SNAP4CITY

KM4CITY

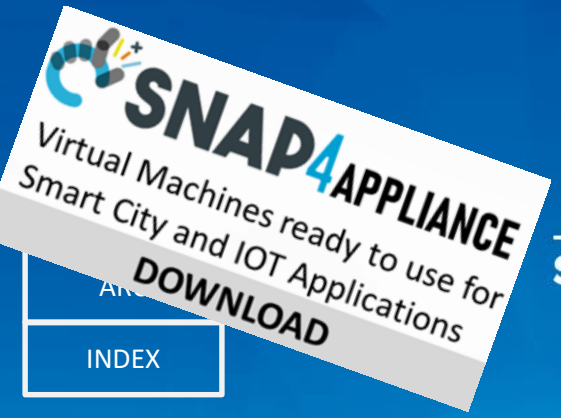
Be smart in a SNAP!



25 June 2019, 1° Training day of 3, Florence

https://www.snap4city.org/drupal/node/485

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES



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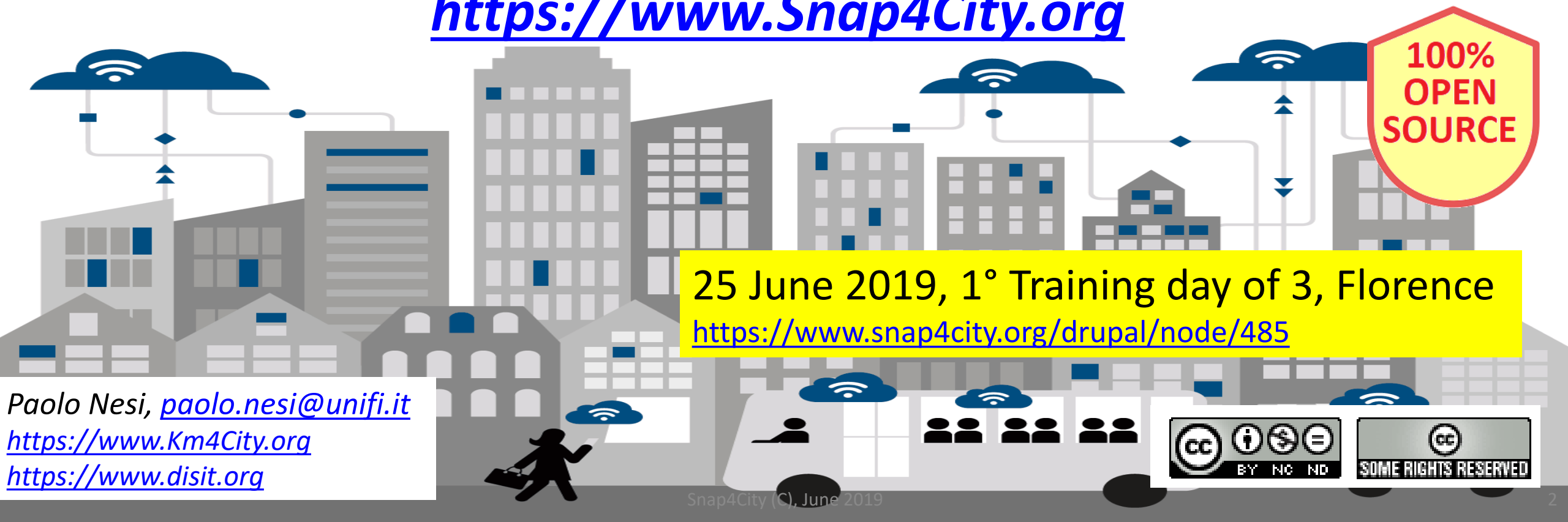
SNAP4CITY

Powered by KM4CITY

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

https://www.Snap4City.org



100% OPEN SOURCE

25 June 2019, 1° Training day of 3, Florence

https://www.snap4city.org/drupal/node/485

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

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Agenda of today

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

Training piattaforma Snap4City. Dai Dati alla città Senziente, Smart City and IOT

- **25 Giugno**: ***visione generale sulla piattaforma: dai dati alle Dashboard passando da IOT e Data Analytic, GDPR, Living Lab, Smart City API, smart city control room (SCCR).***
- **9 Luglio**:
  - Esempio di Data ingestion via ETL
  - High Level Types per dashboard: KPI, IOT, sensor, heatmap, tracking, mobile data, PAX, etc.
  - creazione di Dashboard di vario tipo, per applicazioni e, Smart City Control Room
  - Gestione Data Type in accordo a GDPR
  - dai vostri dati sul telefono alle dashboard
  - *(si consiglia di venire con il vostro portatile, di avere già installato **Toscana in a Snap**)*
- **23 Luglio**:
  - Lo sviluppo di applicazioni IOT data driven con strumenti visuali
  - Creazione di applicazioni smart, IOT Applications integrate con Dashboard
  - Sviluppo di soluzioni di Data Analytic
  - Esempio di Web Scraping integrato
  - La gestione della sicurezza
  - *(si consiglia di venire con il vostro portatile, di avere già installato **Toscana in a Snap**)*

TOP



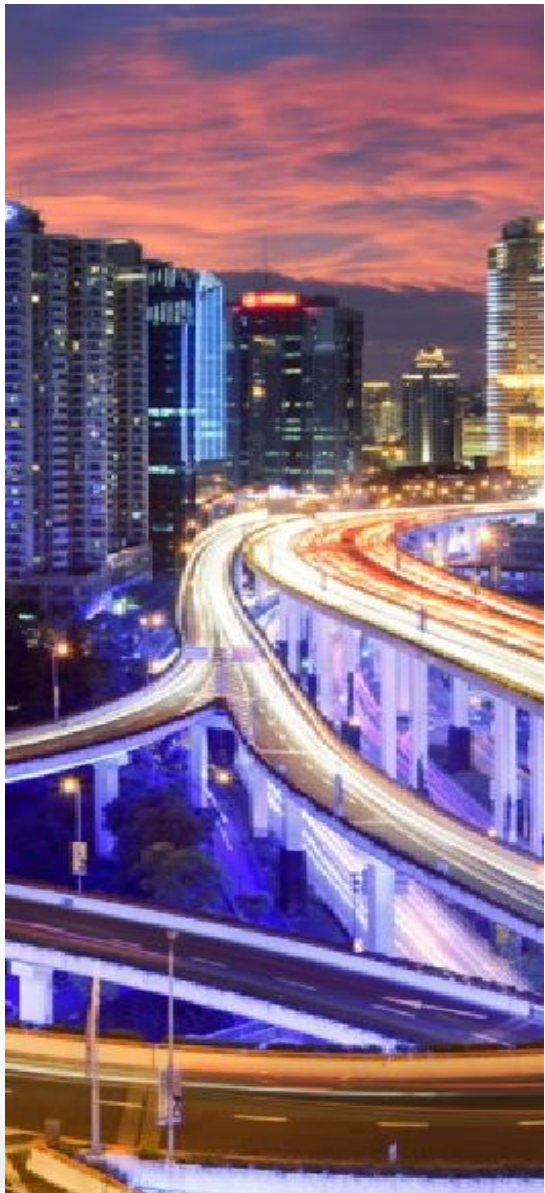
Urban Platform

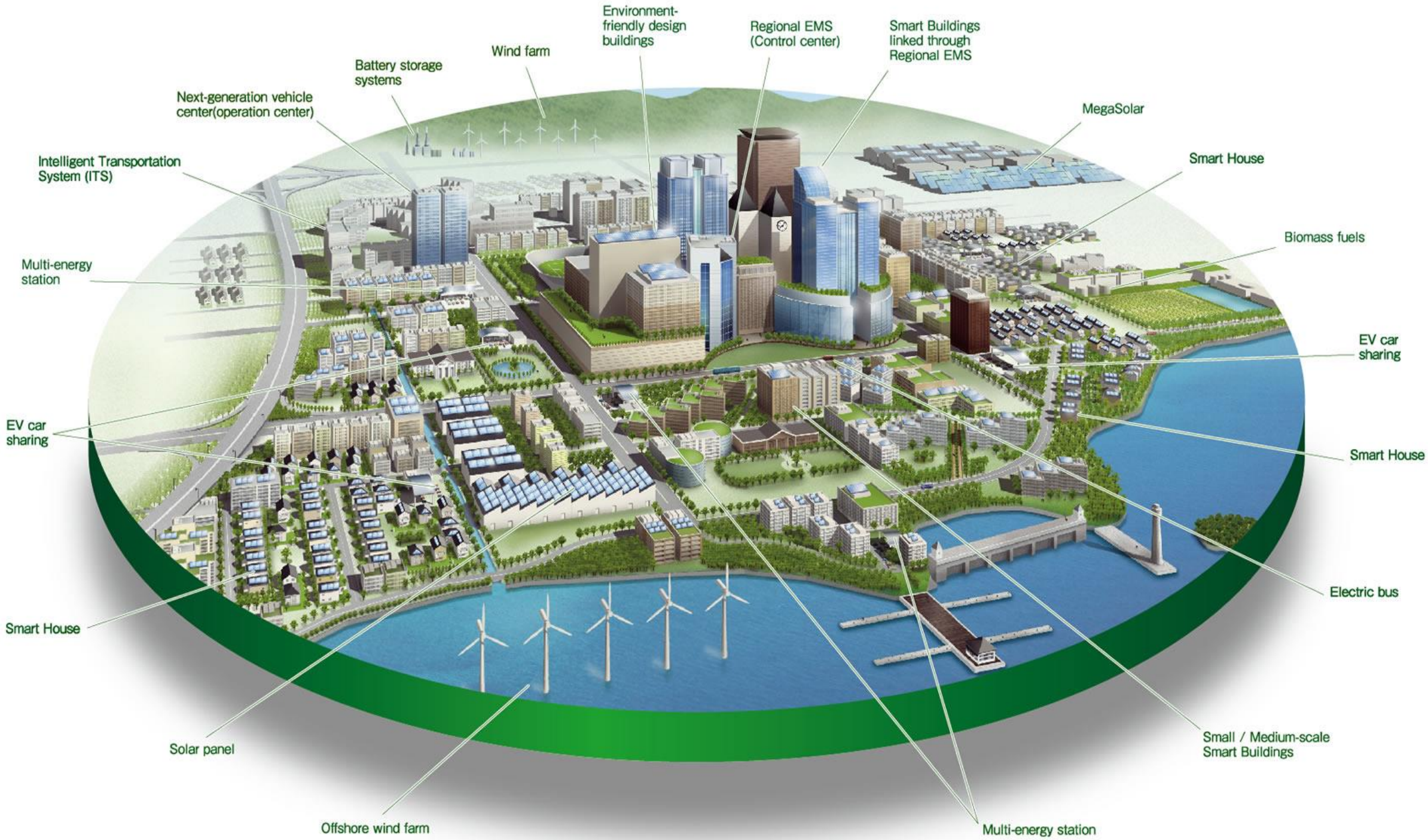
ARC
INDEX

- *Motivations to become a Smart City*
- *Structure of a Smart City Urban Platform*
- *Comparison with the State of the Art*
- *Living Lab Support*

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 …



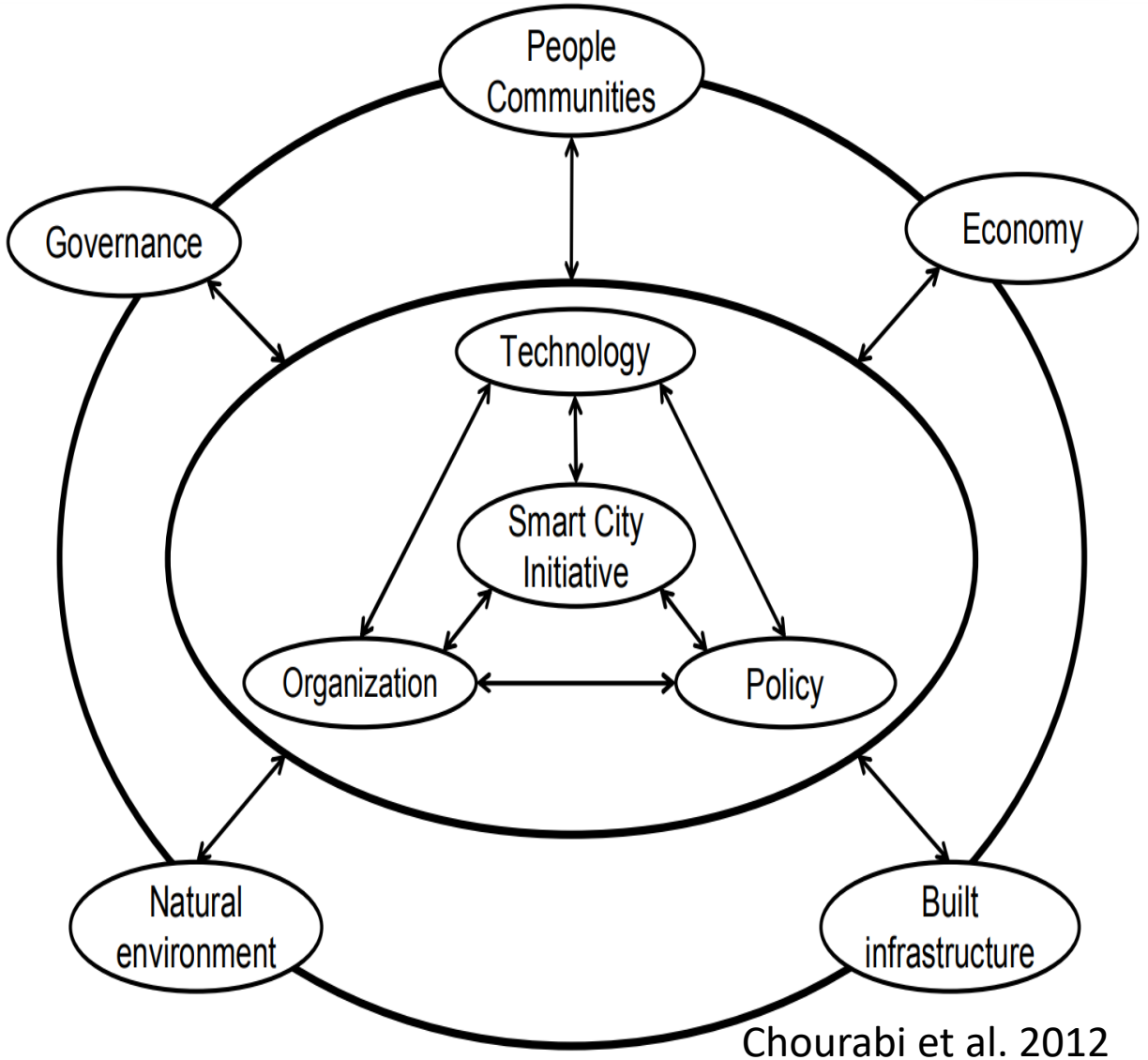

Environment-friendly design buildings
Regional EMS (Control center)
Smart Buildings linked through Regional EMS
Wind farm
Battery storage systems
Next-generation vehicle center(operation center)
MegaSolar
Intelligent Transportation System (ITS)
Smart House
Biomass fuels
Multi-energy station
EV car sharing
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, …

Collection of requirements: creating,… validating

European Network of Living Labs

EIP-SCC

SELECT for Cities

- **ENOLL**: https://www.openlivinglabs.eu/
  - European Network of Living Labs
- **EIP-SCC**: European Innovation Partnership on Smart Cities and Communities
  - https://eu-smartcities.eu/
- **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

SELECT for Cities

- 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

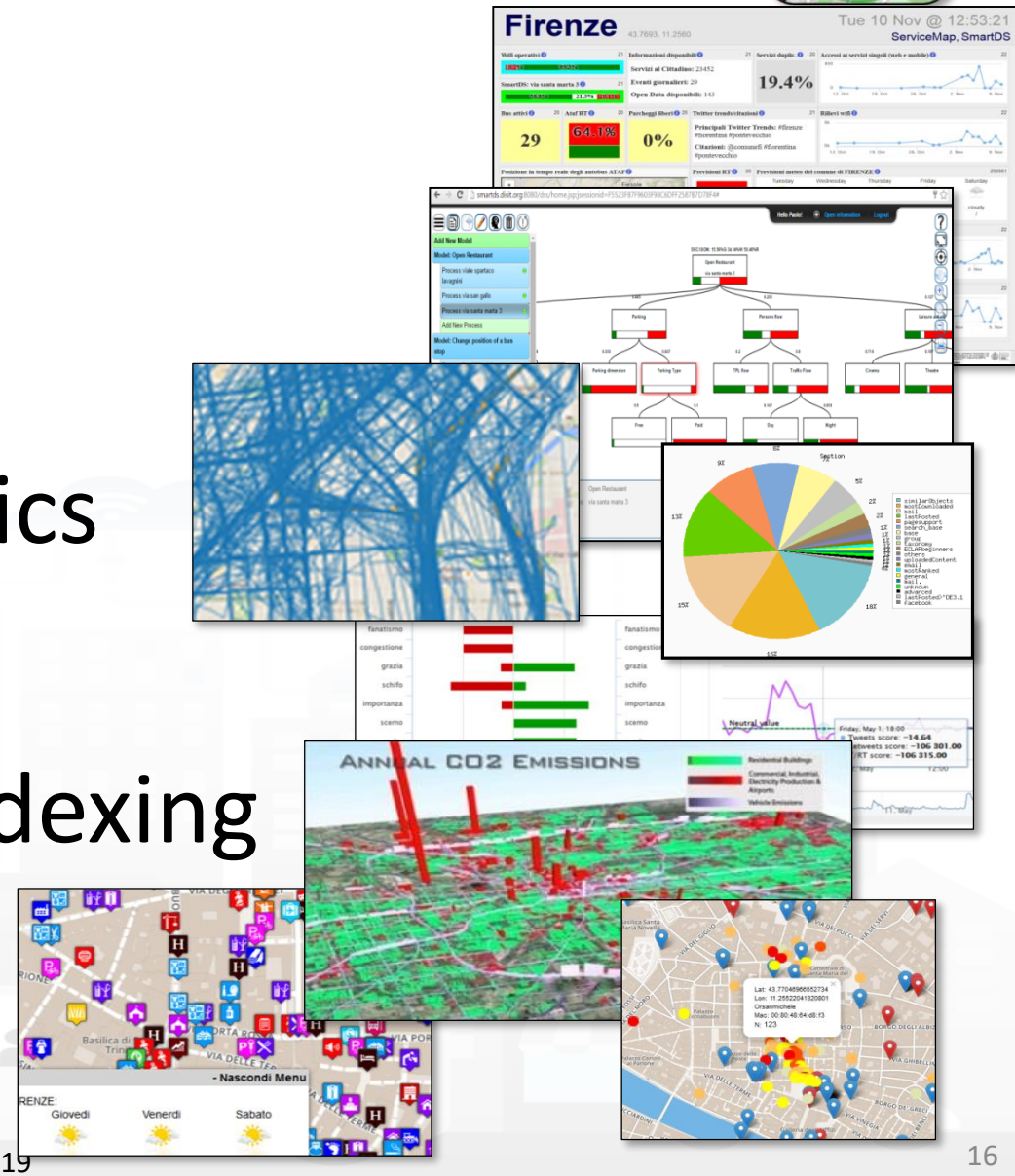
- **Open Source** and based on Open Source Tools and OS
- Open **Standard** for communication and API for In/Out
- **Scalable, Robust, Distributed** and Decoupled, modular, Service Oriented, open to external services and data sets
- **Data driven**, for reading and data analytic
- **Heterogeneous**: 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

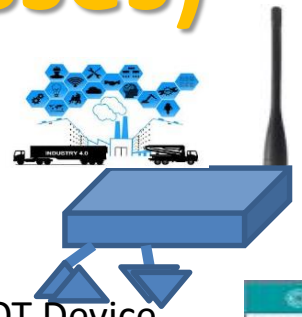
- Decision Support system
- Assessment / Strategies
- Data Rendering, visual analytics
- Data Processing
- Data aggregation, Storage, indexing
- Data Ingestion



Data Collection, ingestion (processes)

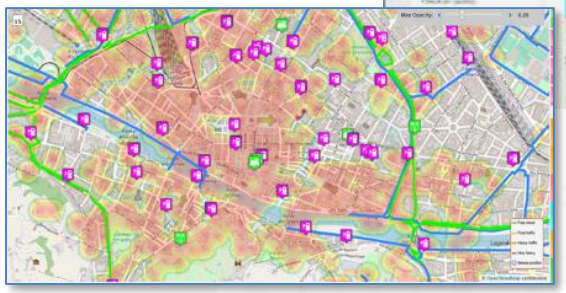
- **Data**
  - Open and private: Open Data: CKAN
    - licensing, private, GDPR
  - Static vs Real time
  - Any protocol, any standard: Push and Pull
  - Any format
- From **observations and milestones**:
  - sensors, database, KPI, etc.
- From **legacy services** of in-place operators
  - External Services: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

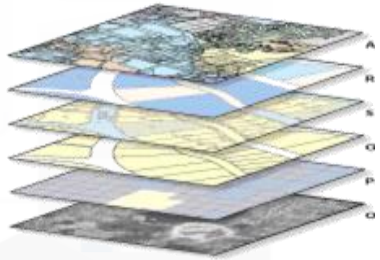




IOT Device

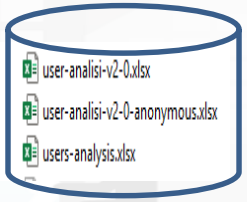












Private and static

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

Static Public (open data)

statistics: accidents, census, votations

- # Accesses to RTZ ZTL
- Data from Public GOV

- Personal movements
- GPS traces
- Relationships among people

- Position of commercial activities, POI

- Museums
- City services data, almost
- Active services

- TV cameras

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

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

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

- Stato accessi alla ZTL
- Stato dei servizi

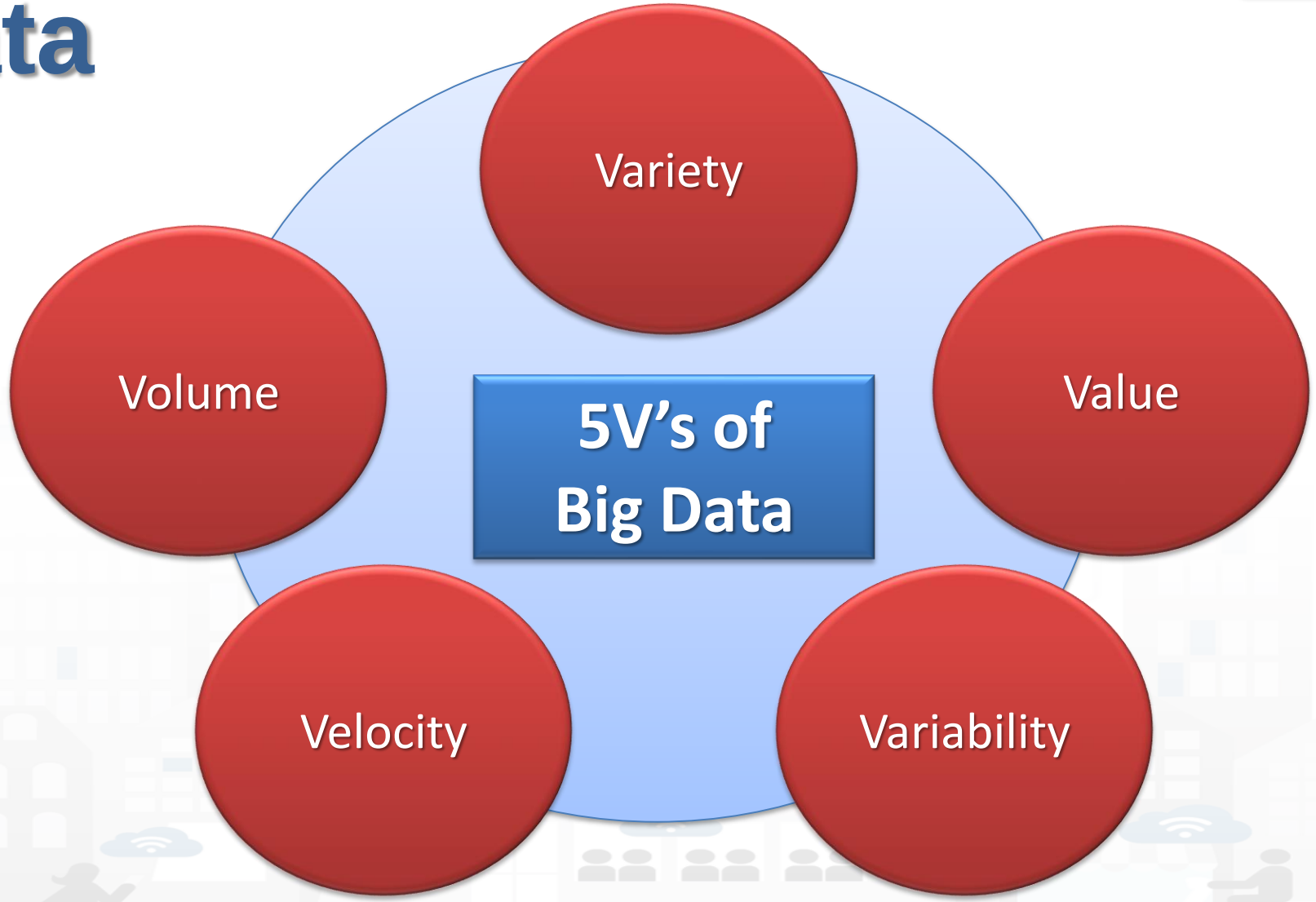
Real time private

Real time public (open data)

5V of Big Data

When data are BIG data?

The excel file size?

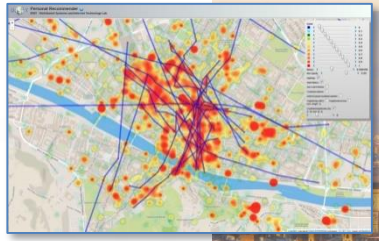


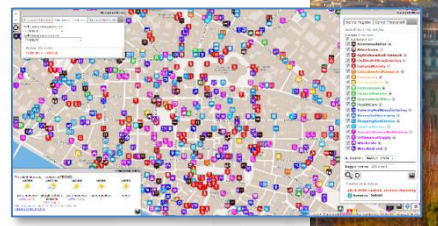
Other Vs have been also proposed…

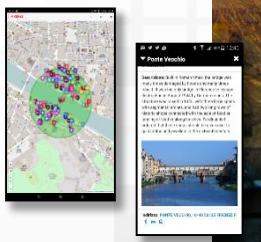
Integrated Urban Platform

- **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, ...

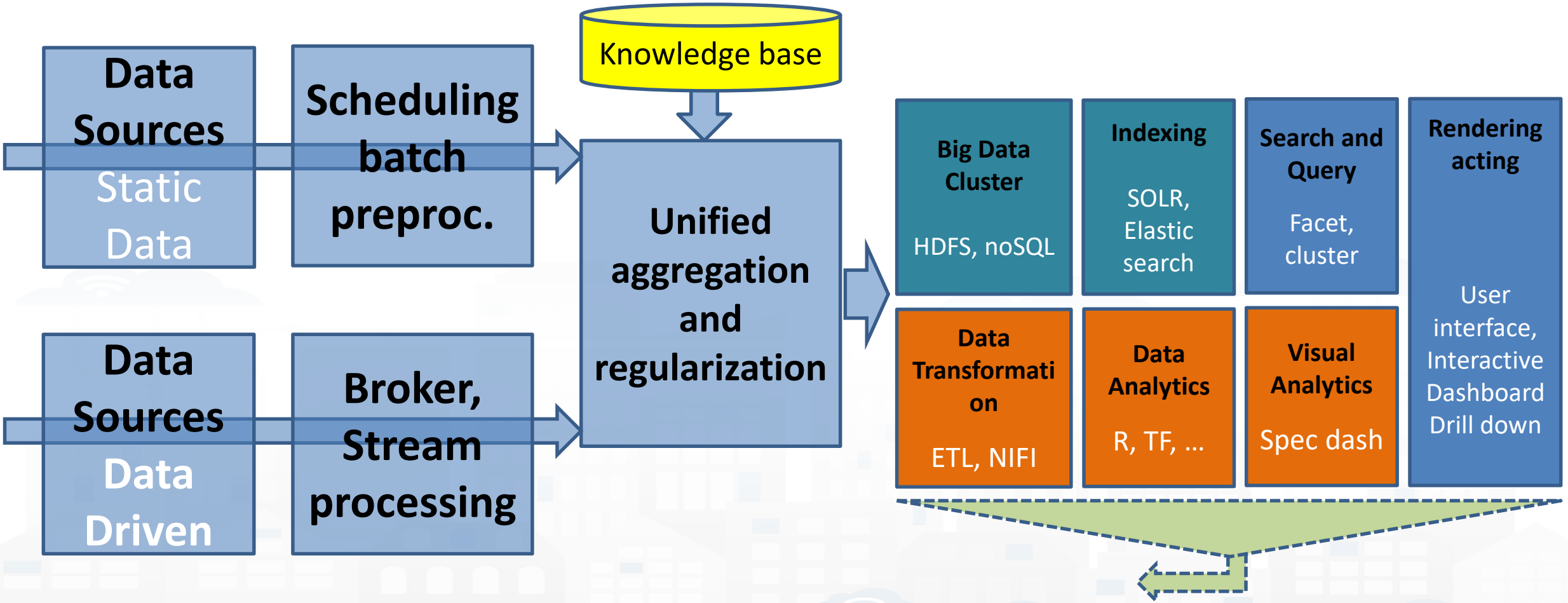








Lambda Architecture

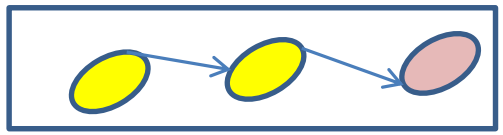


Data Indexing & Semantic Data Indexing

- **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*

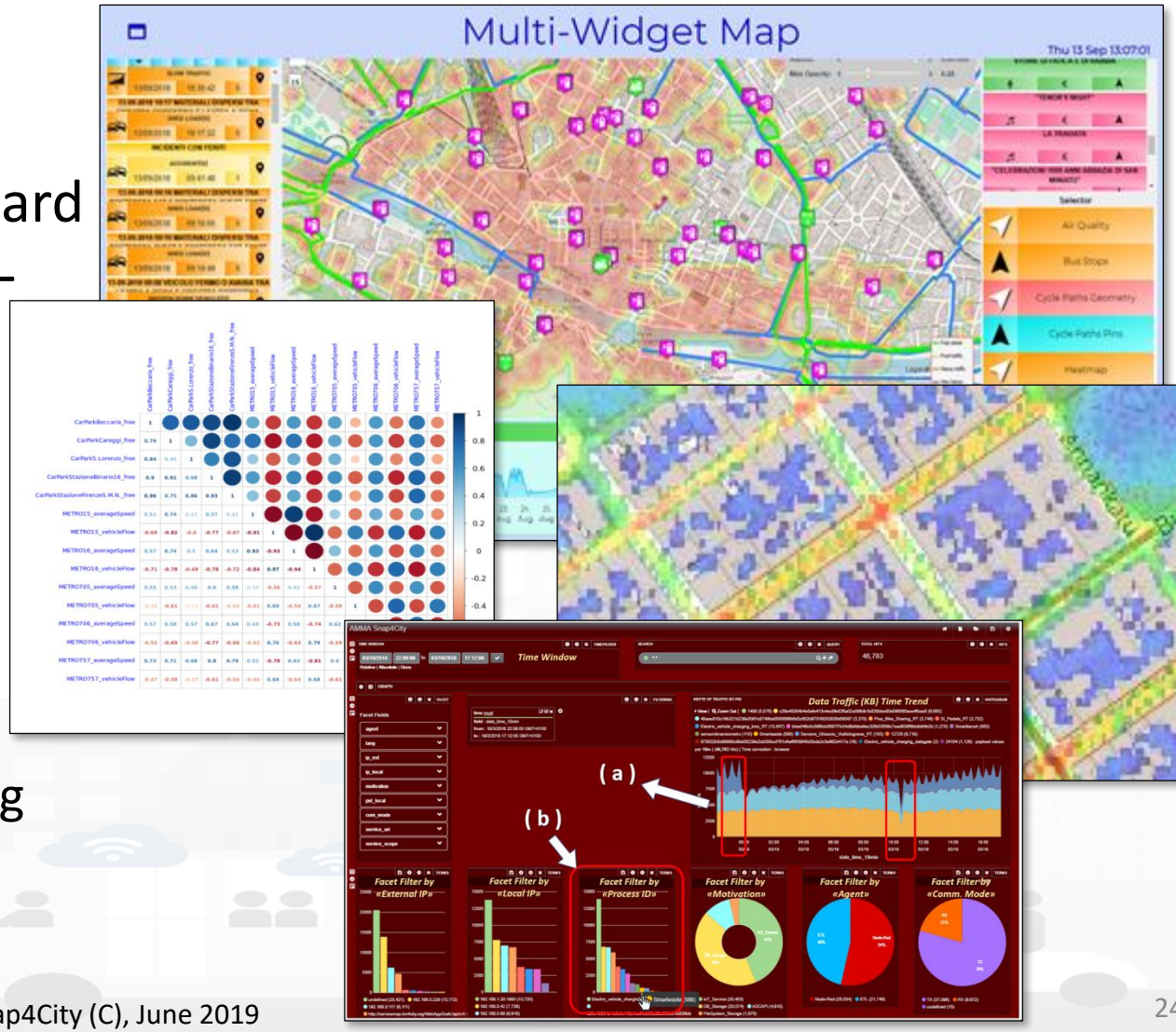
Data processing



- **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

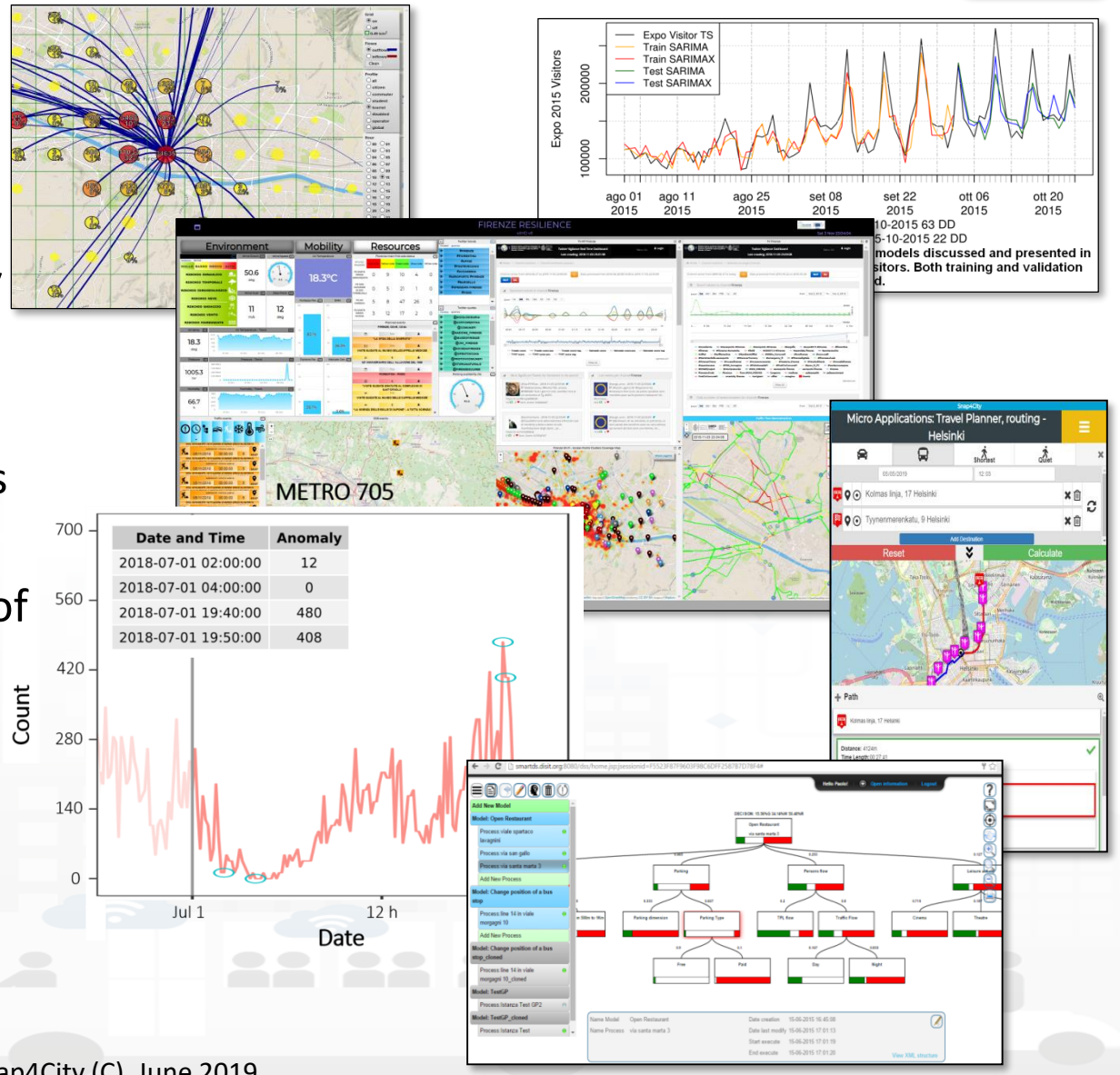


Decision Support, Act!

Smart City Control Room, SCCR, SCR

- Not only a collection of verticals

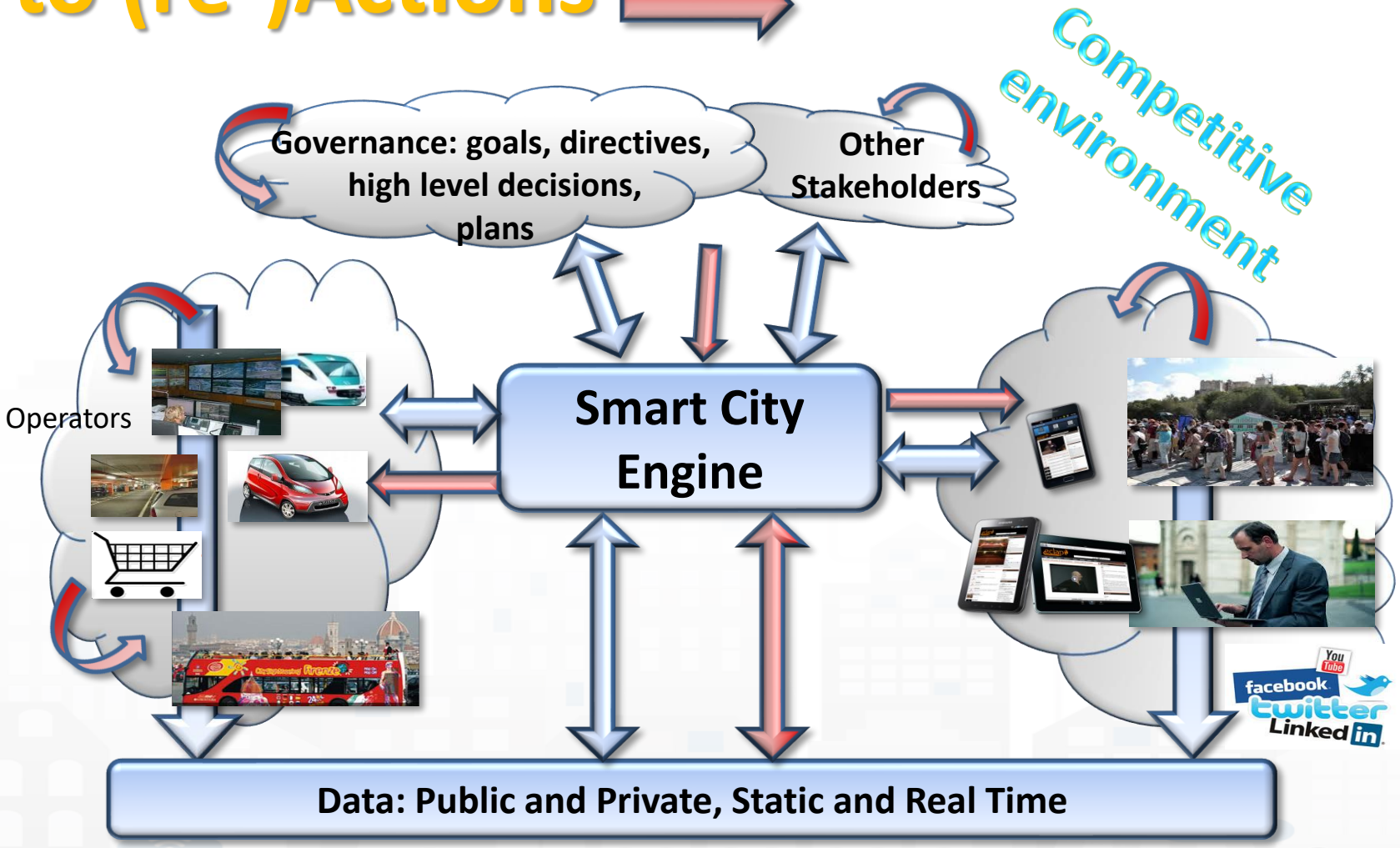
- **Exploiting analytics**: prediction, simulations, anomaly detection. ..
  - Big data approach to Data Analytics
- **Connecting Heterogeneous data** to defined strategies and alerting
- **Connected interactive dashboards** for different kind of decision makers: operators and majors
- **What-if Analysis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



From strategies to Actions

From Strategies to (re-)Actions

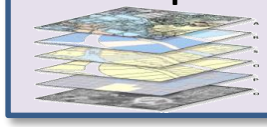
- Informing
- Suggesting
- Engaging
- Alerting, Early Warning
- Making Decision active
- New Plan



Open Data



GIS + Map Data



Proprietary Data



Personal Data



IoT/IoE



Industry 4.0



Social Media



Static, Quasi static and Real Time data flows

Data Processing Tools

Big Data Storage Knowledge Base

Smart City Cloud Infrastructure

Smart City API

Final Users' Tools



Dashboards

IOT / IOE Apps



Mobile and Web Apps



Living Lab, Development and Management Tools

Authentication, Authorization, GDPR, Security Assessment

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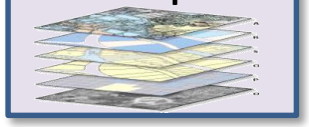
Open Data



GIS + Map Data



Proprietary Data



Personal Data



IoT/IoE



Industry 4.0



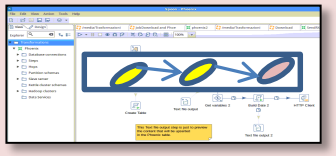
Social Media



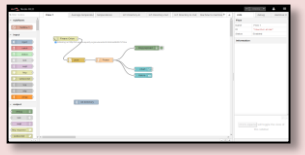
Static, Quasi static and Real Time data flows

Data Processing Tools

ETL Processes, Data Analytic, R; IOT App; etc.



ETL Processes

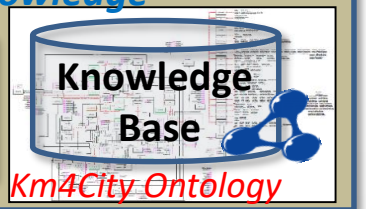


IoT/IoE Applications

Elastic Management of Containers

Big Data Storage Knowledge

Phoenix, Hbase + indexing



Km4City Ontology

Smart City Cloud Infrastructure

Smart City API

Final Users' Tools



Dashboards

IOT / IOE Apps

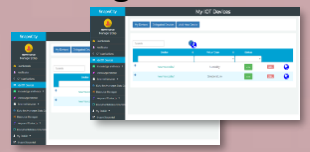


Mobile and Web Apps



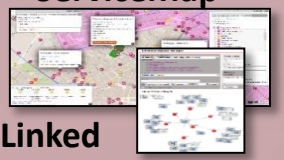
Living Lab, Development and Management Tools

Management



IOT Directory

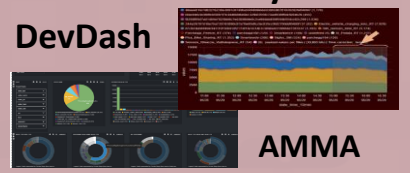
ServiceMap



Linked Open Graph

Data Flow Analysis

DevDash



AMMA

DataGate/ CKAN



Resource Manager

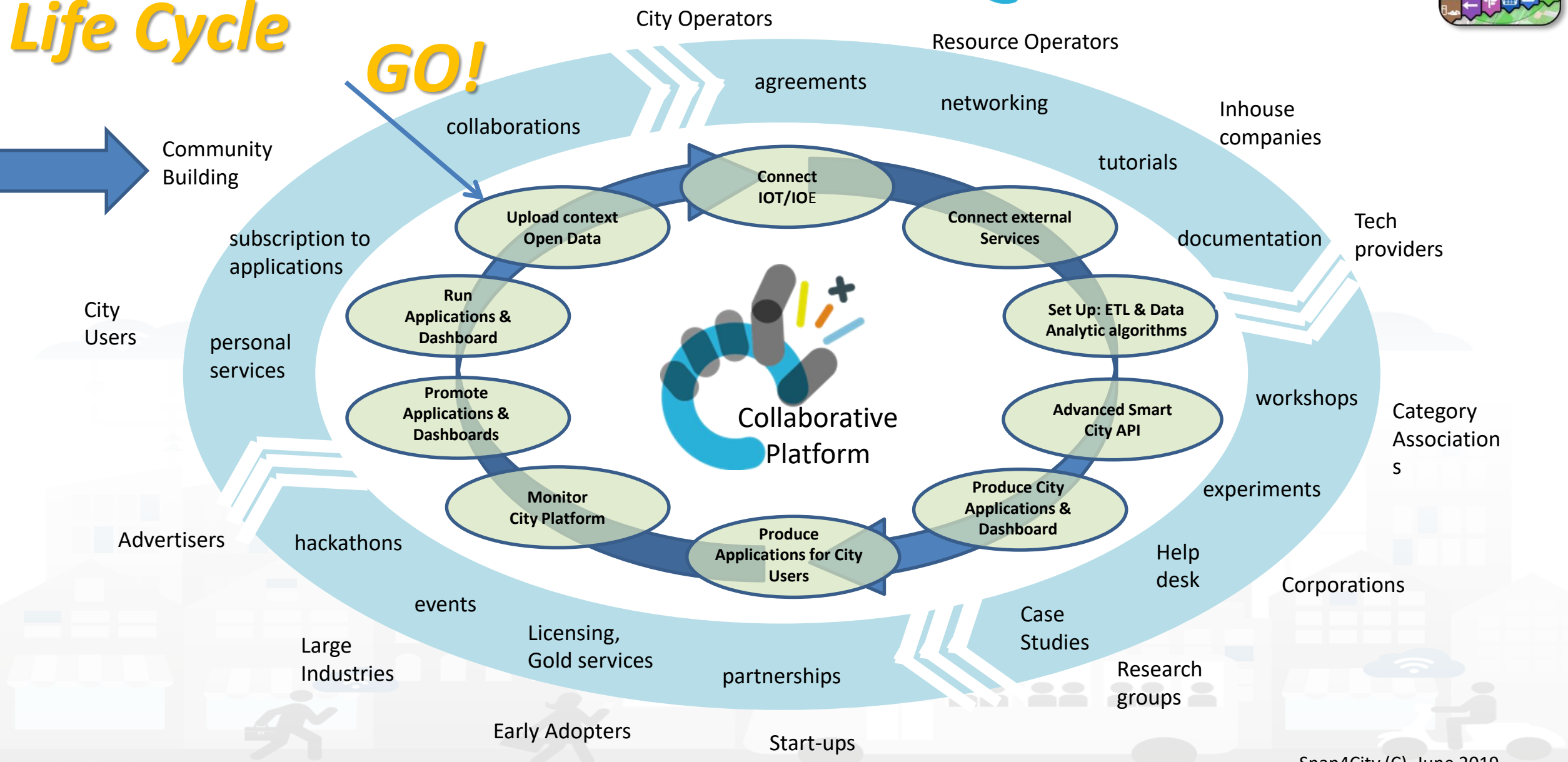
Authentication, Authorization, GDPR, Security Assessment

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**

Life Cycle


GO!
City Operators
Resource Operators
agreements
networking
Inhouse companies
tutorials
collaborations
Community Building
Connect IOT/IOE
Upload context Open Data
Connect external Services
documentation
Tech providers
subscription to applications
City Users
Run Applications & Dashboard
Set Up: ETL & Data Analytic algorithms
personal services
Promote Applications & Dashboards
Collaborative Platform
Advanced Smart City API
workshops
Category Associations
Monitor City Platform
Produce City Applications & Dashboard
experiments
Advertisers
hackathons
Produce Applications for City Users
Help desk
Corporations
events
Case Studies
Licensing, Gold services
Large Industries
partnerships
Research groups
Early Adopters
Start-ups

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

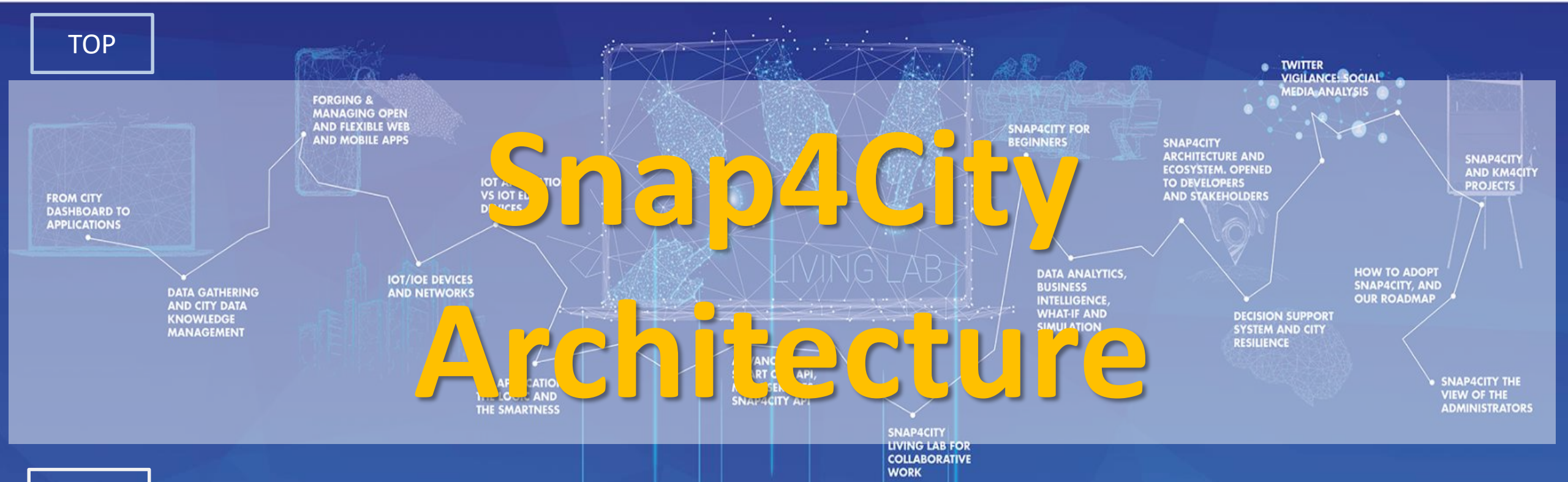
Benvenuto al nostro Sindaco ed al suo Team new roottooladmin1

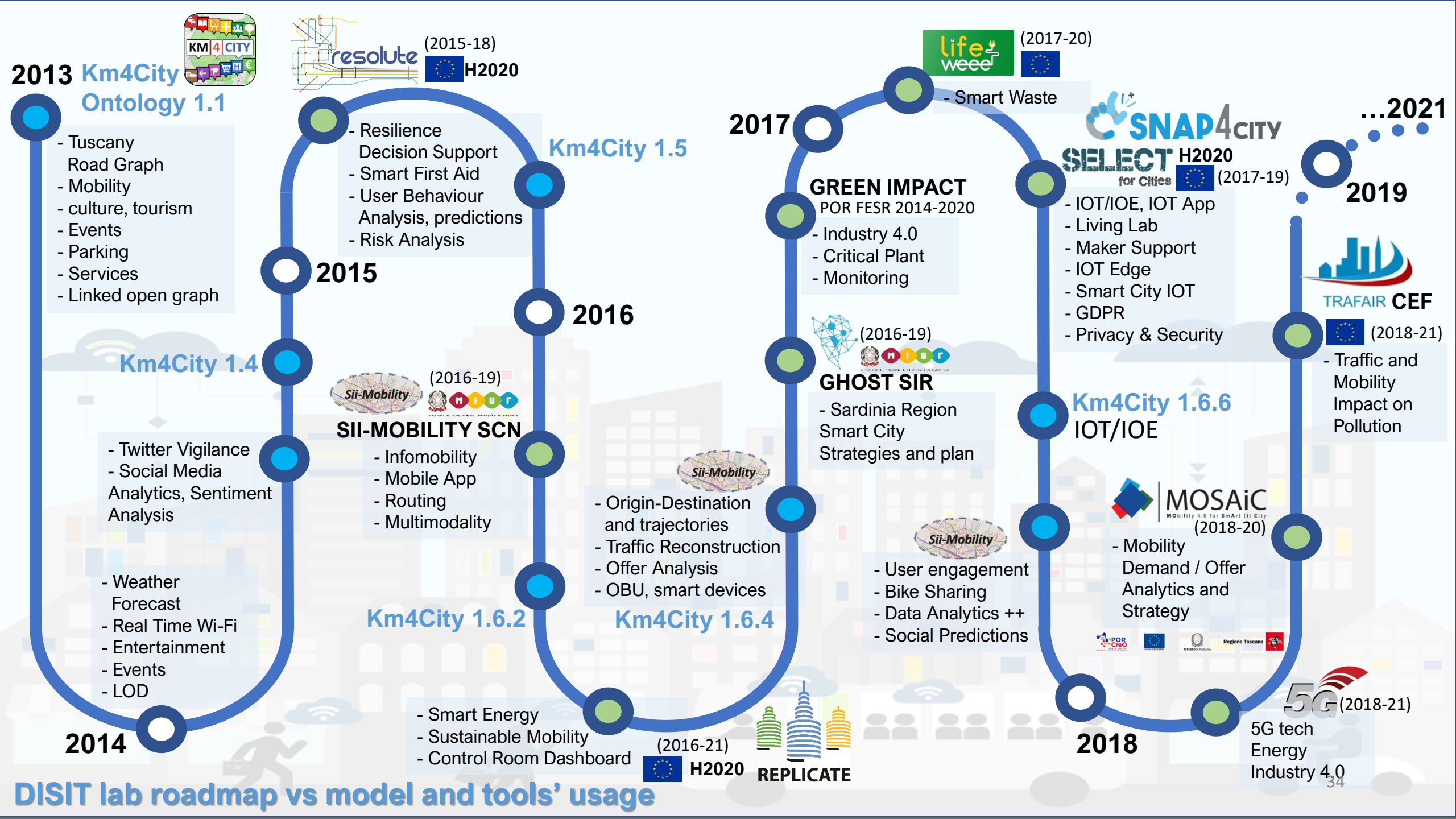
We sugges to Antwerp Developers: How to manange my Dashboards

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!

Snap4City Architecture





DISIT lab roadmap vs model and tools' usage

SNAP4CITY

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

Projects

SELECT for Cities · Sii-Mobility · REPLICATE · resolute · GHOST · TRAFAIR · 5G · MOSAiC · life weee · smartGARDAlake

Green Impact

Co-founding institutions on projects

EUROPEAN COMMISSION · MIUR MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA · POR CreO 2014 2020 REGIONE TOSCANA · UNIONE EUROPEA · REPUBBLICA ITALIANA · Regione Toscana

Qualified Partners

COMUNE DI FIRENZE · CITTÀ METROPOLITANA DI FIRENZE · comune di PRATO · REGIONE AUTÒNOMA DE SARDIGNA REGIONE AUTONOMA DELLA SARDEGNA · CITTA' METROPOLITANA DI CAGLIARI · COMUNE DI CAGLIARI · Comune di Castelnuovo del Garda

Technical Partnerships

Node-RED · JS Foundation · Powered by FIWARE · sigfox partner network · ckan · GJL · LABGEO · esri Italia THE SCIENCE OF WHERE

SNAP4CITY

KM4CITY

100% OPEN SOURCE URBAN PLATFORM: SMART CITY AND LIVING LAB

- 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

- OPEN HW/SW
- IOT EDGE
- IOT BUTTONS
- IOT DEVICES

IOT APPLICATIONS • INSTANT APPS



PERSONAL DATA • DATA DRIVEN • REAL TIME - ANY PROTOCOL & FORMAT

DASHBOARDS & APPLICATIONS



CONTROL ROOM • KPI • BUSINESS INTELLIGENCE • DECISION SUPPORT • WHAT-IF ANALYSIS

MOBILE & WEB APPLICATIONS



DEV KIT • SUGGESTIONS • USER ENGAGEMENT • COWORKING • 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 ANALYTICS



SMART SOLUTIONS • PREDICTIONS • ANOMALY DETECTION • TRAFFIC RECONSTRUCTION • ORIGIN-DESTINATION MATRIX • SOCIAL MEDIA ANALYSIS • OFFER & DEMAND ANALYSIS • RISK & RESILIENCE ANALYSIS

SMART MICRO-APPLICATIONS – OPEN TO EXTERNAL SERVICES



SMART PARKING • ROUTING • PERSONAL ASSISTANT • INFOMOBILITY • ALERTING • INFO TRIAGE

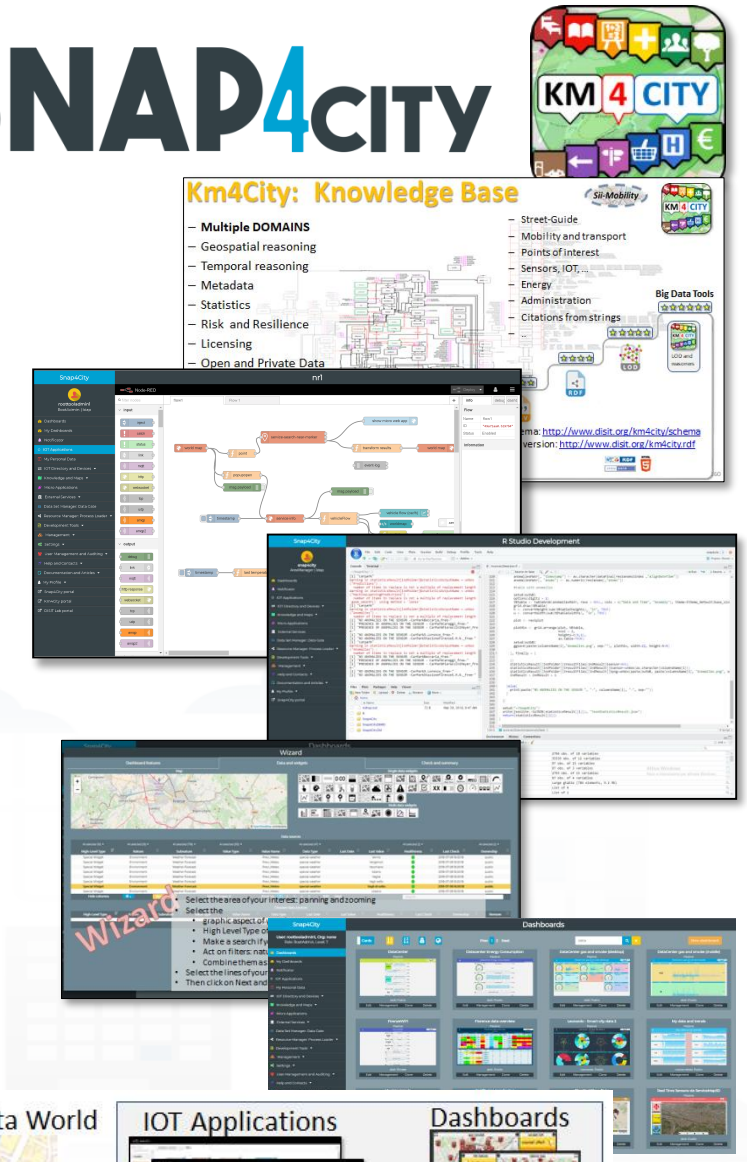
KM4CITY DATA AGGREGATOR, KNOWLEDGE BASE OF THE CITY

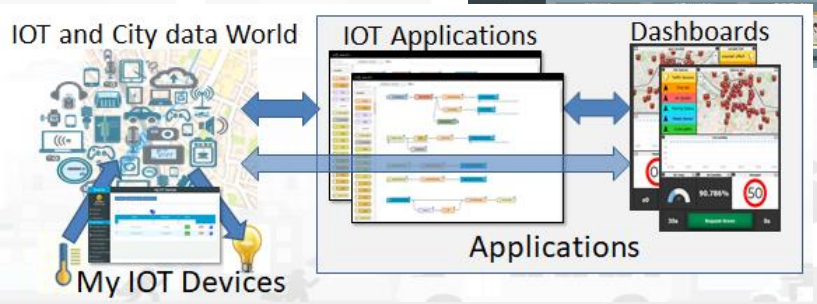
OPEN DATA | GIS+MAP DATA | PROPRIETARY DATA | PERSONAL DATA | IOT / IOE | INDUSTRY 4.0 | SOCIAL MEDIA



Unique of Snap4City Platform (1)

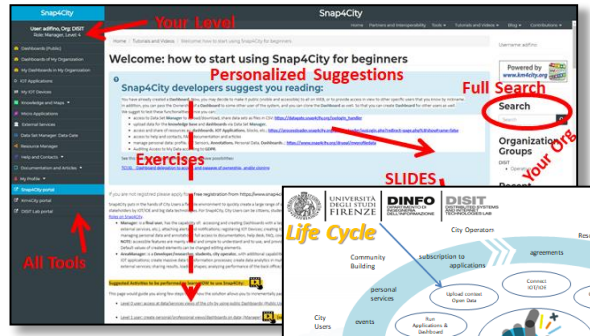
- Data ingestion and model
  - **Unified data model** (exploited in the Wizard and Knowledge base)
  - **Semantic Reasoner** modelling city entities, supporting sematic search, expert system, digital Twin, etc.
  - **IOT Directory abstracting complexity of IOT Devices, Edge, Brokers**, protocols and 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
  - **Ready to use Mobile App, instant App, MicroApplication**
  - **Strategies** formalization supports

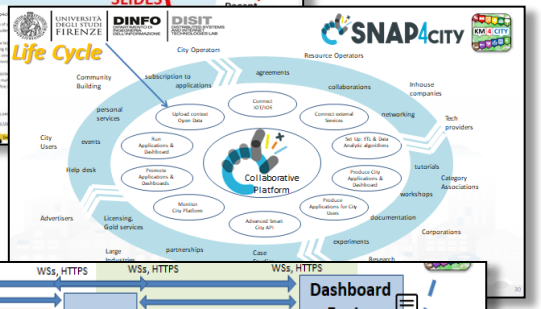


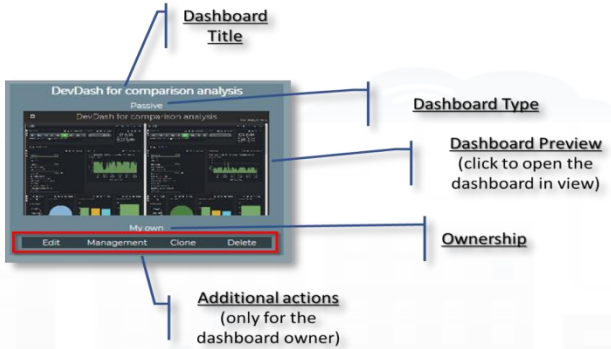


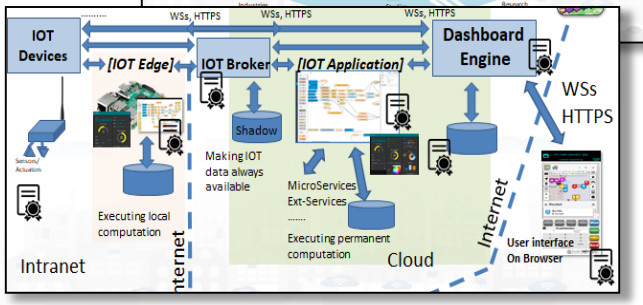
Unique of Snap4City Platform (2)

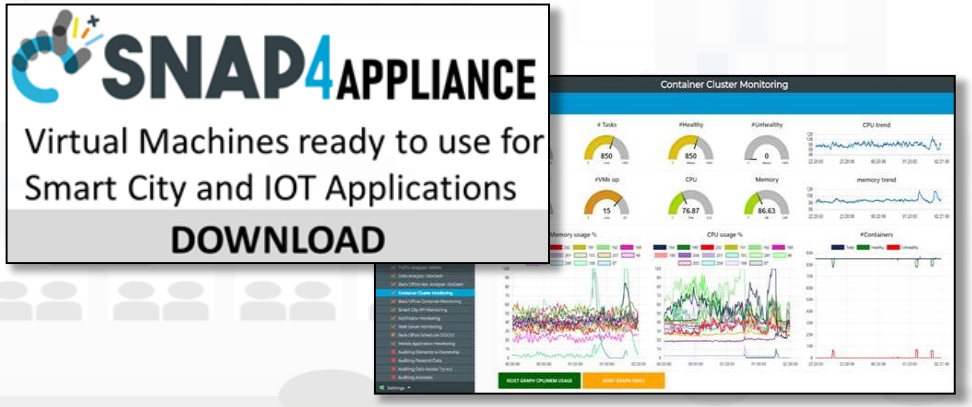
- Openness to any developers
  - **Living Lab support for coworking, sharing, and delegating**
  - **Advanced Smart City APIs and MicroServices**
  - **100% Open Source, Open hardware**
- Security and Privacy
  - **End-2-end encrypted communication**, on devices, platform, ... dashboards
  - **GDPR compliant** 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**











LOGIN

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



Home / Snap4City - scalable Smart aNalytic APplication builder for sentient Cities

Snap4City - scalable Smart aNalytic APplication builder for sentient Cities

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









Snap4City improves city services, security and safety by offering a sustainable solution for smart city and **Living Lab**, thus attracting industries and stakeholders. Snap4City is capable to keep under control the real time city evolution: reading sensors; computing and controlling key performance indicators, KPI; detecting unexpected evolutions; performing analytics; taking actions on strategies and alarms. Snap4City supports the city in the process of continuous innovation on services, infrastructures, with control and supervision, tools for business intelligence, predictions, anomaly detection, early warning, risk assessment, whatif analysis, also setting up strategies for increasing city resilience with respect to unexpected unknown events. Thanks to knowledge base support, Snap4City provides flexible solutions to get immediate insights and deductions of the city status and evolution, exploiting ultimate artificial intelligence, data analytics and big data technologies, activating sentient solutions collecting, and exploiting heterogeneous data of any kind, from any data source (open and private; static, real time, event driven, streams, certified and personal). Please perform a free registration. if you are interested on testing by selecting "DISIT" as preferred organization, on which you can find a large number of data accessible. Snap4City provides services and data of several cities/Organizations as: Firenze, Helsinki, Antwerp, Pisa, Prato, Pistoia, Lucca, Arezzo, Grosseto, Livorno, Siena, Massa, Modena, Cagliari, Venezia, etc.; and from regions as Tuscany, Garda Lake, Sardegna, Belgium, Finland, Emilia Romagna, etc. Snap4City is open to your contributions, using Snap4City tools and contributing in improving them, adding more tools and features, etc. Please join the community on this portal and on

Login

Registration

- New Registration
- Request a new password



Managed by DISIT Lab

Powered by www.km4city.org

Virtual Assistant

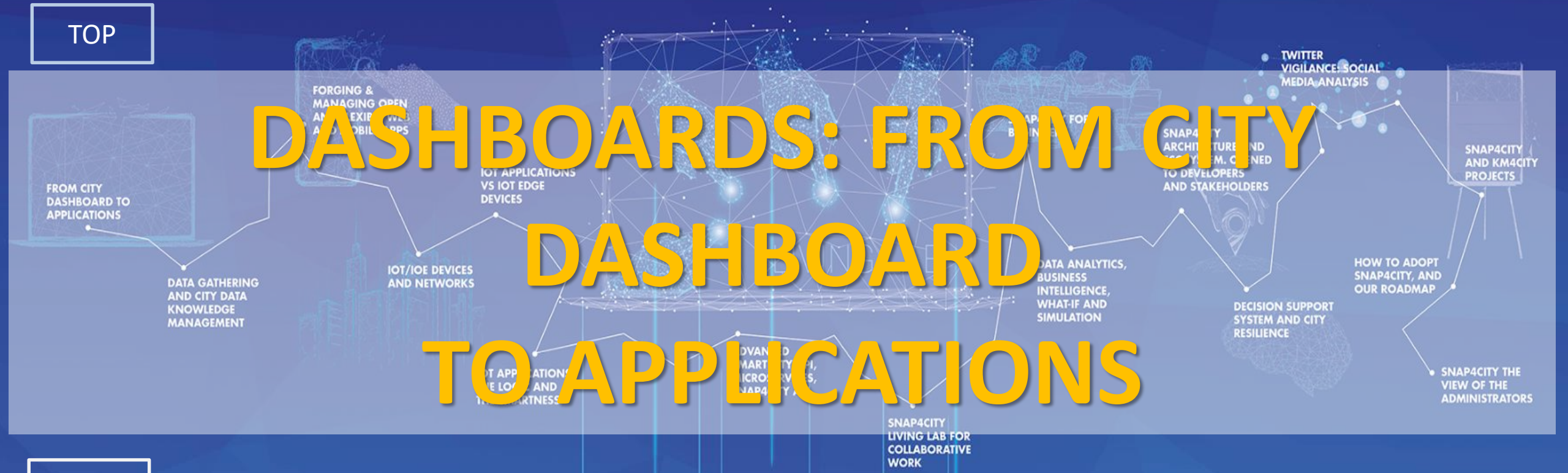
Search

Search

-Any-

TOP

DASHBOARDS: FROM CITY DASHBOARD TO APPLICATIONS



ARC
INDEX

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB http://www.disit.org

https://www.snap4City.org

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

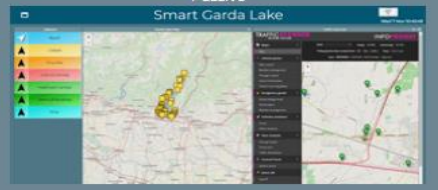

Public (DISIT)

Smart City Data Overview
Passive


Public (DISIT)

Smart City Data Overview 2
Passive


Public (DISIT)

Smart Garda Lake
Passive


Public (DISIT)

SmartCity processes
Passive

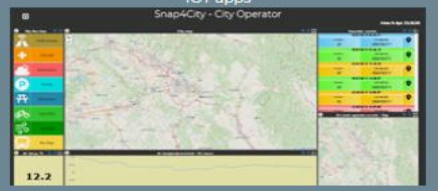

Public (DISIT)

Snap4City - App dashboard
IOT apps

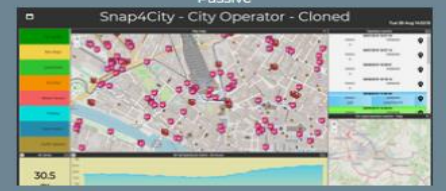

Public (DISIT)

Snap4City - Buttons with images
Passive


Public (DISIT)

Snap4City - City Operator
IOT apps


Public (DISIT)

Snap4City - City Operator - Cloned
Passive


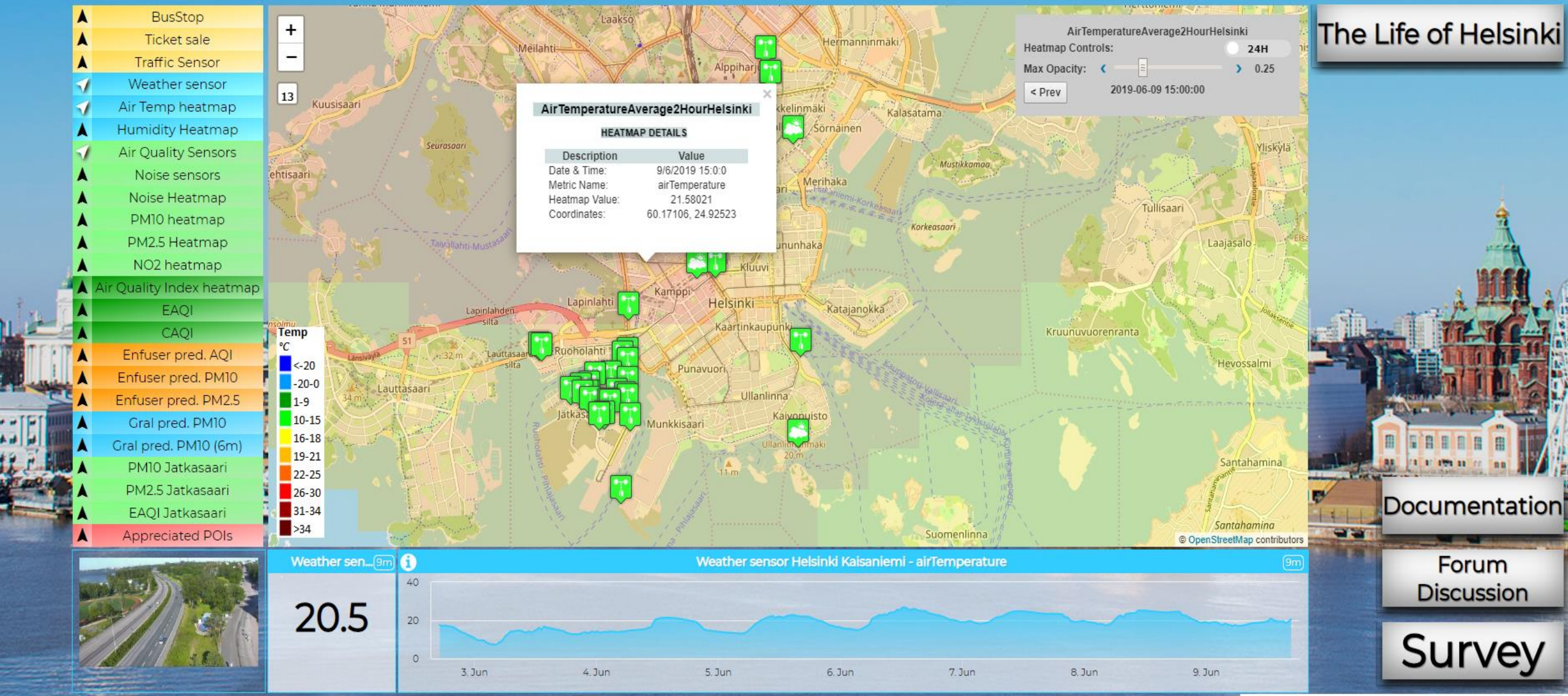
Public (DISIT)


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
Concentration - 7 days
Main

Helsinki City Overview (H5a)

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

Sun 9 Jun 17:07:25



The Life of Helsinki

Documentation

Forum Discussion

Survey

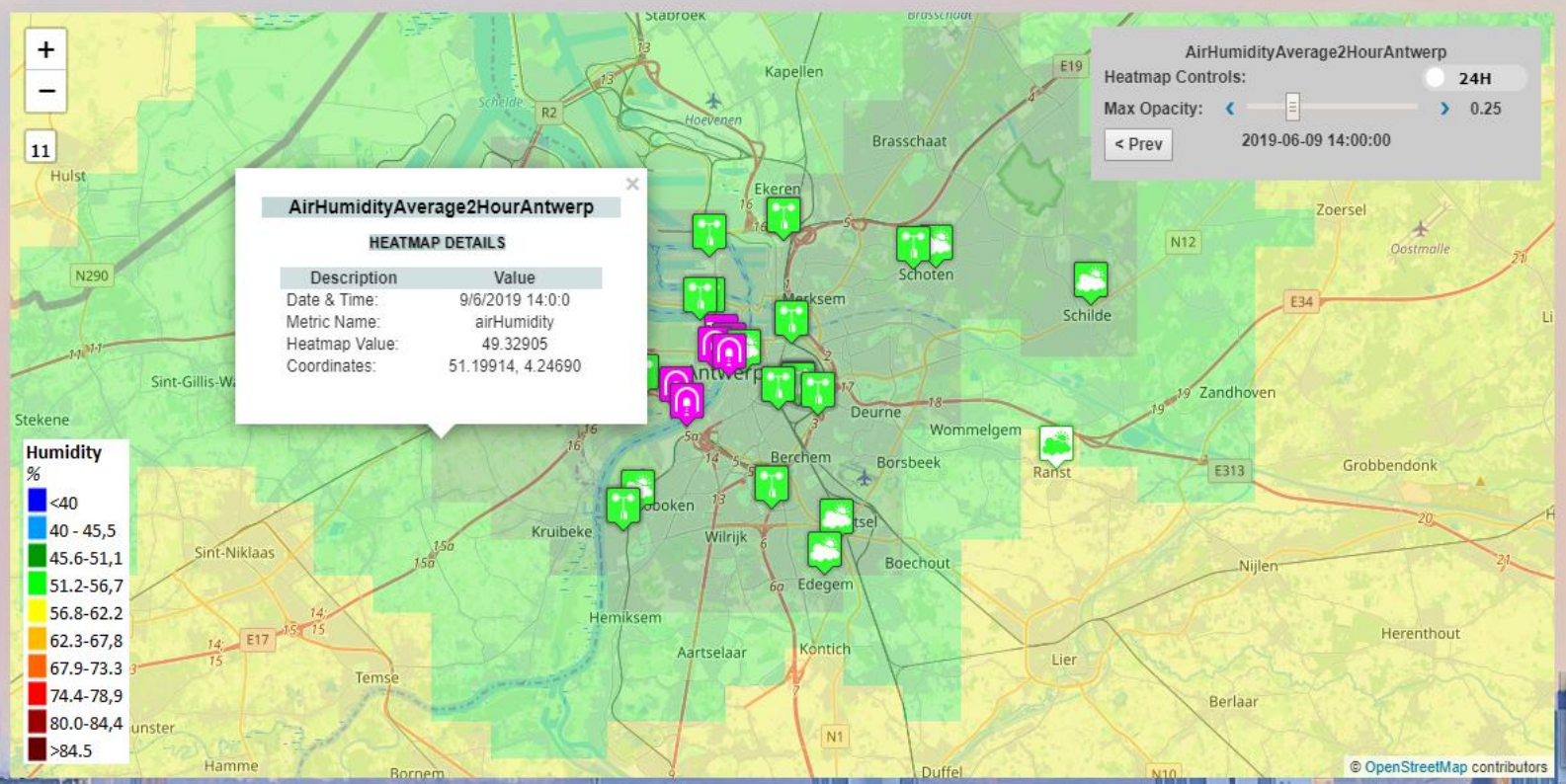
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

Antwerp City Overview - A5

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

Sun 9 Jun 17:09:04

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



Weather sensor Zwijndr... 9m

19.4



Documentation

Survey

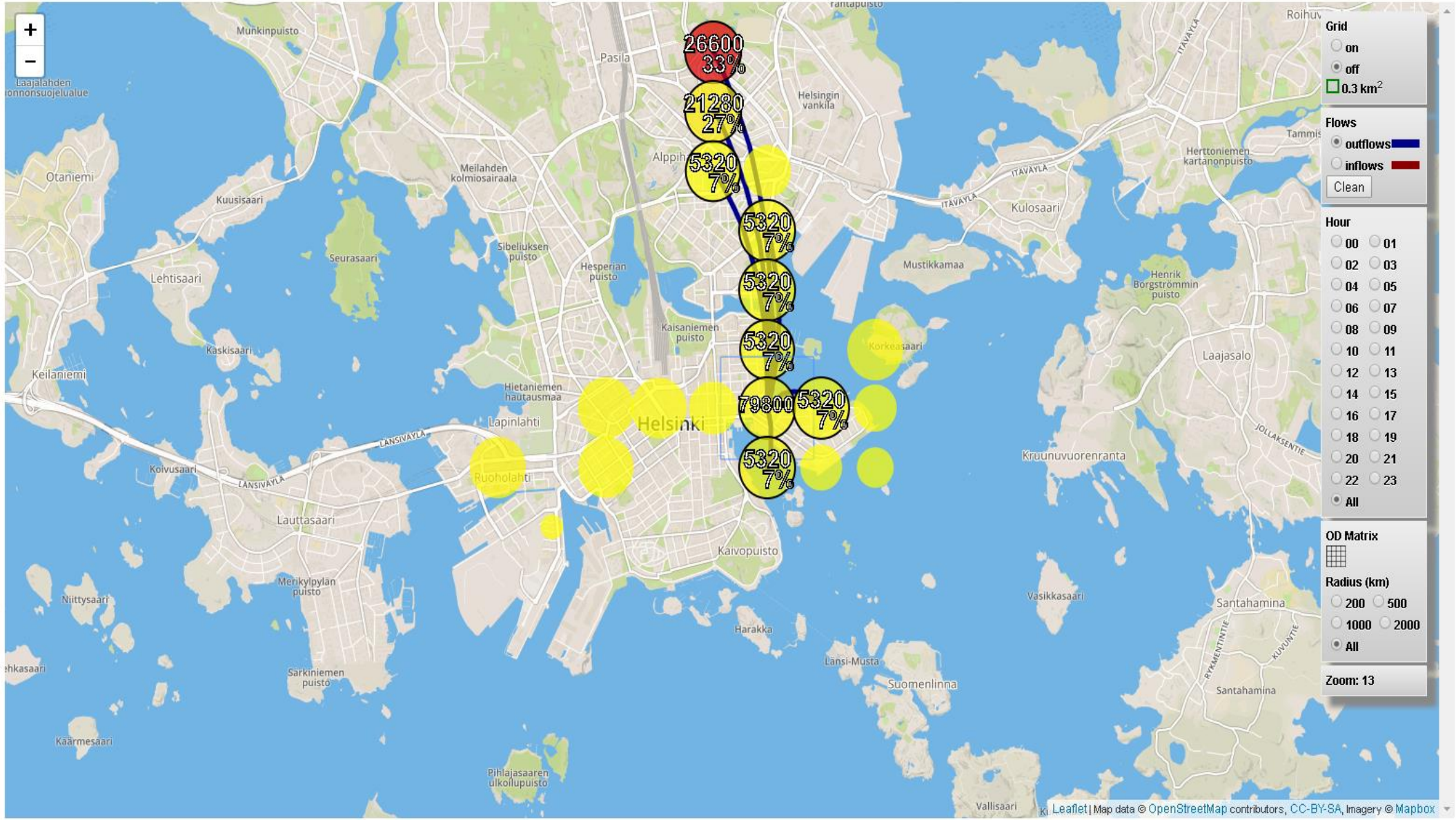
Forum Discussion

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

Helsinki White Dashboard

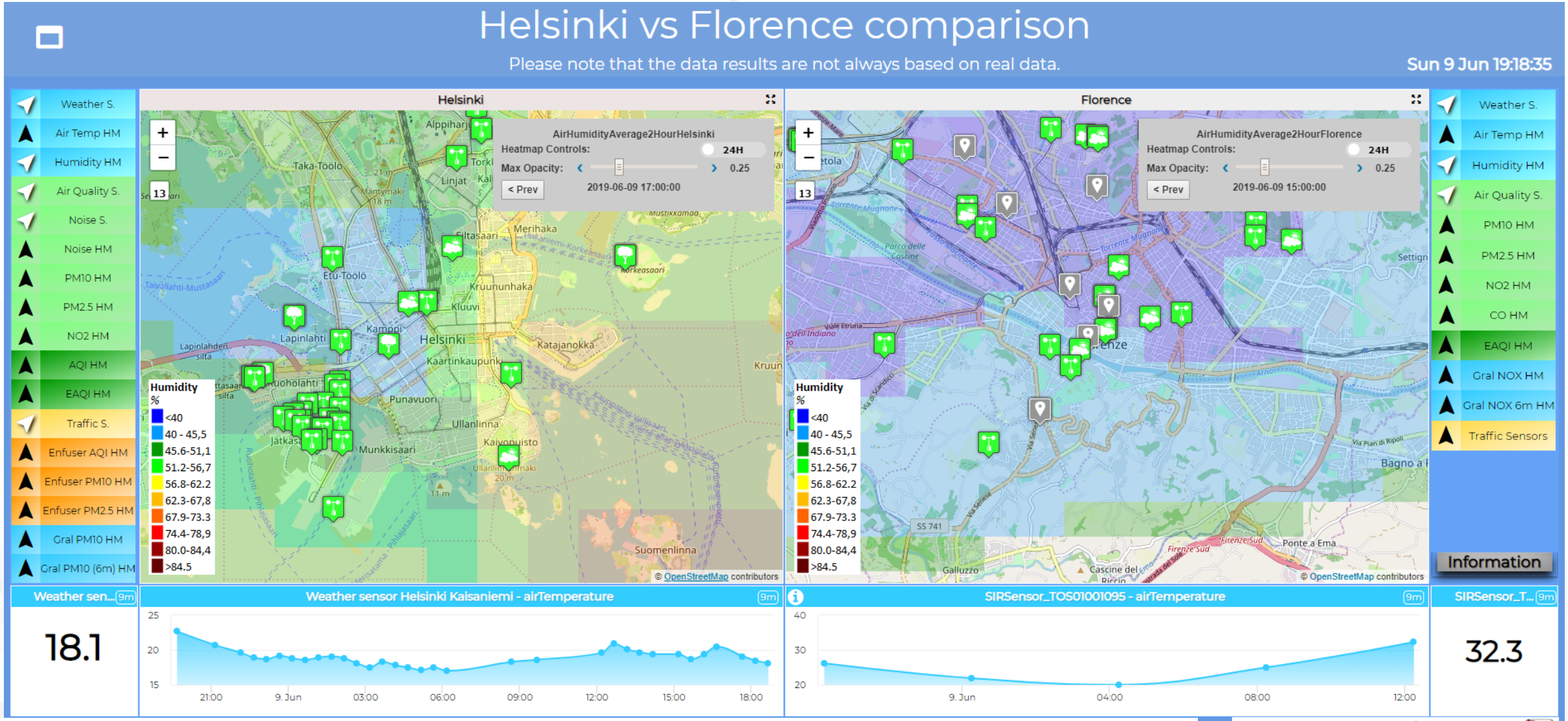
Please note that the data results are not always based on real data.

