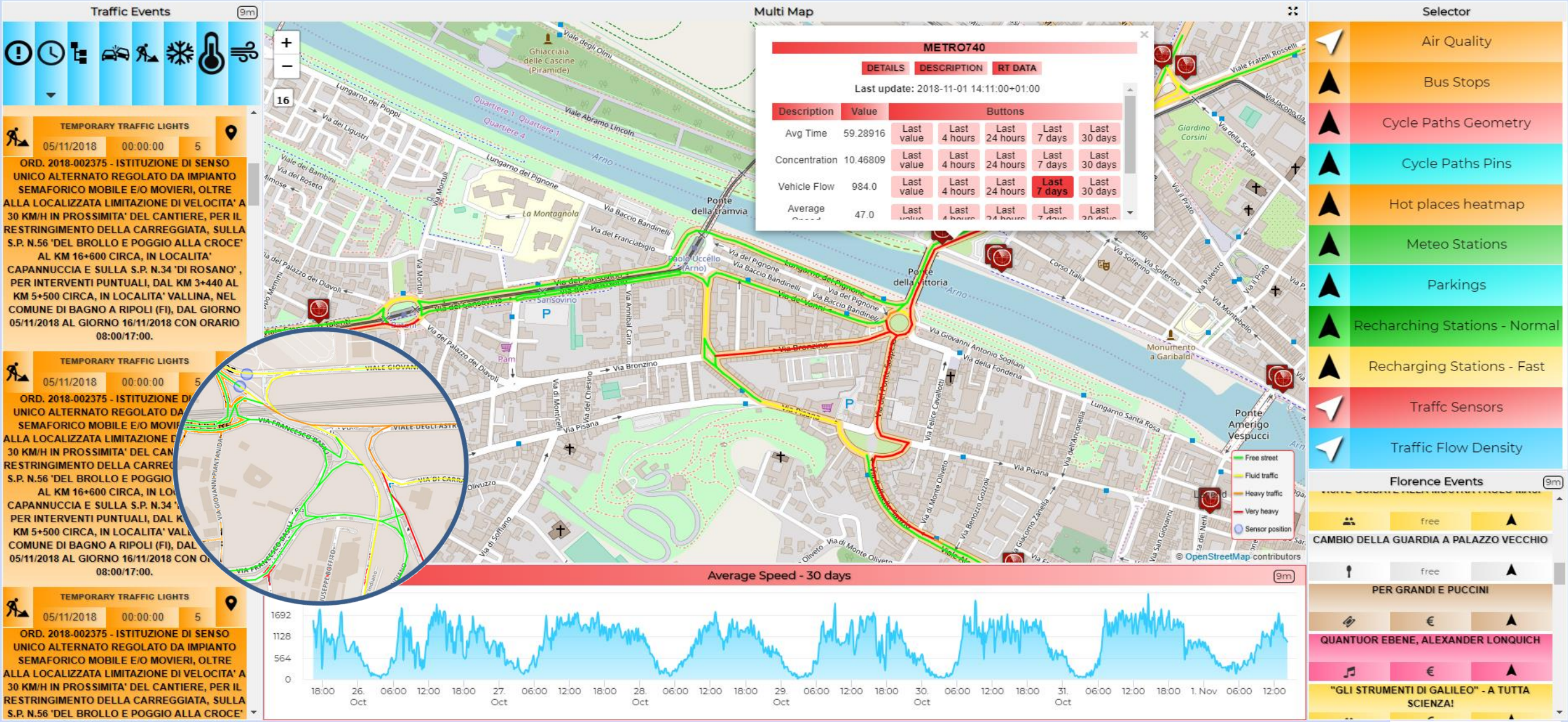
Quality of Measure in percentage - ZTL in time trend compare 9m



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc2MQ==

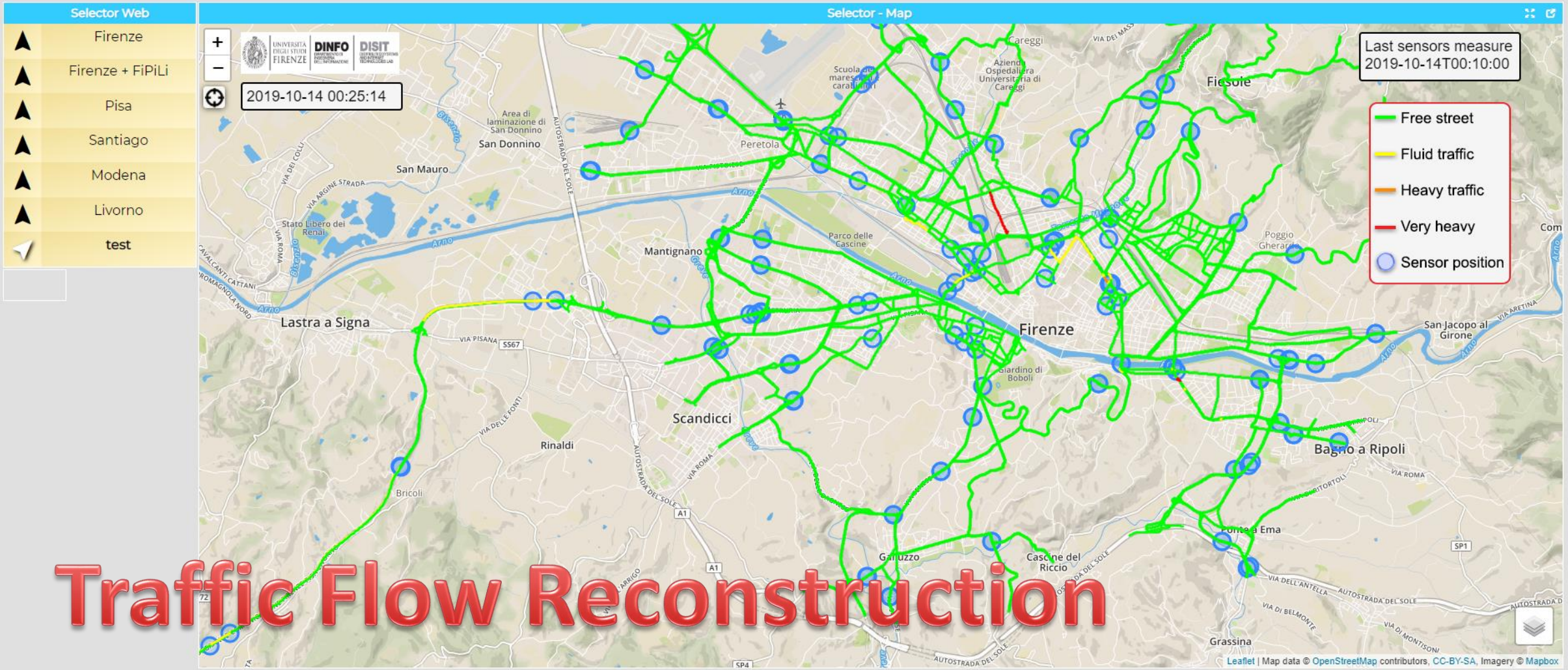
Toscana Traffico

Thu 1 Nov 14:15:47



https://main.snap4city.org/view/index.php?iddasboard=MTE5MQ==

Traffic Flow Reconstruction for the cities

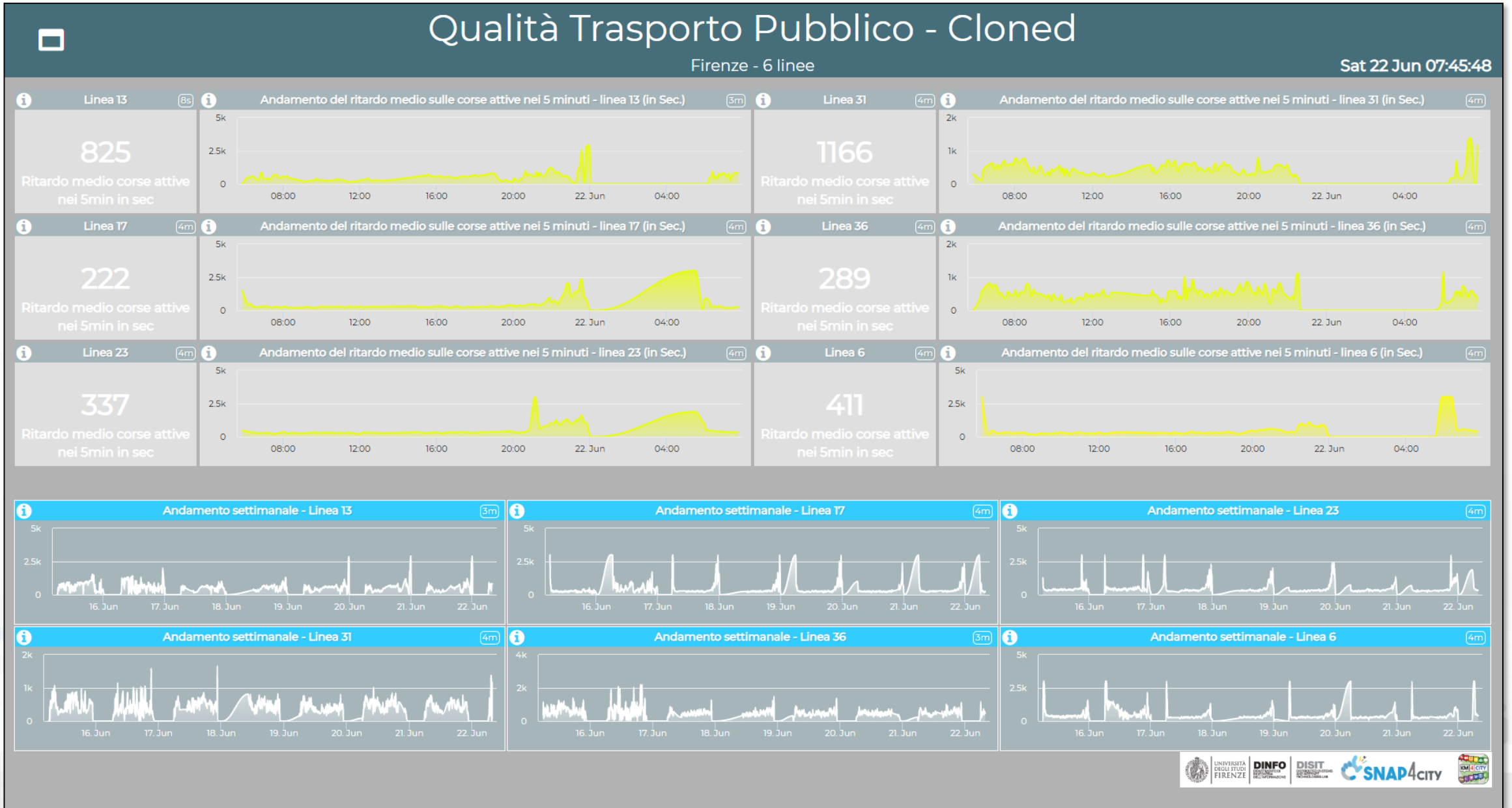


Traffic Flow Reconstruction

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

Quality of Public Transport




Qualità Trasporto Pubblico - Cloned
Firenze - 6 linee
Sat 22 Jun 07:45:48
Linea 13
825
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 13 (in Sec.)
Linea 31
1166
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 31 (in Sec.)
Linea 17
222
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 17 (in Sec.)
Linea 36
289
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 36 (in Sec.)
Linea 23
337
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 23 (in Sec.)
Linea 6
411
Ritardo medio corse attive nei 5min in sec
Andamento del ritardo medio sulle corse attive nei 5 minuti - linea 6 (in Sec.)
Andamento settimanale - Linea 13
Andamento settimanale - Linea 17
Andamento settimanale - Linea 23
Andamento settimanale - Linea 31
Andamento settimanale - Linea 36
Andamento settimanale - Linea 6

Origin Destination Matrices



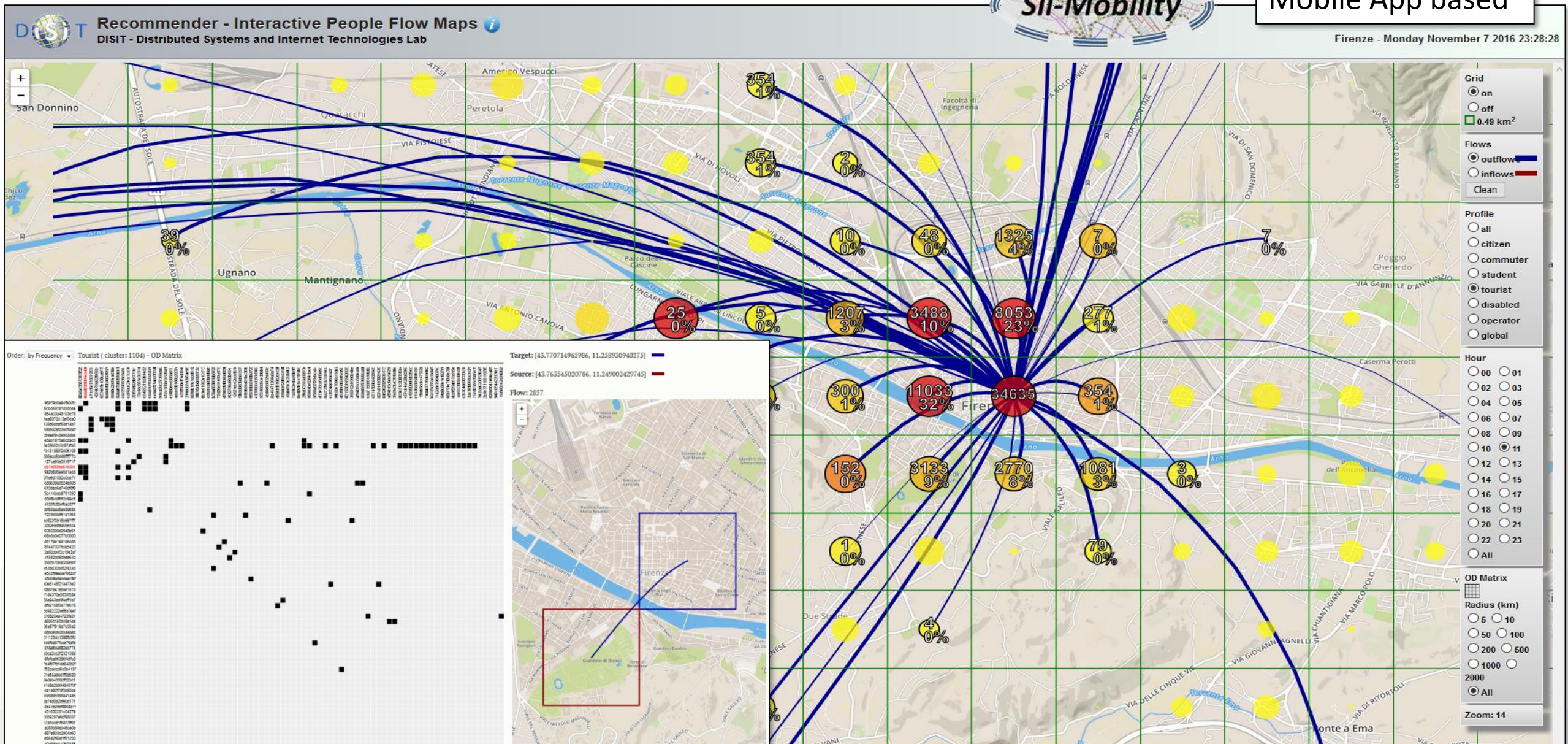
Scalable multiresolution OD matrix

SNAP4CITY

KM4CITY

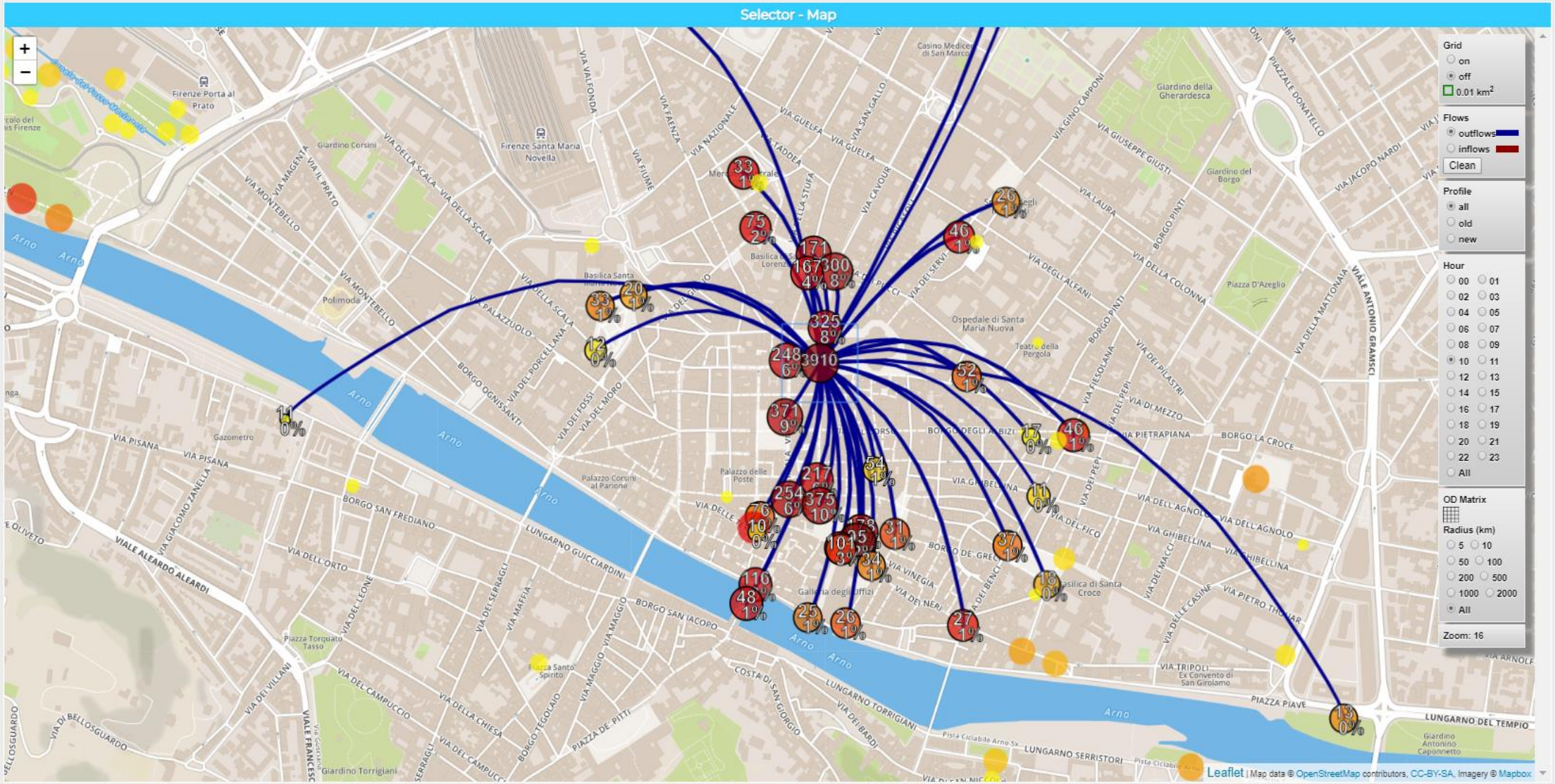
Sii-Mobility

Mobile App based



Life in Toscana: Dashboard

Sun 20 Oct 23:44:05

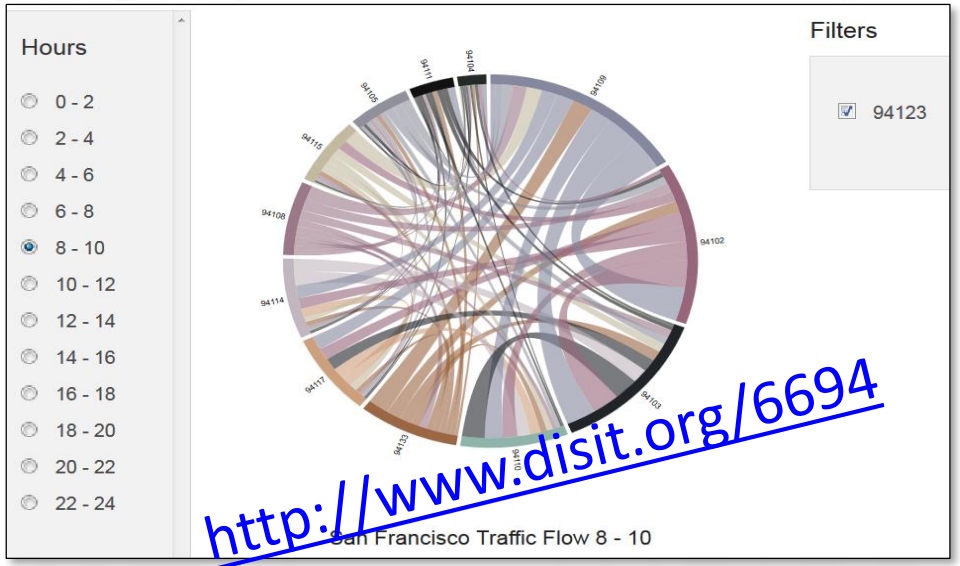


- Line of Transport
- Public Transport
- Travel Plan
- Traffic Flow FIPILI
- Air Quality
- Weather
- Origin Dest. Matrix
- Typical Trajectories
- People Flow WIFI
- People Flow KM App
- Cultural Activities
- Forum Discussion
- CAM
- Ponte Vecchio
- Real Time Busses

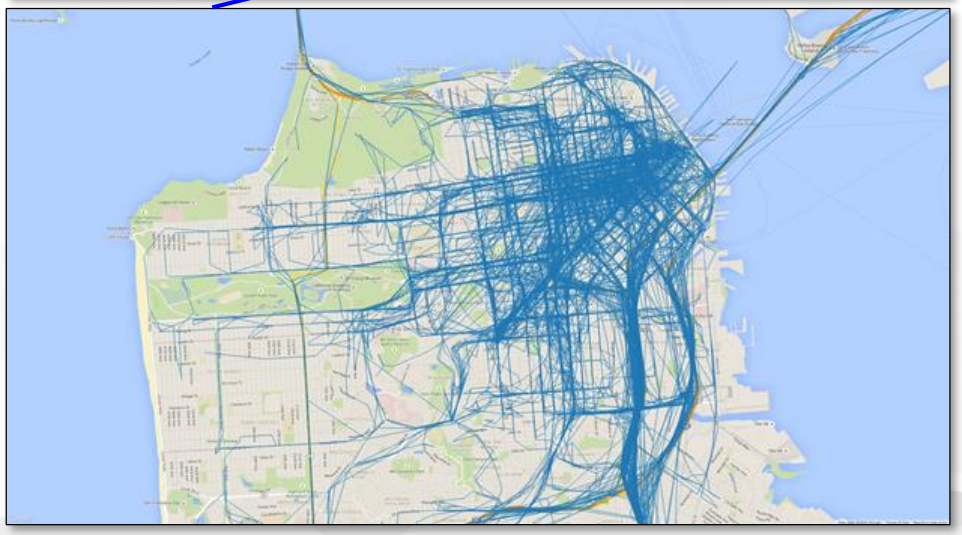
Main

Traffic and People Flow Assessment

- **Origin Destination Matrix**
  - Specific Sensors, vehicle Kits, mobile App, Wi-Fi Access Points, etc.
  - Data from Taxi in San Francisco
- **Assess people and traffic flows to**
  - improve services
  - predict critical conditions on Crit. Infra.
  - take real time decisions and sending messages in push to population
  - Increase city resilience
  - optimize traffic flow
  - take decision of routing



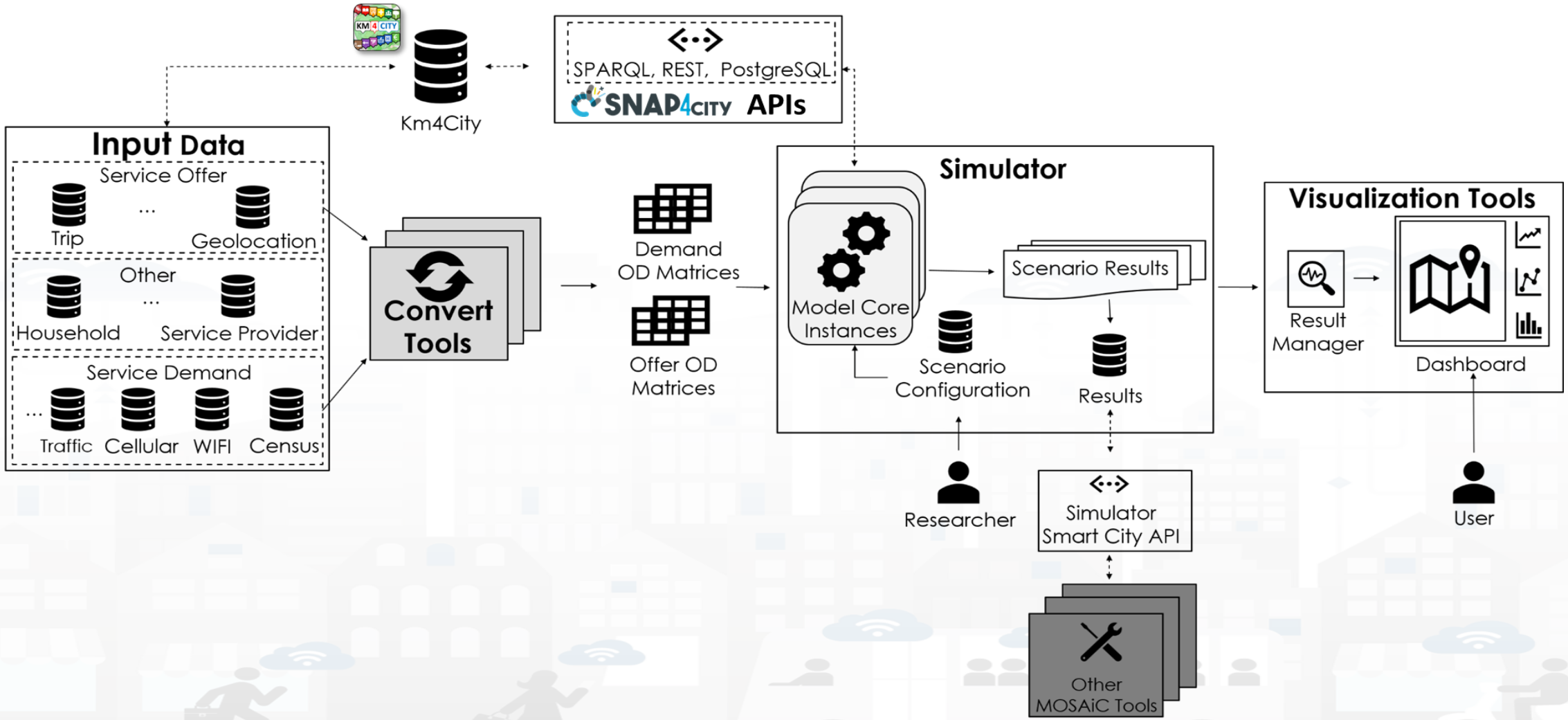
http://www.disit.org/6694



Demand of Mobility vs Offer of Transportation



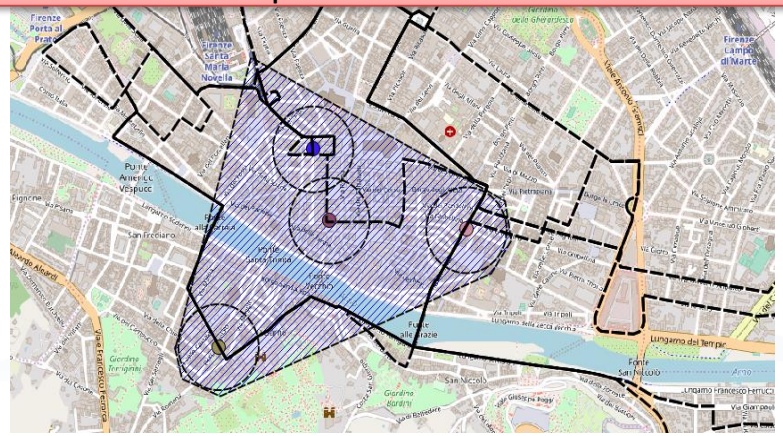
Demand vs Offer of Mobility Analysis



What the Analysis tool produces

- Identification of critical Bus Stops over time
- Identification of critical courses of bus lines, over day and week
- Effects of changing the position of Bus Stops, courses and line schedules, bus size, etc.
- Effects of changing the contextual conditions:
  - The opening of shopping centers, cinemas, schools, etc..
  - Size of the buses
  - Etc.

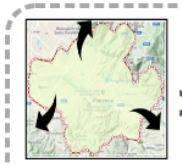
Area and Bus stops considered for the Validation



Parameters	Value
Morning interval	$05:00 - 13:59$
Afternoon interval	$14:00 - 23:59$
Time interval size	$60\ (min)$
Morning outbound trips $(\widetilde{Out}_{mng})$	42393
Afternoon outbound trips $(\widetilde{Out}_{aft})$	52798
Radius (r) of circle $c(s,r)$ around each stop s	$250\ (m)$

Bus Stop Analysis: identification of criticalities





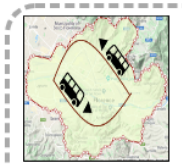
> 42300

Daily individual Production Trips



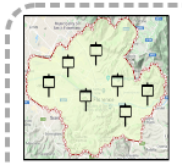
> 52900

Daily Individual Attraction Trips



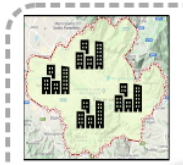
21289

Daily bus trips



1875

Bus Stops



31070

Residential Buildings



31059

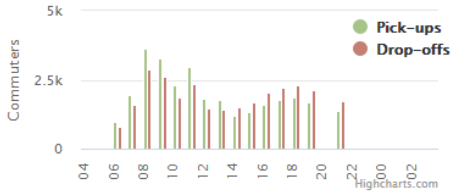
Service Providers

The Most Crowded Stops

Piazza Di San Marco

Daily Pick-ups: 29525

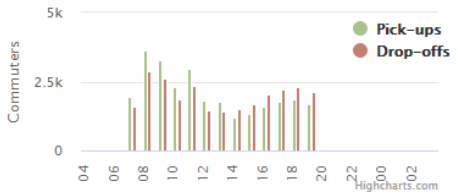
Daily Drop-offs: 28503



SantAnna

Daily Pick-ups: 27168

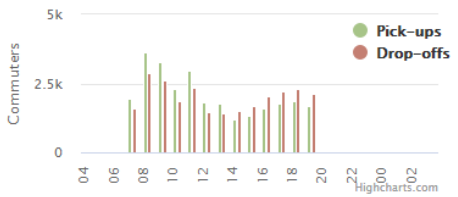
Daily Drop-offs: 26000



Salvestrina

Daily Pick-ups: 27168

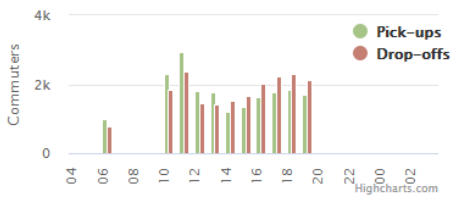
Daily Drop-offs: 26000



Stazione Piazza Adua

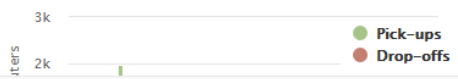
Daily Pick-ups: 19294

Daily Drop-offs: 19699



San Zanobi

Daily Pick-ups



Modal & Multimodal Routing for Navigation and Travel Planning



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

- Dashboards
- My Dashboards
- Notificator
- IOT Applications
- My Personal Data
- IOT Directory and Devices
- Knowledge and Maps
  - Service Map
  - Loading WKT on Service Map
  - Creating WKT
  - Service Map 3D
  - Helsinki Service Map
  - Antwerp Service Map
  - My Annotation on Services/Data
  - Mapping Services Data
  - ArcGIS DISIT Service
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal
- Km4City portal
- DISIT Lab portal

- 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
Coord: 43.7130,10.9272
Address: VIA DI PRATOVECCHIO, 58, EMPOLI

Path from here | Path to here | Search geometry

Path
From: VIA DELLA PERGOLA, 39, FIRENZE
To: VIA DI PRATOVECCHIO, 58, EMPOLI
Route via: public_transport
Start date&time: today now

Search Path

3. Piazza della Santissima Annunziata 49m (14:40:13)
4. Via Cesare Battisti 148m (14:40:52)
5. Piazza San Marco 126m (14:42:47)
6. Via Camillo Cavour 1m (14:44:17)
7. 11 : Arazzieri - Volterrana 7800m (15:06:00)
8. 37 : Galluzzo Via Volterrana - Montespertoli (V. Risorgimento) Sn 26620m (18:52:00)
9. Viale Risorgimento 207m (19:45:00)
10. 32 : Montespertoli (V. Risorgimento) Sn - Viasanzio Fr.157 Sn 17534m (07:16:00)
11. 1 : Via Sanzio Fr.157 - Via Sanzio Fr. Coop Sn 1002m (08:08:00)
12. Via Raffaello Sanzio 45m (08:10:00)
13. nd 33m (08:10:35)

- 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: 100

Search Range 100 mt
Search Area
select...

Firenze
Galluzzo
Cascine del Riccio
Soffiano
San Paolo a Mosciano

Multimodal routing

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

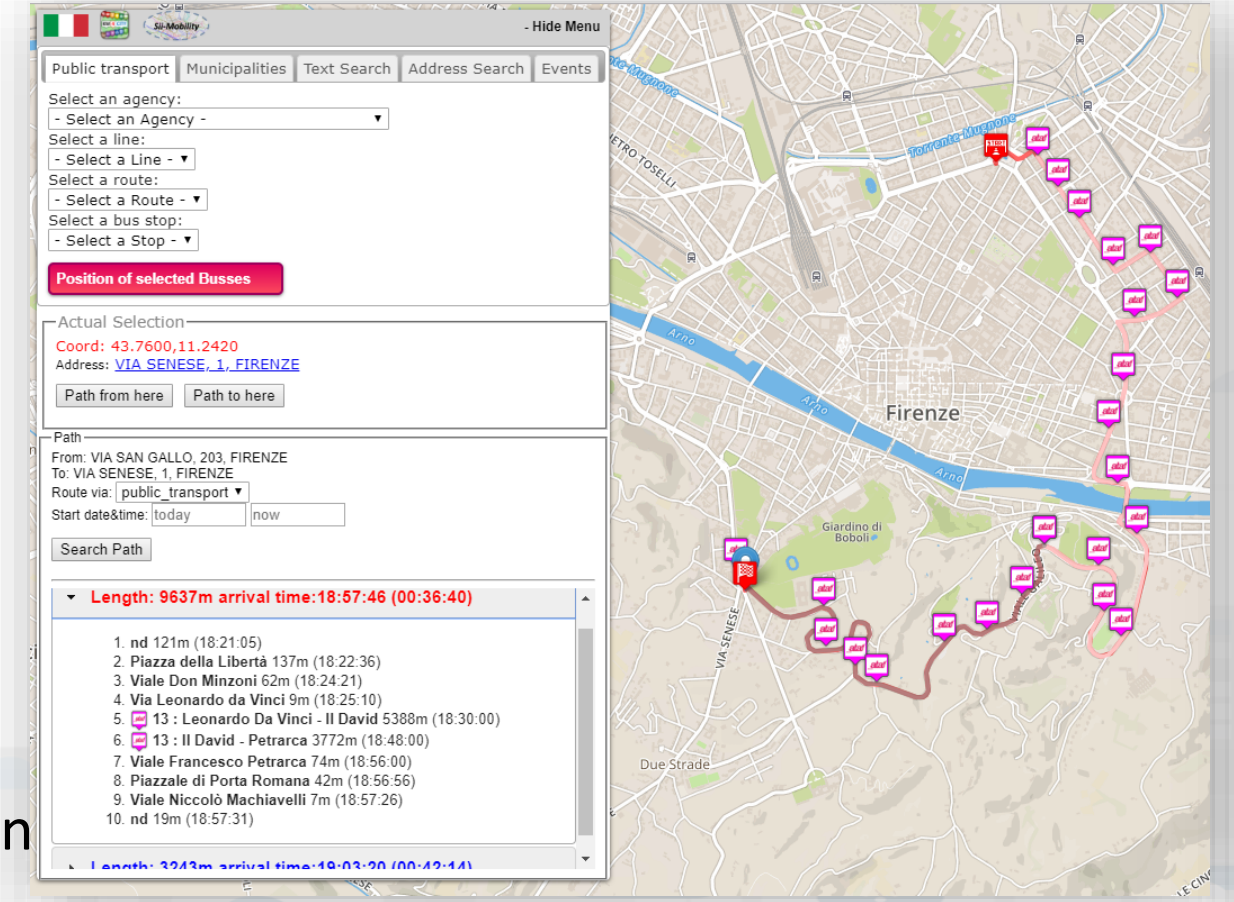
Routing and Multimodal Routing

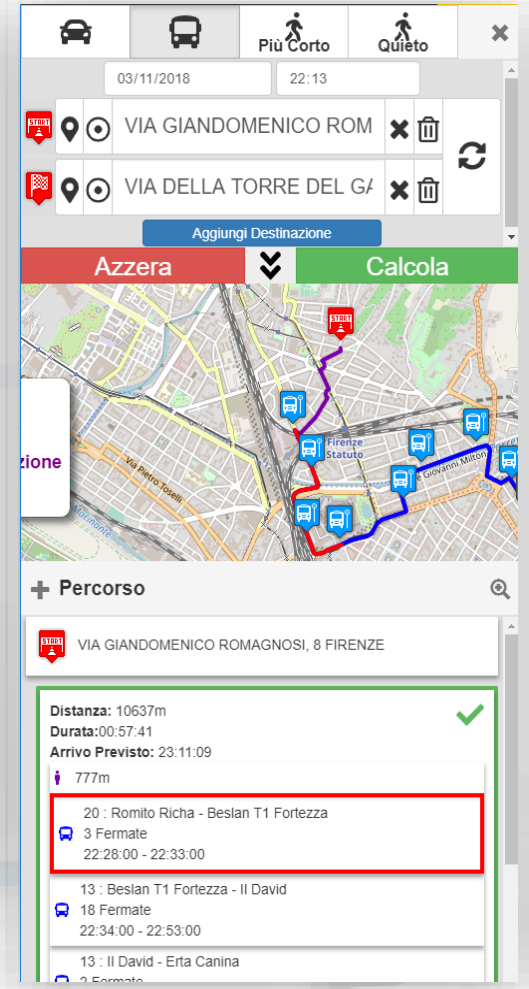
Modes:

- Pedonal, Vehicles
- Public Multimodal
- Multi Point for Delivering
- Constrained: quite, blocked, etc.

Test it on our:

- Mobile Apps
- MicroApplication
- Dashboard
- ServiceMap service on Tuscany in Snap4City

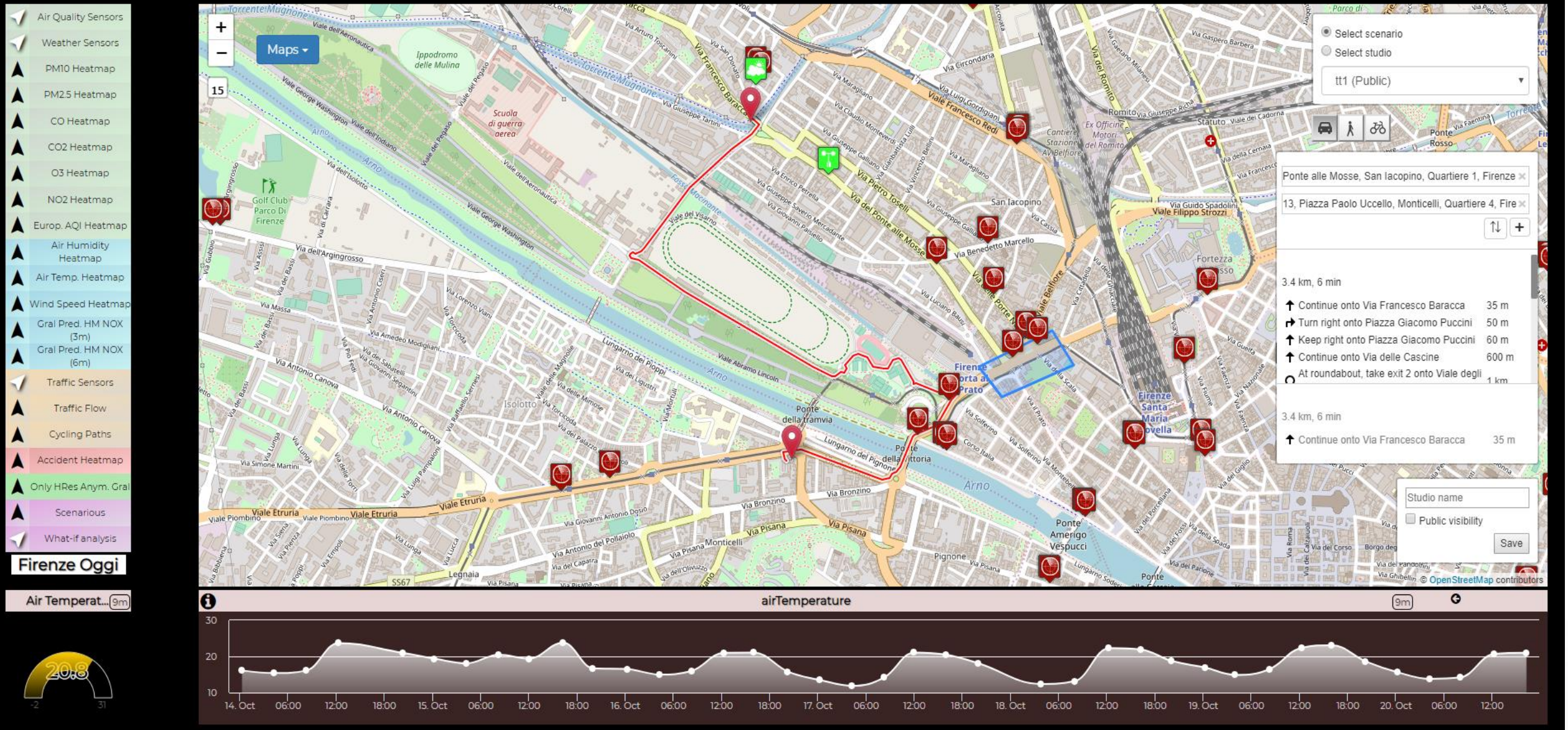




Mobility and Environment What-IF Analysis

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

Sun 20 Oct 23:50:38



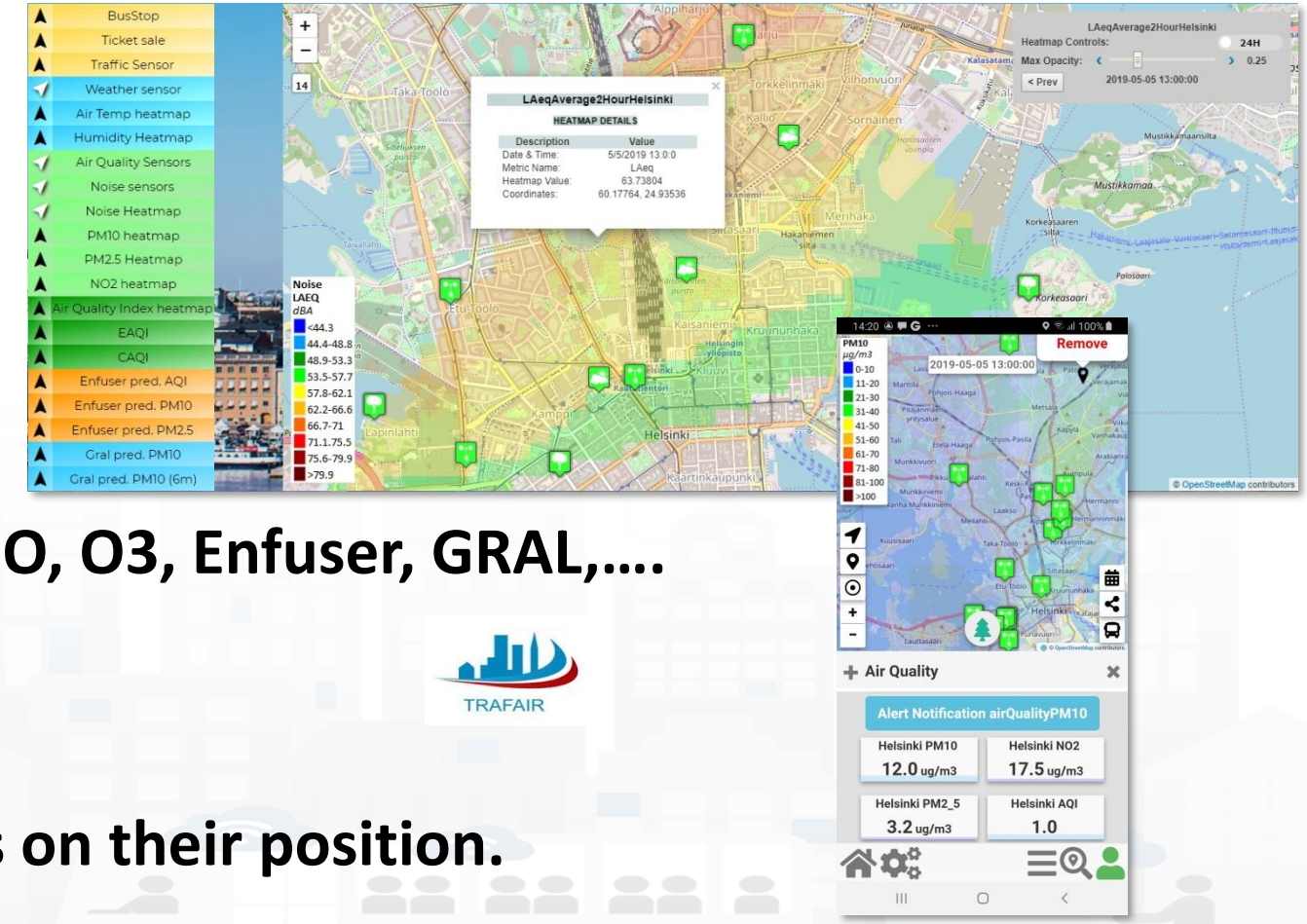
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

Environmental Data Predictions



Data Analytics: Heatmaps

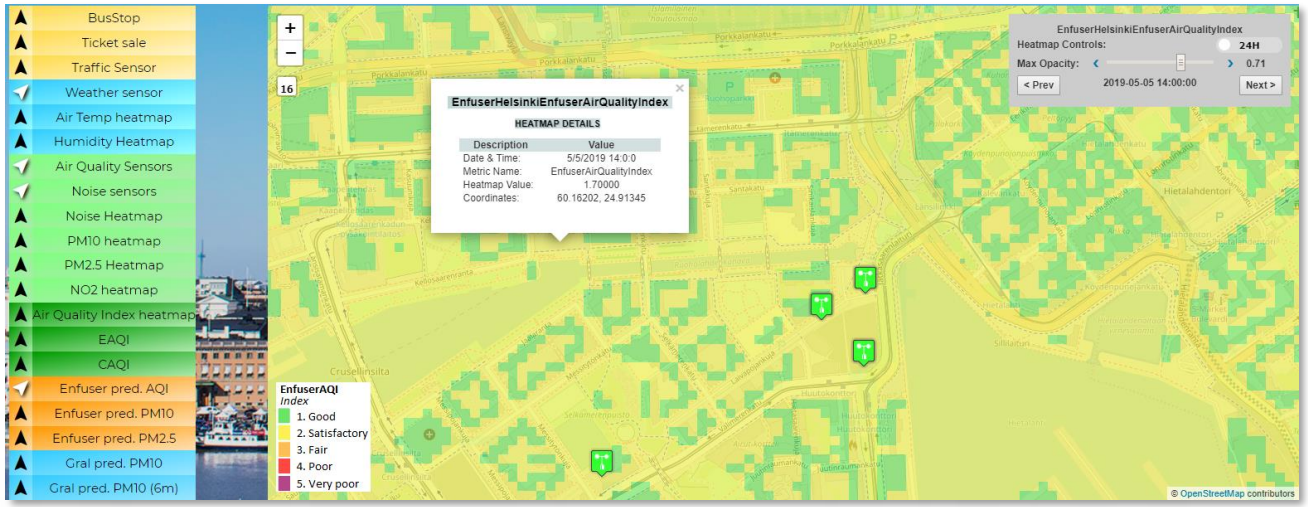
- **Over the Gaussian Heatmaps**
- **Calibrated heatmaps on the basis of Interpolated data for:**
  - **From 200x200 to 4x4 mt**
  - **PM10, PM2.5, SO2, NO2, Noise, NO, O3, Enfuser, GRAL,….**
  - **Any programmed Color map**
  - **Animations over H24**
  - **Picking values in any place, values on their position.**
  - **On Web and Mobile App**

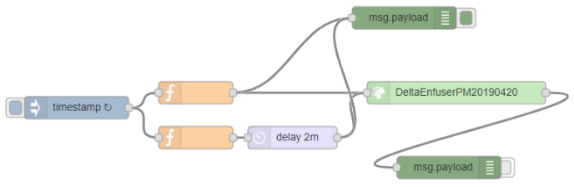


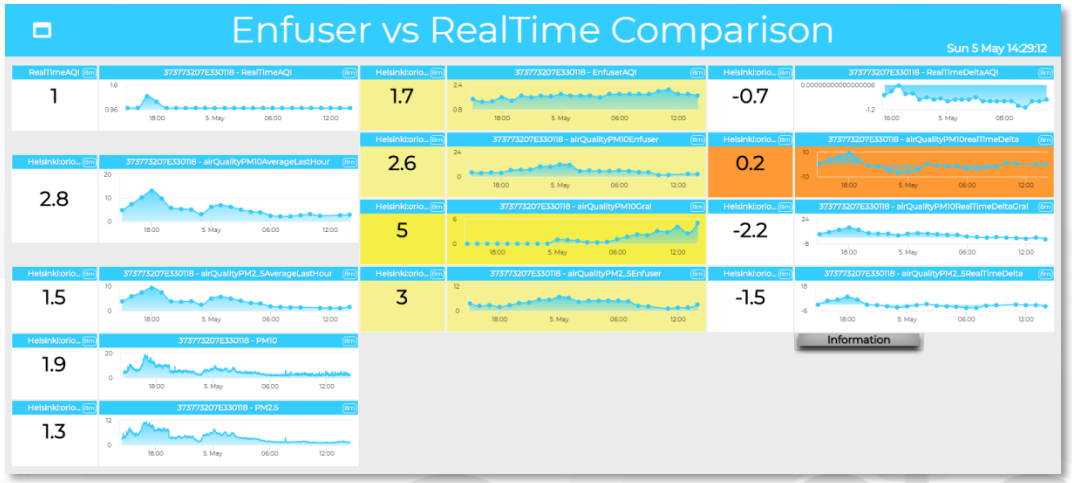
TRAFAIR

Data Analytics: Enfuser predictions

- **Enfuser predictions: AQI, PM10, PM2.5**
  - Data gathering, data processing for Piking
  - Delta Estimation Predictions vs Actual: on 12 points/sensors via R-Studio and IOT App
  - API for accessing data of Heatmaps in real time







Data Analytics: AQI estimations

- **Legenda of Environmental data:**
  - https://www.snap4city.org/drupal/node/435

- **AQI estimation via Rstudio and IOT App:**
  - **EAQI, European Air Quality Index**
  - **Enfuser AQI for Delta,**
  - **CAQI**
  - **Their corresponding Heatmaps**



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

Heatmap Firenze - trafair

different data

Fri 17 May 12:49:34



Florence, Pisa, Livorno

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

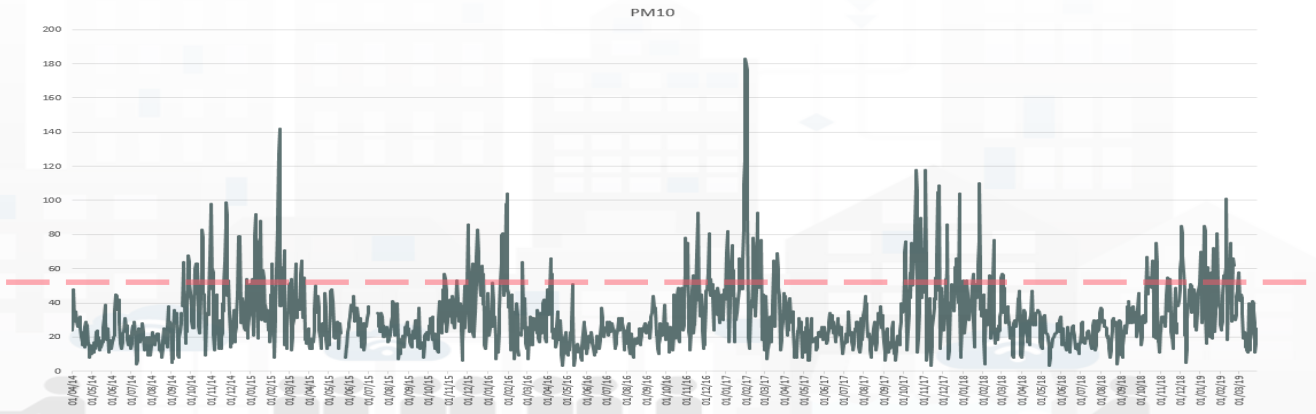
Prediction of Air Quality



Predicting Air Quality

- European Air Quality Directive
- Predicting critical days
  - PM10 with an accuracy of more than 90% and precision of 85%;
  - PM2.5 with an accuracy of 90% and precision greater than the 95%.
- Simulating Long terms values
  - For long terms predictions

		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	

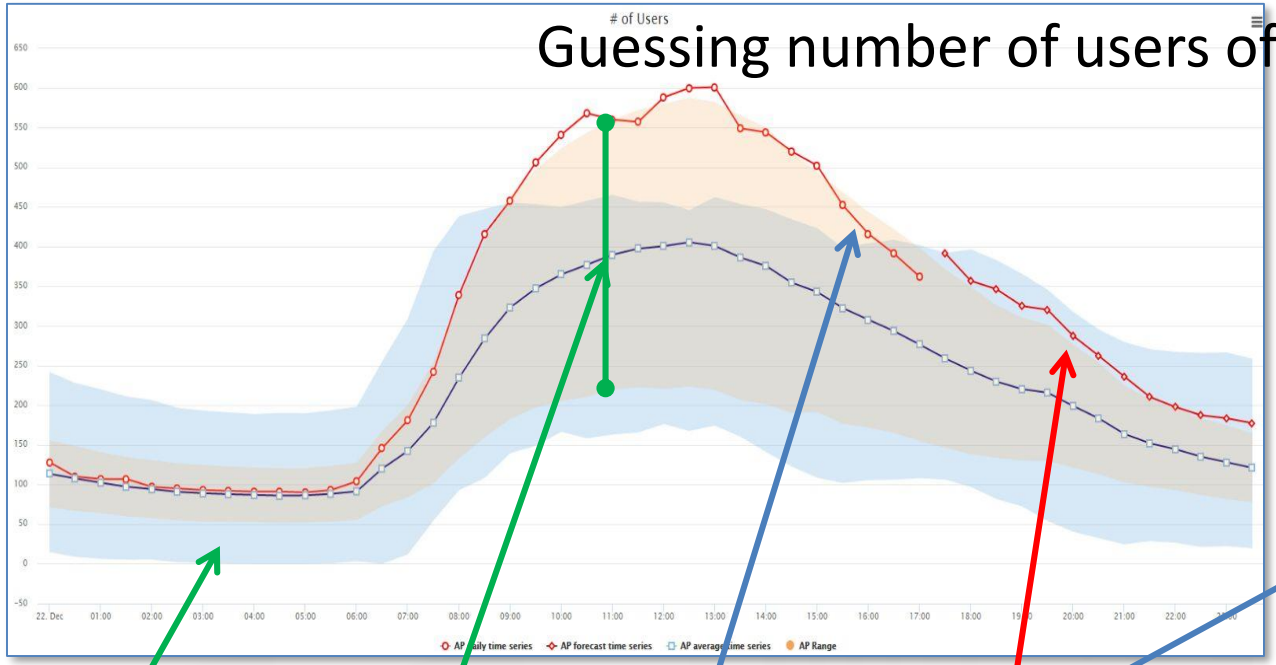


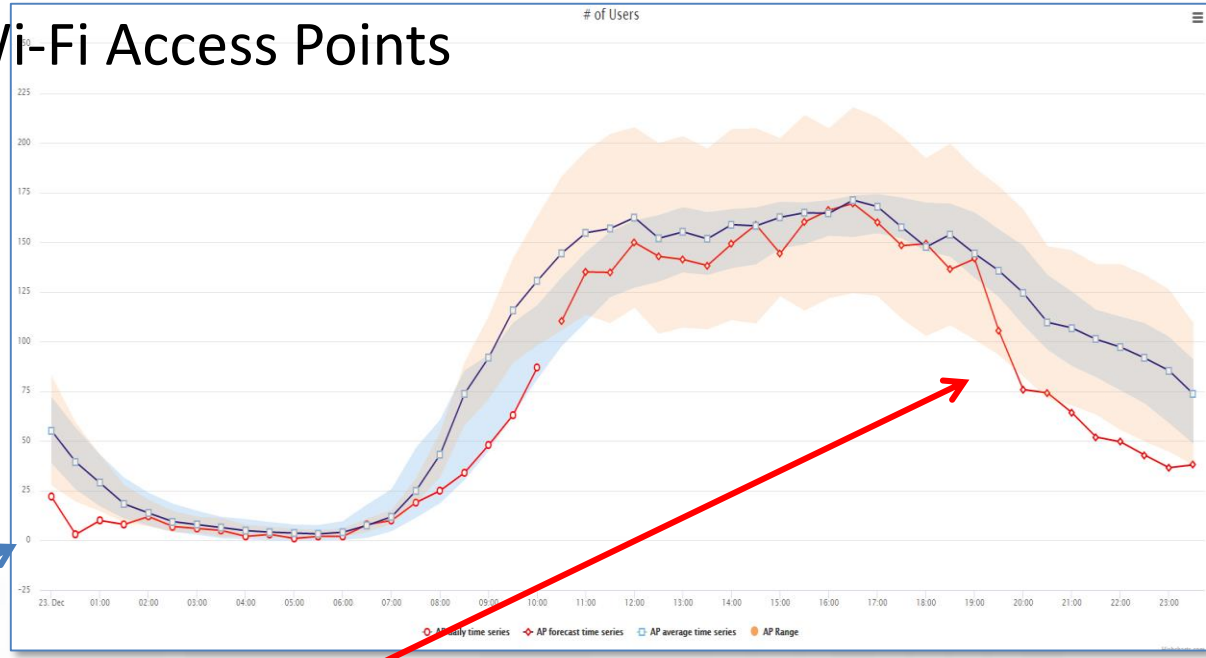
Anomaly Detection



Prediction and Identification of Anomalies

Guessing number of users of Wi-Fi Access Points





Cluster confidence

AP average and confidence

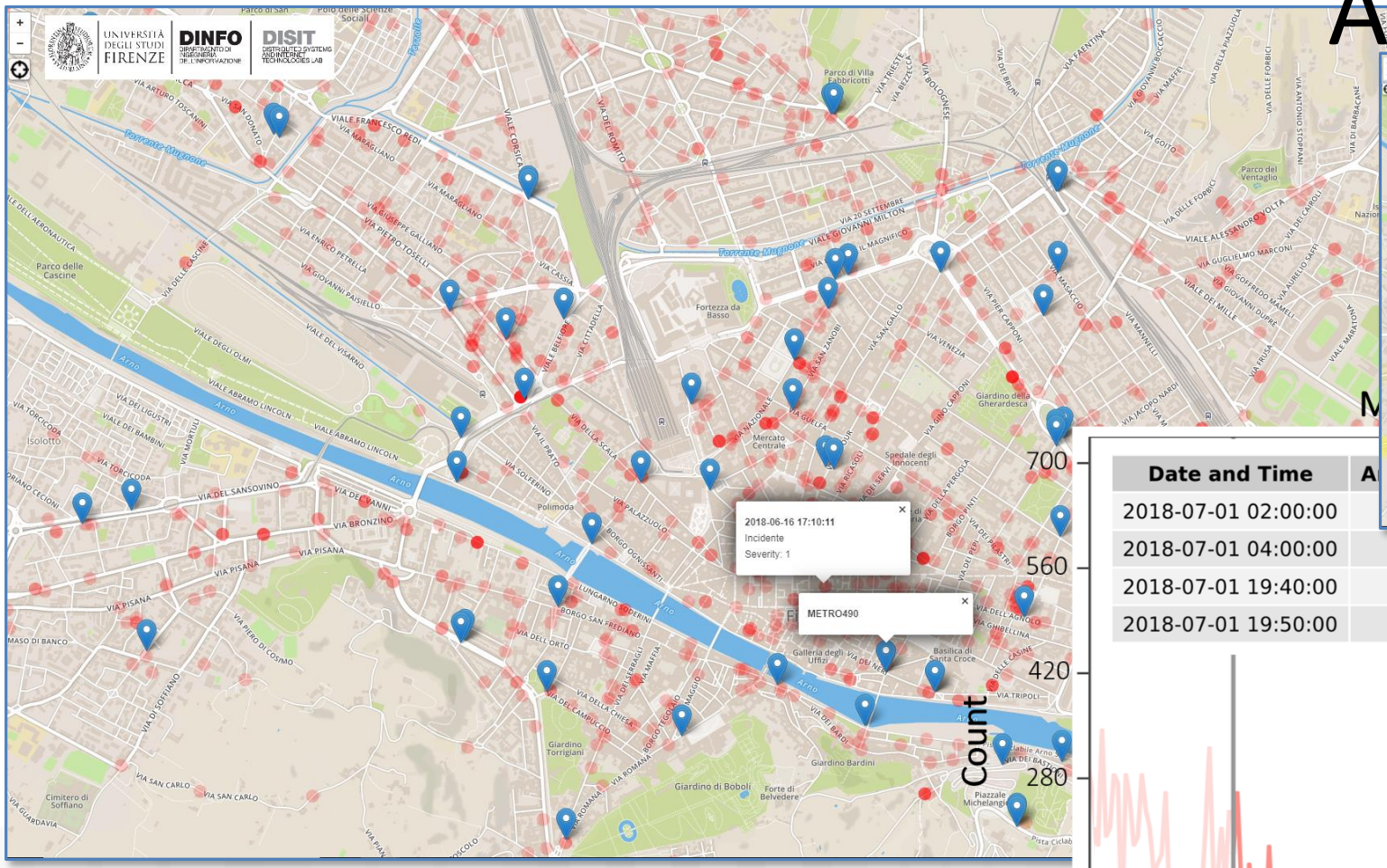
Actual AP trend for today

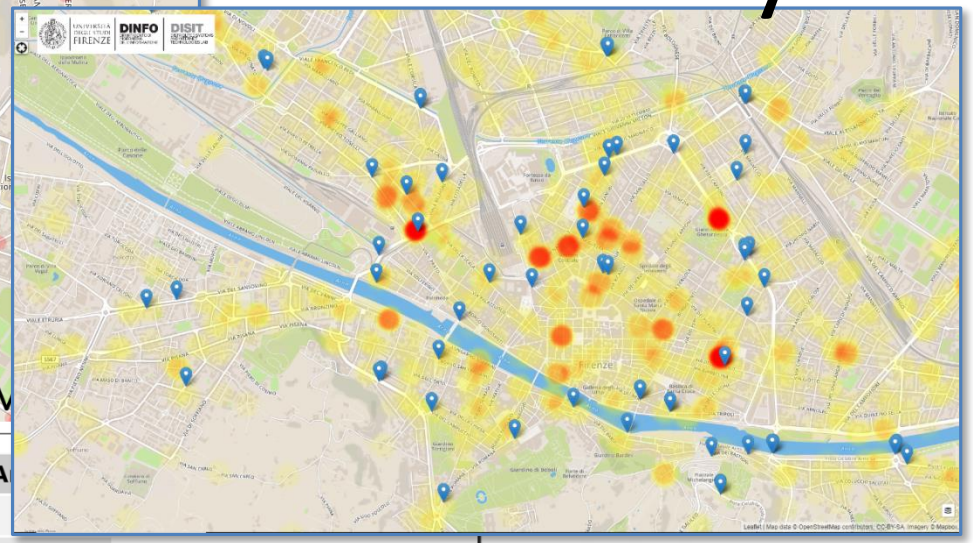
AP prediction for the next time slot in the day on the basis of past weeks