Thu 13 Jun 23:37:56



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

Helsinki vs Florence comparison



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

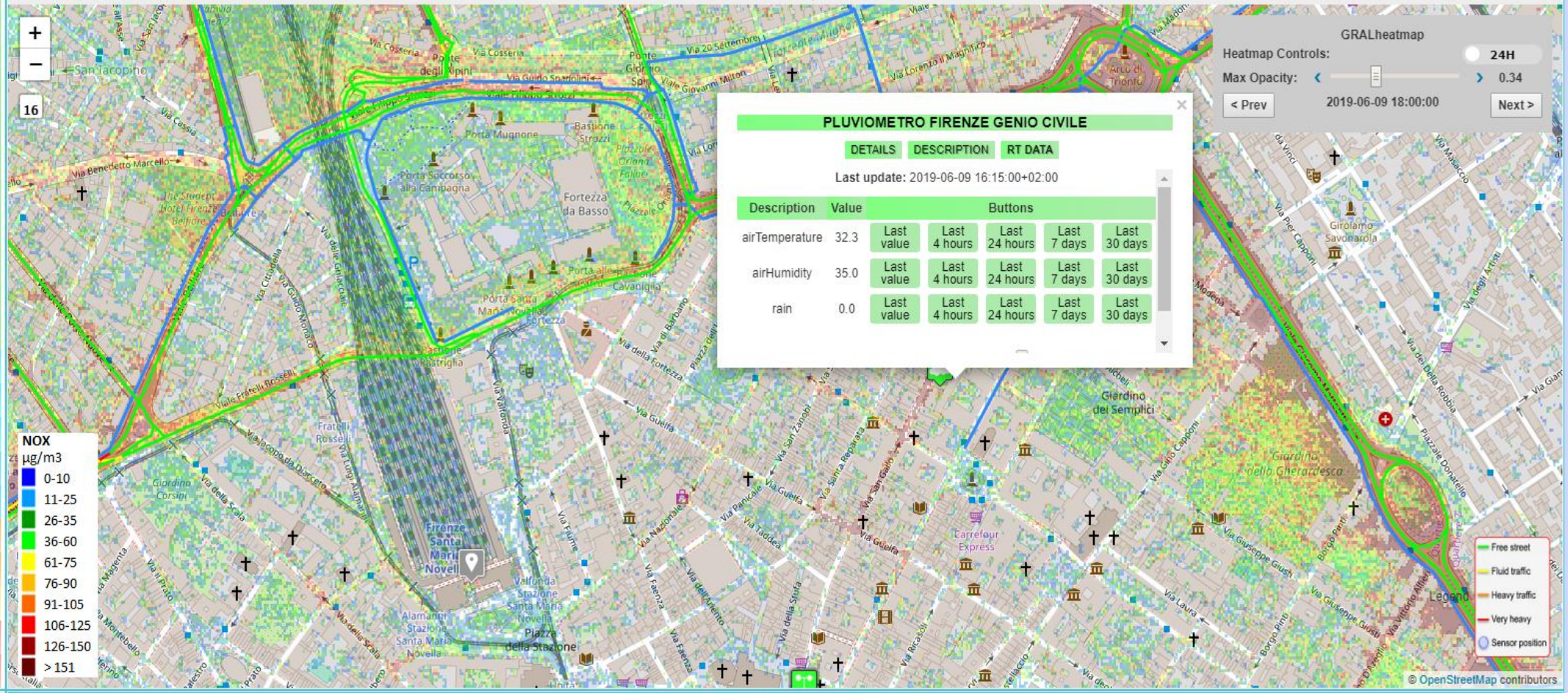
Firenze - Trafair - AirQuality Heatmaps

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

Sun 9 Jun 18:53:01

- Air Quality Sensors
- Weather 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



Air Temperature Bolognese 8m



SIRSensor_TOS01001095 - airTemperature 8m



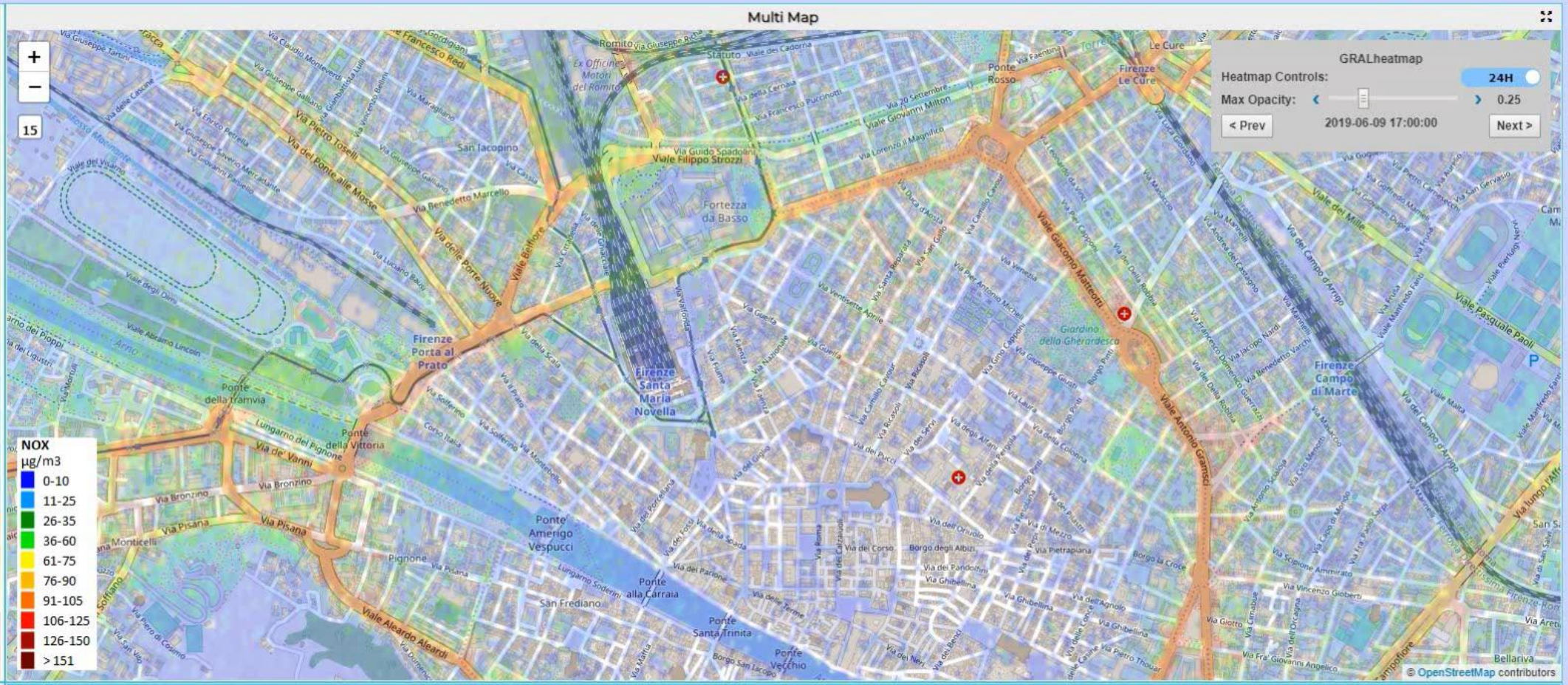
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTUzMg==

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



Air Temperature Bolognese 7m



SIRSensor_TOS01001095 - airTemperature 7m





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/

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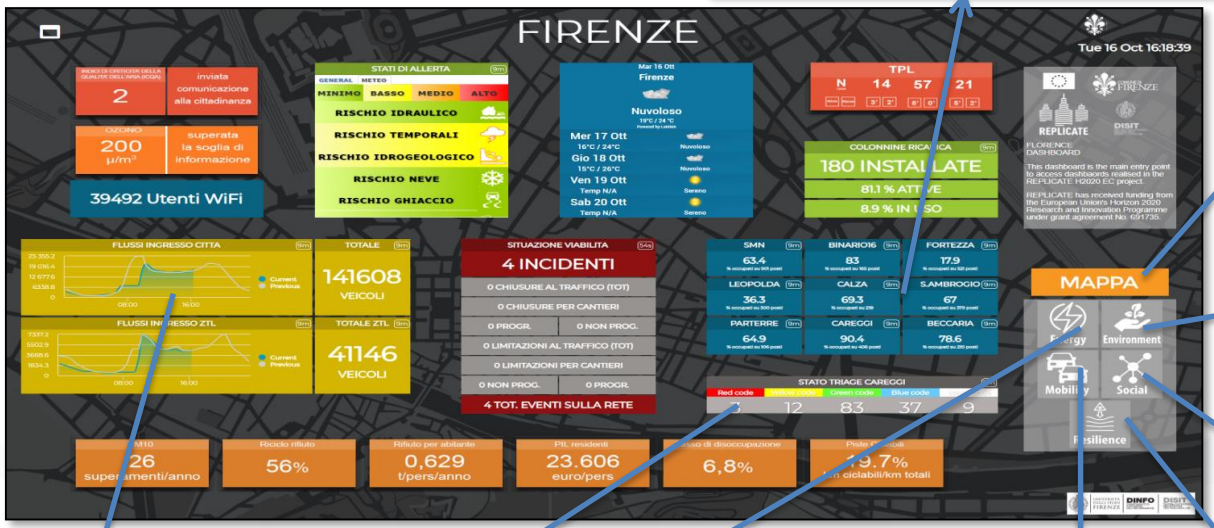
REPLICATE

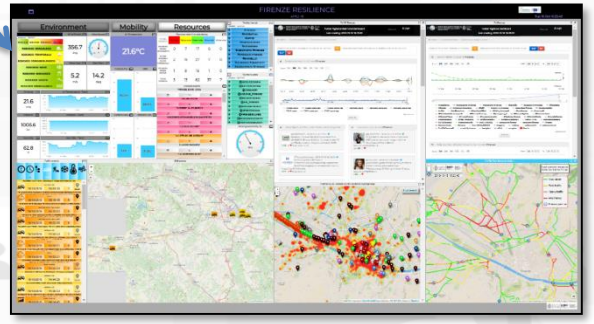


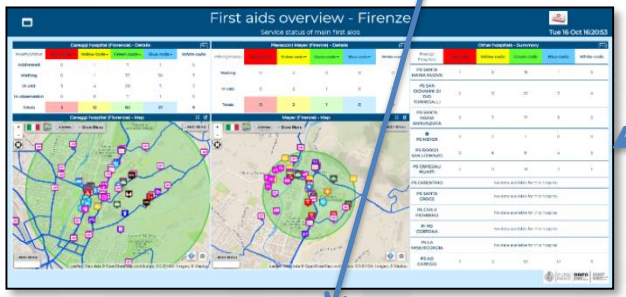


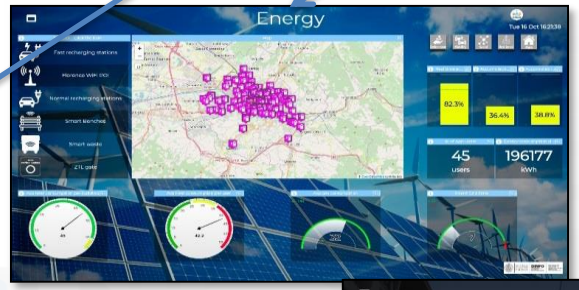


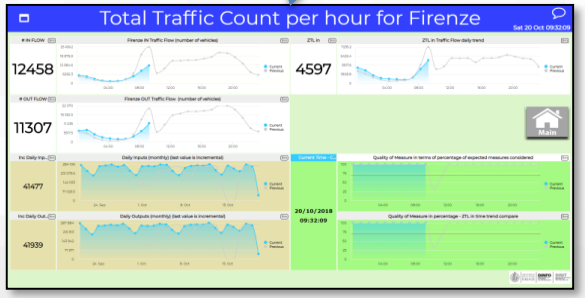










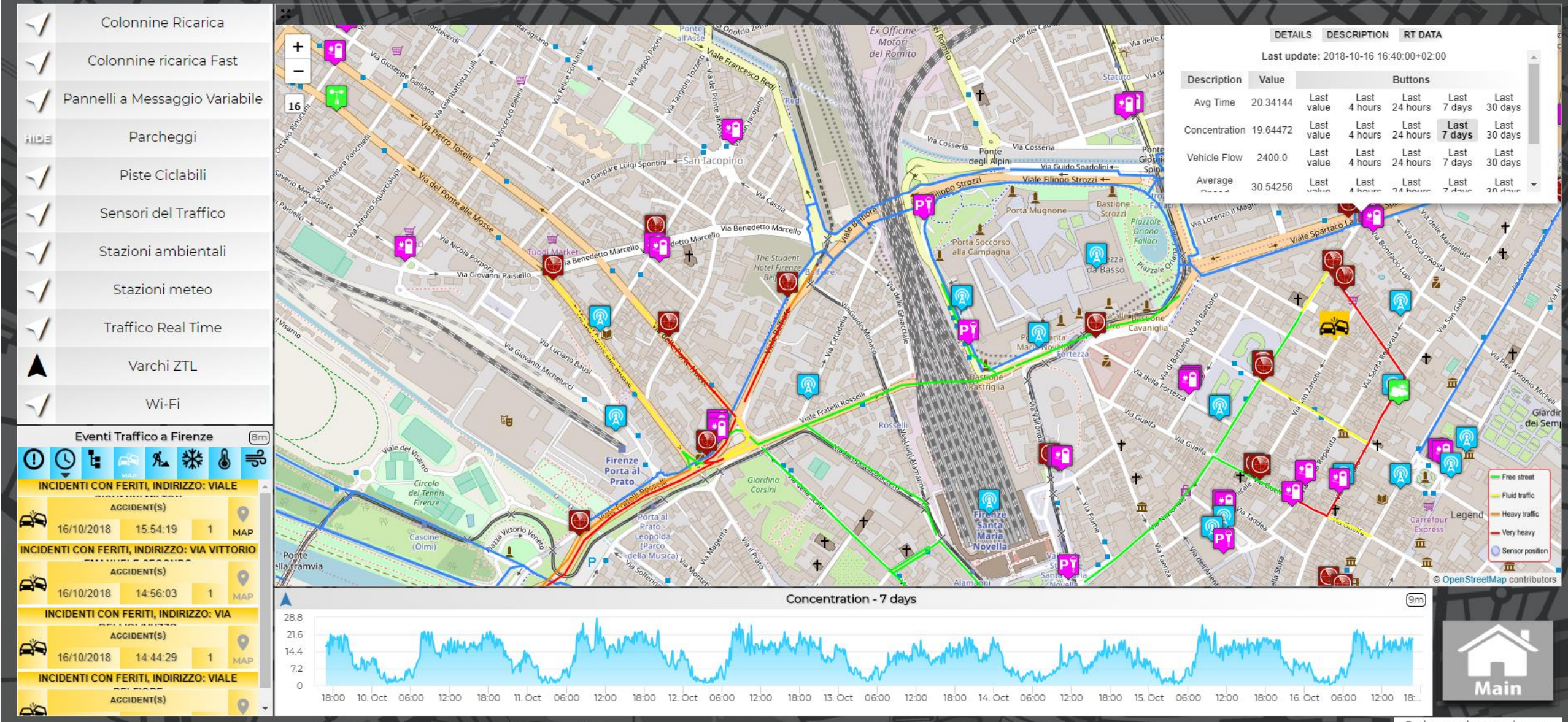




MAPPA FIRENZE

REPLICATE

Tue 16 Oct 16:46:17



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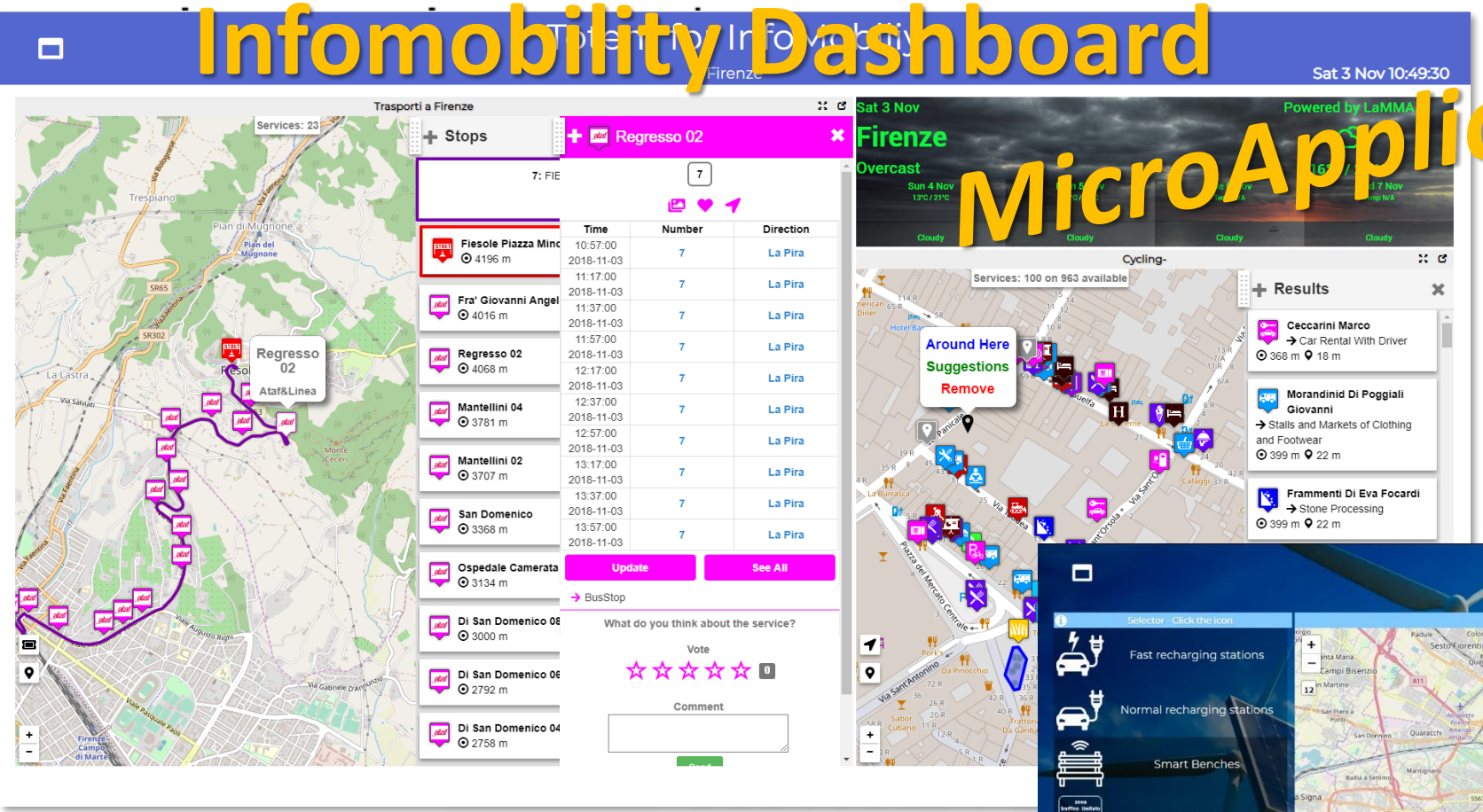
Infomobility Dashboard

MicroApplications



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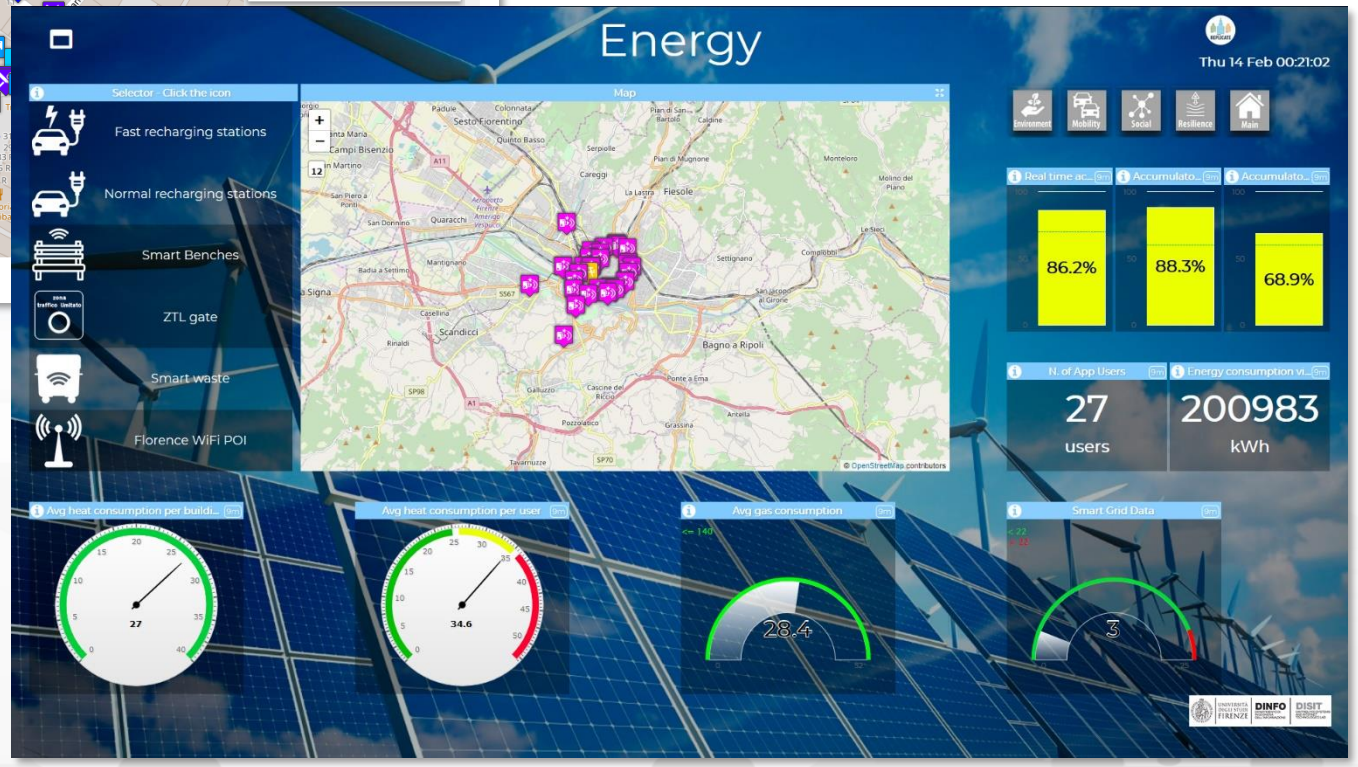


https://main.snap4city.org/view/index.php?iddasboard=MjE0

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

Real Time Sensors via ServiceMap3D

3D data rendering

Sat 1 Dec 16:57:33

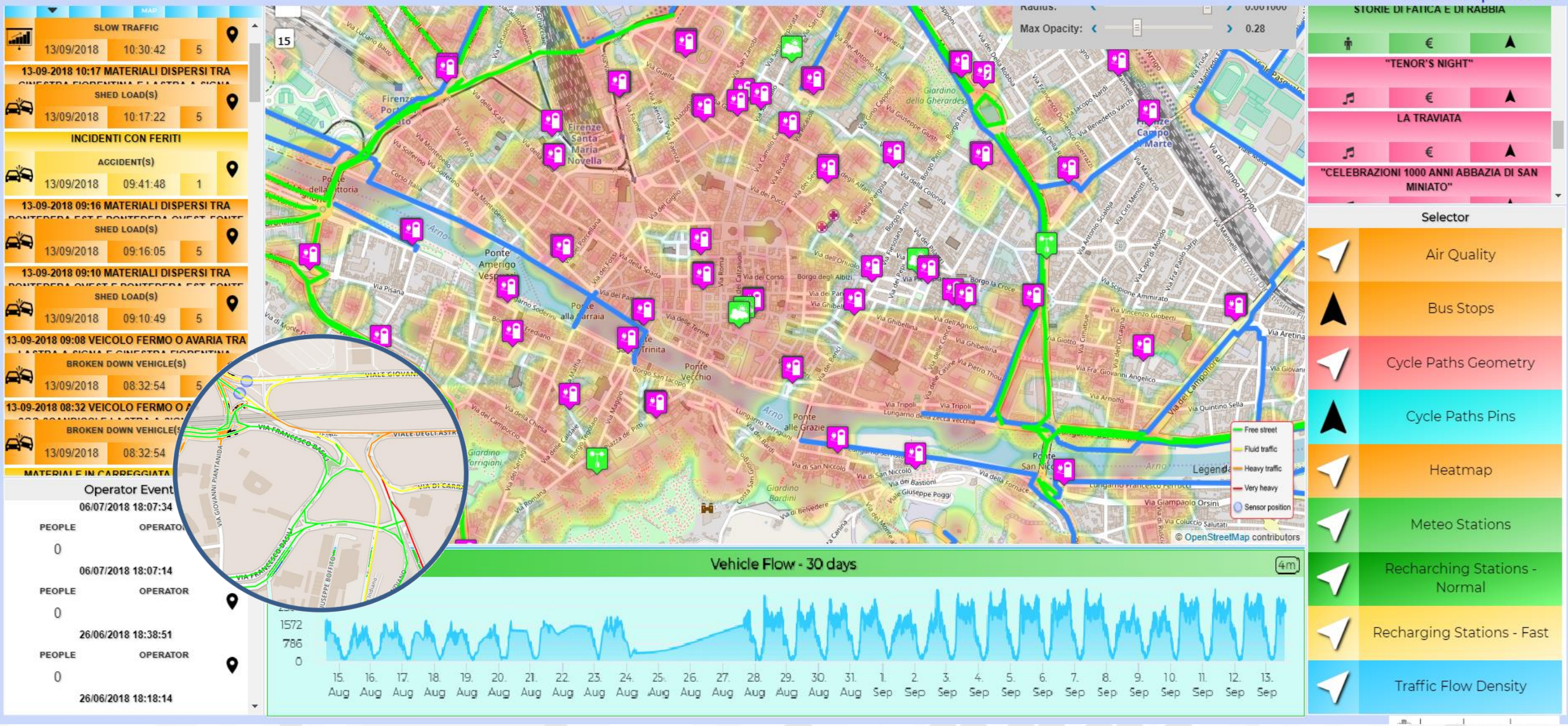
Firenze

Airport

Empoli



Multi-Widget Map



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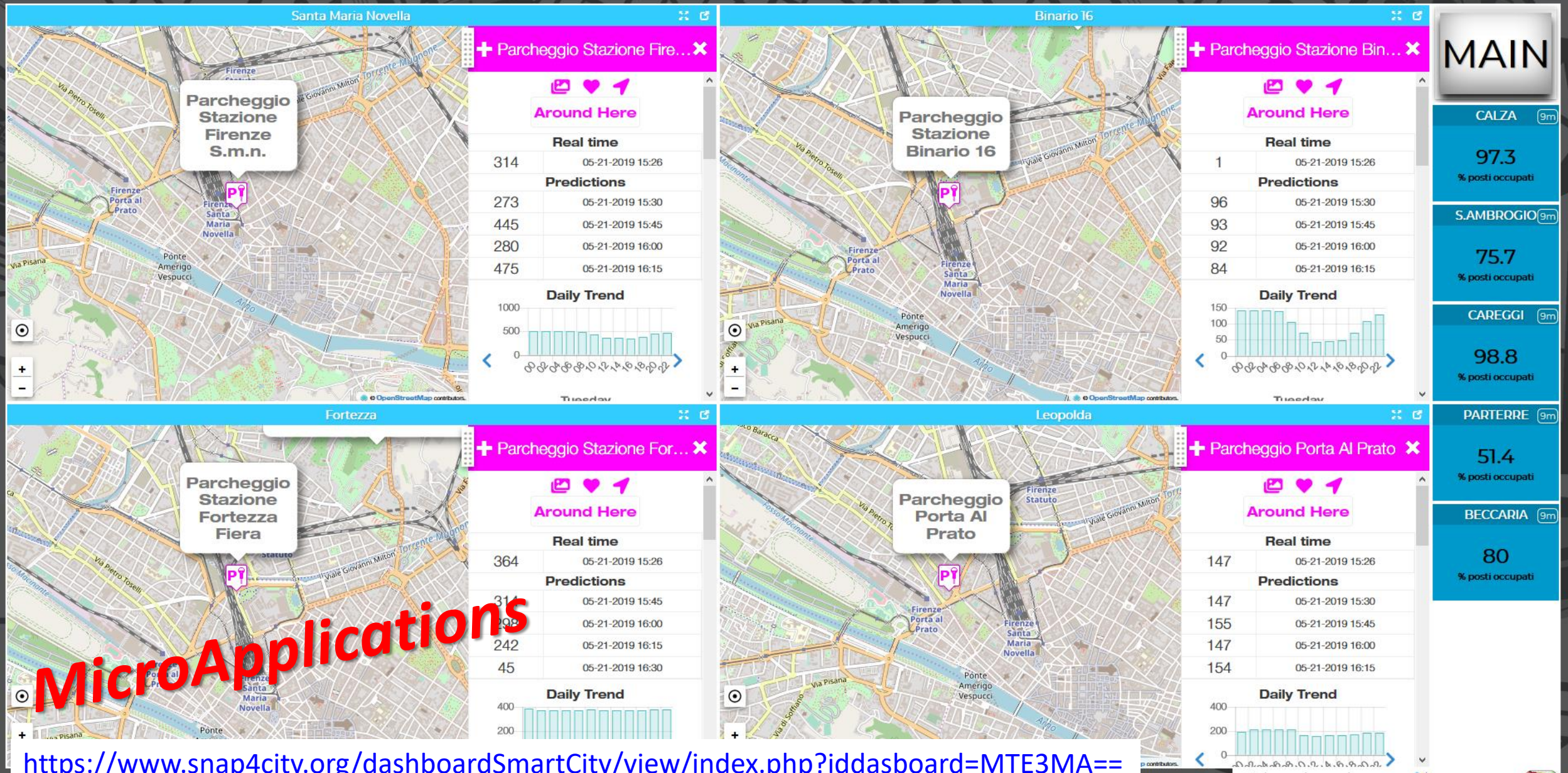
Parking Monitoring Firenze

Tue 21 May 15:23:09



MicroApplications

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

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

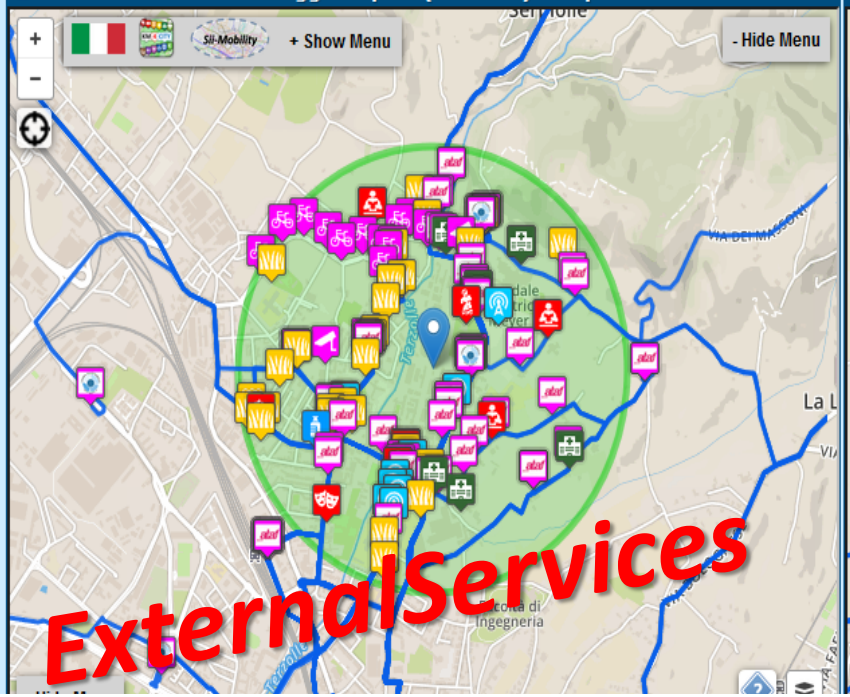
Santa Chiara hospital (Pisa) - Details 9m

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

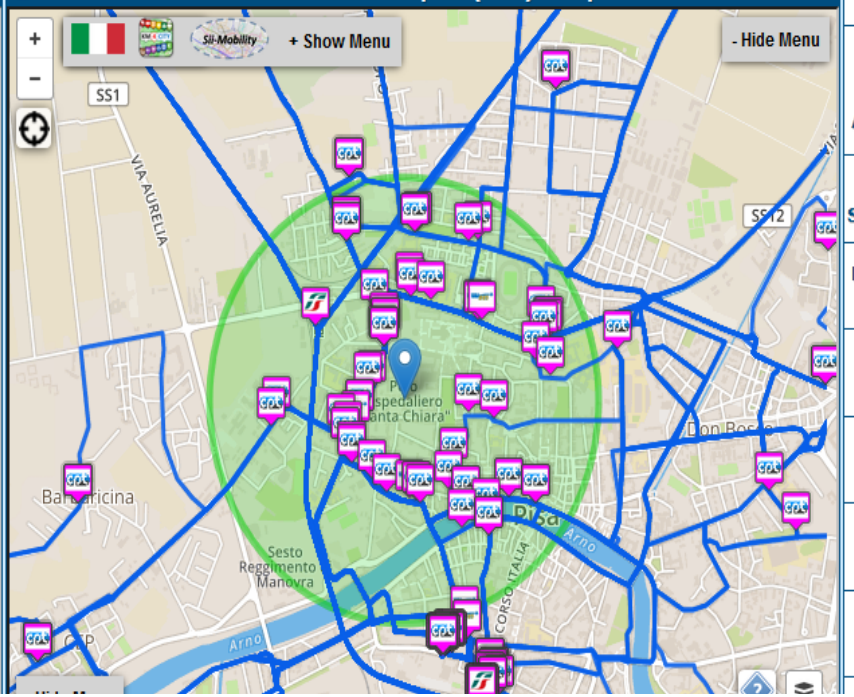
Other hospitals - Summary 9m

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



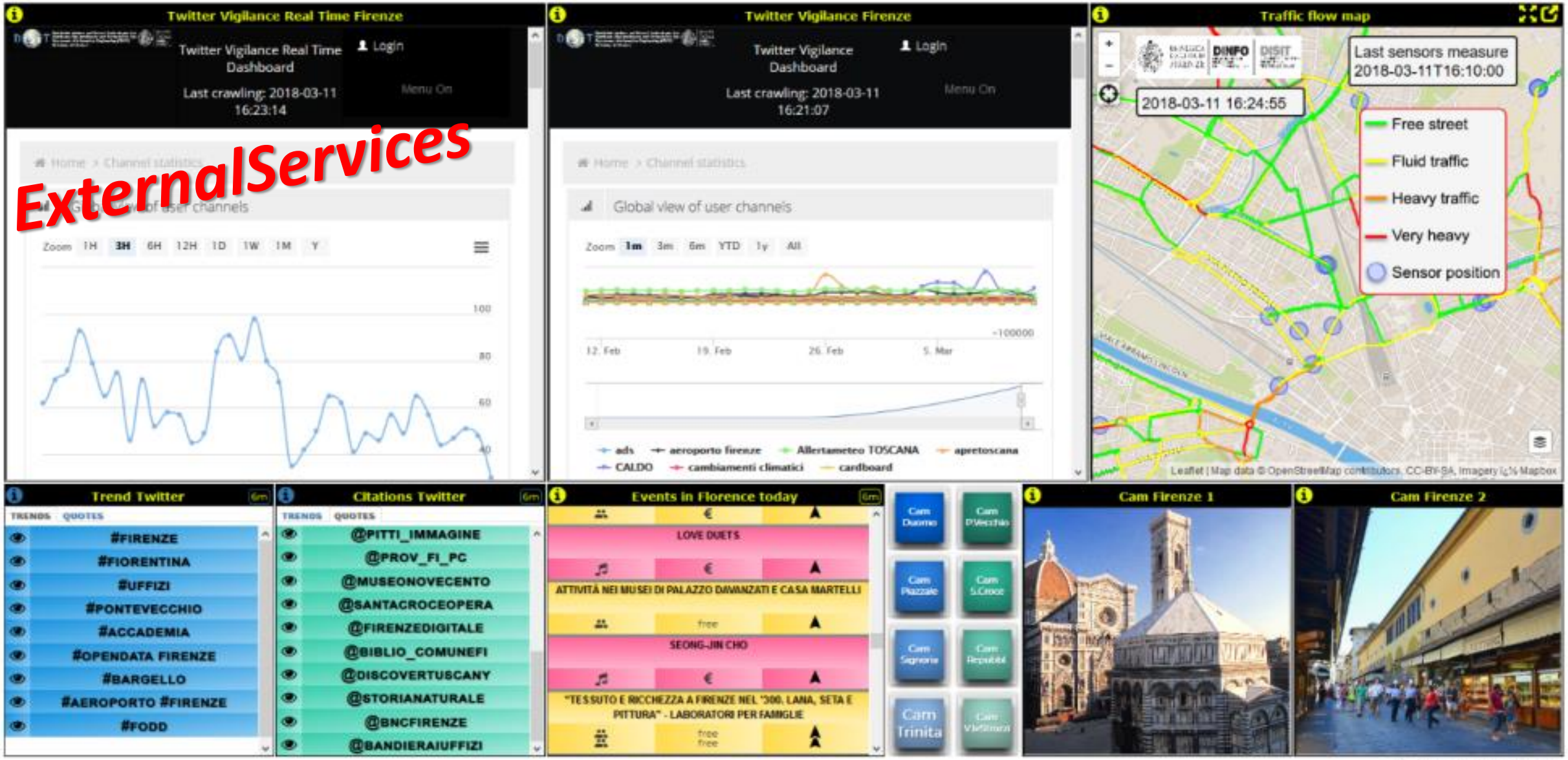


https://main.snap4city.org/view/index.php?iddasboard=MTIy

Firenze Social and Social Media new

Demo cams

Sun 11 Mar 16:24:55



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

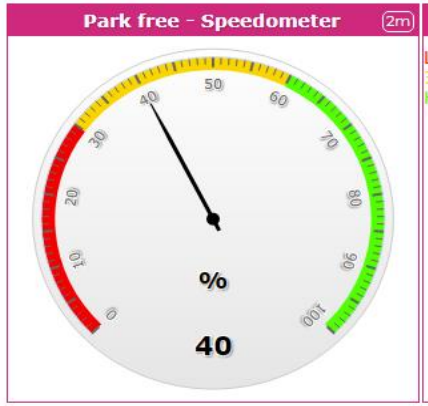
Cross widget interaction 2

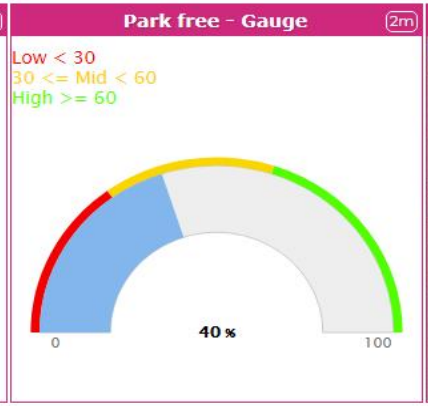
E Experimental

Mon 15 Jan 15:16:37

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

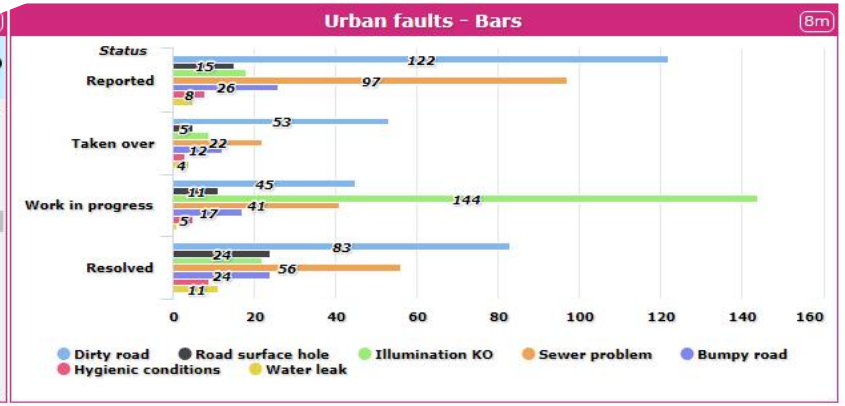




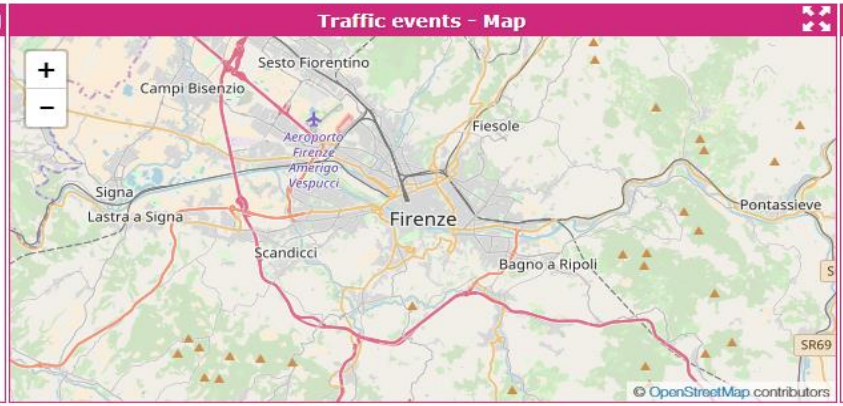


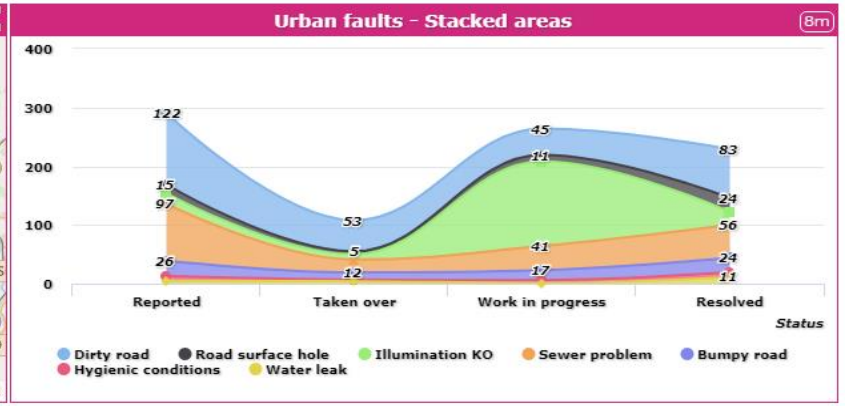












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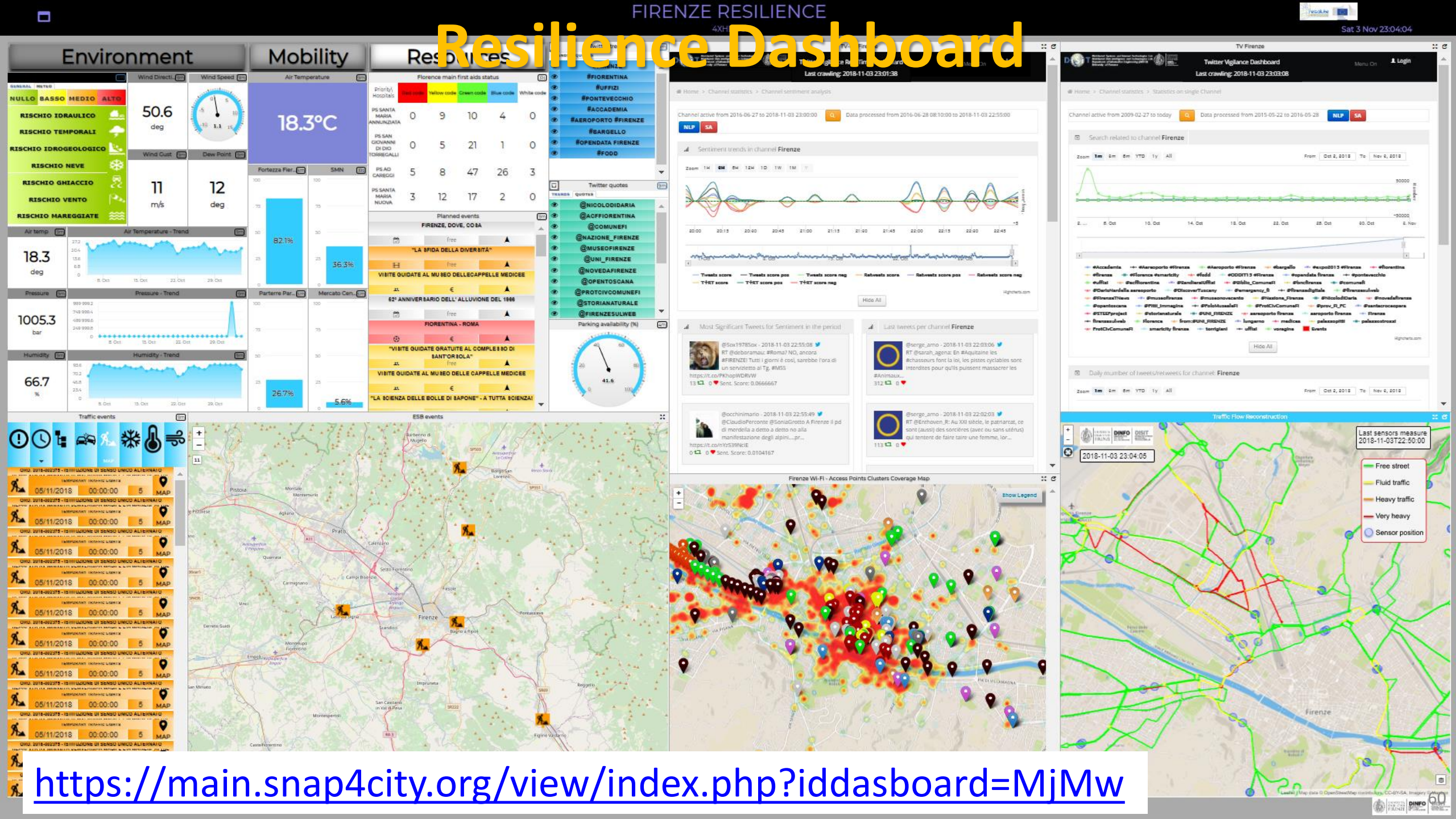
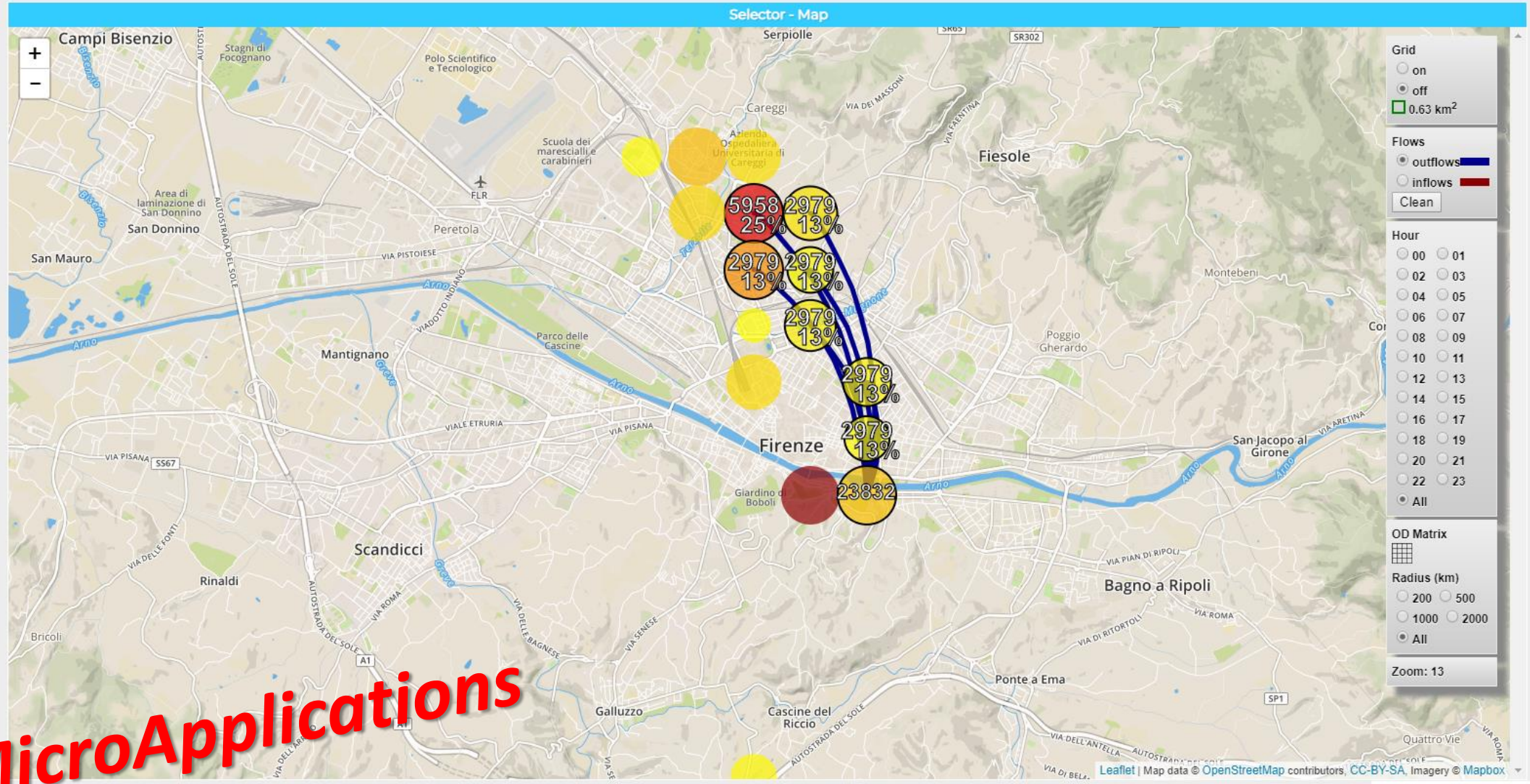


https://main.snap4city.org/view/index.php?iddasboard=MjMw

Life in Toscana: Dashboard

Mon 24 Jun 09:19:20

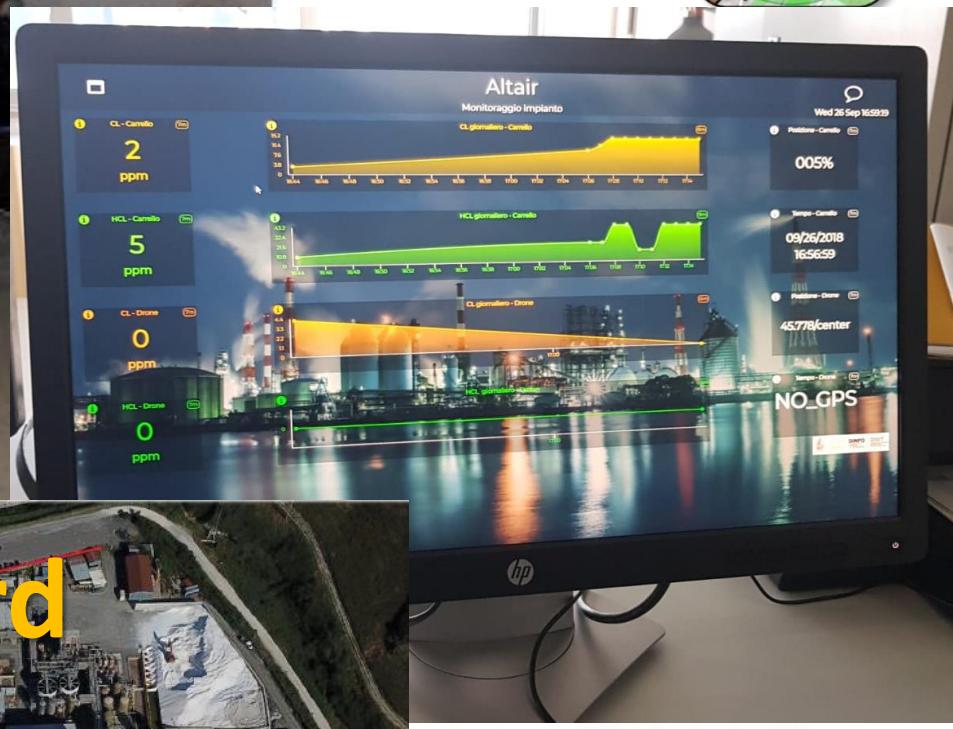


Line of Transport
Public Transport
Travel Plan
Air Quality
Weather
Origin Dest. Matrix
Typical Trajectories
Cultural Activities
Forum Discussion

MicroApplications

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



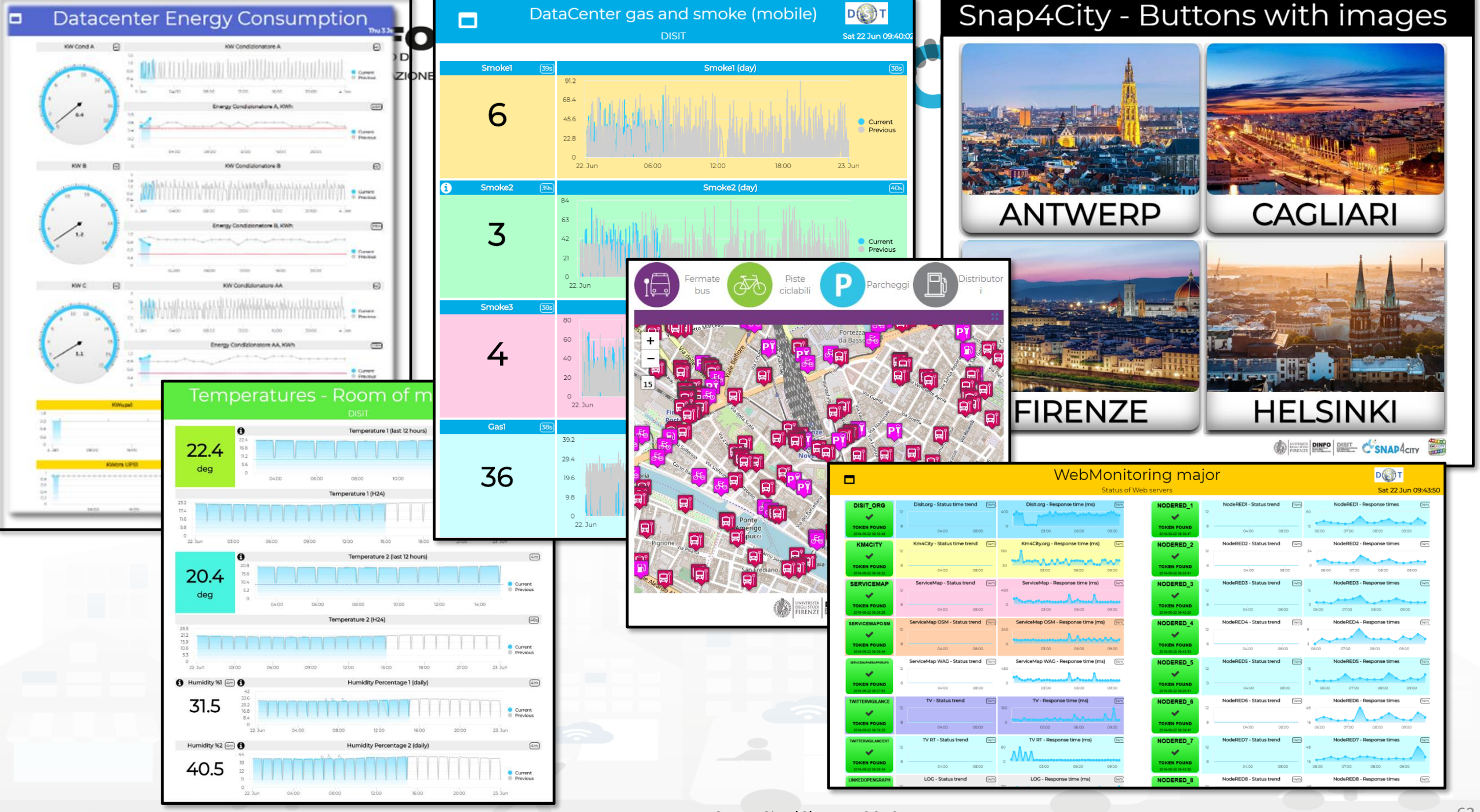


Chemical Plant Dashboard



Green Impact Capacity (GIC)

Altair Control room


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
Current
Previous
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
DISIT_ORG
KM4CITY
SERVICEMAP
SERVICEMAPOSM
TWITTERVIGILANCE
LINKEDOPENGRAPH
NODERED_1
NODERED_2
NODERED_3
NODERED_4
NODERED_5
NODERED_6
NODERED_7
NODERED_8
TOKEN FOUND

Snap4City - Tuscany weather

Horizontal widgets - English

Mon 24 Jun 20:08:41

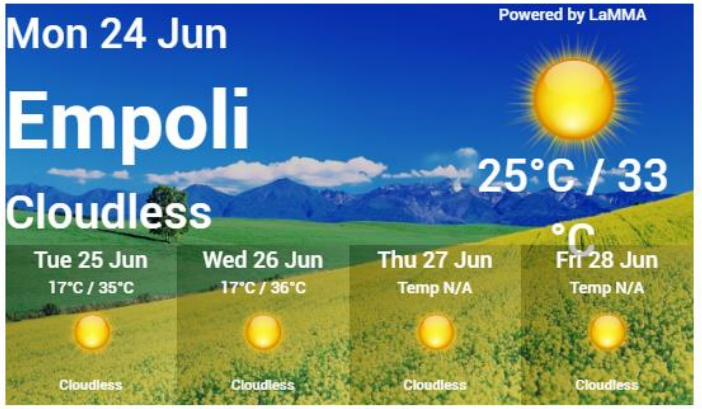


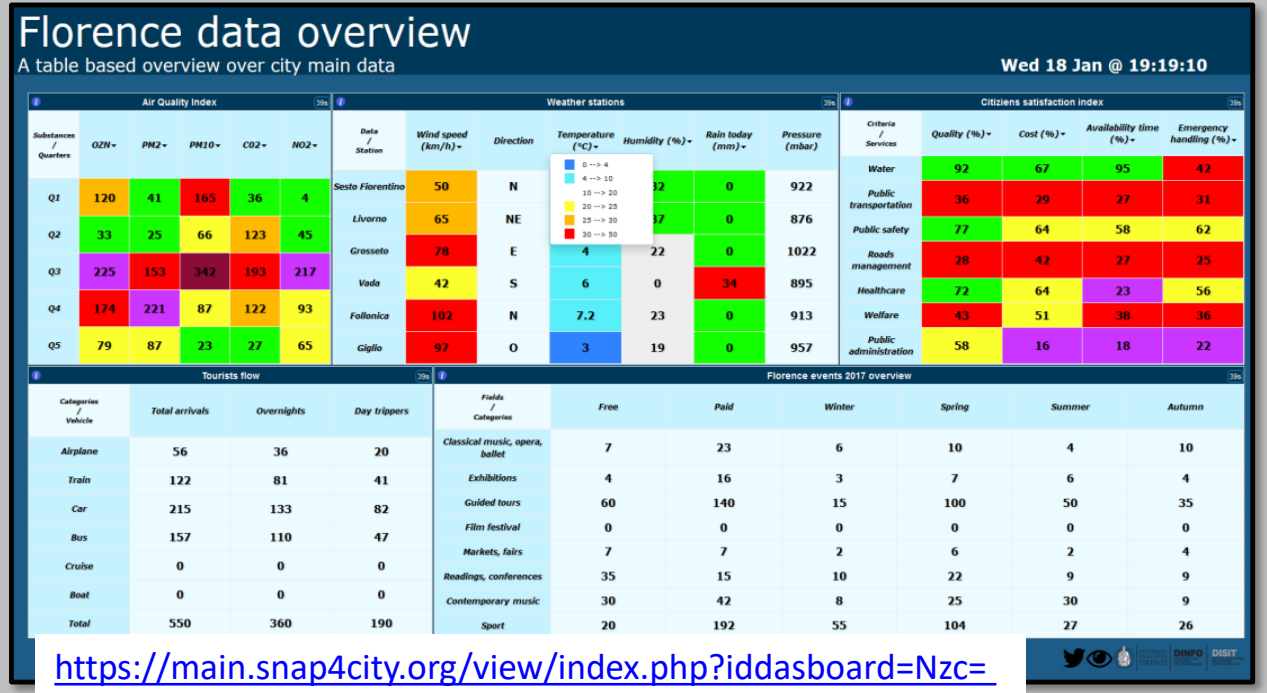












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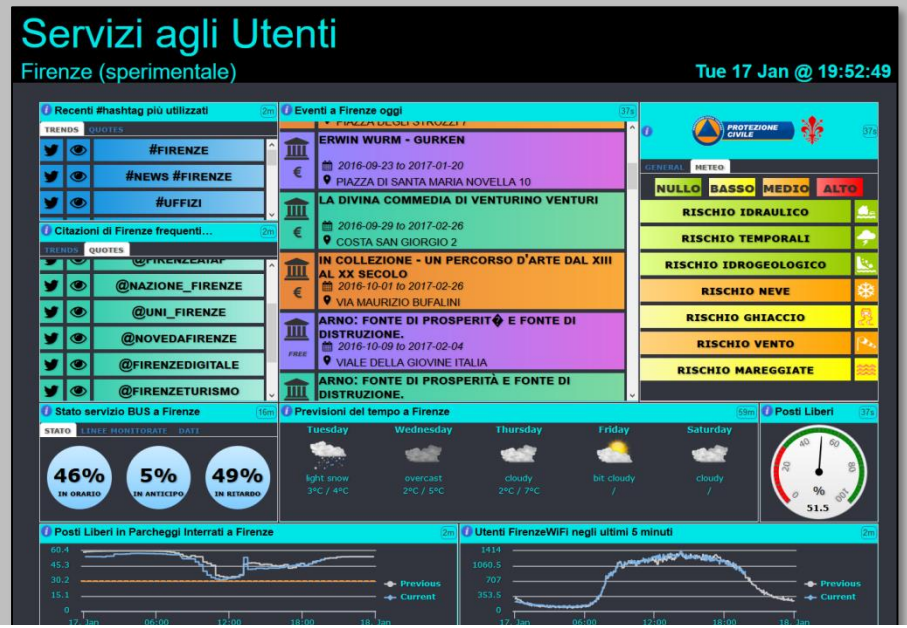

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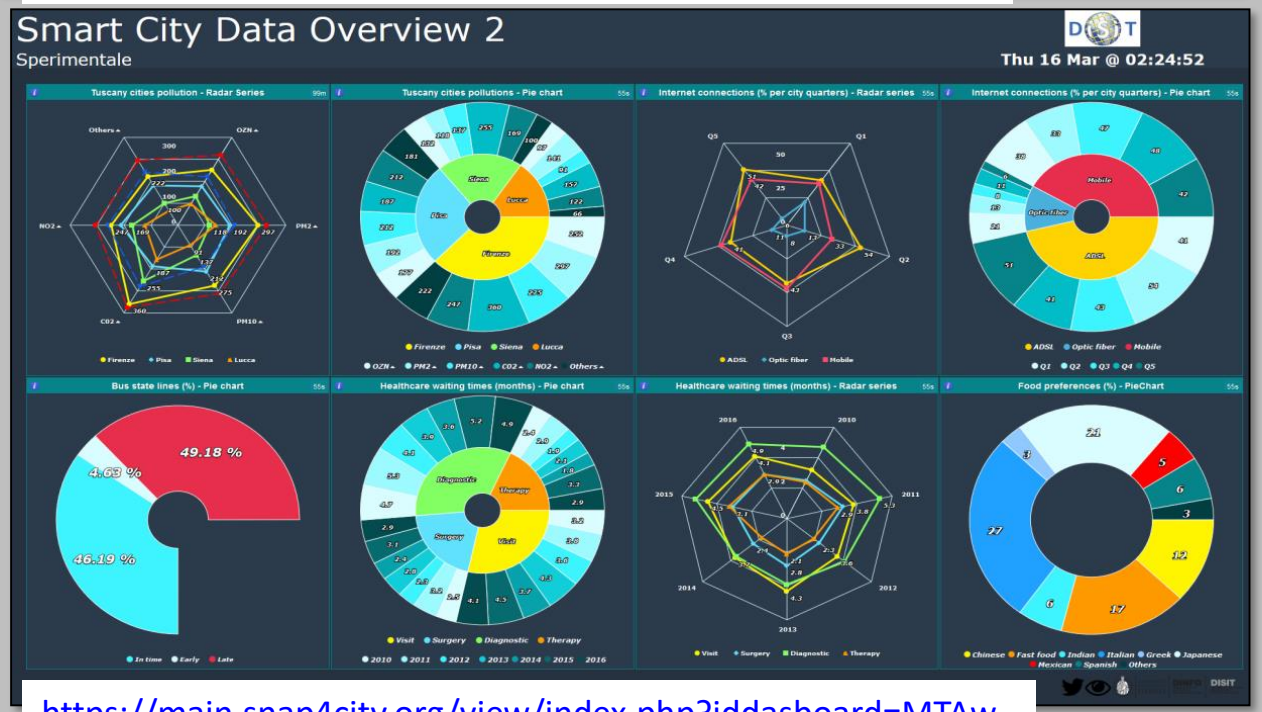

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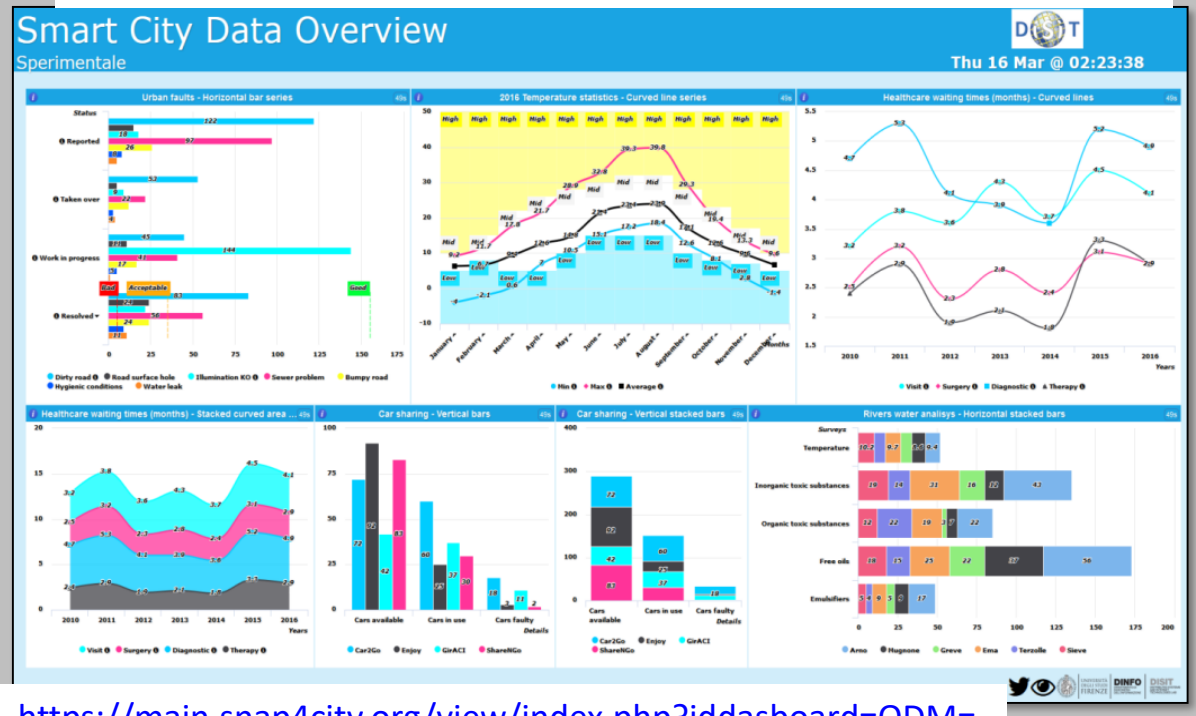

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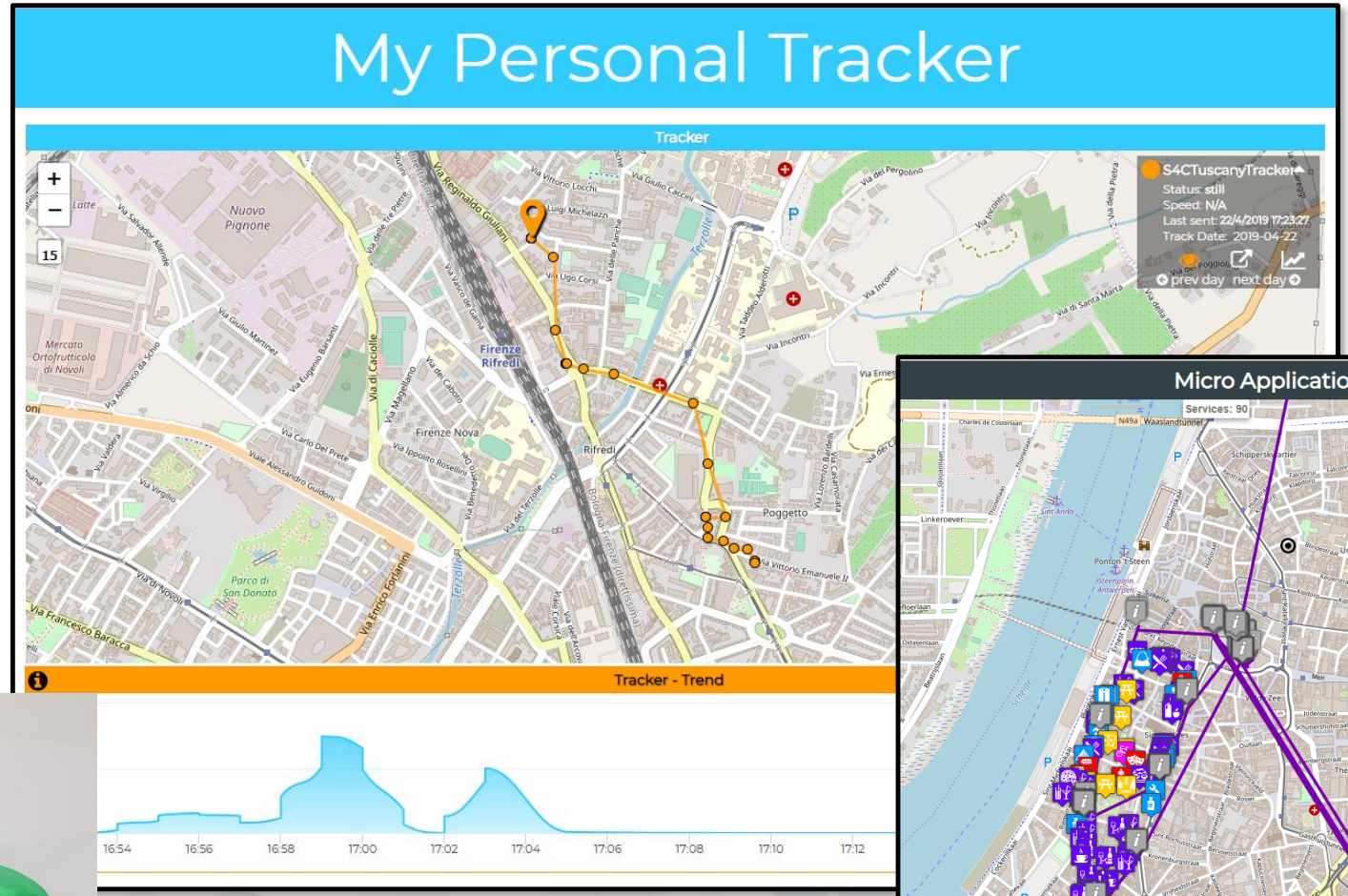
Smart Bench

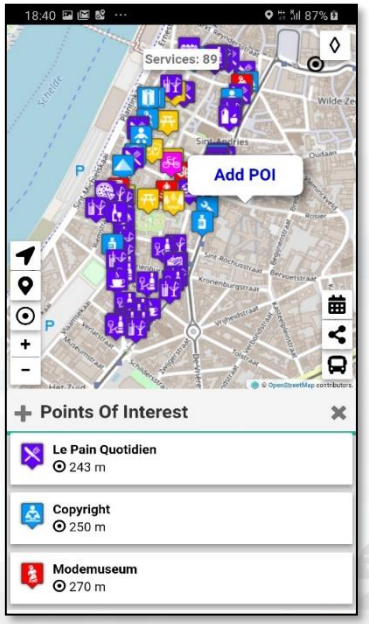
Sat 22 Jun 15:45:23



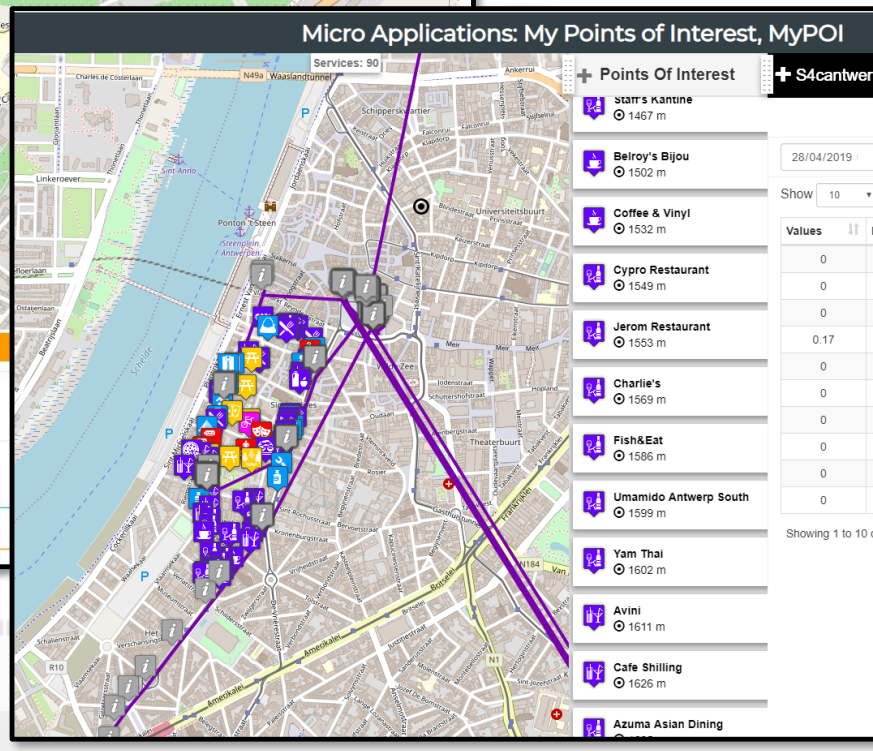
Tracking of Devices and Mobiles

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









Real Time Tracking

From mobile app:

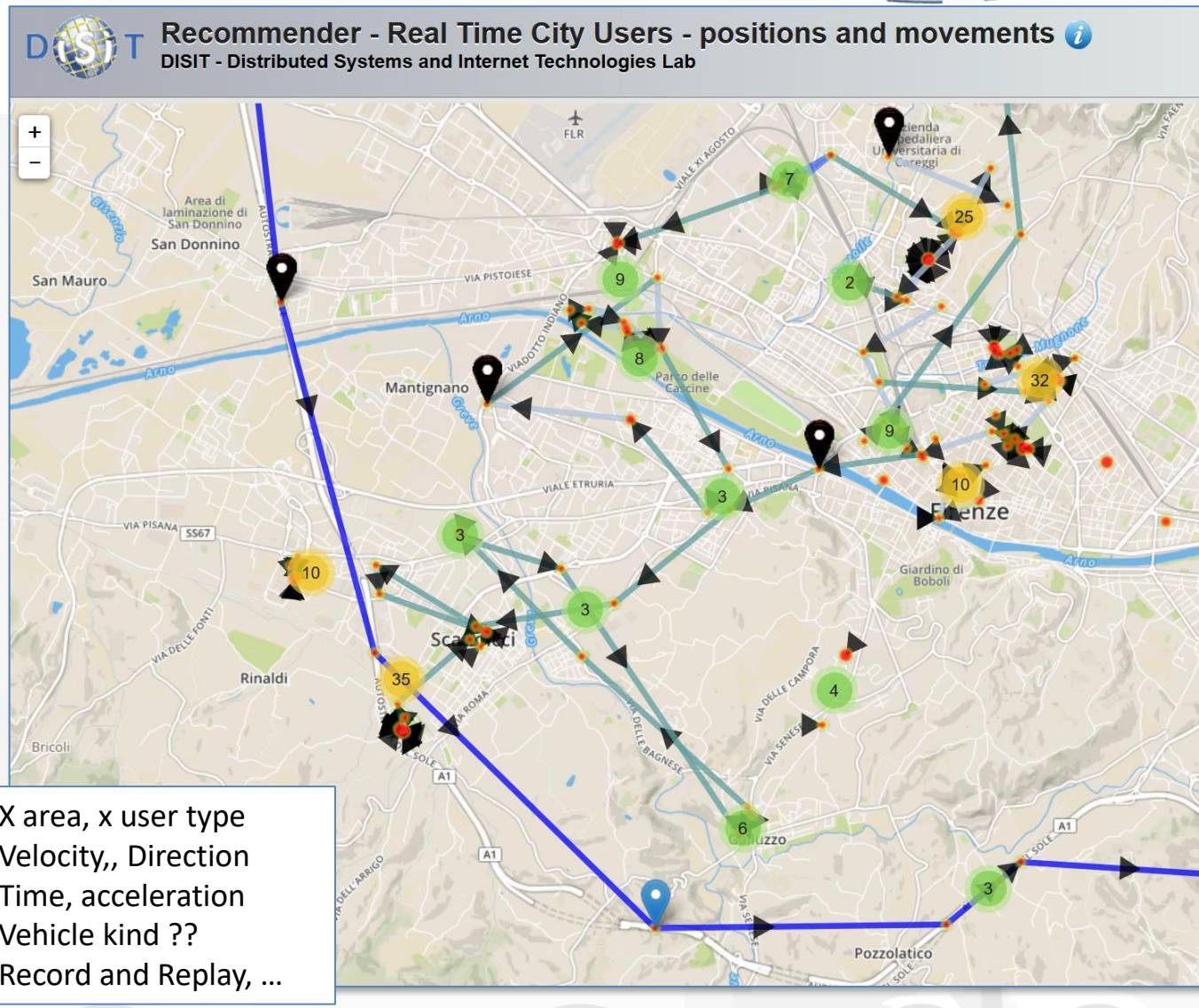
- Resolving GPS location: GPS, cells, wifi-network, … mixt
- Noisy, different kind of devices, …
- Smart algorithm on devices for location acquisition
- Anonymized data, terms of use on mobile

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



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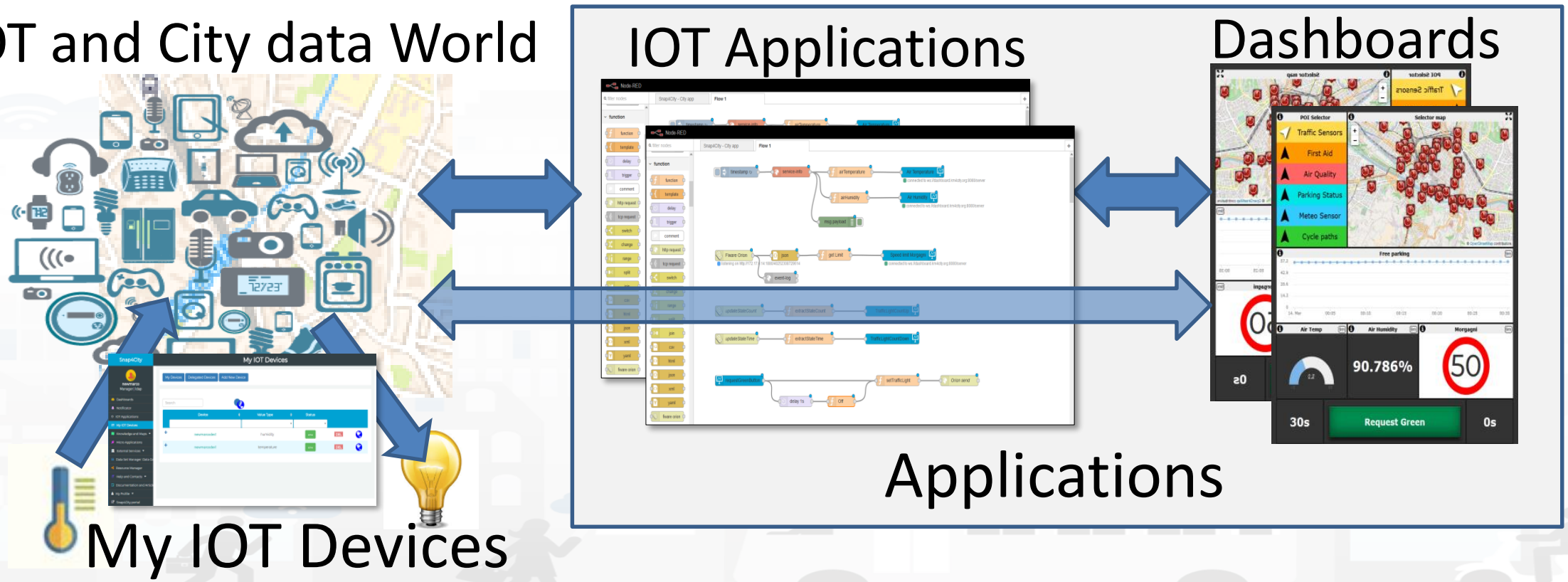
Dashboard with intelligence App

Dashboards with IOT Applications for enforcing data driven smart and intelligence into them

Dashboard-IOT App

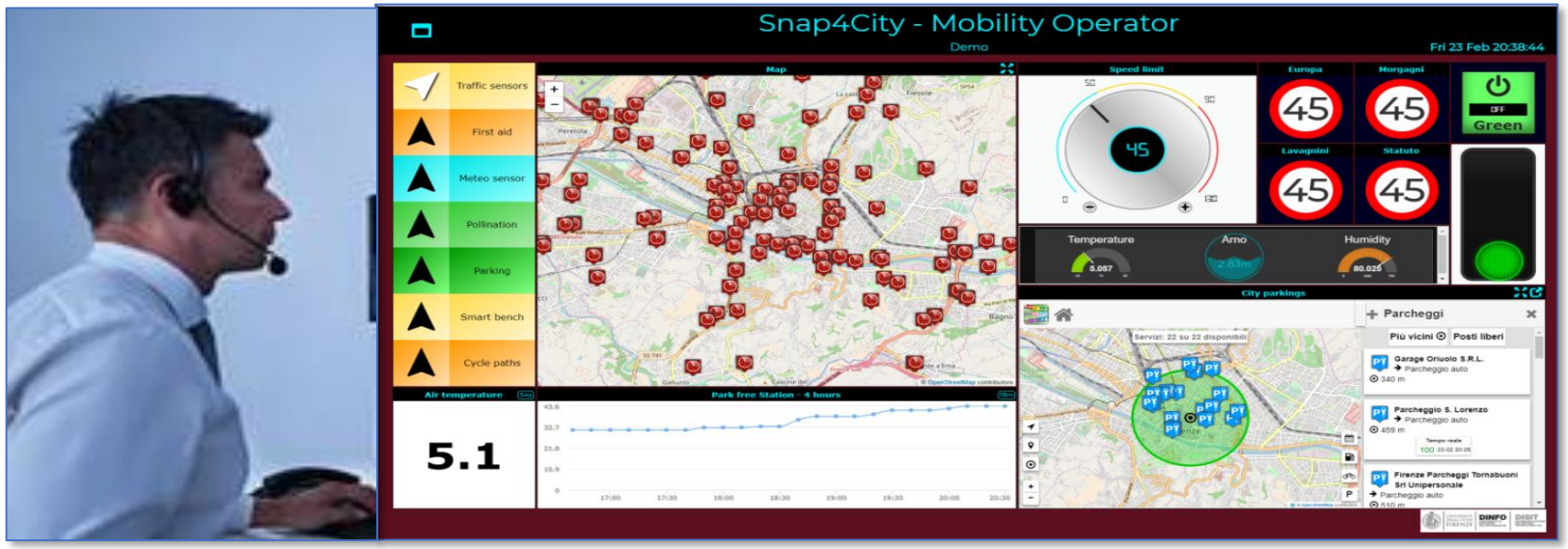


City Dashboard + IOT App

Control Room Operator

Would like to:

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

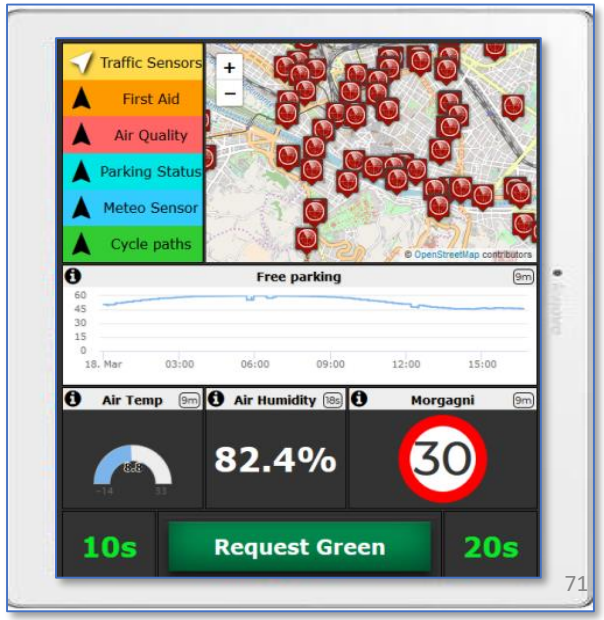


Driver, Policeman

Would like to:

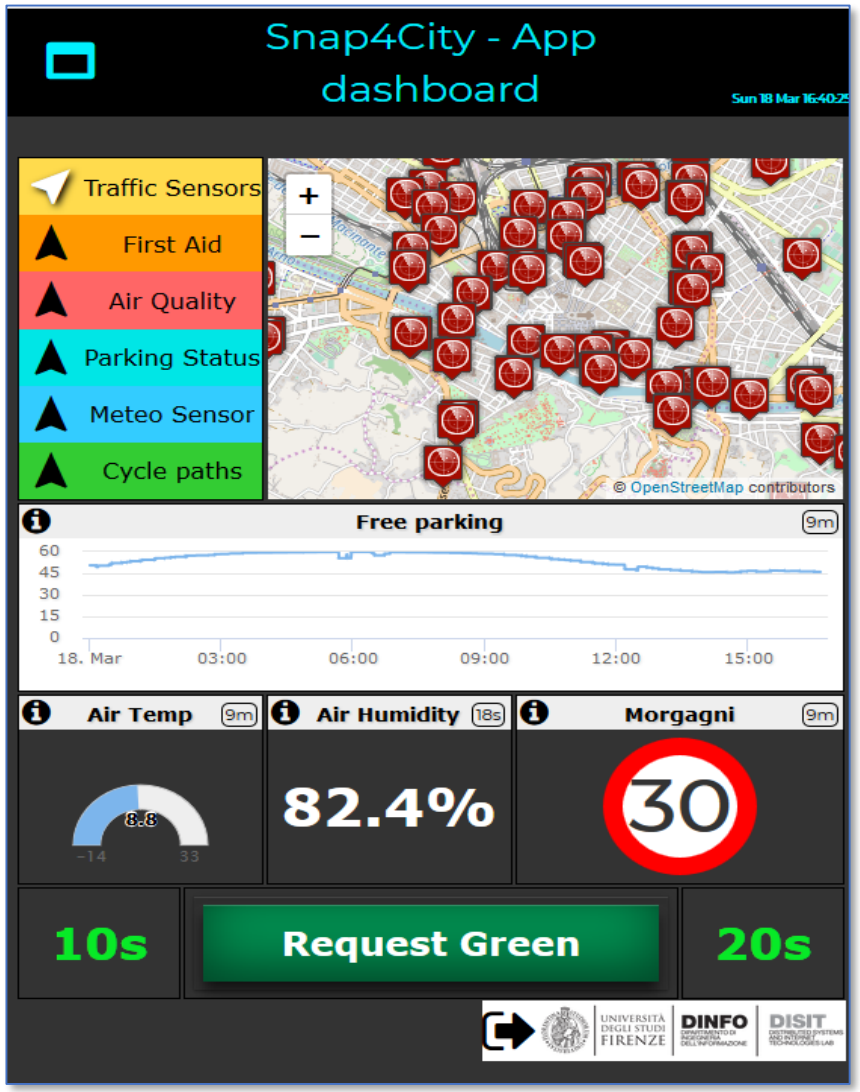
- **Monitor** traffic, Parking, env., speed limit, …
- **Act and monitor** red lights

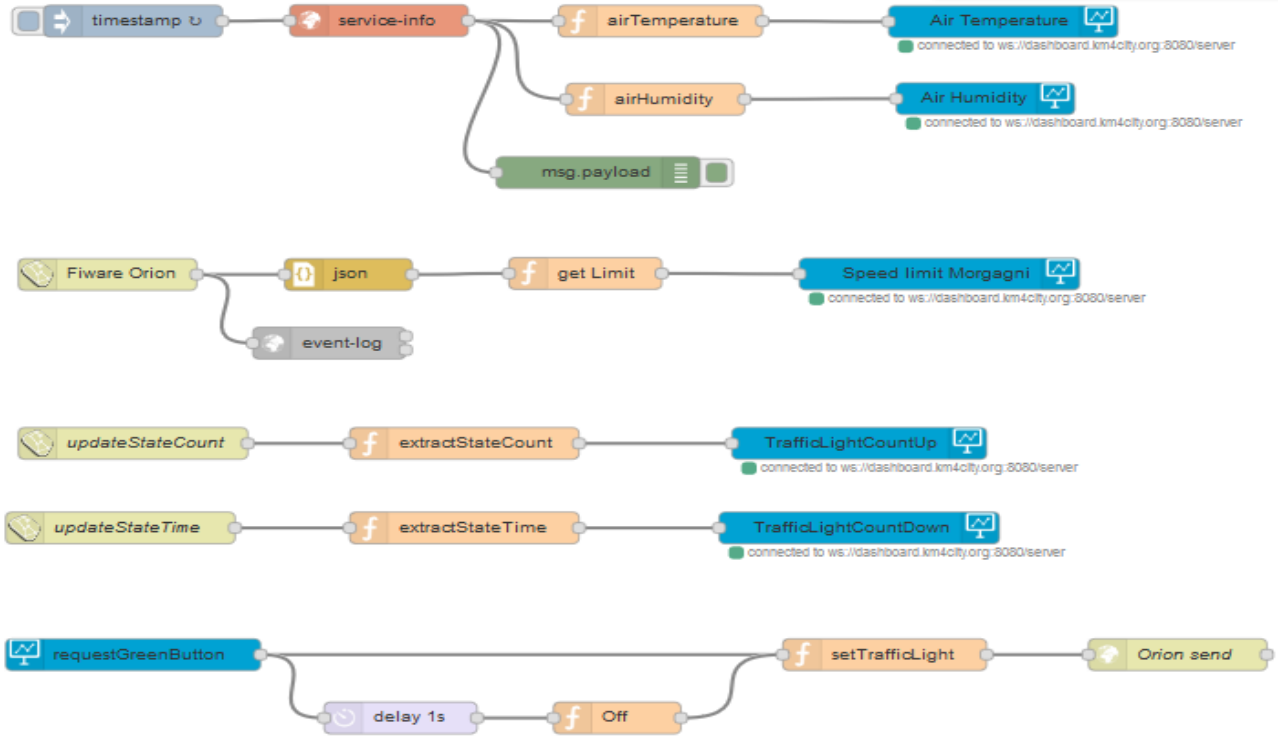




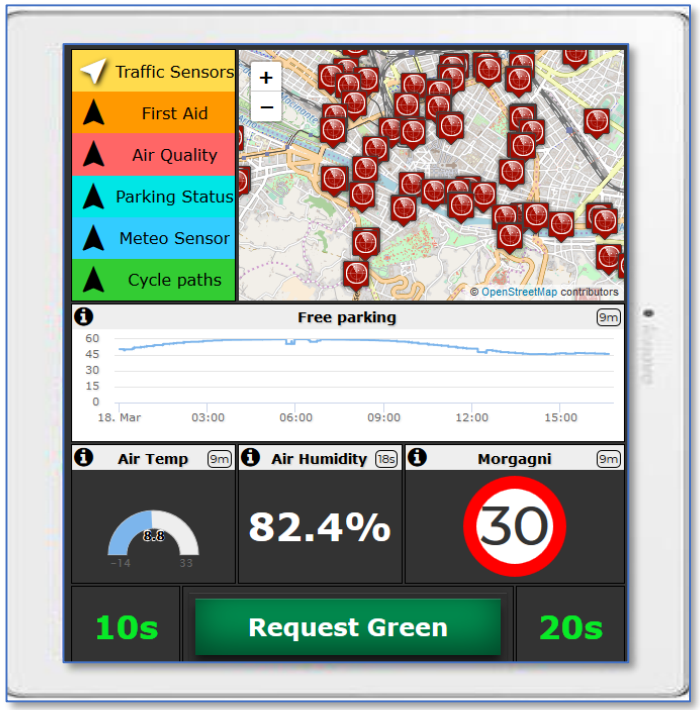
IOT Application with City Dashboard Simple development

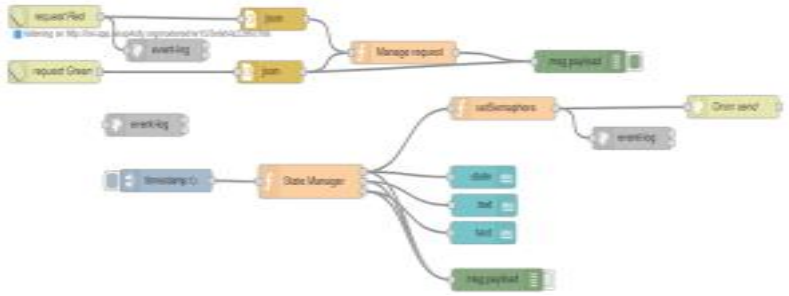






-Virtual Sensors and Virtual Actuators
-From Dashboard to IOT App and viceversa
-From Dashboard to IOT Brokers/Devices and viceversa


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





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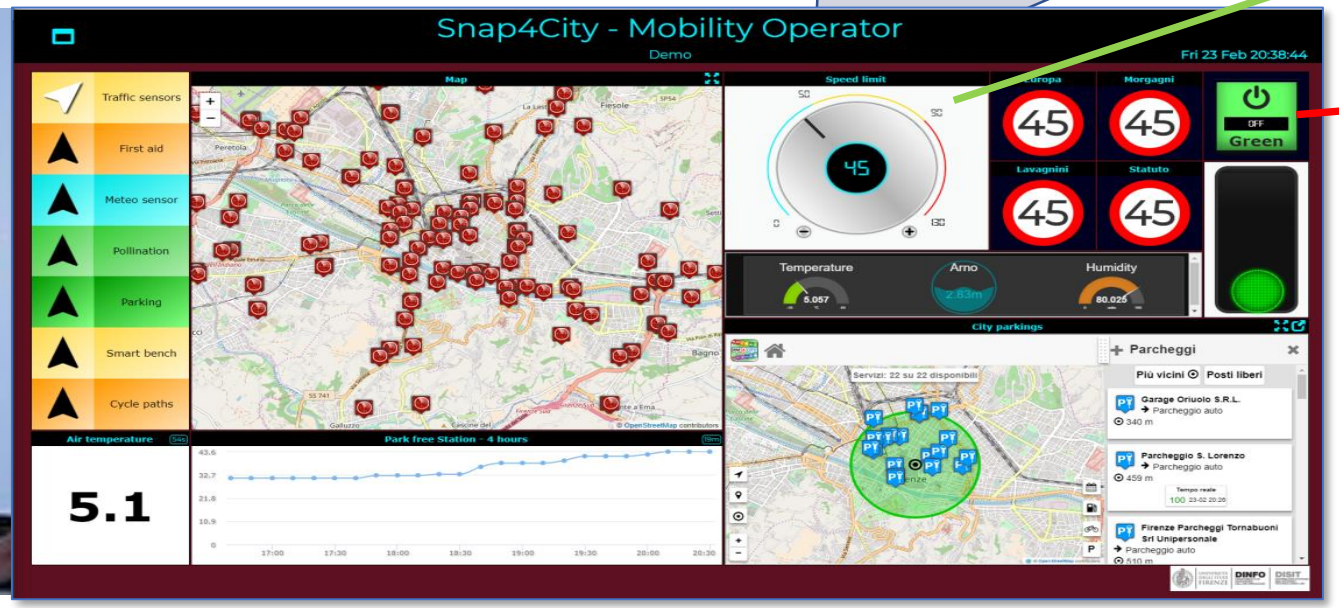
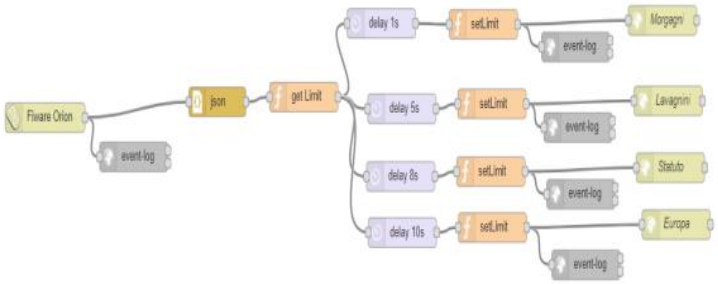

Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
45
Europa
45
Morgagni
45
Lavagnini
45
Statuto
45
OFF
Green
Temperature
5.057
Arno
Humidity
80.025
City parkings
Parcheggi
Più vicini
Posti liberi
Garage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


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



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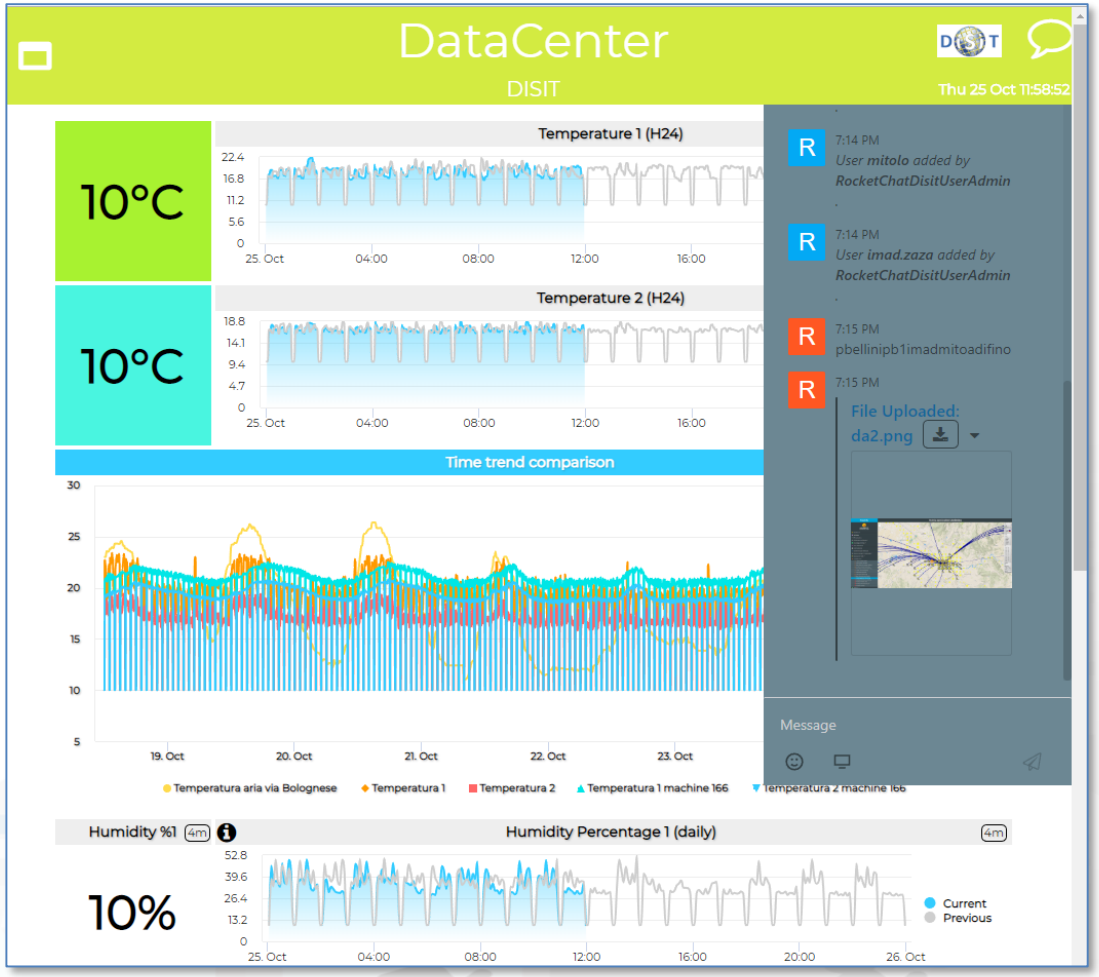
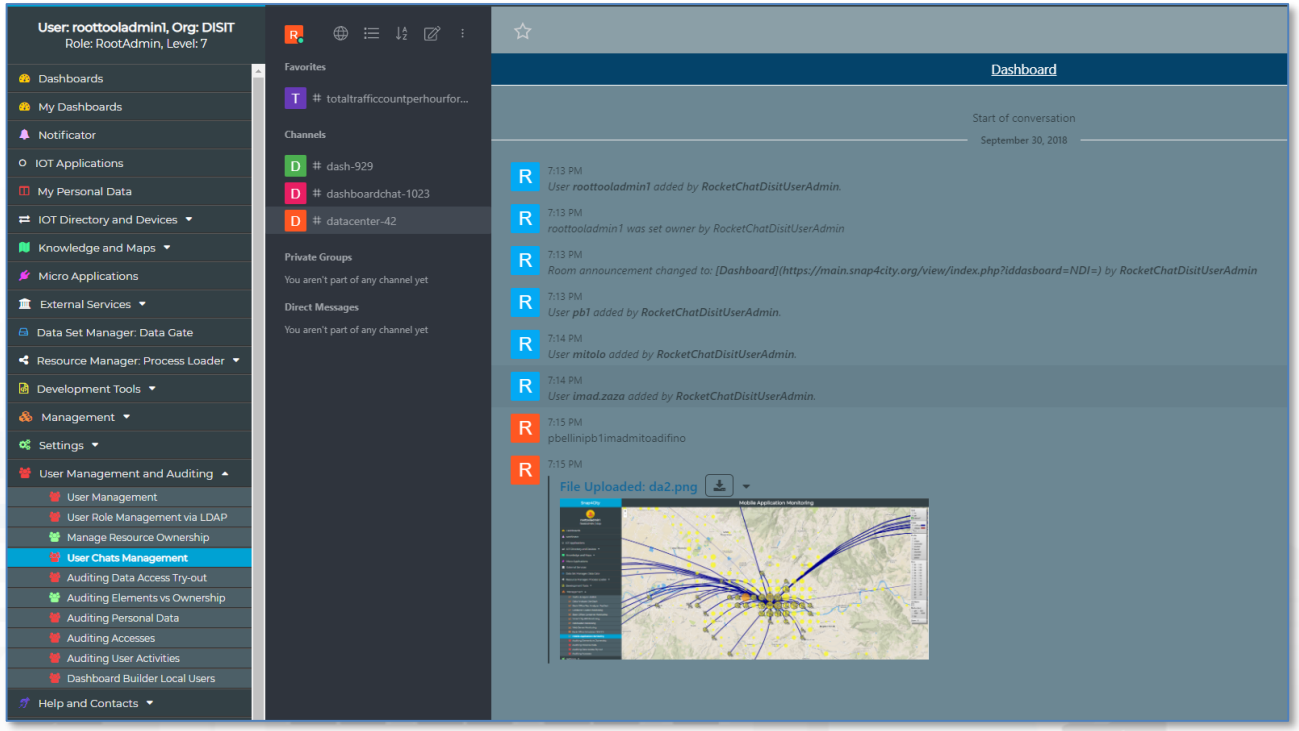
ChatRoom Per Dashboard

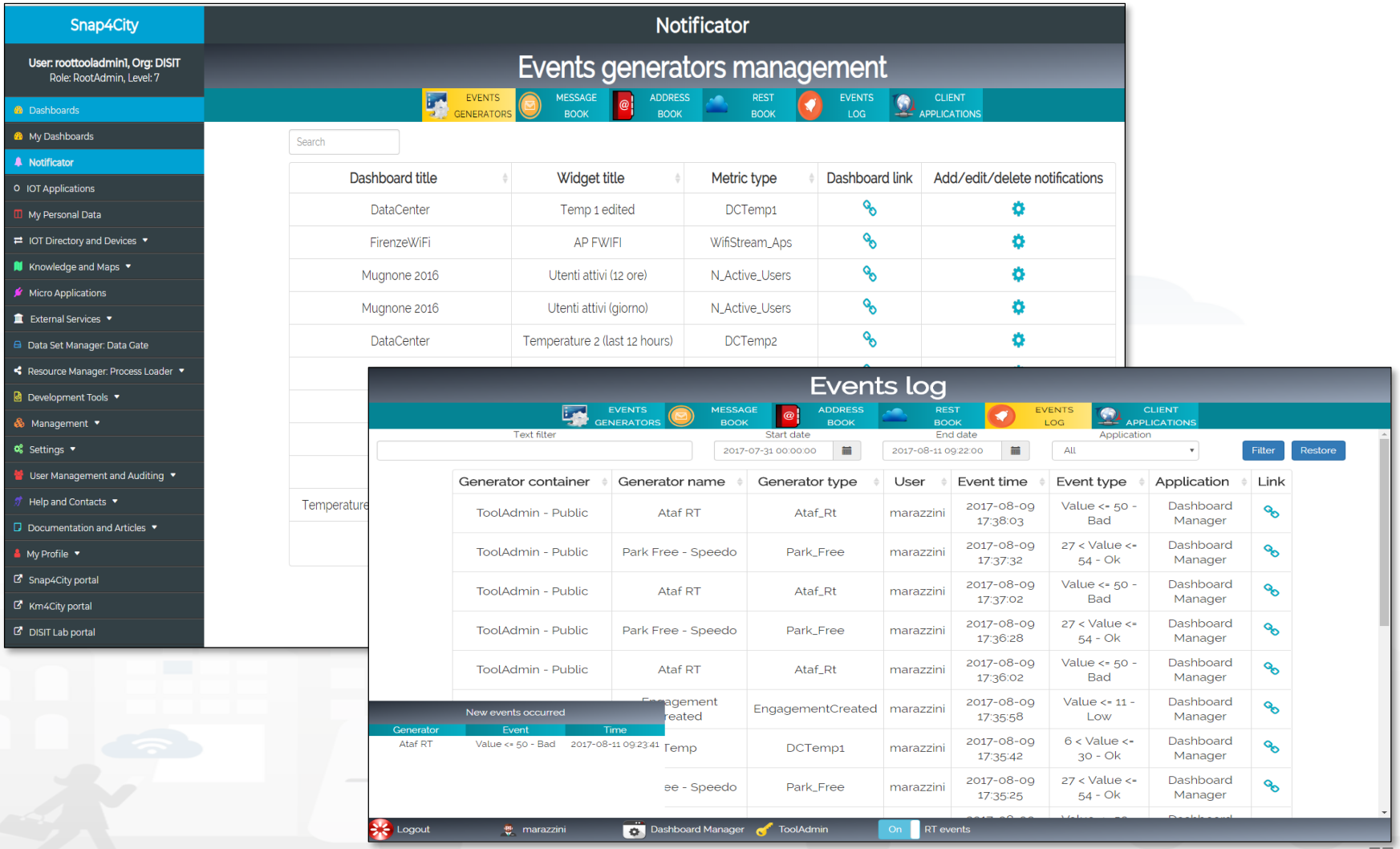


Chat Management



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



Dashboards Production



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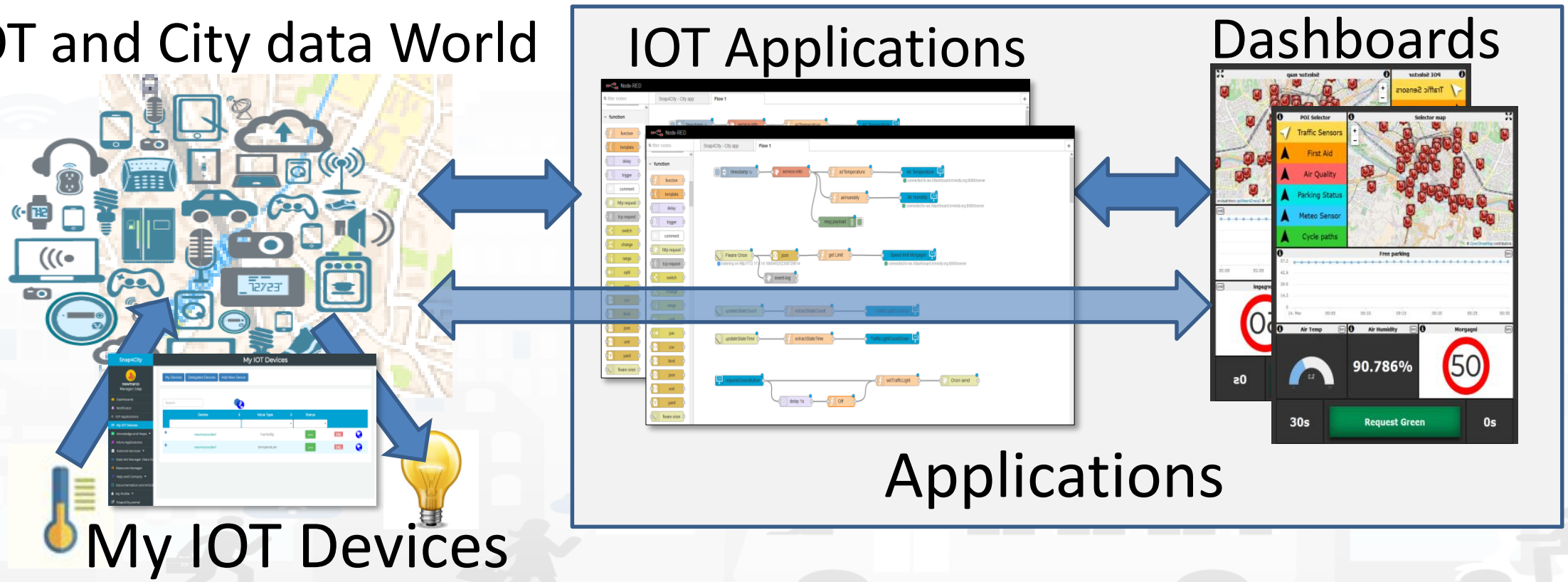
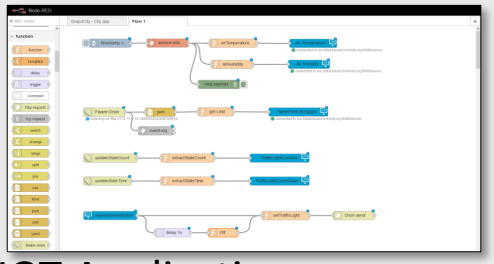
Dashboard with intelligence App

Dashboards with IOT Applications for enforcing data driven smart and intelligence into them

Dashboard-IOT App



Dashboard Development



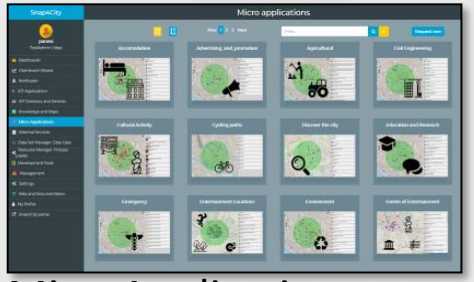
IOT Applications



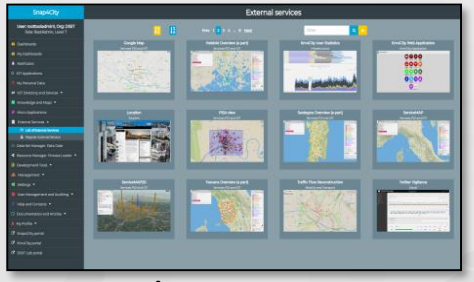
Knowledge and Storage
Data from the Field and City

Widget Collection



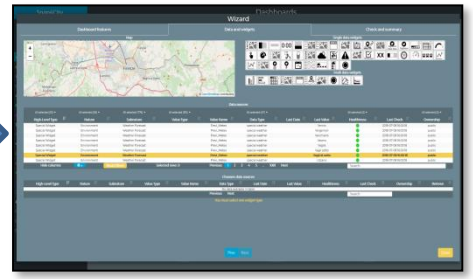


MicroApplications



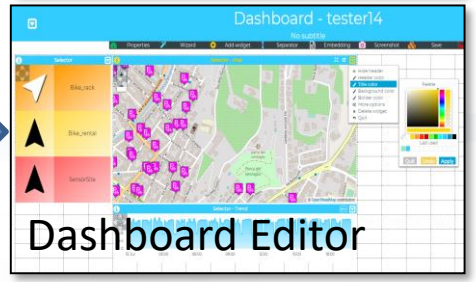
External Services

Dashboard Wizard

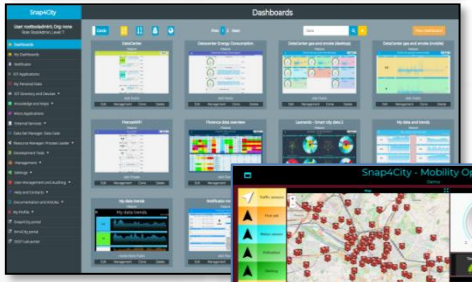


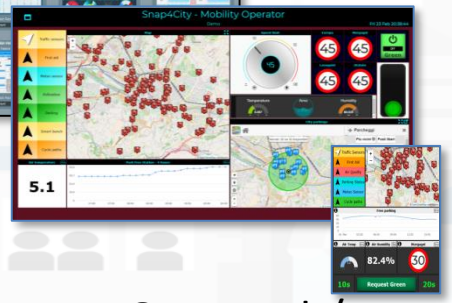
Create, save, load, delegate, grant access





Dashboard Editor



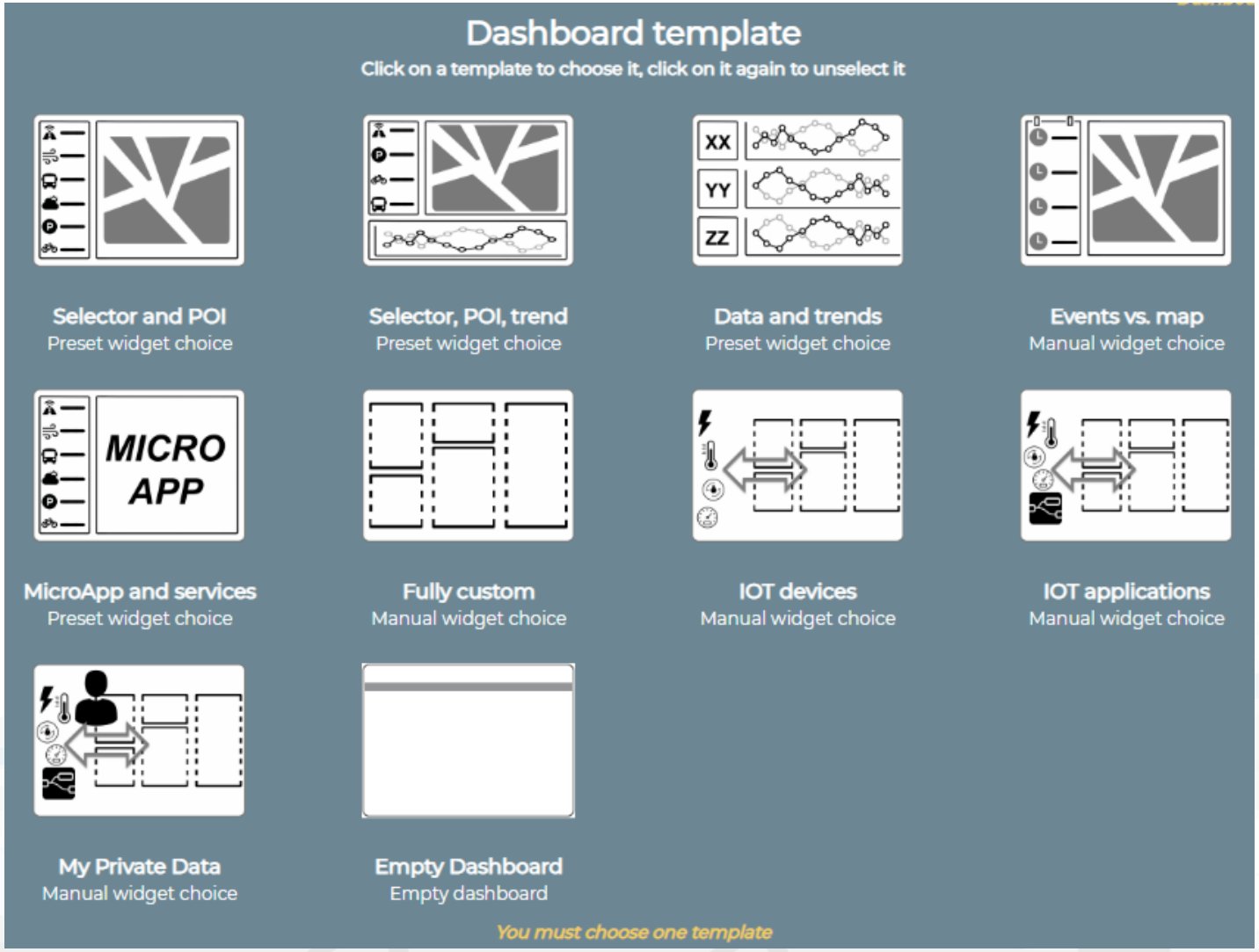


Public Dashboard Collection



My Own Dash/App

From Templates to Wizard and Dashboards



- to create a new Dashboard

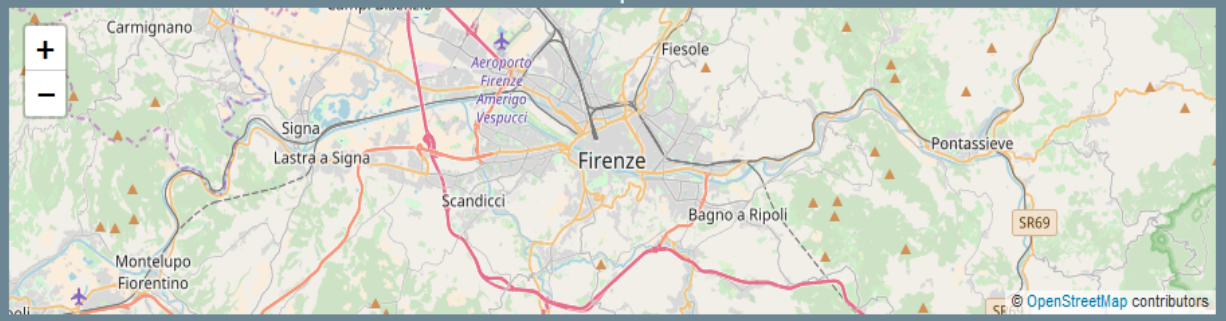
- to add widgets and/or groups of them on any Dashboard

Snap4City Dashboards

Wizard

Dashboard features | Data and widgets | Check and summary

Map



Single data widgets



Multi data widgets



SNAP4CITY

Data sources

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Last Date	Value	Healthiness	Last Check	Ownership
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Vergemoli		2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Vaglia		2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Vagli sotto		2018-07-08 16:00:18	public
Special Widget	**Environment**	**Weather Forecast**		**Previ_Meteo**	**special weather**		**Vagli di sotto**		**2018-07-08 16:00:18**	**public**
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Uzzano		2018-07-08 16:00:18	public

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

Choosen data sources

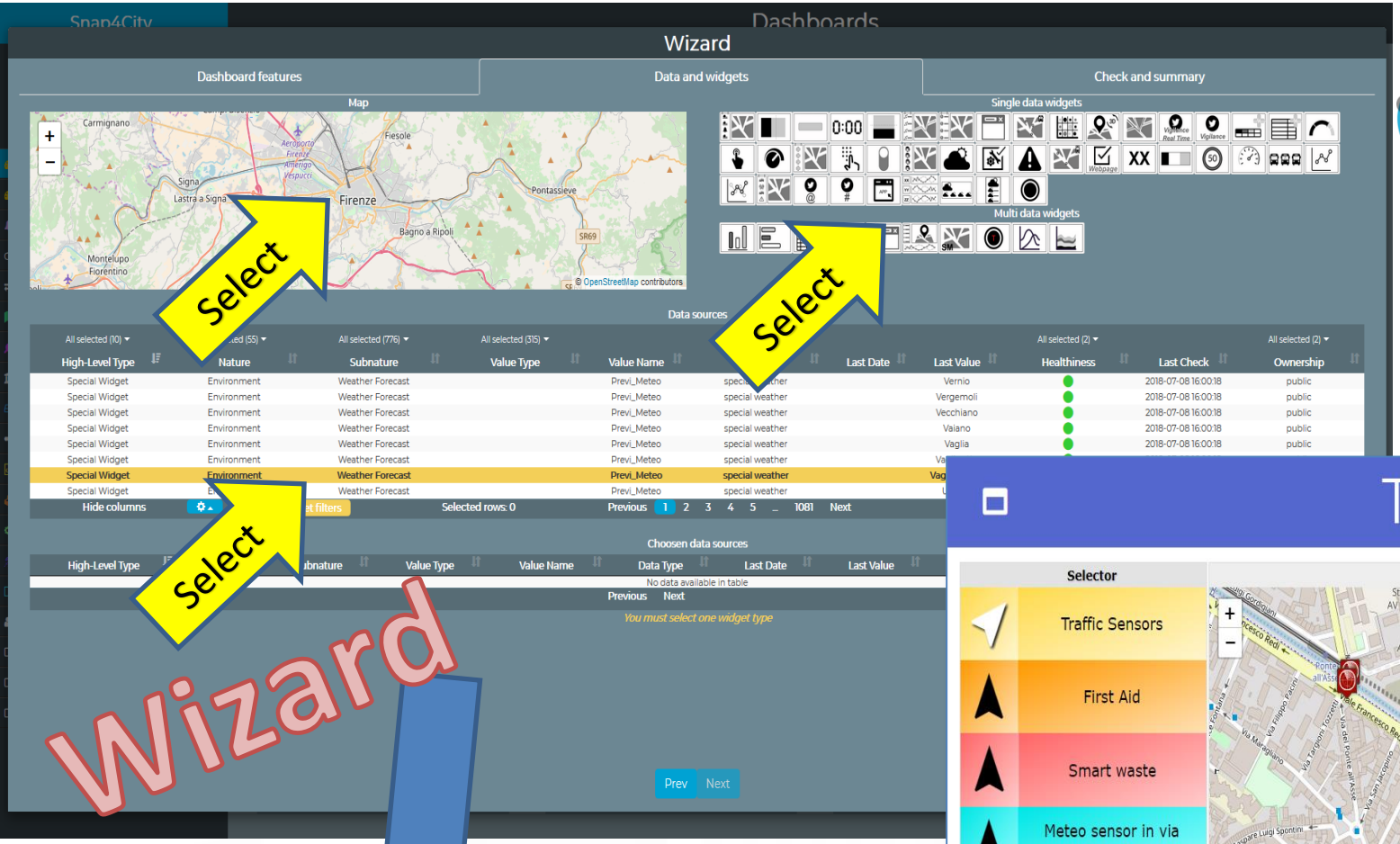
High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Last Date	Last Value	Healthiness	Last Check	Ownership	Remove

Previous Next | Search

Close

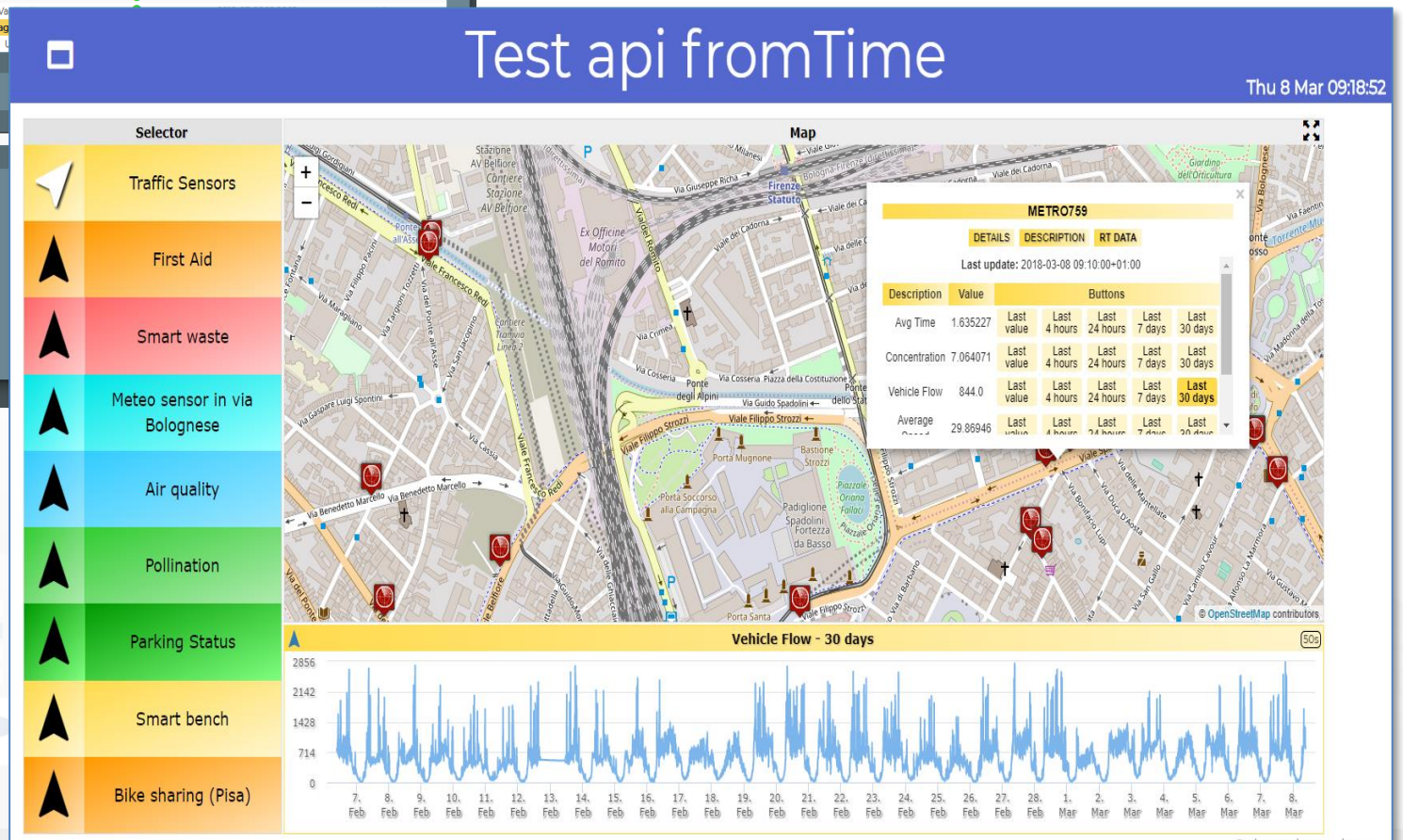
Wizard

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



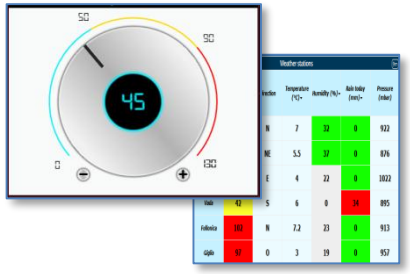
The Wizard help you in selecting only possible combination of data vs graphic representation

Dashboard Wizard



Dashboard List and Editor





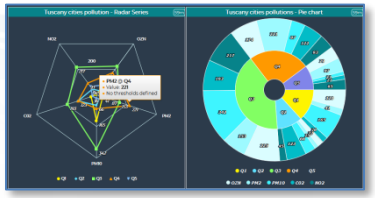


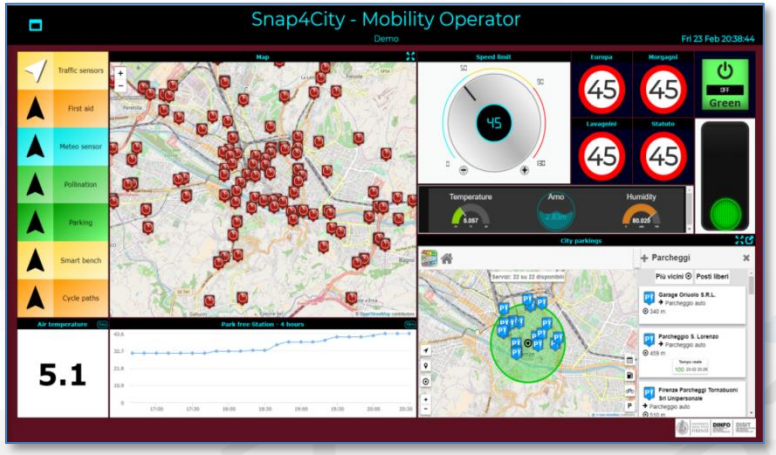


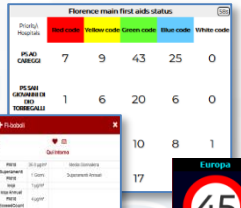


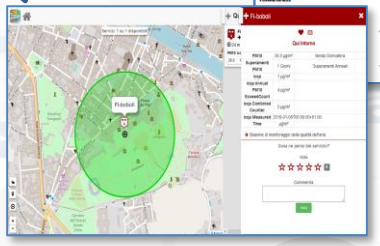




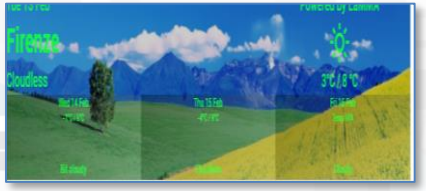


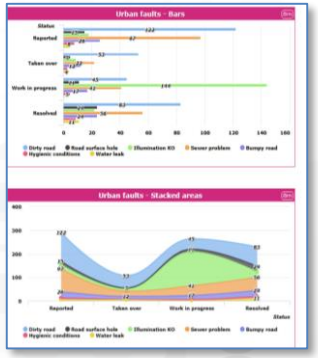












Dashboards

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

TOP

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT



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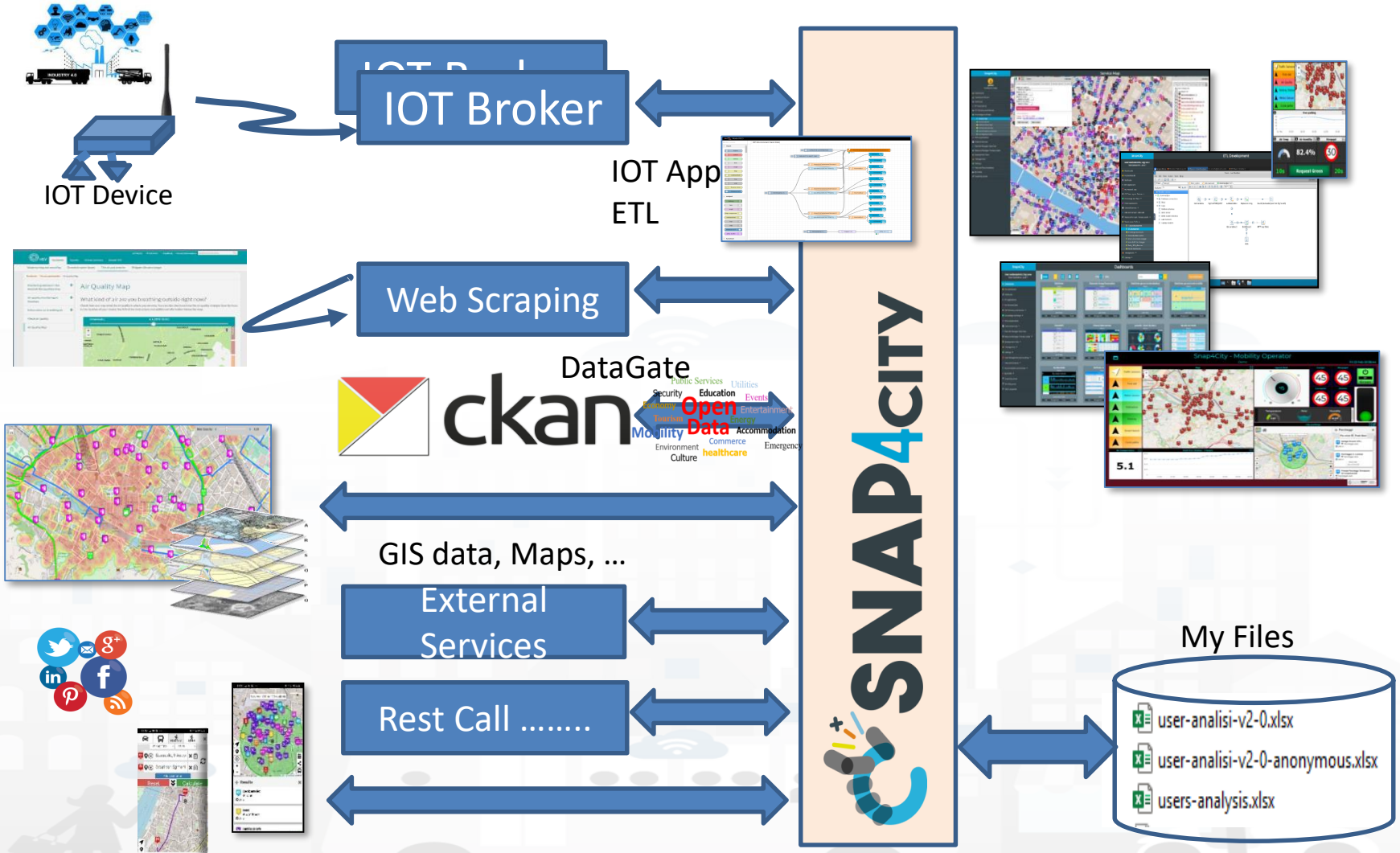
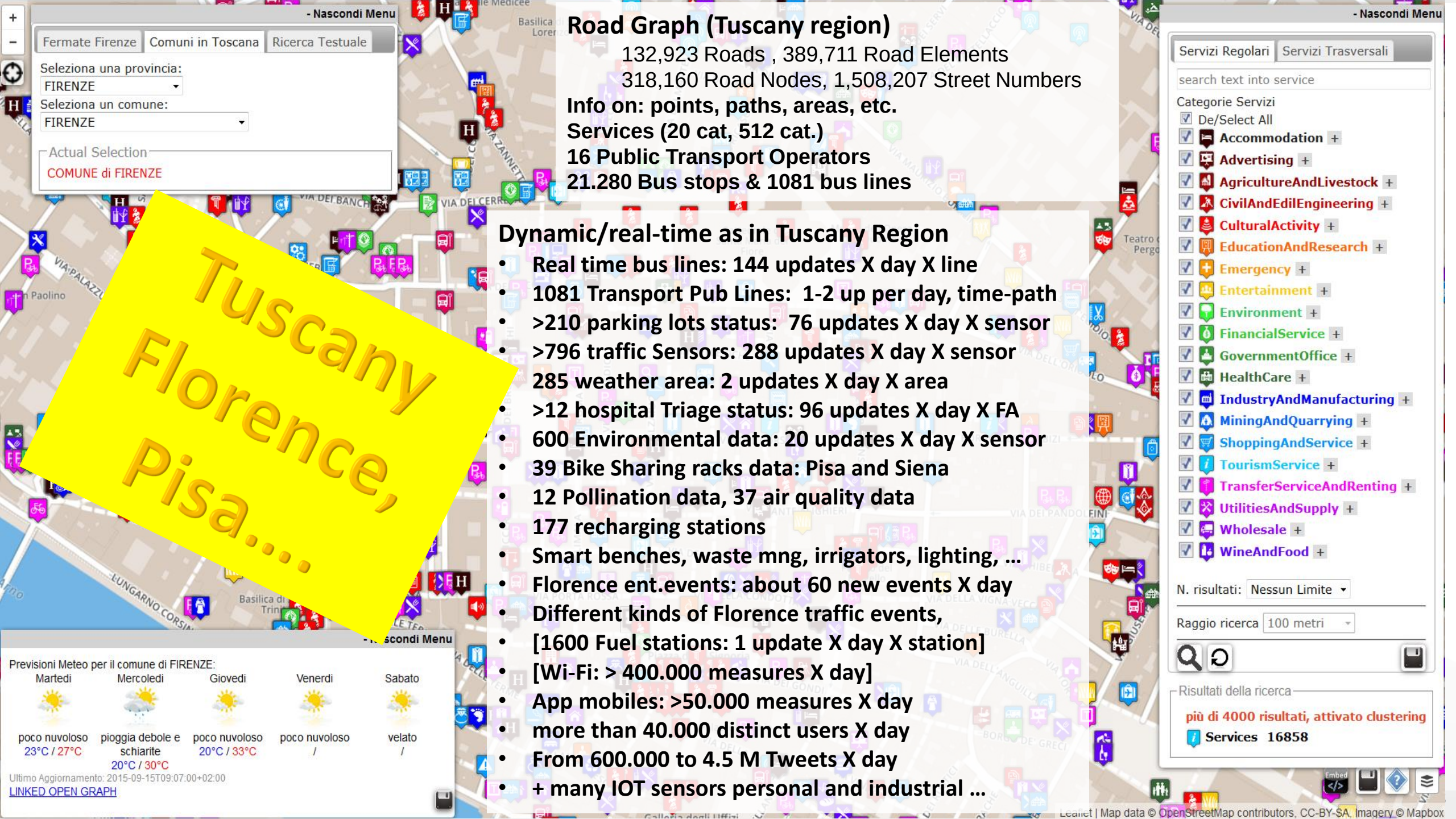
Data Gathering/ingestion

- **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 Application
- **Mobile Apps**
  - Smart City API
- **Files upload: CSV, Excel, etc.**
  - IOT Application
- **Data base accesses**
  - GIS: WFS, WMS
  - ETL, IOT Application




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

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

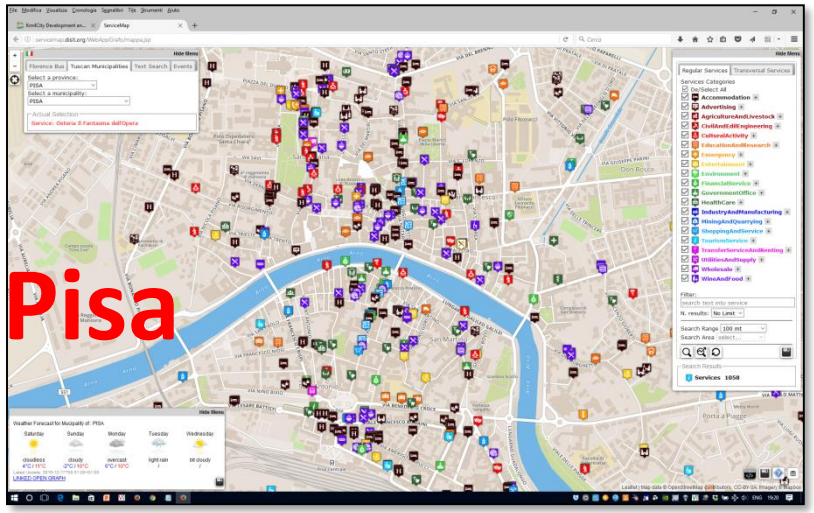
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
http://www.disit.org