Predictive precision of the 95%

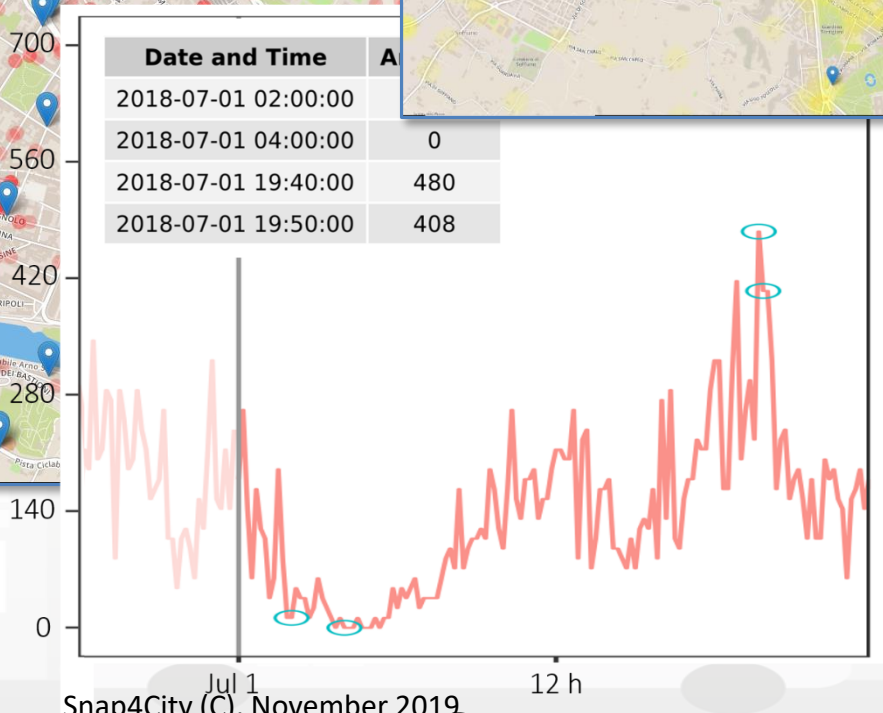
Anomaly Detection

Accidents Density

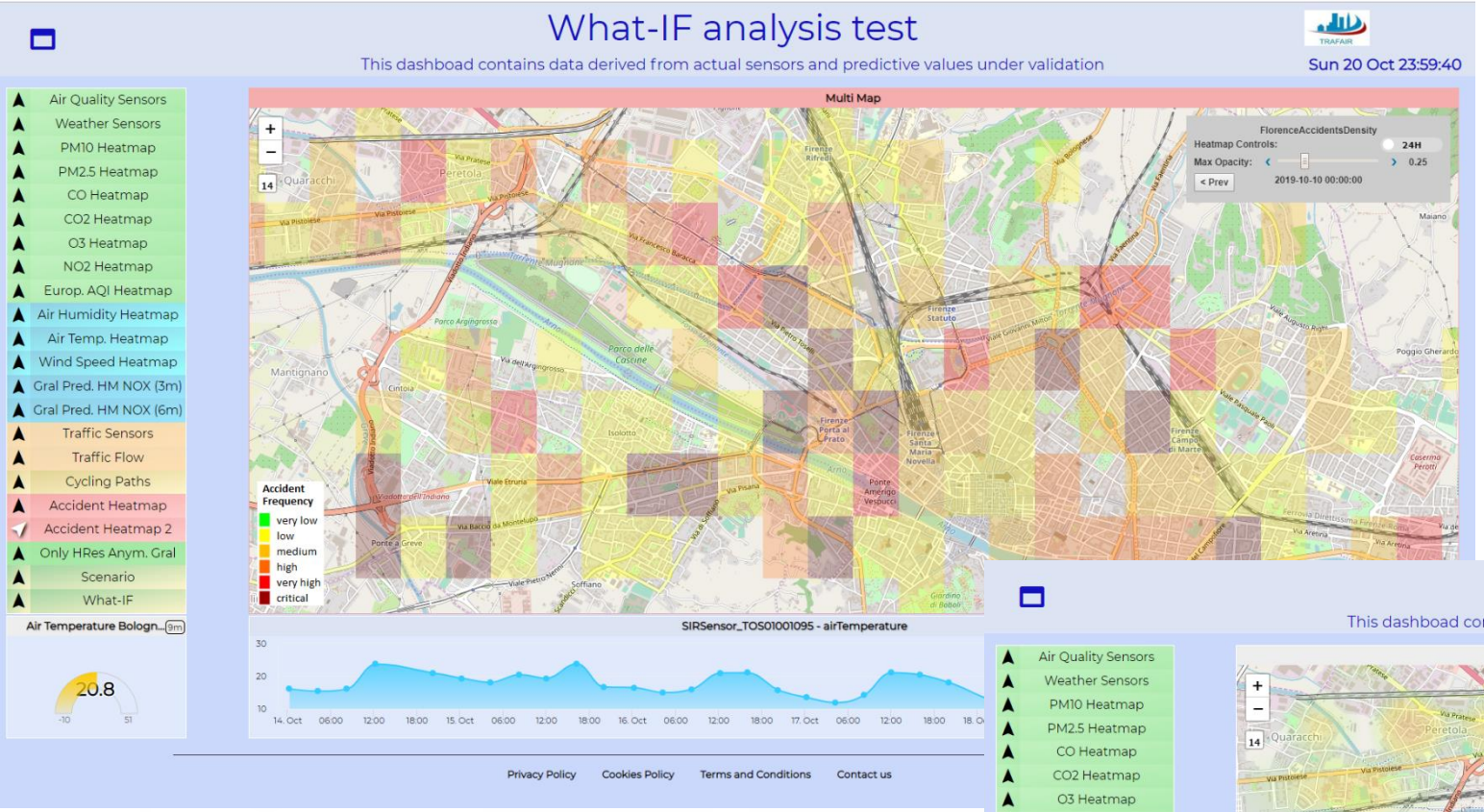




Date and Time	A
2018-07-01 02:00:00	
2018-07-01 04:00:00	0
2018-07-01 19:40:00	480
2018-07-01 19:50:00	408

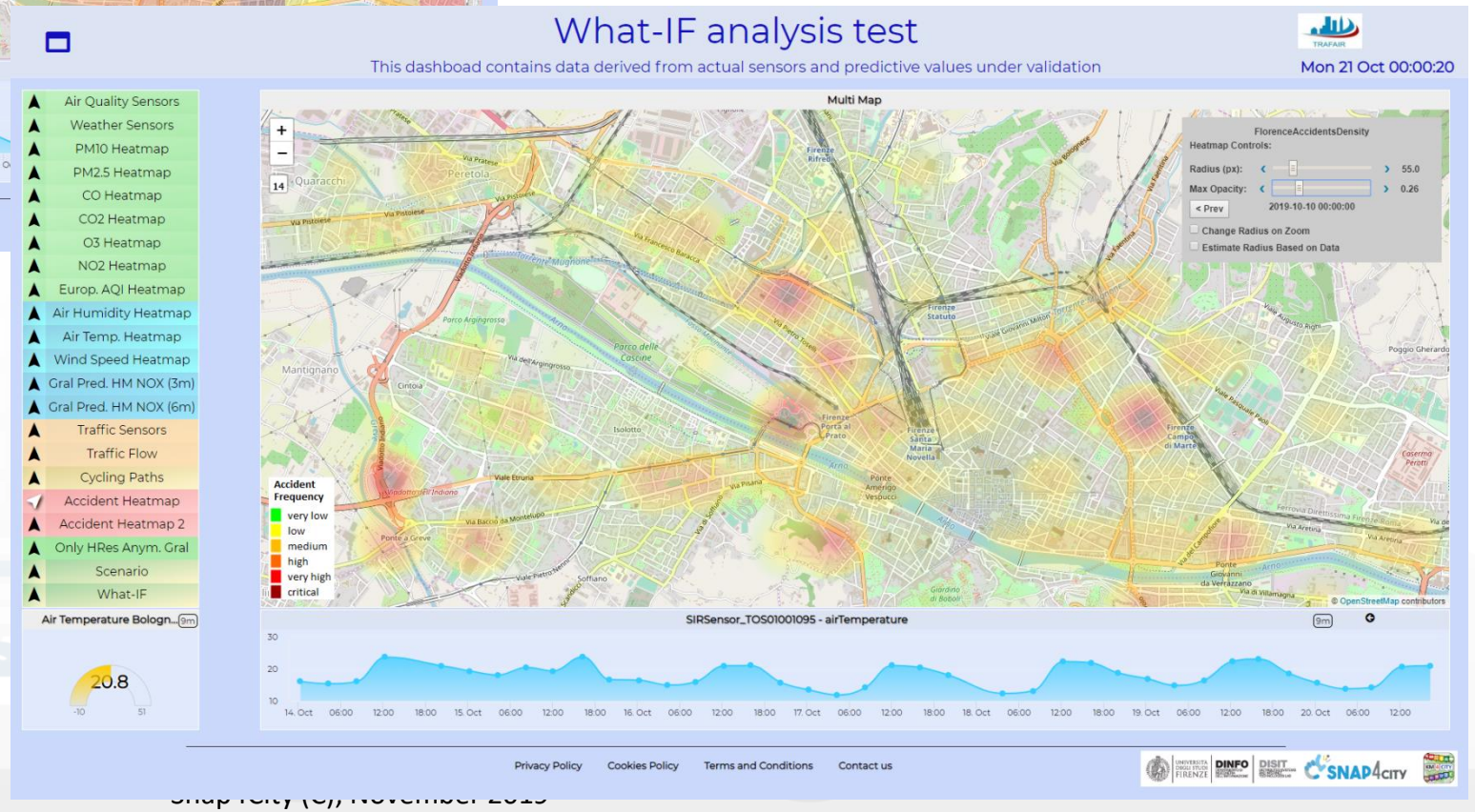


Accidents vs Traffic



Florence

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE4Nw==



WHAT-IF Analysis



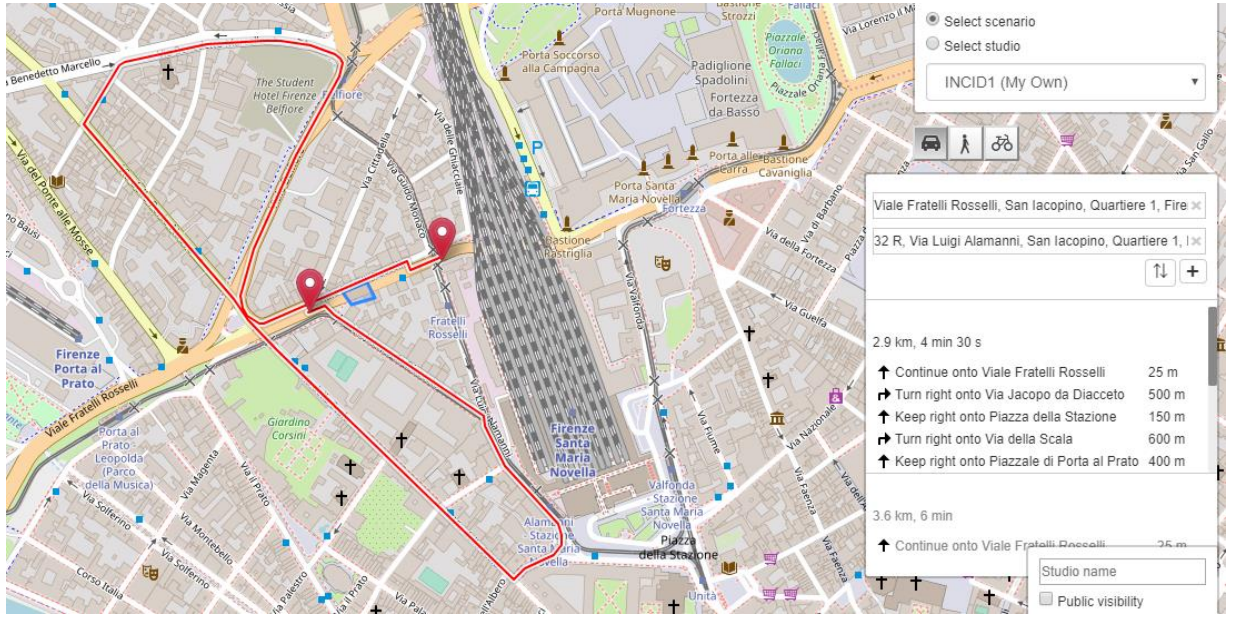
What-If Analysis

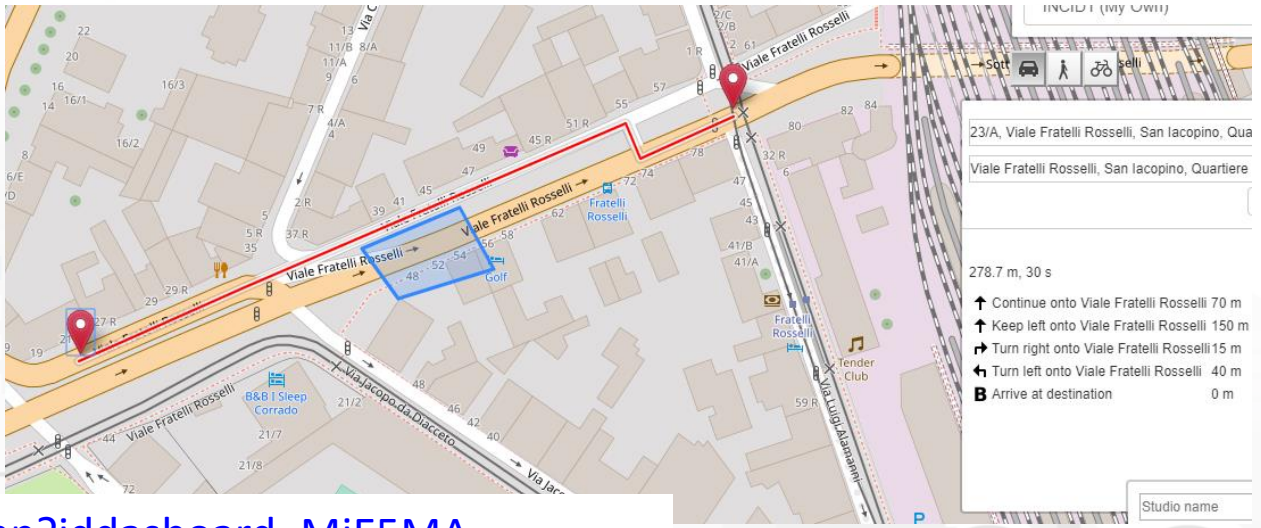
Accidents and elements blocking Points and Shapes taken into account for:

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

Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment



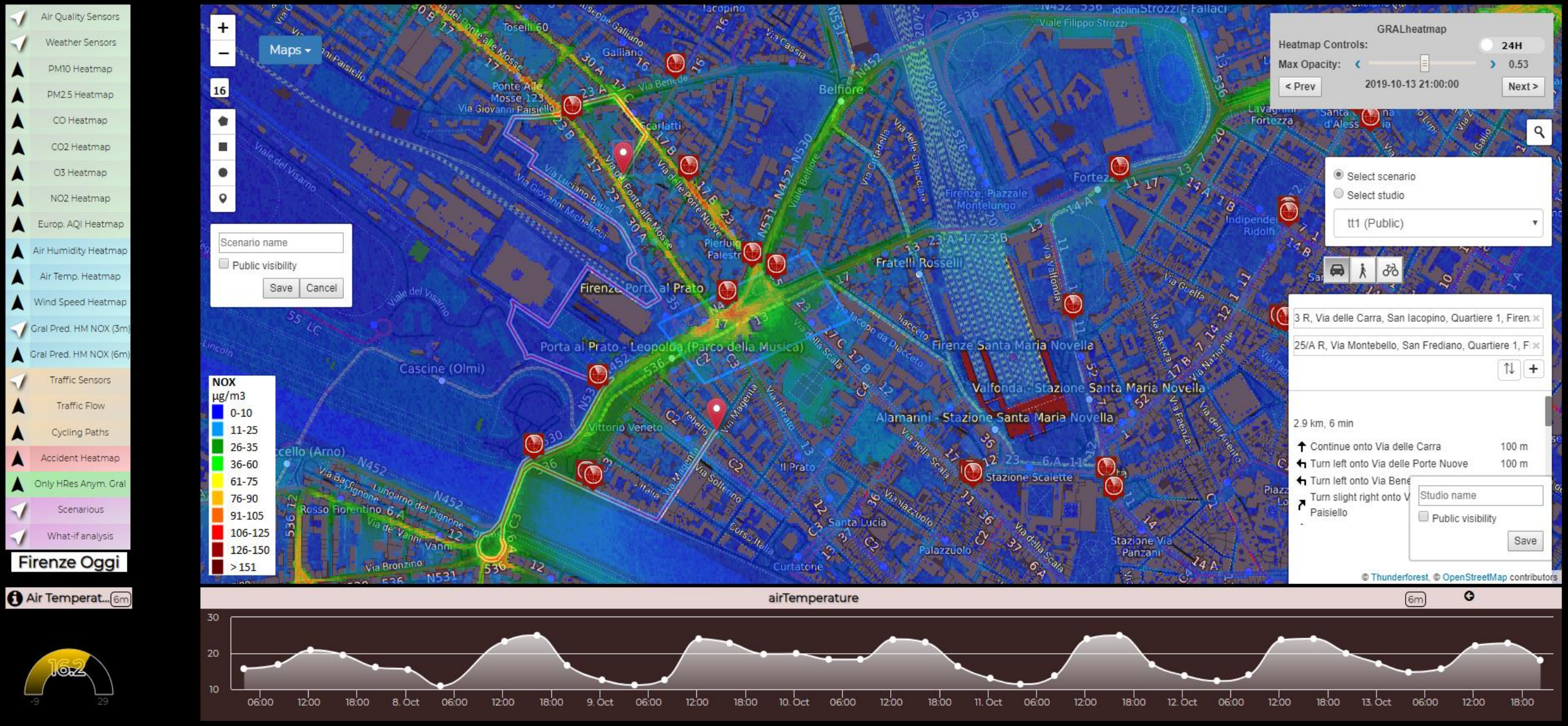


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

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



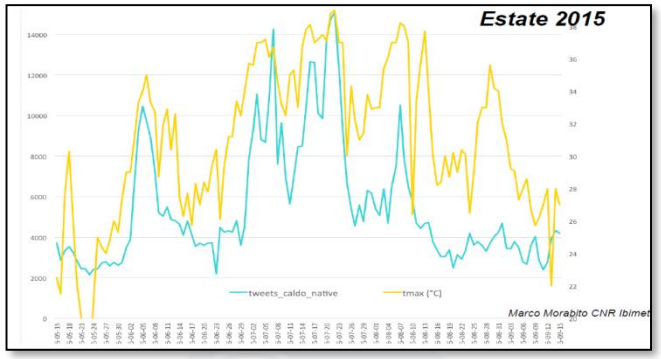
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

Social Media Analysis



Prediction/Assessment

- Football game results as related to the volume of Tweets
- Number of votes on political elections, via sentiment analysis, SA
- Size and inception of contagious diseases
- marketability of consumer goods
- public health seasonal flu
- box-office revenues for movies
- places to be visited, most visited
- number of people in locations like airports
- audience of TV programmes, political TV shows
- weather forecast information
- Appreciation of services



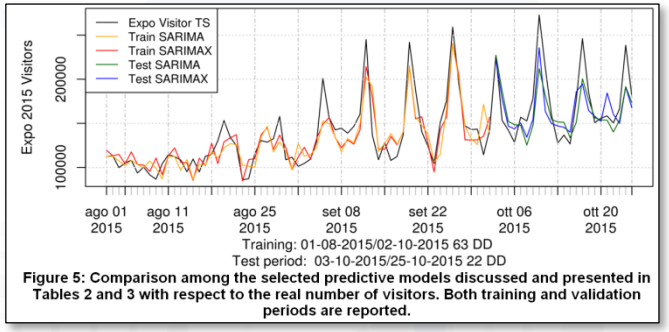
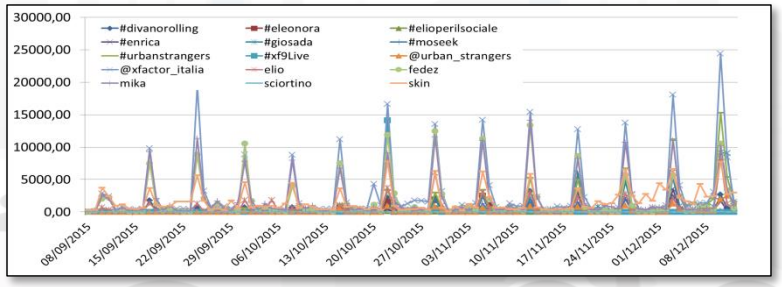
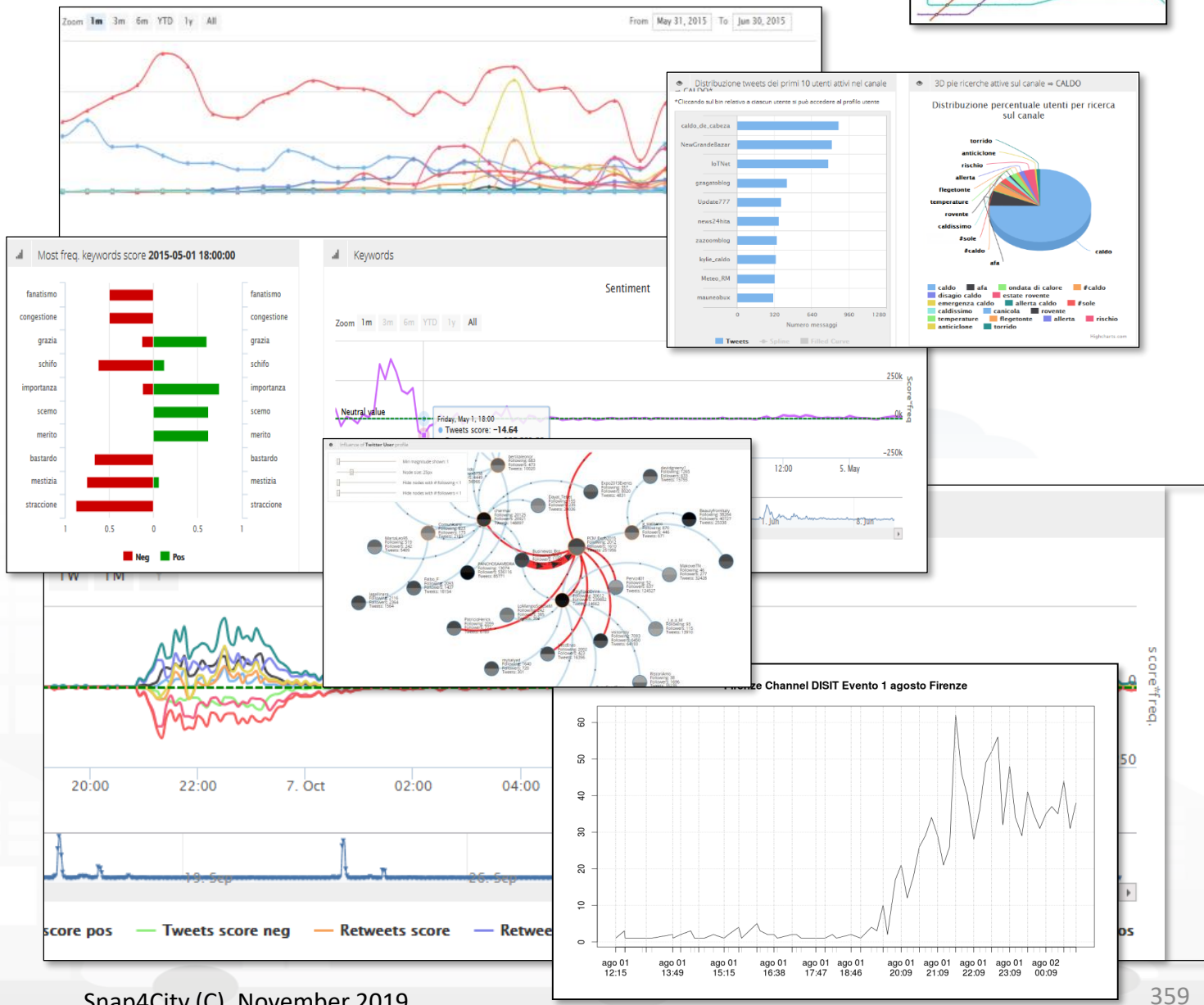


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.



Twitter Vigilance

- http://www.disit.org/tv
- http://www.disit.org/rttv
- Citizens as sensors to
  - Assess sentiment on services, events, …
  - Response of consumers wrt, …
  - Early detection of critical conditions
  - Information channel
  - Opinion leaders
  - Communities
  - Formation
  - Predicting volume of visitors for tuning the services



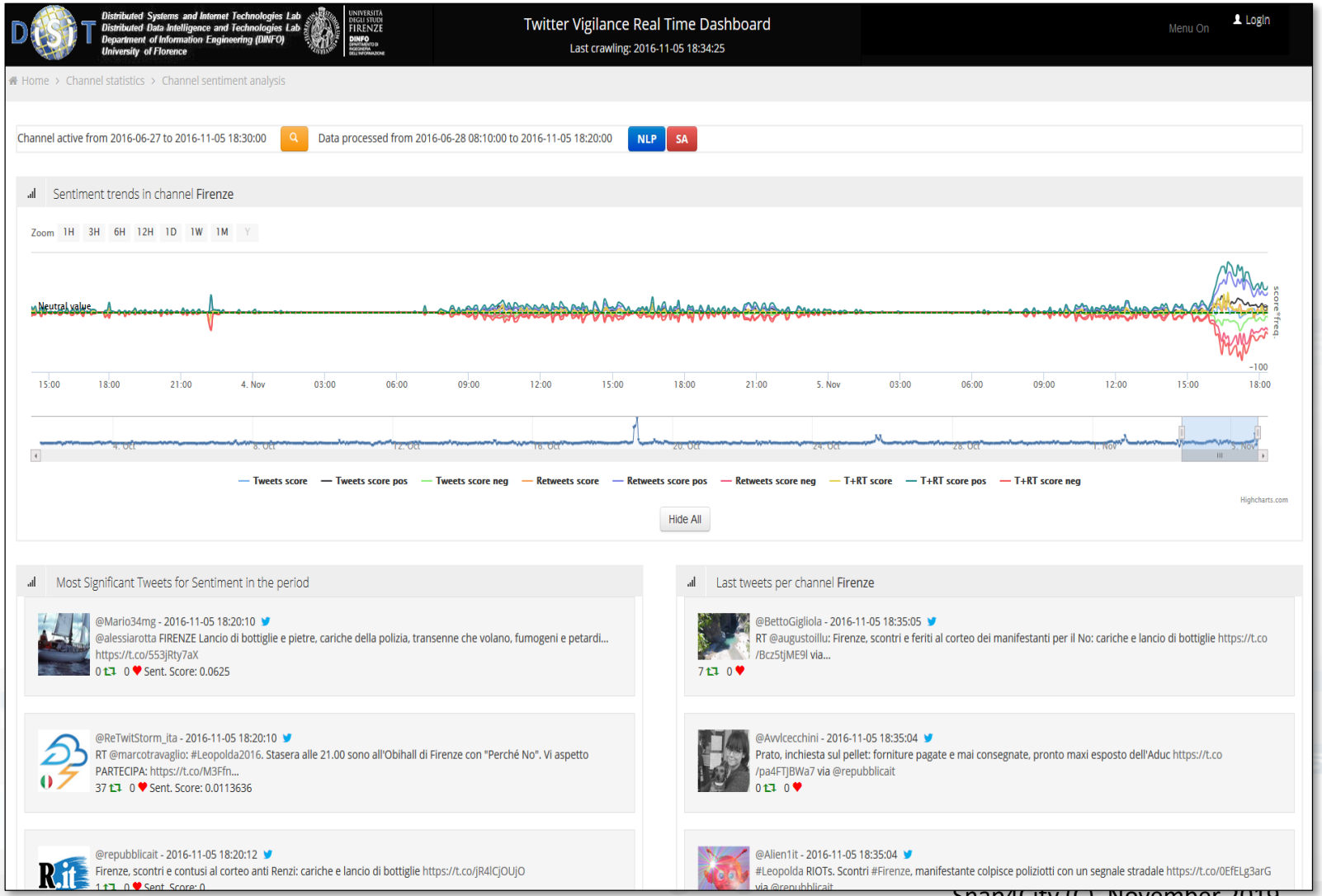
Twitter Vigilance

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

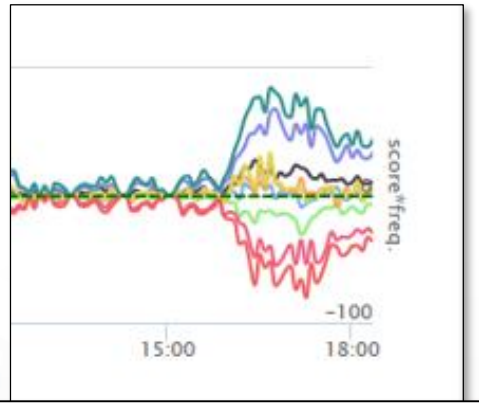
Twitter Vigilance

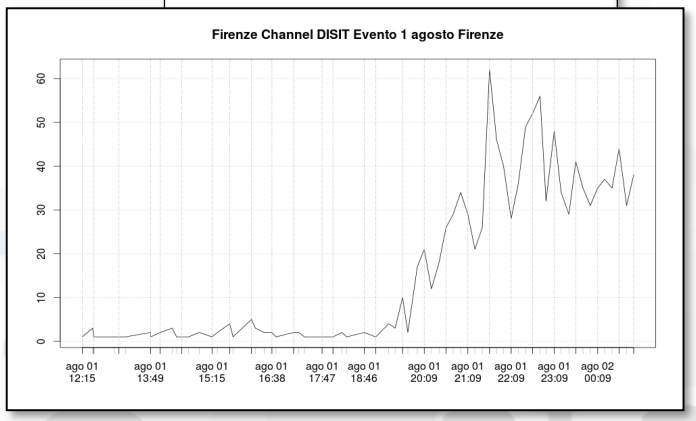
resolute

Twitter Vigilance RT: sentiment analysis



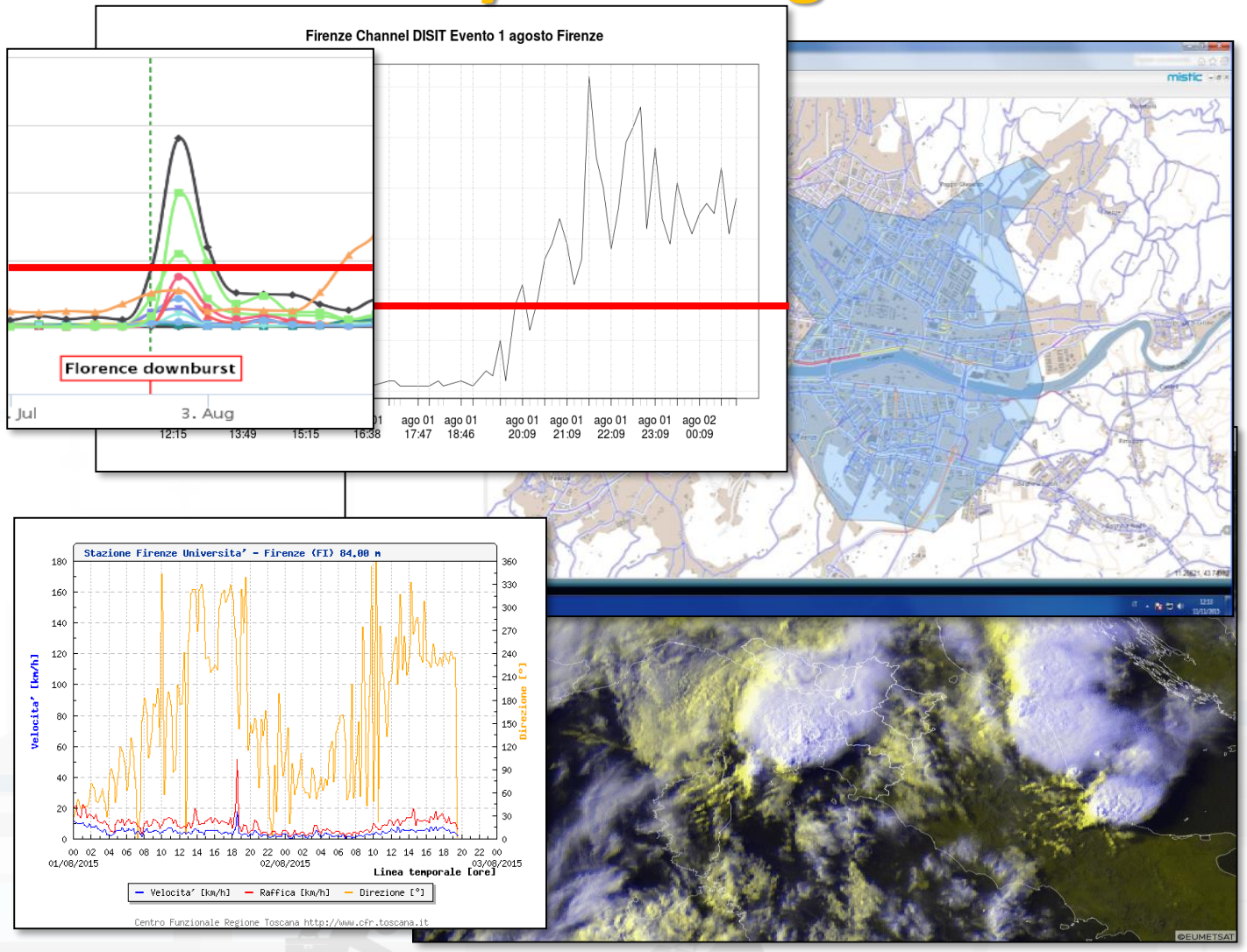
Real time
Early Warning



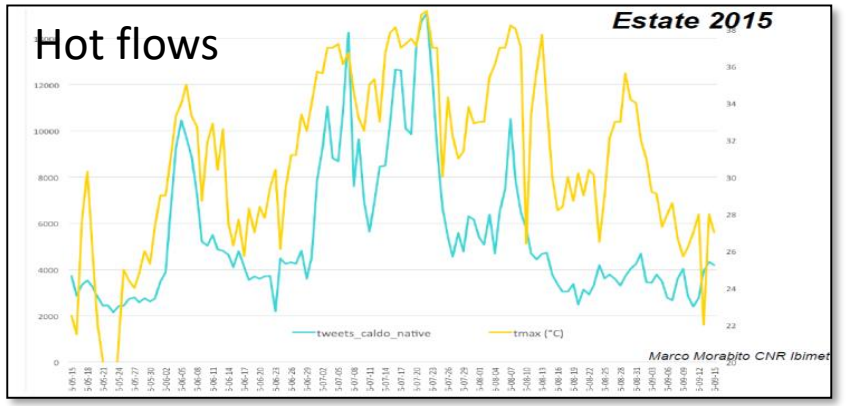


Twitter Vigilance

Early Warning



Predictive models



Attendance at long lasting events: EXPO2015

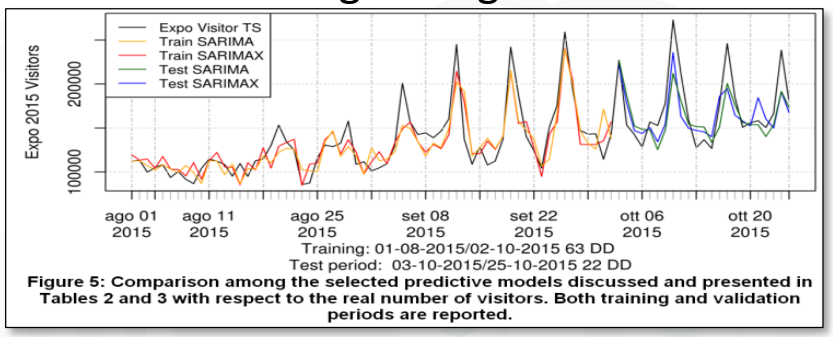
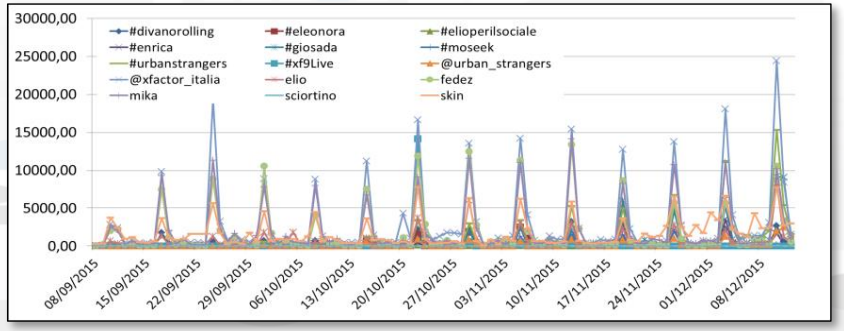