Km4City in …

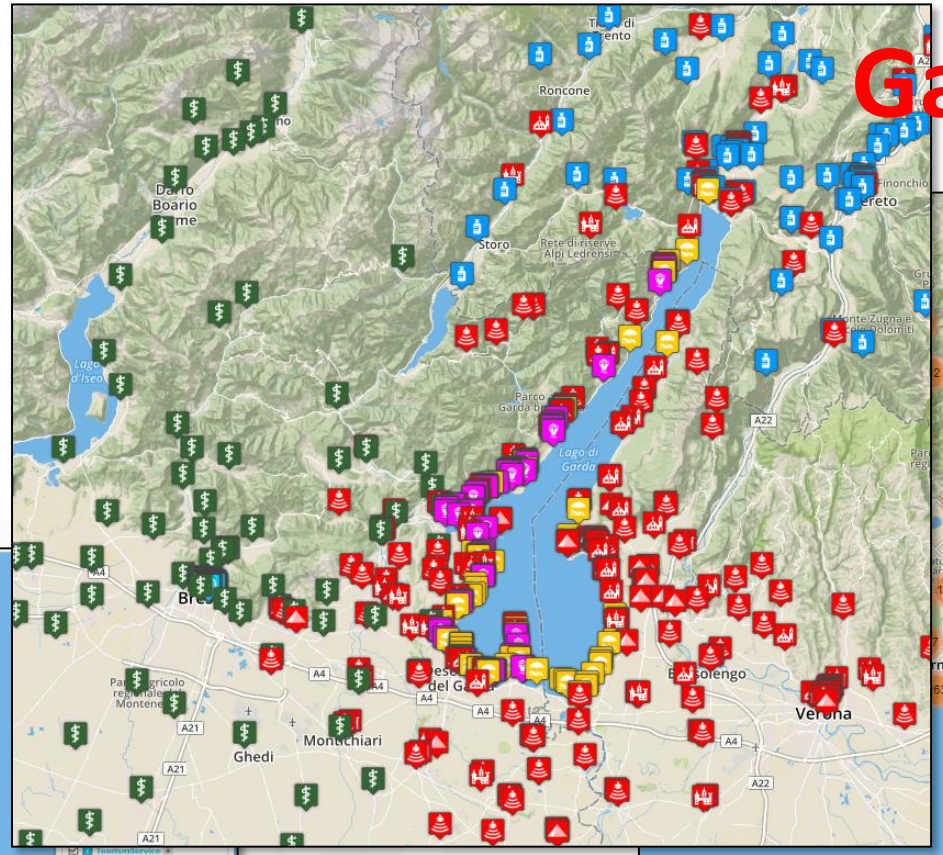
KM 4 CITY

Sii-Mobility

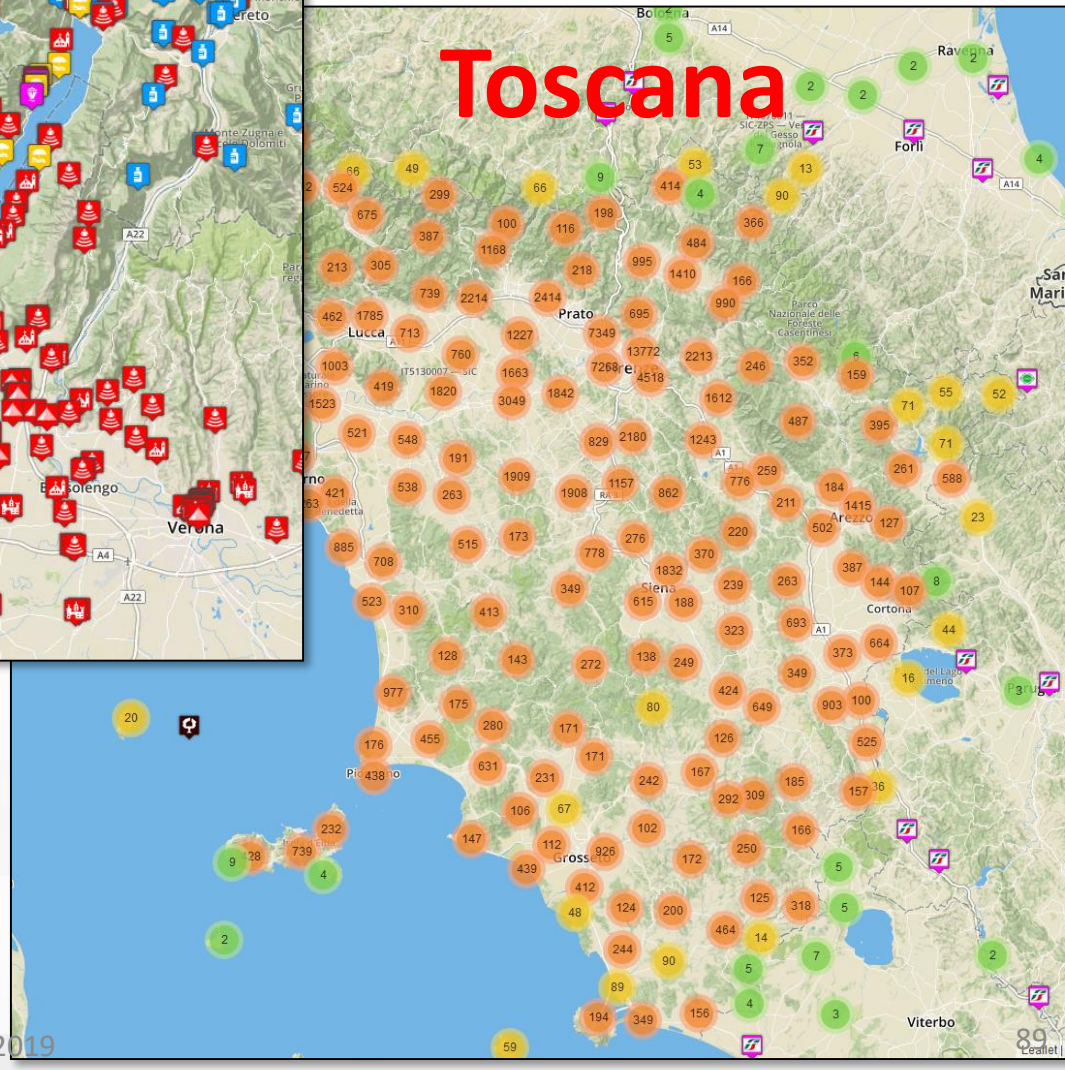
Pisa



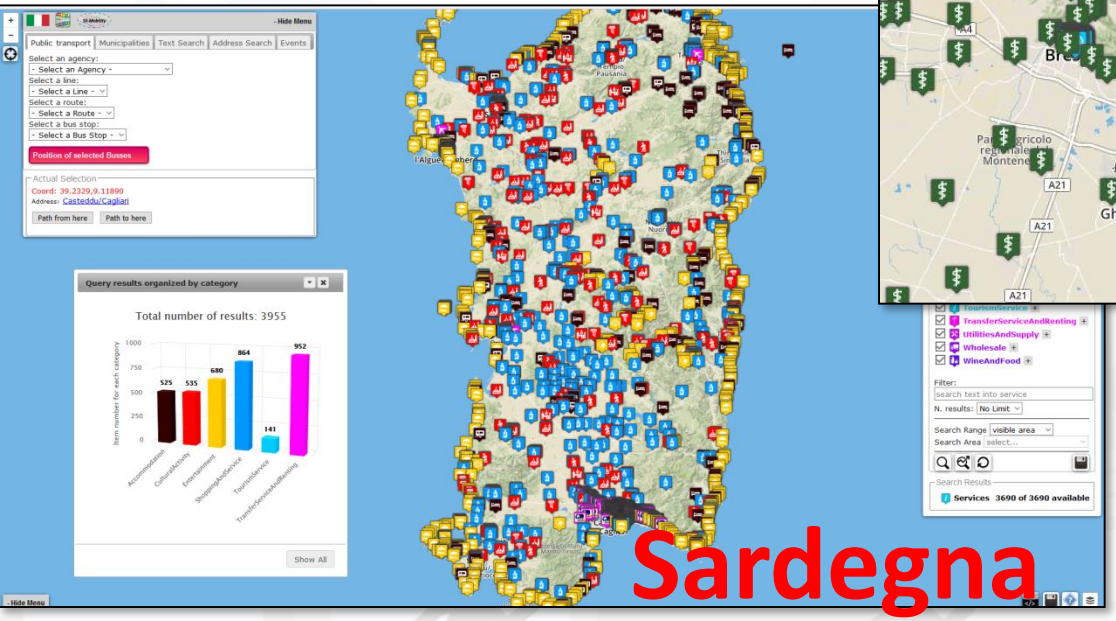
Garda Lake



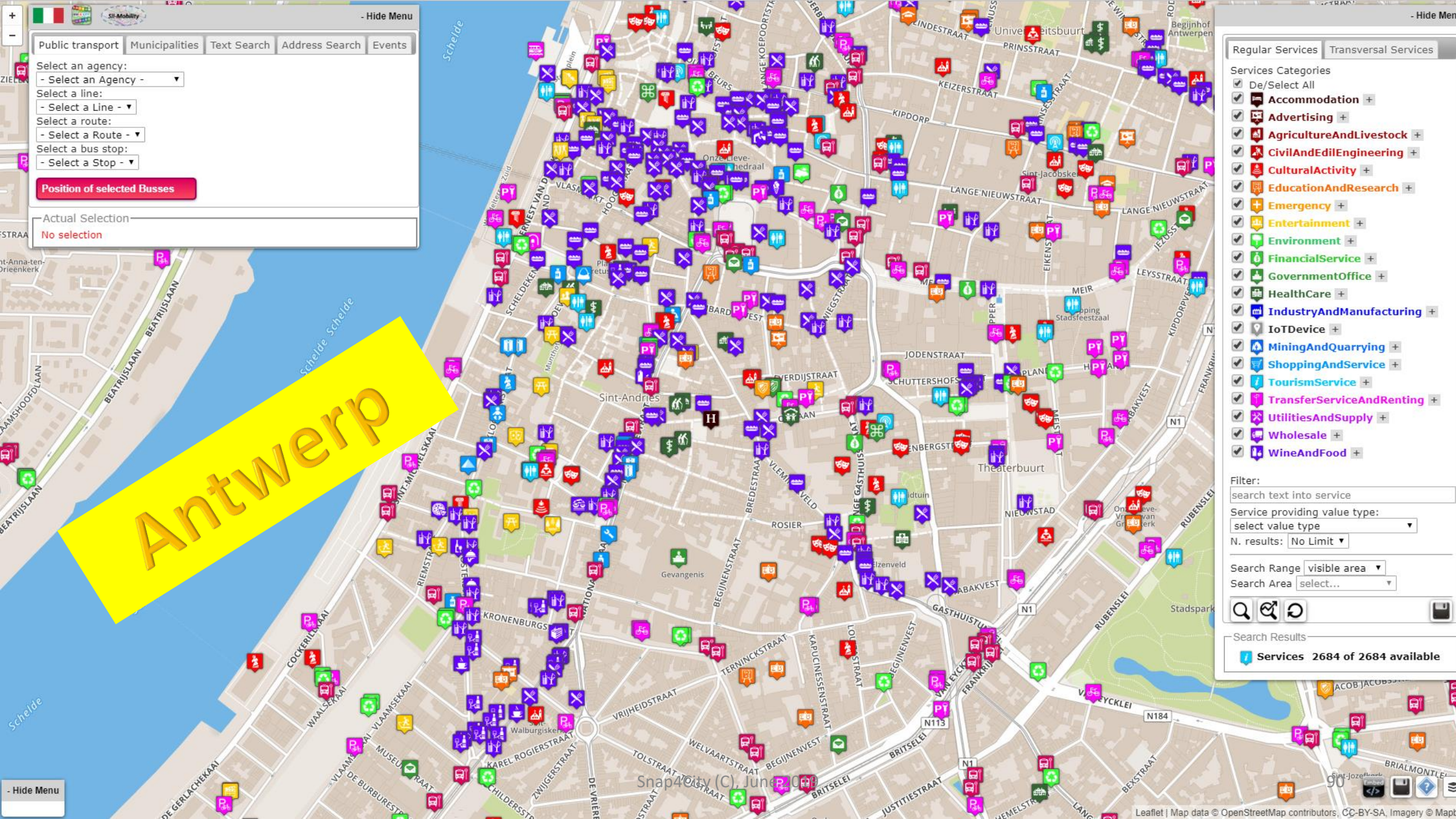
Toscana



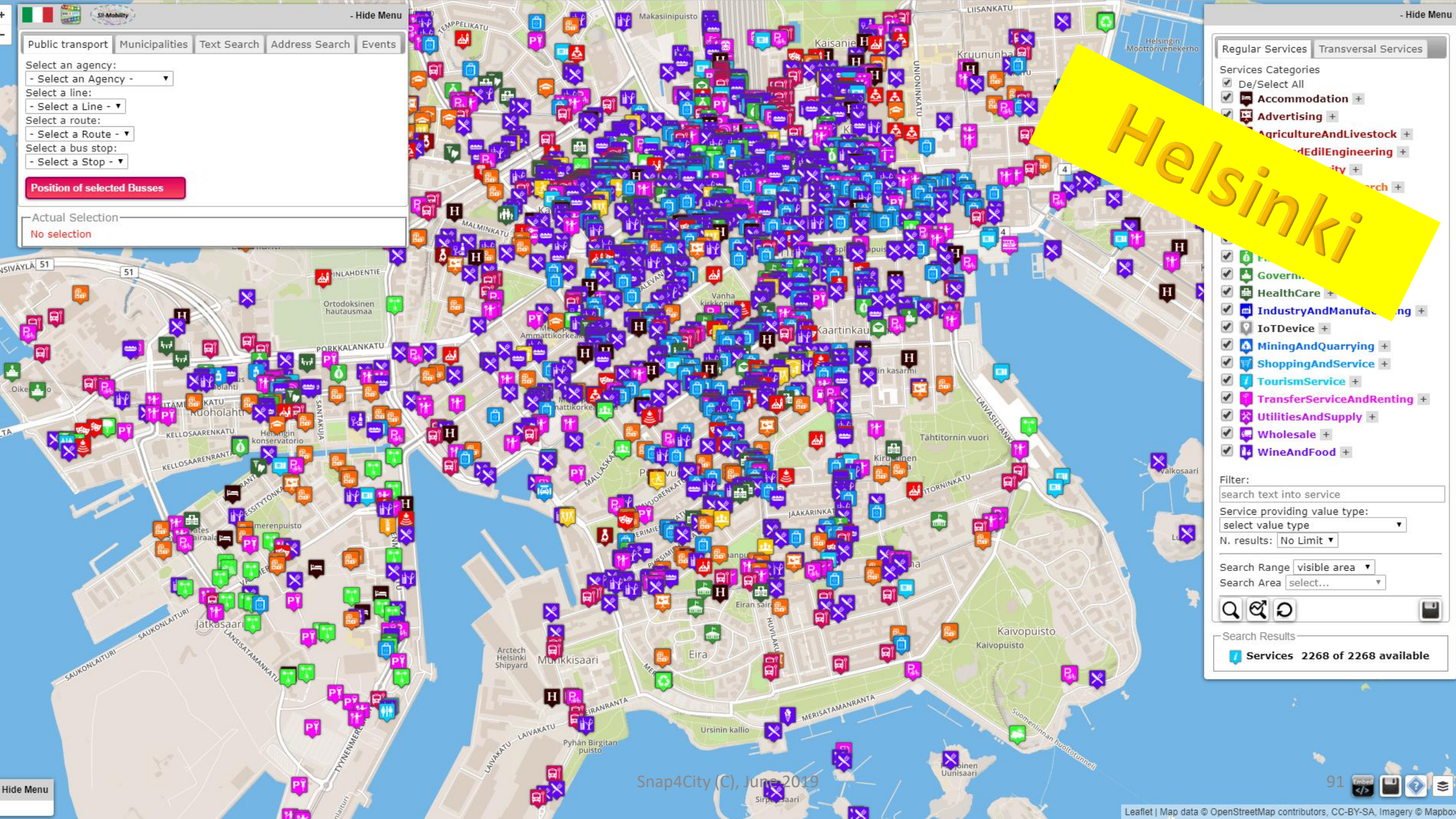
Sardegna



Search all services in the area



Snap4City (C), June 2019


- Hide Menu
Public transport
Municipalities
Text Search
Address Search
Events
Select an agency:
- Select an Agency -
Select a line:
- Select a Line -
Select a route:
- Select a Route -
Select a bus stop:
- Select a Stop -
Position of selected Busses
Actual Selection
No selection
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

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** (……your exercise…….
  - **search for POI and public transport services** (…….
  - **Social Media Monitoring and acting** (…….
  - **Entertainment Events** (…….
  - **Origin Destination Matrices, trajectories, heatmaps** (…….
  - **People Monitoring Assessment in the City** (…….
  - **People Monitoring, via App** (…….
  - **Counting People on the street** (…….
- **Weather and environment**
  - **Weather forecast/condition** (…….
  - **Air quality Pollution** (…….
  - **Pollination** (…….
  - **Air quality predictions for multiple parameters** (…….
  - **Heatmaps for weather and air quality** (…….
  - **Air quality indexes, and forecast** (…….

Protocols vs Data



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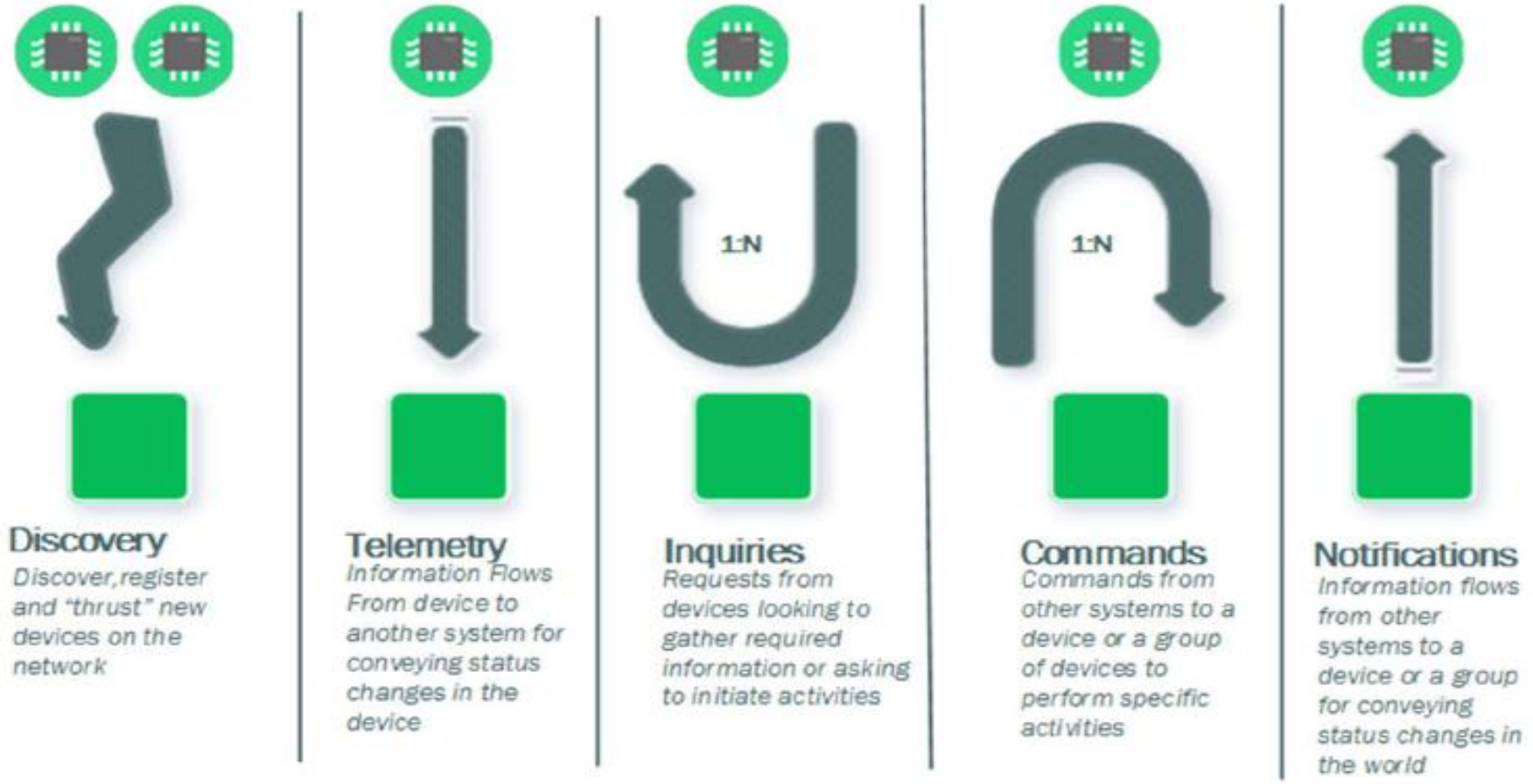
IOT/IOE Protocols

Communication Patterns



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

Interoperability

Powered by FIWARE

http://marketplace.fiware.org/pages/solutions/b8905e91973b420189cce972

https://partners.sigfox.com/companies/disit-lab-university-of-florence

https://partners.sigfox.com/products/snap4city

https://flows.nodered.org/?num_pages=1

https://flows.nodered.org/?term=snap4city&num_pages=1

E015 digital ecosystem Official API

http://www.e015.regione.lombardia.it/

Compliant
Federated

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, 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, RS485, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, JSON, XML, GeoJSON, Enfuser FMI, Android, Raspberry, Local File System, etc.

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



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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

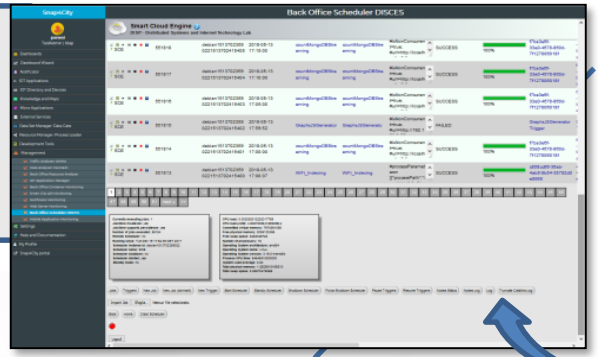
Distributed Back Office

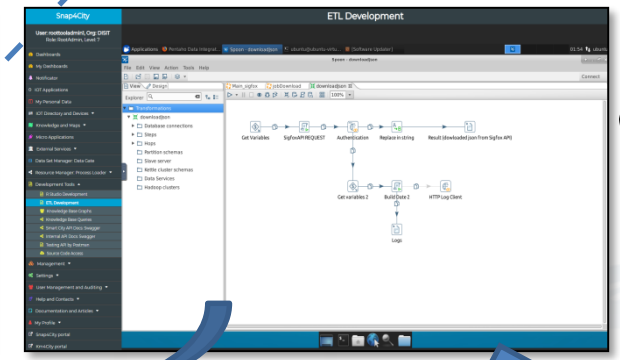
DISCES scheduler production

ETL Development Environment

Data sources

ETL Process





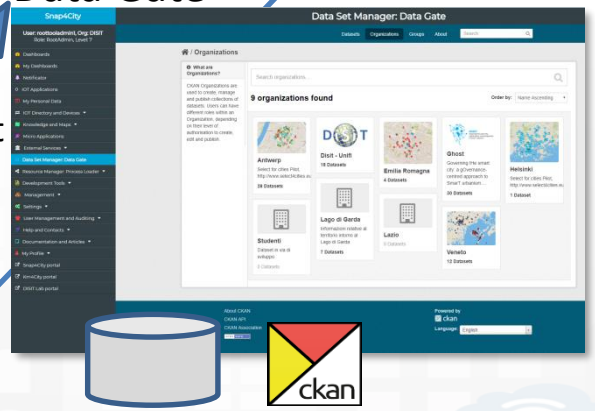


Knowledge Base, Km4City



Knowledge and Storage Data from the Field and City

Data Gate



Data Set Saving / Sharing

Saving / Sharing reusing

Data Set Loading/ Downloading



Resource Manager

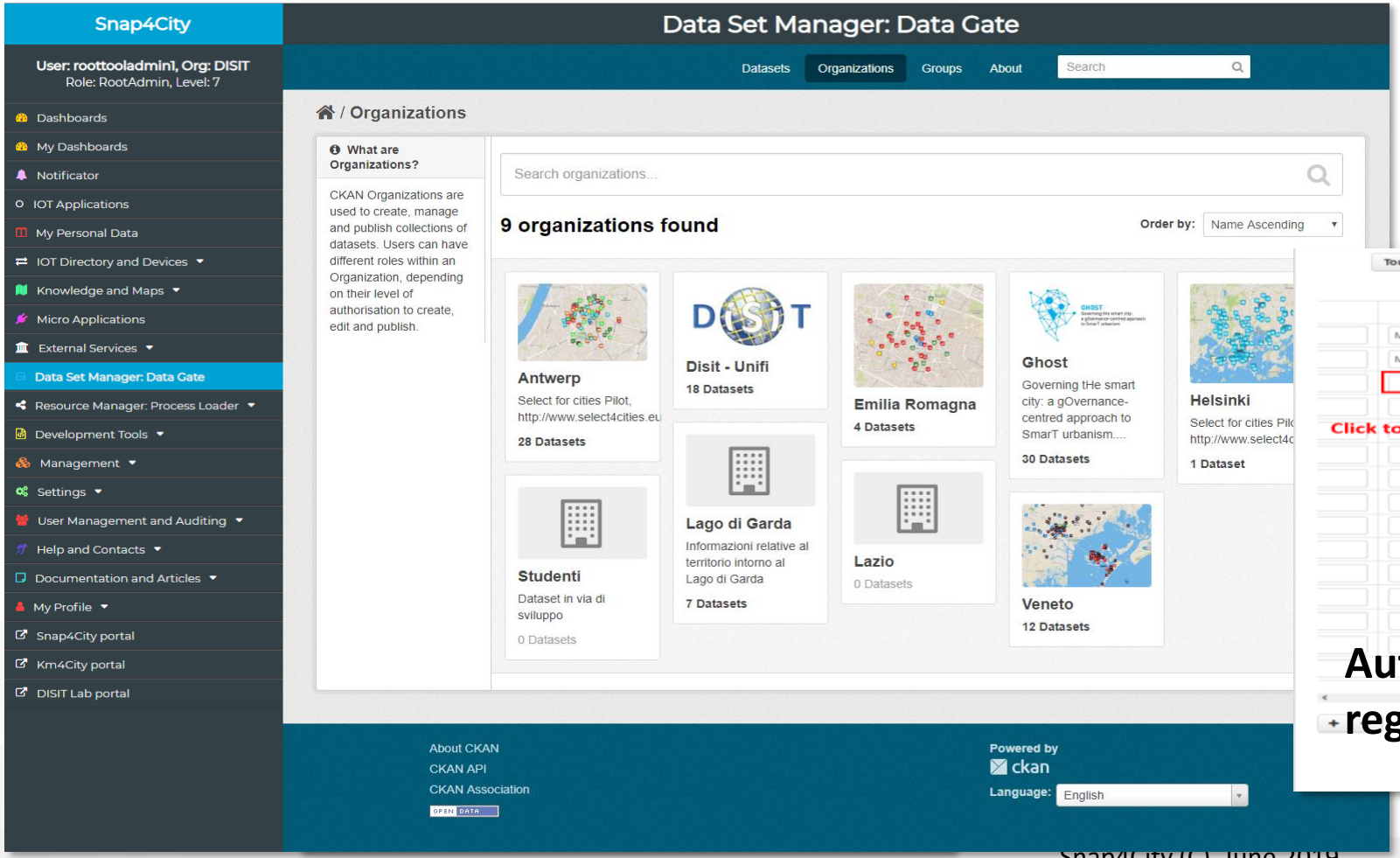
Schedule Execute

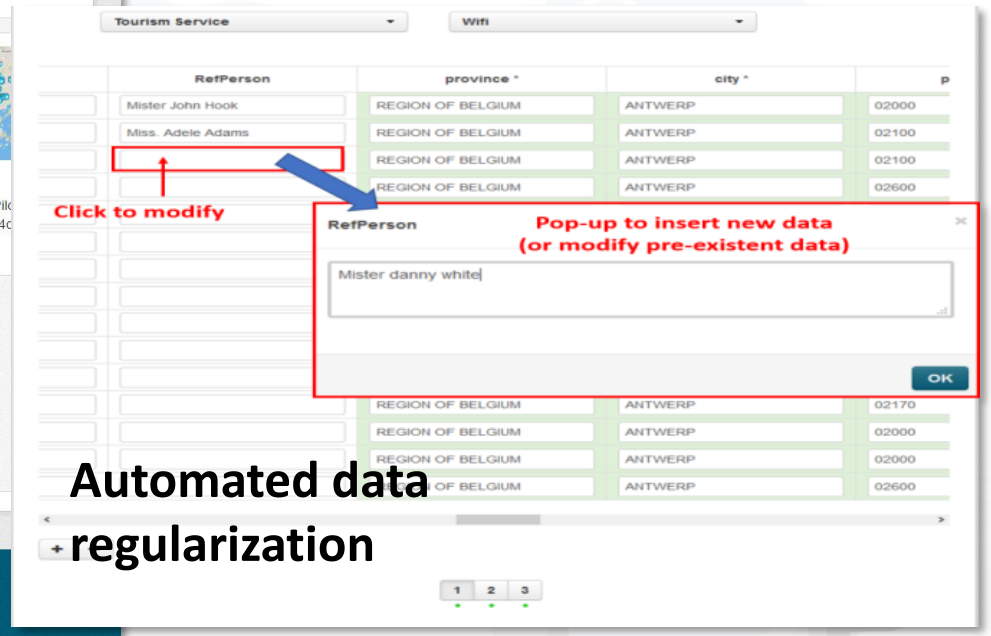
Load data or prepare for data ingestion

Integrated DataGate/CKAN
Static open data ingestion

Federated Crawling
Federated Distribution

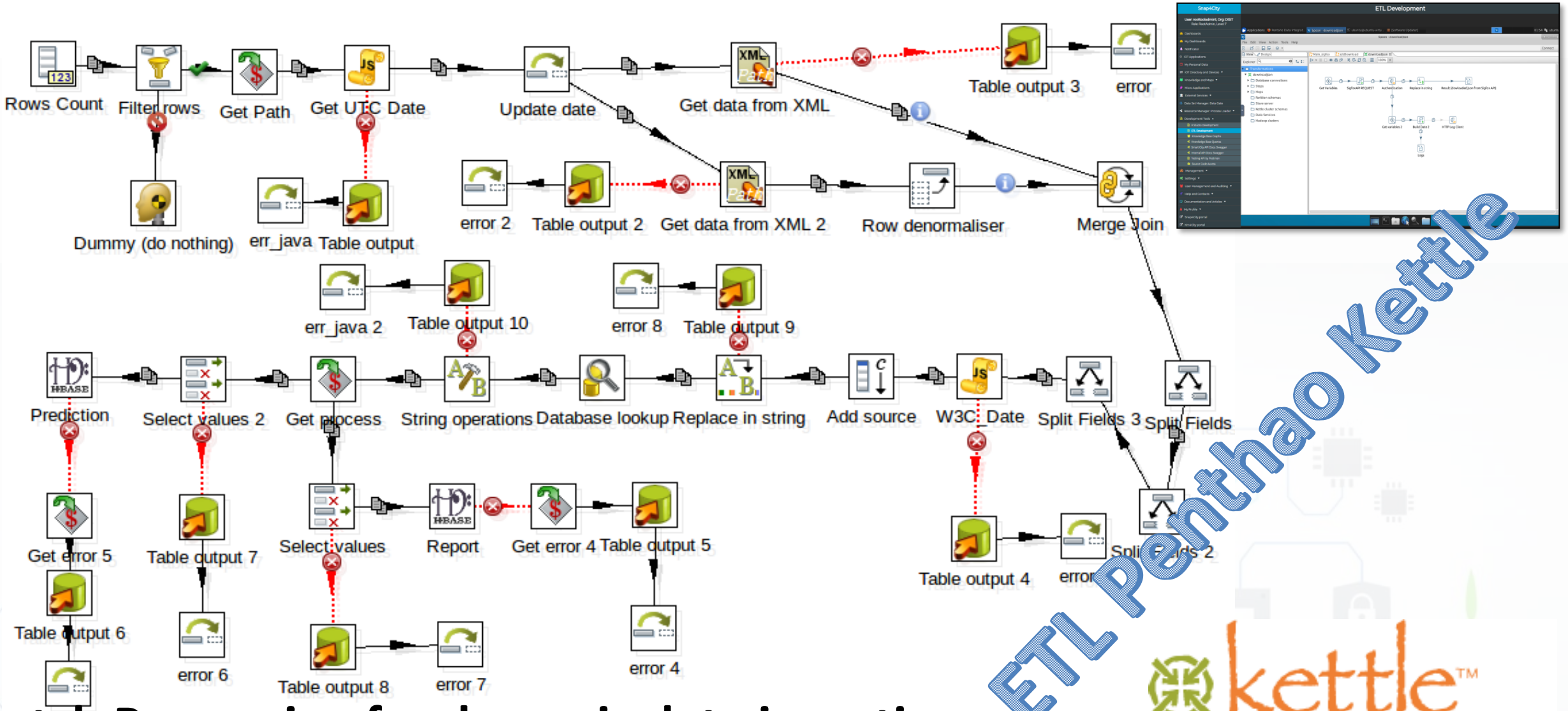
Data Set:
- Search
- Loading
- Download
- Share
- Publish
- Also automated





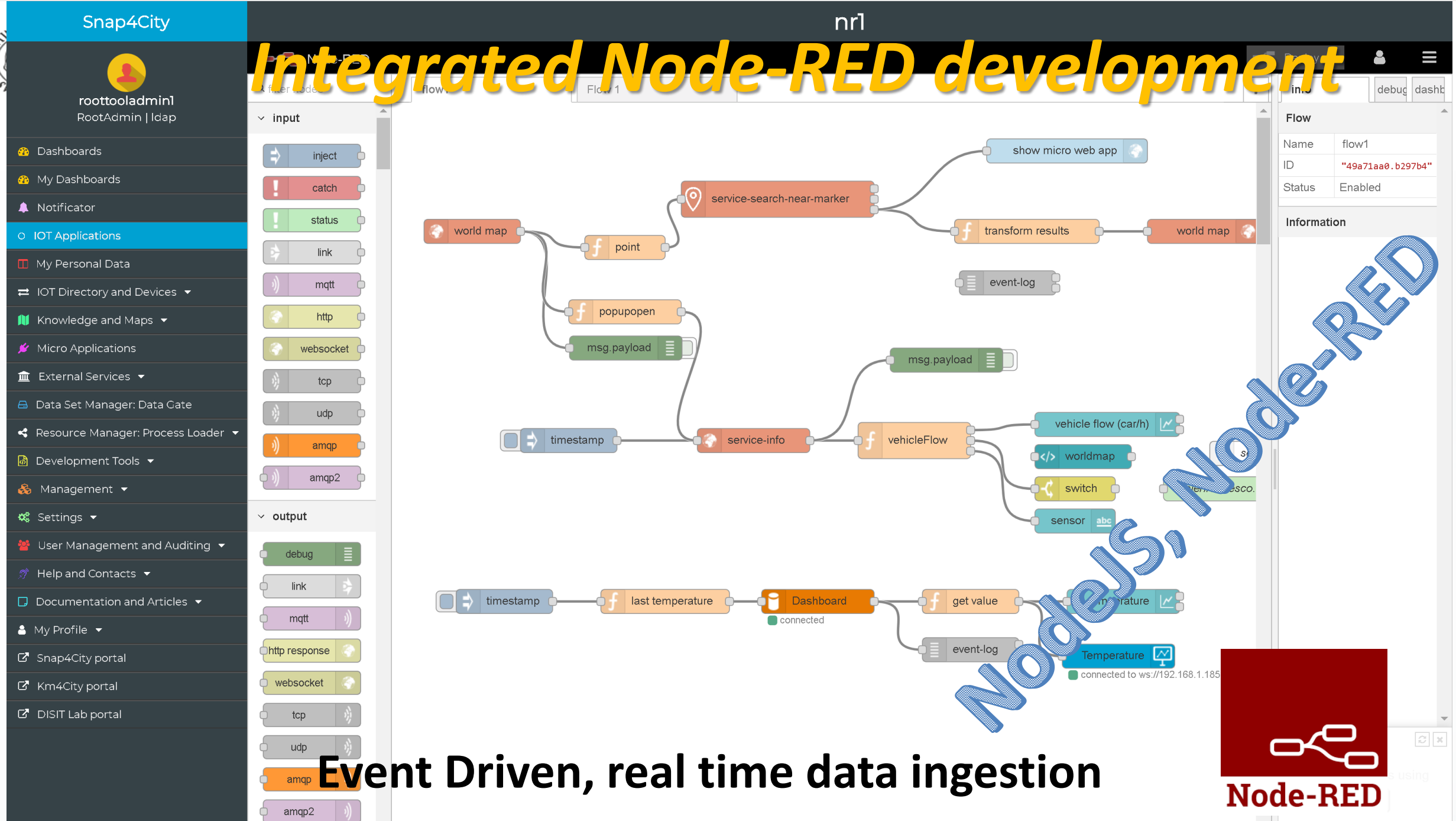
Automated data regularization

Integrated ETL development



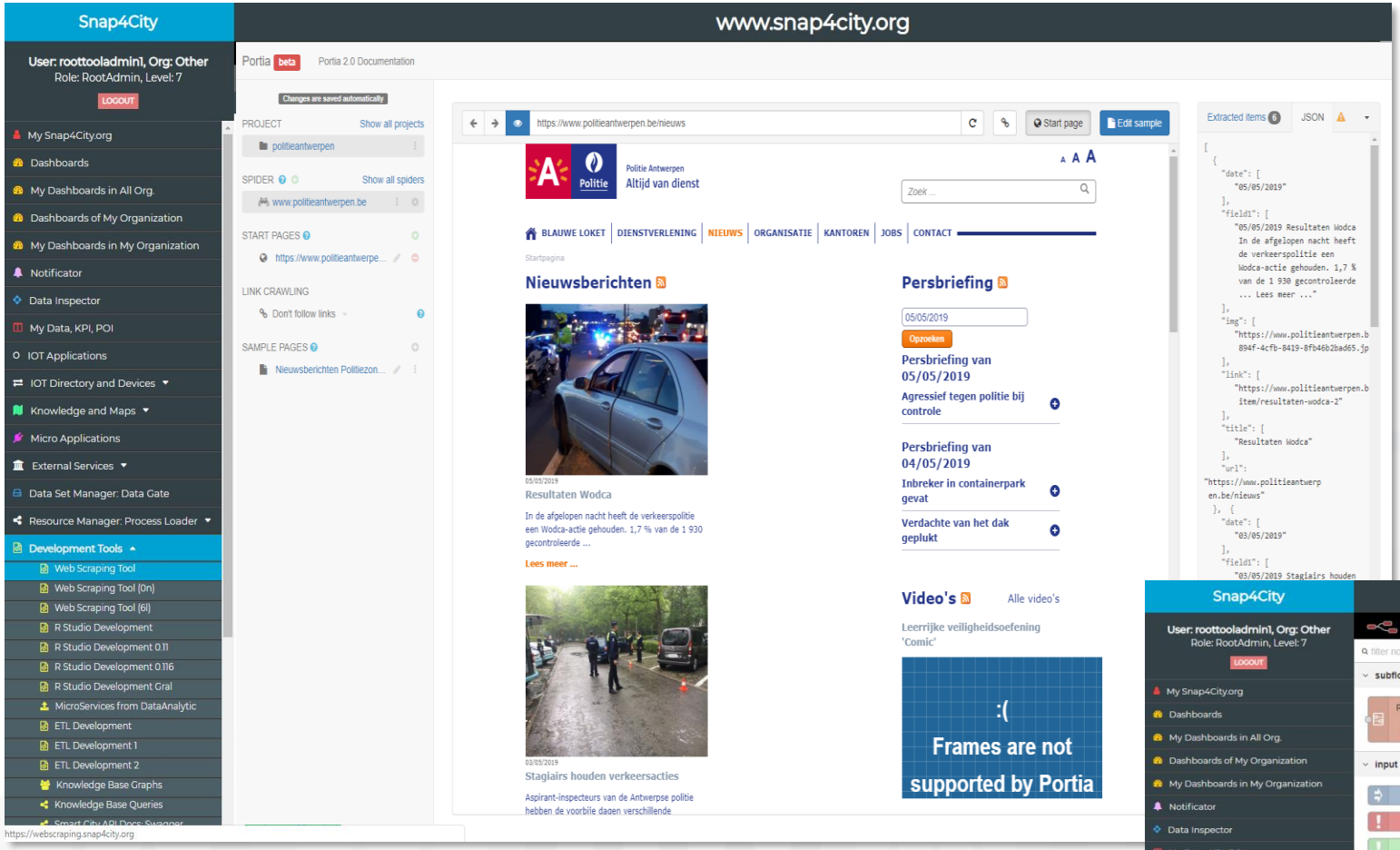
Batch Processing for dynamic data ingestion

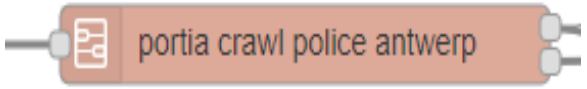
Integrated Node-RED development

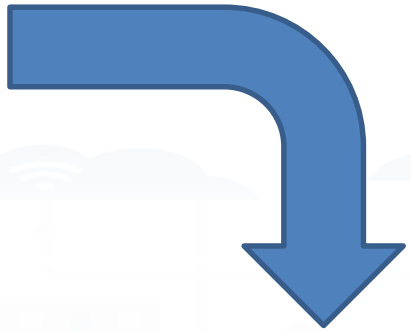


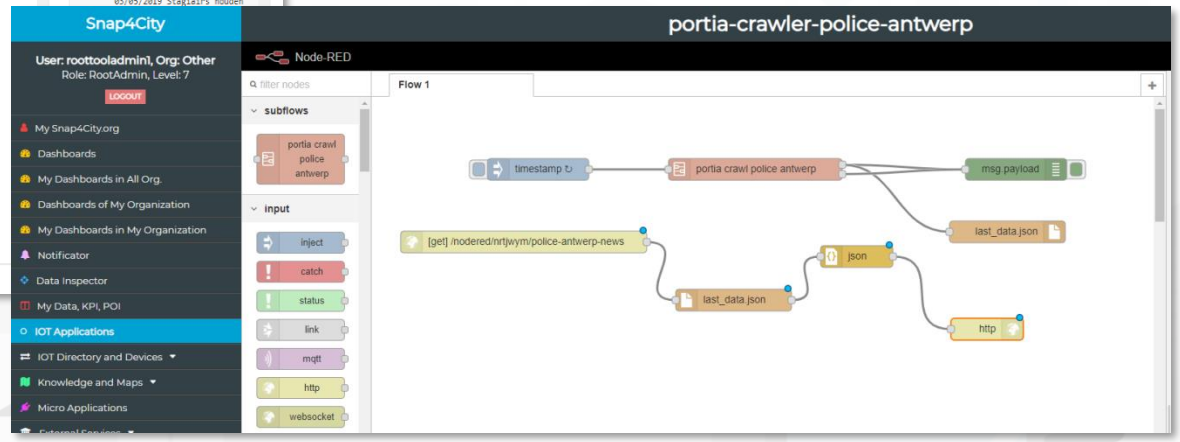
Event Driven, real time data ingestion

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 Gathering/Connection

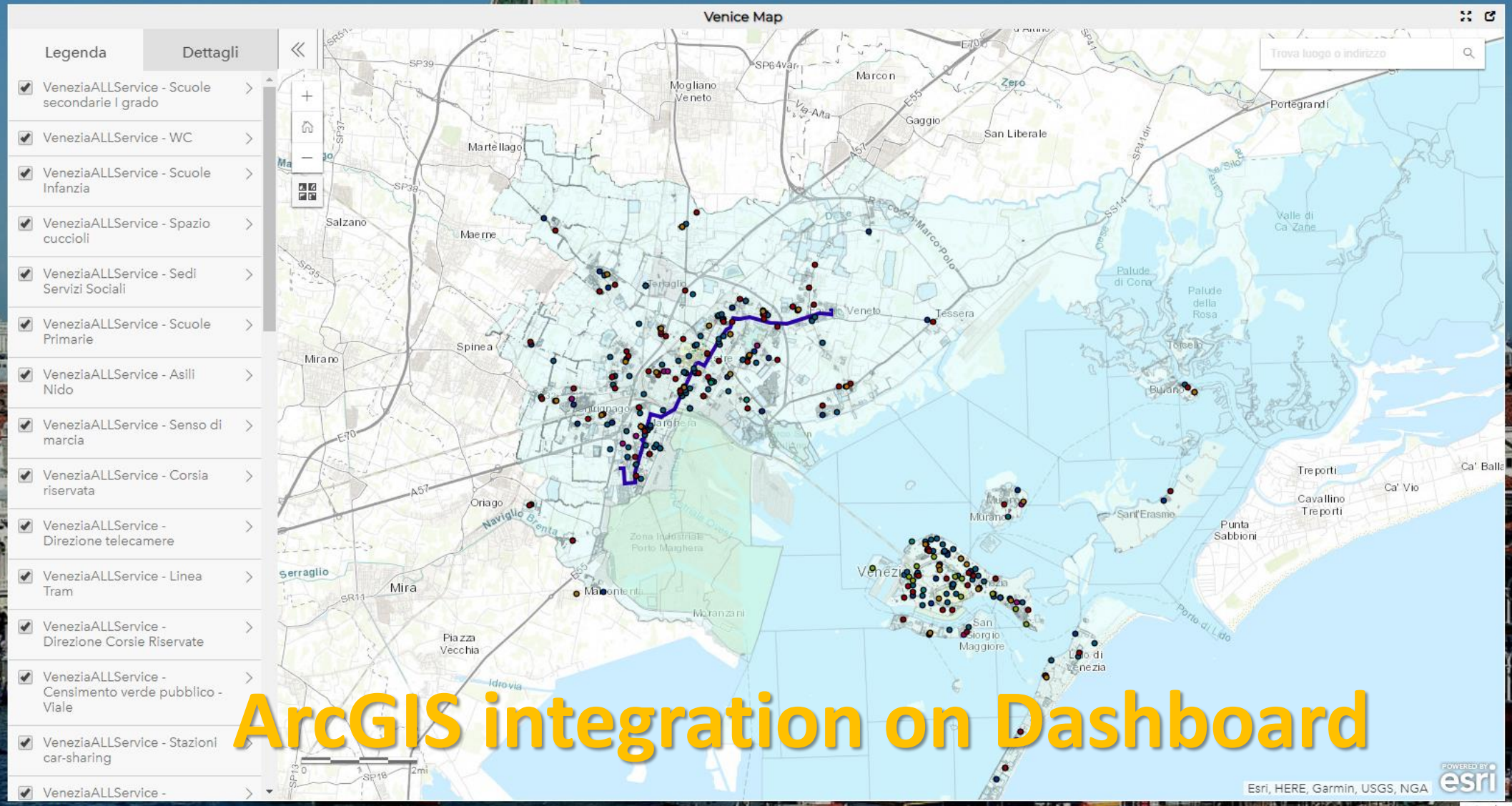


ARC

INDEX

ArcGIS Integration

Sat 10 Nov 16:58:32

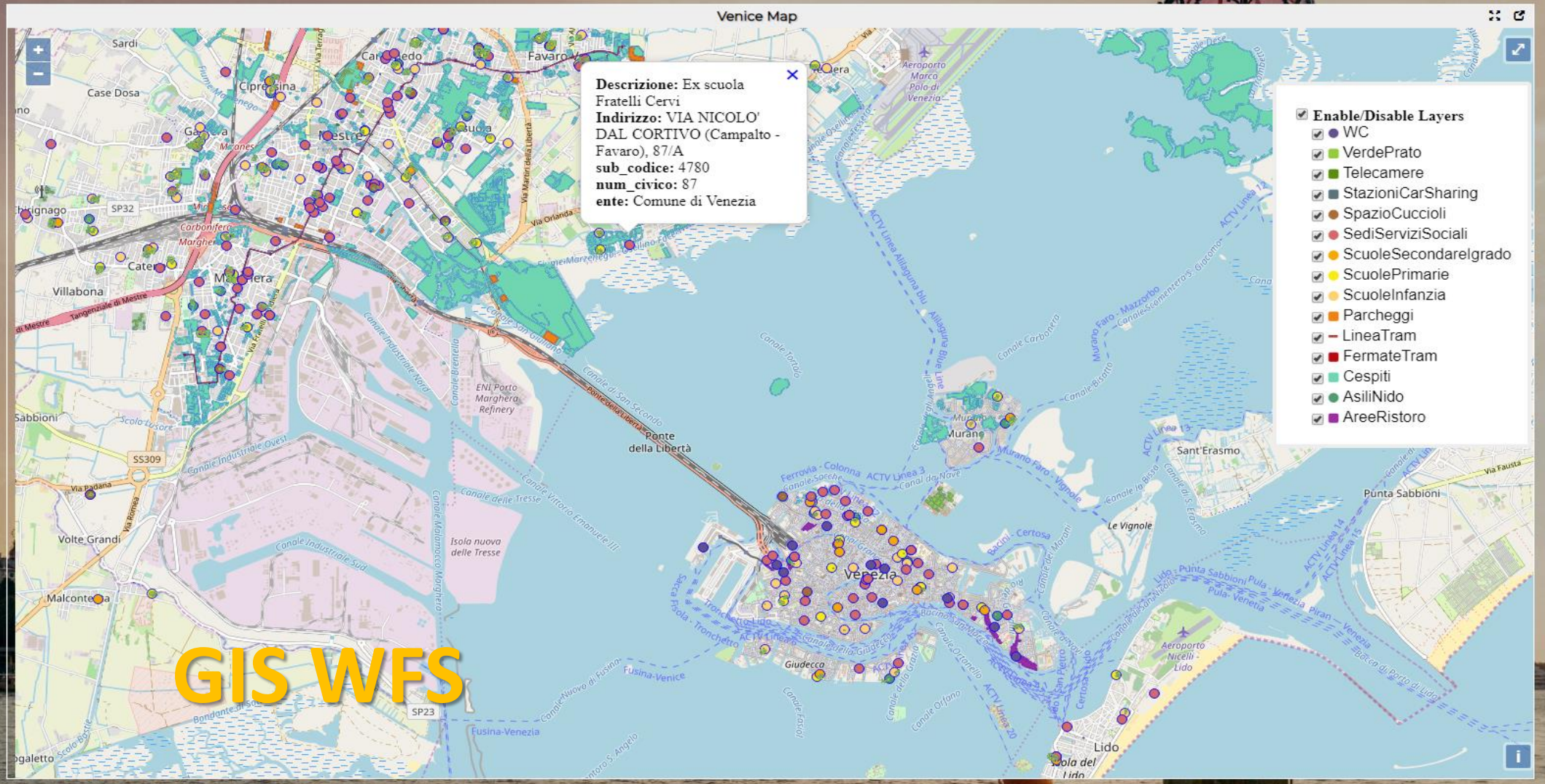


ArcGIS integration on Dashboard

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

GIS WFS WMS connected

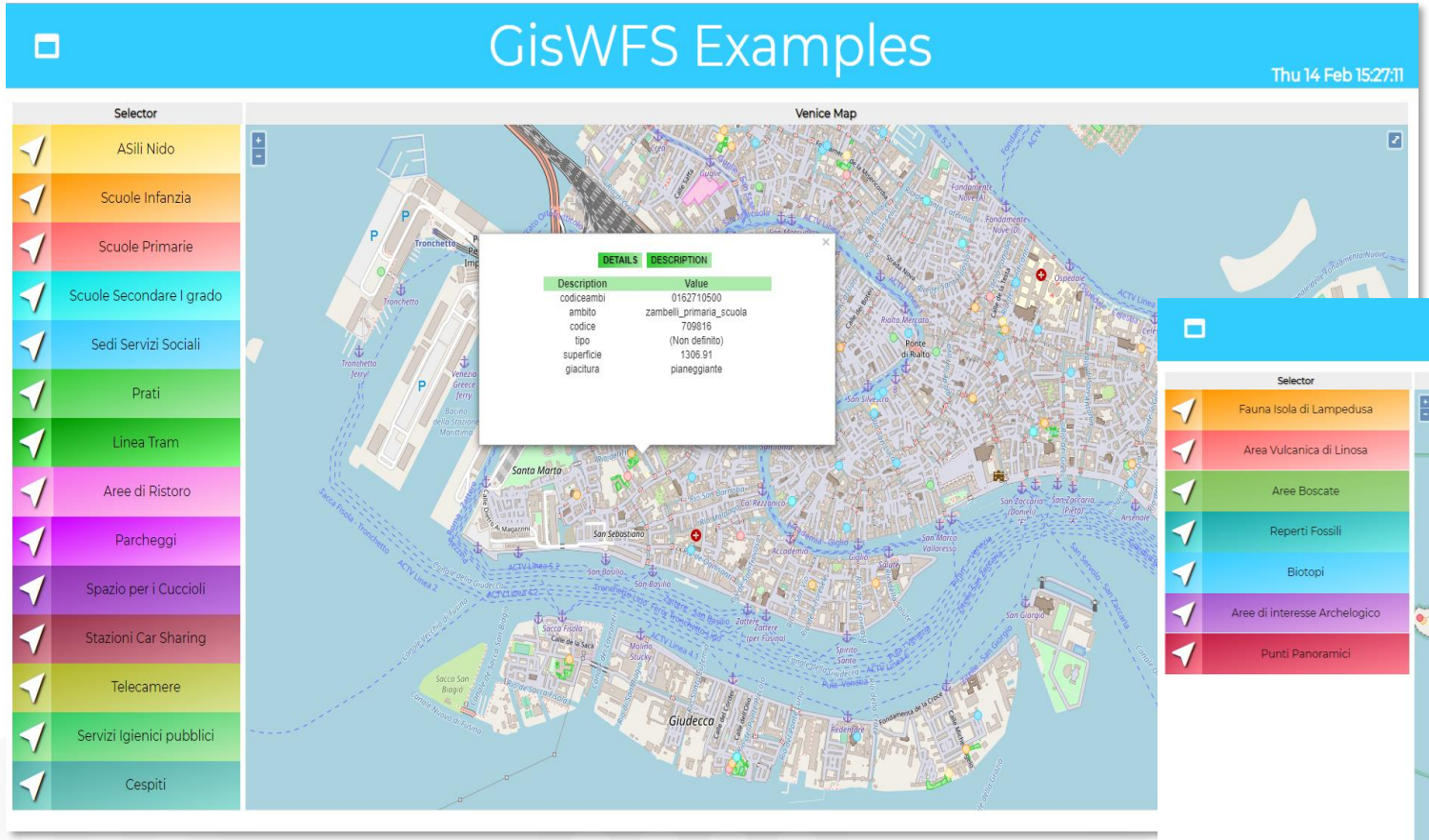
Sun 11 Nov 00:27:54

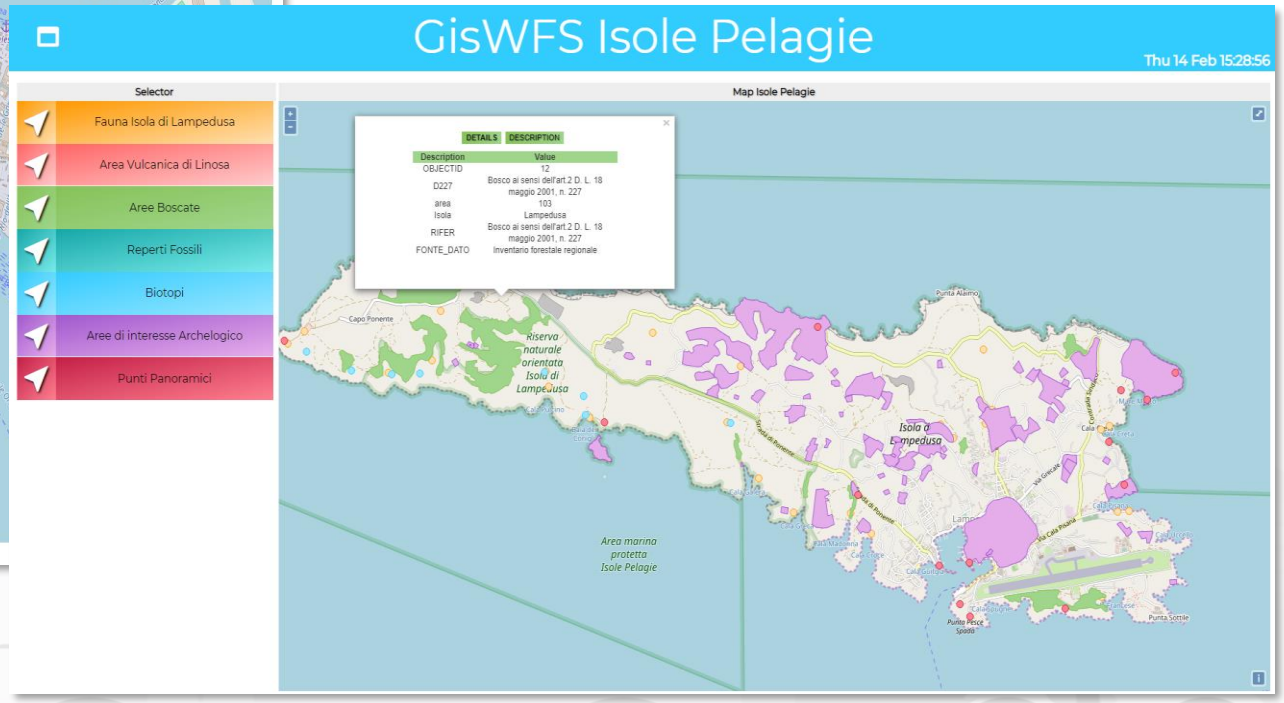


GIS WFS

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

GIS data connection exploiting WFS/WMS map





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

Snap4City vs GIS, WFS/WMS

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

Semantic Modeling and City Knowledge Base, Km4City



ARC

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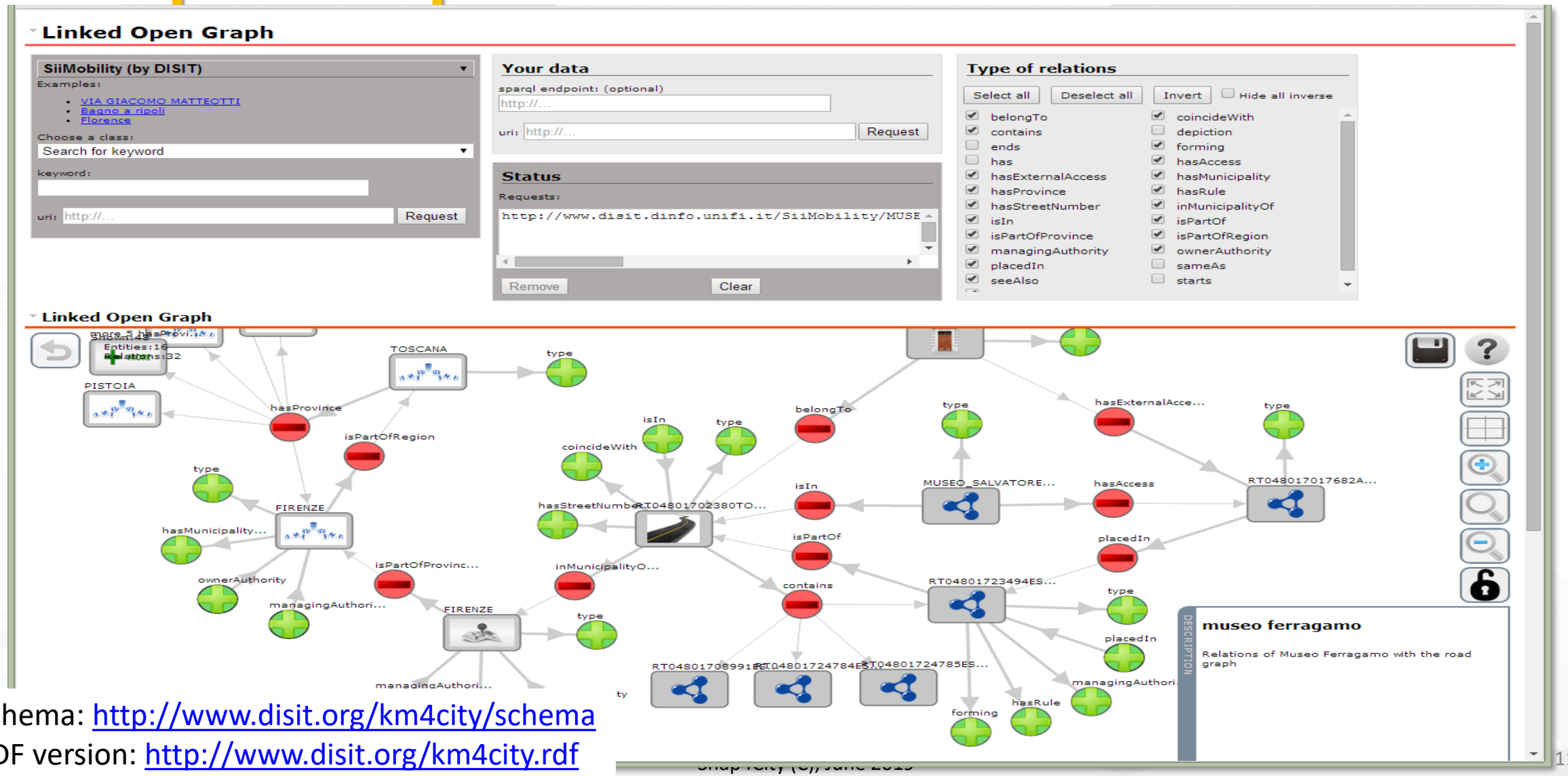
Linked Open Data

Linked Open Graph

LOG: https://log.disit.org



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

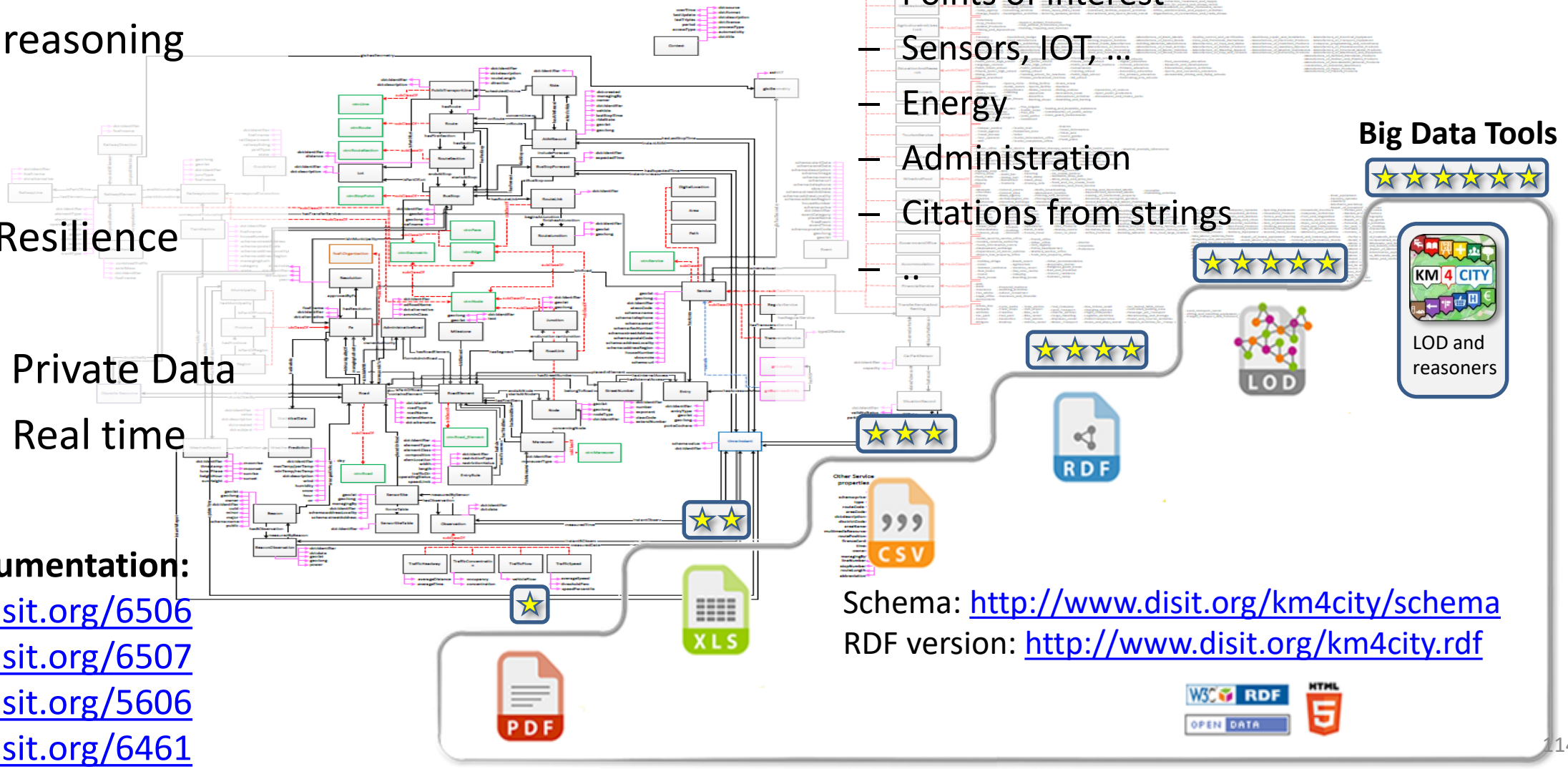
RDF version: http://www.disit.org/km4city.rdf

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

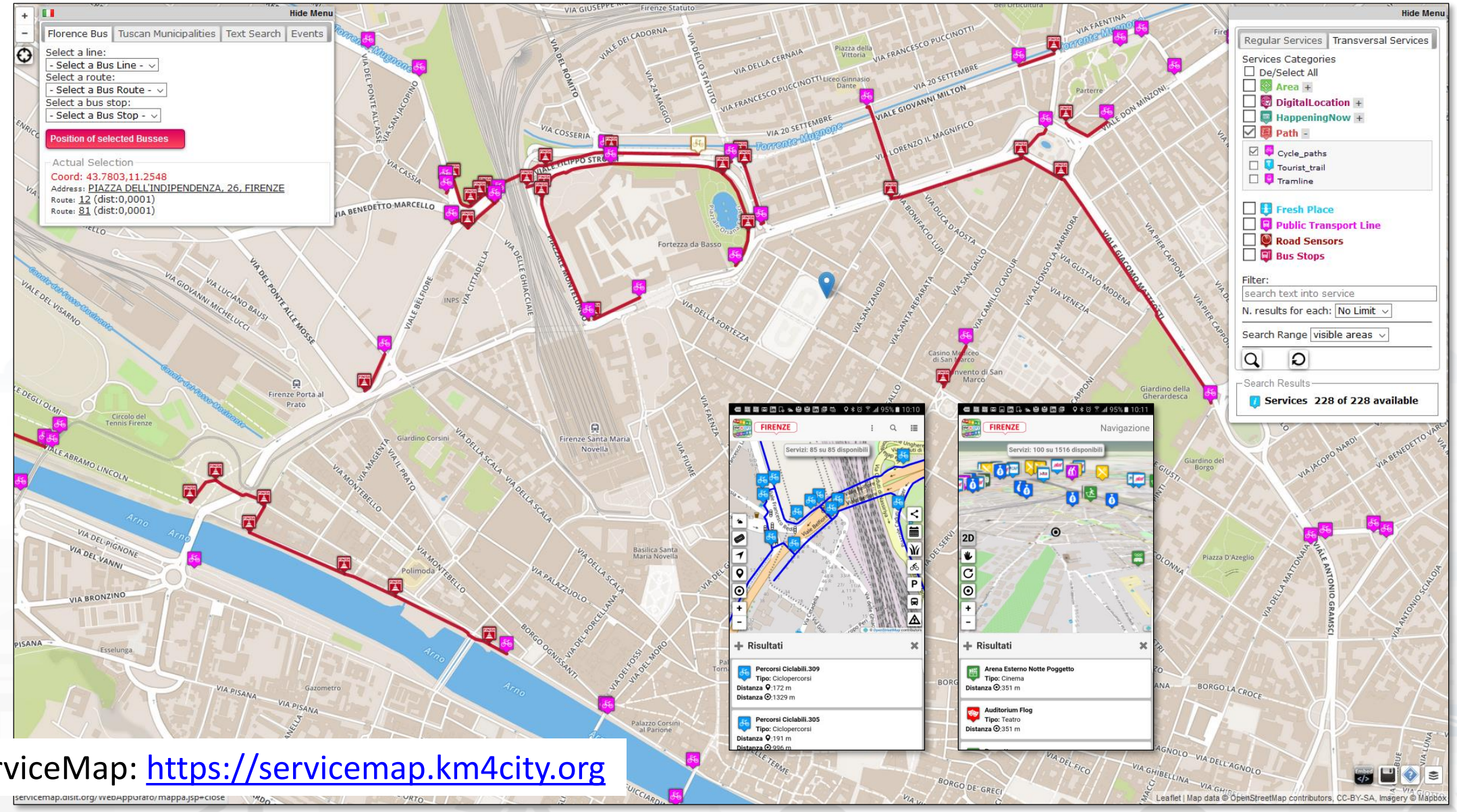
Ontology Documentation:
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

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



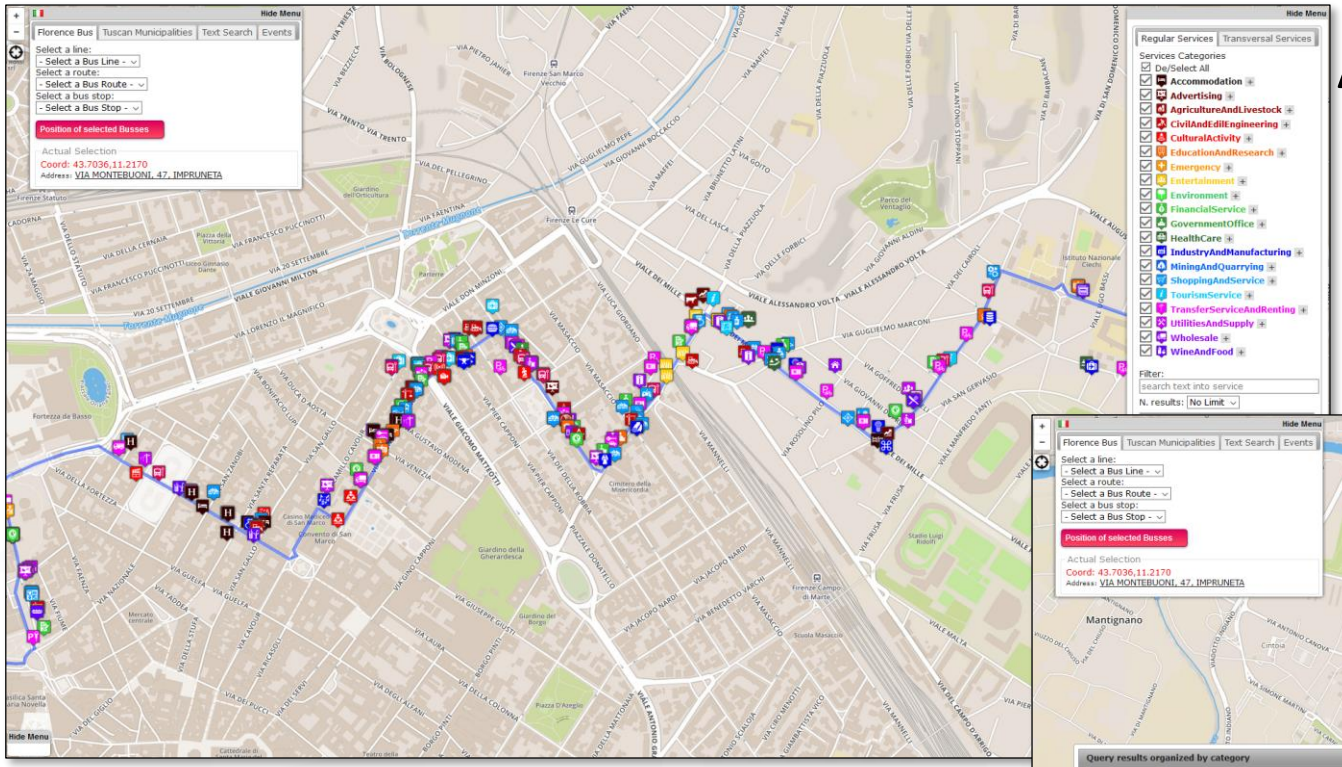
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
http://www.disit.org

Cycling Paths

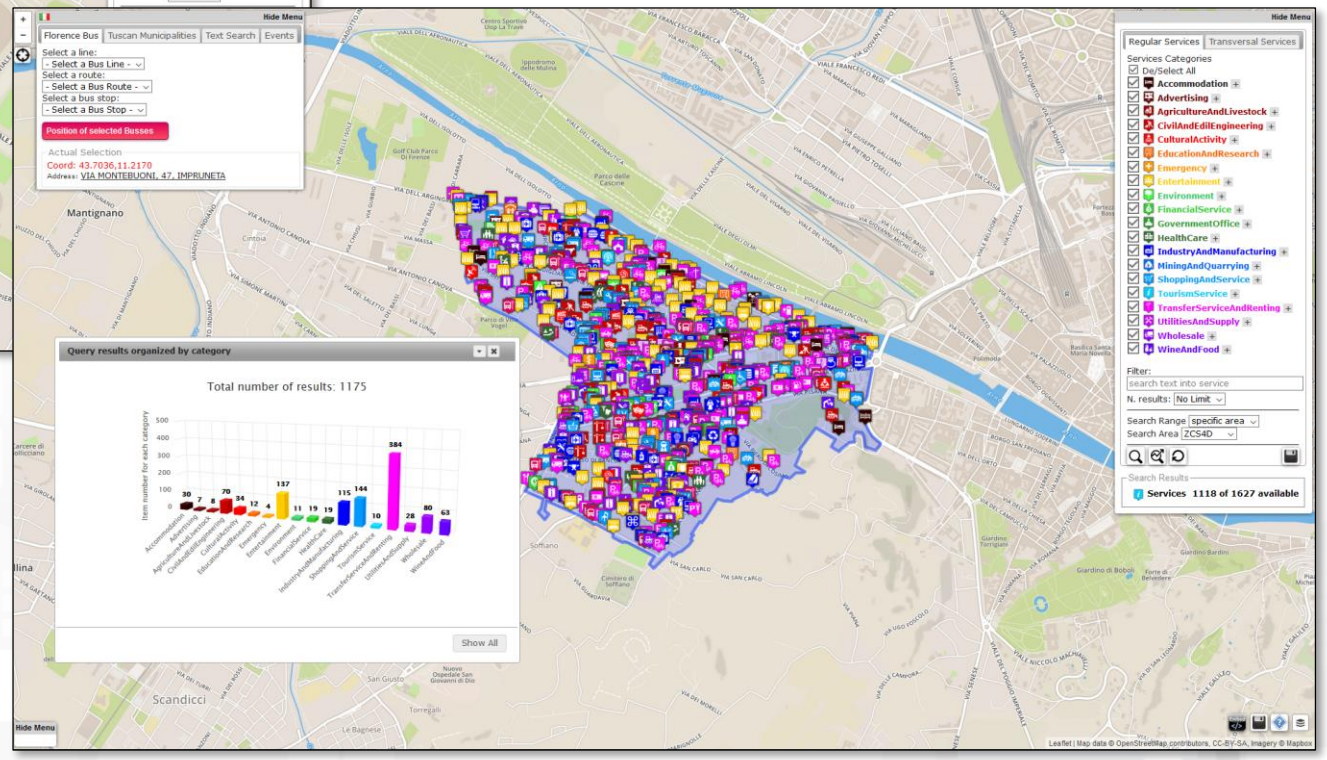


ServiceMap: https://servicemap.km4city.org

Searching …



Along a path



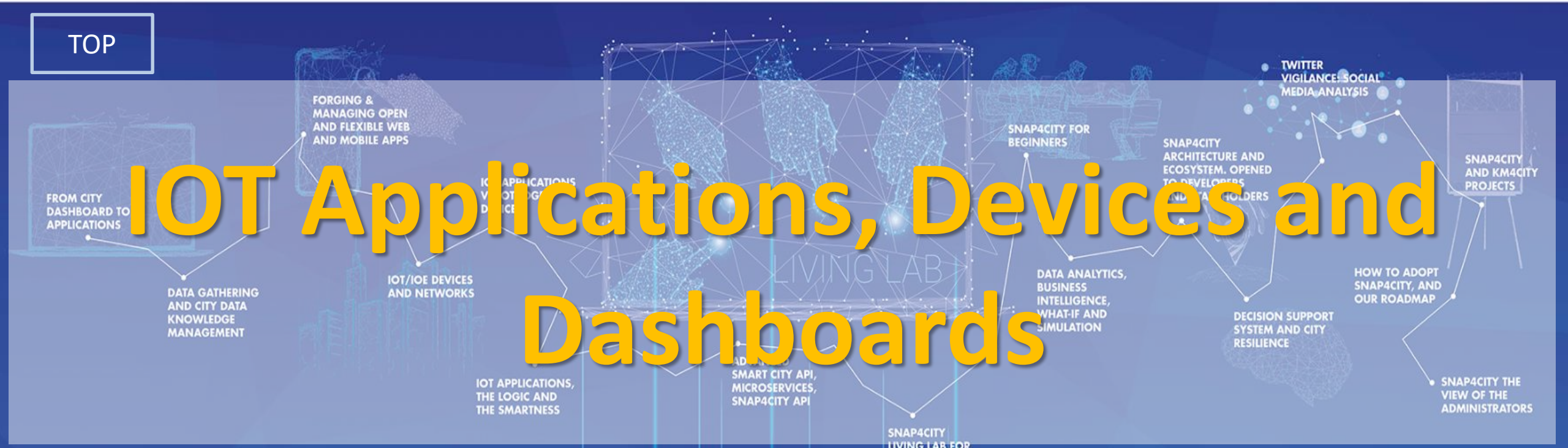
Inside an area

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**



IOT Applications, Devices and Dashboards

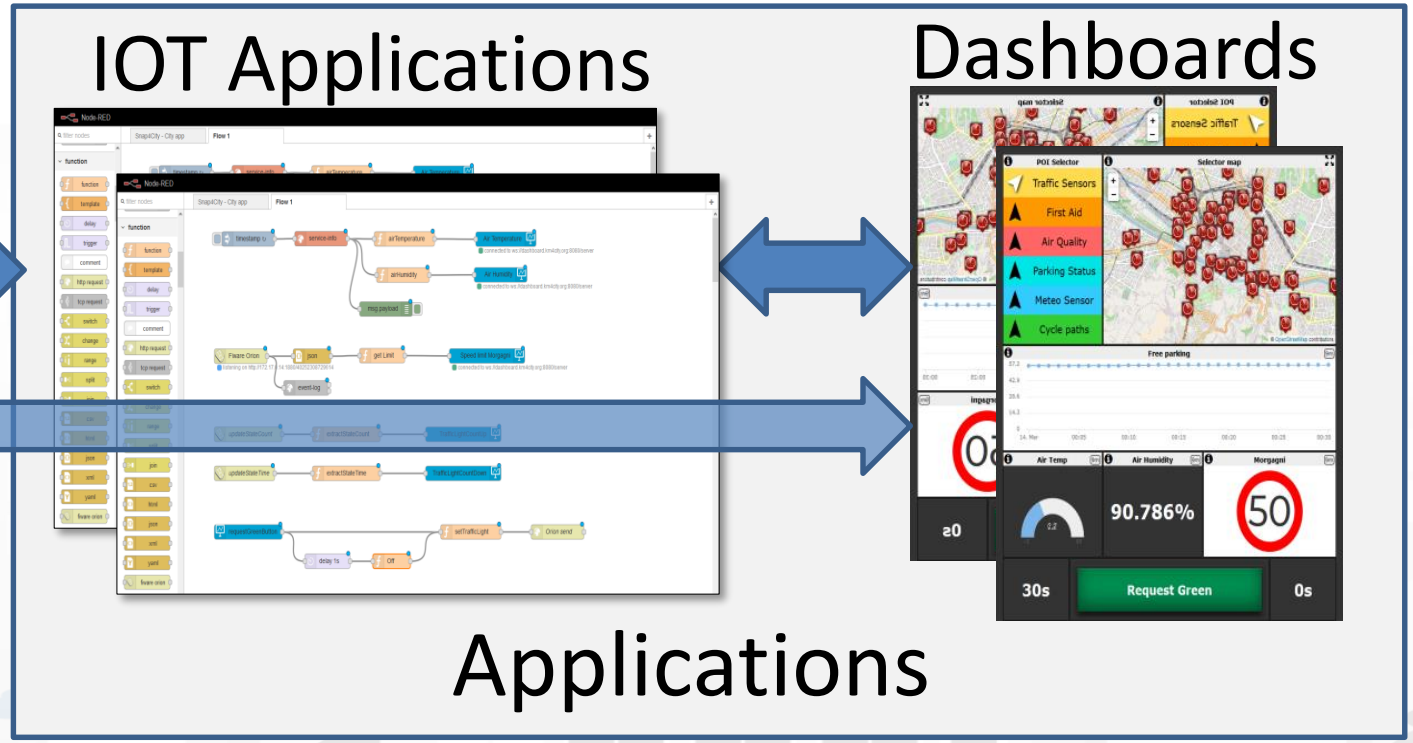
Dashboard with intelligence App

Dashboards with IOT Applications for entorcing smart and intelligence into them

Dashboard-IOT App

IOT and City data World





IOT Applications

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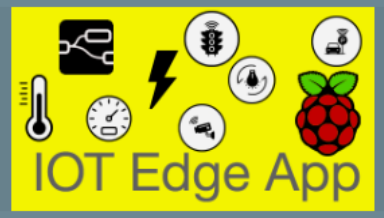

owner: badii
Management

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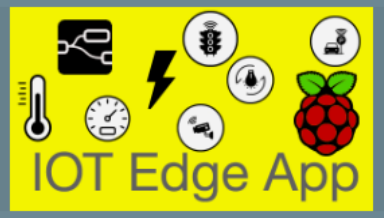

owner: panesi
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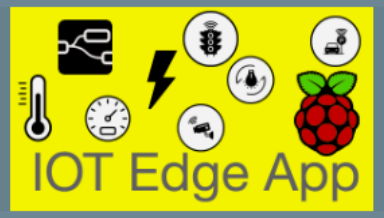

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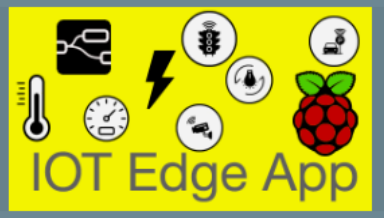

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Management

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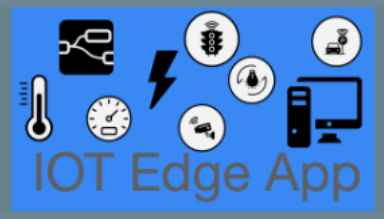
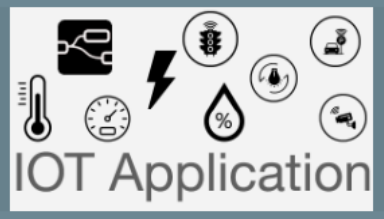
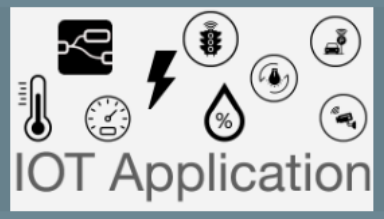


owner: semolarudy
Management

application


owner: tester5
Management

Bib APP


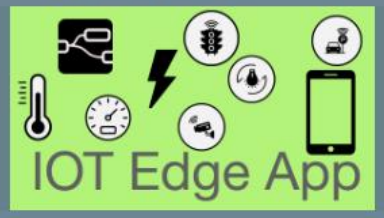
owner: semolarudy
Management

ChargingStations


owner: comunedashres
Management

Deprecated - SiiMobilityControlRoom


owner: badii
Management

SamsungGalaxyS4BarCode


owner: badii
Management

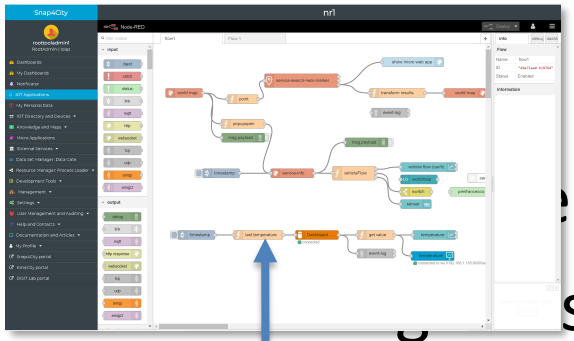
esercitazione


owner: tester2
Management

Iot-App


owner: tester14
Management

IOT Applications



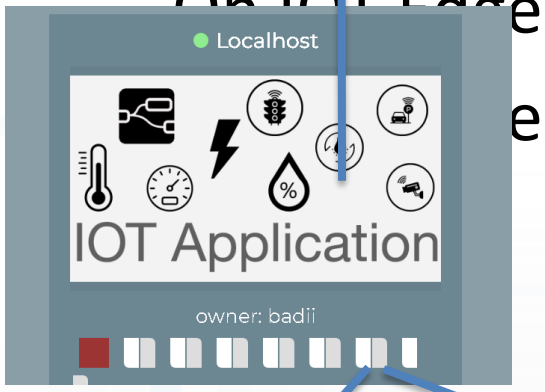
EDIT IOT APP

ed

spberry Pi

On IOT Edge Android

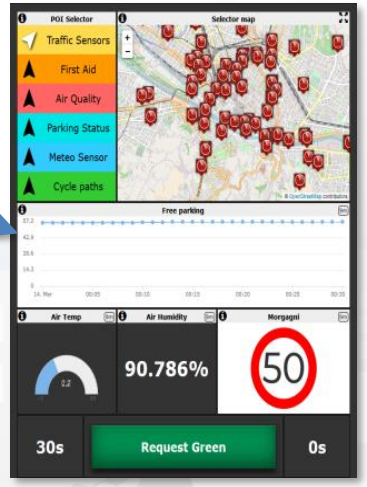
e Win/Linux



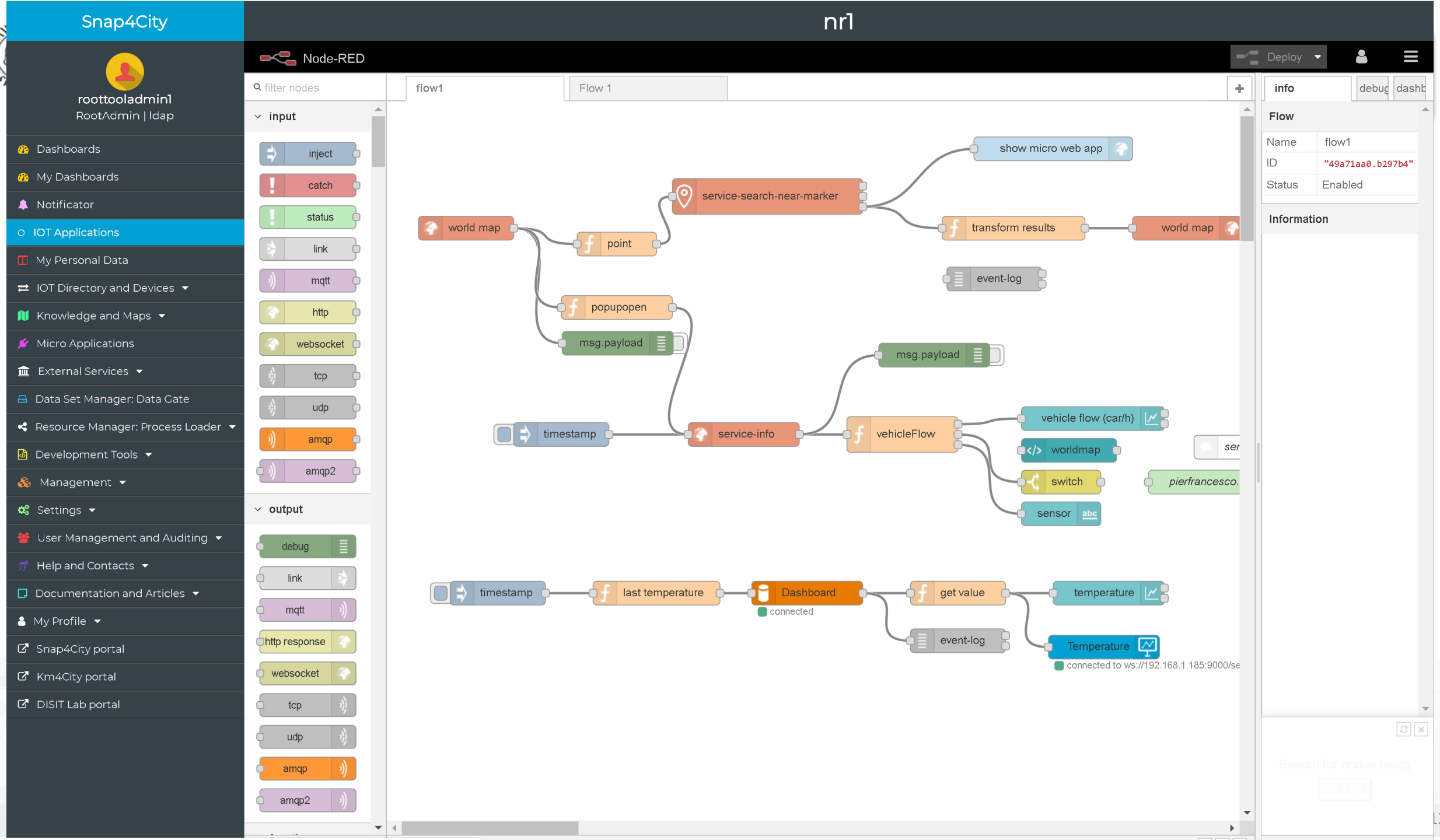
VIEW

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

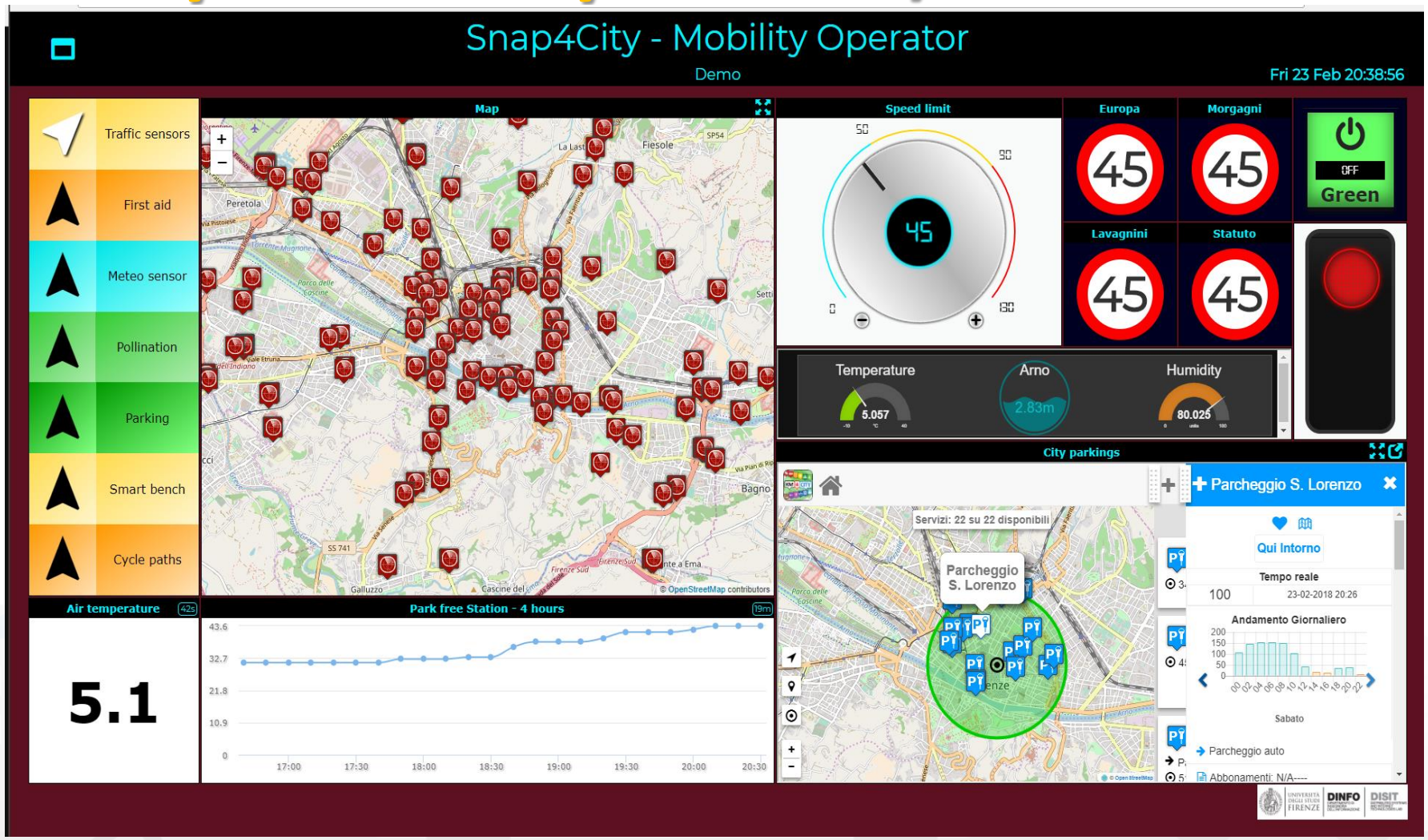
Sensors:

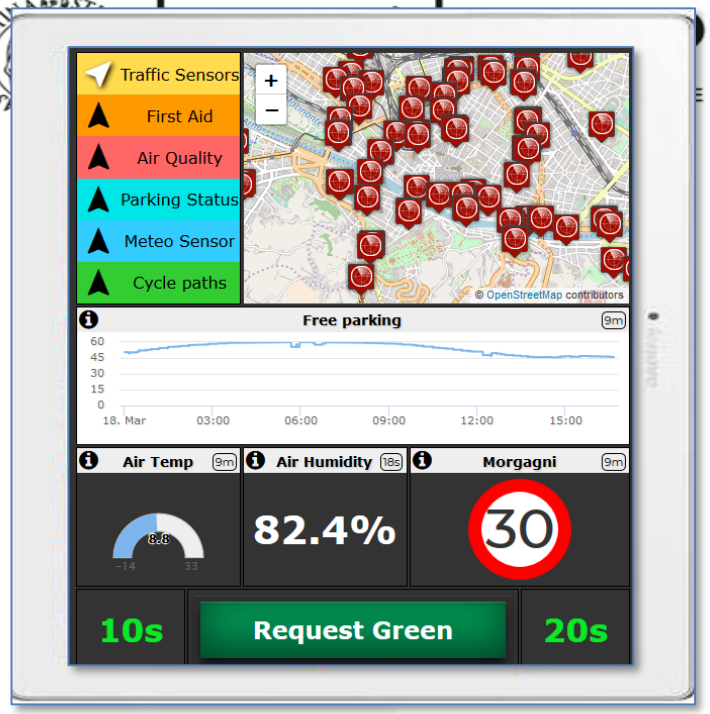
- Values
- Status

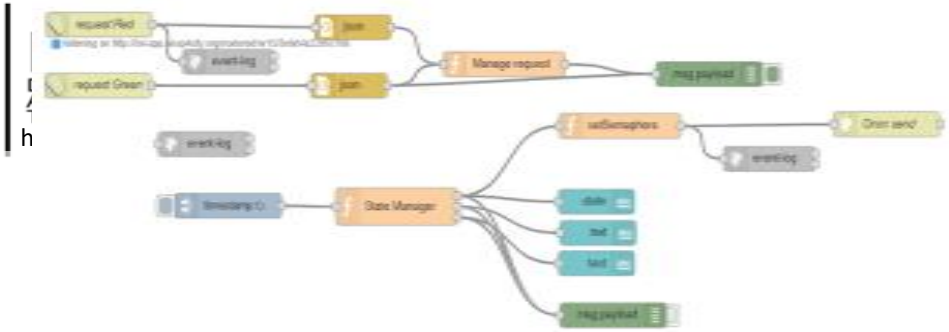
Actuators:

- 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





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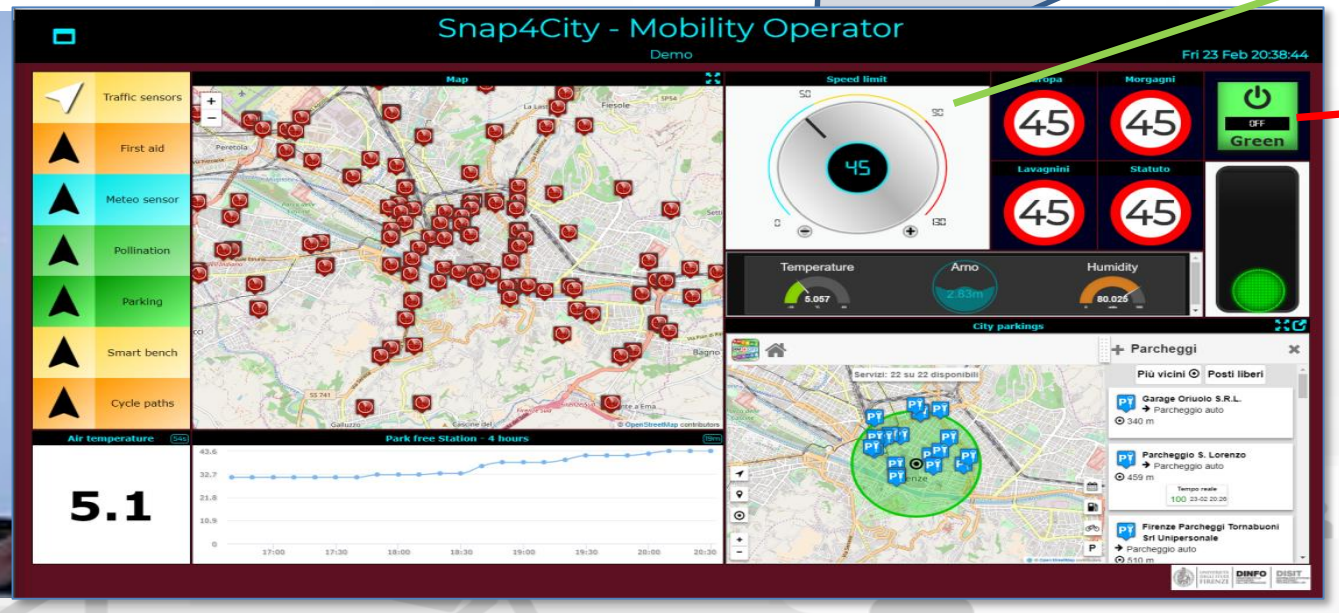
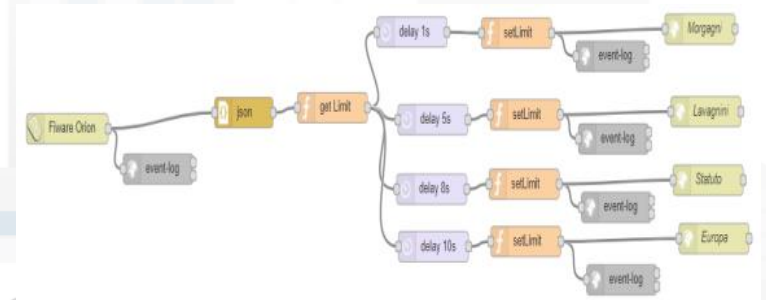
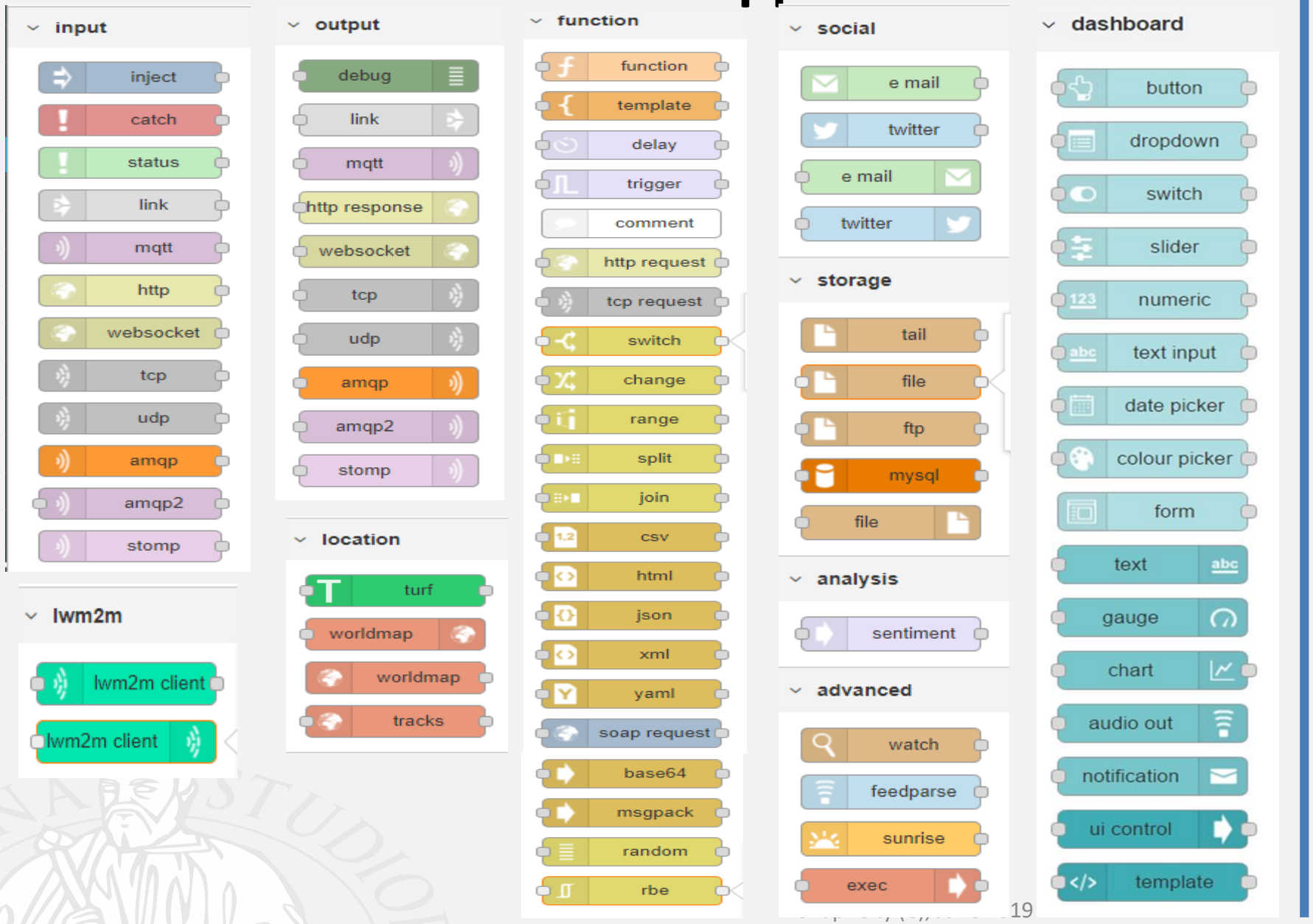

Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
45
Europa
Morgagni
Lavagnini
Statuto
OFF
Green
Temperature
Arno
Humidity
City parkings
Parcheggi
Più vicini
Posti liberi
Air temperature
5.1
Park free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

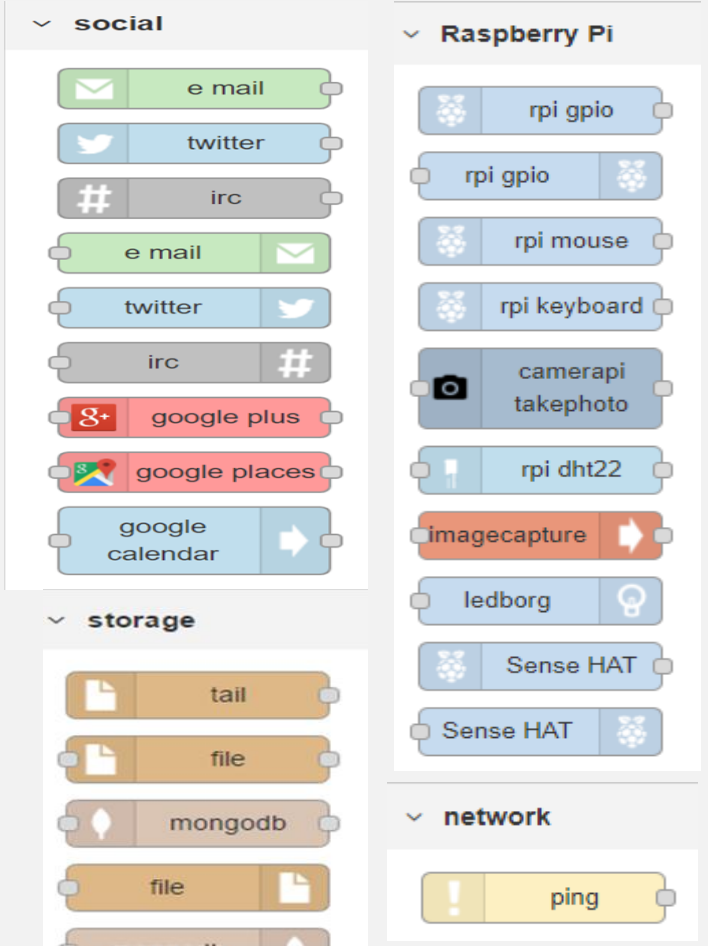

Fiware Orion
event-log
json
get Limit
delay 1s
delay 5s
delay 8s
delay 10s
setLimit
event-log
Morgagni
Lavagnini
Statuto
Europa

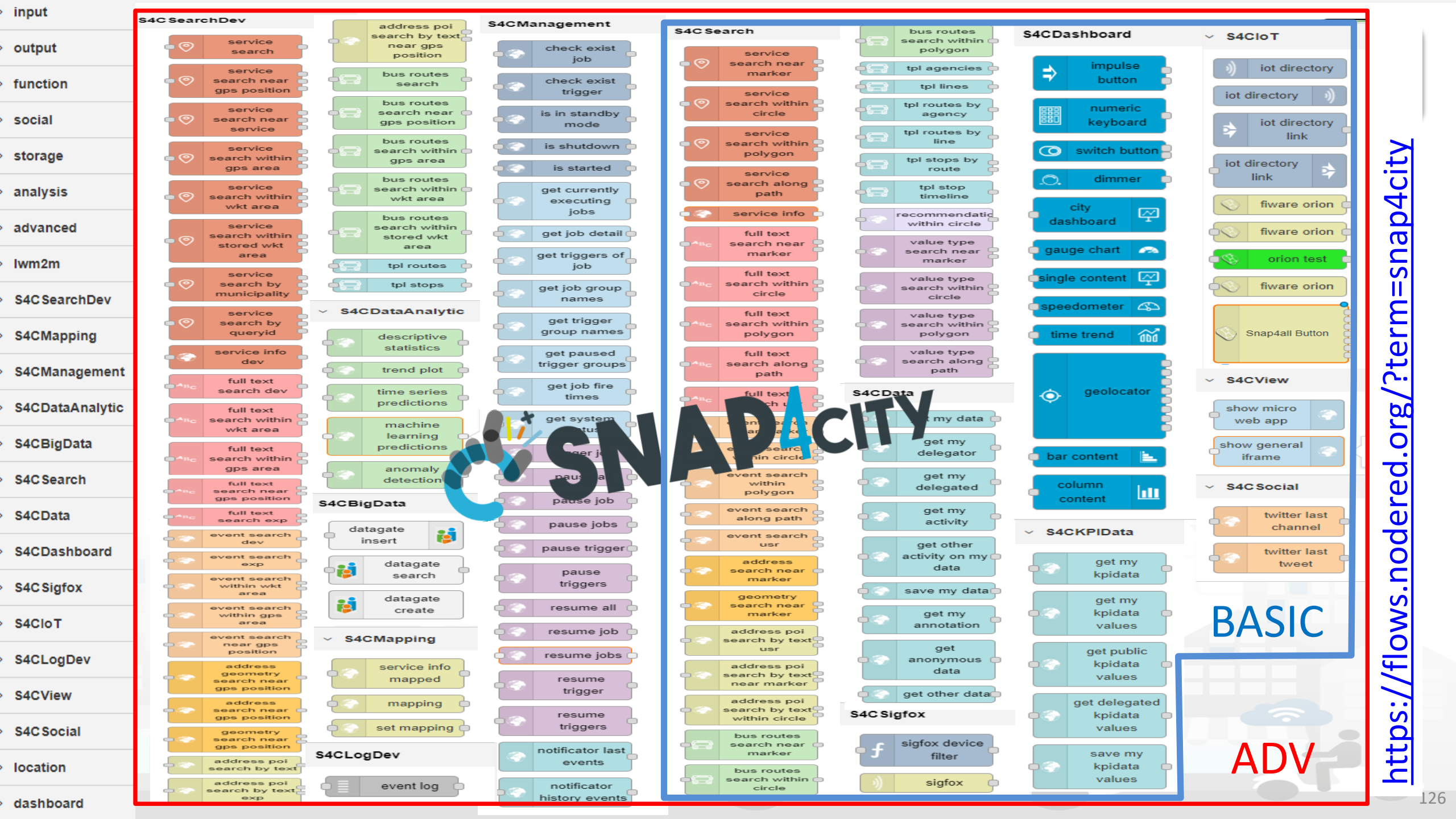
Basic Node.js Blocks on NodeRed on our Advanced IOT Apps





+ 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
service search
service search near gps position
service search near service
service search within gps area
service search within wkt area
service search within stored wkt area
service search by municipality
service search by queryid
service info dev
full text search dev
full text search within wkt area
full text search within gps area
full text search near gps position
full text search exp
event search dev
event search exp
event search within wkt area
event search within gps area
event search near gps position
address geometry search near gps position
address search near gps position
geometry search near gps position
address poi search by text
address poi search by text exp
address poi search by text near gps position
bus routes search
bus routes search near gps position
bus routes search within gps area
bus routes search within wkt area
bus routes search within stored wkt area
tpl routes
tpl stops
descriptive statistics
trend plot
time series predictions
machine learning predictions
anomaly detection
datagate insert
datagate search
datagate create
service info mapped
mapping
set mapping
event log
check exist job
check exist trigger
is in standby mode
is shutdown
is started
get currently executing jobs
get job detail
get triggers of job
get job group names
get trigger group names
get paused trigger groups
get job fire times
get system status
pause job
pause jobs
pause trigger
pause triggers
resume all
resume job
resume jobs
resume trigger
resume triggers
notificator last events
notificator history events
service search near marker
service search within circle
service search within polygon
service search along path
service info
full text search near marker
full text search within circle
full text search within polygon
full text search along path
event search within polygon
event search along path
event search usr
address search near marker
geometry search near marker
address poi search by text usr
address poi search by text near marker
address poi search by text within circle
bus routes search near marker
bus routes search within circle
bus routes search within polygon
tpl agencies
tpl lines
tpl routes by agency
tpl routes by line
tpl stops by route
tpl stop timeline
recommendation within circle
value type search near marker
value type search within circle
value type search within polygon
value type search along path
get my data
get my delegator
get my delegated
get my activity
get other activity on my data
save my data
get my annotation
get anonymous data
get other data
sigfox device filter
sigfox
impulse button
numeric keyboard
switch button
dimmer
city dashboard
gauge chart
single content
speedometer
time trend
geolocator
bar content
column content
get my kpidata
get my kpidata values
get public kpidata values
get delegated kpidata values
save my kpidata values
iot directory
iot directory
iot directory link
iot directory link
fiware orion
fiware orion
orion test
fiware orion
Snap4all Button
show micro web app
show general iframe
twitter last channel
twitter last tweet
SNAP4CITY
BASIC
ADV
https://flows.nodered.org/?term=snap4city

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**

IOT Devices



ARC
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Dashboard with intelligence App

Dashboards with IOT Applications for enforcing data driven smart and intelligence into them

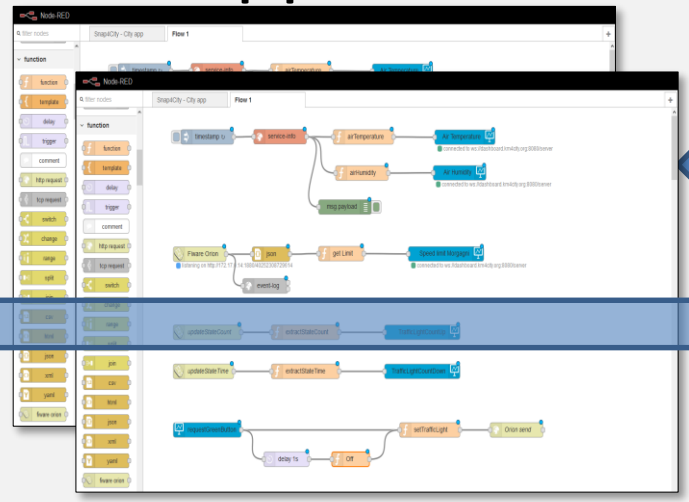
Dashboard-IOT App

IOT and City data World

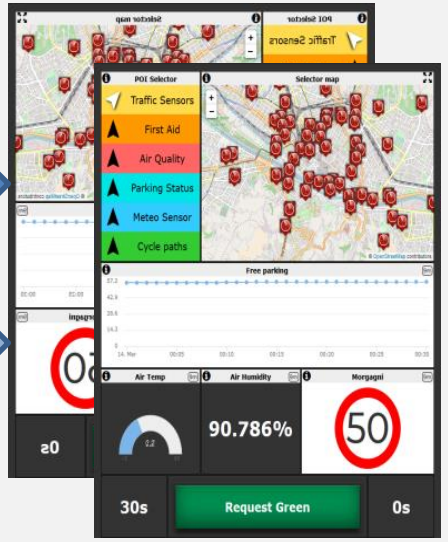


My IOT Devices

IOT Applications



Dashboards



Applications

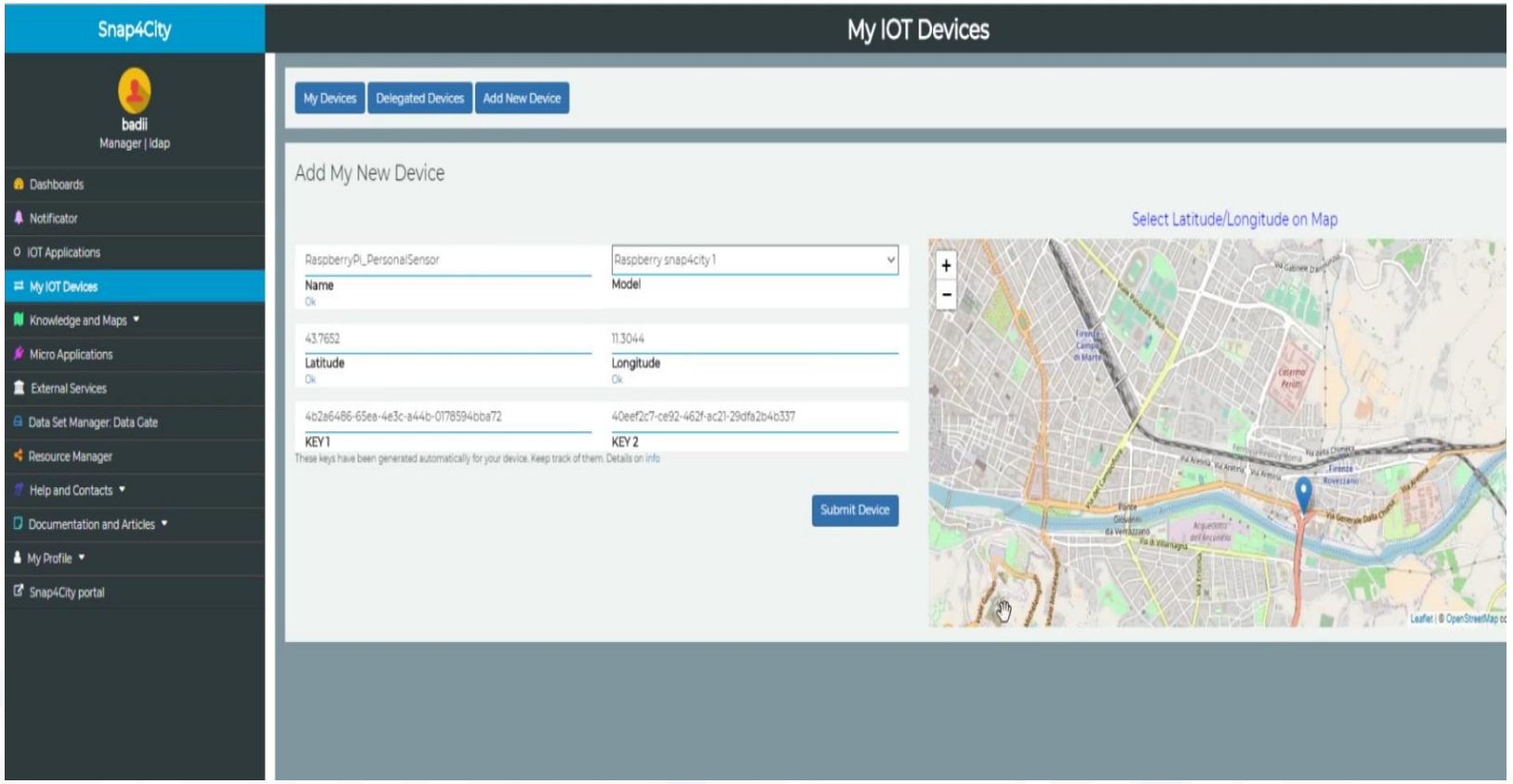
Add IOT/IOE Devices

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

Interoperability

Powered by FIWARE

http://marketplace.fiware.org/pages/solutions/b8905e91973b420189cce972

https://partners.sigfox.com/companies/disit-lab-university-of-florence

https://partners.sigfox.com/products/snap4city

https://flows.nodered.org/?num_pages=1

https://flows.nodered.org/?term=snap4city&num_pages=1

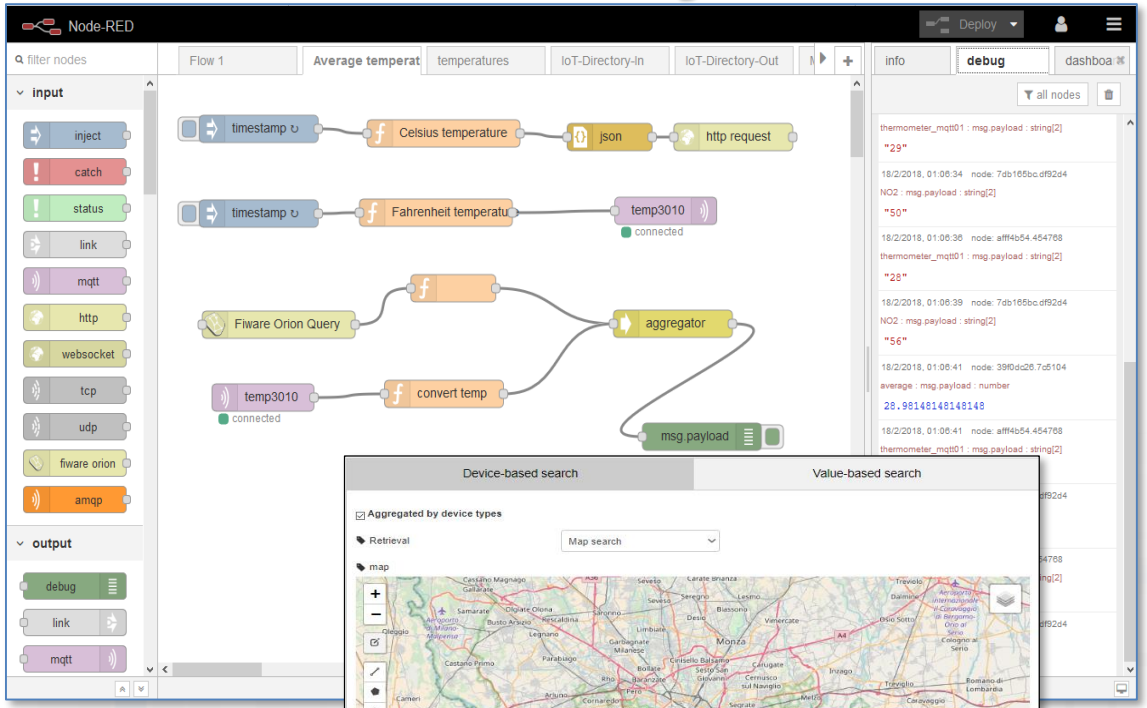
E015 digital ecosystem Official API

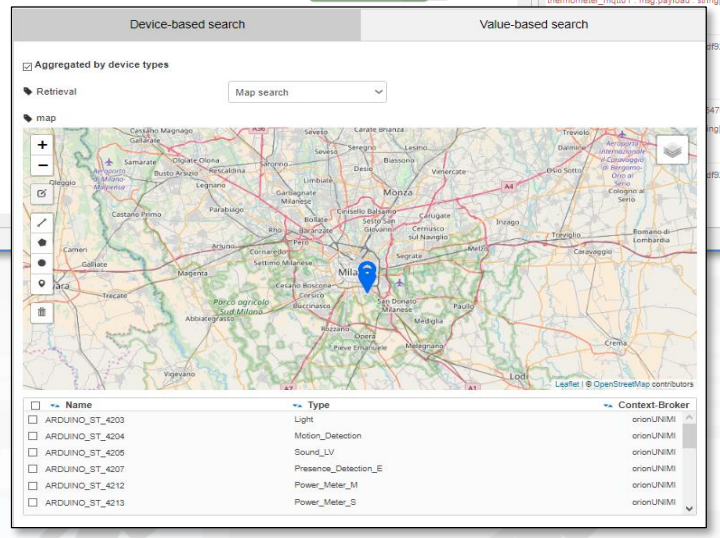
http://www.e015.regione.lombardia.it/

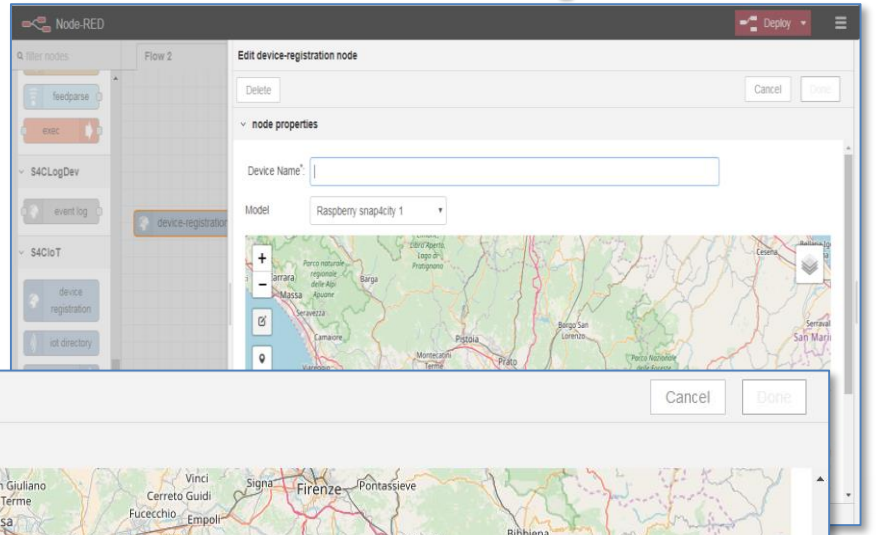
Compliant Federated

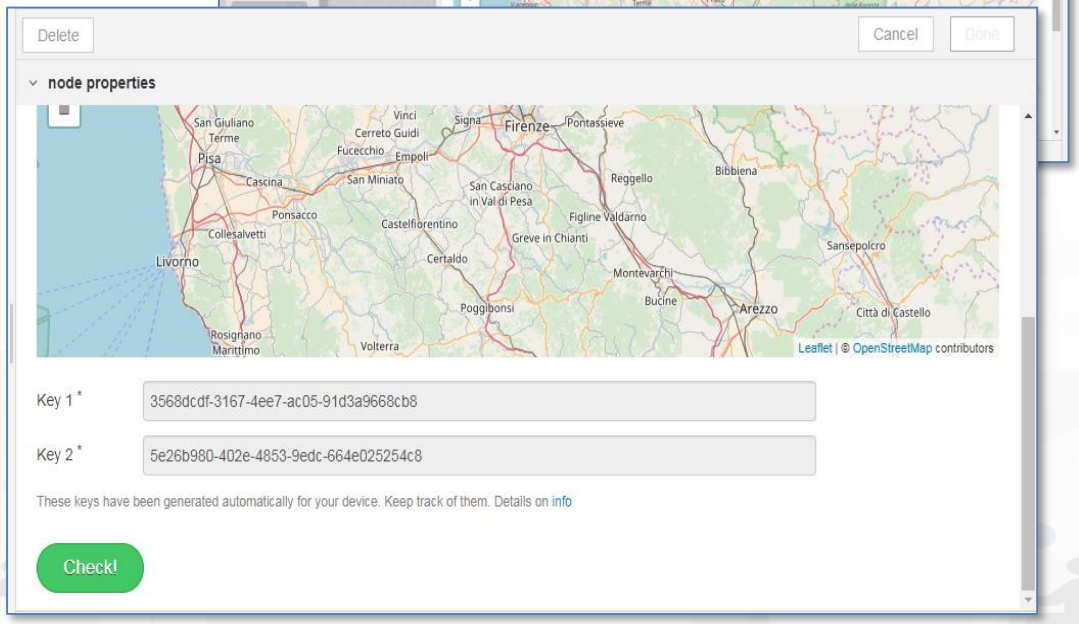
Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, Rest Call, SMTP, TCP, UDP, NGSI, LoraWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, RS485, WFS, WMS, ODBC,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

IOT Discovery on IOT Application Development





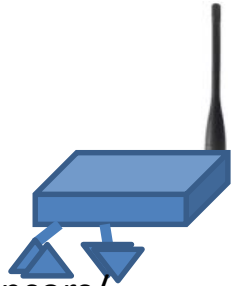




IOT Devices Registration

- 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

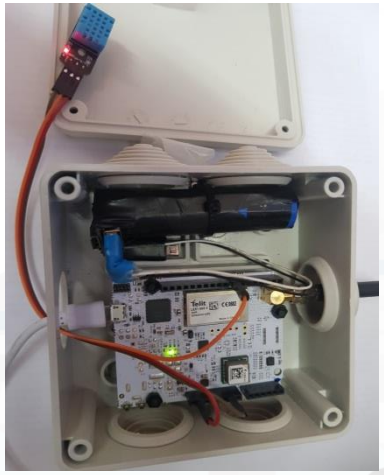
IOT Devices



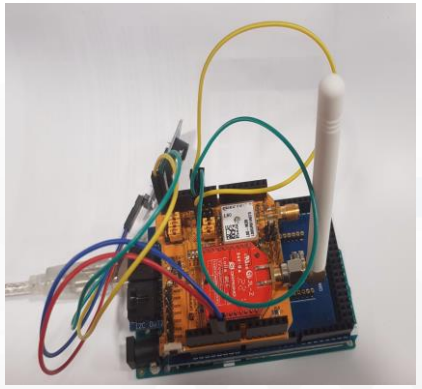
Sensors/
Actuators

IOT Edge Devices

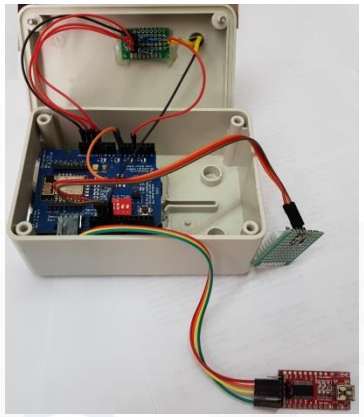
SigFOX
Any and
Arduino



LoraWAN +
Arduino +
I2C, NGSI



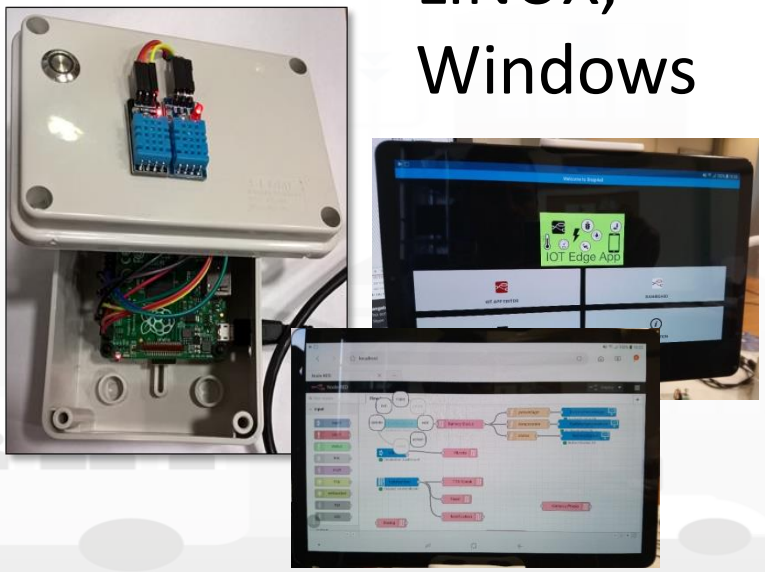
Arduino,
Wi-Fi,
NGSI



Snap4All
IOT Button
ESP



IOT Edge
NodeRED:
Raspberry



IOT Edge
NodeRED:
Android,
LINUX,
Windows

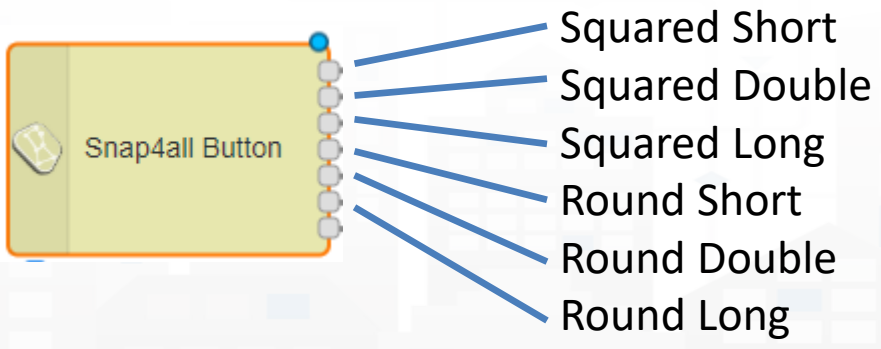
Snap4All IOT Button

- 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



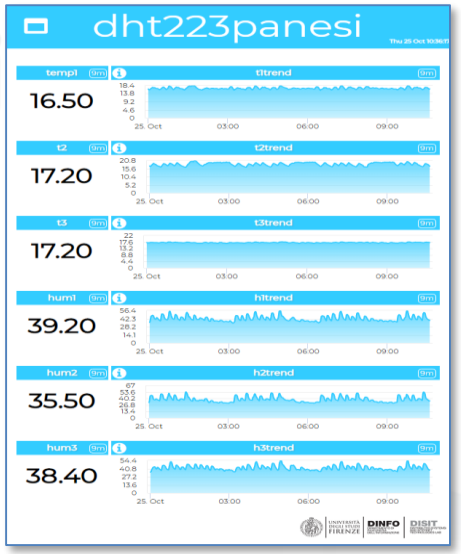




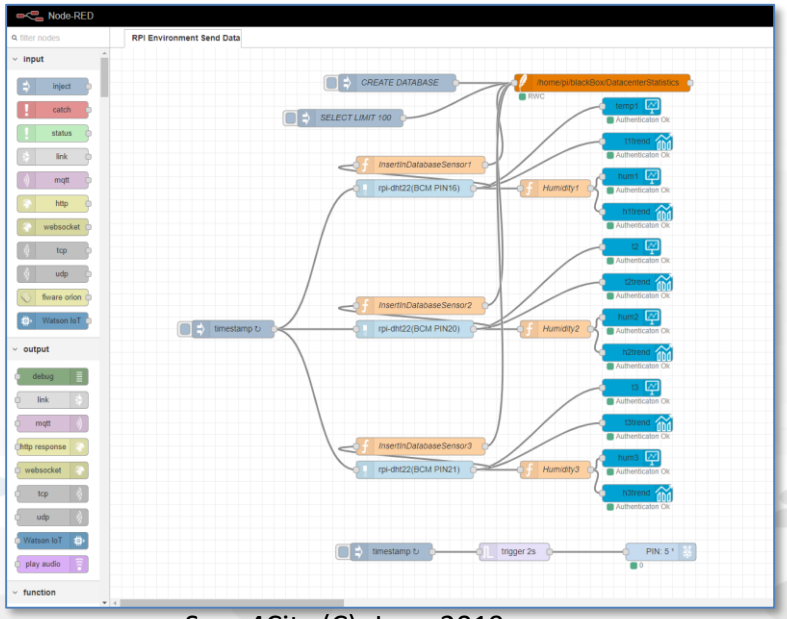
https://www.snap4city.org/drupal/node/276
https://www.snap4city.org/drupal/node/297 help config

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**





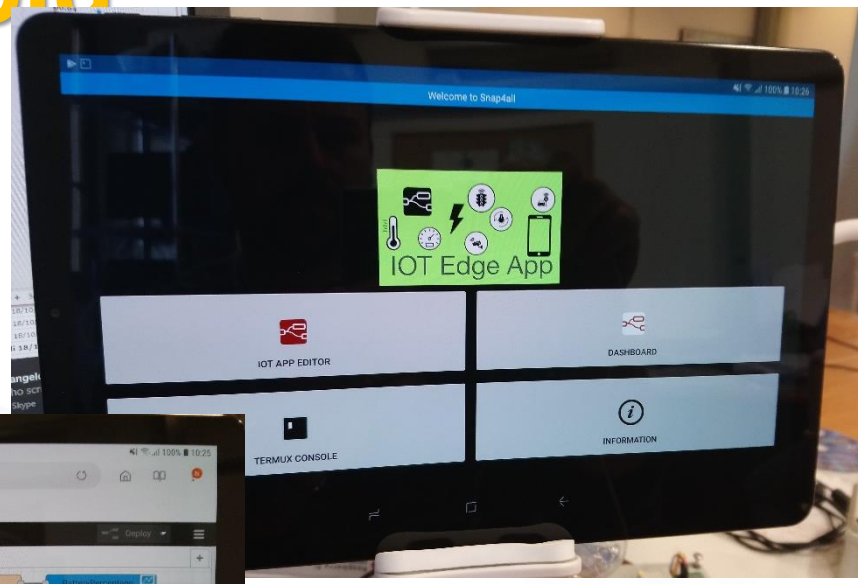


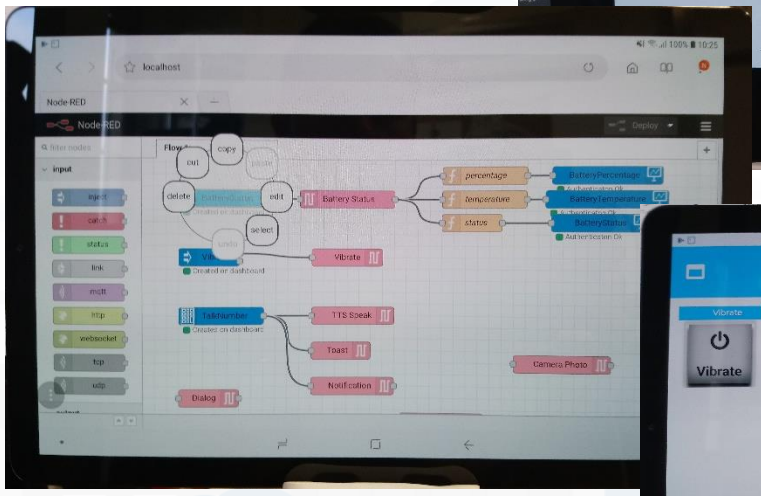


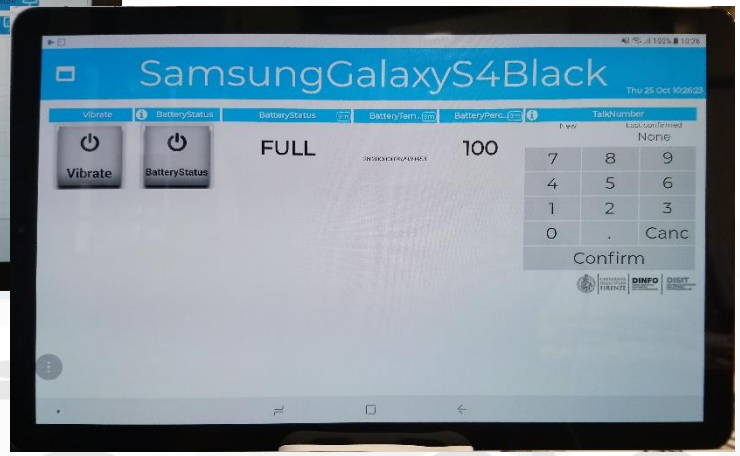
MicroServices:
- DHT
- ModBus
- any shield
- etc....

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



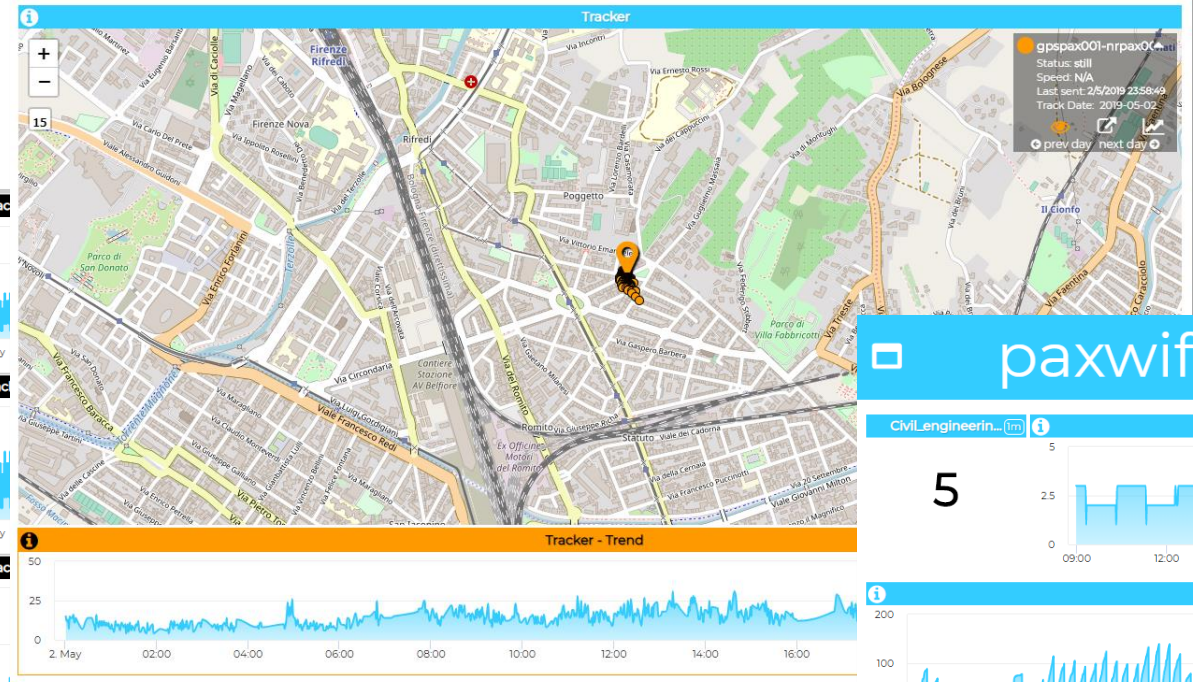


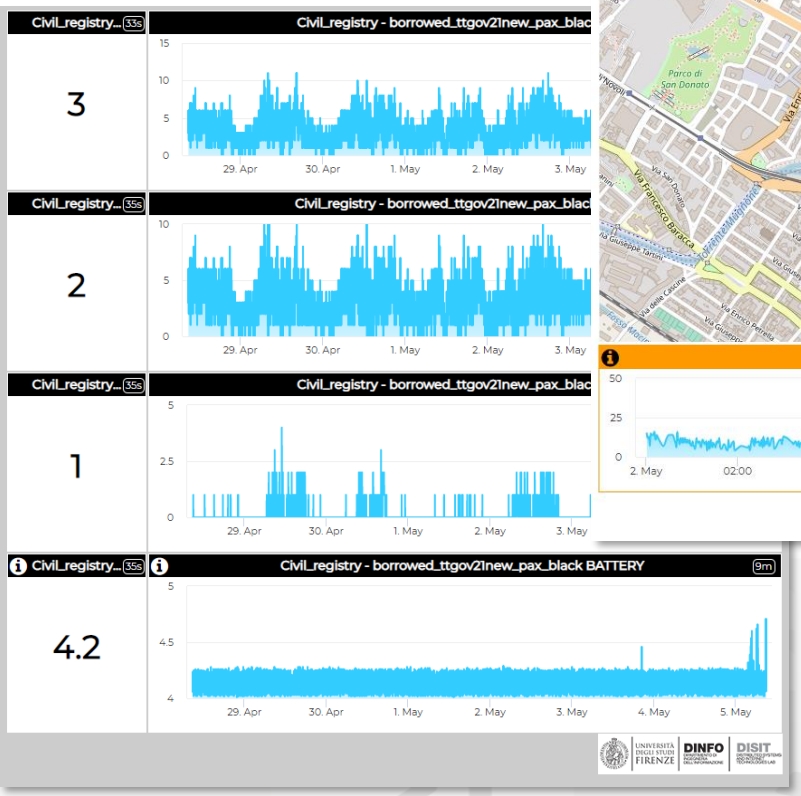


- Fixed PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Mobile PaxCounter LoraWan
  - Based on Wi-Fi- Bluetooth
- Fixed PaxCounter(LoraWan+Wifi out)
  - Based on Wi-Fi- Bluetooth

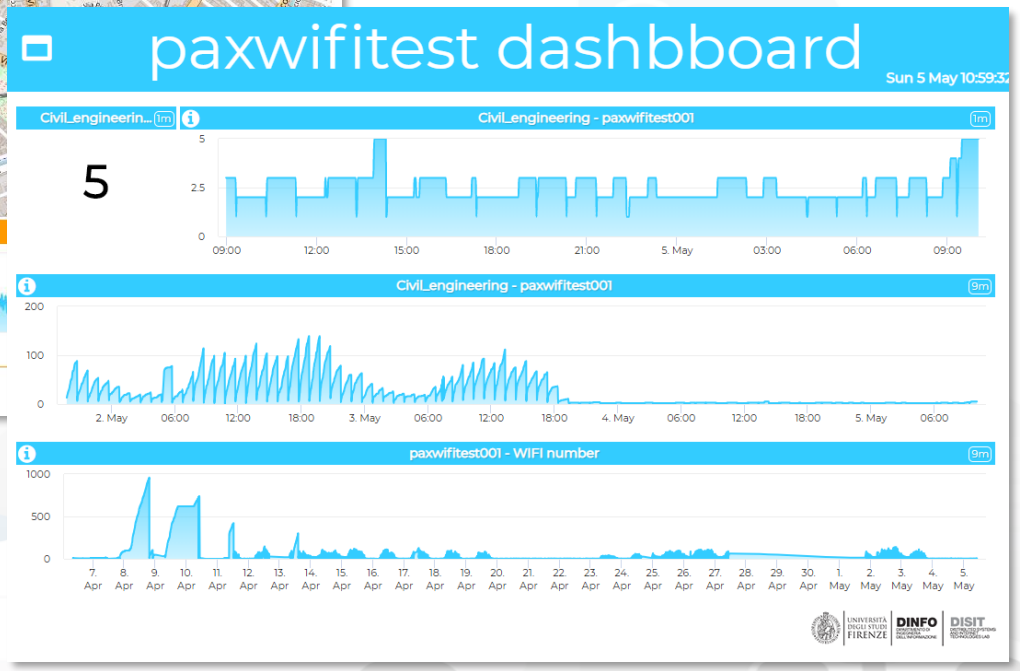
Programmable PAX counting

gpspax001-nodered tracking





paxwifitest dashbboard



TOP



FORGING & MANAGING FLEXIBLE MOBILE APPS, Web Apps and MicroApplications

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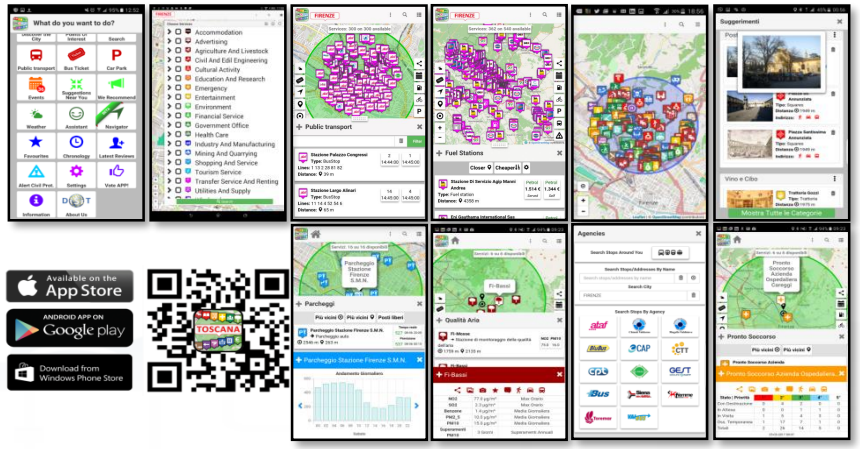
Web and Mobile App Developers, to generate

Mobile Apps



Web App HTML5



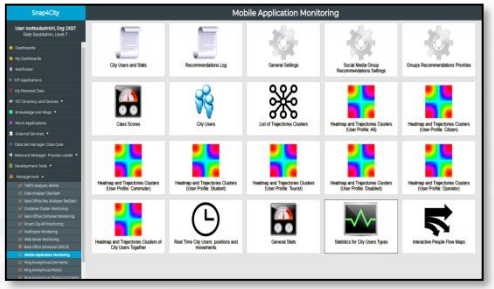
Embed into Web pages



City User



Advanced Smart City API

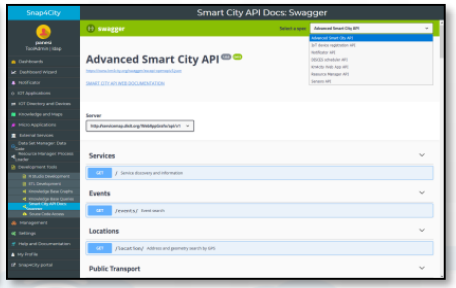


Mobile Application Monitoring Administrator

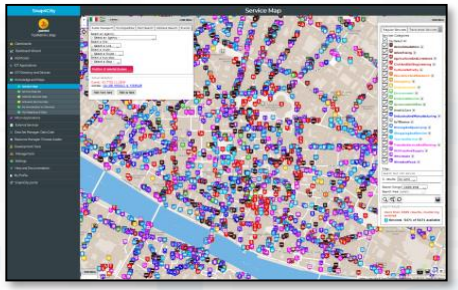




Km4City Open Source examples dev. tool kit



Swagger



ServiceMap

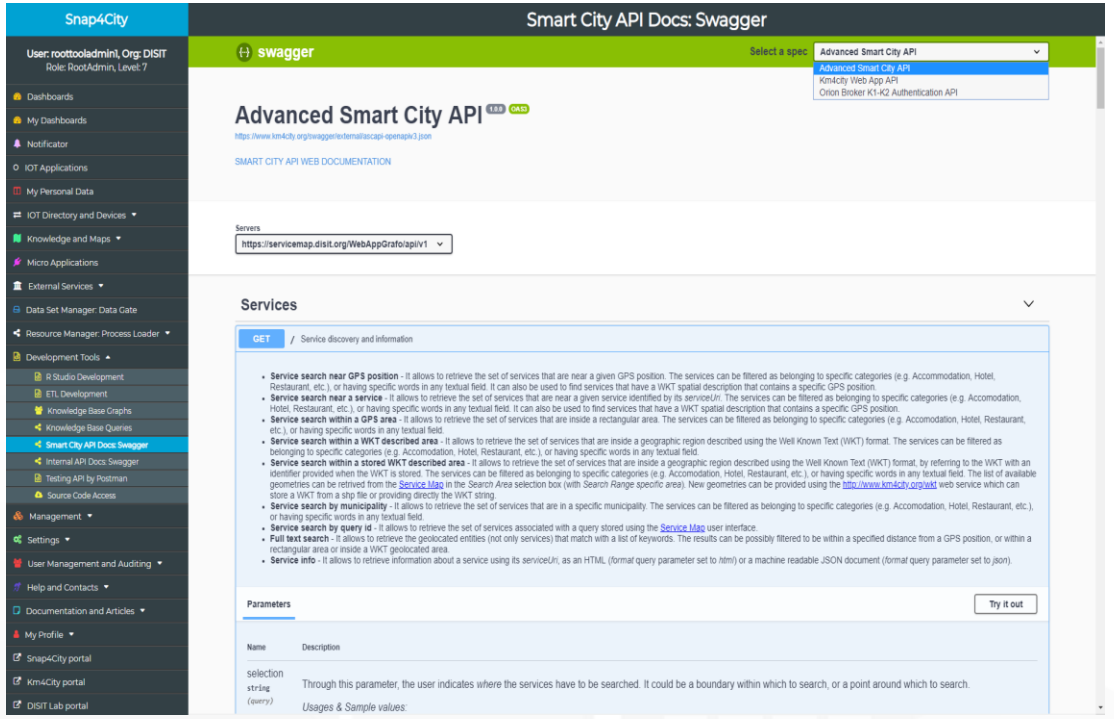
Developer



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



ARC

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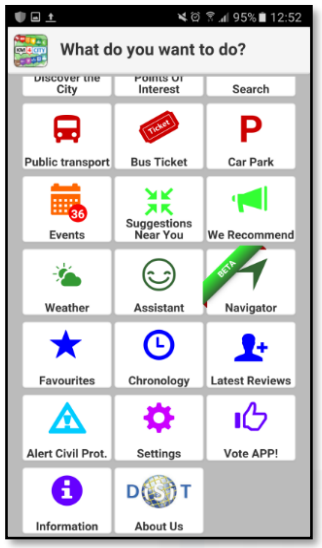
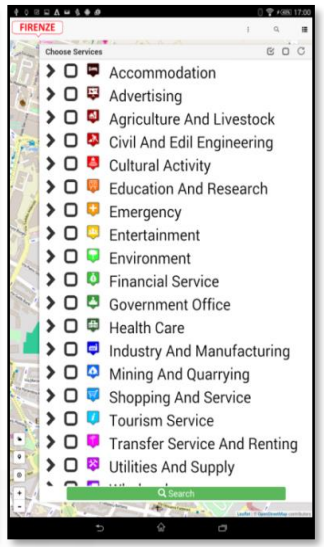
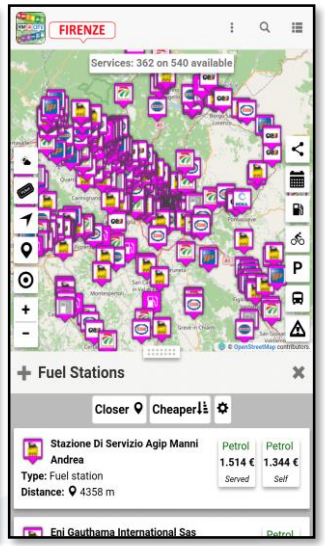
Km4City APP