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

Attendance at recurrent events: TV, footbal

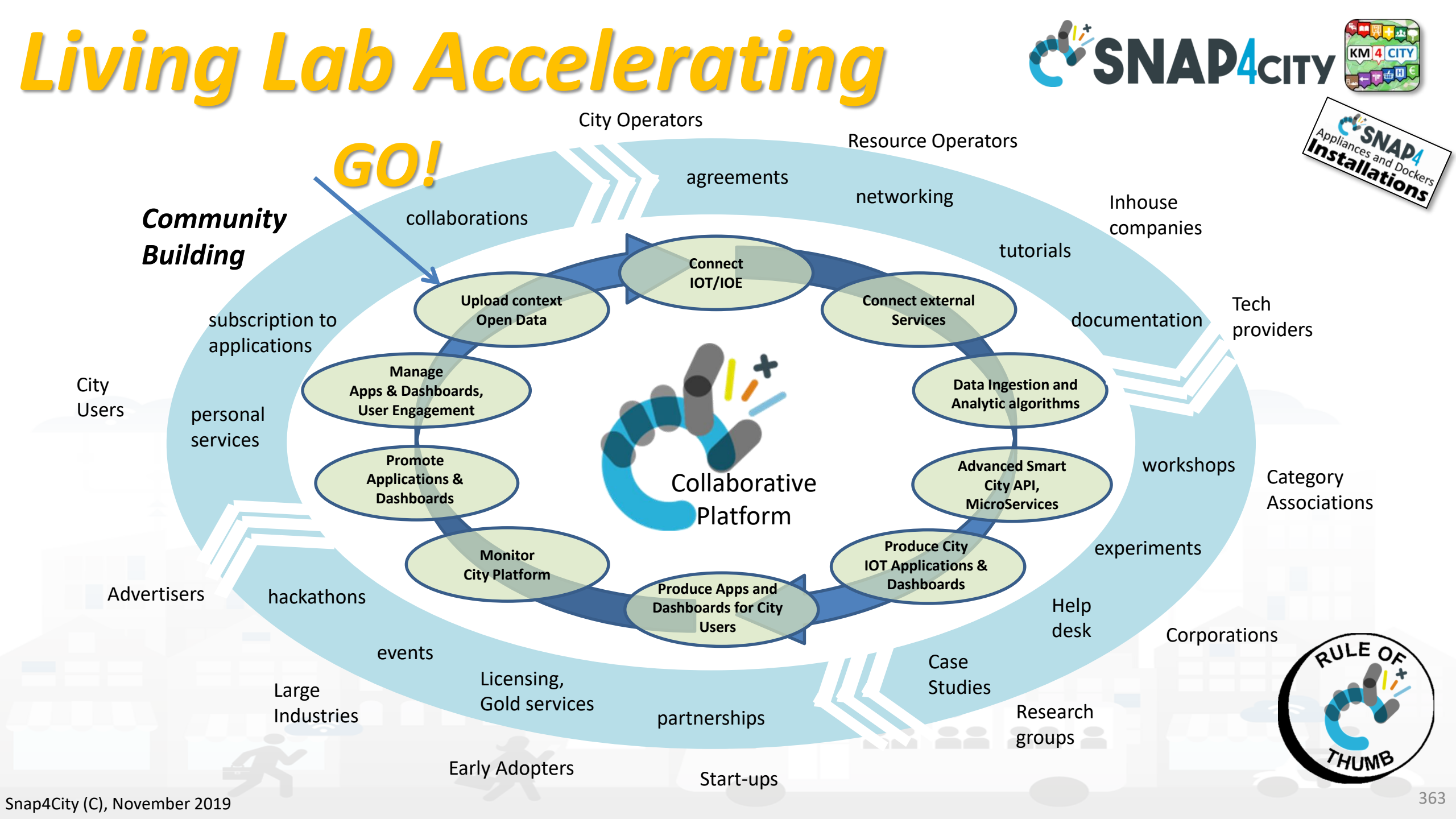


TOP



SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

Living Lab Accelerating



Snap4City

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

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

Your Level

All Tools

Snap4City

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

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

Welcome: how to start using Snap4City for beginners

Personalized Suggestions

Snap4City developers suggest you reading:

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

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

See this test case to experiment some of the above possibilities:

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

Exercises

SLIDES

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

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

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





NEWS

News

Flyer

VIDEOS

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

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

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

Username: adifino

Powered by www.km4city.org

Full Search

Search

Search

Organization Groups

DISIT

- Operativo

Your Org

Recent comments

- 1 month 6 days ago

Recent content

Last Art.

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

Benvenuto al nostro Sindaco ed al suo Team new roottooladmin1

We sugges to Antwerp Developers: How to manange my Dashboards



Virtual Assistant

Virtual Assistant

Snap4City

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

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Km4City portal
- DISIT Lab portal

www.snap4city.org

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Home / TC2.24 - IOT Applications developed exploiting MicroServices, also supporting GDPR, real time, data sharing, etc.

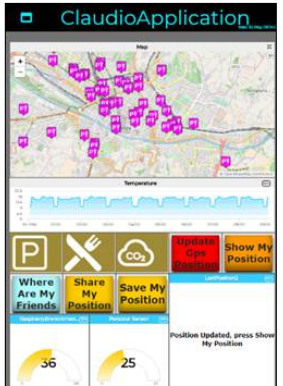
TC2.24 - IOT Applications developed exploiting MicroServices, also supporting GDPR, real time, data sharing, etc.

View | Edit | Track | Access control | Convert

Test Case Title	IOT Applications developed exploiting MicroServices, also supporting GDPR, real time, data sharing, etc.
Goal	I can: build IoT applications using the Microservices in simple manner
Prerequisites	Using a PC or Mobile with a web browser. Simple skill on use IotBlocks on Nodered. The following functionalities are available only for specific Snap4city users with specific privileges.
Expected successful result	Being able to implement your IoT application quickly and easily
Steps	

1. It is possible to see how is simple make an IoT Application using Microservices reading the follows test cases:

See TC2.2: Scenario with IOT Applications with users sharing position, GDPR, real time data



EN

Open tutorial

TC2.4
The daisy of MicroServices for Snap4City Dashboard and IOT App
Open tutorial

TC2.5
IOT application; IOT Discovery of sensors and actuators for reading observations
Open tutorial

TC2.12
Creating IOT Applications
Open tutorial

TC2.14
IOT Applications using multiple protocols, and formats for files Creating IOT Applications coping with heterogeneous data
Open tutorial

TC2.16
IOT Application Creation, using personal devices and exploiting city devices
Open tutorial

TC2.17
Event Driven IOT Applications, from brokers: Orion, SigFox, etc.
Open tutorial

TC2.18
Event Driven Data Management in Dashboards from: IOT Brokers and IOT Applications
Open tutorial

11:32

how can i develop an IOT App

11:32

You could be interested in one of these **tutorials**:

TC2.24
IOT Applications developed exploiting MicroServices, also supporting GDPR, real time, data sharing, etc.
Open tutorial

11:32

What do you want to know?

Submit

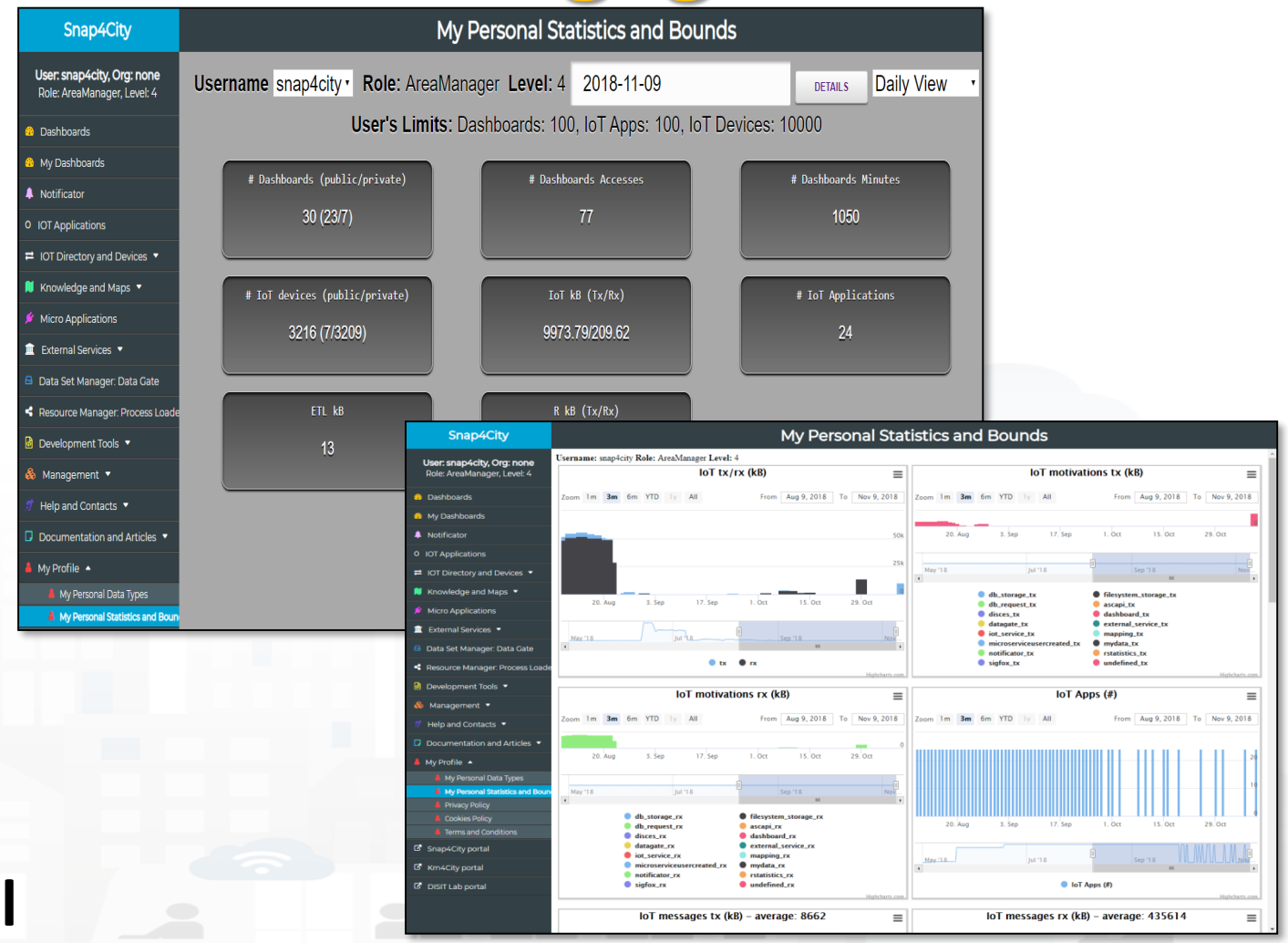
Living Lab Flexibility

Snap4City Satisfies all Requirements of ENOLL Select4Cities and EIP-SCC

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

For the user: different levels of engagement

- **Multiple Organizations**
- **Roles:**
  - Managers
  - AreaManagers (developers): special access to computing resources
- **Levels for self-assessment**
  - **Suggestions on next steps to learn on the basis of personal progresses**

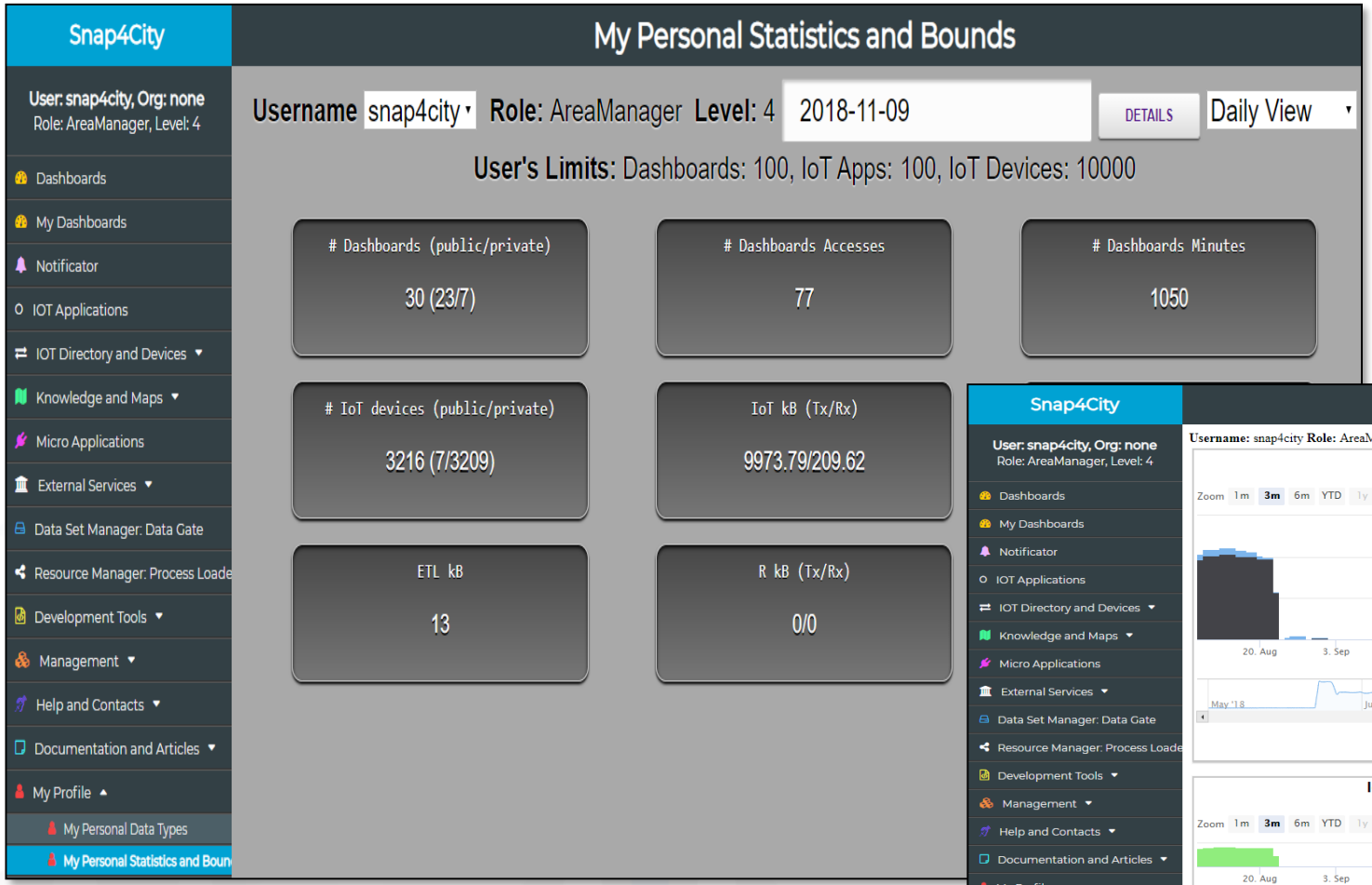


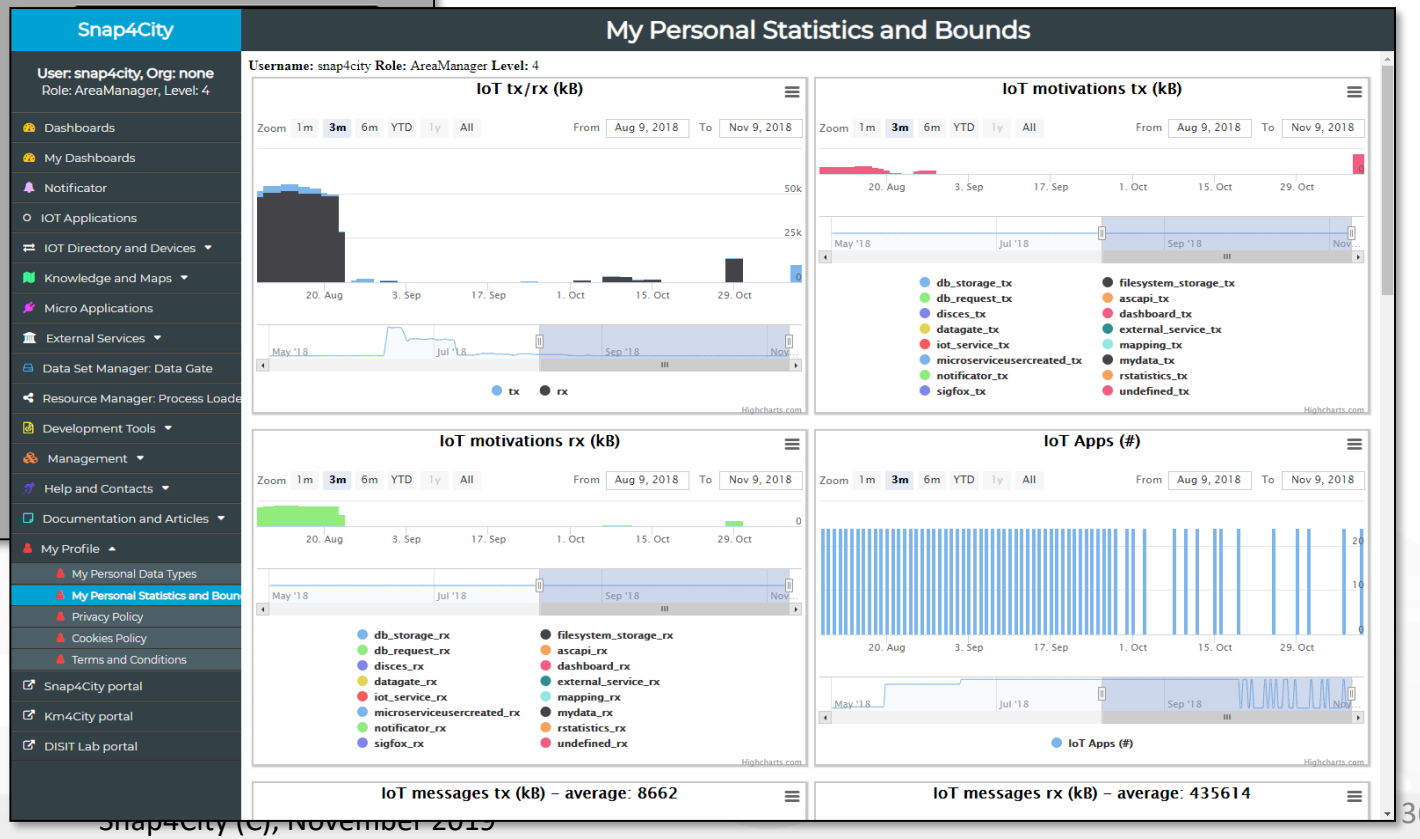
For the user: different levels of engagement

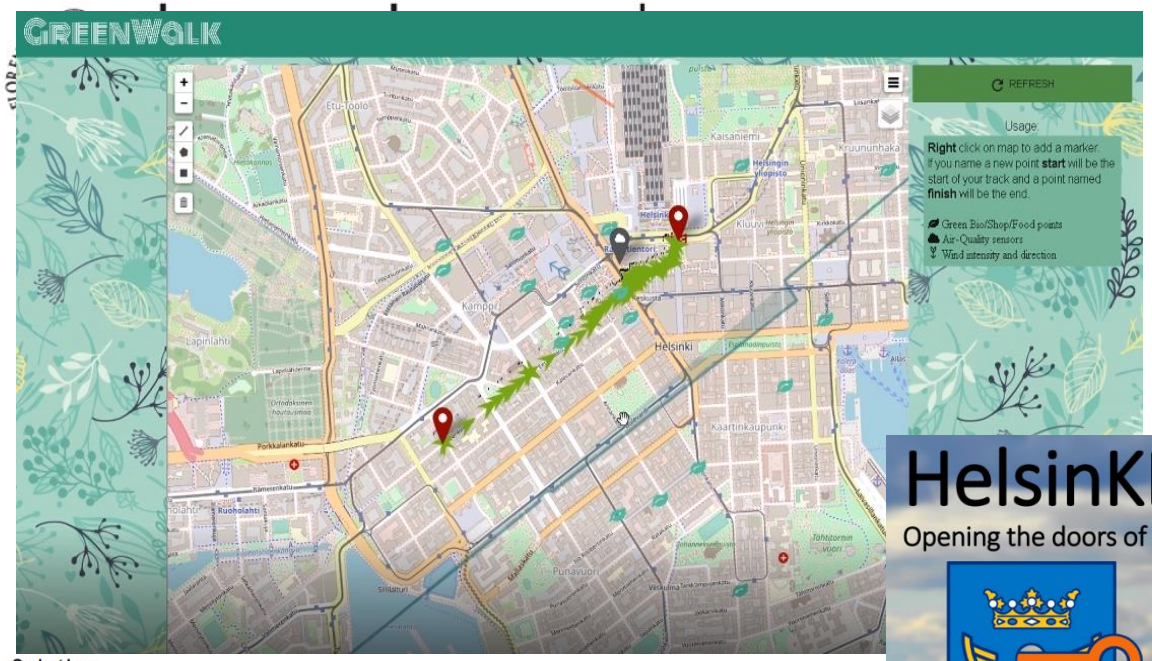


- **Manager: Final Users**
  - Level 1: create Dashboards
  - Level 2: create Dashboards that get and produce data, act on city
  - Level 3: add your own IOT Device, create Dashboards with them and city data
  - Level 4: create IOT Applications to make smarter your Dashboards, services, notifications, exploiting MicroServices
- **Area Manager: Developers, Researchers, Operators (Level 5):**
  - Developer of complex services exploiting: R Studio, ETL, External Services, ...
  - Creating: MicroApplications, MicroServices, web and mobile application exploiting Advanced Smart City APIs, …

Self Assessment

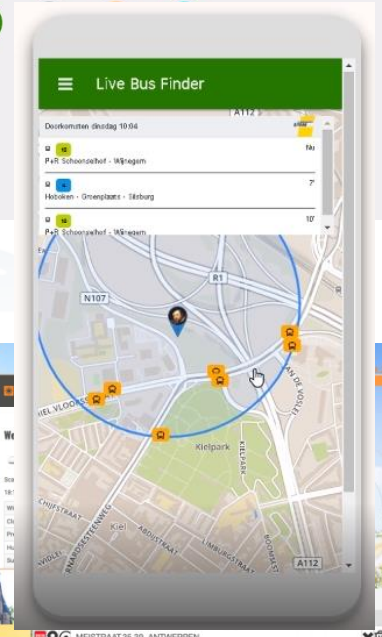












Solution

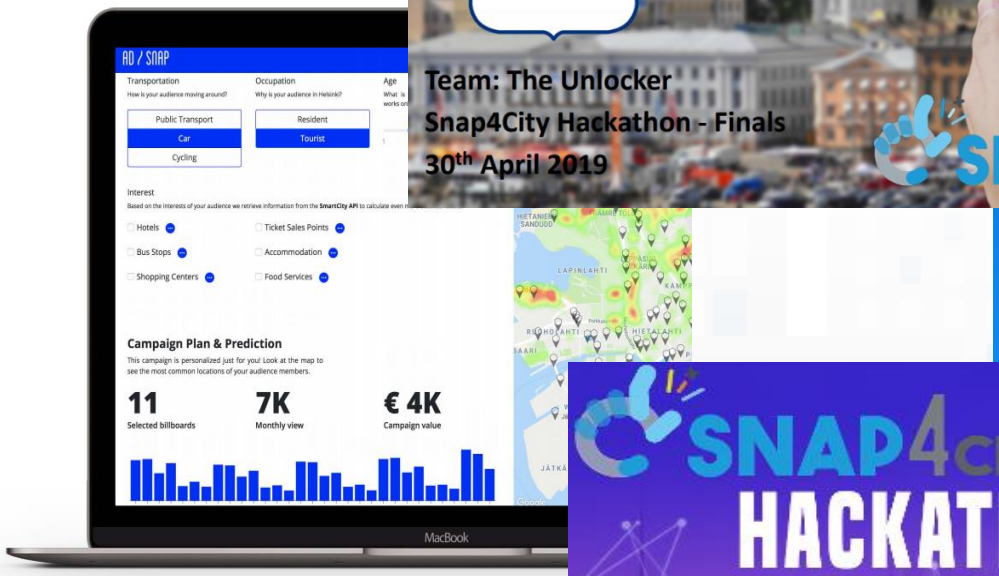
Data-driven design platform for offline advertising

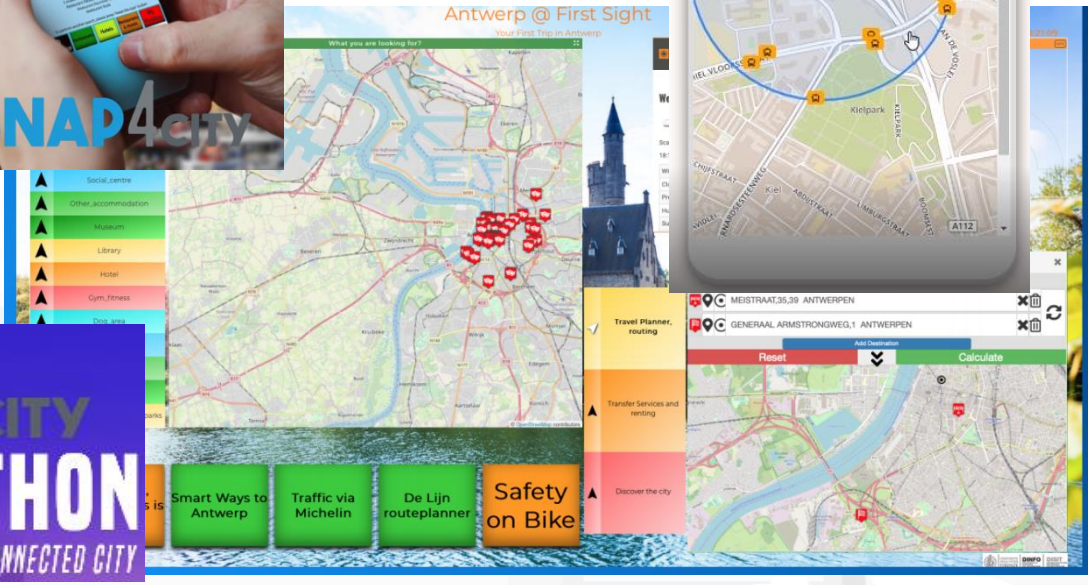
Built on big data to determine the most popular location for a customer group

Automatically select billboards with the highest traction. The platform is capable of predicting the reach of every location on a city based on big data analytics.

Skyrocket the traction of offline campaigns

Citizens will run into more relevant advertisements resulting in higher conversion rates and more successful campaigns.

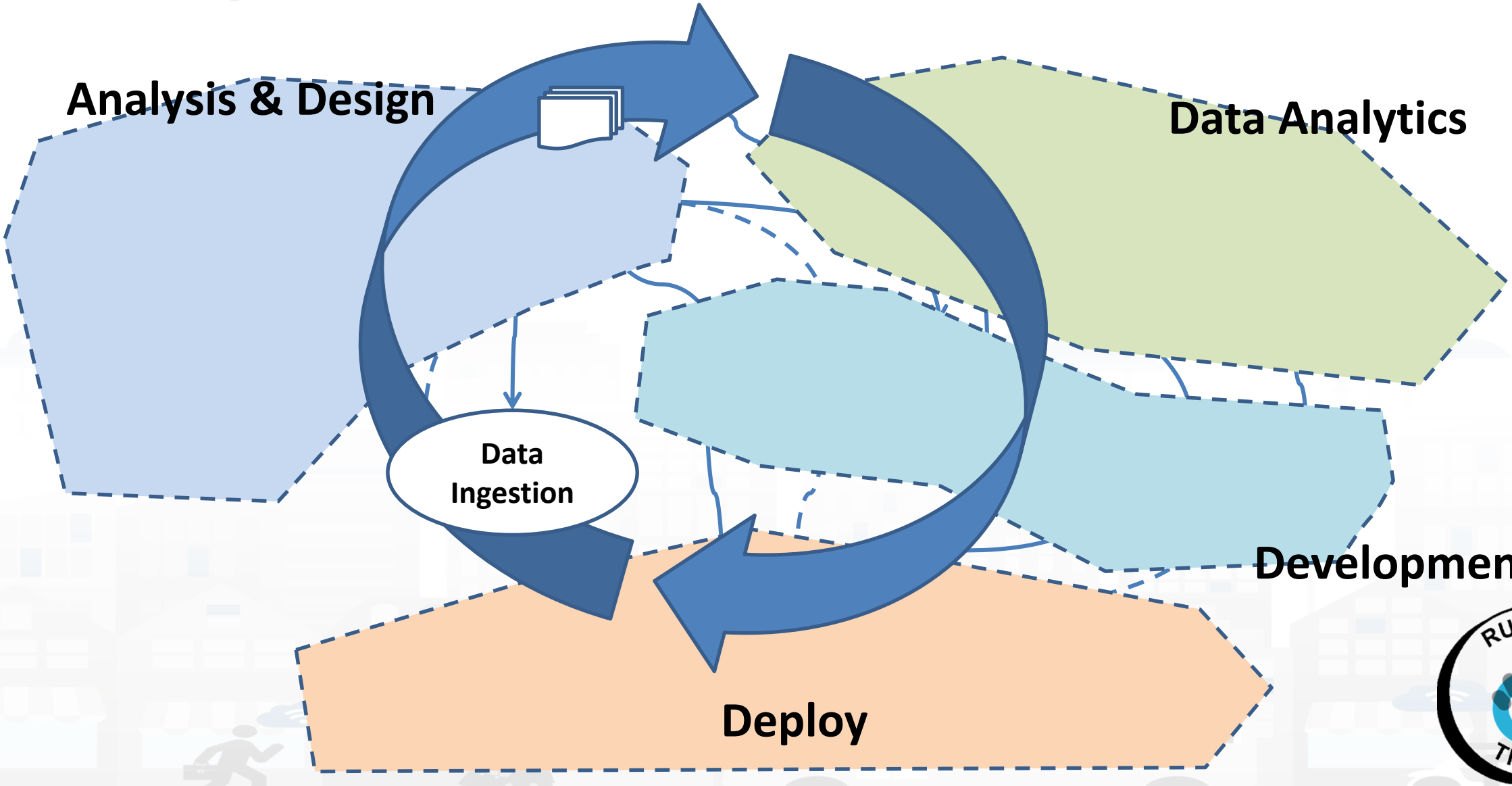




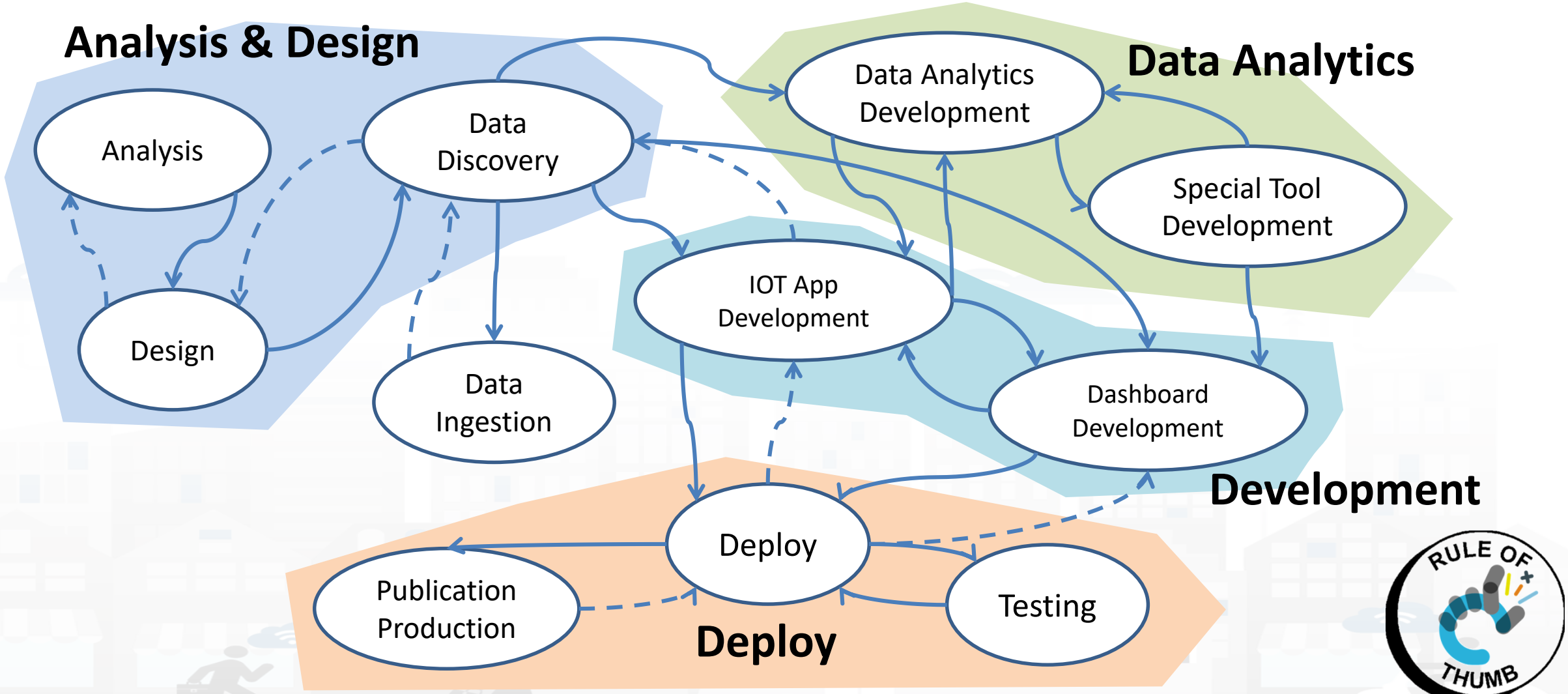
Development Life Cycle



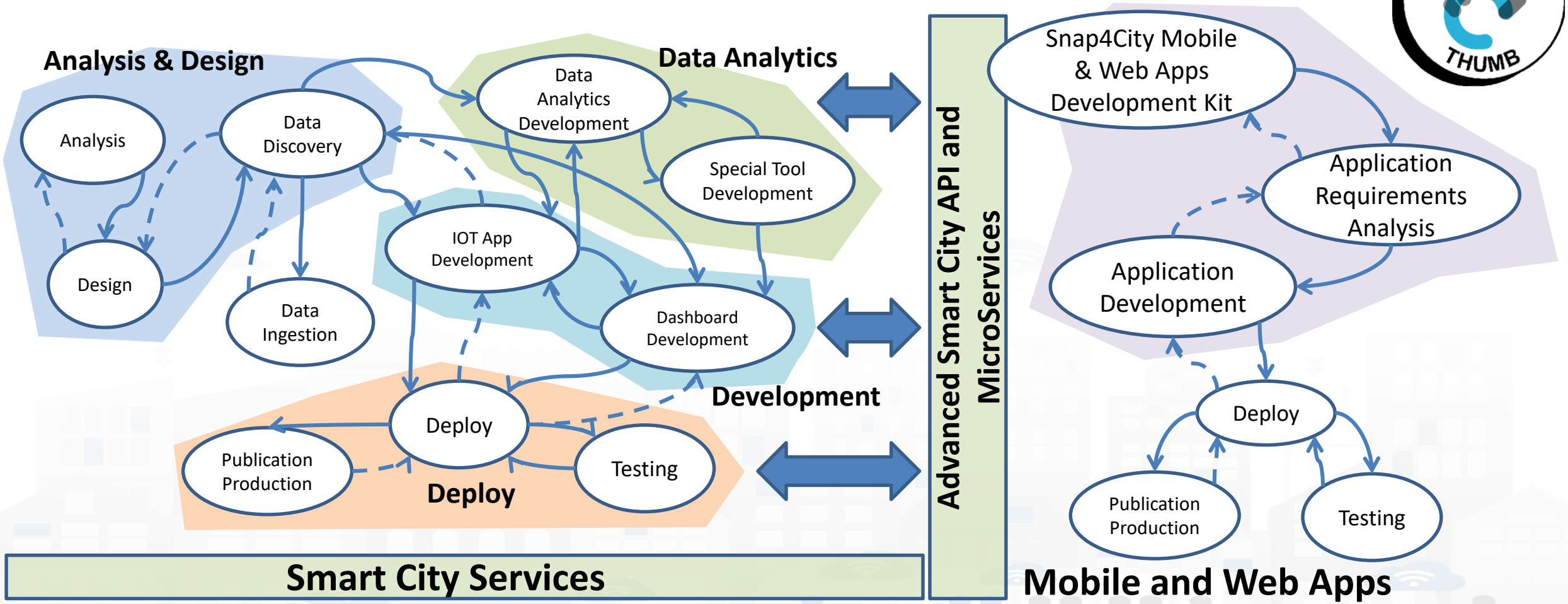
Development Life Cycle
Smart City Services



Development Life Cycle
Smart City Services



Develop Mobile & Web Applications Exploiting Snap4City Smart City Services

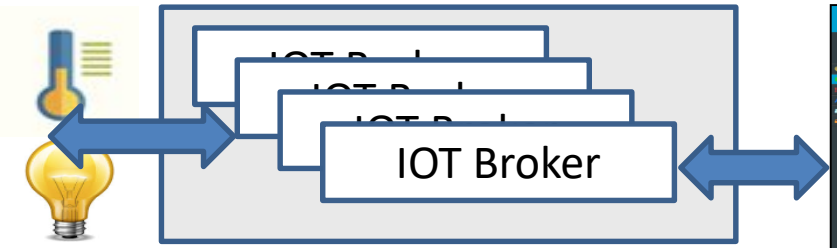


Development Tools

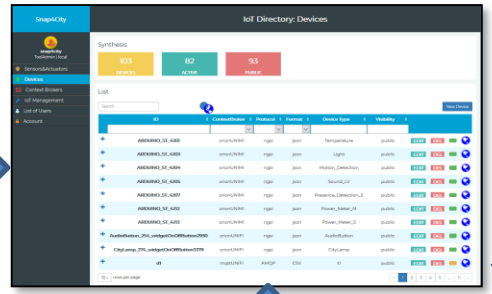


IOT Network Manager vs Final User

Network of IOT Brokers



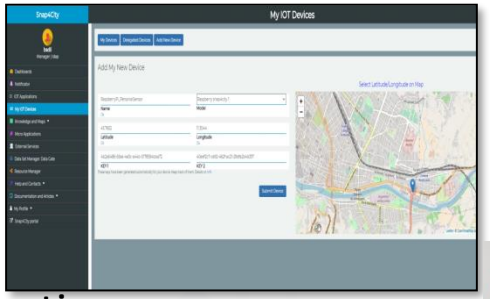
IOT Directory



IOT Network Manager



My IOT Device



Register



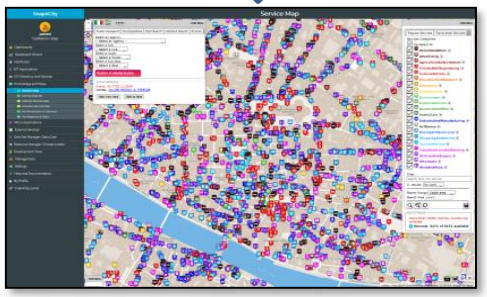
Registering

Discovering



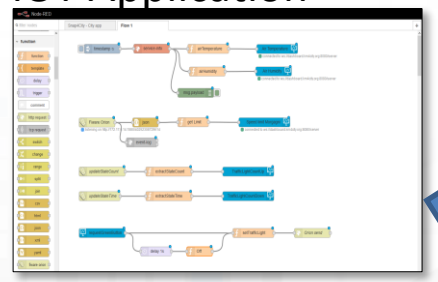
Knowledge and Storage
Data from the Field and
City

Browsing



ServiceMap
Knowledge Base

IOT Application



Discovering

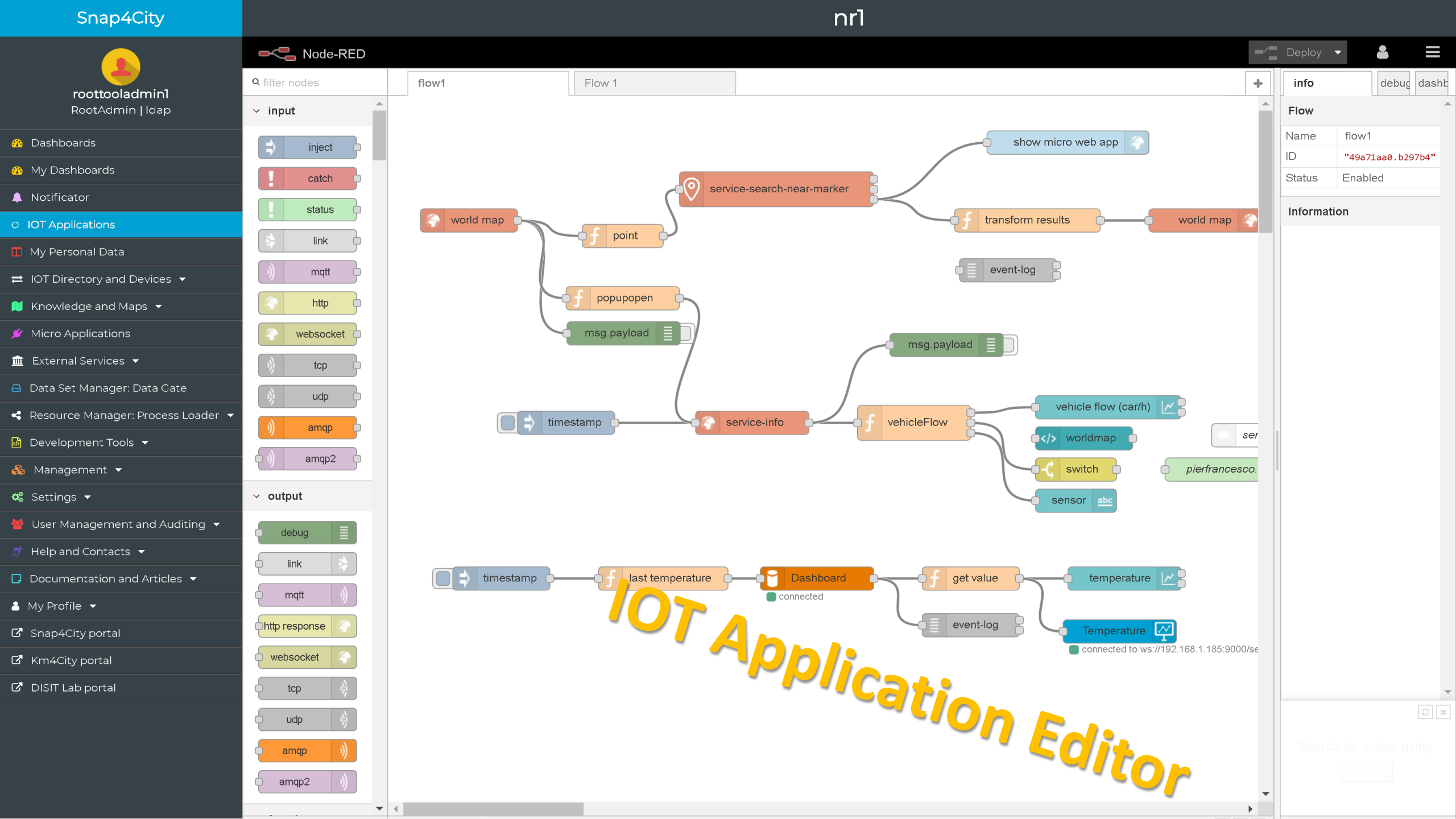
Final user Manager



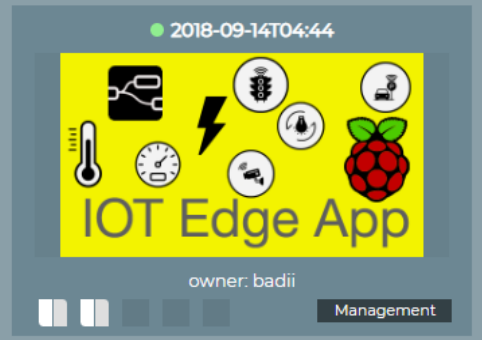


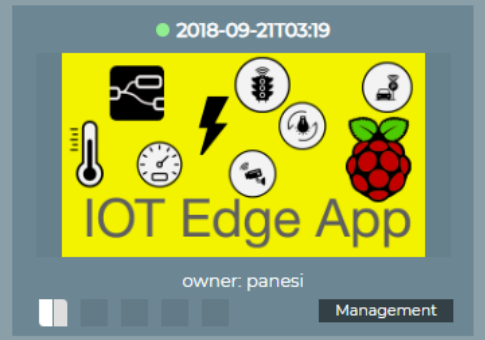
Dashboard Wizard

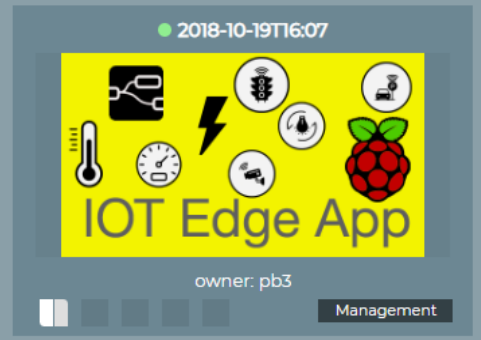


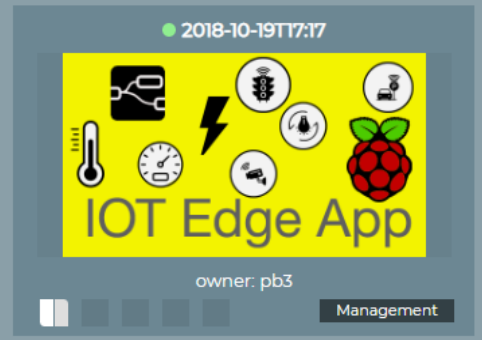

Snap4City
nr1
roottooladmin1
RootAdmin | ldap
Dashboards
My Dashboards
Notificator
IOT Applications
My Personal Data
IOT Directory and Devices
Knowledge and Maps
Micro Applications
External Services
Data Set Manager: Data Gate
Resource Manager: Process Loader
Development Tools
Management
Settings
User Management and Auditing
Help and Contacts
Documentation and Articles
My Profile
Snap4City portal
Km4City portal
DISIT Lab portal
Node-RED
Deploy
filter nodes
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
flow1
Flow 1
world map
point
service-search-near-marker
show micro web app
transform results
world map
event-log
popupopen
msg.payload
msg.payload
timestamp
service-info
vehicleFlow
vehicle flow (car/h)
worldmap
switch
sensor
timestamp
last temperature
Dashboard
connected
get value
temperature
event-log
Temperature
connected to ws://192.168.1.185:9000/se
IOT Application Editor
info
debug
dashb
Flow
Name
flow1
ID
"49a71aa0.b297b4"
Status
Enabled
Information