- 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

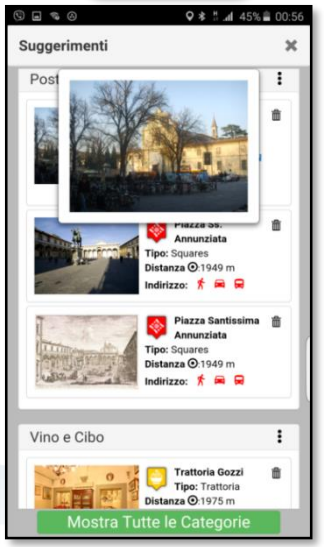


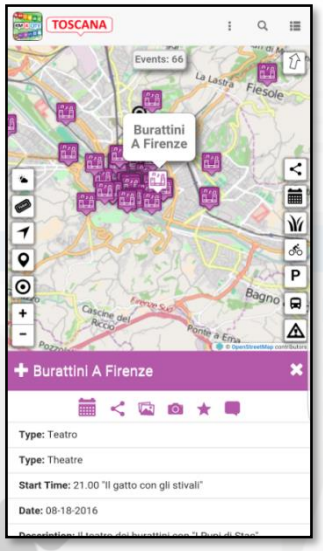




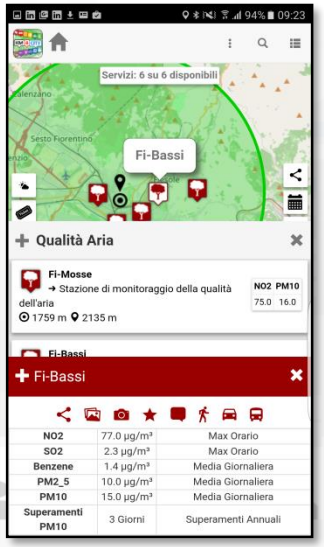


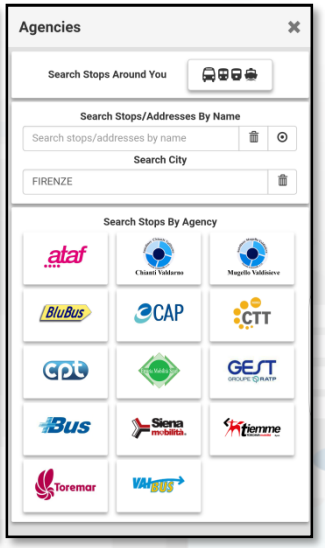










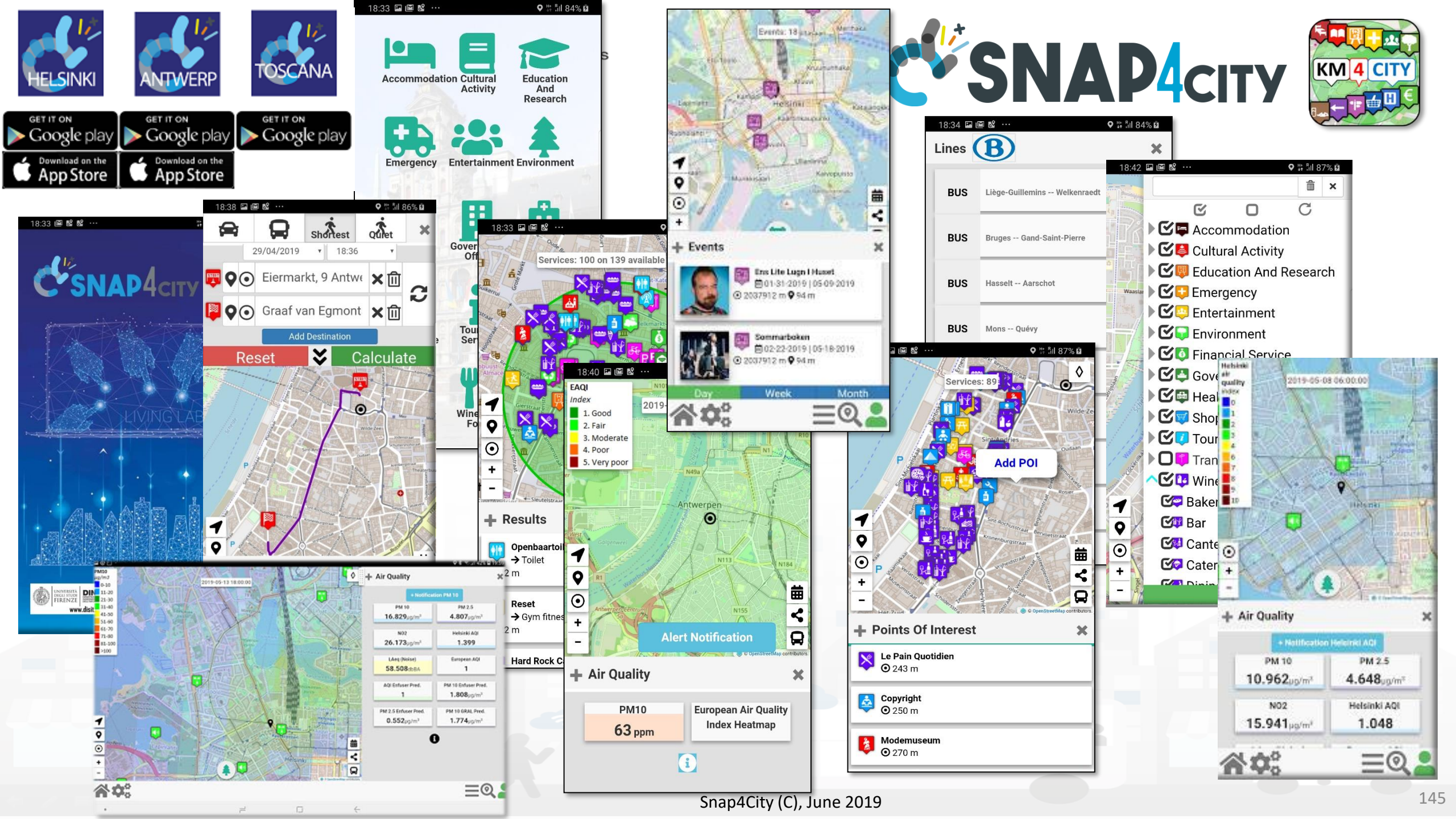




Available on the App Store

ANDROID APP ON Google play

Download from Windows Phone Store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ANTWERP
TOSCANA
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SNAP4CITY
KM 4 CITY
Accommodation
Cultural Activity
Education And Research
Emergency
Entertainment
Environment
Shortest
Quiet
Add Destination
Reset
Calculate
Events
Day
Week
Month
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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
Financial Service
Add POI
Points Of Interest
Le Pain Quotidien
243 m
Copyright
250 m
Modemuseum
270 m
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**

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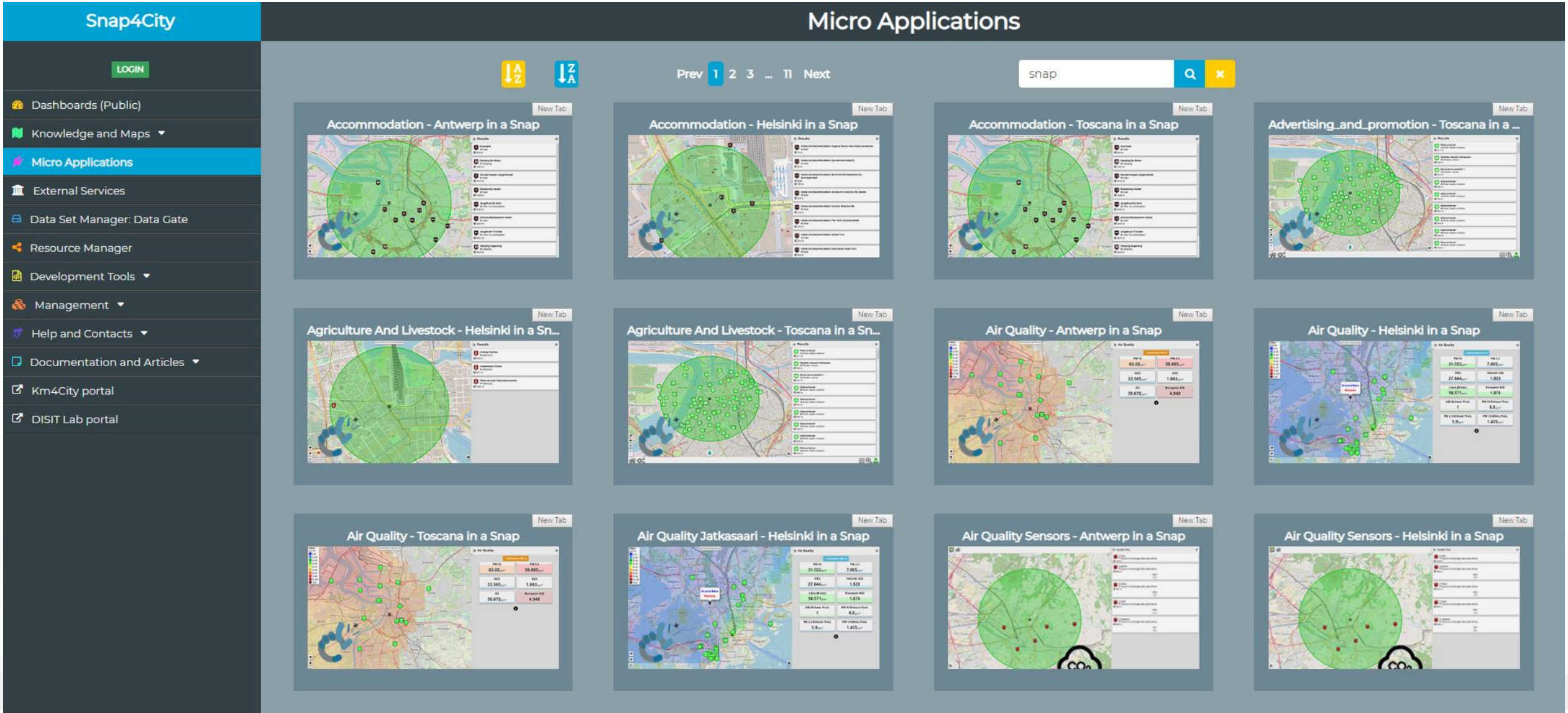
SNAP4CITY

KM4CITY

MicroApplications



Understanding how City Users are using the City Services



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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 ?
- …



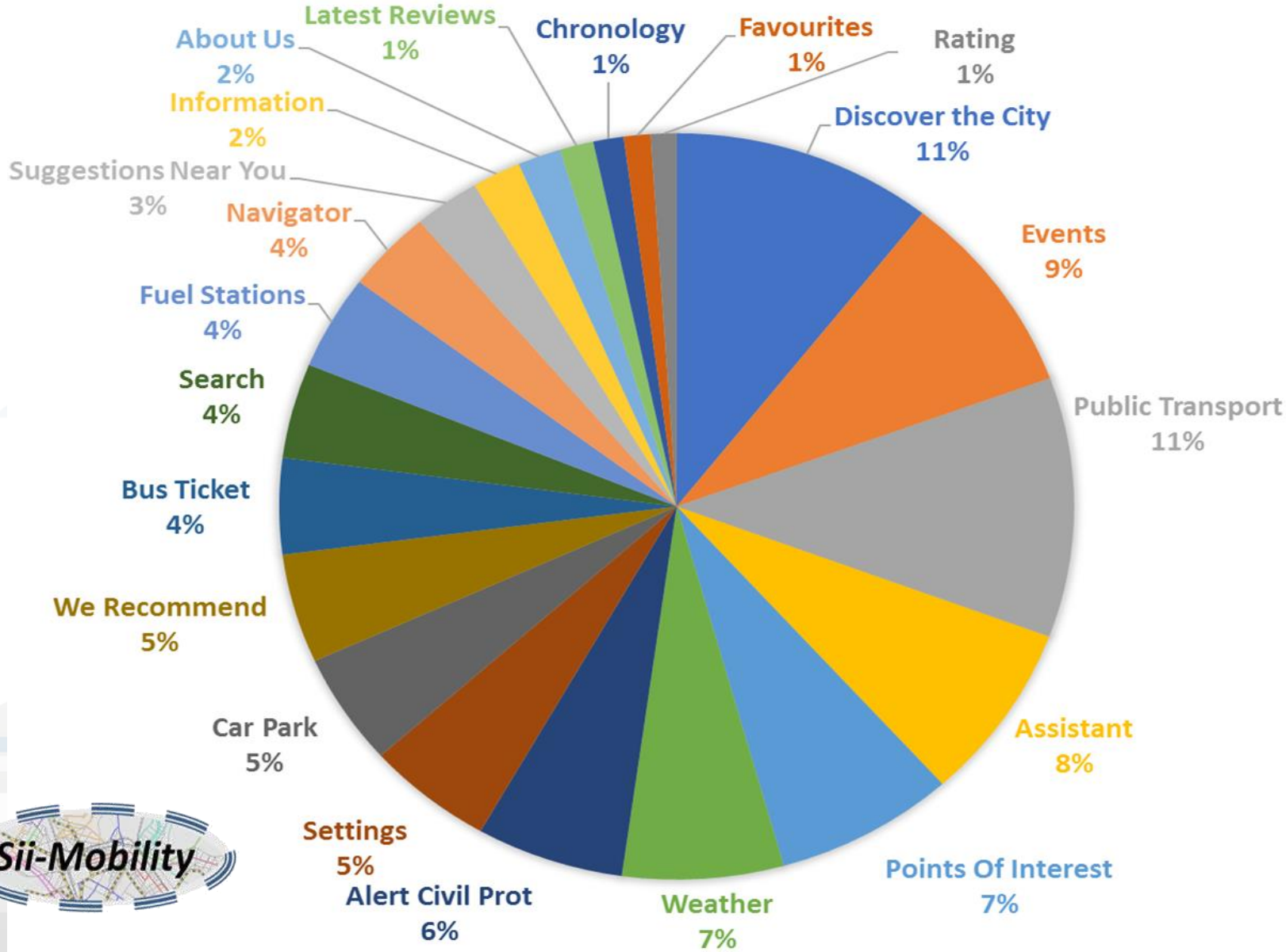
Derived information

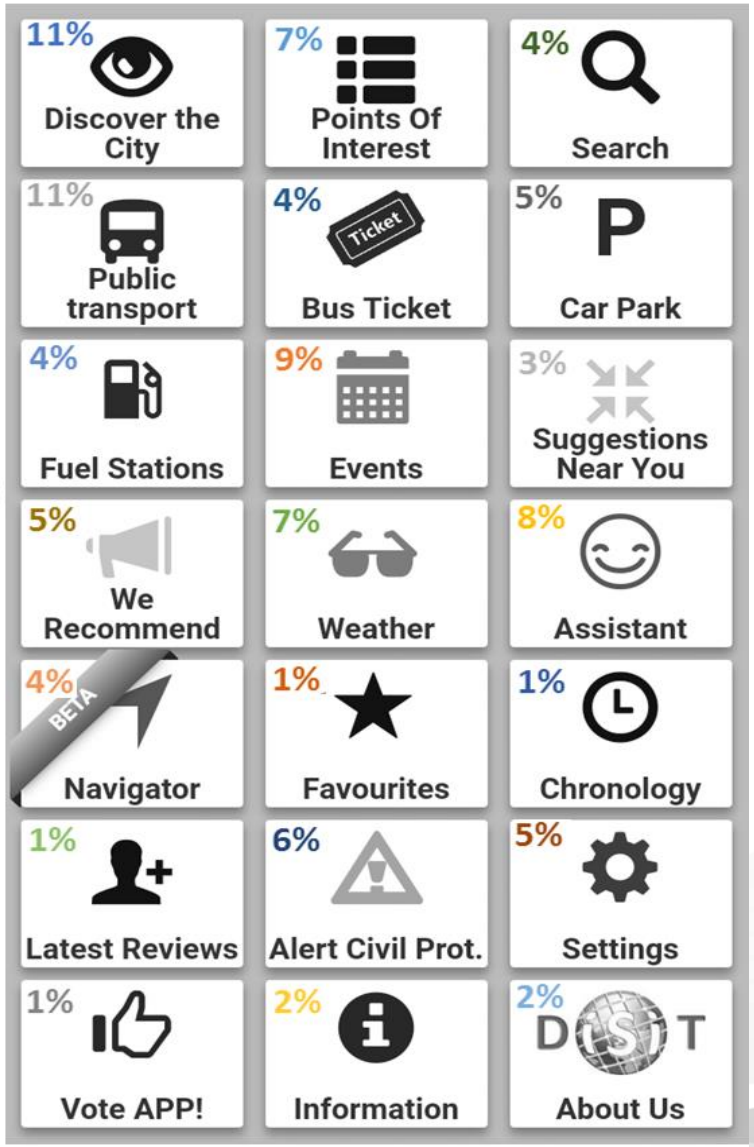
- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- Requested information
- Routing performed
- …..

Produced information

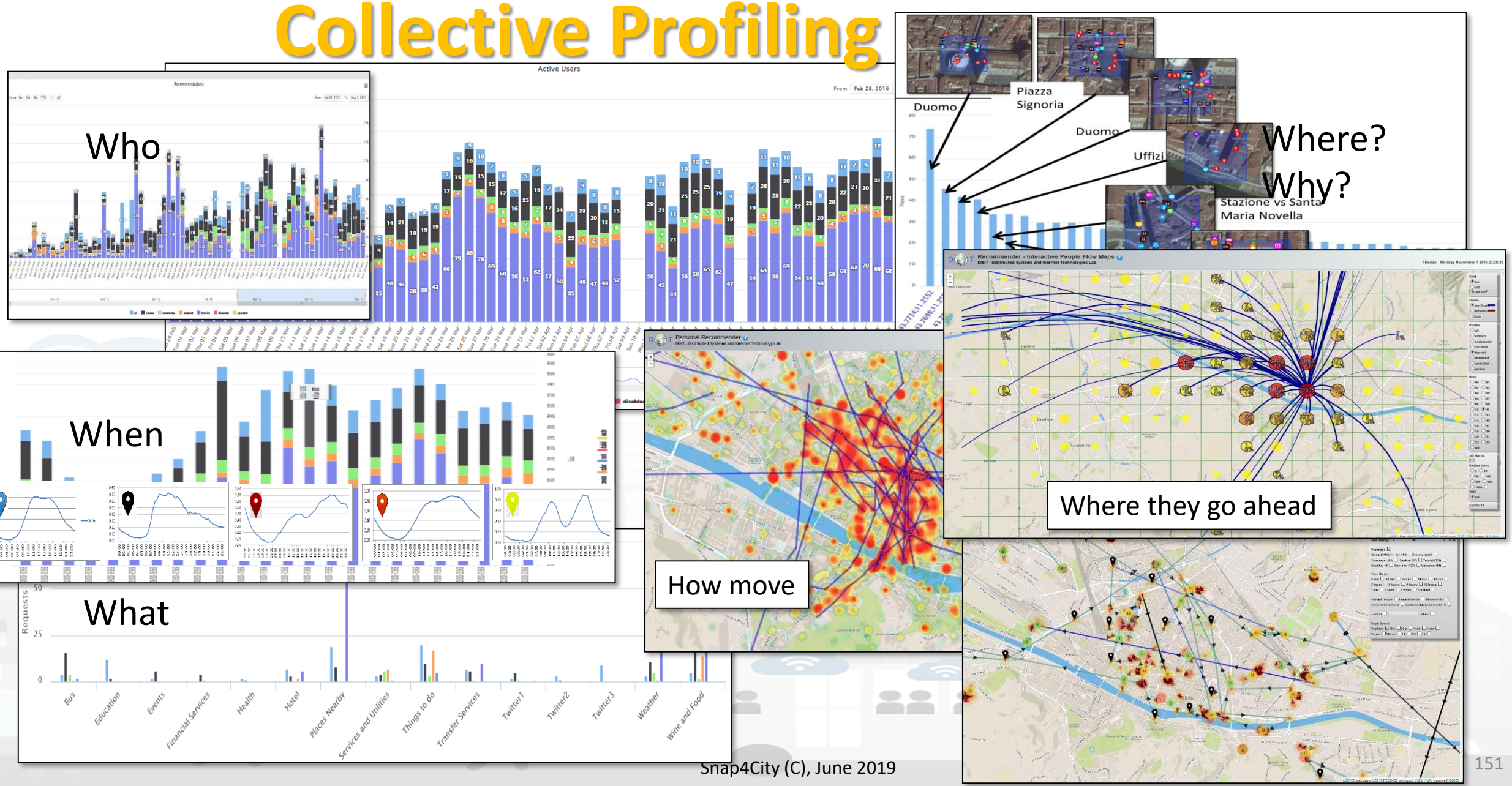
- Suggestions
- Engagements
- Notifications
- …

Users' preferences

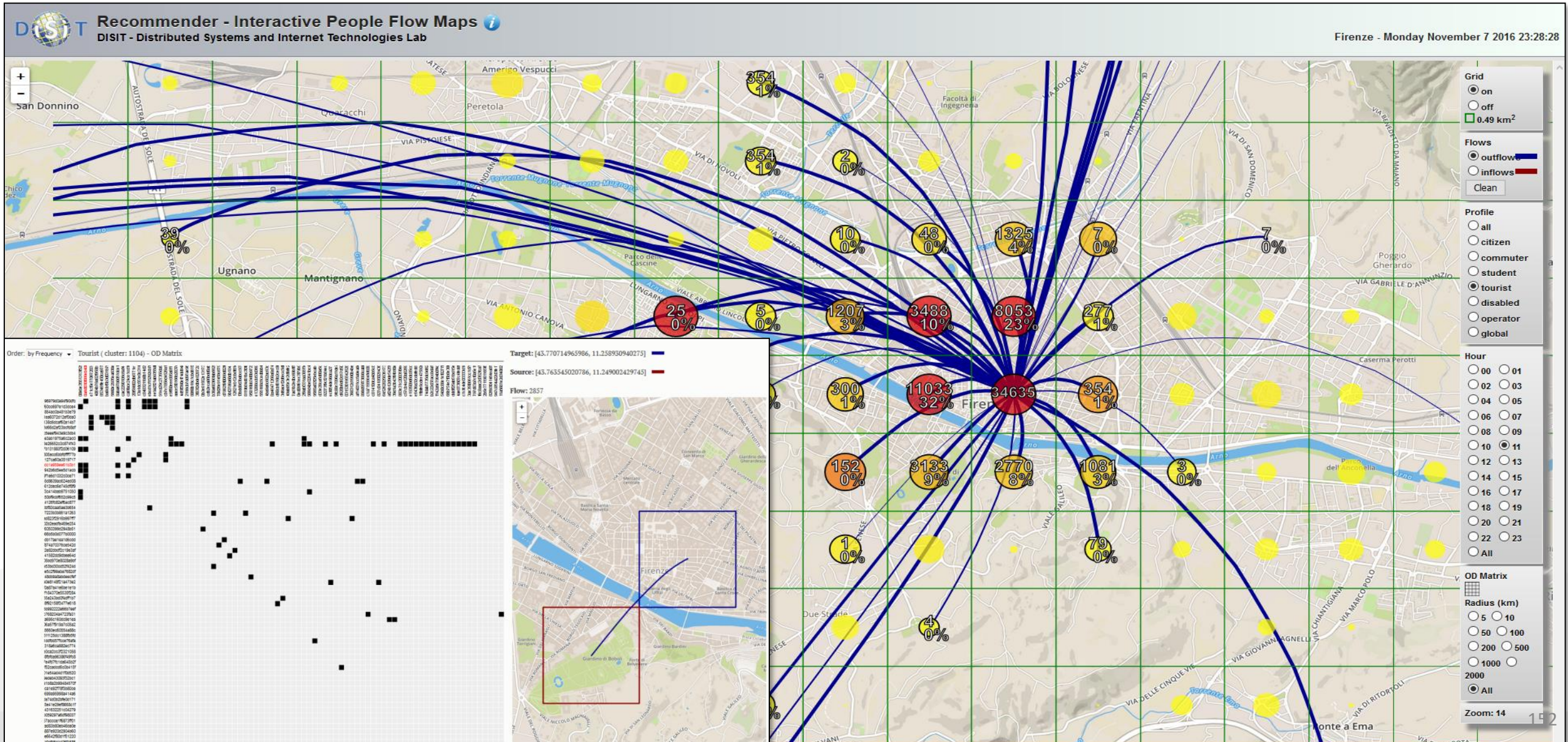




User Behavior Analyser for Collective Profiling



Scalable OD Matrix



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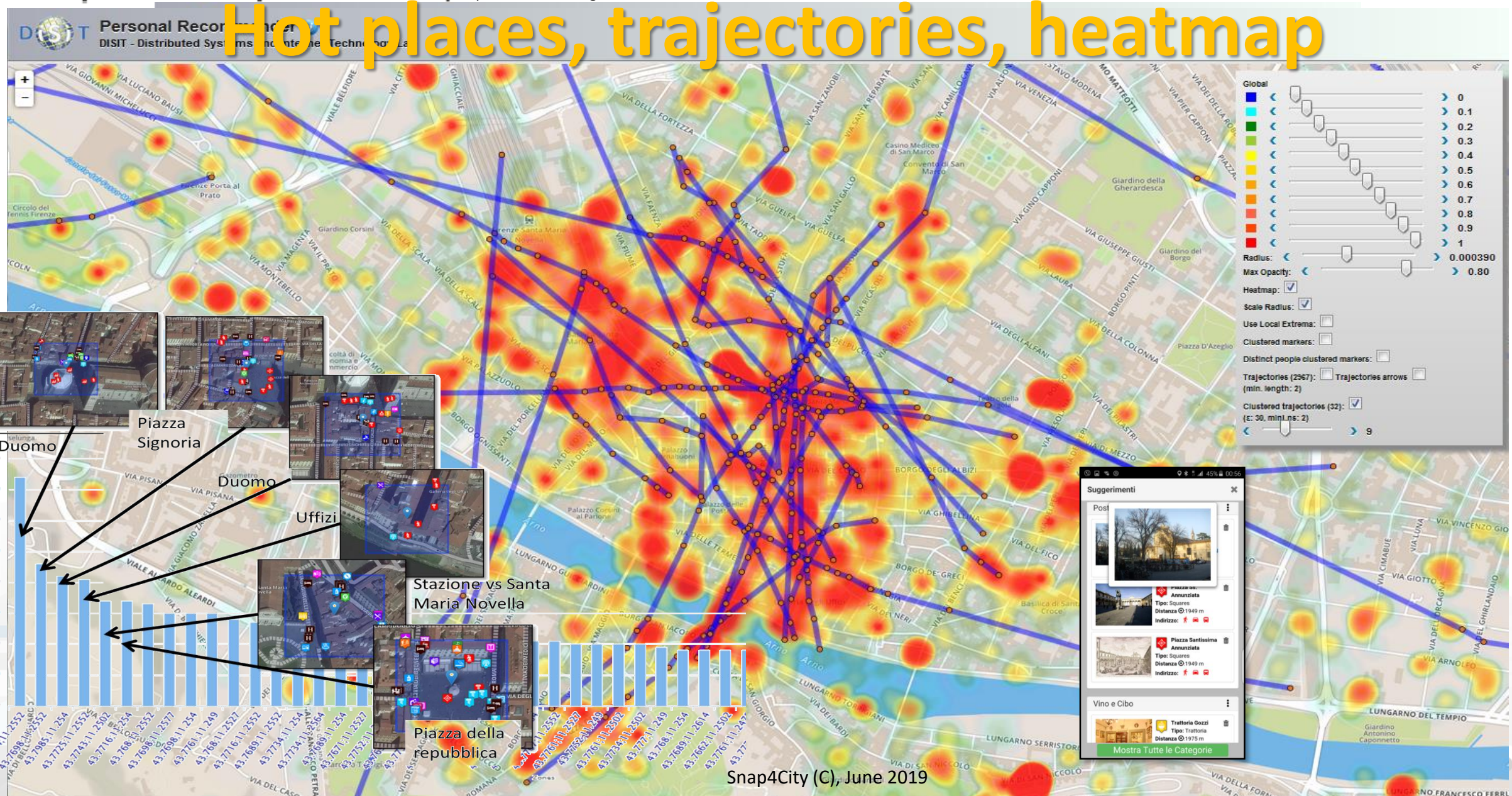
User Behaviour Analyser

Hot places, trajectories, heatmap



Engaging City Users Towards Virtuous Behaviours (real time)



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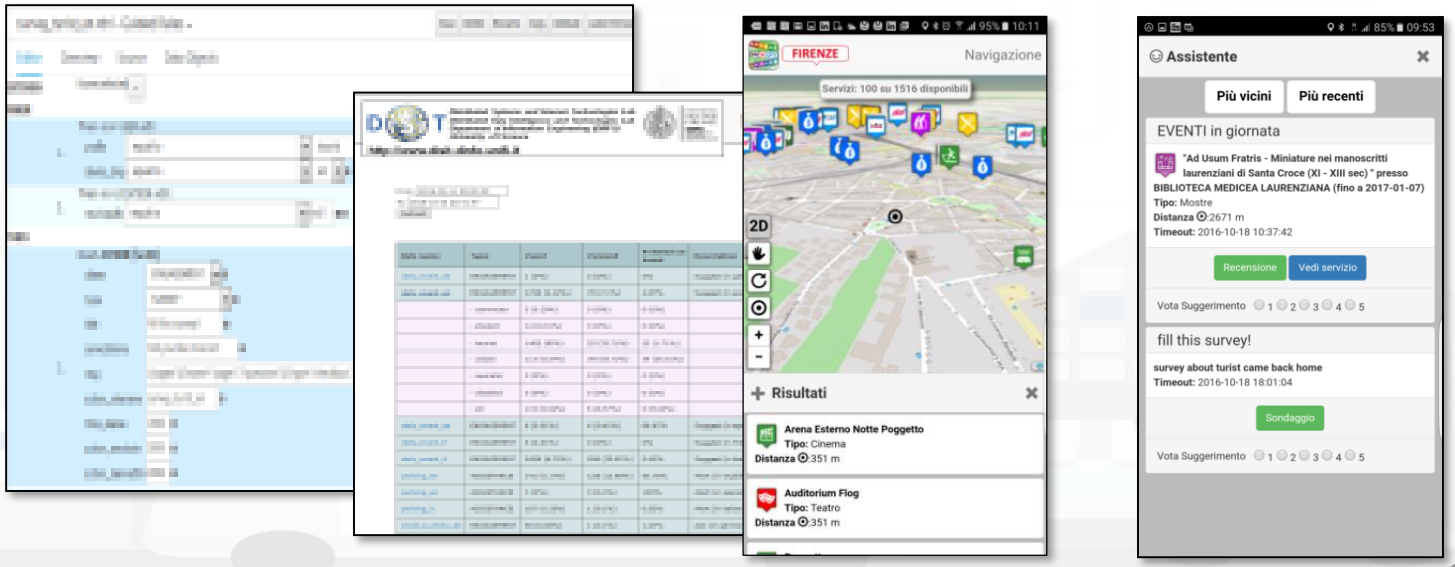
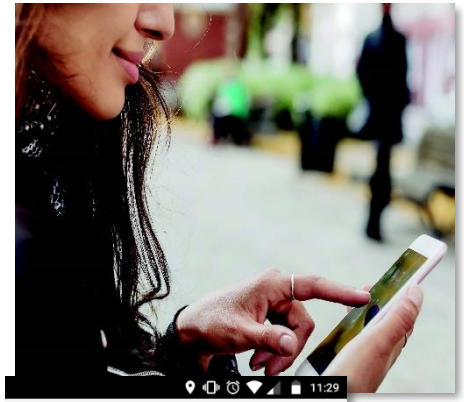
Profiled Engagements to City Users

- 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, ….

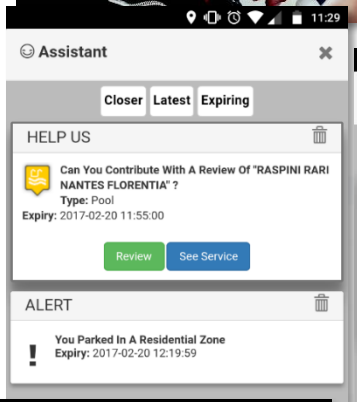


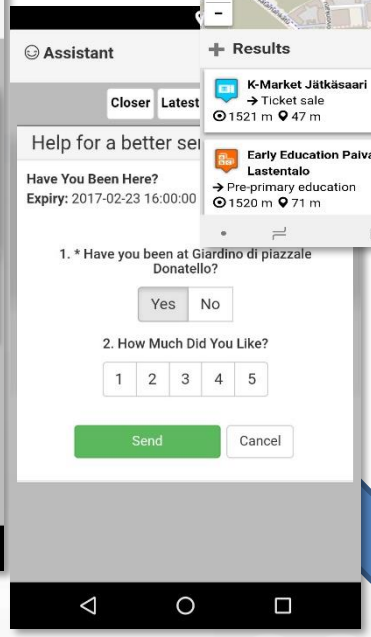


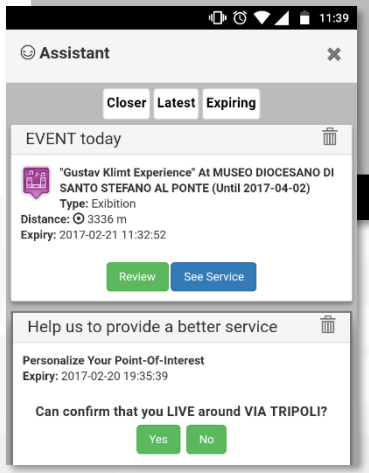
Users' Engagement

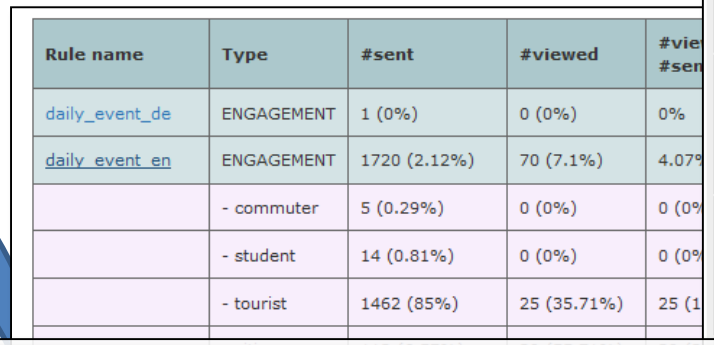




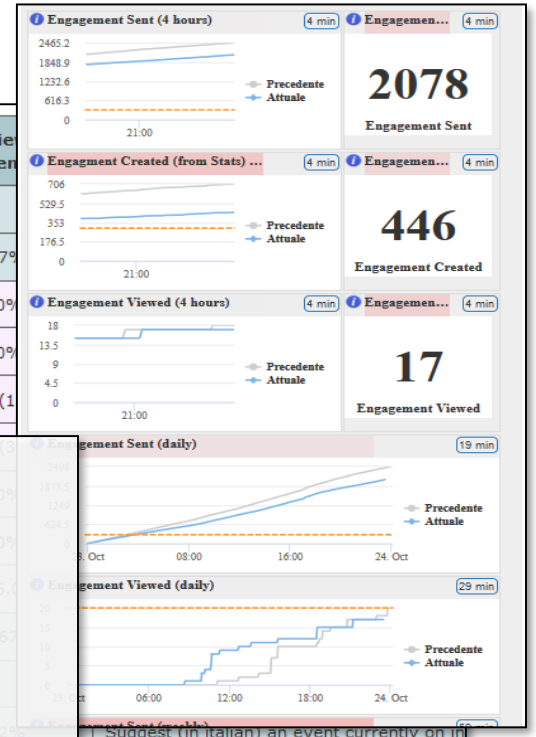








Rule name	Type	#sent	#viewed	#vie #sen
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%
	- commuter	5 (0.29%)	0 (0%)	0 (0%
	- student	14 (0.81%)	0 (0%)	0 (0%
	- tourist	1462 (85%)	25 (35.71%)	25 (1



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 by a bus ticket

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

User context

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
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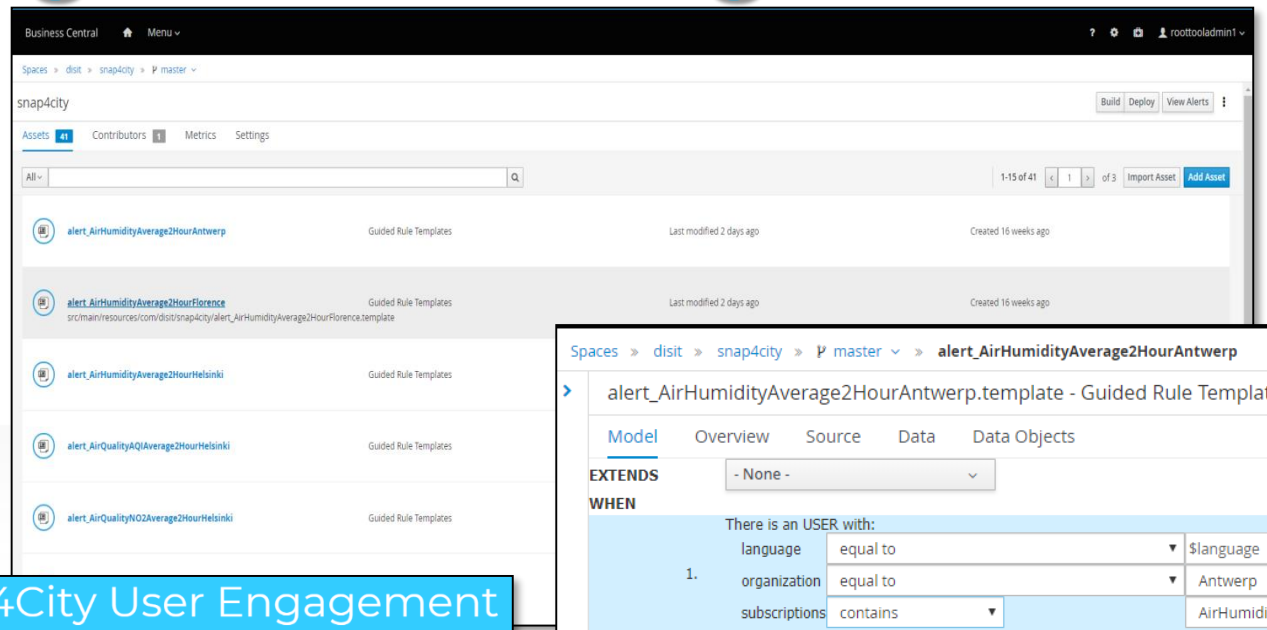
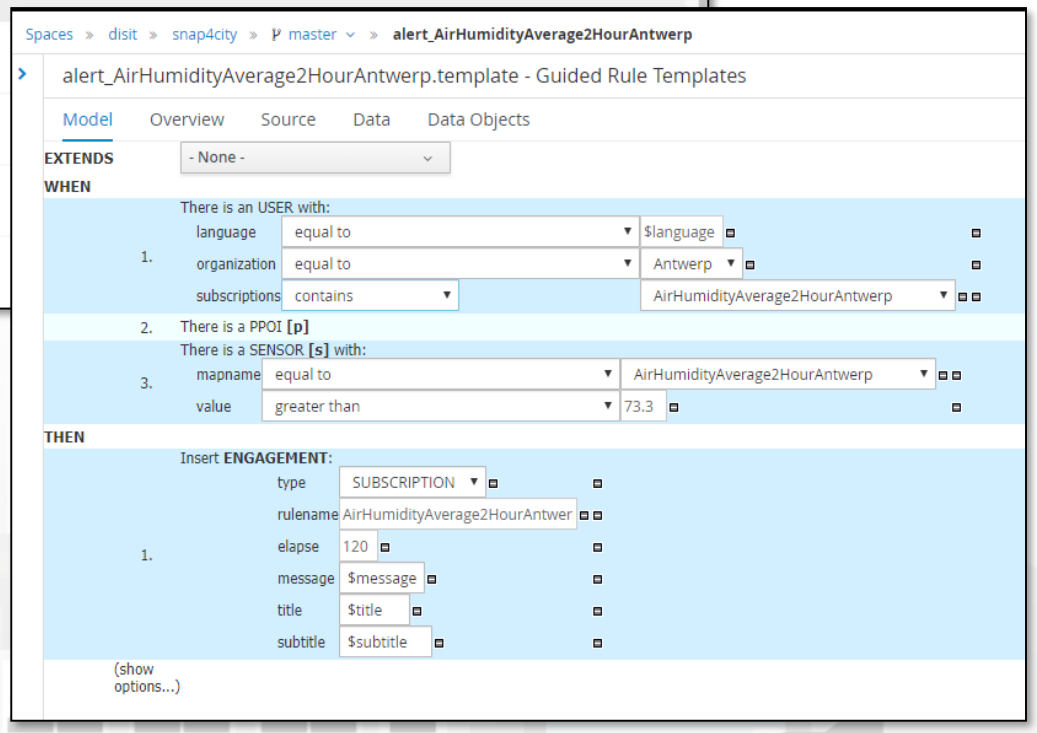
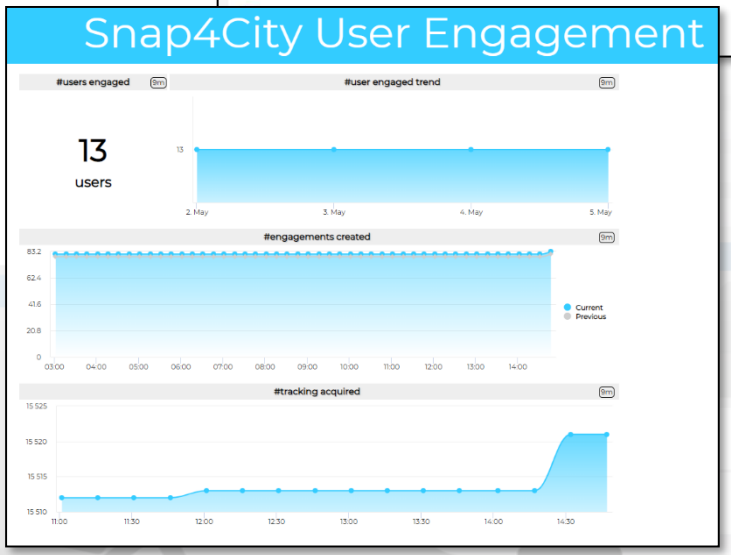
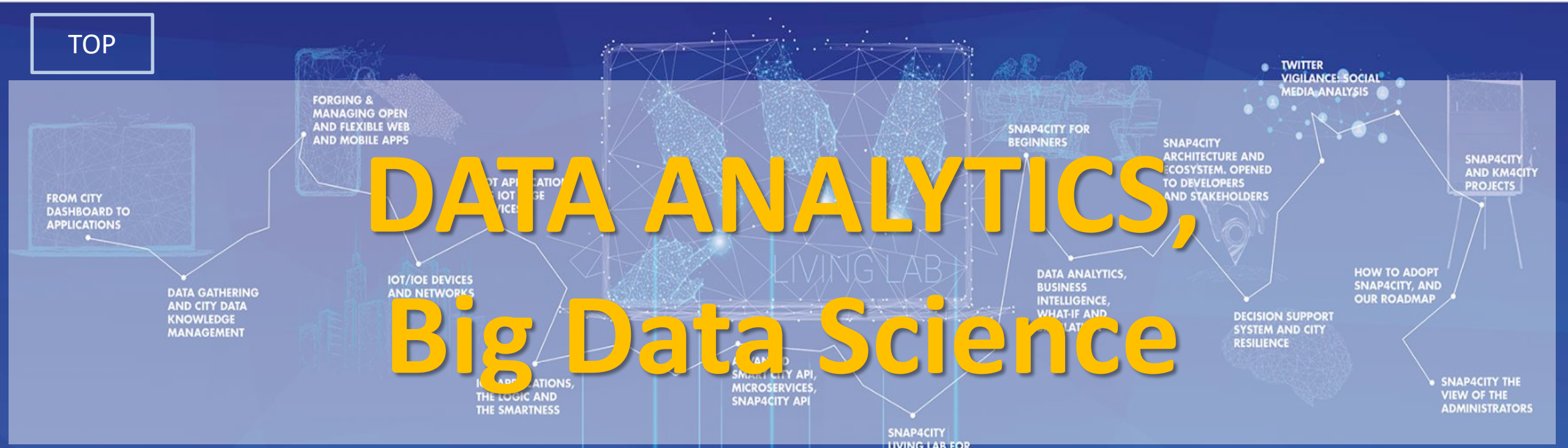
Engagement Manager

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





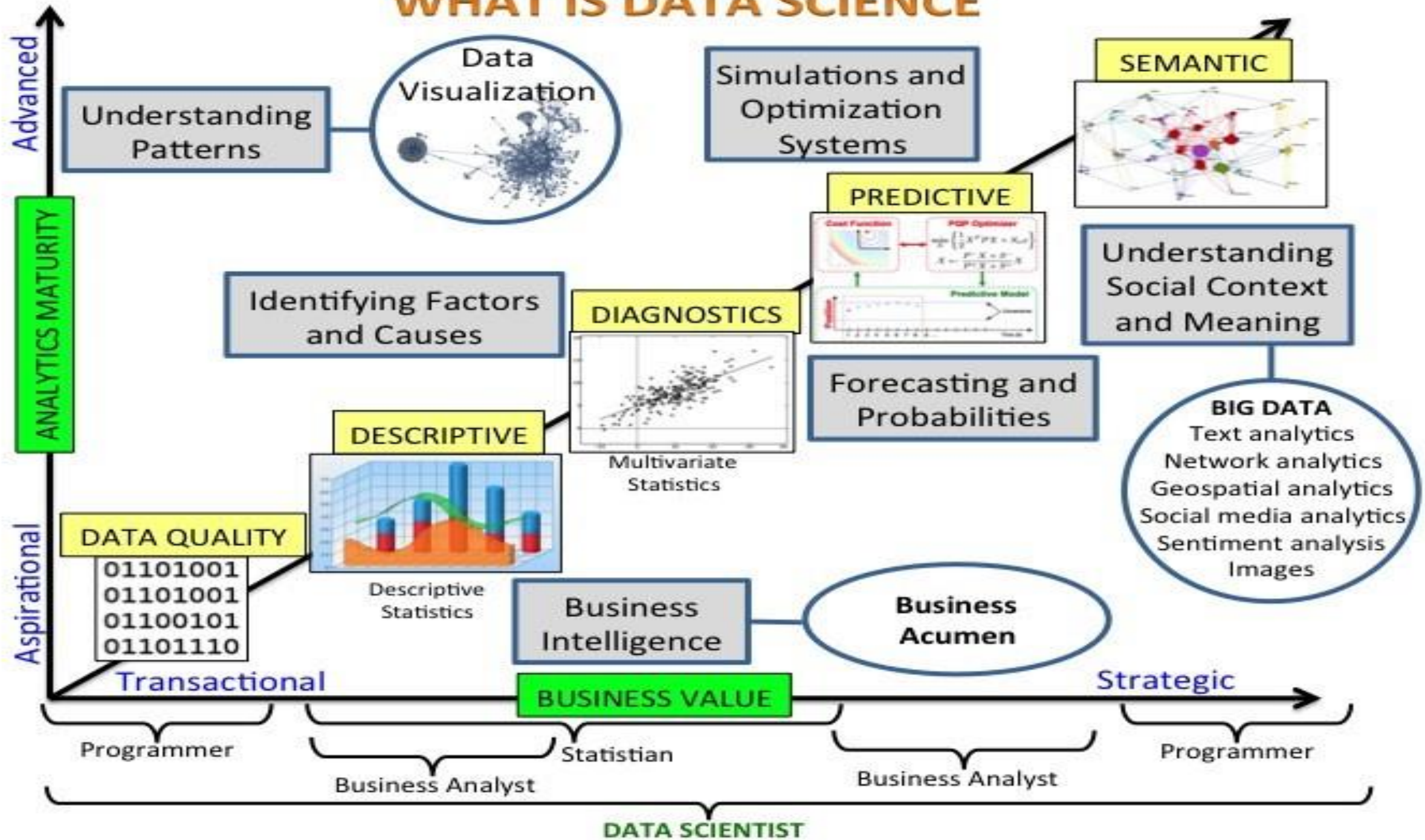




DATA ANALYTICS, Big Data Science



WHAT IS DATA SCIENCE



Data Analytics: Predictions



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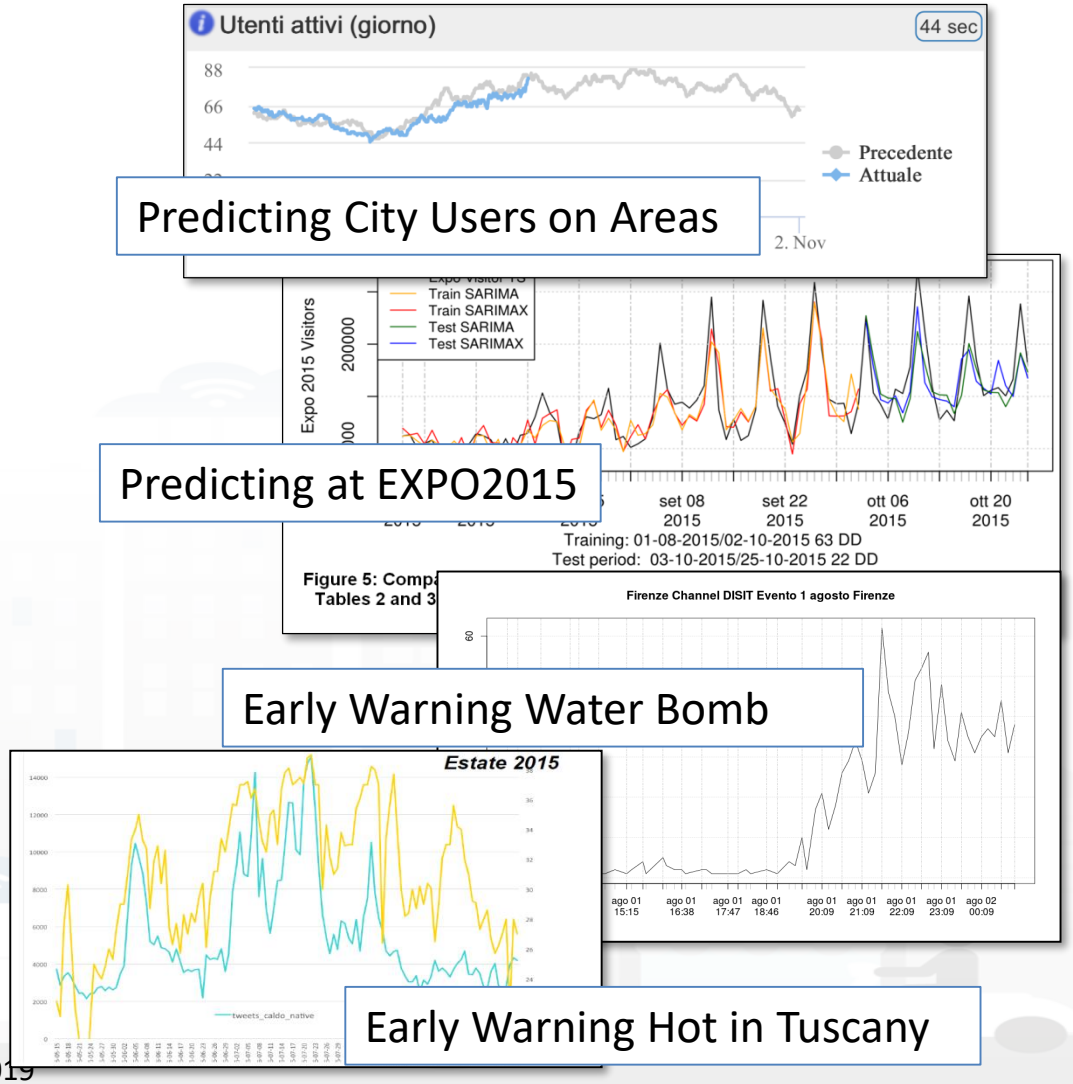
Predicting Models for Administrators & City Users

- **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



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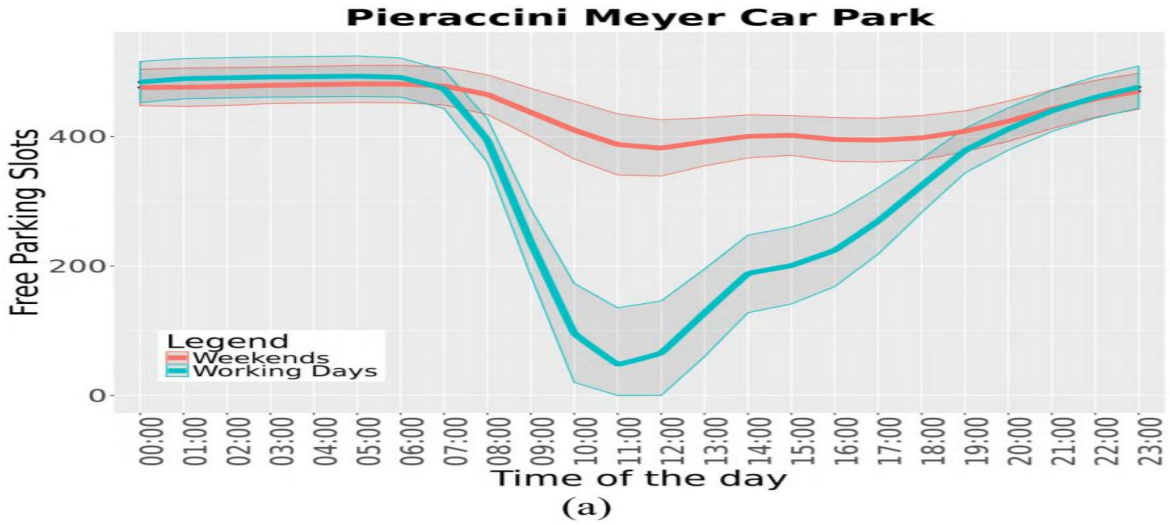
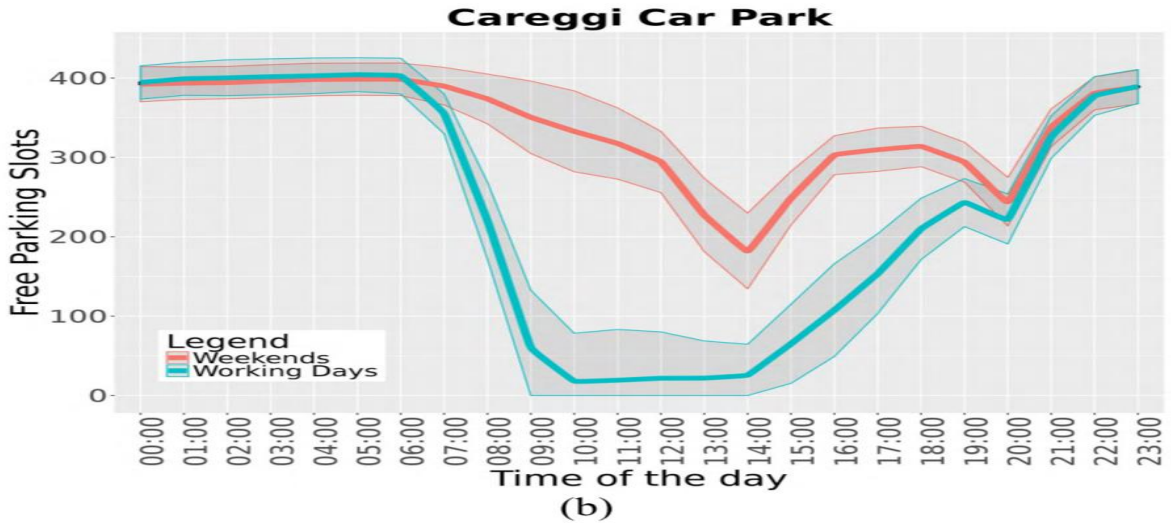
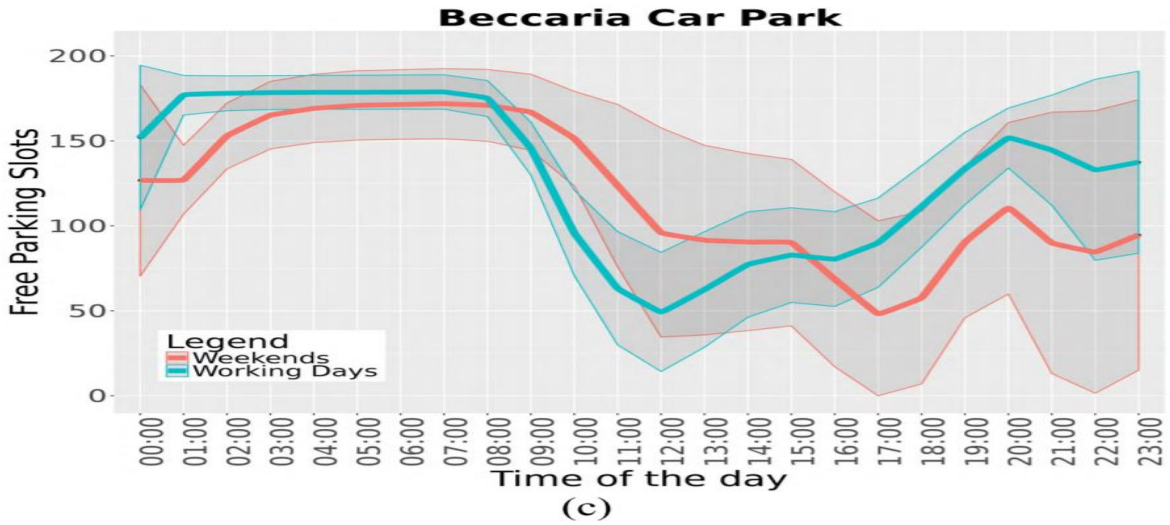
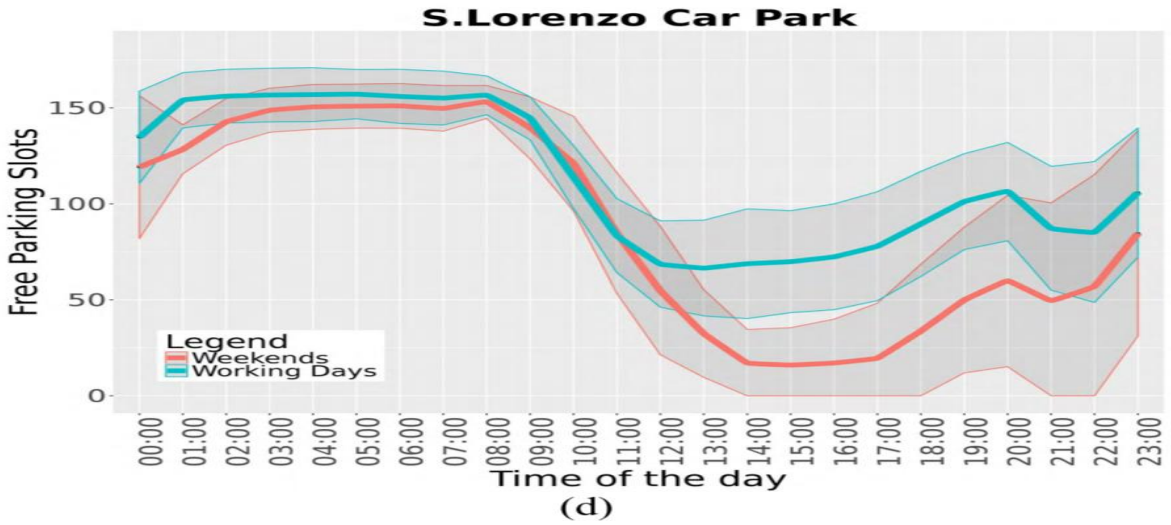
Free Parking space trends









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



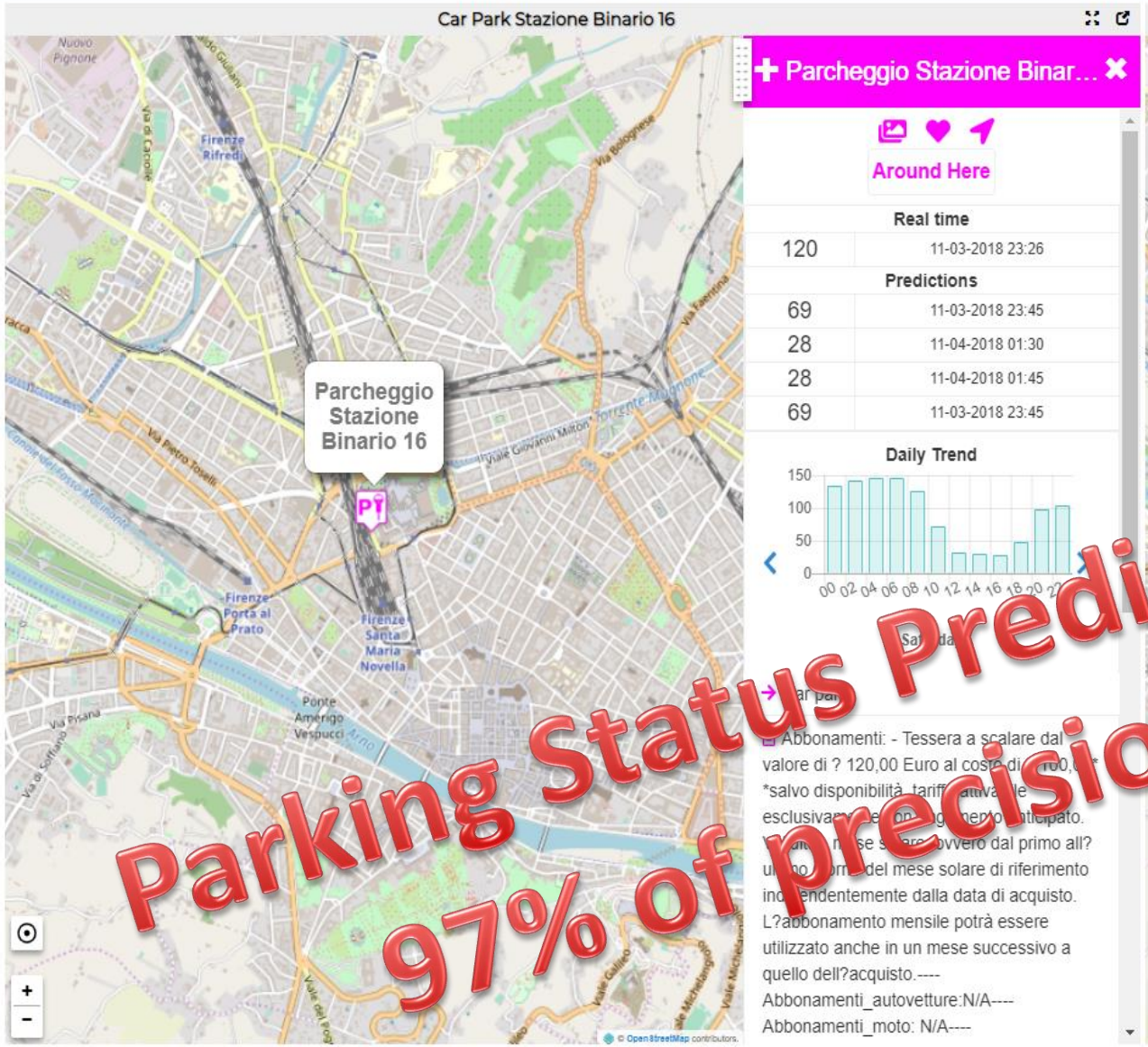
Active on Mobile Apps as:

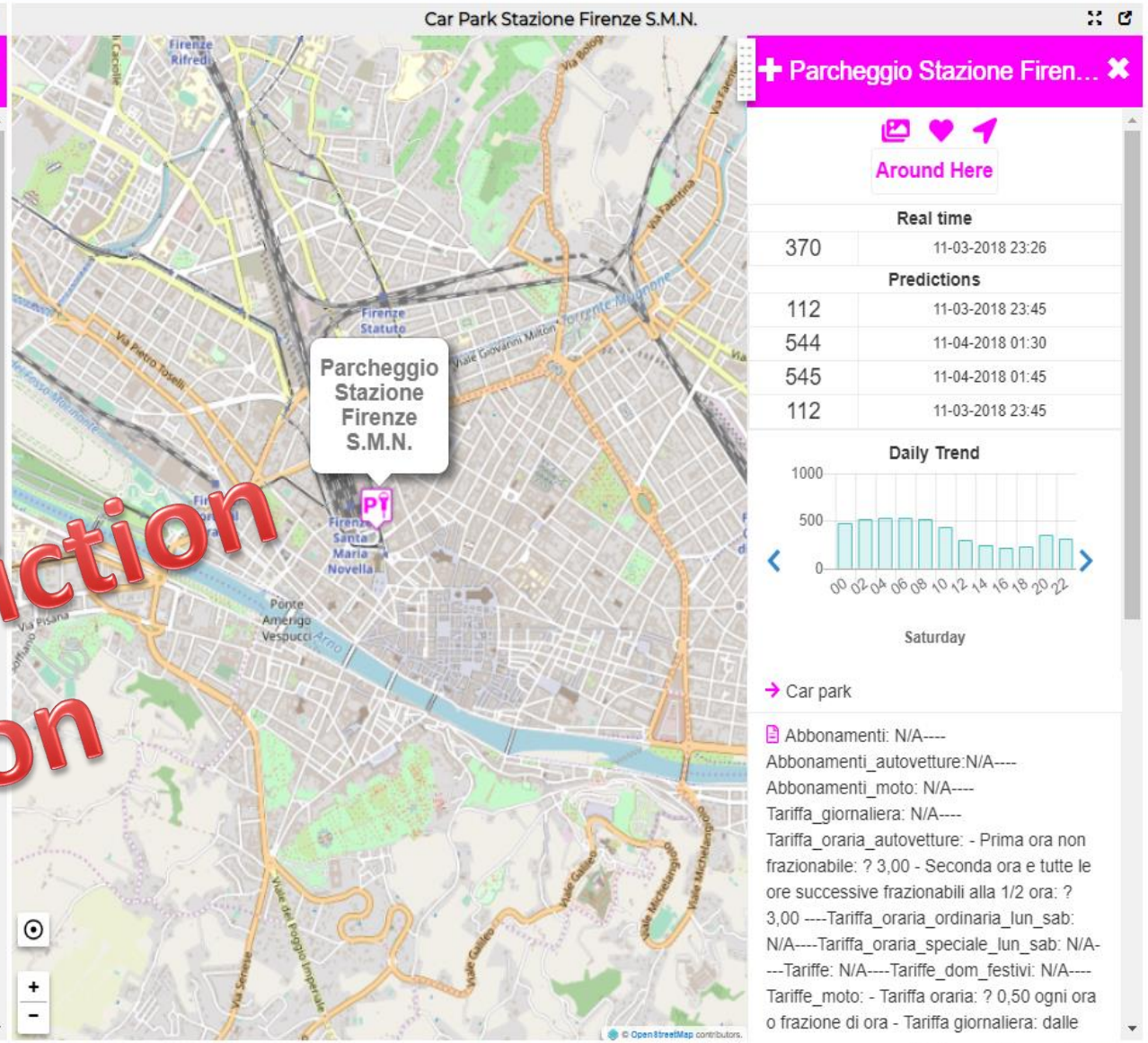
- «Firenze dove cosa»
- «Toscana dove cosa»

Precision: 97,5%

Monitoring Station for Parking

Sat 3 Nov 23:39:55





Parking Status Prediction 97% of precision

https://www.disit.org/dashboardSmartCity/view/index.php?iddasboard=MjQ2

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



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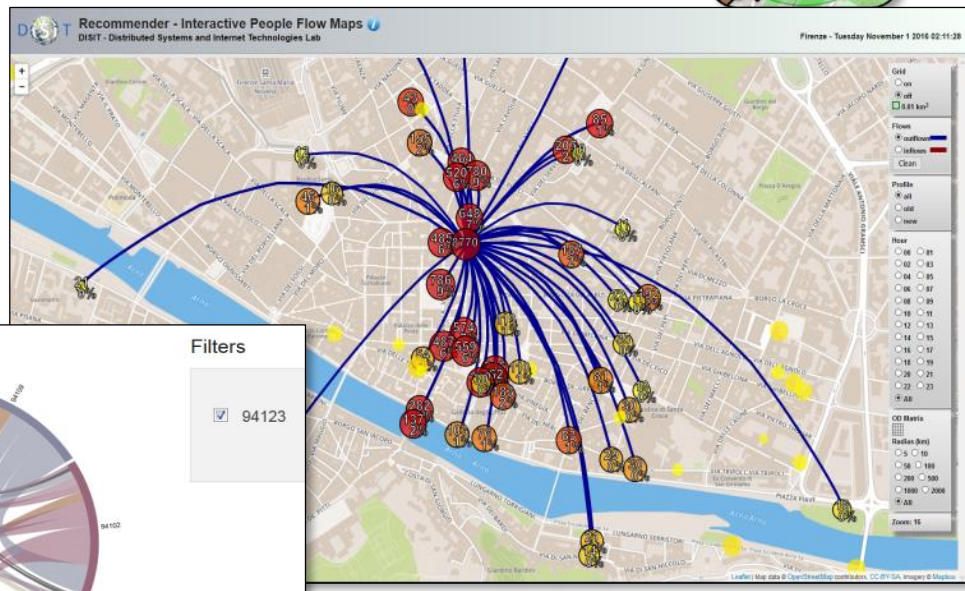
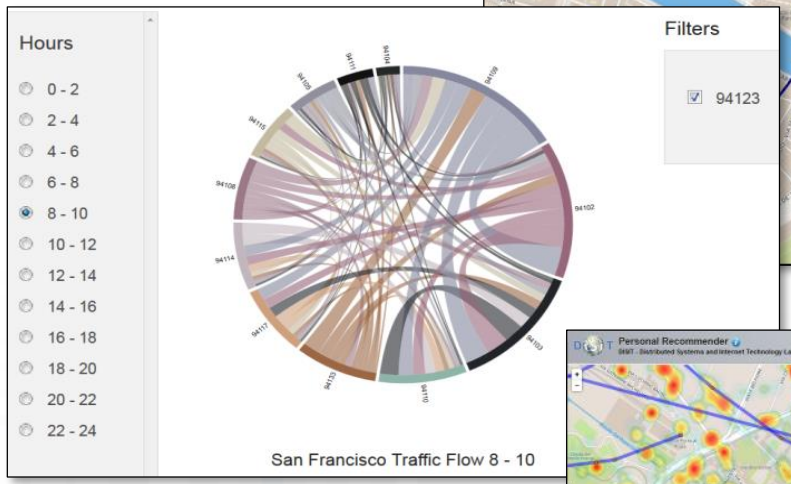
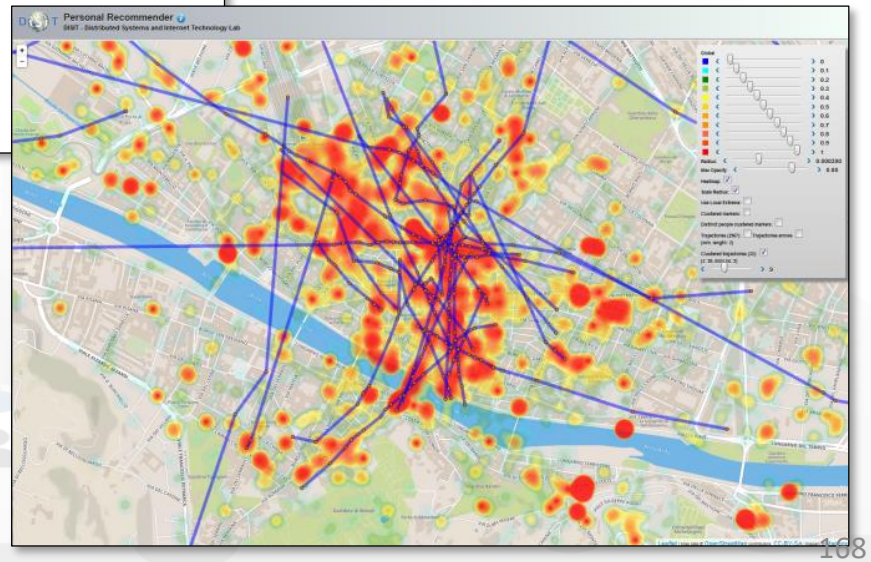
User Behaviour Analysis

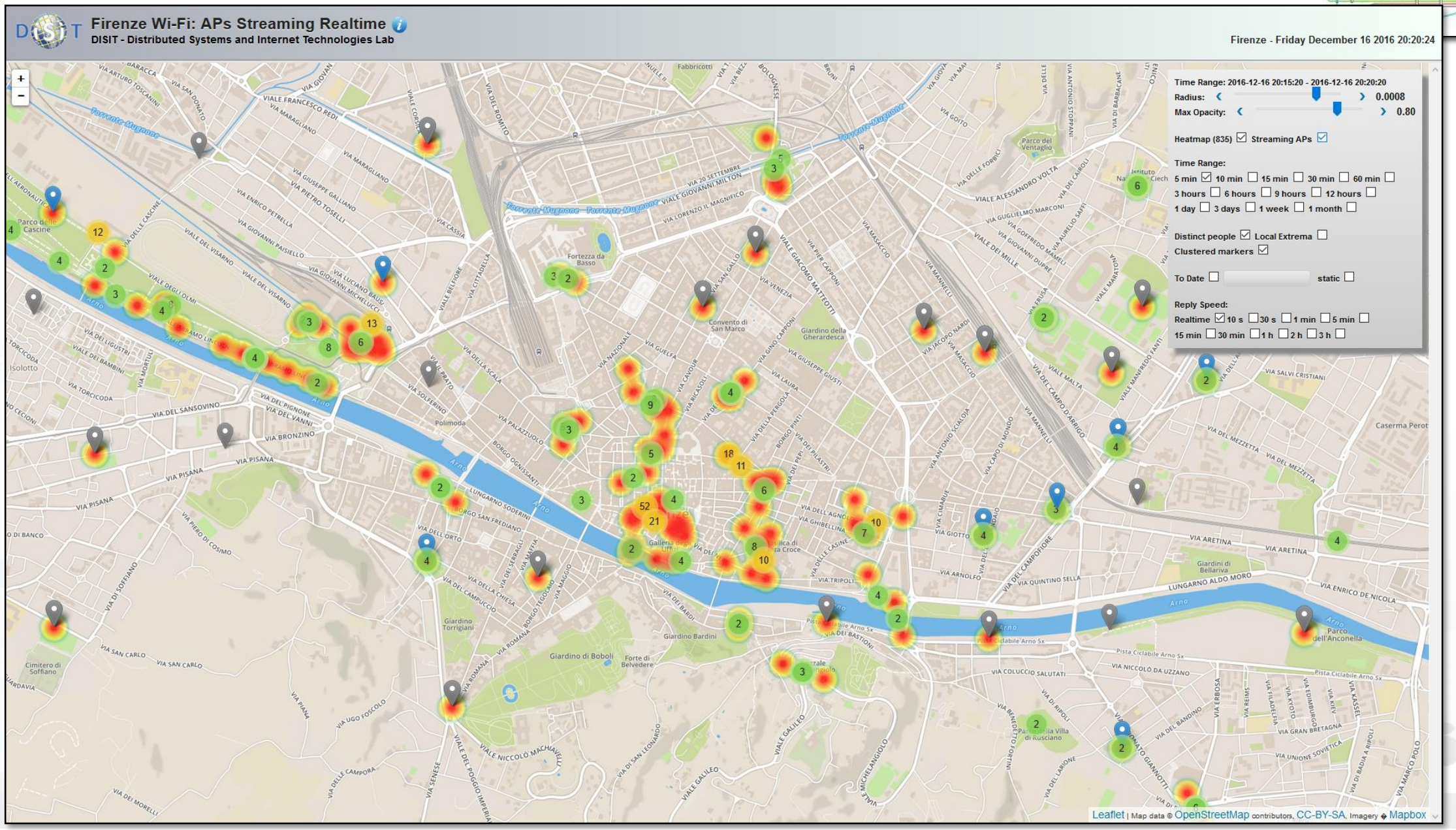
- **Monitoring movements by traffic flow sensors**
  - Spires and virtual spires
- **Monitoring movements from Mobile Cells**
  - Unsuitable for precise tracking and OD production
- **Monitoring movements from Wi-Fi**
- **Monitoring movements** and much more from mobile Apps







Real Time Monitoring of Wi-Fi network



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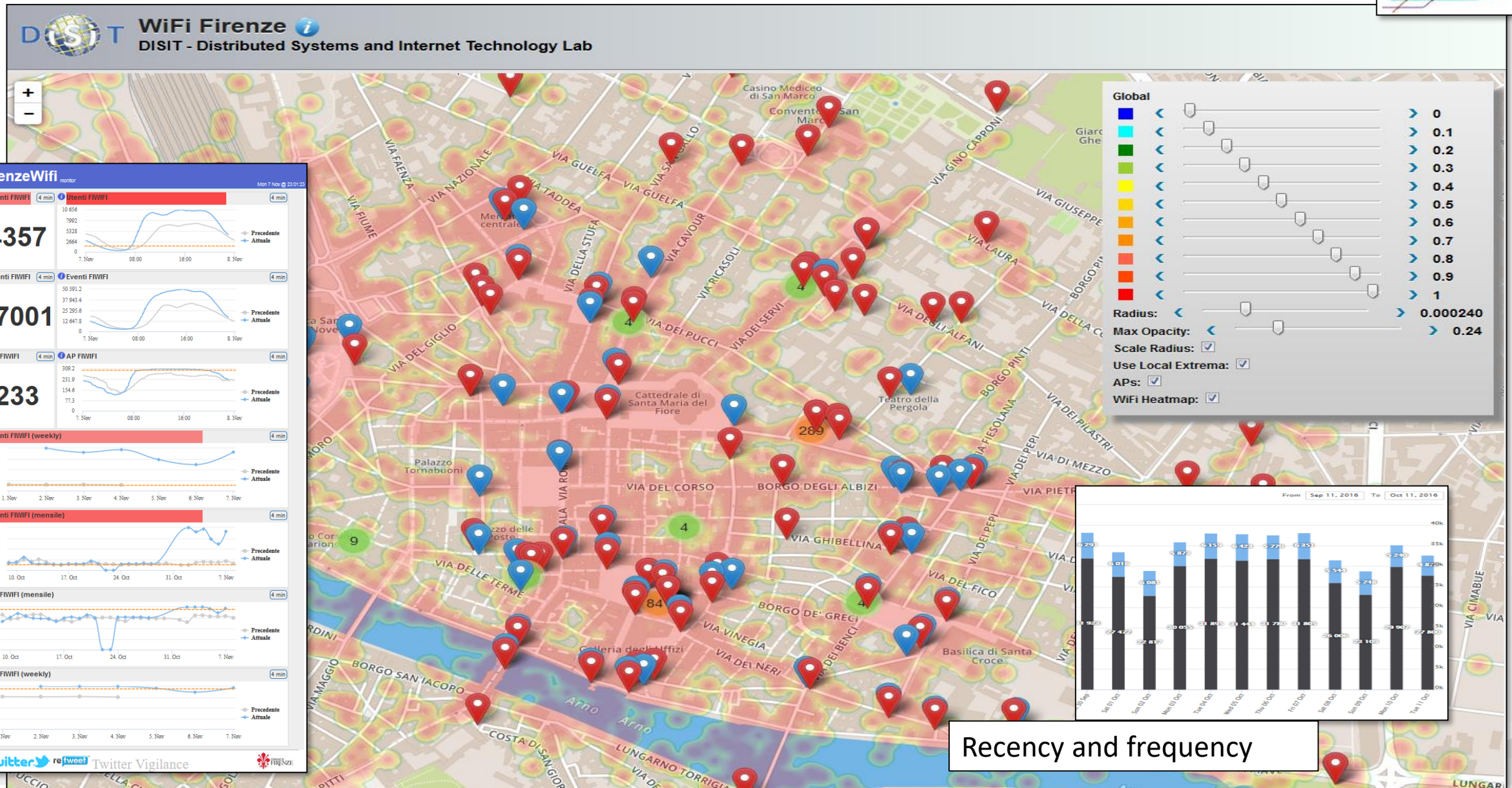
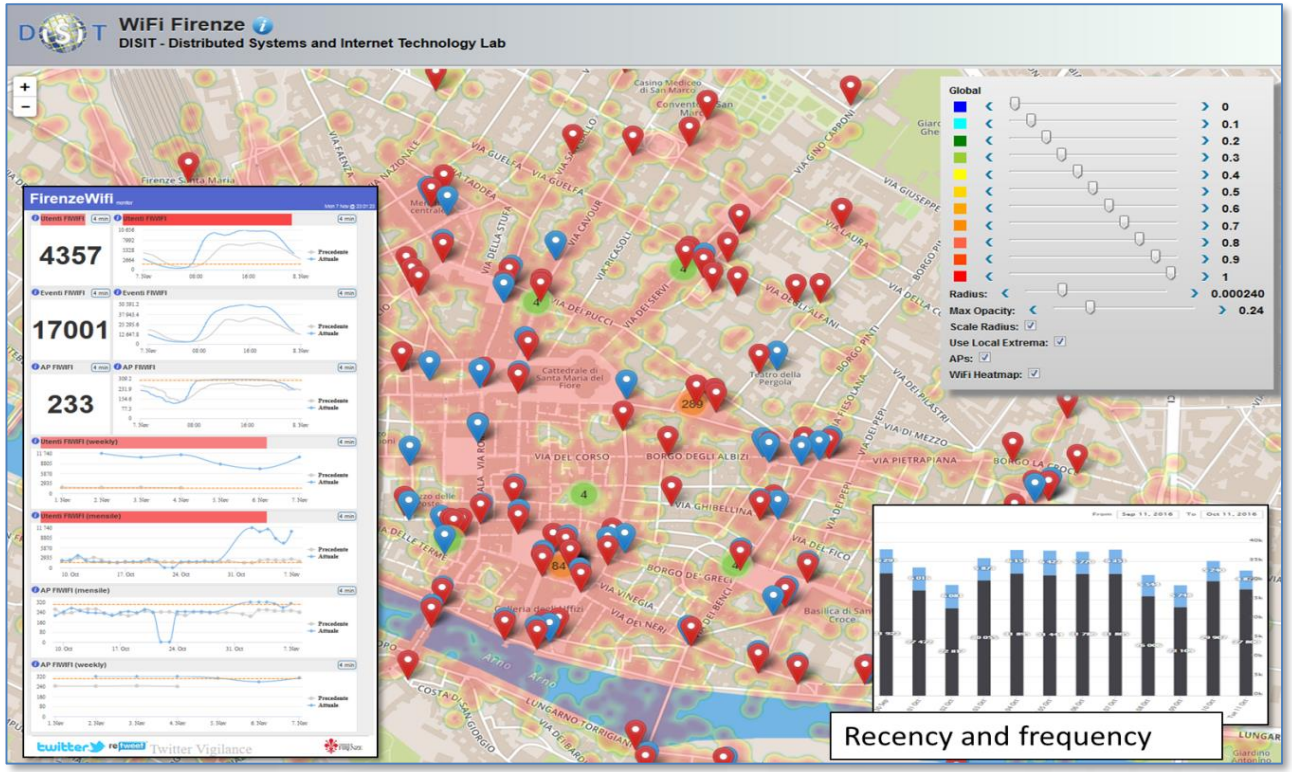
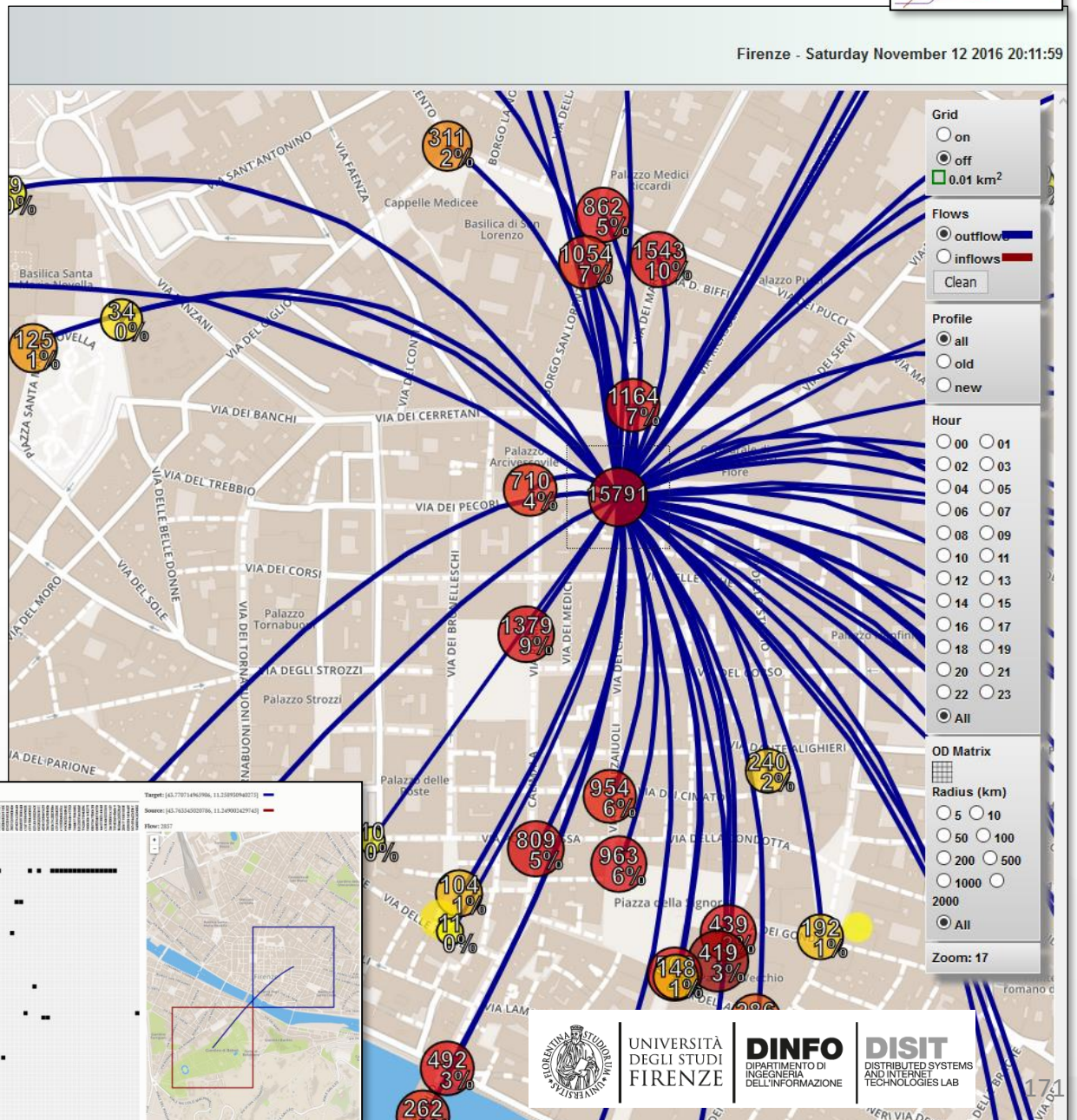
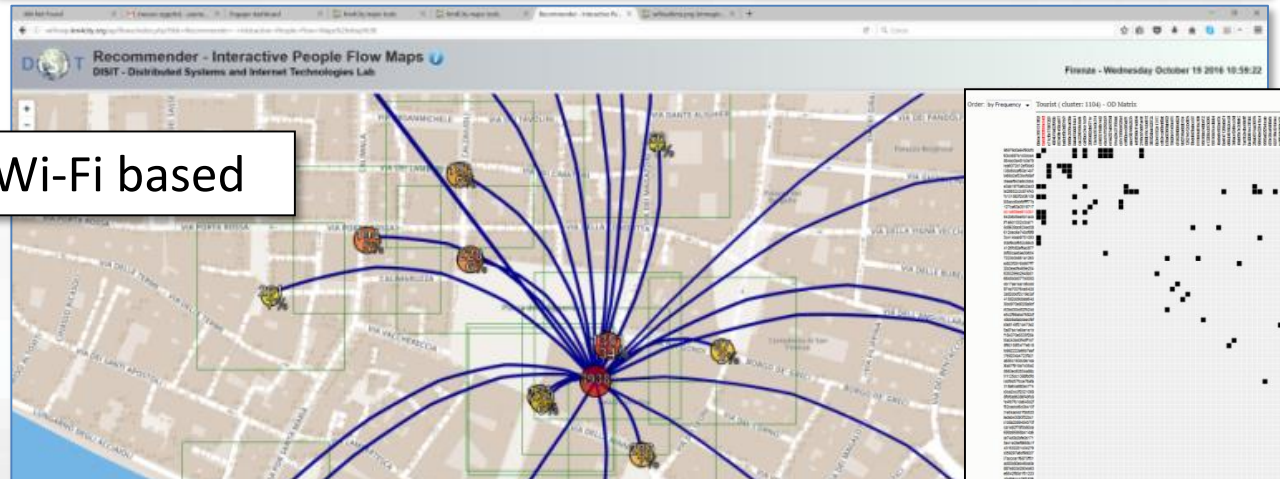
Wi-Fi Monitor Tool



Origin Destination Matrix Estimation



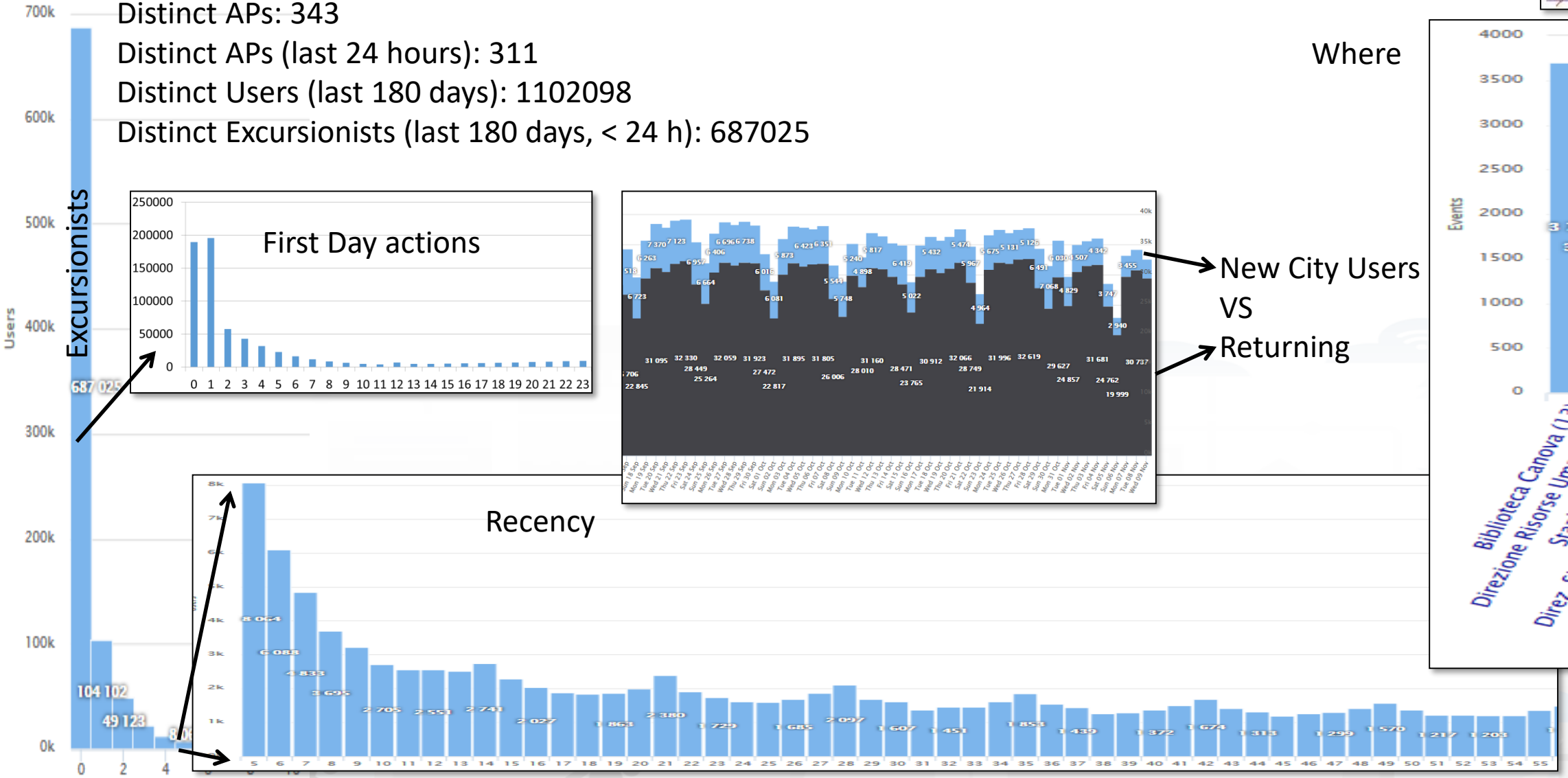




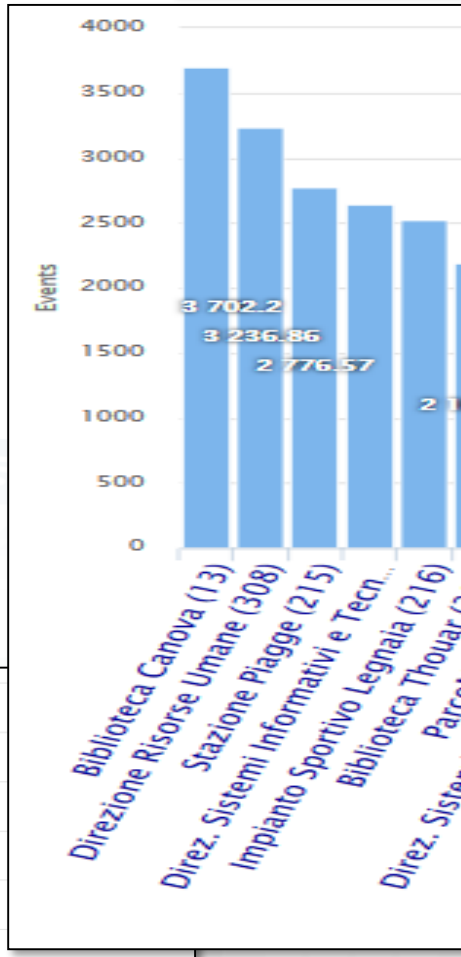
Wi-Fi based

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



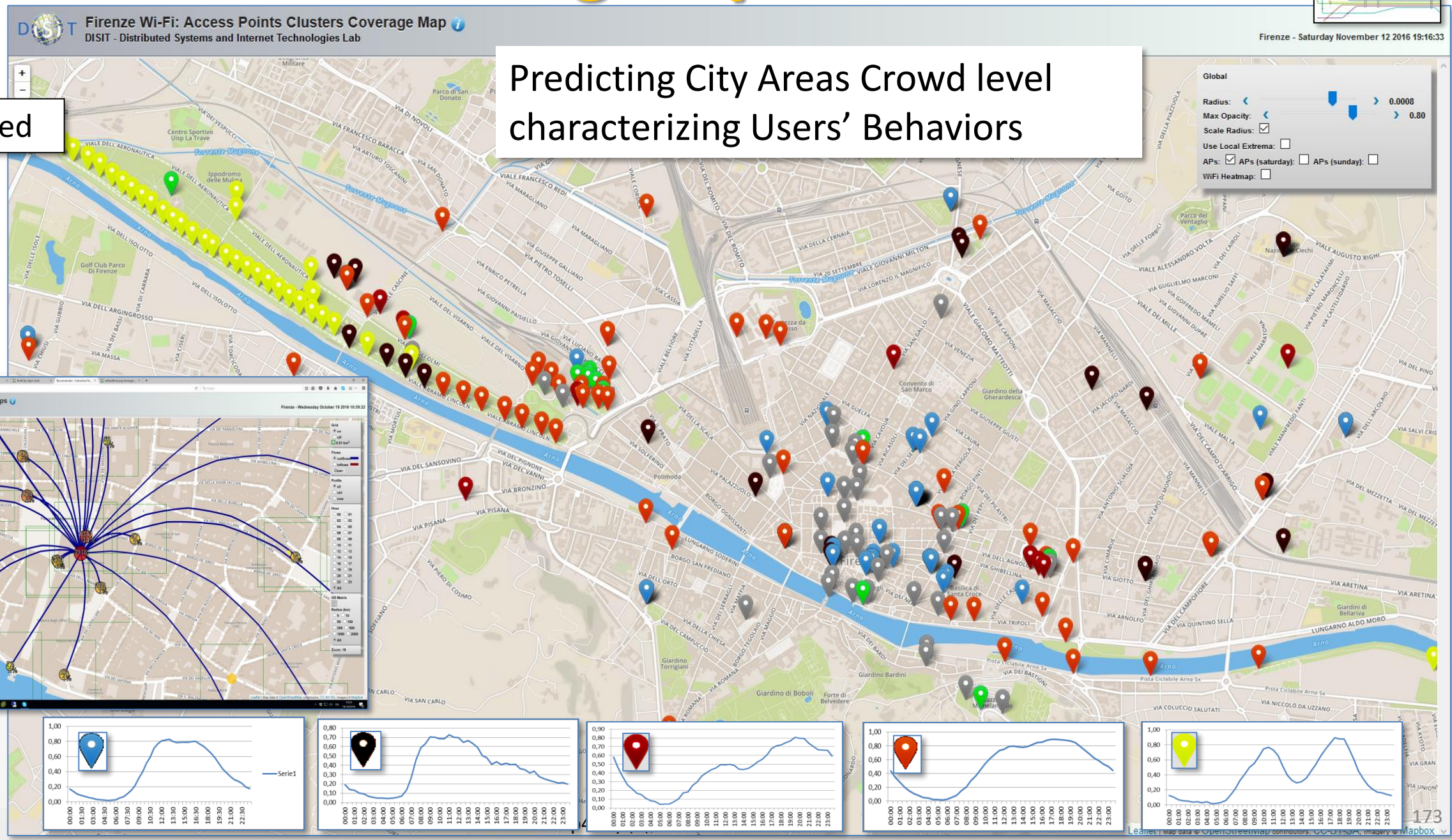
Where



Characterizing City Areas

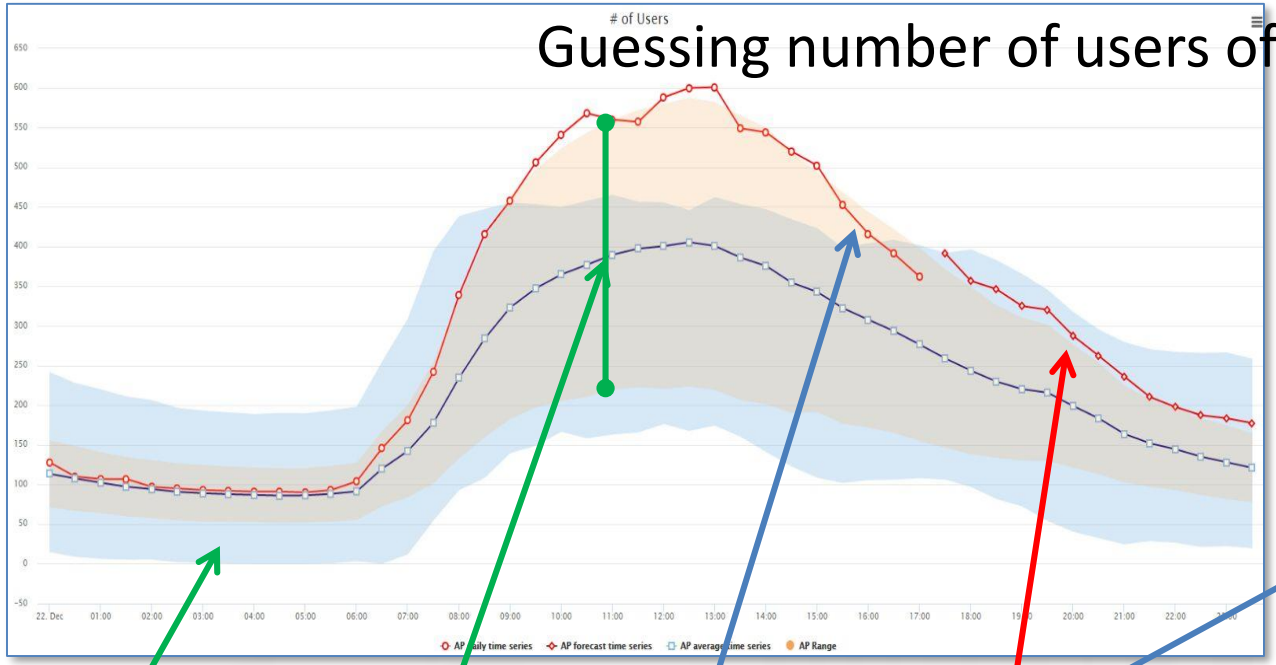
Wi-Fi based

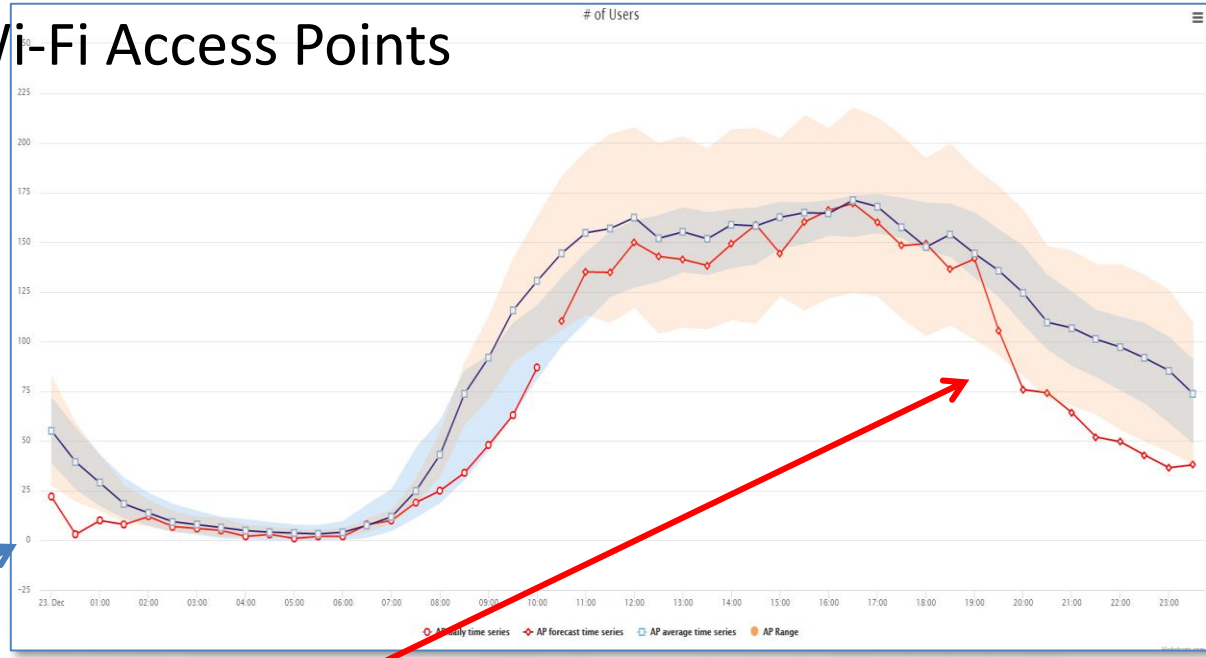
Predicting City Areas Crowd level characterizing Users' Behaviors



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%

Traffic Flow Reconstruction from Traffic Sensors Data



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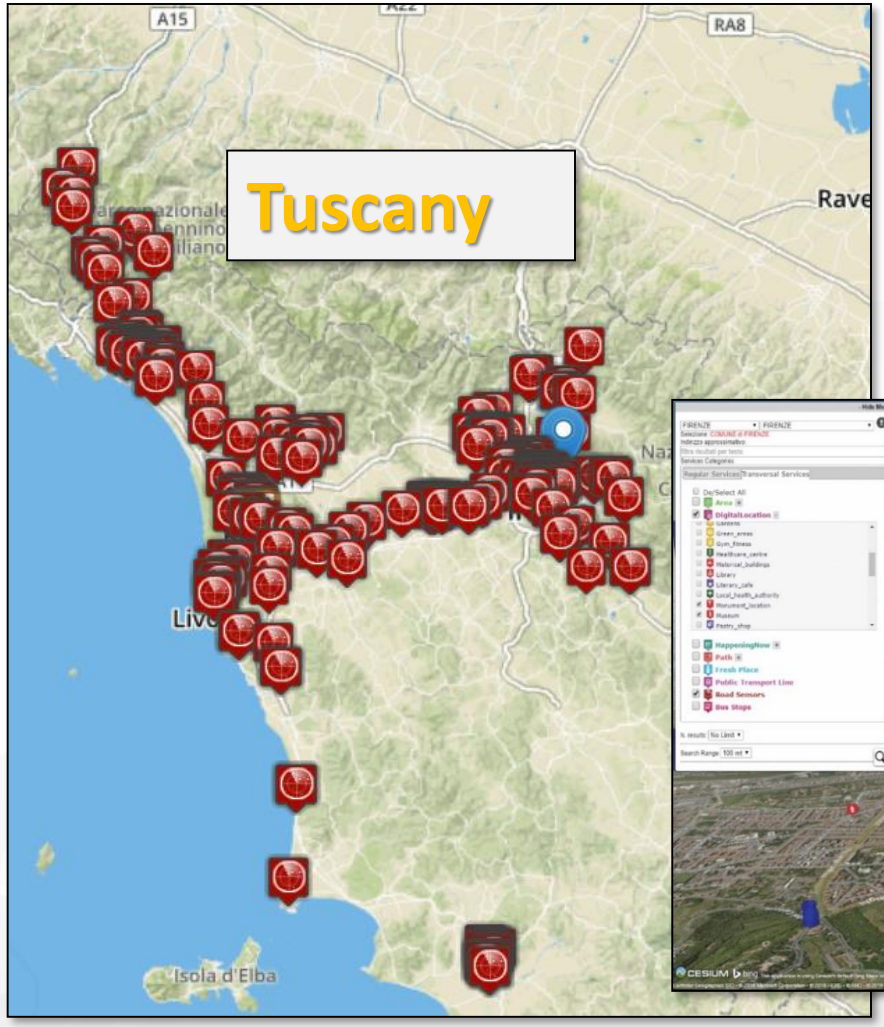
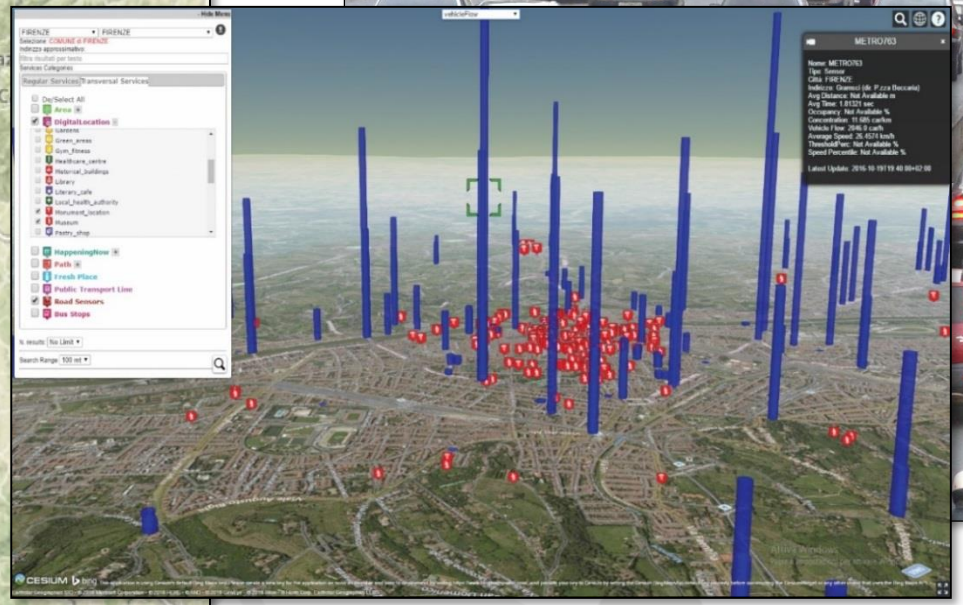
Traffic Flow Tools

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

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





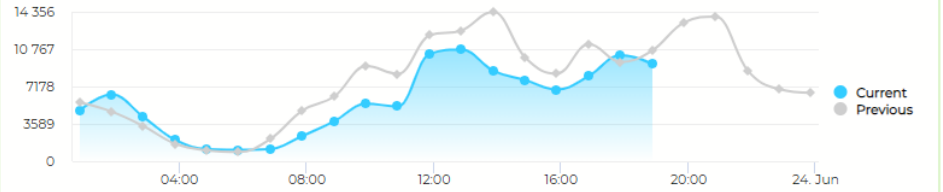
Traffic Flow Monitoring - Firenze - Cloned

Sun 23 Jun 19:38:15

 # IN FLOW 9m

9350

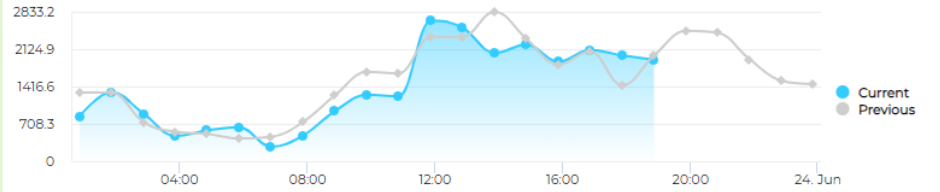
Firenze IN Traffic Flow (number of vehicles) 9m



ZTL in 9m

1925

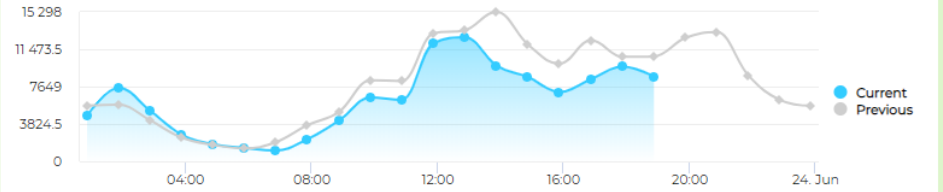
ZTL in Traffic Flow daily trend 9m



 # OUT FLOW 9m

8684

Firenze OUT Traffic Flow (number of vehicles) 9m



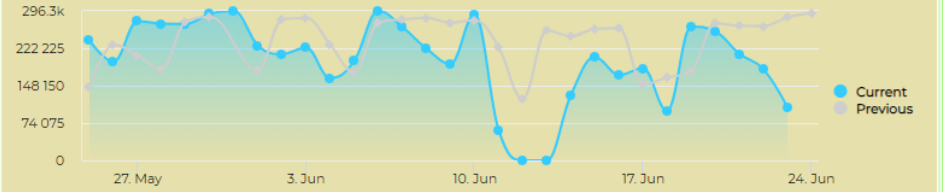
status comments 4m

All OK

Inc Daily Inp... 9m

105354

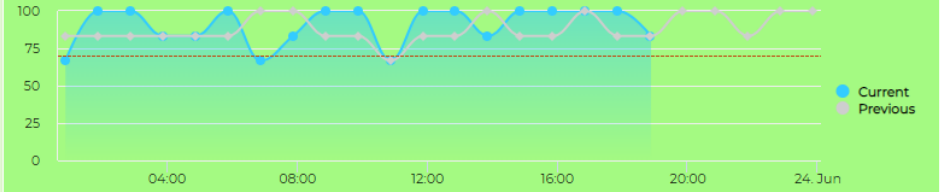
Daily Inputs (monthly) (last value is incremental) 9m



Current Time - C...

23/06/2019
19:38:15

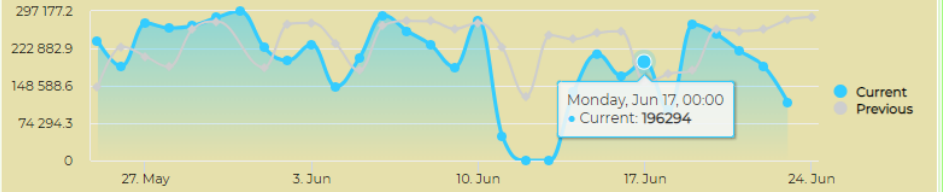
Quality of Measure in terms of percentage of expected measures considered 9m



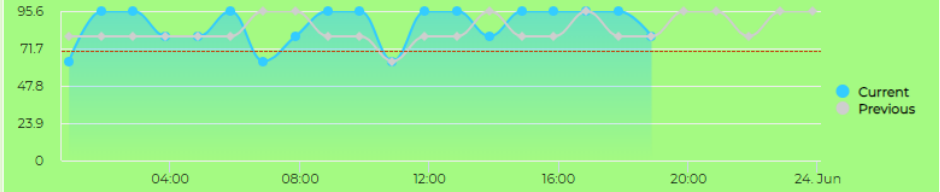
Inc Daily Out... 9m

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==



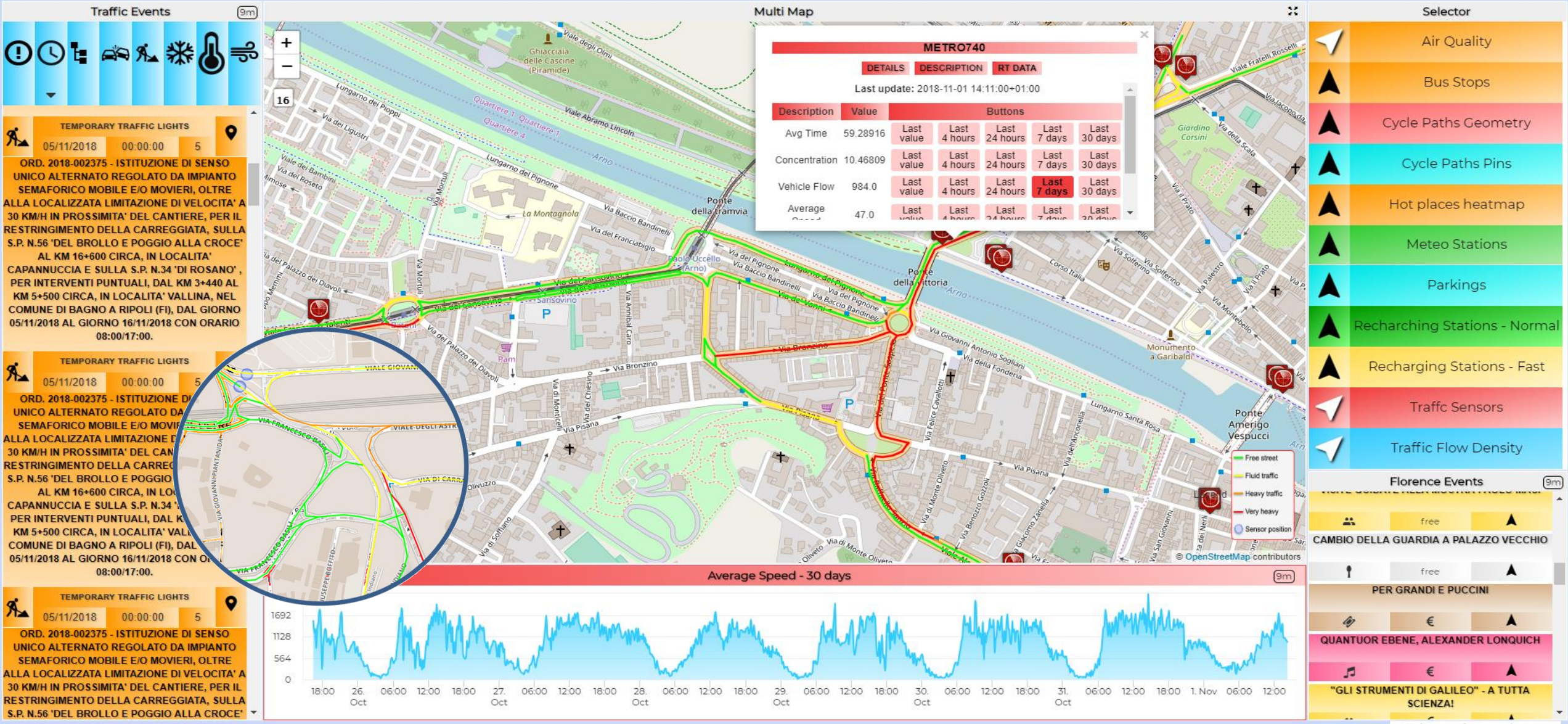
http://firenzetraffic.km4city.org

http://firenzetraffic.km4city.org/new.html

http://firenzetraffic.km4city.org/newSensors.html

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==

Origin Destination Matrices



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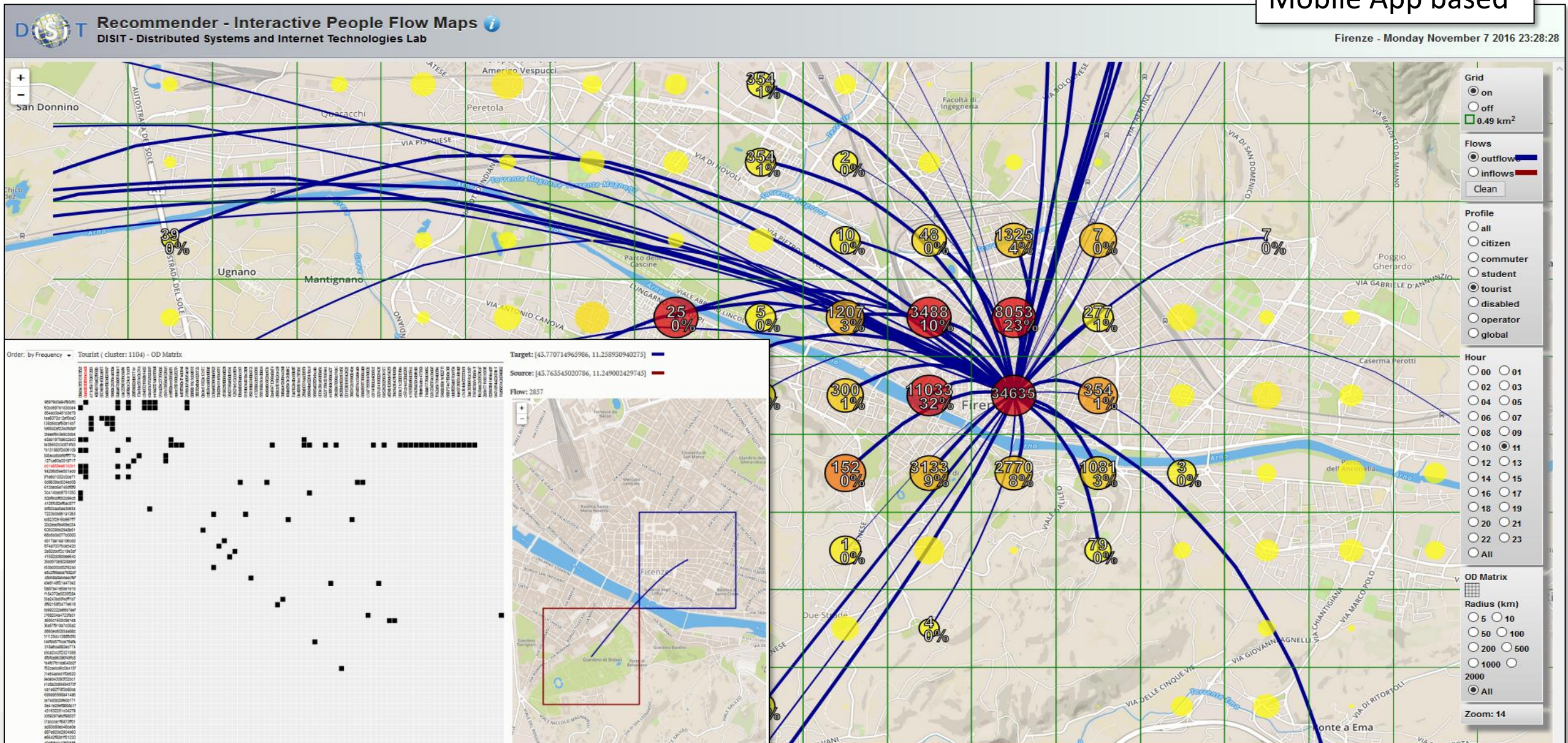
Scalable multiresolution OD matrix

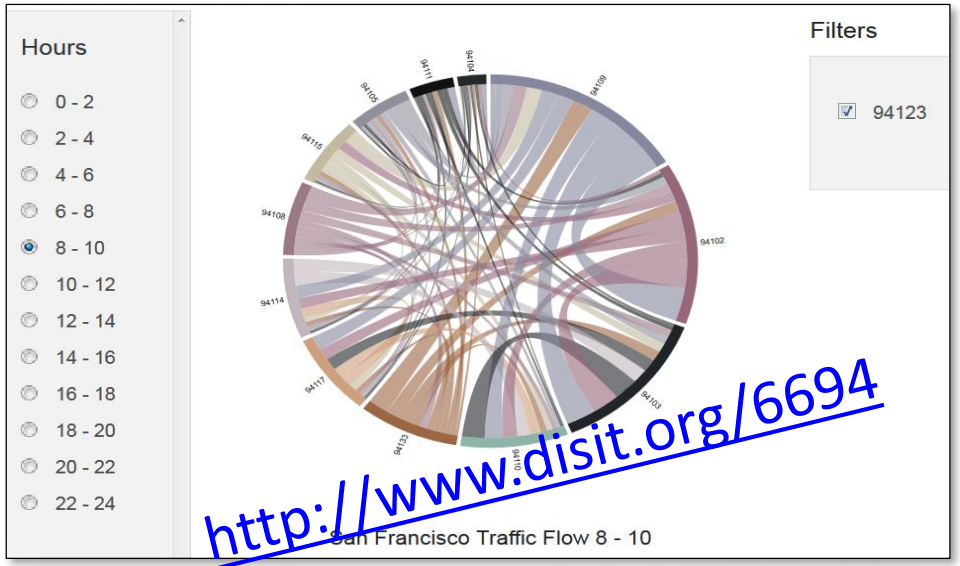
Sii-Mobility

Mobile App based

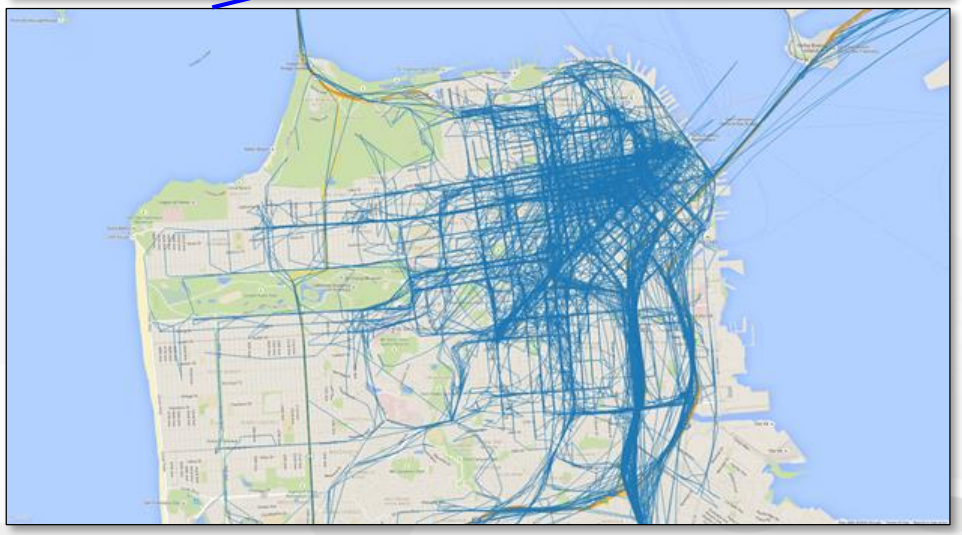


Traffic and People Flow Assessment

- **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



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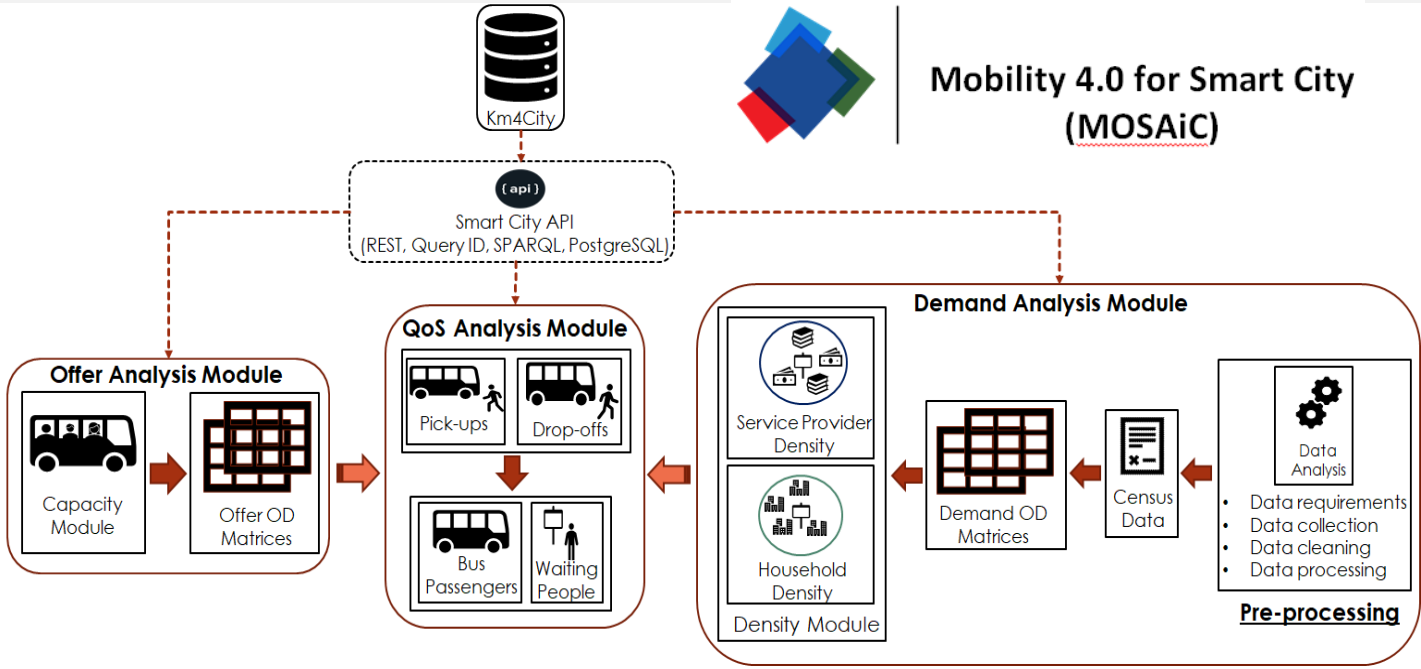
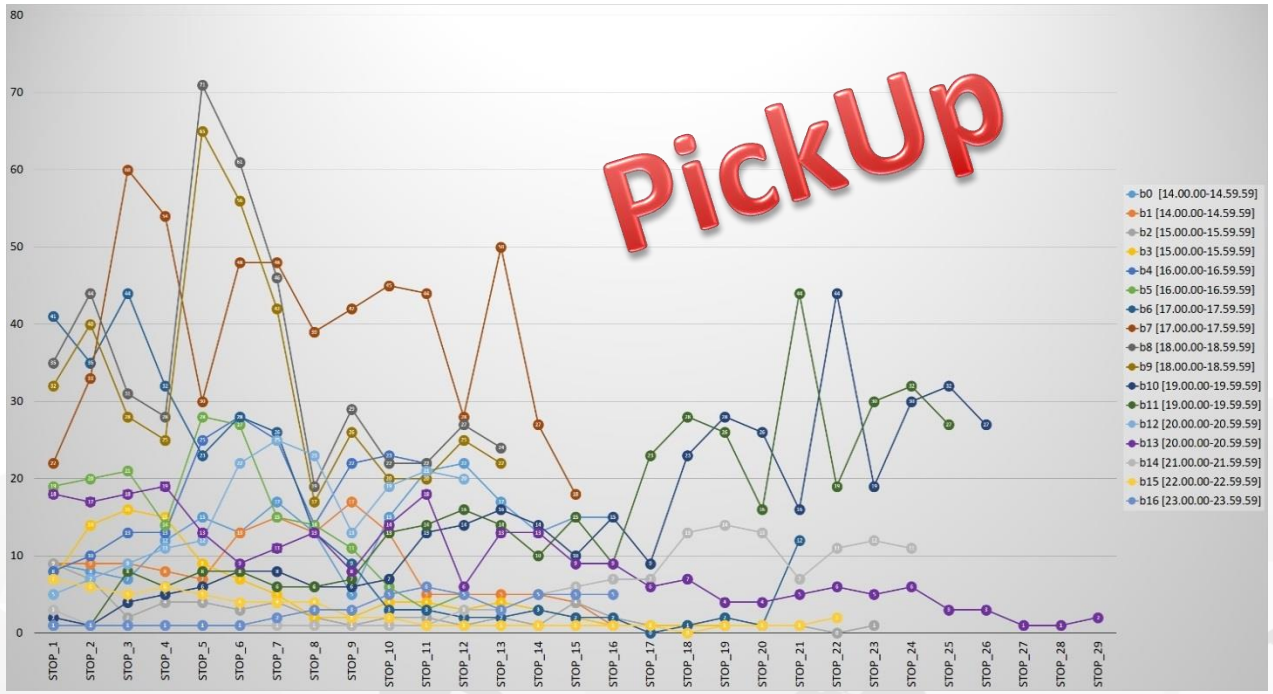
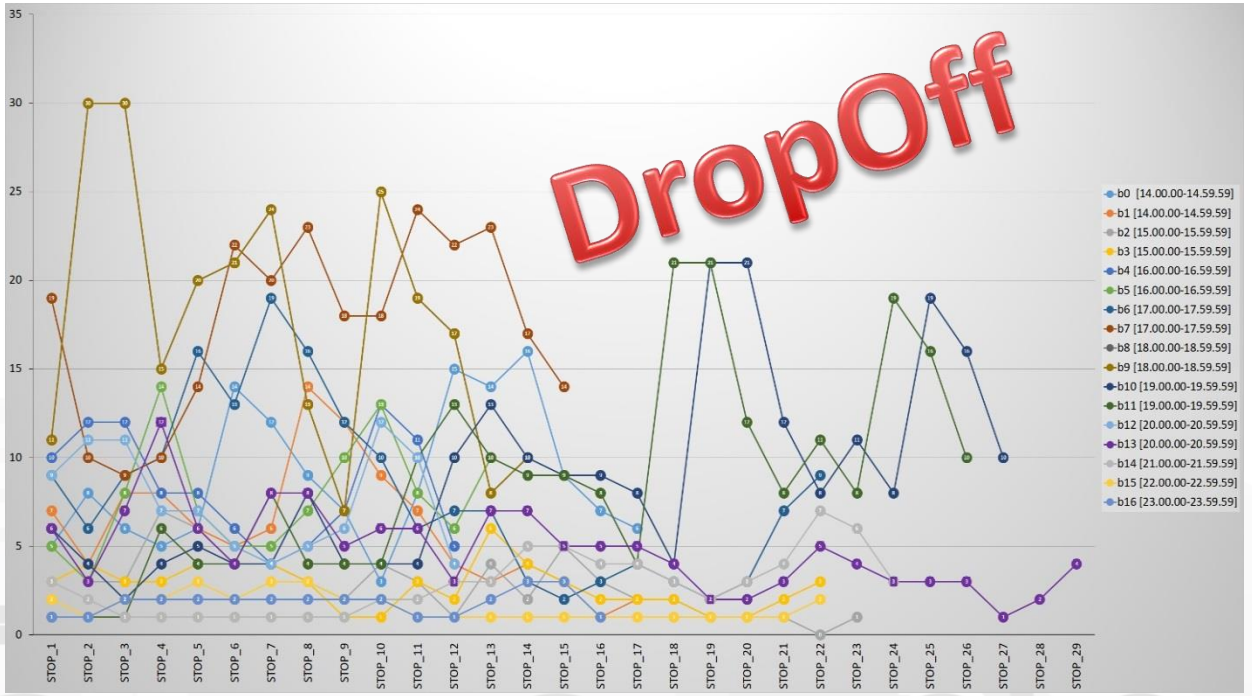
Demand vs Offer of Mobility Analysis







Modal & Multimodal Routing for Navigation and Travel Planning



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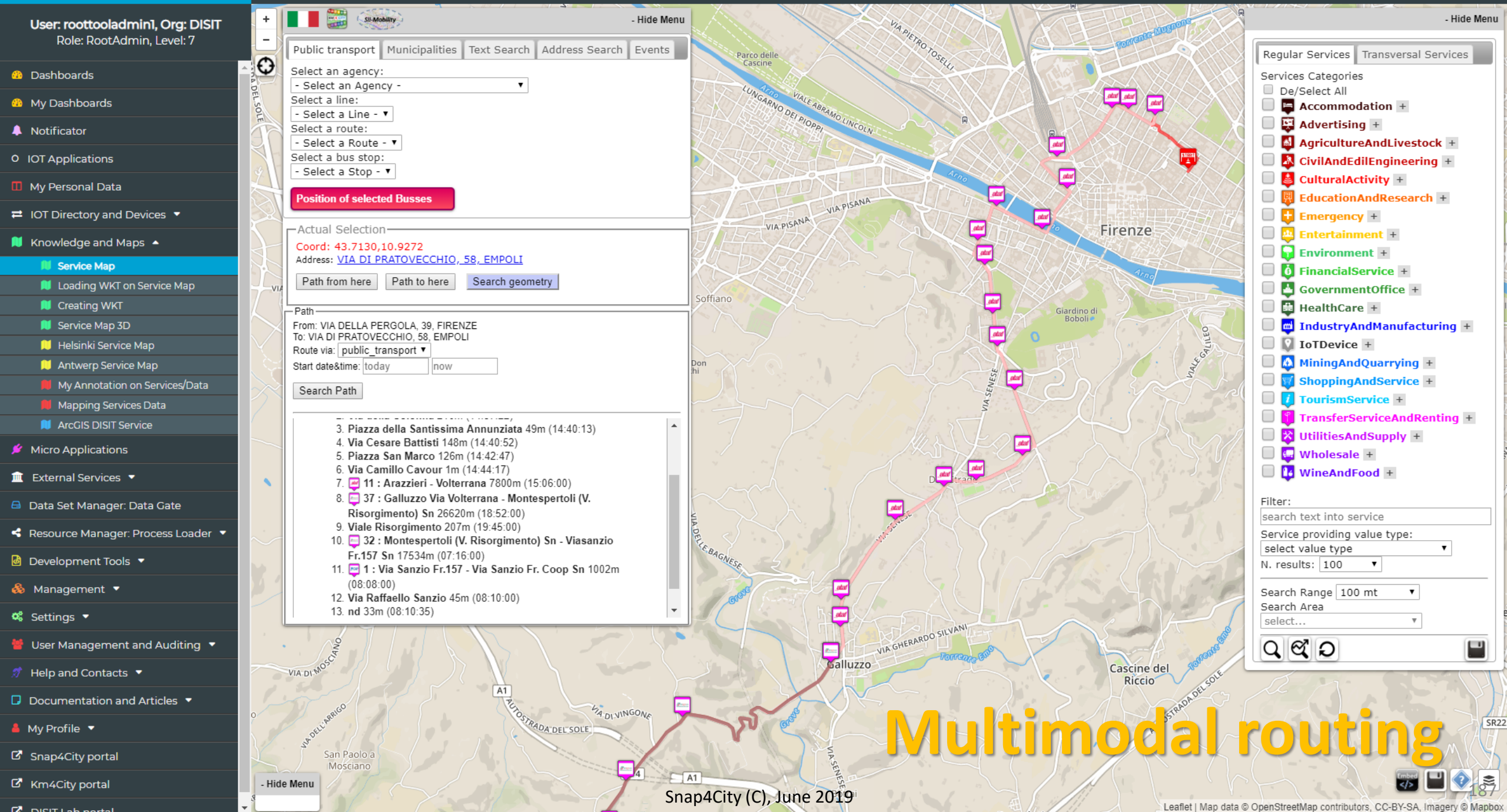

User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7
Dashboards
My Dashboards
Notificator
IOT Applications
My Personal Data
IOT Directory and Devices
Knowledge and Maps
Service Map
Loading WKT on Service Map
Creating WKT
Service Map 3D
Helsinki Service Map
Antwerp Service Map
My Annotation on Services/Data
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
- 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
Giardino di Boboli
Parco delle Cascine
San Paolo a Mosciano
Multimodal routing
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

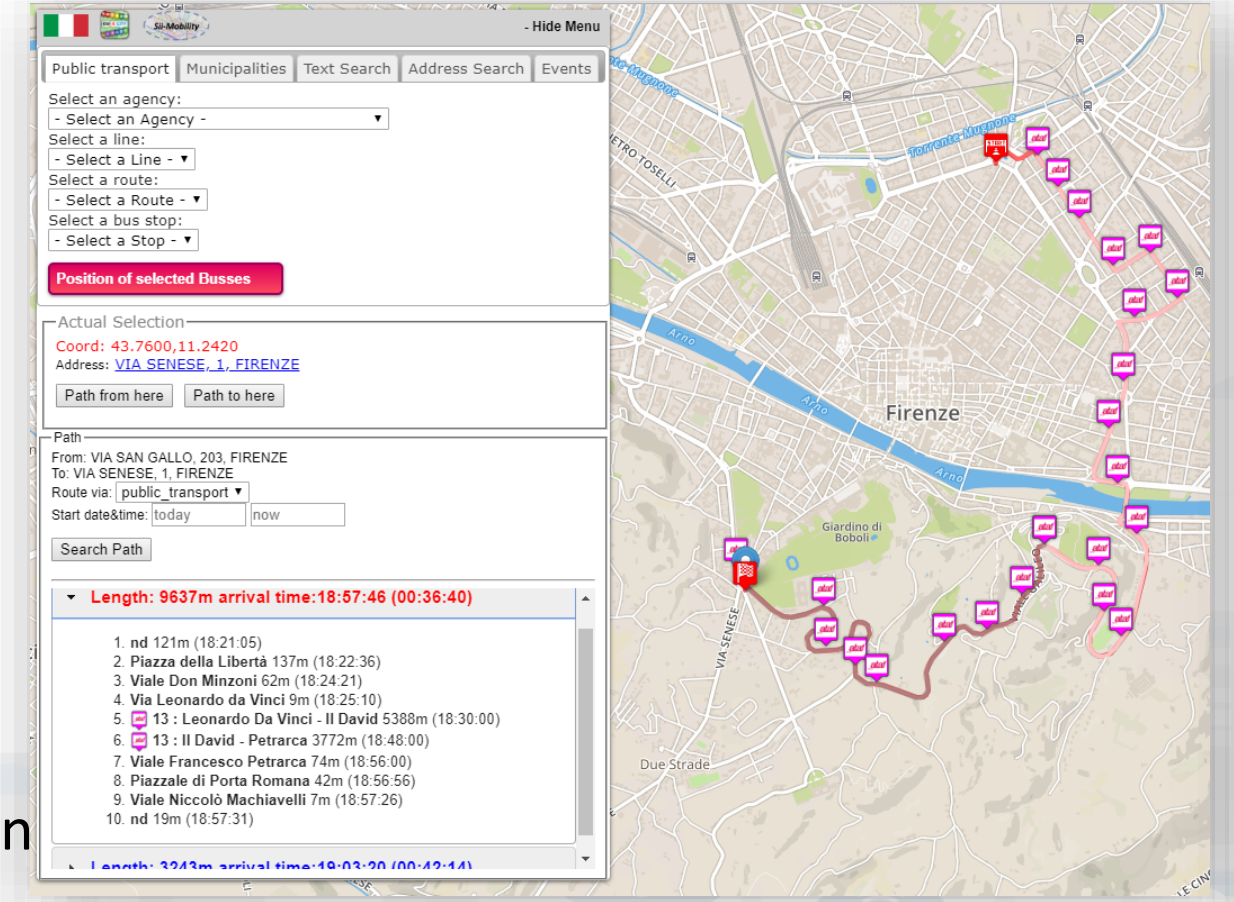
Routing and Multimodal Routing

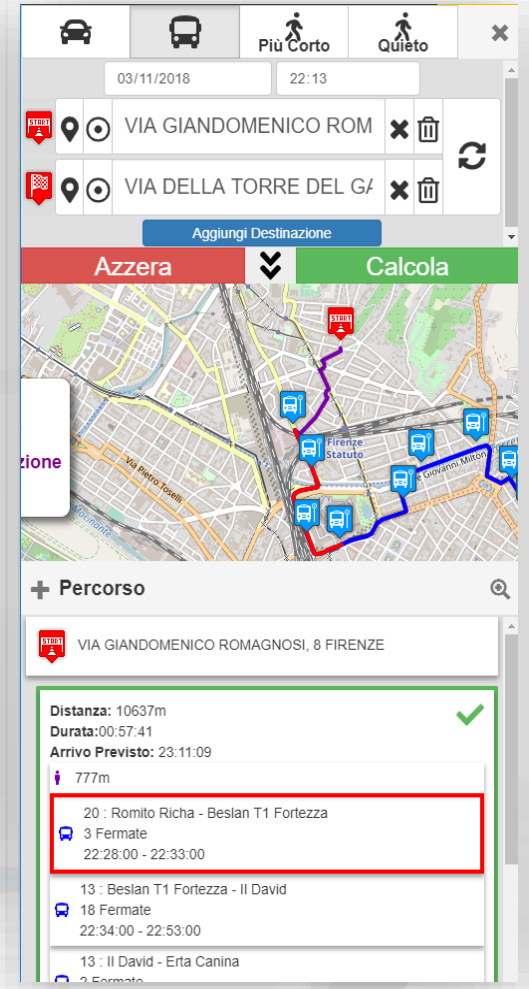
Modes:

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

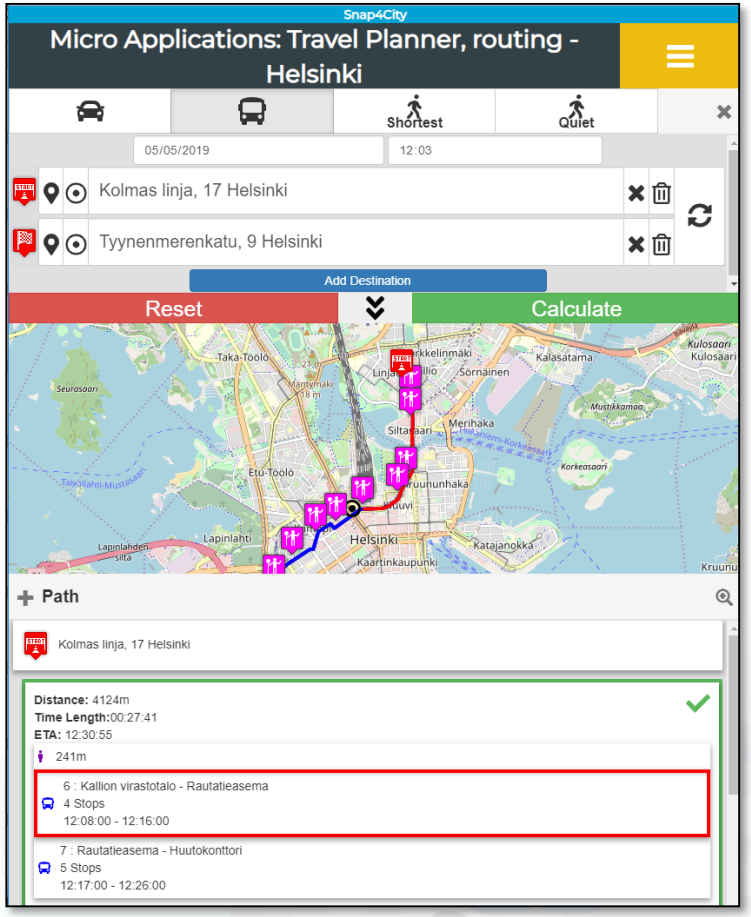
Test it on our:

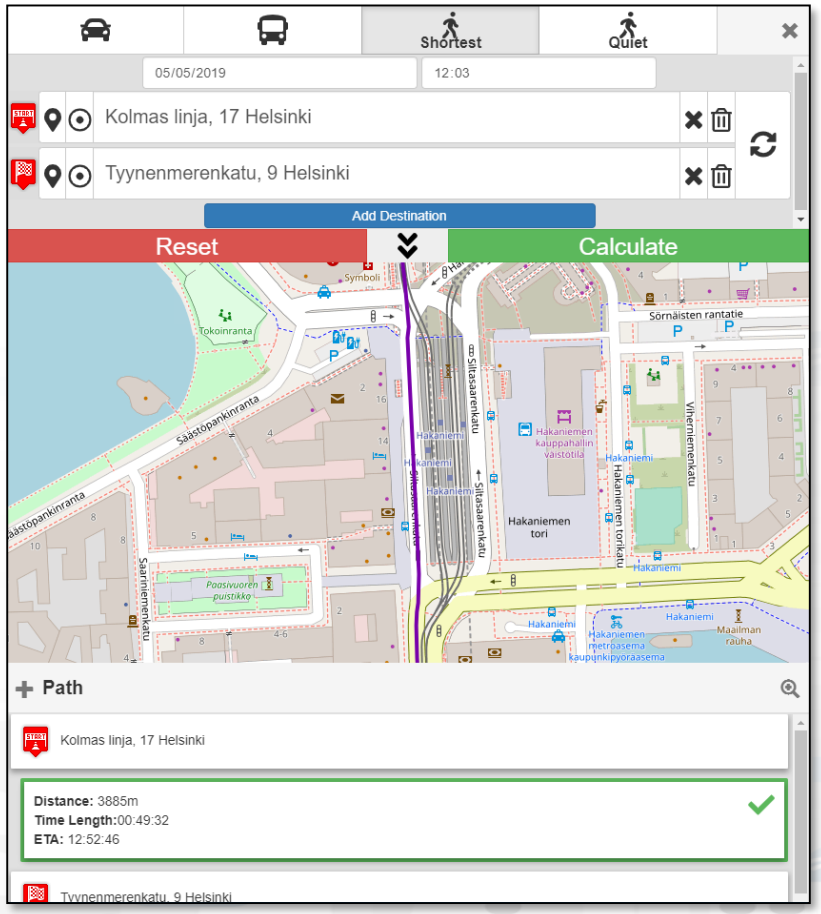
- Mobile Apps
- MicroApplication
- Dashboard
- ServiceMap service on Tuscany in Snap4City

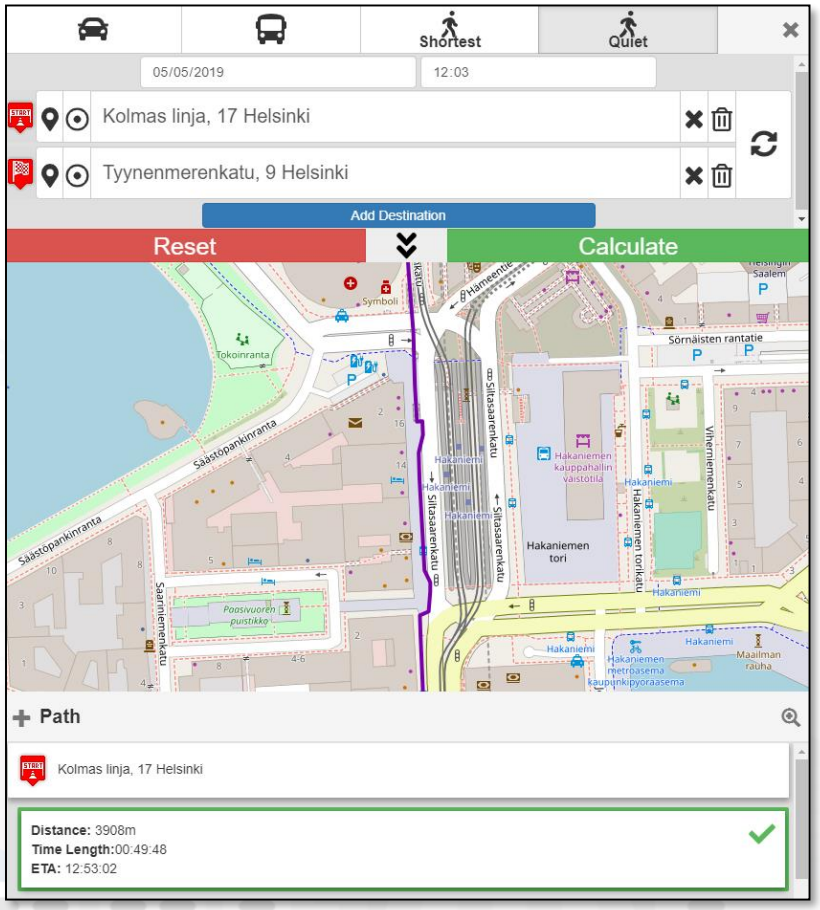




Routing for quite







Anomaly Detection



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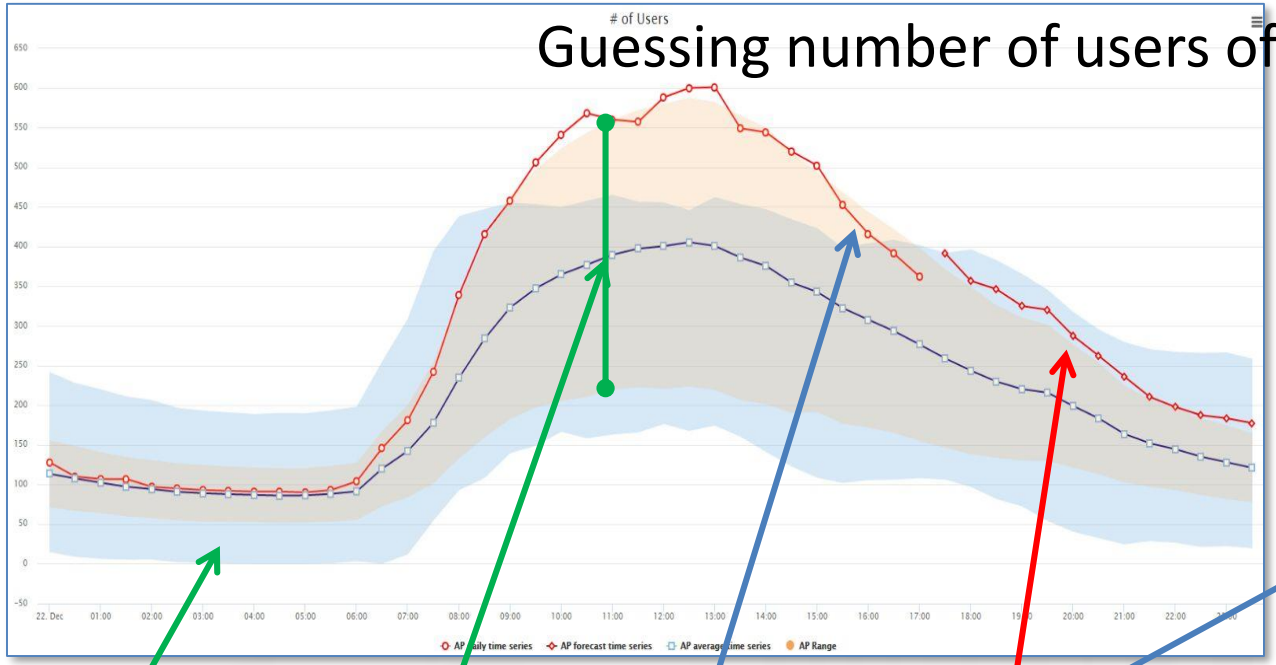
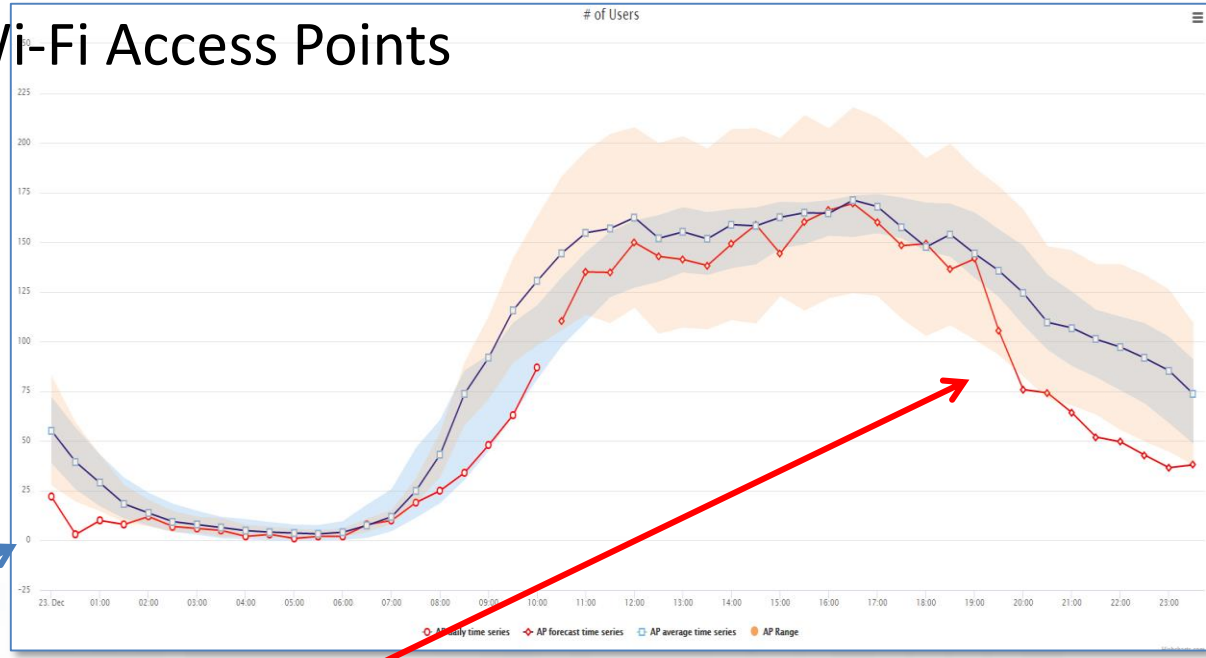
Prediction and Identification of Anomalies