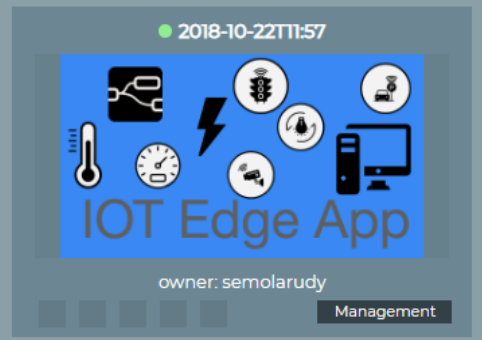
IOT Applications

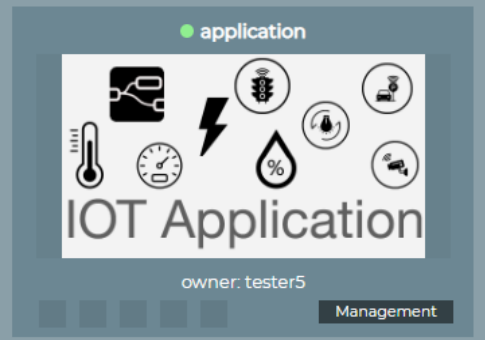


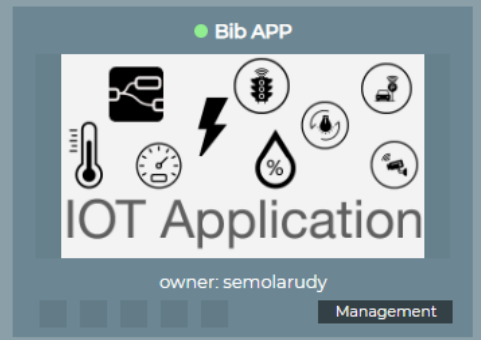


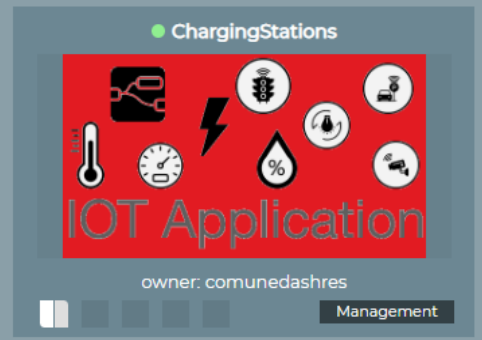


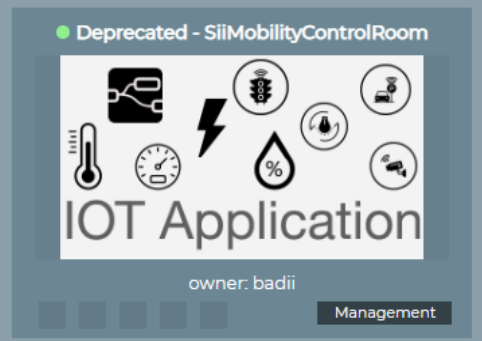


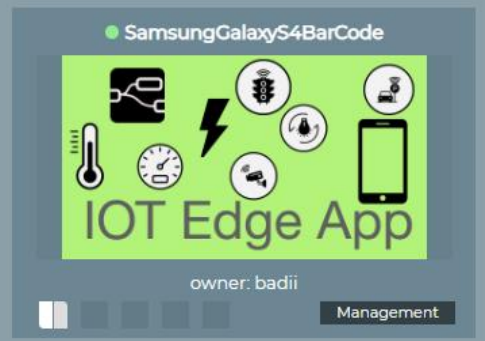




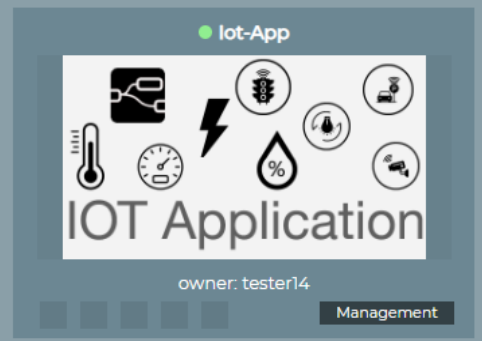








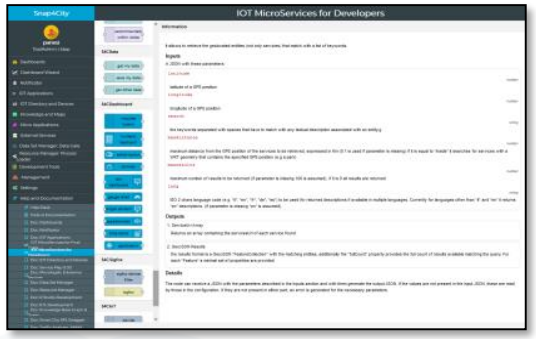




IOT Applications Development

IOT Discovering

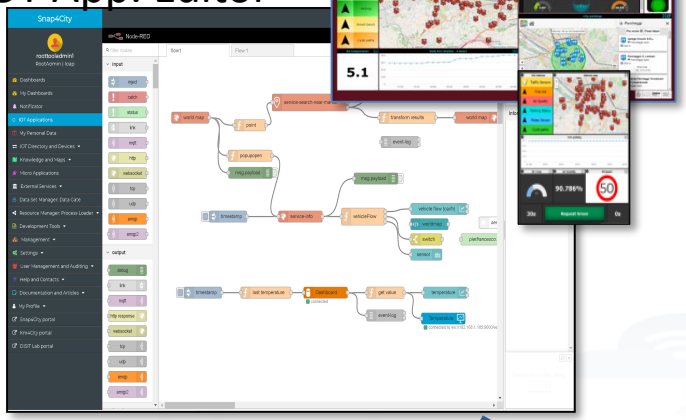
MicroServices collections



My IOT Applications

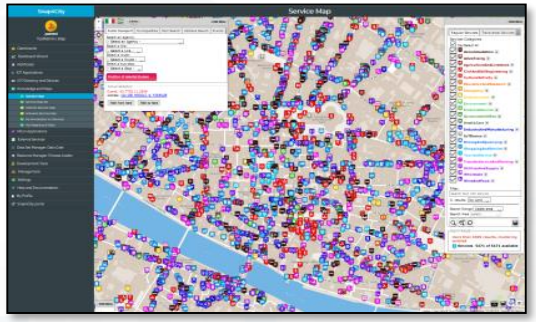


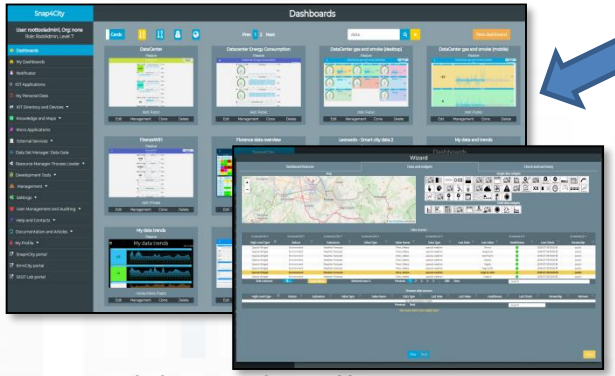
IOT App. Editor



Generating IOT App
With Dashboard







Sharing/saving
reusing IOT App

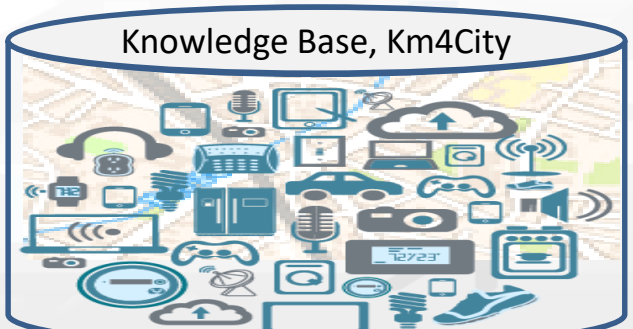




Resource Manager

ServiceMap Discovery

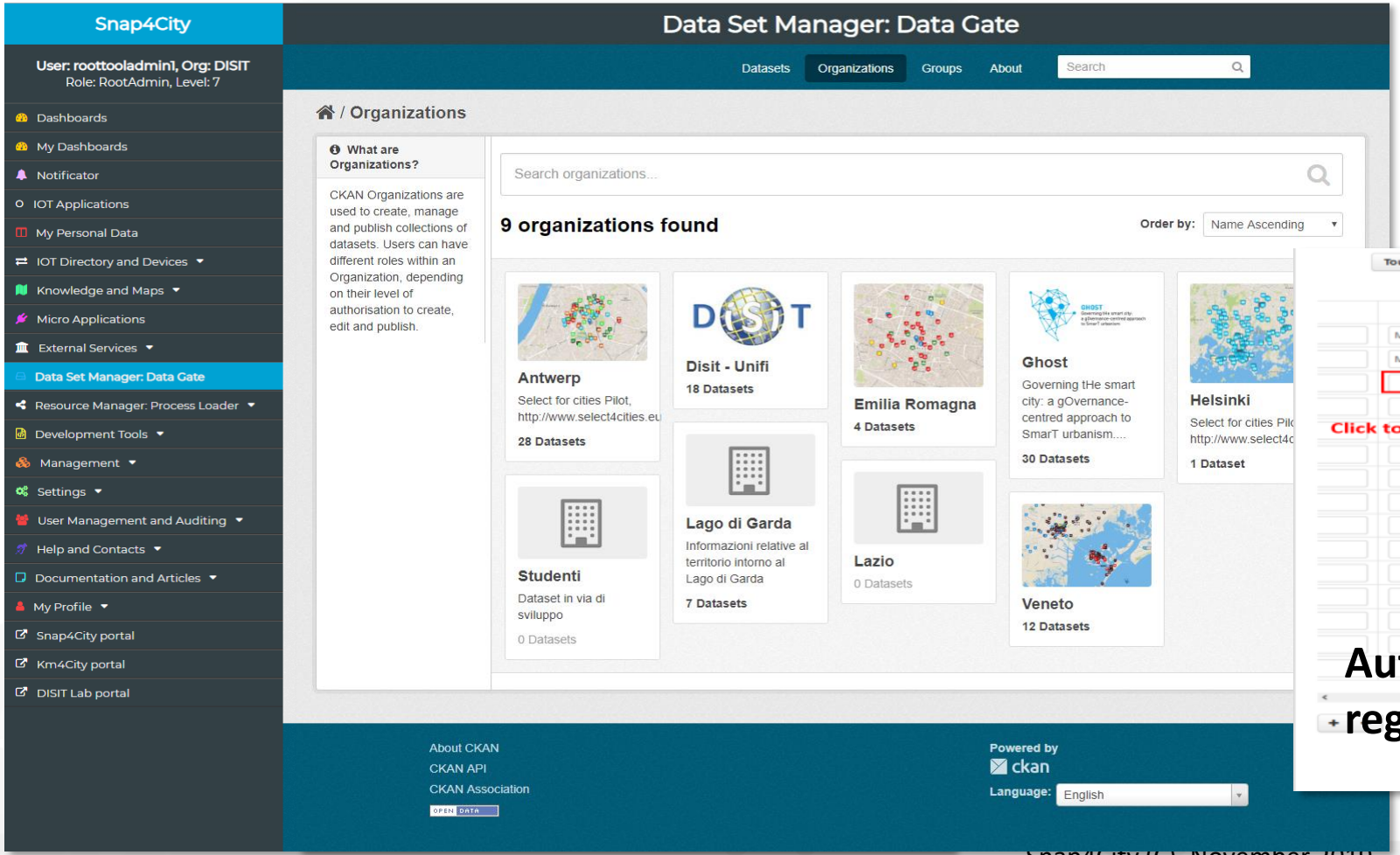
Dashboard Collection,
Editor and Wizard

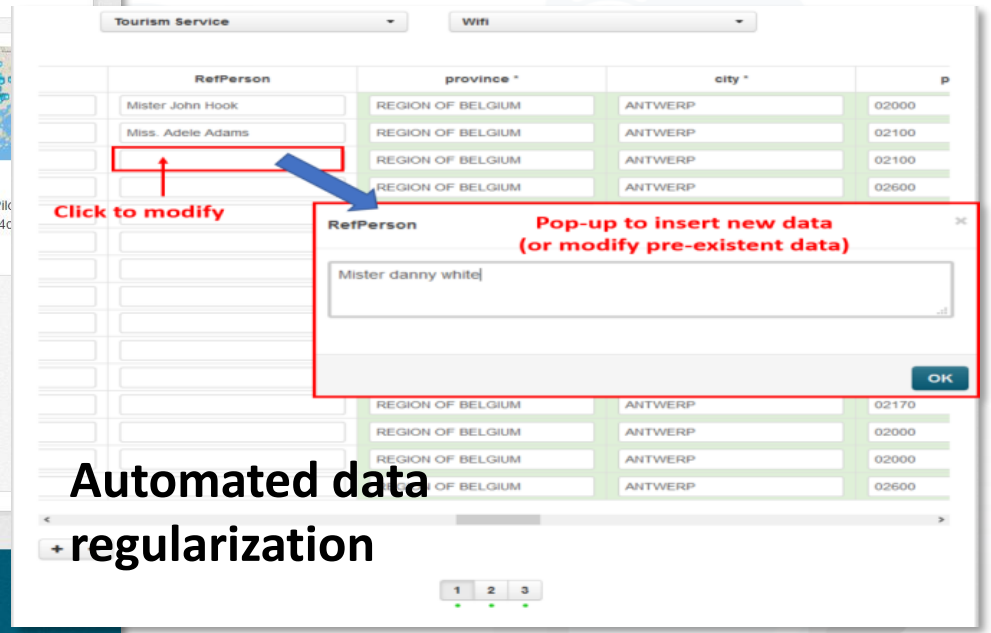


Integrated DataGate/CKAN
Static open data ingestion

Federated Crawling
Federated Distribution

Data Set:
- Search
- Loading
- Download
- Share
- Publish
- Also automated





Automated data regularization

Developers of ETL, Data Manager

kettle™ pentaho data integration

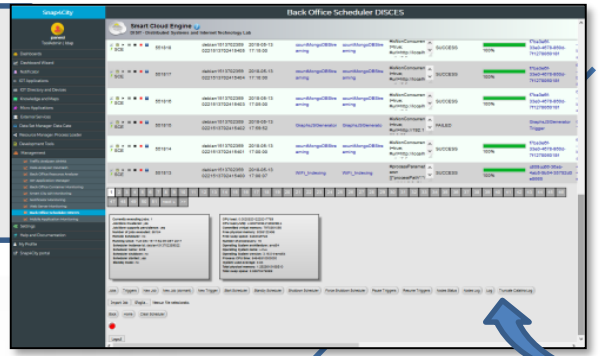
Distributed Back Office

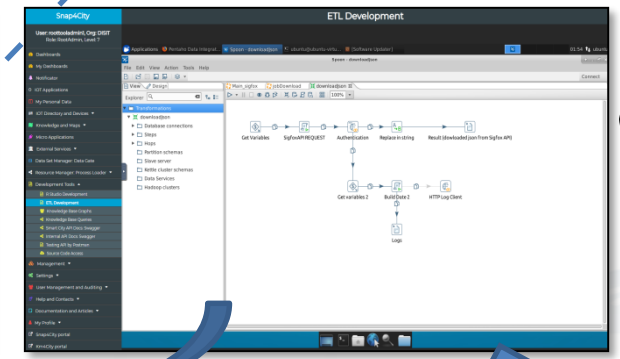
DISCES scheduler production

ETL Development Environment

Data sources

ETL Process





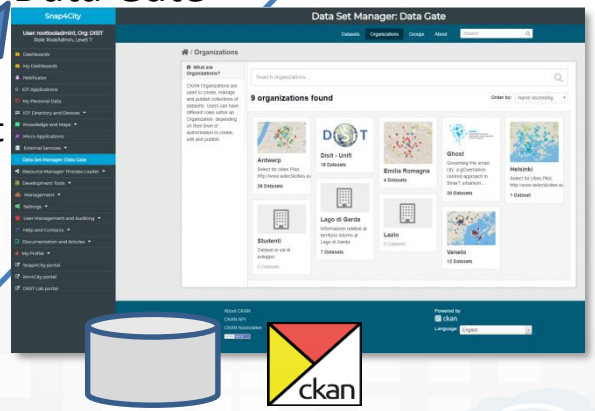


Knowledge Base, Km4City



Knowledge and Storage Data from the Field and City

Data Gate



Data Set Saving / Sharing

Saving / Sharing reusing



Data Set Loading/ Downloading



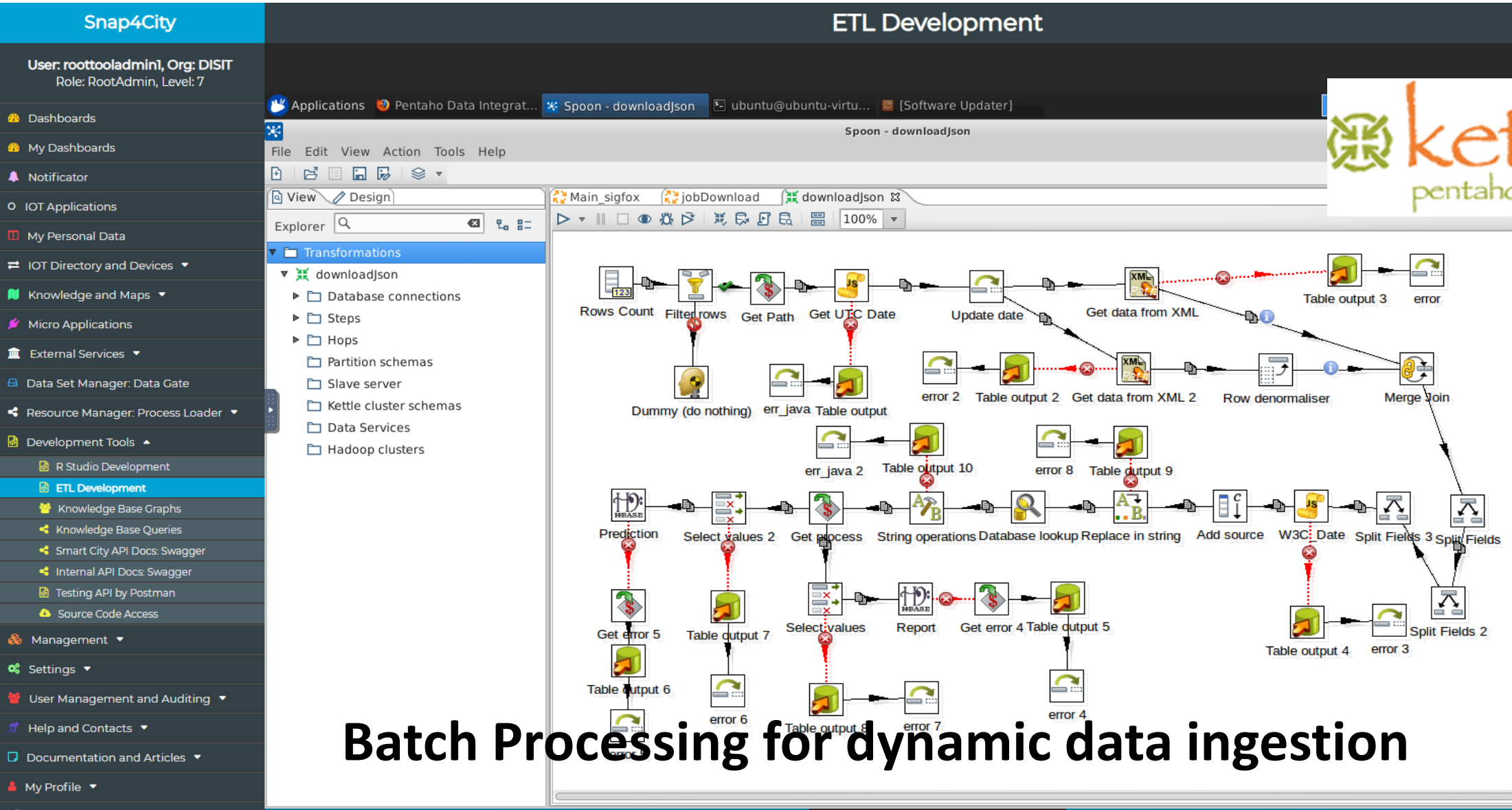


Resource Manager

Schedule Execute

Load data or prepare for data ingestion

ETL Development



Batch Processing for dynamic data ingestion

Resource Manager: public and sharing

Snap4City

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

- Dashboards
- My Dashboards
- Notificator
- IOT Applications
- My Personal Data
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
  - View Resources
  - Managing Resources
  - MicroServices for IOT Applications
  - Process Models
  - Processes in Execution
  - Process execution Archive
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal

View Resources

Pages: Prev 1 2 3 ... 12 Next

dev

Reset | Username | Nature | Sub_nature | License | Resource_type | Format

- IoTApp (118)
- ETL (53)
- MicroService (8)
- AMMA (4)
- R (3)
- DevDash (2)
- IoTBlocks (2)

Florence_Pharmacies_CSV.zip
developer1: Public
Username: developer1
Resource type: ETL
Nature: geolocated
Description: Florence Pharmacies o...
View Edit Unpublish Owner

developer1: Public
Username: developer1
Resource type: ETL
Nature: sensors
Description: Smart bench
View Edit Unpublish Owner

DeveloperDash-V3-1523555417880
snap4city: Private
Username: snap4city
Resource type: DevDash
Nature: data category (ie: geolocat...
Description: Snap4city Developer D...
View Edit Publish Owner

node-red-contrib-snap4city-developer.rar
snap4city: Private
Username: snap4city
Resource type: IoTBlocks
Nature: data category (ie: geolocat...
Description: Snap4city NodeRed Li...
View Edit Publish Owner

PaoloApplication.json
developer1: Private
Username: developer1
Resource type: IoTApp
Nature: data category (ie: geolocat...
Description: NodeRed Flow Shared ...
View Edit Publish Owner

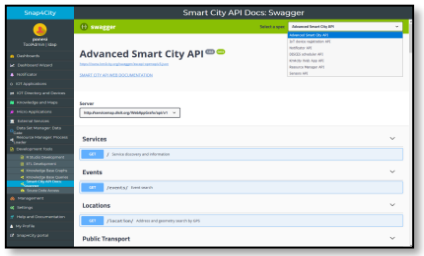
AMMADashSnap4City-30minview-v2-152...
developer1: Private
Username: developer1
Resource type: AMMA
Nature: ToBeDefined
Description: AMMA snap4city dash...
View Edit Publish Owner

Developer Dashboard New-1526308876256
developer1: Private
Username: developer1
Resource type: DevDash
Nature: ToBeDefined
Description: Developer Dashboard ...
View Edit Publish Owner

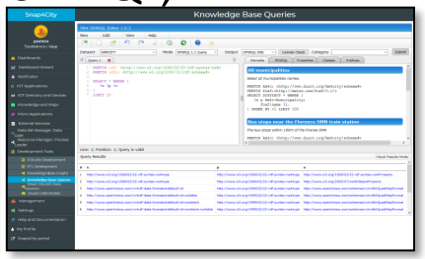
ResDash Docker-1526308998809
developer1: Private
Username: developer1
Resource type: ResDash
Nature: ToBeDefined
Description: Resource Dashboard: ...
View Edit Publish Owner

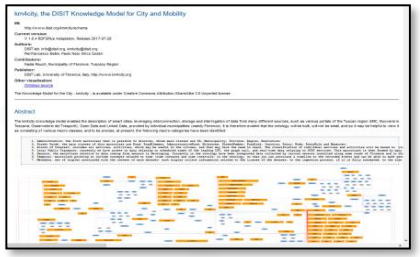
Data Analytics Dev. in R Studio and/or Tensor Flow

Swagger



SPARQL, FLINT





Ontology Schema



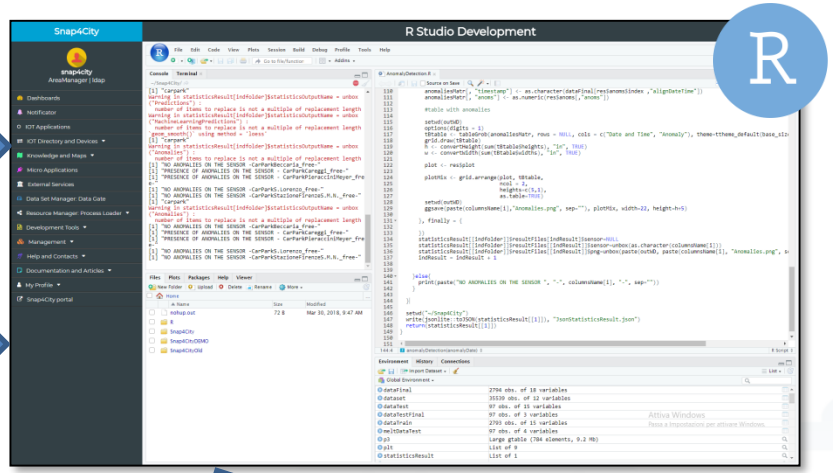
LOG.disit.org

Knowledge Base, Km4City



Big Data Store Facility

Smart City API from Knowledge Base and other tools



R Studio



Creating MicroServices



Using them into IOT Applications

Saving / Sharing reusing

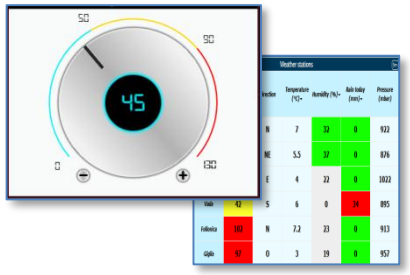


Resource Manager



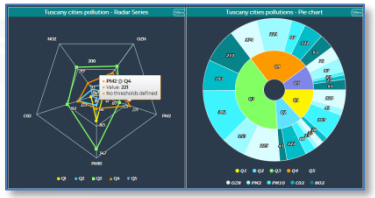
Dashboard List and Editor







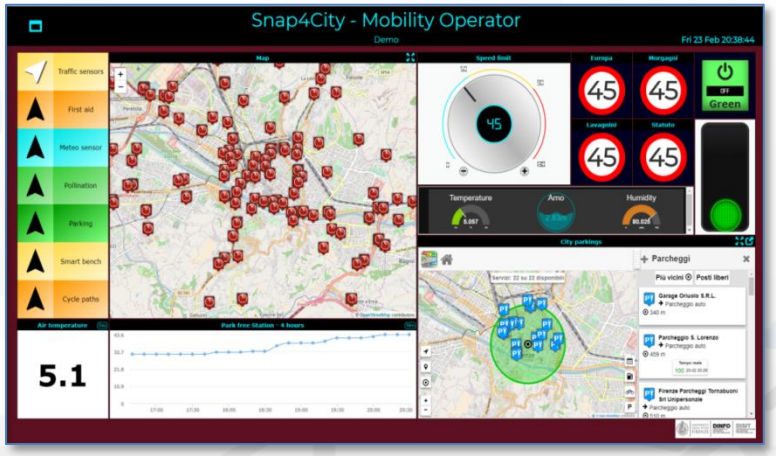




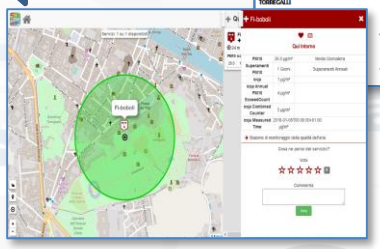




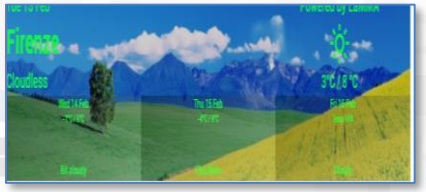


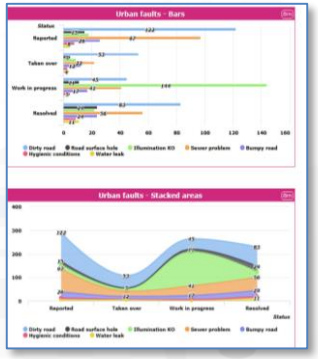




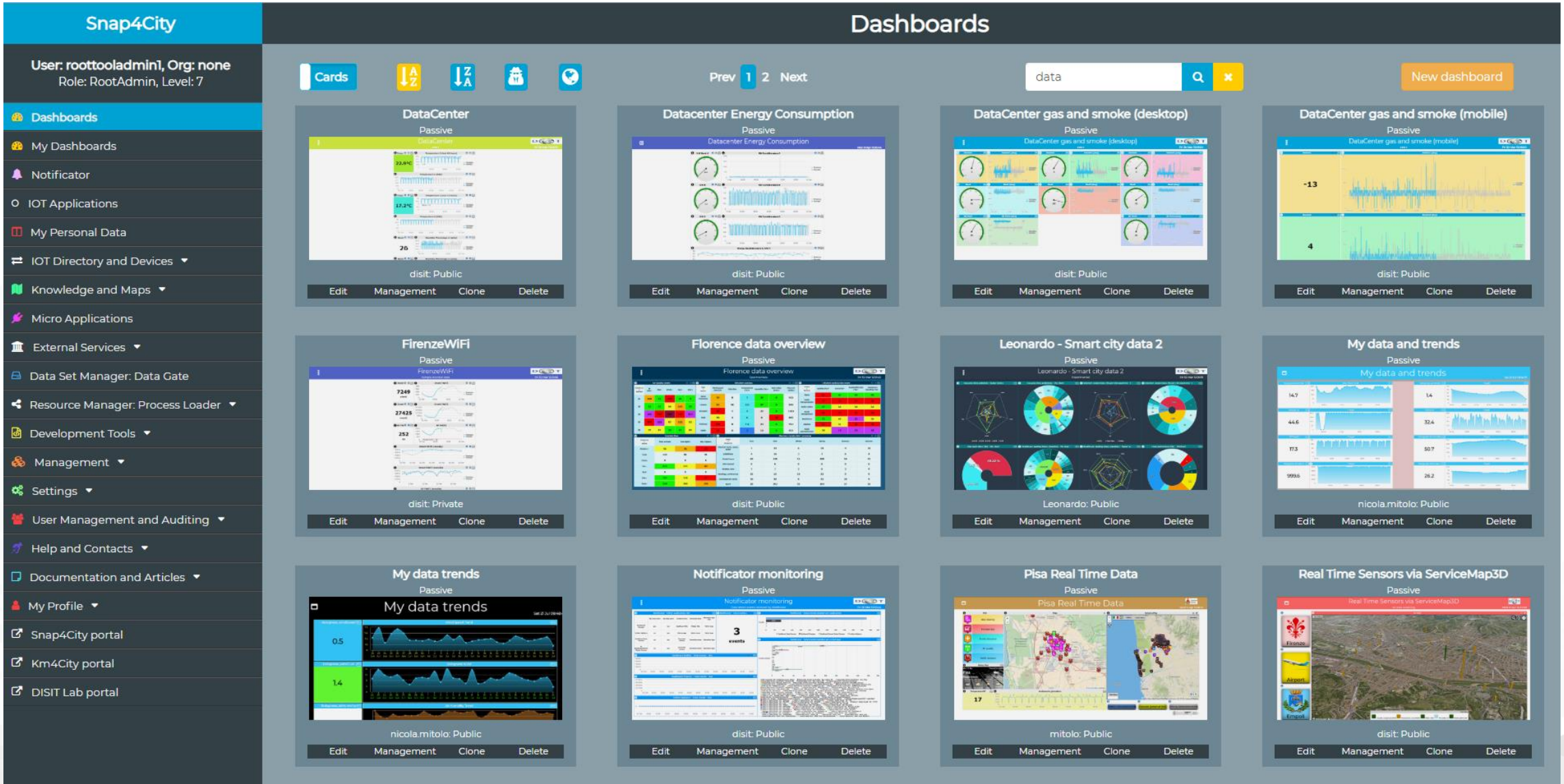




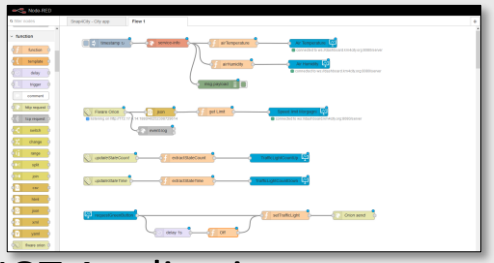




Dashboard List and Editor



Dashboard Development



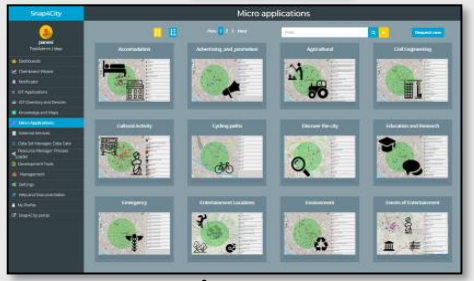
IOT Applications



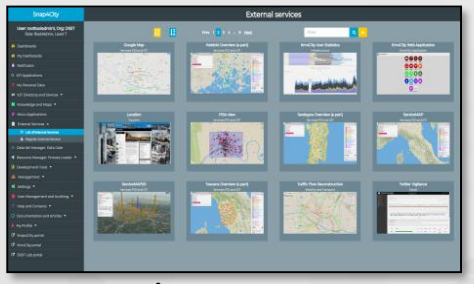
Knowledge and Storage
Data from the Field and City

Widget Collection



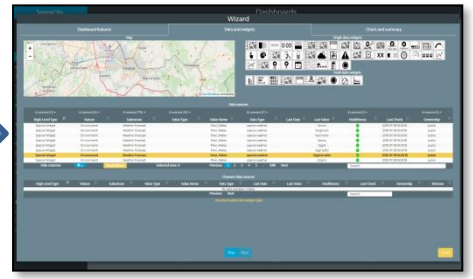


MicroApplications



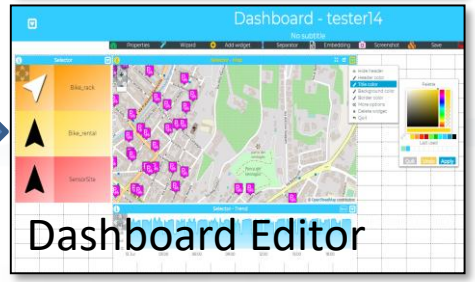
External Services

Dashboard Wizard



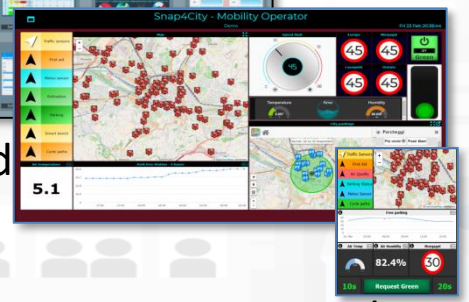
Create, save, load, delegate, grant access





Dashboard Editor





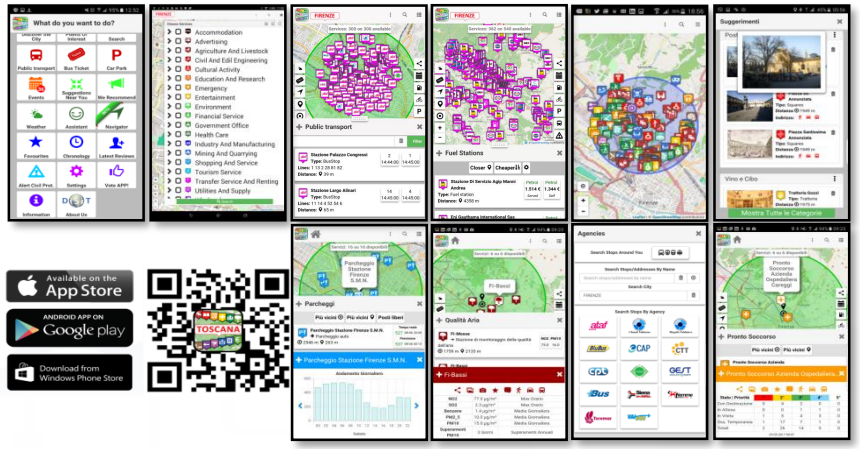
Dashboard Collection

My Own Dash/App



Web and Mobile App Developers

Mobile Apps



Web App HTML5



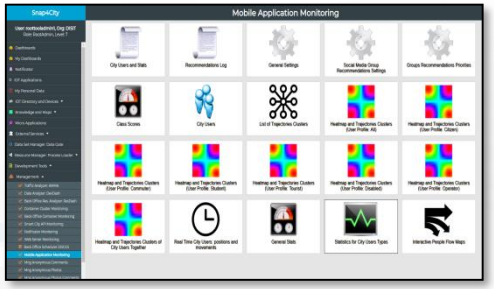
Embed into Web pages



City User



Advanced Smart City API



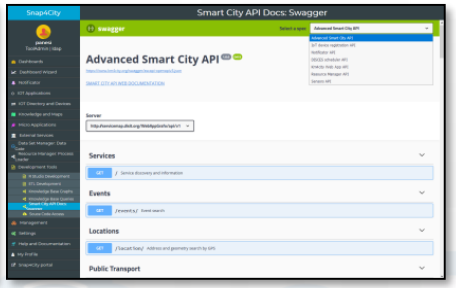
Mobile Application Monitoring Administrator



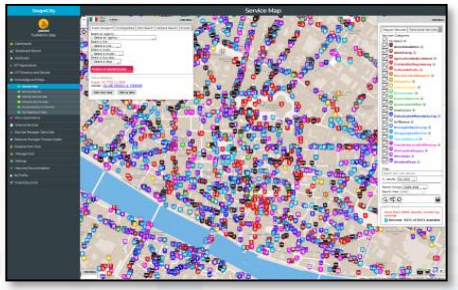
Knowledge Base, Km4City



Km4City Open Source development tool kit



Swagger



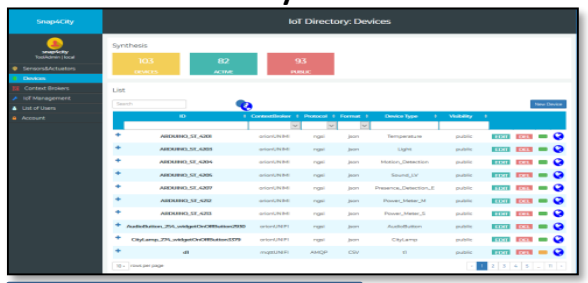
ServiceMap

Developer

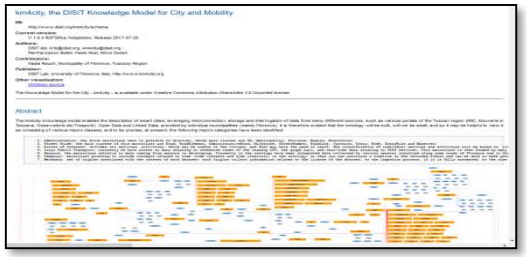


SNAP4CITY

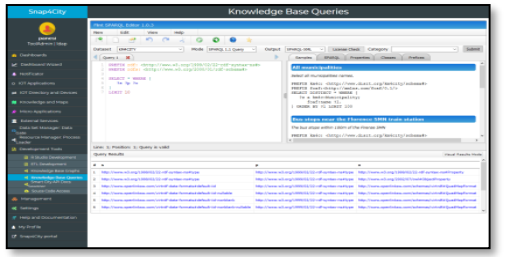
IOT Directory



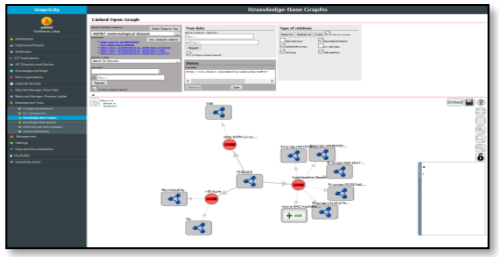
Ontology



SPARQL, FLINT



LOG.disit.org

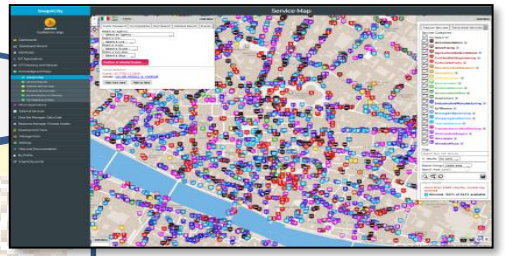


IOT Broker

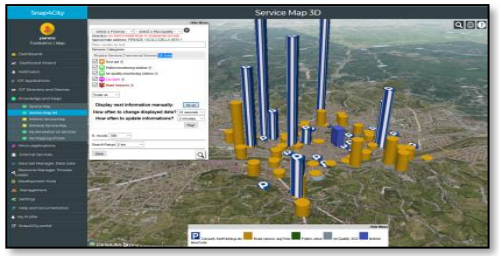
ETL Process

Data Analytics

Knowledge Base, Km4City



ServiceMap



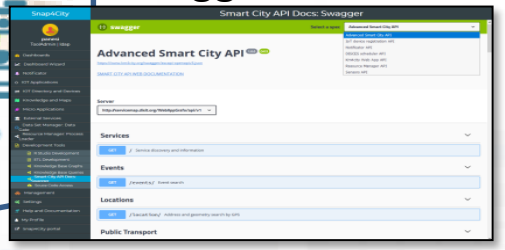
ServiceMap3D

Smart City API from Knowledge Base and other tools

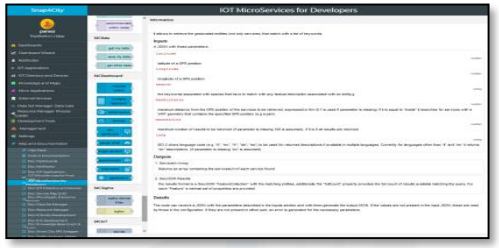
MicroApplications



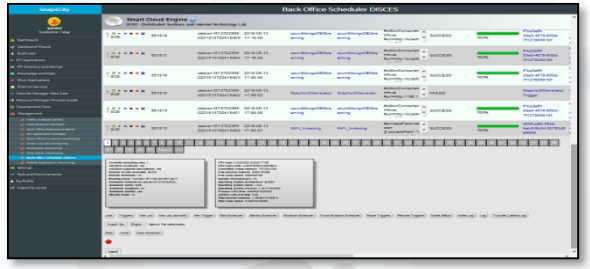
Swagger



MicroServices



Back Office Processes



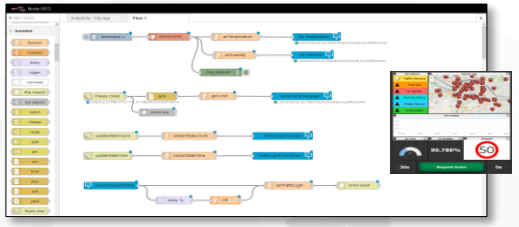
DISCES and back office management tools



Resource Manager



Web and Mobile Apps



IOT Applications

Data Protection, Personal Data vs GDPR



GDPR: General Data Protection Regulation

Users may decide to:

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

From each service, the user is capable to:

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

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

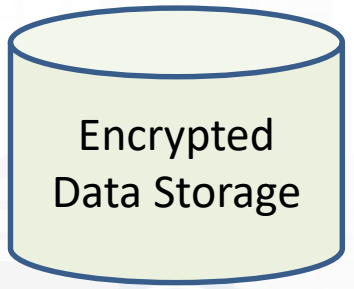
GDPR: General Data Protection Regulation

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

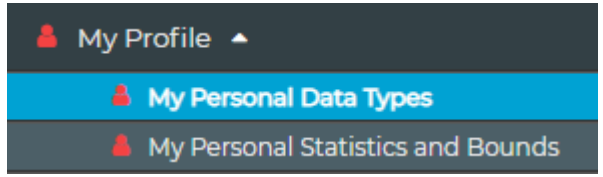
- the data are **released anonymously**,
  → also in this case they can be **revoked at any time**:

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

- **Secure connection** in any private data exchange
- **Encrypted** data store for all private data
- **Decoupling** data and personal IDs
- Allow the **Auditing** of private data usage



GDPR Compliant



My Personal Data Types

View | Edit | Track | Access control | Convert

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

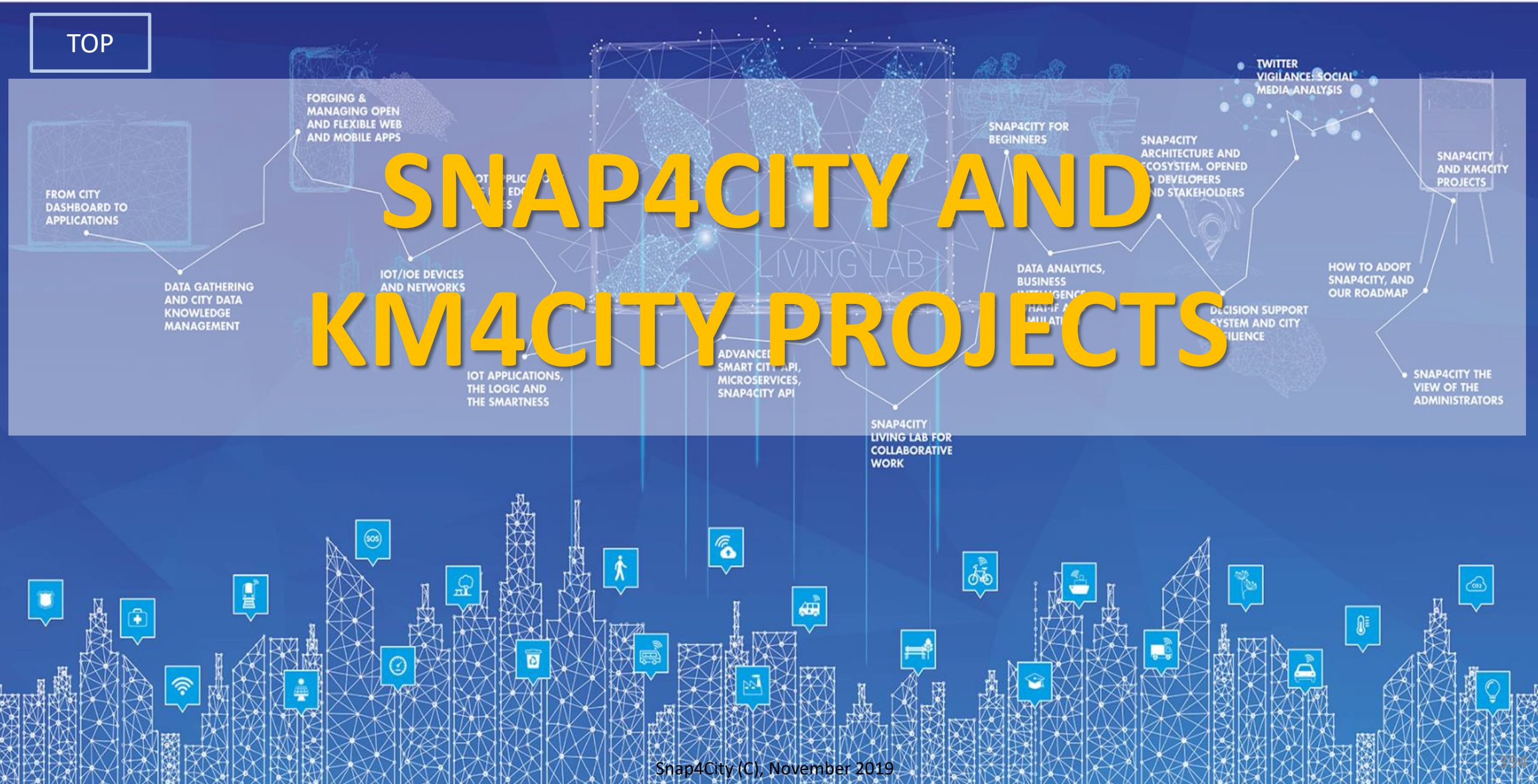
- My profile data and Blogs
  - to manage your user profile data (name, email,): view, edit, delete
- My Personal Statistics and Bounds: daily or Monthly
  - to access at your statistics about the data access and volume of resources use
    that may depend on the Organization at which one belong and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

Manage Profile and MyPersonalData

For each Data Type:

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

TOP



SNAP4CITY AND KM4CITY PROJECTS

DISIT lab roadmap vs model and tools' usage

2013 Km4City Ontology 1.1

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

2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- Events
- LOD

ckan

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015

- Sardinia Region Smart City Strategies and plan

FIWARE

SII-MOBILITY SCN (2016-19)

Km4City 1.5 (2016-21) H2020

resolute (2015-18) H2020

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

E015 digital ecosystem

2016

Km4City 1.6.2

- Infomobility
- Mobile App
- Routing
- Multimodality

- Smart Energy
- Sustainable Mobility
- Control Room Dashboard

REPLICATE

Km4City 1.6.4

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

GHOST SIR (2016-19)

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

Km4City 1.6.6 IOT/IOE

Node-RED

SNAP4CITY

SELECT for Cities H2020 (2017-19)

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

life weee (2017-20)

- Smart Waste

2017

TRAFAIR CEF (2018-21)

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

2018

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

MOSAiC (2018-20)

- Mobility Demand / Offer Analytics and Strategy

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

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

2020

…2022

Reverberi Enetec
Gruppo MPES

bee smart city

GREEN FIELD PEAS
Soda4.0

SIRIUS

LAID Smart Bed

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

Main running projects



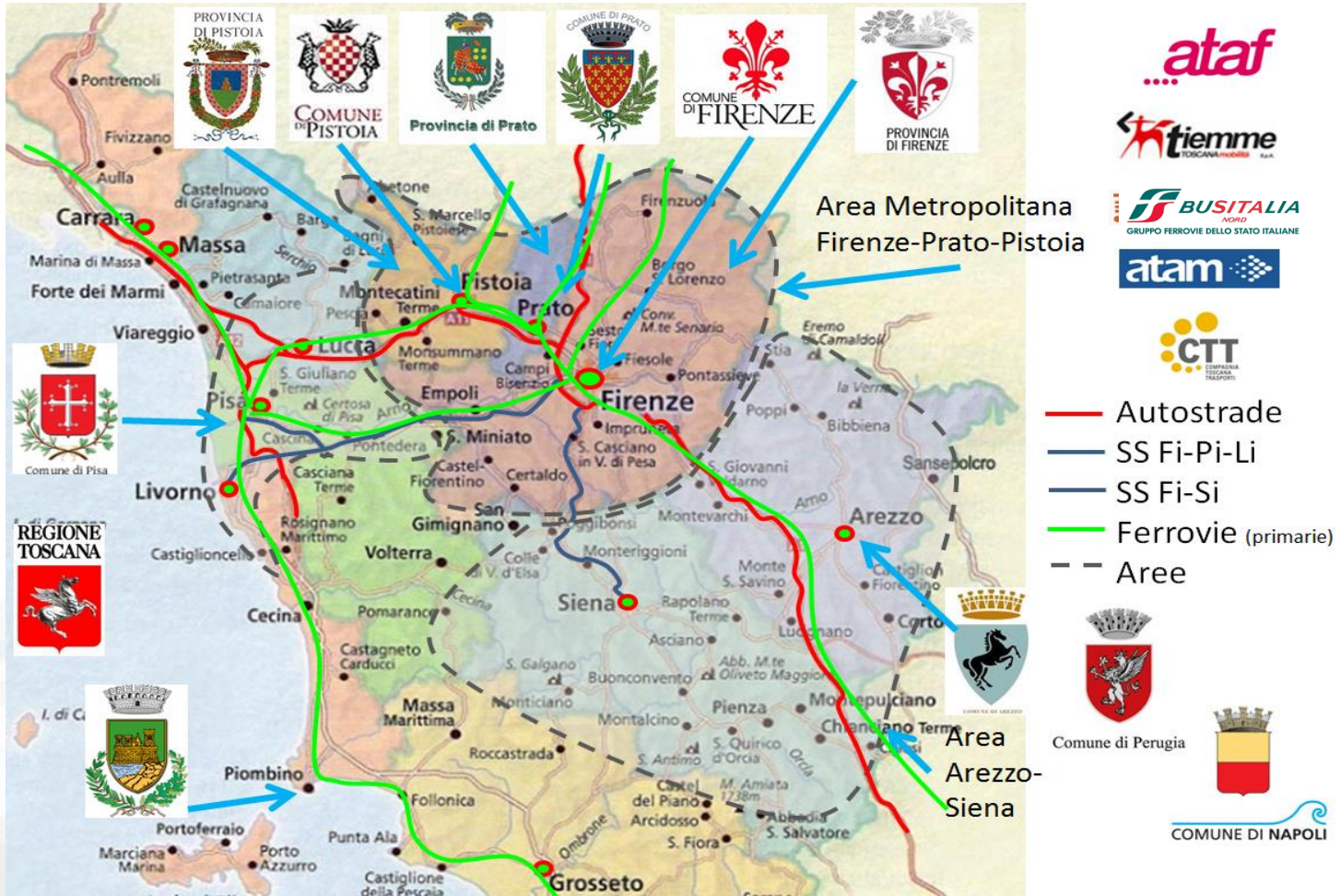
- Sii-Mobility → mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFAIR → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart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

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

Sii-Mobility

http://www.Sii-Mobility.org

- *Experimentations and validation in Tuscany*
- *Integration with present central station and subsystems*
- *DISIT lab, Università di Firenze, is the tech-scientific coordinator*



ECM; Swarco Mizar; Inventi In20; Geoin; QuestIT; Softec; T.I.M.E.; LiberoLogico; MIDRA (autostrade, motorola); ATAF; Tiemme; CTT Nord; BUSITALIA; A.T.A.M.; Effective Knowledge; eWings; Argos Engineering; Elfi; Calamai & Agresti; Project; Negentis

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

Sii-Mobility

http://www.Sii-Mobility.org

MIUR MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITÀ E DELLA RICERCA

KM 4 CITY

Commenti dei cittadini, Social Media





AVM trasporto Pubblico

Merci





Sensori su trasporto Privato





Sensori, sistema monitoraggio

Sensori Parcheggi





UTC





Infomobility





Varchi Telematici, ZTL

Monitoraggio traffico, autostrade





Rete Ferroviaria



Parametri ambientali



Servizi ed enti



Ordinanze: eventi, lavori pubblici, ..



Emergenze, polizia, 118



General Objectives

http://www.Sii-Mobility.org

- Reduce the social costs of mobility
  - minor inconvenience,
  - greater efficiency,
  - greater sensitivity to the needs of the citizen,
  - lower emissions,
  - better environmental conditions;
  - info-training programs to help city user in getting virtuous habits;
  - reduce transportation costs and travel times for users, for operators and administrations,
  - optimization solutions.
- **simplify the use of mobility systems**
  - innovative sensors for AVM and private transport on the territory
  - integrated systems for payment and identification
  - driving / offline routing solutions
  - connect the drive, smart drive or walk
  - Integration of data from operators and different type sources
  - advanced management of resources measurement of flows realization of sensors, actuators
- **Testing on municipalities and provinces of Tuscany**
- **Contribute to the improvement of national and international standards**

REPLICATE

Horizon 2020
European Union Funding
for Research & Innovation

REnaissance of PLaces
with Innovative Citizenship
And TEchnology

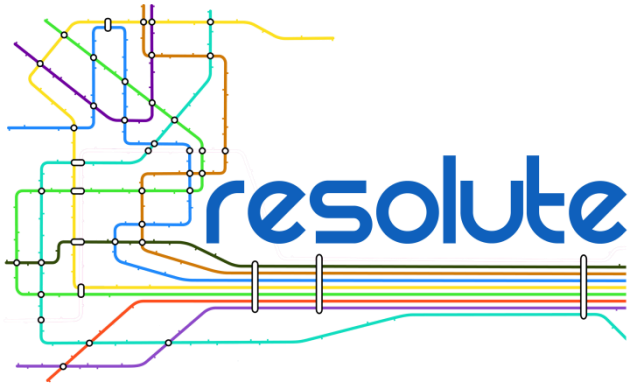
http://replicate-project.eu/

- Demonstrate Smart City technologies in energy, transport and ICT in districts in:
  - San Sebastian, Florence and Bristol,
  - follower cities of Essen, Nilufer and Lausanne
- Cities are the customer: considering local specificities
- Solutions must be replicable, interoperable and scalable:
  - Integrated Infrastructure: deployment of ICT architecture, from internet of things to applications
  - Low energy districts
  - Urban mobility: sustainable and smart urban services

SNAP4CITY

KM 4 CITY

- ***1 (coordinator) FOMENTO DE SAN SEBASTIAN FSS SPAIN***
- *2 AYUNTAMIENTO DE SAN SEBASTIAN SAN SEBASTIAN SPAIN*
- ***3 COMUNE DI FLORENCE FLORENCE ITALY***
- *4 BRISTOL COUNCIL BRISTOL UNITED KINGDOM*
- *5 STADT ESSEN ESSEN GERMANY*
- *6 NILUFER BELEDIYESI NILUFER TURKEY*
- *7 VILLE DE LAUSANNE LAUSANNE SWITZERLAND*
- *8 IKUSI ANGEL IGLESIAS, S.A. IKUSI SPAIN*
- *9 ENDESA ENERGÍA, S.A. ENDESA SPAIN*
- *10 EUROHELP CONSULTING, S.L. EUROHELP SPAIN*
- *11 ILUMINACION INTELIGENTE LUIX, S.L. LUIX SPAIN*
- *12 FUNDACION TECNALIA RESEARCH & INNOVATION TECNALIA SPAIN*
- *13 EUSKALTEL, S.A. EUSKALTEL SPAIN*
- *14 COMPAÑÍA DEL TRANVÍA DE SAN SEBASTIÁN DBUS SPAIN*
- ***15 CONSIGLIO NAZIONALE DELLE RICERCHE CNR ITALY***
- ***16 ENEL DISTRIBUZIONE, SPA ENEL ITALY***
- ***17 MATHEMA, SRL MATHEMA ITALY***
- ***18 SPES CONSULTING SPES ITALY***
- ***19 TELECOM ITALIA, SPA TELECOM ITALY***
- ***20 UNIVERSITA DEGLI STUDI DI FLORENCE UNIFI ITALY: DINFO.DISIT Lab and DIEF***
- ***21 THALES ITALIA, SPA THALES ITALY***
- *22 ZABALA INNOVATION CONSULTING ZABALA SPAIN*
- *23 TECHNOMAR TECHNOMAR GERMANY*
- *24 UNIVERSITY OF BRISTOL UOB UNITED KINGDOM*
- *25 UNIVERSITY OF OXFORD UOXF UNITED KINGDOM*
- *26 BRISTOL IS OPEN, LTD BIO UNITED KINGDOM*
- *27 ZEETTA NETWORKS ZEETTA UNITED KINGDOM*
- *28 KNOWLE WEST MEDIA CENTRE, LGB KWMC UNITED KINGDOM*
- *29 TOSHIBA RESEARCH EUROPE, LTD TREL UNITED KINGDOM*
- *30 ROUTE MONKEY, LTD ROUTE MONKEY UNITED KINGDOM*
- *31 ESOTERIX SYSTMES, LTD ESOTERIX UNITED KINGDOM*
- *32 NEC LABORATORIES EUROPE, LTD NEC UNITED KINGDOM*
- *33 COMMONWHEELS CAR CLUB CIC CO-WHEELS UNITED KINGDOM*
- *34 UNIVERSITY OF THE WEST OF ENGLAND UWE UNITED KINGDOM*
- *35 ESADE BUSINESS SCHOOL ESADE SPAIN*
- *36 SISTELEC SOLUCIONES DE TELECOMUNICACION, S.L. SISTELEC SPAIN*



Horizon 2020
European Union Funding
for Research & Innovation

http://www.resolute-eu.org

- **Develop European Resilience Management Guidelines (ERMG)**
  - Develop a conceptual framework for creating/ maintaining Urban Transport Systems
- **Enhance resilience** through improved support of human decision making processes, particularly by training professionals and civil users on the ERMG and the RESOLUTE system
- **Operationalize and validate the ERMG** by implementing the RESOLUTE Collaborative Resilience Assessment and Management Support Systems (CRAMSS) for Urban Transport Systems addressing Road and Urban Rail Infrastructures
  - Pilots in **Florence and Athens**
- Adoption of the ERMG at EU and Associated Countries level

University of Florence: DISIT lab DINFO (Proj coordinator), DISIA and DST	UNIFI	IT
THALES	THALES	IT
ATTIKOMetro	ATTIKO	GR
Comune di Firenze	CDF	IT
Centre for Research and Technology Hellas	CERTH	GR
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	FHG	DE
HUMANIST	HUMANIST	FR
SWARCO Mizar	SWMIZ	IT
Associação para o Desenvolvimento da Investigação no Instituto Superior de Gestão	ADI-ISG	PT
Consorzio Milano Ricerche	CMR	IT

GHOST: Governing tHe smart city: a gOvernance-centred approach to SmarT urbanism

General Objectives

- Offer a **comprehensive framework** for measuring and reassessing urban smart development and related rankings
- **Critical assessment** of Smart City ranking index existence
- Definition of an **enabling technology** supporting the action plans for strengthening multi-level place-based governance, applied in the tourism context
- Definition of **strategies for good smart governance**, with the purpose of providing recommendations to start or implement an institutional and development process leading towards smart city governance.

Partners:

University of Cagliari (Coordinator) DICAAR and DMI

University of Florence SAGAS and DISIT

University of Turin ESOMAS

University of Sassari DADU

Under the patronage of the Municipality of Cagliari

COMUNE DI CAGLIARI

Duration: 23/09/2015 - 23/09/2018

http://sites.unica.it/ghost

Understanding Traffic Flows to Improve Air quality

- **Objective:** http://trafair.eu/
  - to develop a service that **combines traffic data on air quality**, weather conditions, and traffic flows in order to allow citizens and municipalities to estimate the level of pollution resulting from varying traffic flow conditions.
- **Where:**
  - **Zaragoza, Florence, Modena, Livorno, Santiago de Compostela, and Pisa**

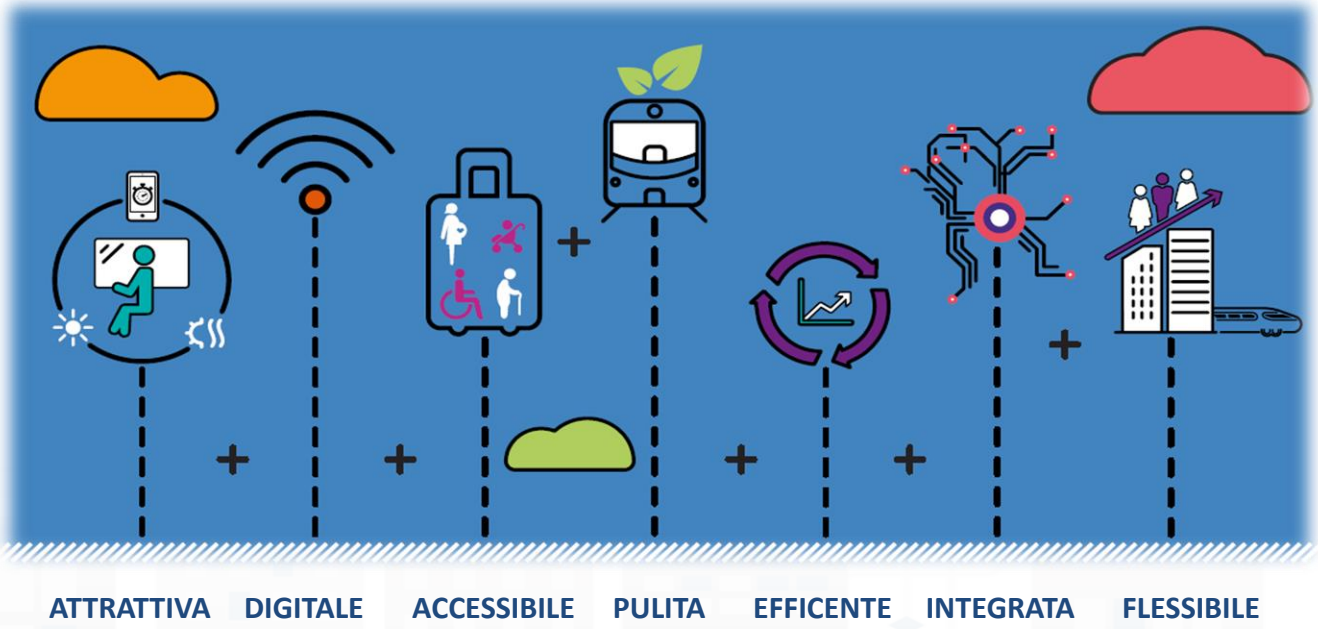
- Università degli studi di Modena e Reggio Emilia (UNIMORE) -- Italy
- **Università degli Studi di Firenze – DISIT DINFO -- Italy**
- Universidade de Santiago de Compostela (USC) - Spain
- Comune di Modena (CMO) - Italy
- Regione Toscana (TR) - Italy
- Concello de Santiago de Compostela (CSC) - Spain
- Fundación Pública Gallega Centro Tecnológico de Supercomputación de Galicia (Fundacion CESGA) - Spain
- Universidad de Zaragoza (UNIZAR) - Spain
- Lepida S.p.A. (LP) - Italy

MObility 4.0 for SmArt (i) City

Tools for Mobility operators

- Demand Analysis
- Prediction on Parking
- Connected Drive
- Offer Analysis
- Simulation of Mobility
- Etc.

Where: in Tuscany



WEEE: Waste from Electrical and Electronic Equipment

- **maximize the collection of WEEE** in Tuscany through a new governance model based on the involvement of SMEs and awareness raising activities towards citizens and its **replication in Andalucía**.
- Actions:
  - Improve the regional governance
  - Support municipalities in capacity building of public officials and improving services to citizens.
  - Develop a system of **services and incentives for SMEs**
  - Develop IT tools for companies and citizens: a **software** and **guidelines** for the simplification of administrative and bureaucratic activities and an **App** to easily locate collection sites.
  - Develop an awareness raising **information campaign** to increase public attention on the topic.
  - Test the **replicability and transferability** of project results through the implementation of actions in the Region of Andalucía.

http://www.regione.toscana.it/-/life-weee

smartGARDAlake

www.smartgardalake.it

1



INTELLIGENT
PUBLIC LIGHTING

SMART
NETWORK

SENSORS

INFRASTRUCTURE

2



OPEN DATA, IoT, SOCIAL

SNAP4CITY

3

APP E SERVIZI ON DEMAND
SMART CITY & SMART TOURISM

4



CONTROL ROOM FOR SMART
GOVERNCANCE

Experimenting 5G

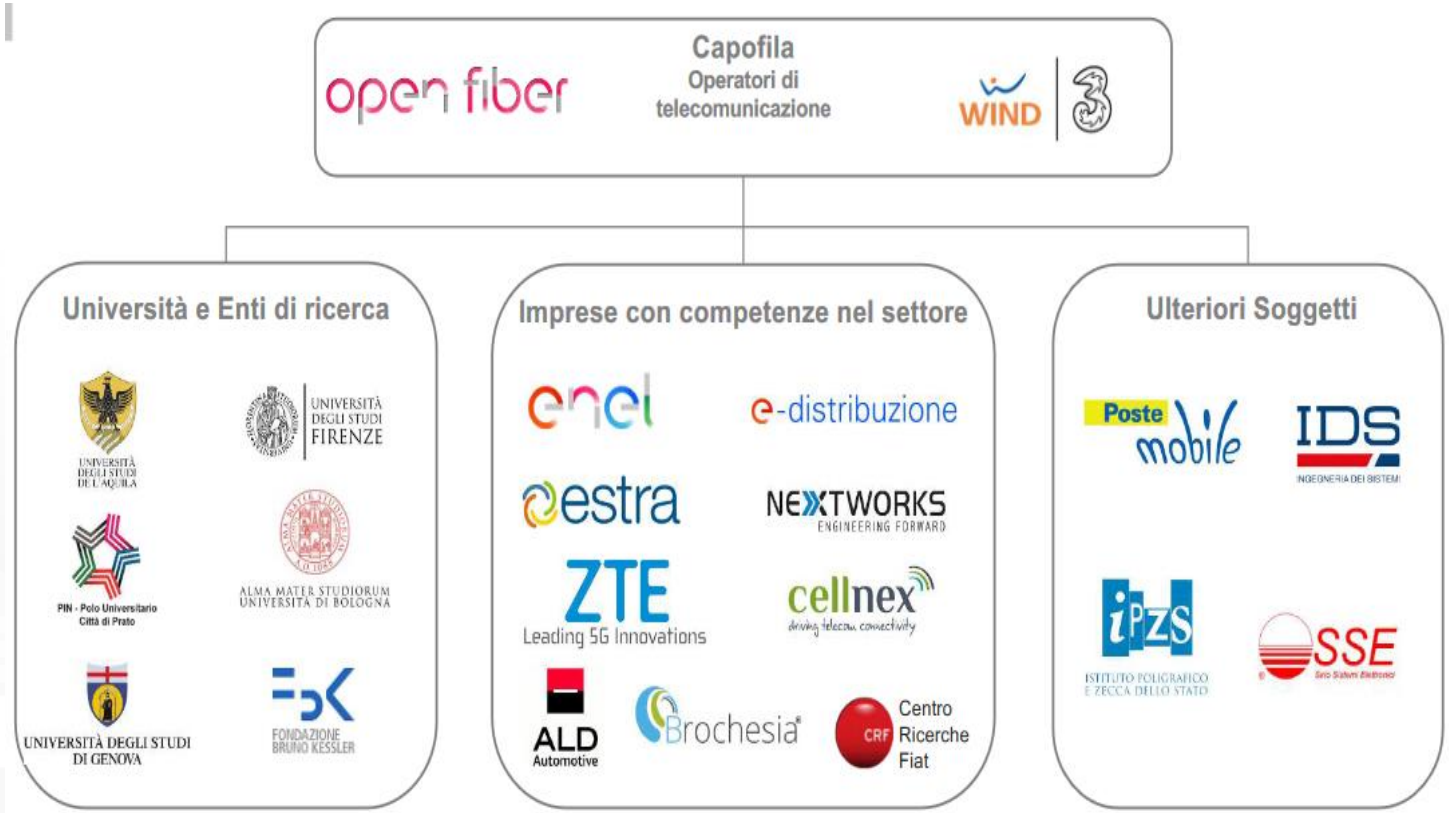
Fields:

- Internet of Things: Industry IOT, Smart City
- Mobility and transport
- Safety & Security: video analysis
- Culture and Tourism, Education, Health

Where in Italy:

- Prato and L'Aquila

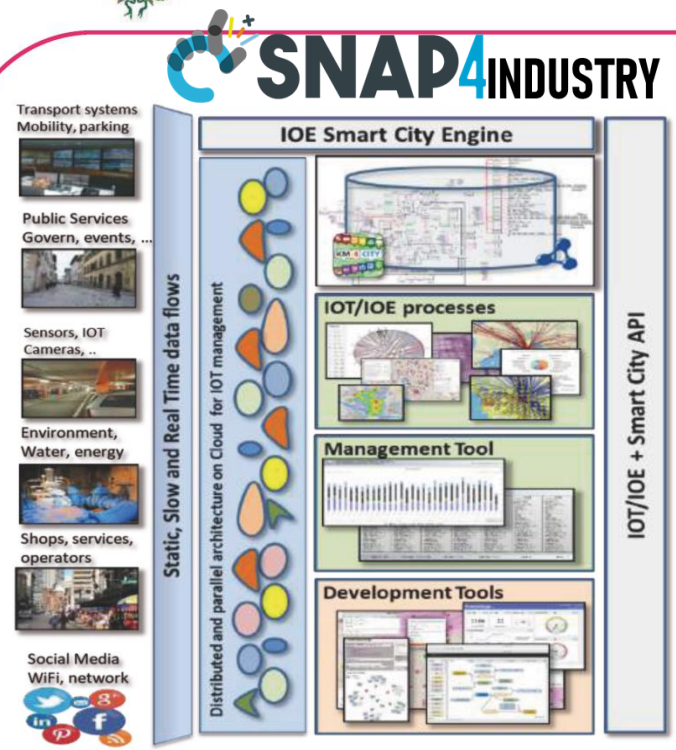
Partners:



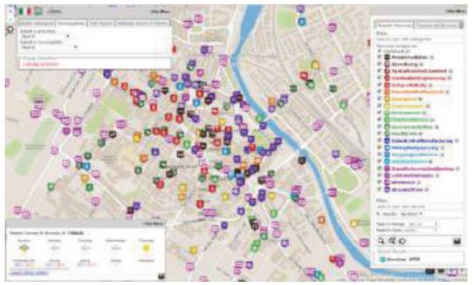
SENSORI E IOT - PRATO

Piattaforma IoT/IoE abilitata dal 5G per applicazioni di:

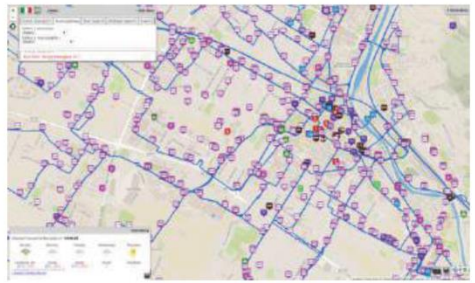
- Smart City management (in ottica Smart City)
- monitoraggio utenze in modo smart
- industrial automation (in ottica Industria 4.0)







Punti di interesse e servizi su Prato



Use Case LEADER: estra

Partner coinvolti: open fiber, ZTE Leading 5G Innovations, Università degli Studi Firenze, cellnex driving telecom connectivity, SSE Sirio Sistemi Elettronici, PIN - Polo Universitario Città di Prato

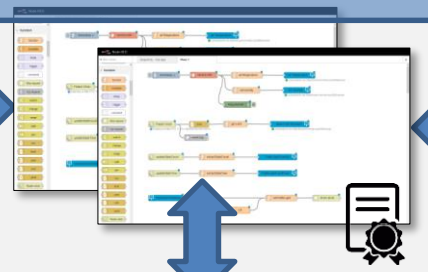
Aziende/Enti Coinvolti: GIDA, Publiacqua, Programma Ambiente, Qualcomm, Interporto della Toscana Centrale, Unione Industriale Pratese Confindustria Prato, centria Reti Gas

GIDA set up

Smart City data from many sources



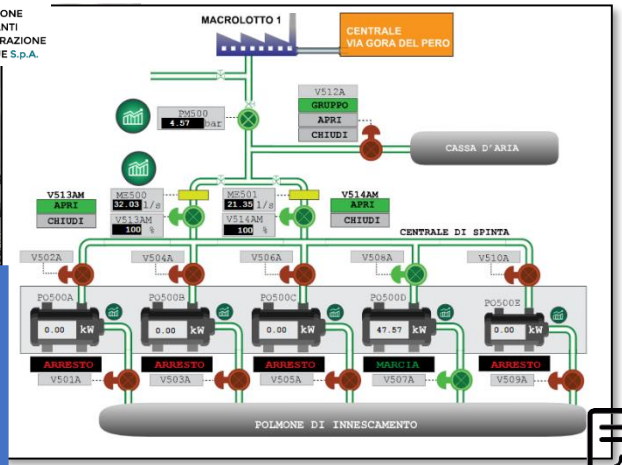
IOT Applications



Dashboards and Apps







IOT Data Shadow Snap4City

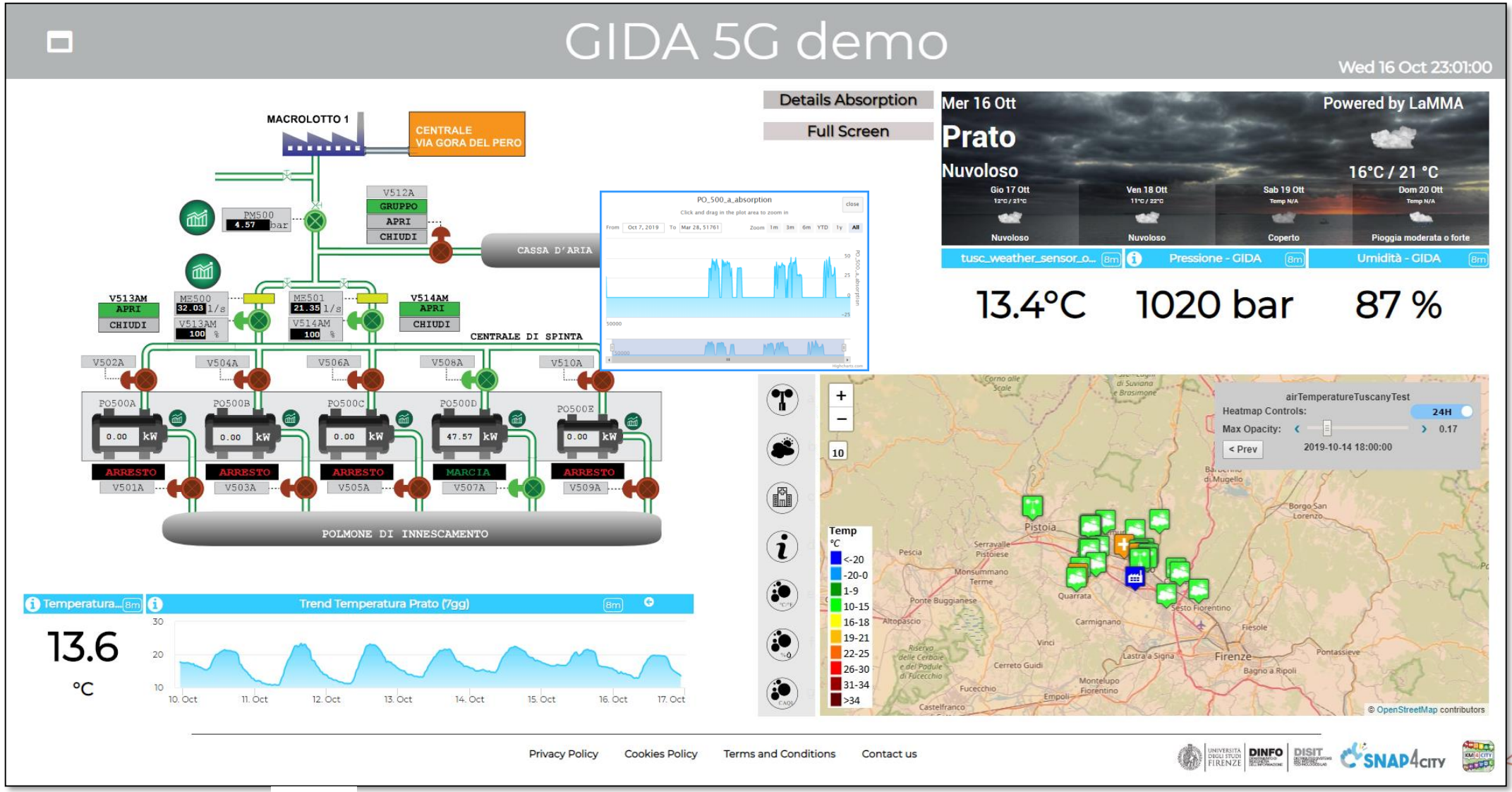
Big Data Analytics, Artificial Intelligence

ModBus to Snap4City Gateway Edge

5G network devices

Telemonitoring Telecontrol

Demo UC5 GIDA



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

Green Impact Capacity (GIC)





- Improve productivity of chemical plant
- Keep GREEN the environmental impact
- Exploiting innovative technologies
- Diversify the production
- Monitoring environmental conditions



ALTAIR CHIMICA

PRINZ

Sigma ingegneria

GIGAPIU planning and development



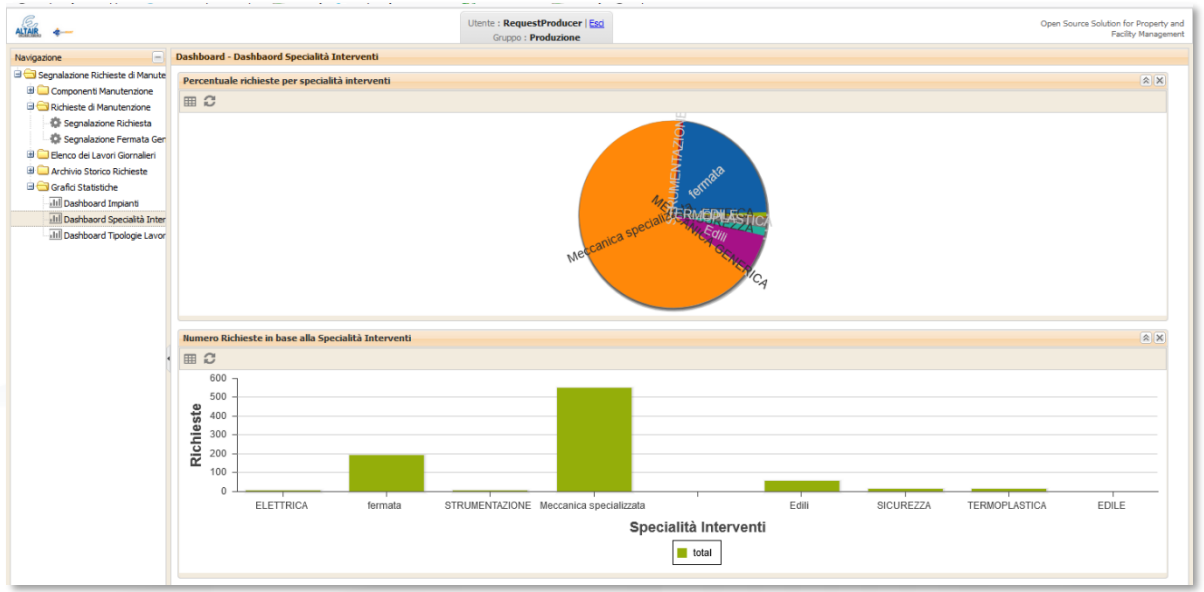


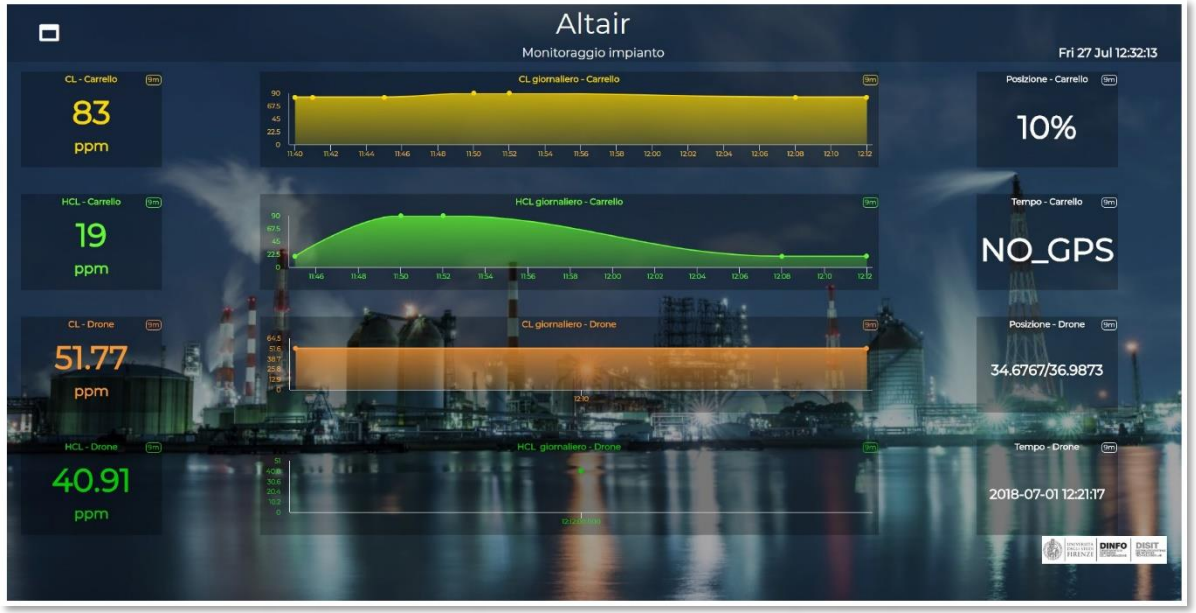
Chemical Plant Dashboard Green Impact Capacity (GIC)

Altair Control room



Reports and Dashboards

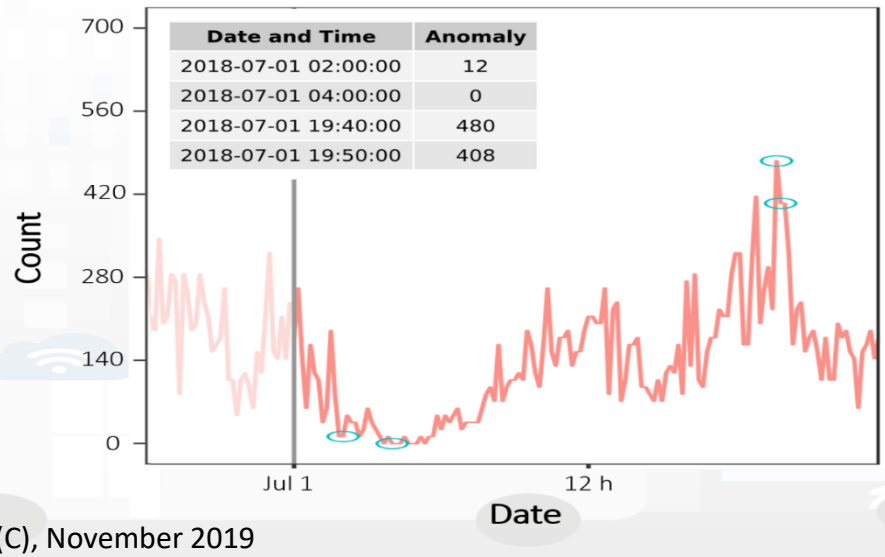




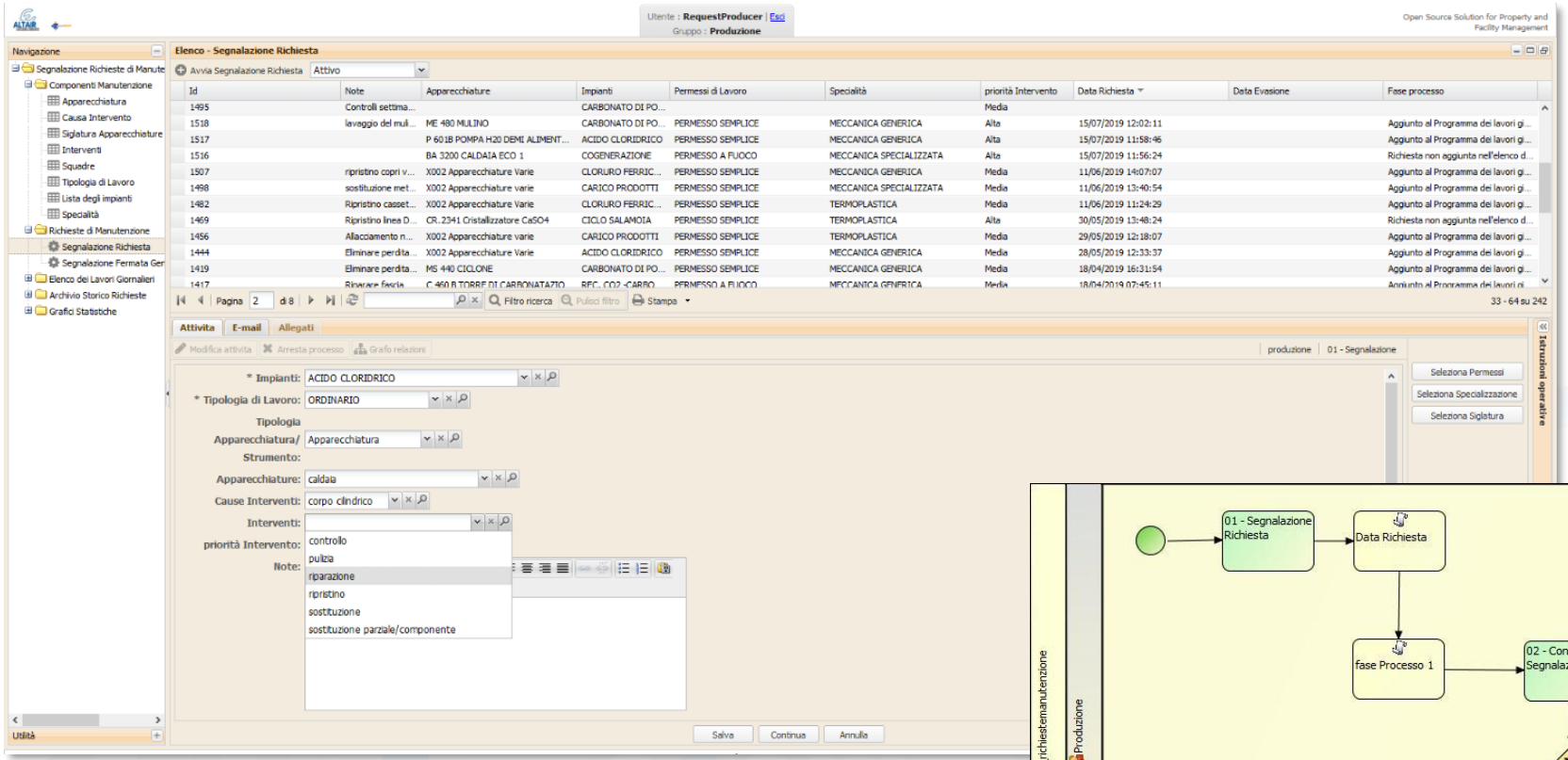
Anomaly detection Early Warning

METRO 705

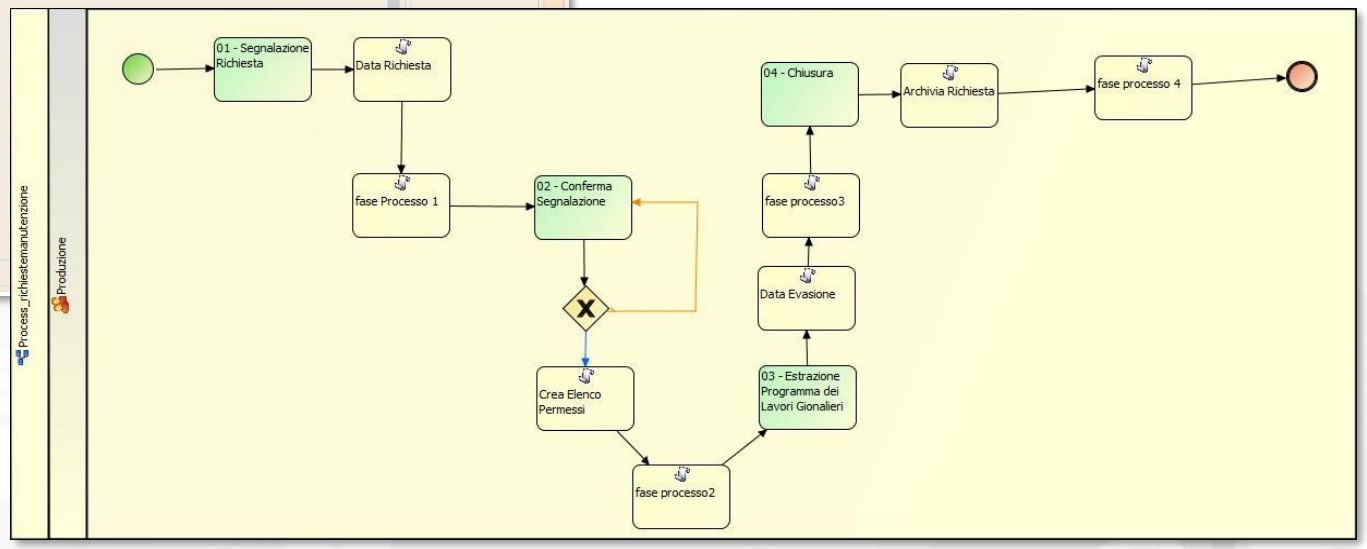
Date and Time	Anomaly
2018-07-01 02:00:00	12
2018-07-01 04:00:00	0
2018-07-01 19:40:00	480
2018-07-01 19:50:00	408



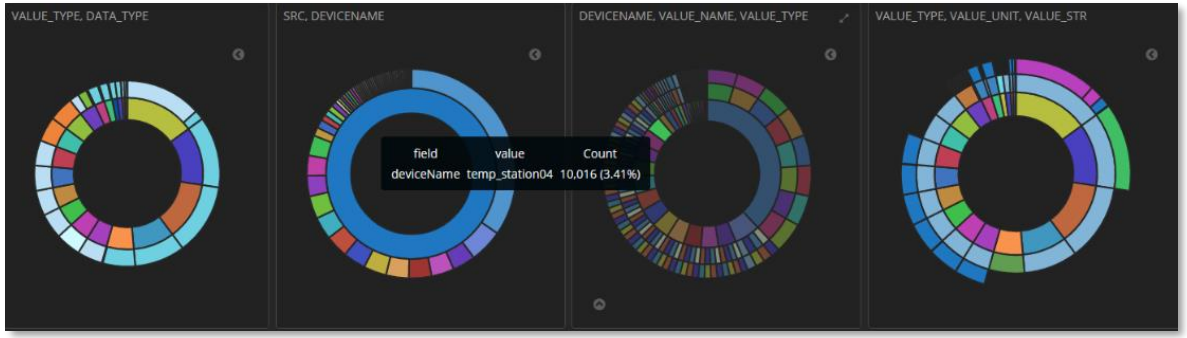
Maintenance: ticket management

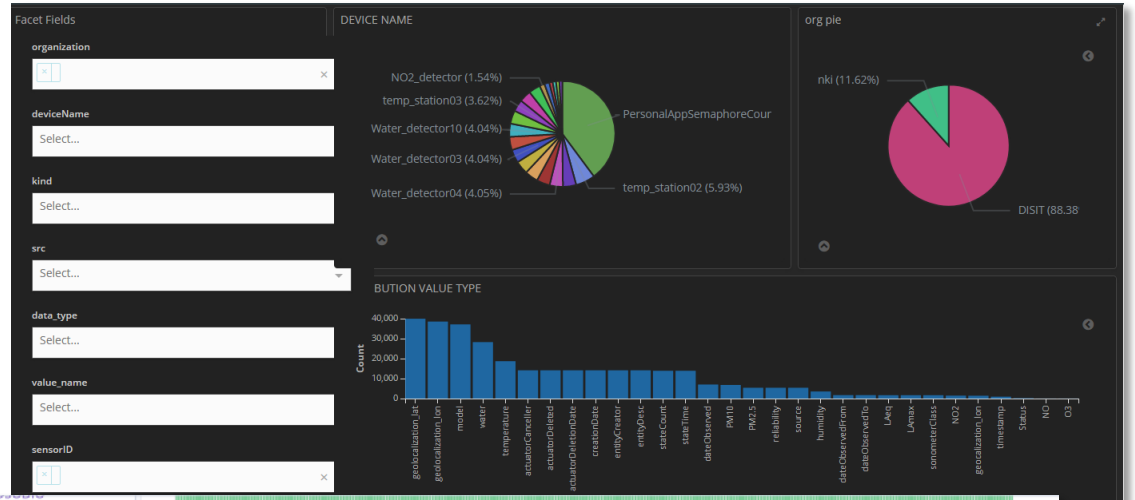


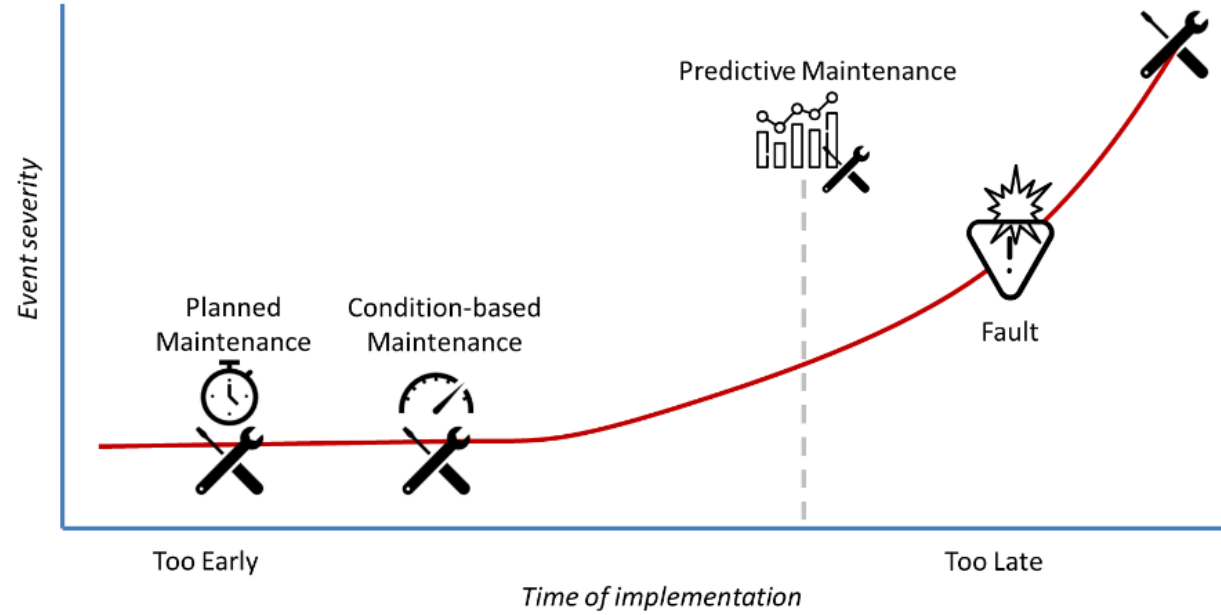
Personalised Workflows

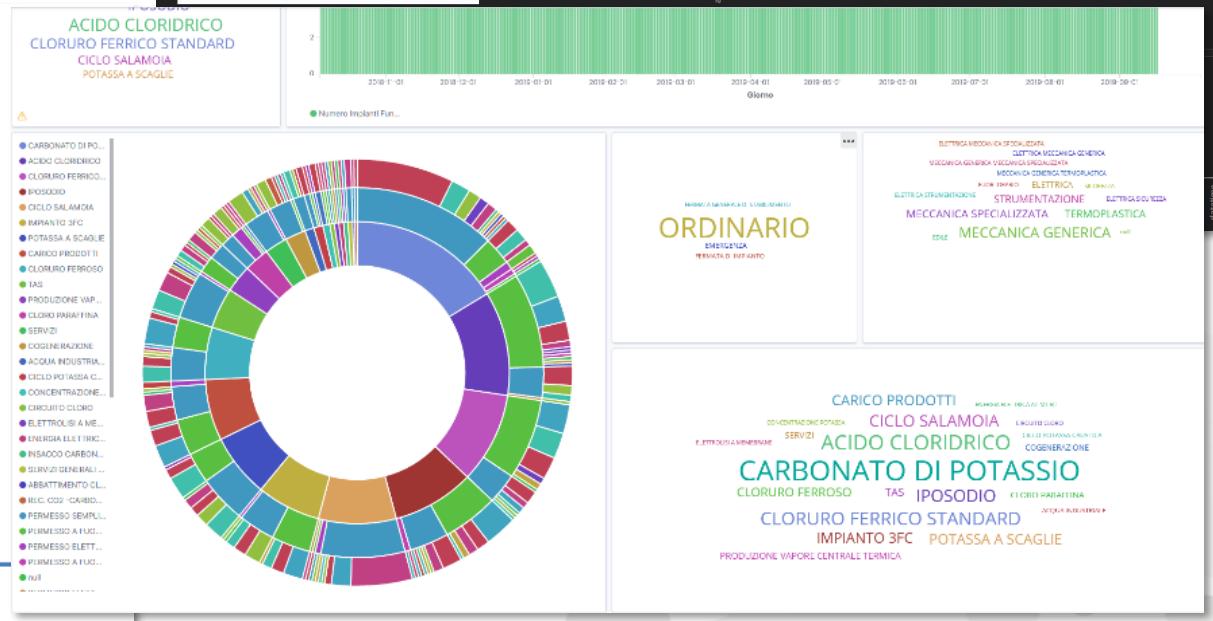


Business Intelligence and Predictive Maintenance









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SNAP4CITY KM4CITY

Coll@bora

Supporto Collaborativo Protetto per Genitori e Operatori di Disabili

Tema primario: **Tecnologie Welfare e Inclusione**

Tema Secondario: **Salute**

Nicola Mitolo, DISIT Lab, UNIFI

Evaristo Ricci, Associazione Modi di Dire

D(S)T Distributed Systems and Internet Technology Lab
Distributed Data Intelligence and Technology Lab
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University of Florence
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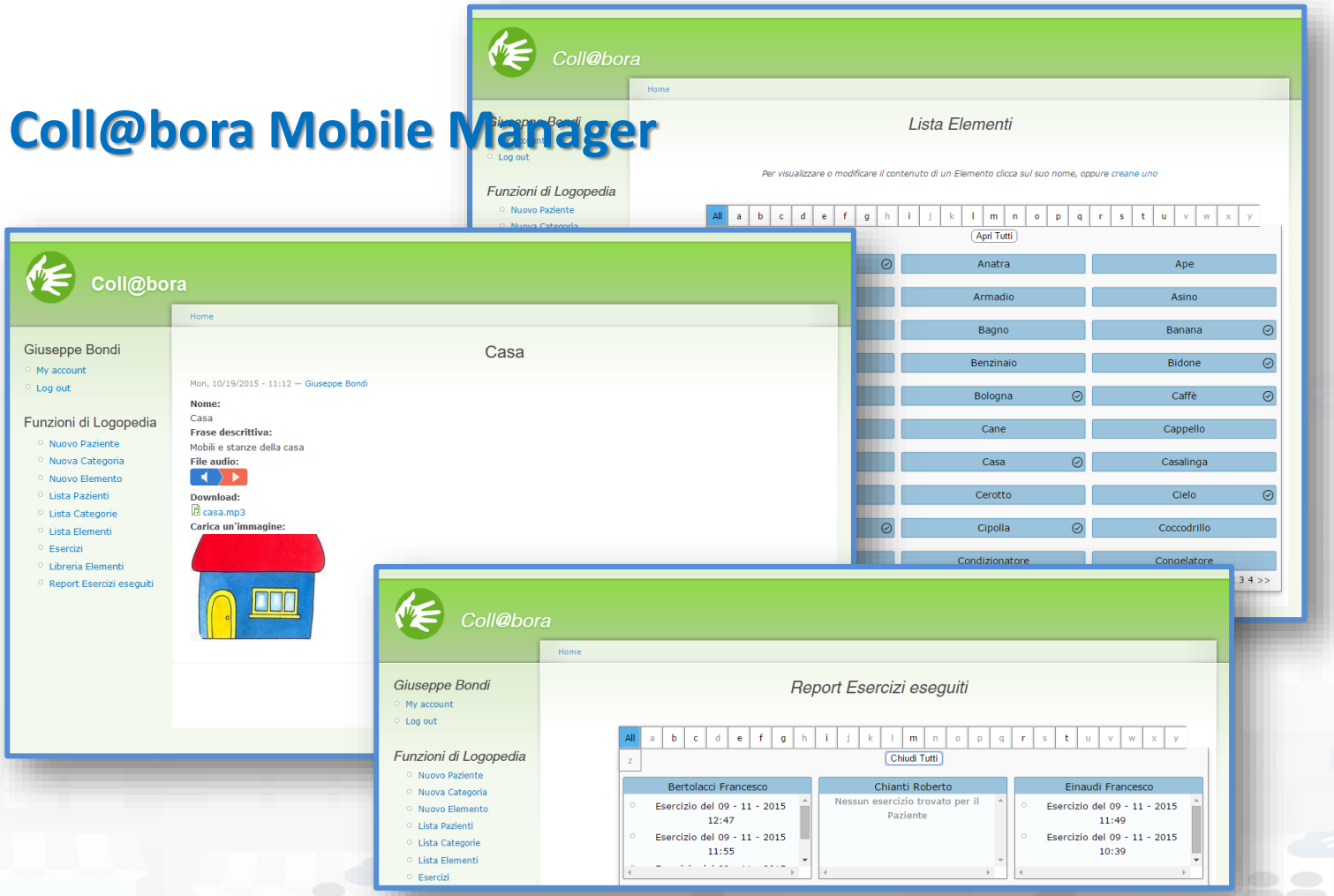
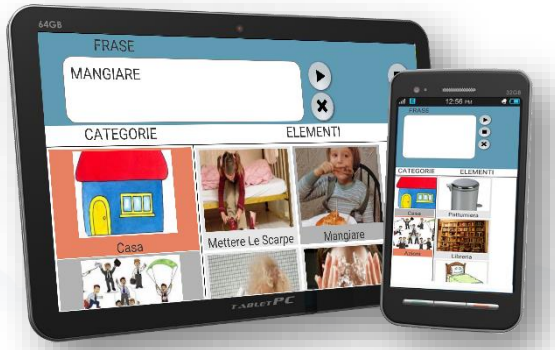
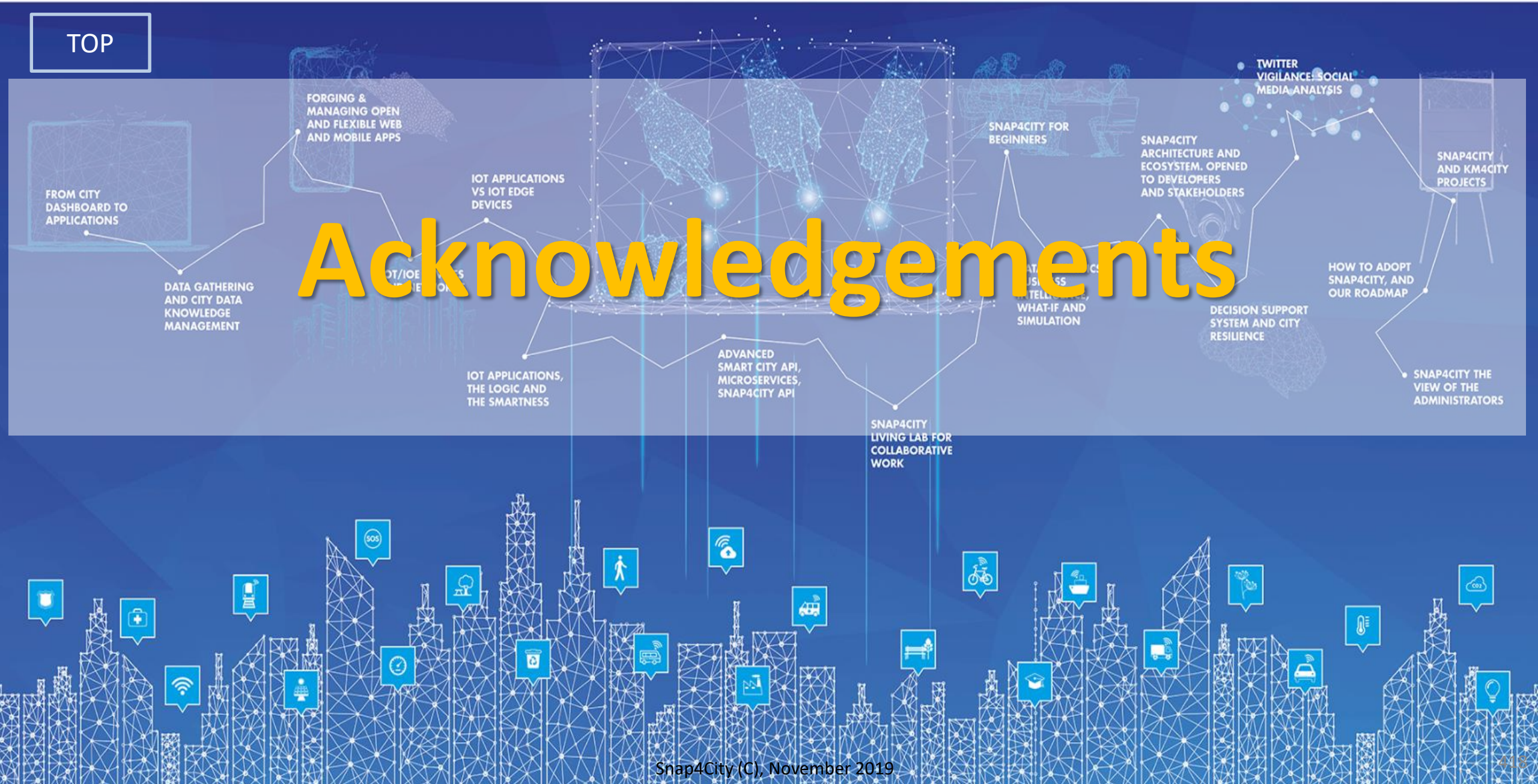




Coll@bora Mobile App

TOP



Acknowledgements

Snap4City managed to provide a maximum of information, flows, in depth analysis with the data provided.

There is no other platform that collects all city actors together.

The City officials and ICT officials were impressed with the performance of the Platform when loading the heavy, "resource-" demanding applications and dashboard.

The technical level of the Platform and its strong points such as the way real-time data is used, the algorithms, data clean-up possibilities of the Platform, presented data and information is state-of-the-art and impressive.

The data handling throughout the Platform is considered as one of the strong points in the Platform and of an extremely sophisticated level.



What People say about us

Acknowledgements

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





State of the Art Solutions vs Snap4City

	IOT Discovery Abstraction	Authentication, Authorization	Security end-2-end, secure on OT and Dashboards	Open HW and Open SW	Integrated Community management	Data Types: IOT Devices, IOT App, Dashboard, Data	Data Type: Publish/share, Delegation, Consent and change	Data Type: Download and Delete	Auditing on Data Type Access	Open Source end-to-end	Scalability IOT	Visual Programming end-to-end applications	Advanced Smart City API, MicroServices	Multi Domain Semantic Platform	Standard based Modules and OT, Open Devices	Resource Sharing	Data Analytics integrated	Dashboard H24/7, protected connection	Multi-protocol on IOT
		G				G	G	G	G										
Snap4City	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
KAA [53]	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	(Y)	N	N	Y	Y
Thingsboard [55]	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	N	N	Y	MQTT,coap, http
IOT eclipse.org [56]	N	N	N	(Y)	N	Y	N	N	N	Y	Y	N	N	N	Y	N	N	N	Y
IOT IGNITE [57]	N	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	N	N	N	Y	MQTT
FIWARE [47]	N	Y	N	Y	N	N	N	Y	N	Y	(Y)	(N)	Y	N	Y	N	N	Y	Y
ARM mbed IoT [48]	Y	Y	Y	Y	Y	N	(N)	N	Y	Y	Y	N	N	N	Y	N	N	Y	Limited
Airvantage [51]	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	N	N	N	N	Y	MQTT, HTTP
AWS [43]	Y	Y	Y	Y	N	Y	(N)	Y	Y	N	Y	N	N	N	Y	Y	(Y)	Y	Limited
Azure IOT [44]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	(Y)	Y	Limited
PTC ThingWorkx [59]	N	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	Y
Bosch IoT Suite [58]	Y	Y	Y	Y	Y	(Y)	(N)	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y
CISCO Jasper [55]	Y	Y	Y	Y	N	(Y)	(N)	N	Y	N	Y	N	N	N	N	--	(Y)	Y	N
Siemens MindSphere [60]	Y	Y	Y	(Y)	N	Y	(N)	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	Y
Carriots [54]	Y	Y	Y	(Y)	N	Y	N	N	Y	N	Y	N	N	N	--	N	N	Y	MQTT
Google IOT [45]	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	N	N	N	(Y)	(Y)	MQTT, HTTP
Homekit Apple [50]	Y	Y	Y	Y	N	Y	N	N	Y	N	(Y)	N	N	N	N	Y	N	Y	Limited
Smarthing Samsung [52]	Y	Y	Y	Y	Y	Y	(Y)	Y	Y	N	(Y)	N	N	N	N	N	N	Y	Limited

Requirements vs Modules

Requirement.description	Security and Privacy Management	Ownership & Delegation	Personal Data	IoI Context brokers	IoT Directory	IoT Firewall	IoT Apps, and management	Dashboard Bui8lder and management	MicroSerivces	Smart City API	IoT Devices	IoT Edge, IoT App on premise	Data Shadow and Storage	Knowledge Base Km4CIty	Snap4City Platform Support Living Lab
	IV.A IV.D	IV.C VI	IV.C VI.A	IV.C	IV.C	IV.A	V.B	IV.C V.C	IV.B	IV.C	V.A V.C	IV.B V.B	IV.B IV.C	IV.B	IV.A IV.B
R1. IOT Brokers				X	X	X									
R2. IOT Discovery Abstraction					X					X				X	
R3. Authentication, Authorization	X	X	X												X
R4. Inform User of Security Level															X
R5. Developing Secure Applications	X	X				X	X		X						X
R6. Secure Communications	X	X													
R7. Open HW and Open SW									X		X	X		X	X
R8. Signed Content Vs Data Types	X	X													X
R9. Managing IoT Data Types	X	X	X	X	X	X	X	X	X	X	X	X	X		X
R10. Managing Ownership and Delegation	X	X	X												X
R11. Support Roles, Org. and Groups		X	X		X		X	X						X	X
R12. Encrypted Personal Data	X		X												X
R13. User Profile Management, forgotten			X												X
R14. Auditing Data Types	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R15. Data Breach Detection	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R16. Accounting	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R17. Data Protection by Design	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R18. Evidence of Level of Security	X	X													X

GDPR vs Requirements

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

TOP

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KM 4 CITY

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SNAP4
Appliances and Dockers
Installations

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