Guessing number of users of Wi-Fi Access Points





Cluster confidence

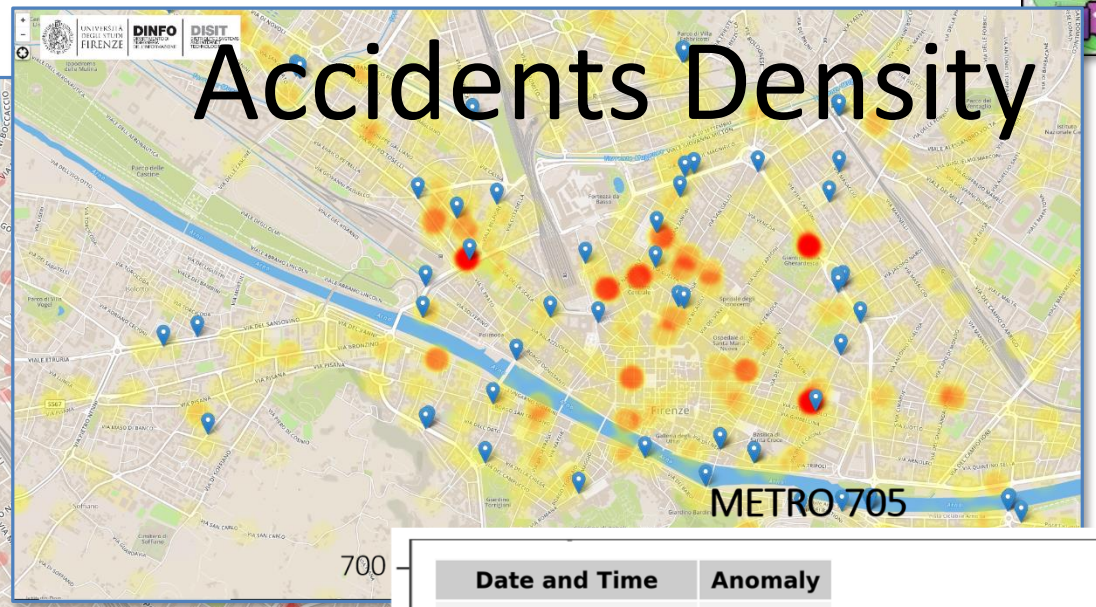
AP average and confidence

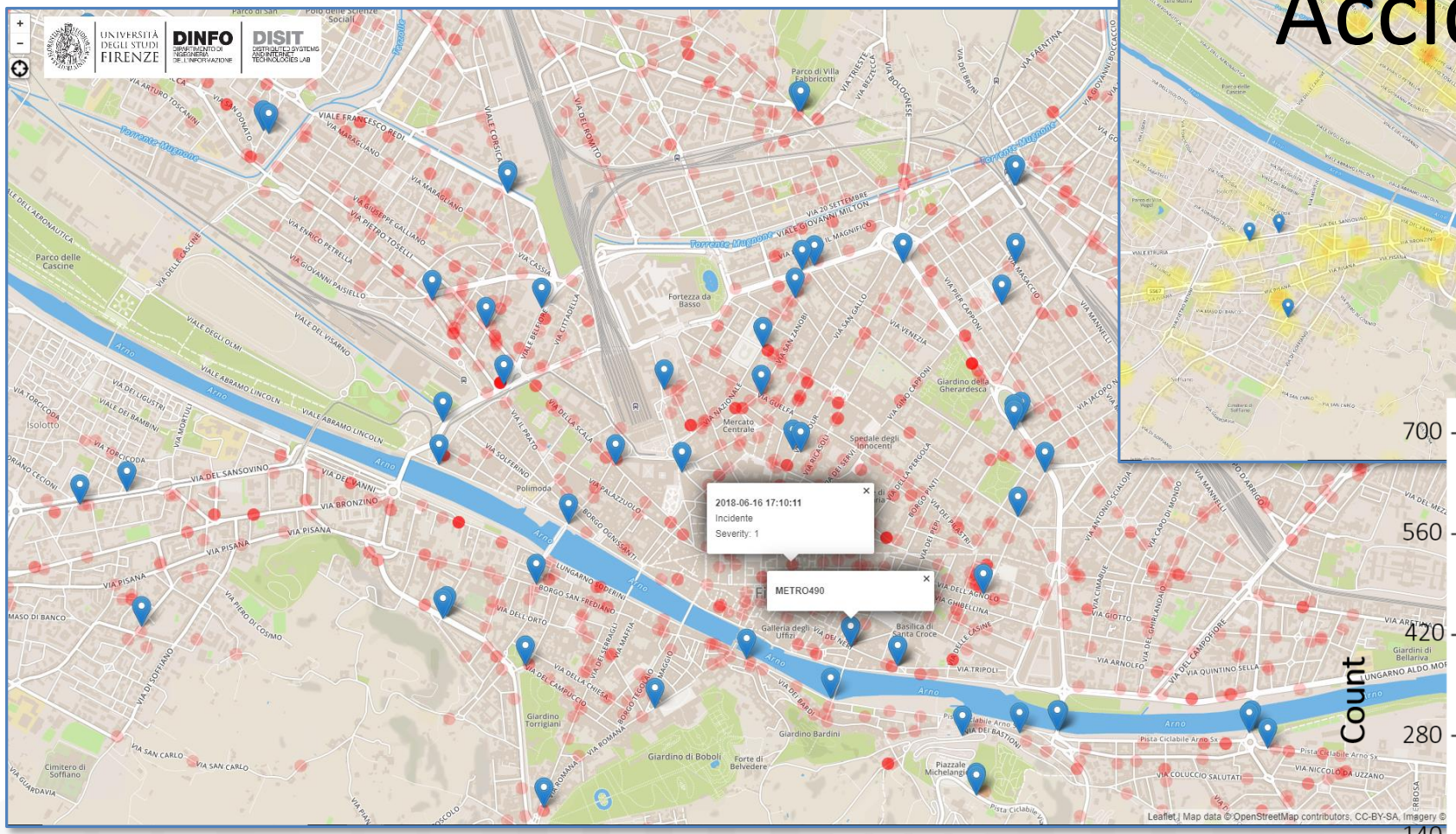
Actual AP trend for today

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

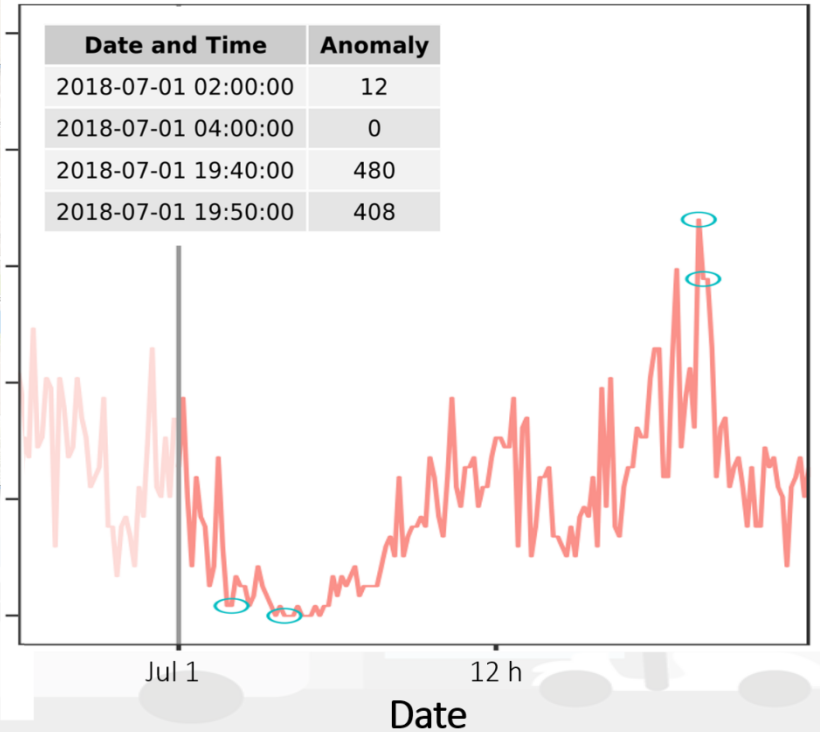
Predictive precision of the 95%

Anomaly Detection





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



Accidents vs Traffic

Environmental Data Predictions



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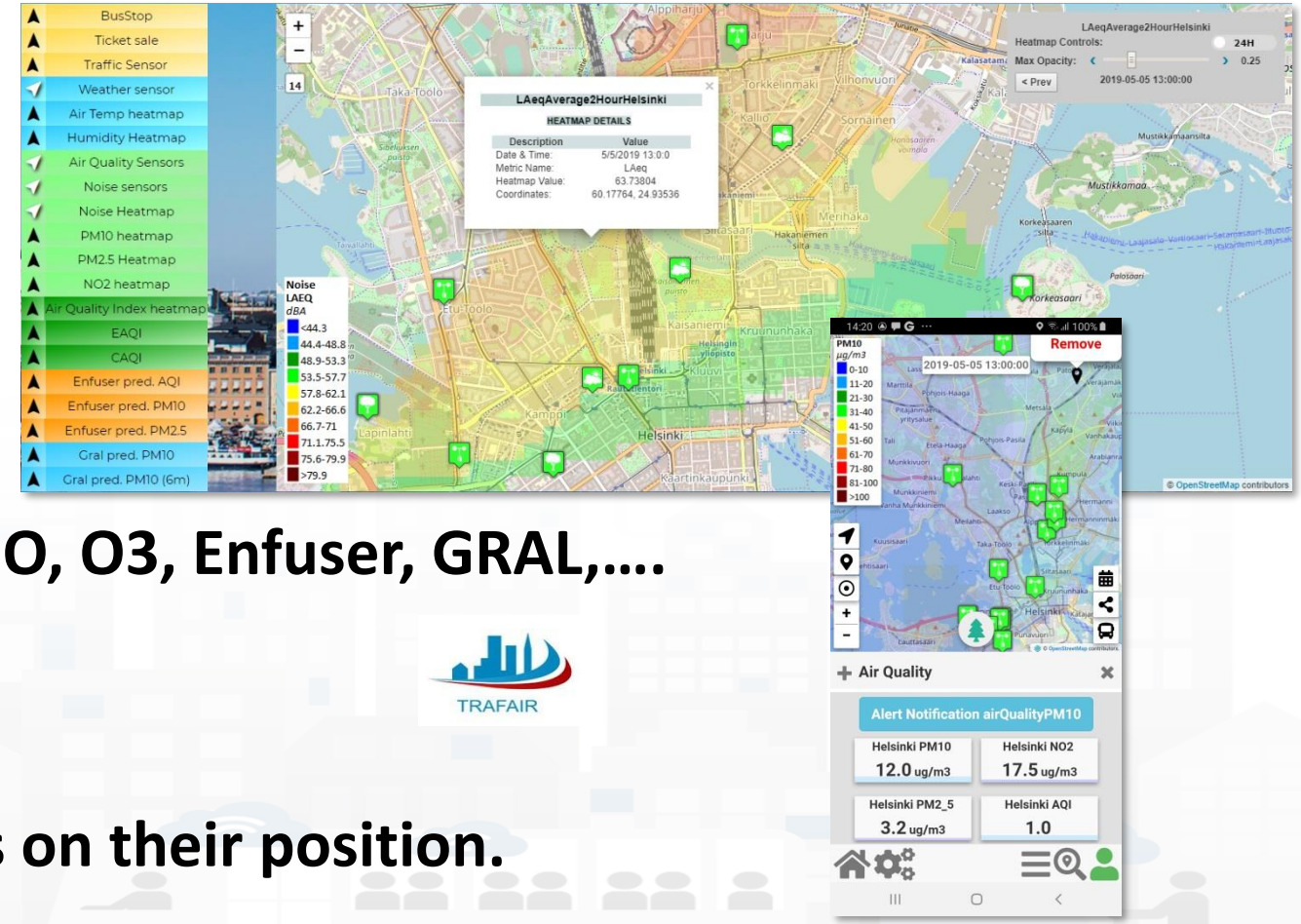
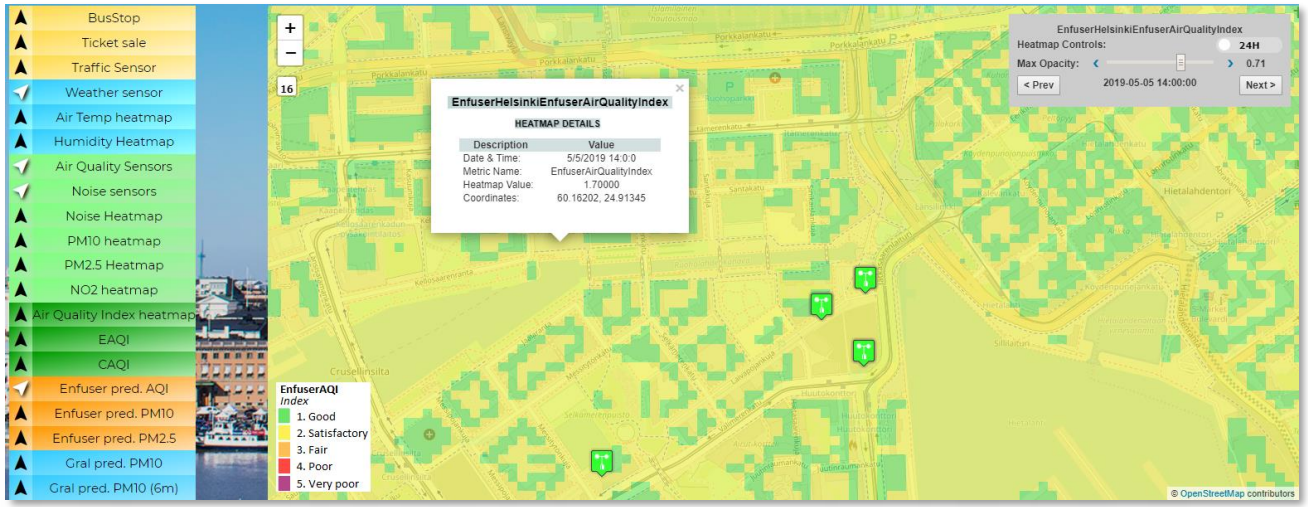
Data Analytics: Heatmaps

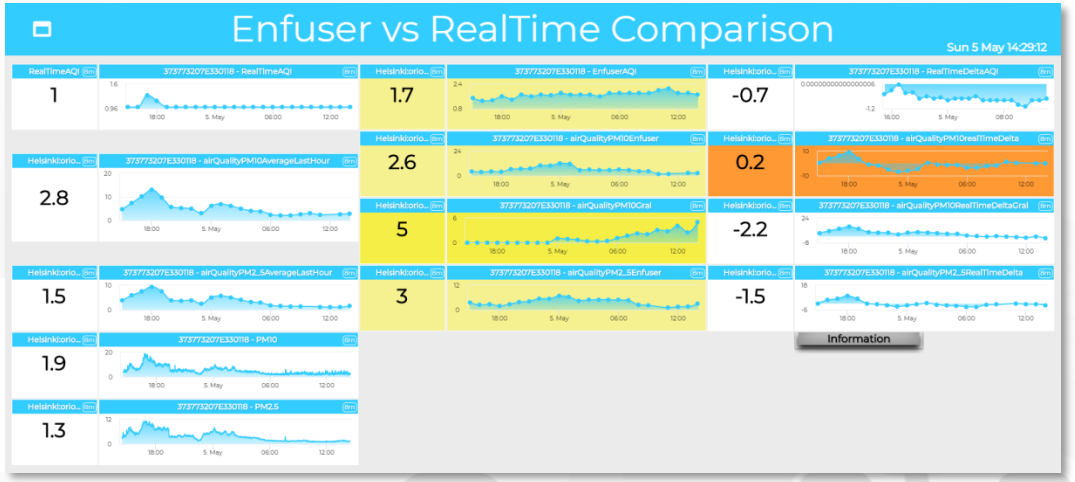
- Over the Gaussian Heatmaps
- Calibrated heatmaps on the basis of Interpolated data for:
  - From 200x200 to 4x4 mt
  - PM10, PM2.5, SO2, NO2, Noise, NO, O3, Enfuser, GRAL,….
  - Any programmed Color map
  - Animations over H24
  - Picking values in any place, values on their position.
  - On Web and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

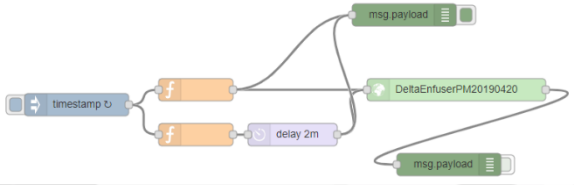


Data Analytics: Enfuser predictions

- **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



Heatmap Firenze - trafair

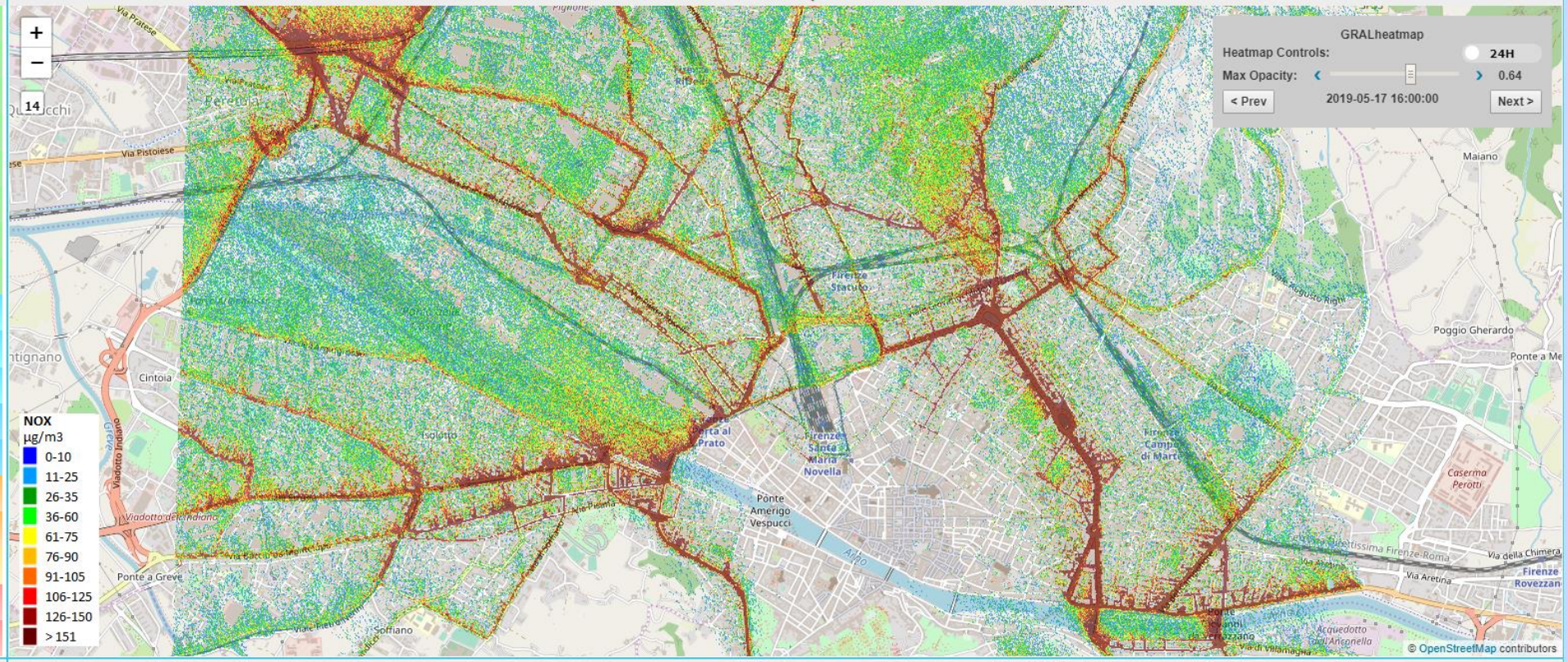
different data

Fri 17 May 12:49:34

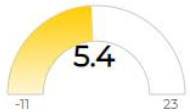
Selector

- Air Quality Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- SO2 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

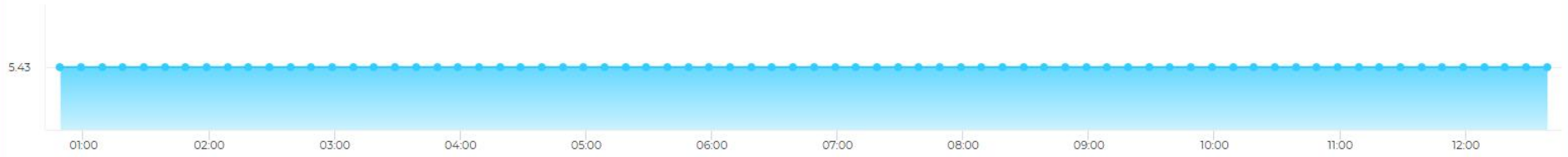
Multi Map



Air Temperature Bolognese 8m



Termperature Bolgonese 8m



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

Social Media Analysis



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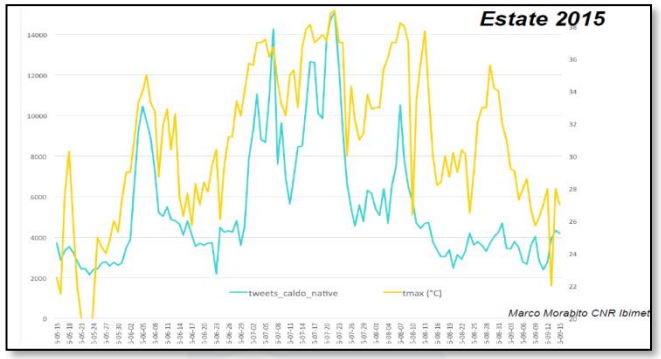
Prediction/Assessment

- 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



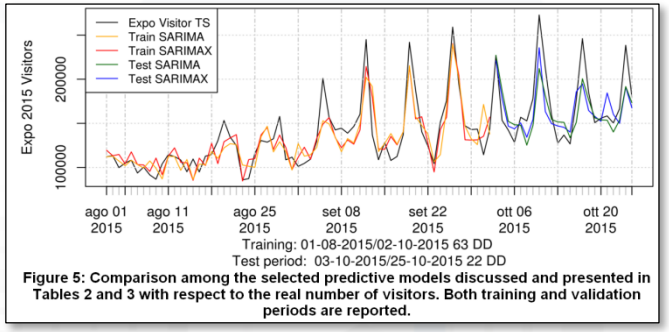
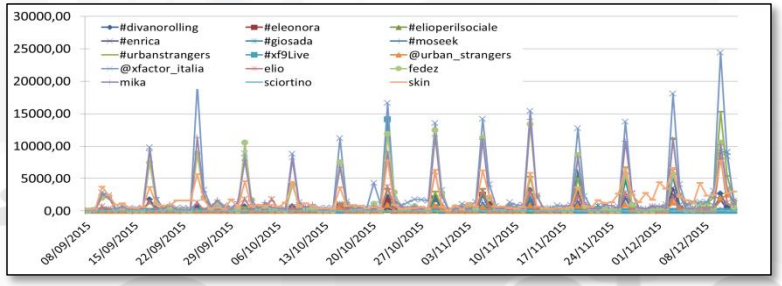


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.



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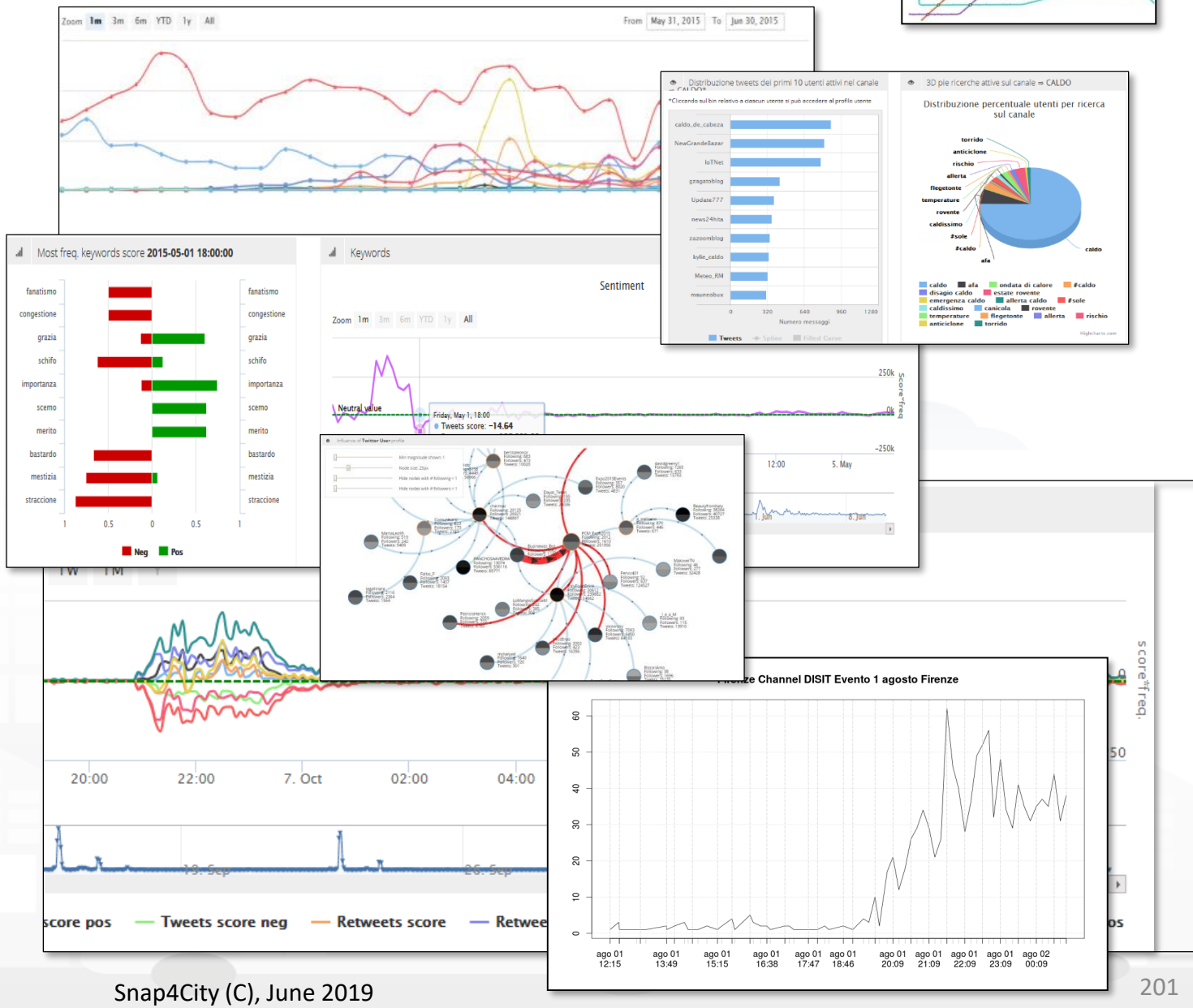
TwitterVigilance

SNAP4CITY

resolute

- 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

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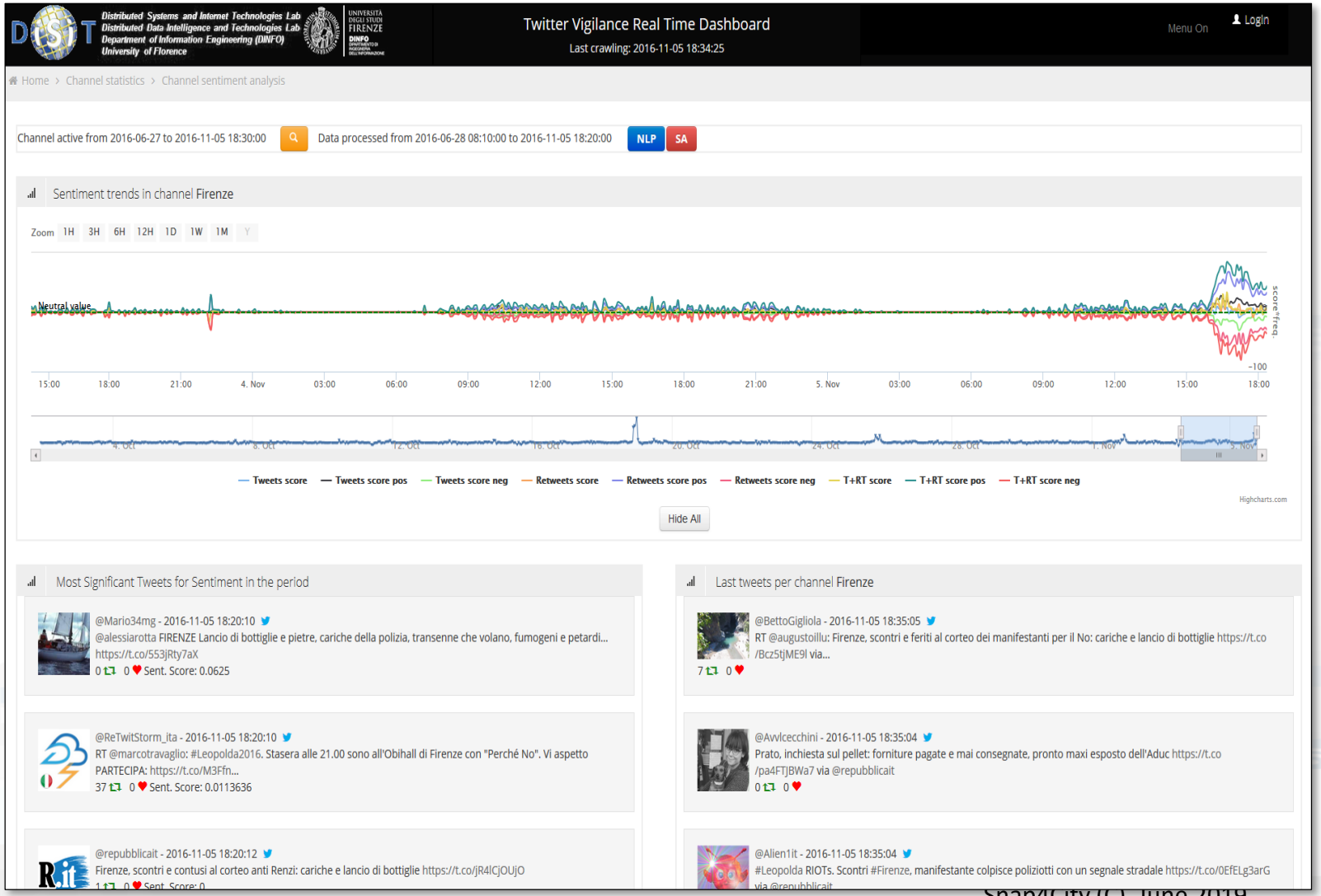
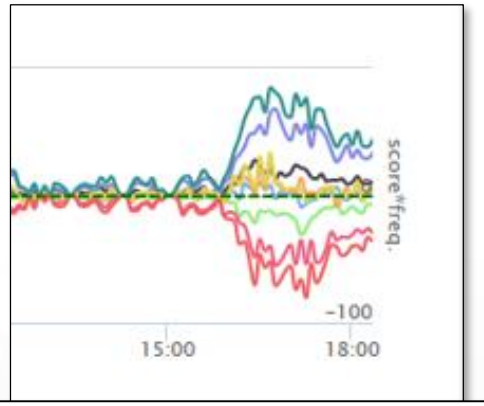
Twitter Vigilance

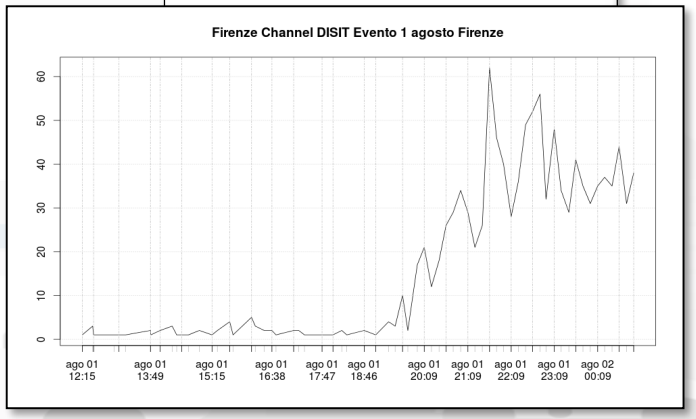
resolute

Twitter Vigilance RT: sentiment analysis



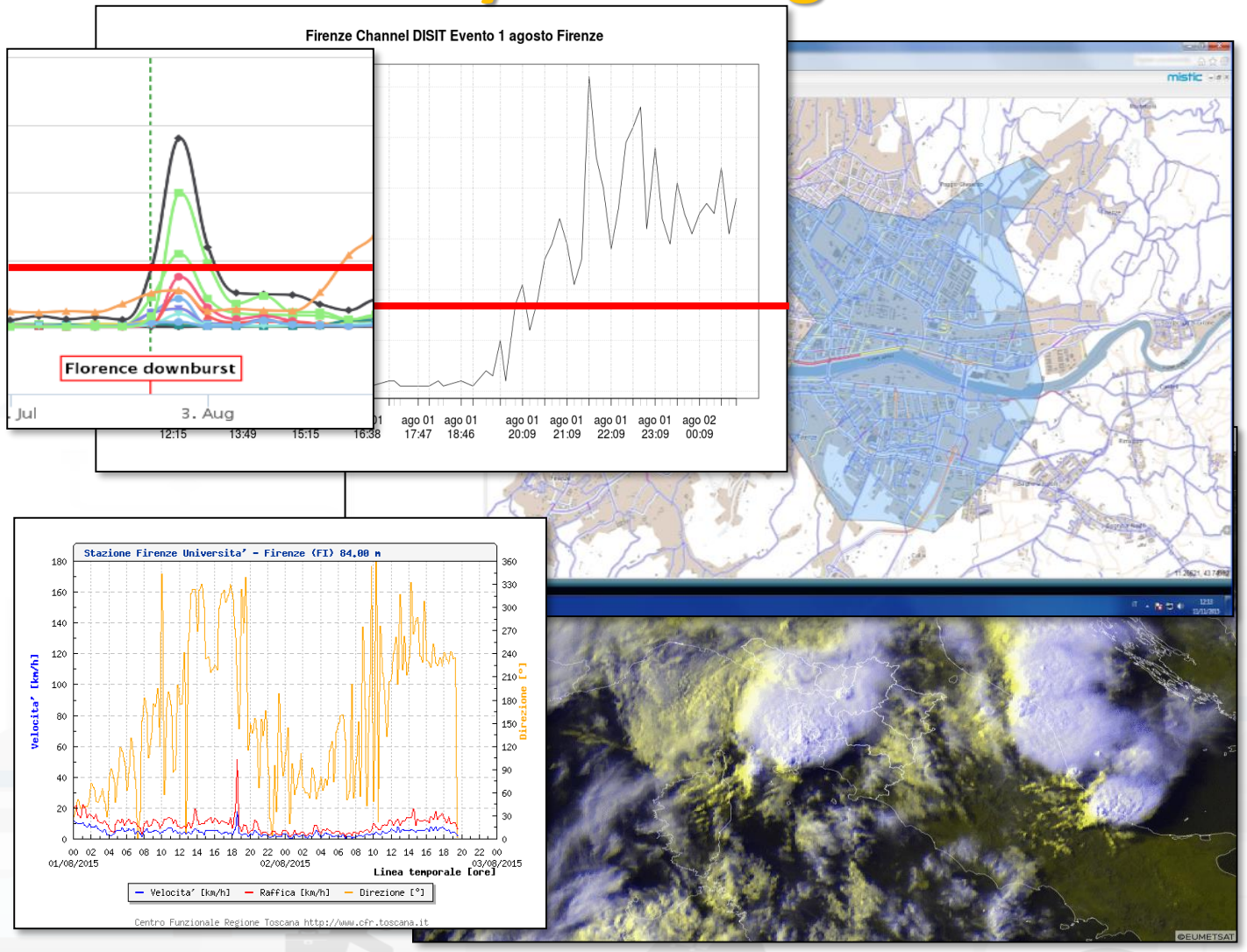
Real time
Early Warning



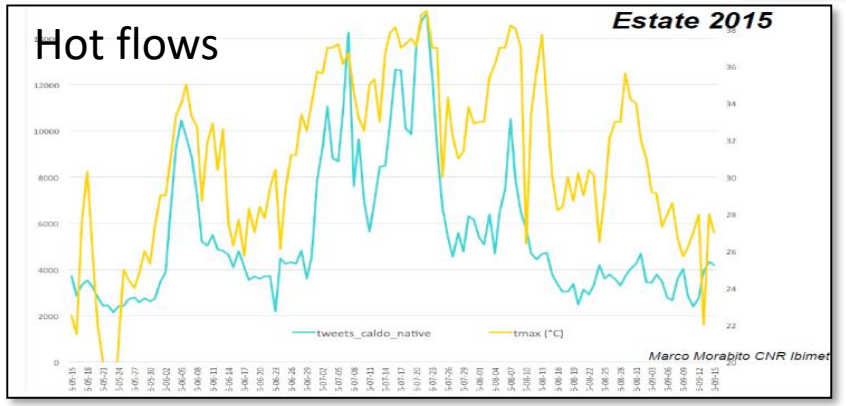


Twitter Vigilance

Early Warning



Predictive models



Attendance at long lasting events: EXPO2015

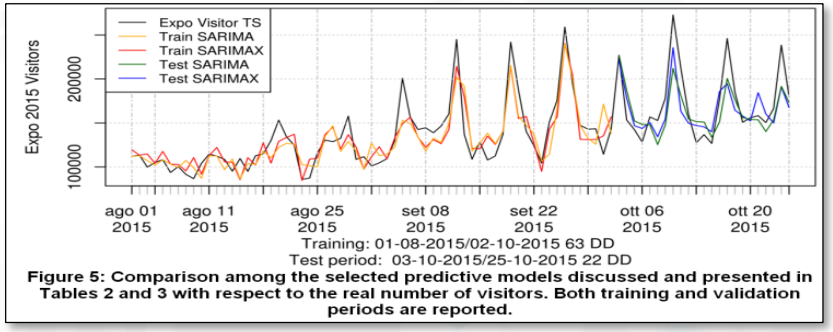
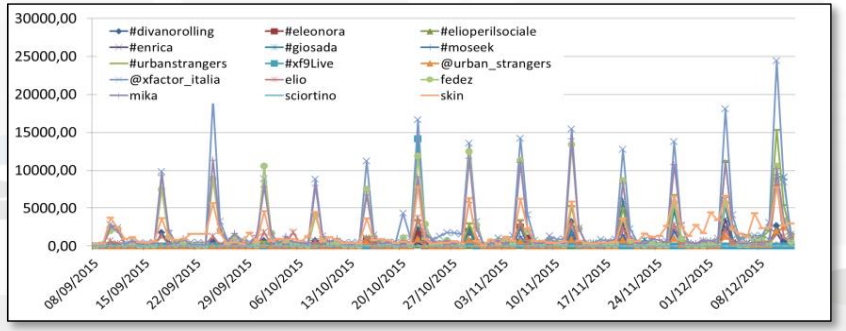


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

Attendance at recurrent events: TV, footbal



TOP

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



ARC
INDEX

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
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Your Level

All Tools

Snap4City

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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

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

KM4CITY

Virtual Assistant

Snap4City

www.snap4city.org

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

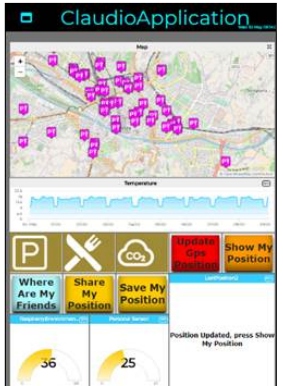
TC2.24 - IOT Applications developed exploiting MicroServices, also supporting GDPR, real time, data sharing, etc.

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

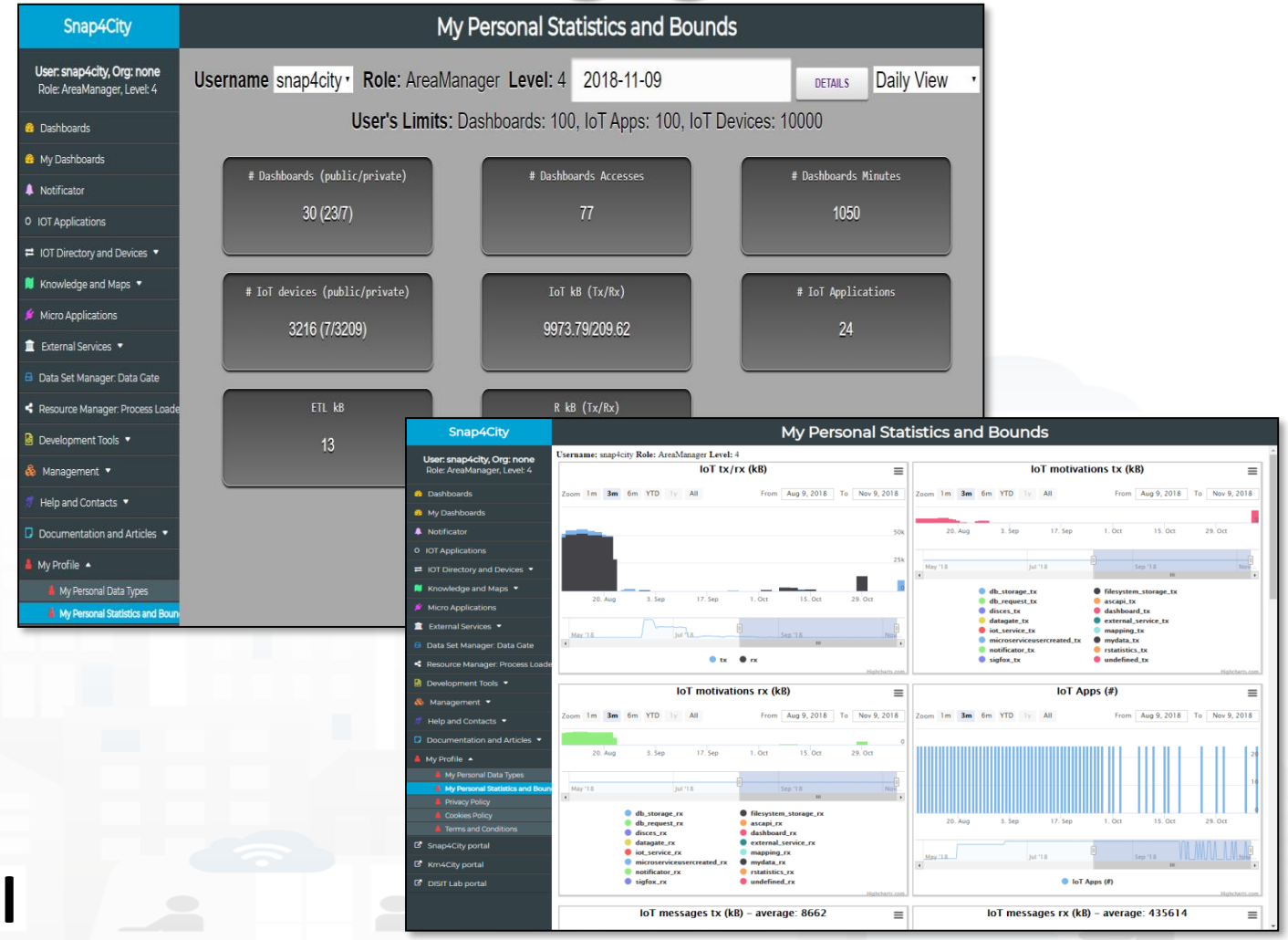
Living Lab Flexibility

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

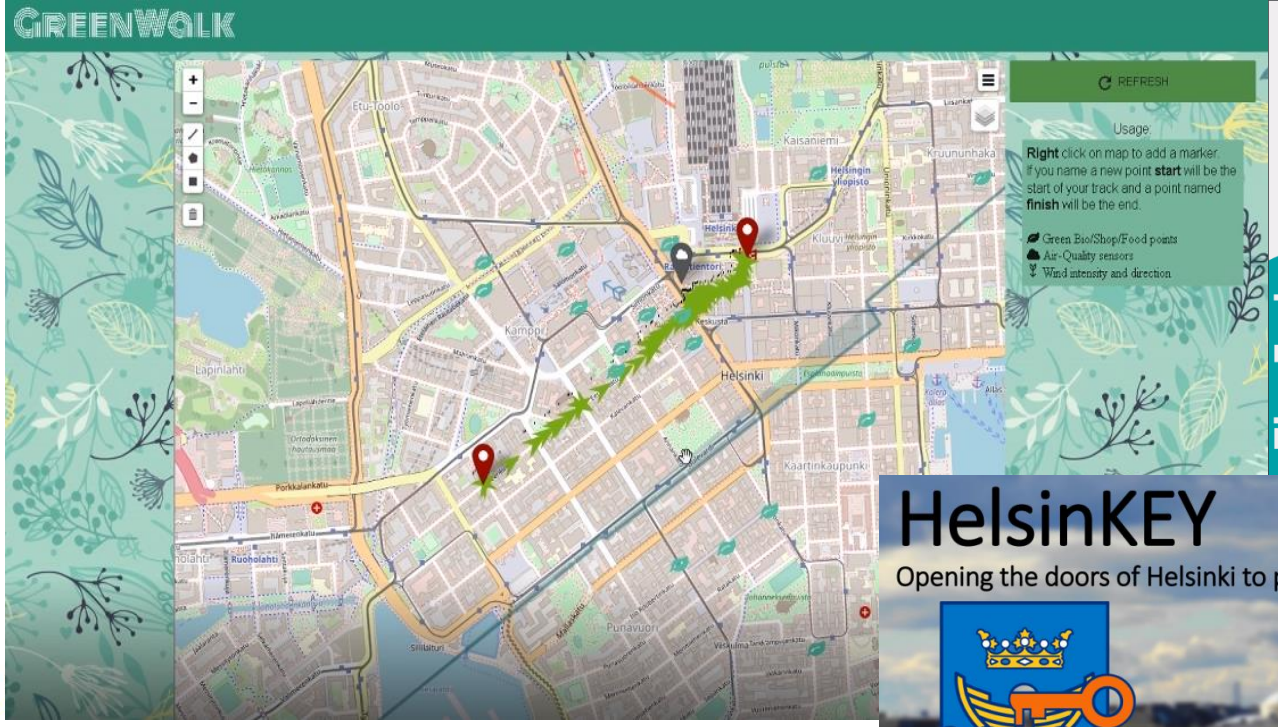
- **Multiple Organizations**
- **Roles:**
  - Managers
  - AreaManagers (developers): special access to computing resources
- **Levels for self-assessment**
  - **Suggestions on next steps to learn on the basis of personal progresses**



Validation with developers

- 65 performed operational activities:
  - dashboards, IOT Applications, registering IOT devices, etc.
  - More than the 80% created both Dashboards and IOT Applications, thus validating the solution and the process of engaging them in working on the platform

The 65 users	left on platform	Average per day over last 90 days	Total activity 90 days
Number of IOT Applications	117	81,6	7341
Number of private IOT devices	27	25,5	2296
Number of public dashboards	11	6,2	562
Number of private dashboards	173	135,1	12159
Number of accesses to dashboards	--	33,9	3048
Number of minutes	--	337,1	30337



The End
Details
Data
App
Context
About

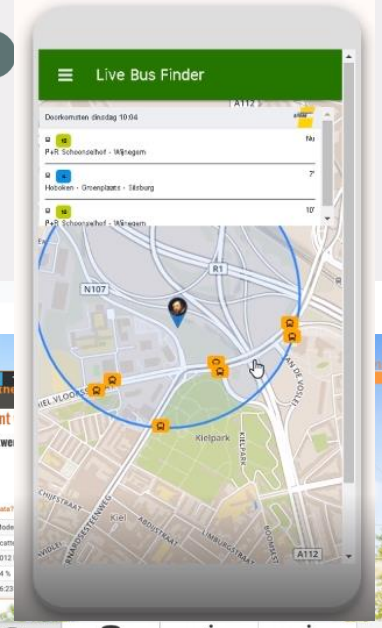
Greenifiers

BIG DATA FOR SMART CITIES

An app for sustainable mobility

ndrea Pescetti





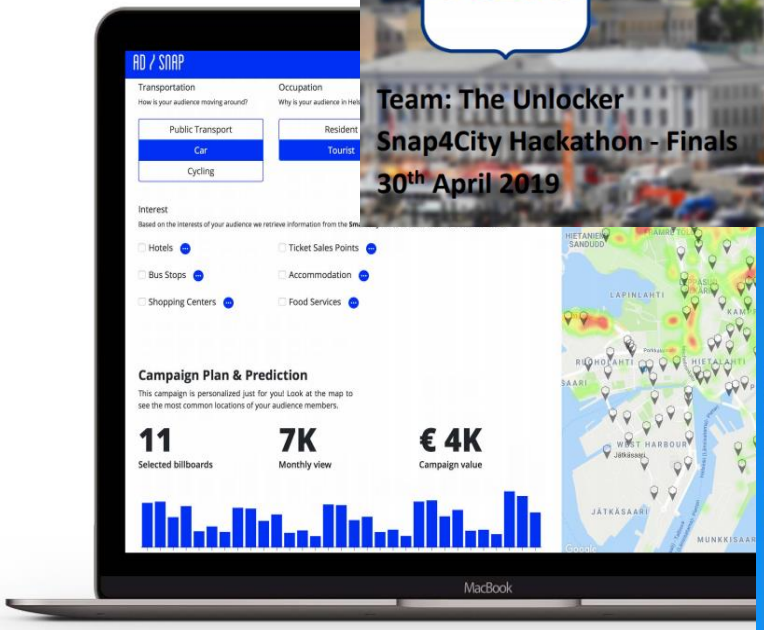
Data-driven design platform for offline advertising

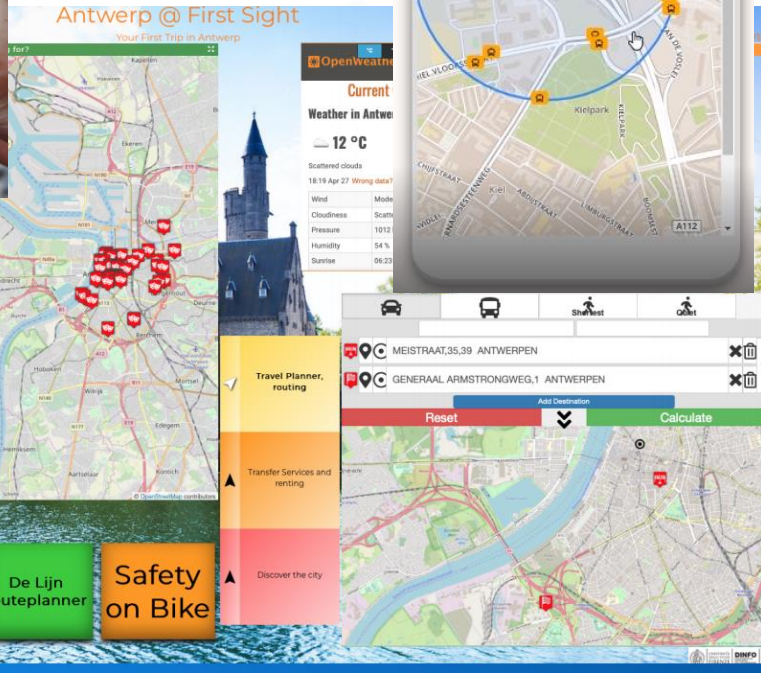
Built on big data to determine the most popular location for a customer group

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.

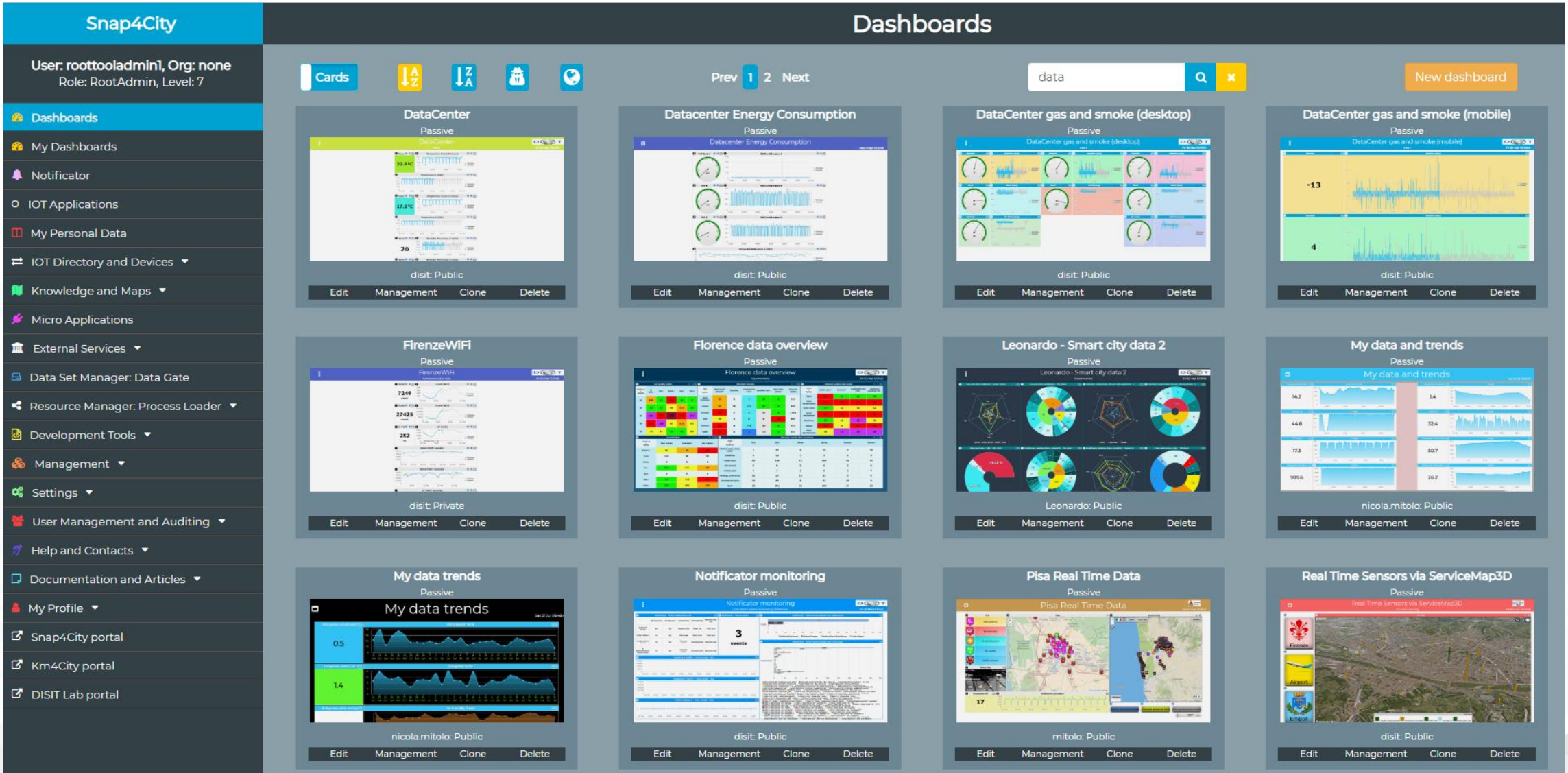
Skyrocket the traction of offline campaigns

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

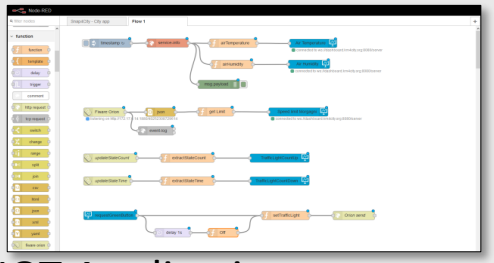




Dashboard List and Editor



Dashboard Development



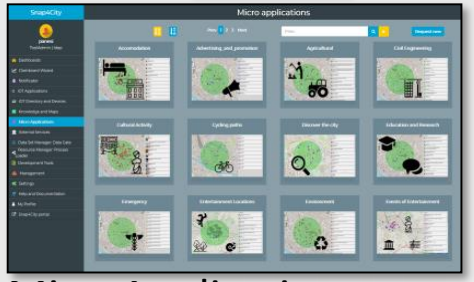
IOT Applications



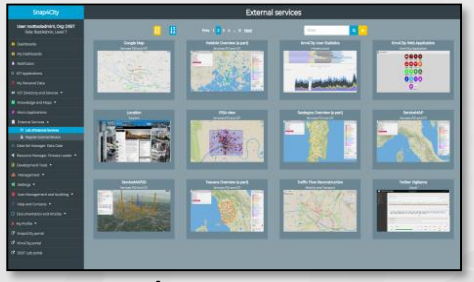
Knowledge and Storage
Data from the Field and City

Widget Collection



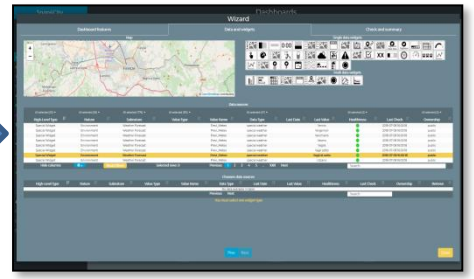


MicroApplications

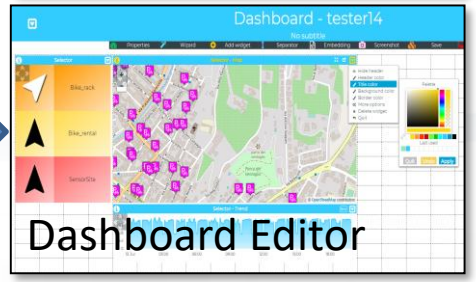


External Services

Dashboard Wizard



Dashboard Editor



Create, save, load, delegate, grant access



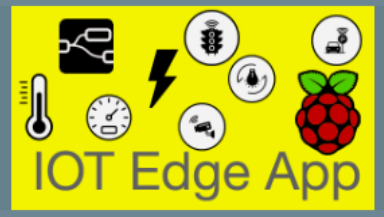
Dashboard Collection



My Own Dash/App



IOT Applications

2018-09-14T04:44


owner: badii
Management

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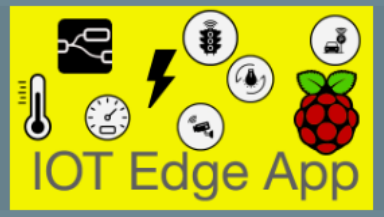

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Management

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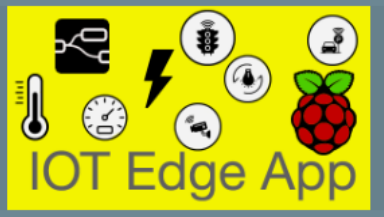

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Management

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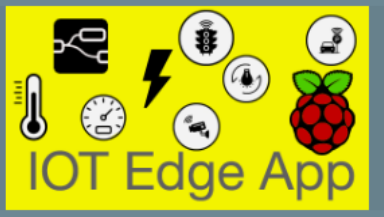

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Management

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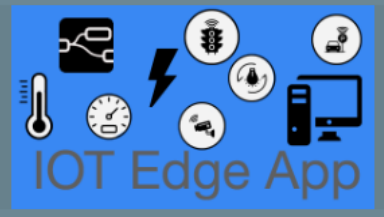


owner: semolarudy
Management

application

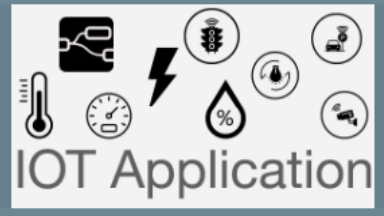

owner: tester5
Management

Bib APP


owner: semolarudy
Management

ChargingStations


owner: comunedashres
Management

Deprecated - SiiMobilityControlRoom


owner: badii
Management

SamsungGalaxyS4BarCode

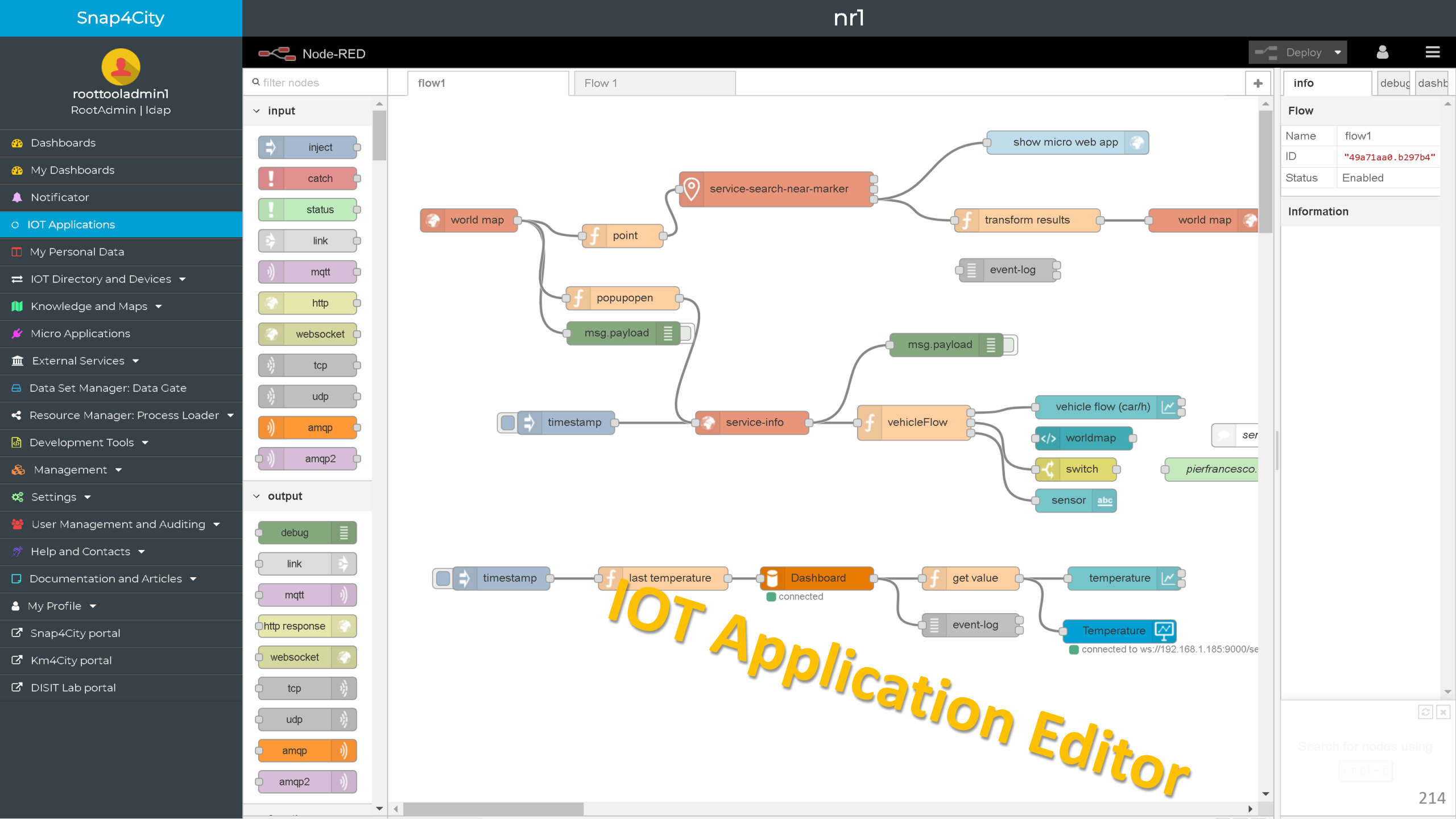

owner: badii
Management

esercitazione


owner: tester2
Management

Iot-App


owner: tester14
Management


Snap4City
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roottooladmin1
RootAdmin | ldap
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My Personal Data
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Knowledge and Maps
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transform results
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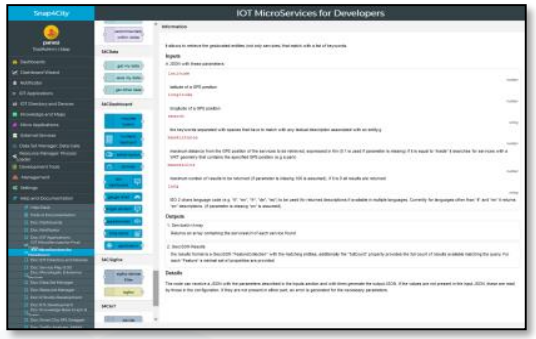
IOT Applications Development

IOT Discovering

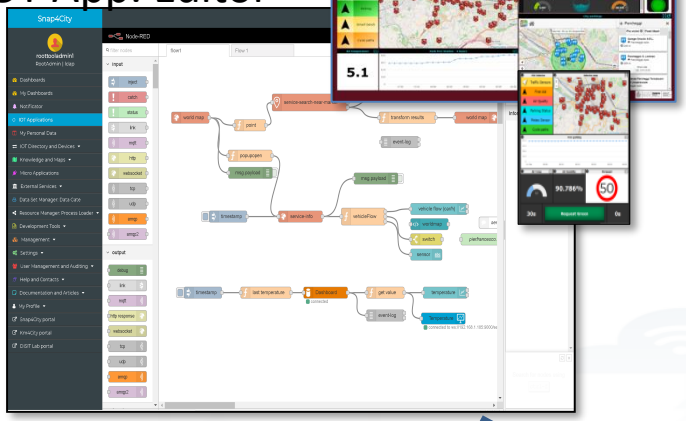
MicroServices collections



My IOT Applications

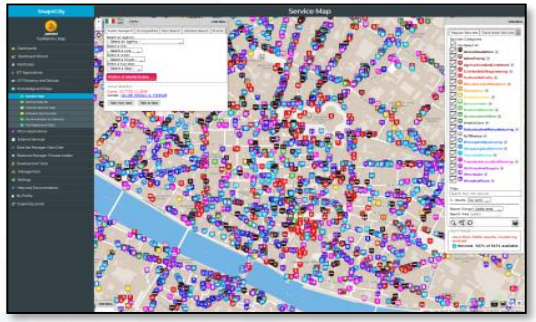


IOT App. Editor



Generating IOT App
With Dashboard





ServiceMap Discovery



Dashboard Collection,
Editor and Wizard

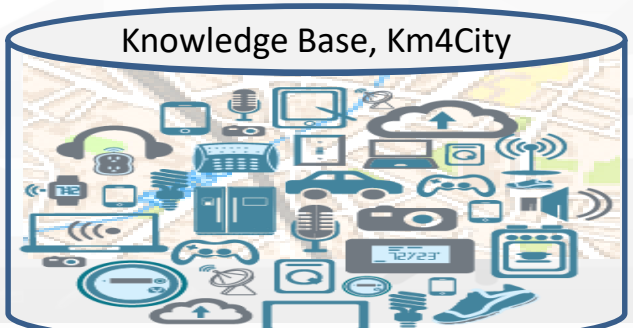
Sharing/saving
reusing IOT App



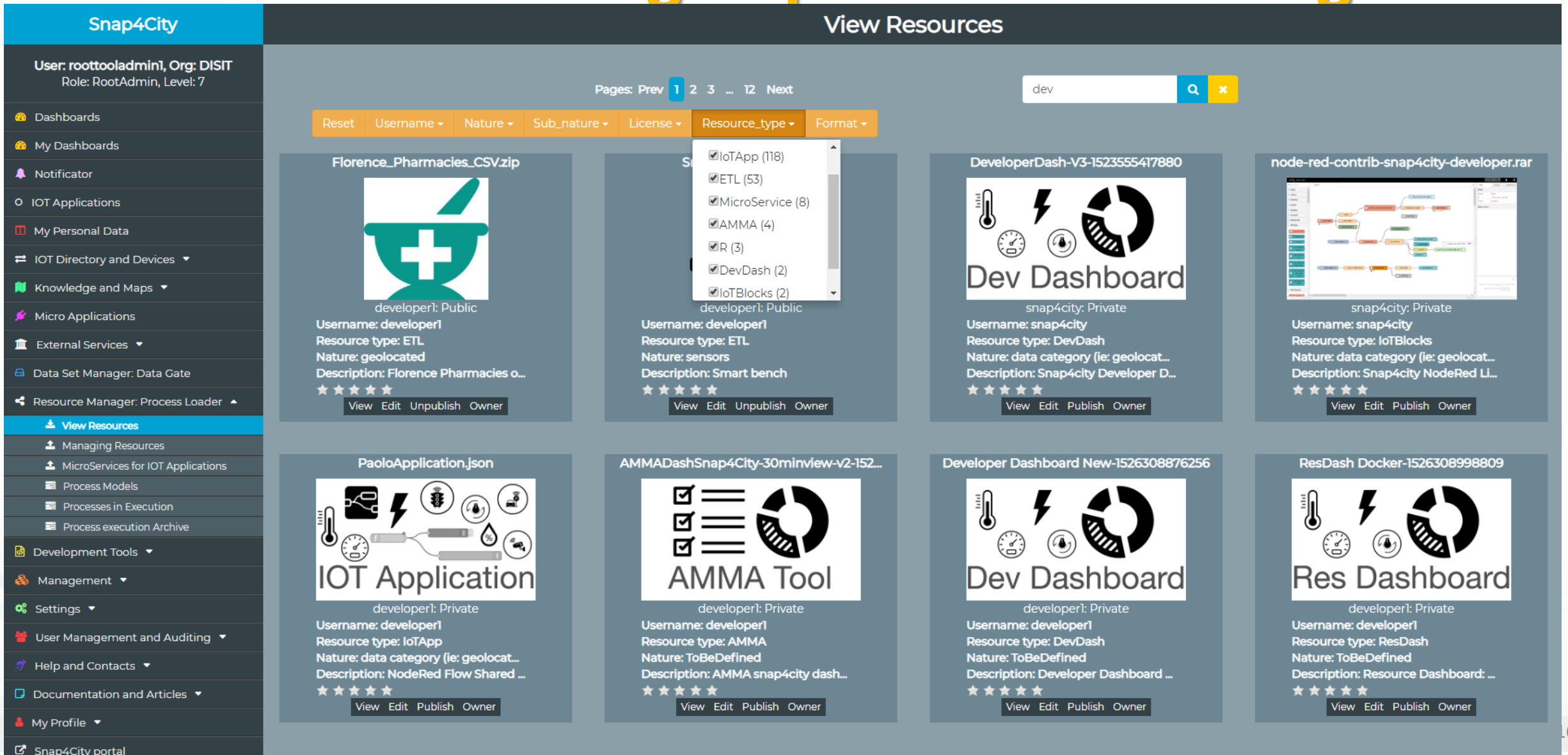
Resource Manager



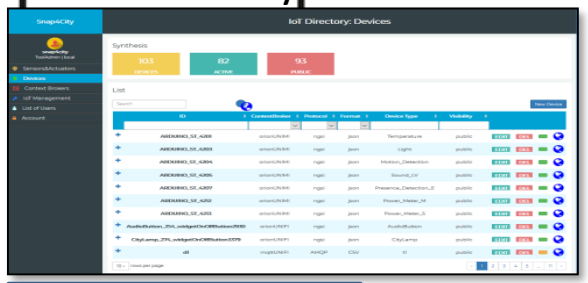
Knowledge Base, Km4City



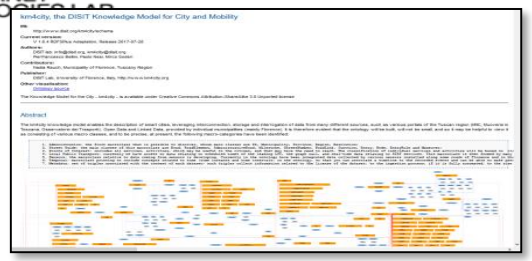
Resource Manager: public and sharing



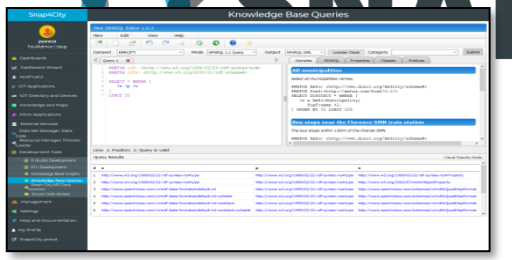
IOT Directory

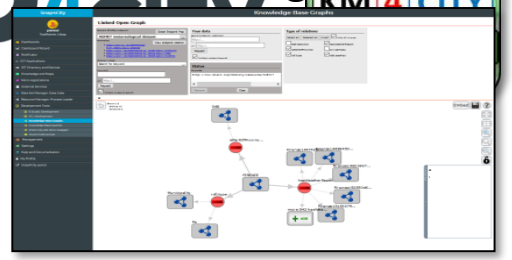


Ontology



SPARQL, FLINT



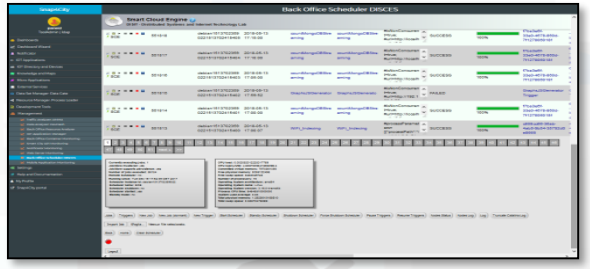


IOT Broker

ETL Process

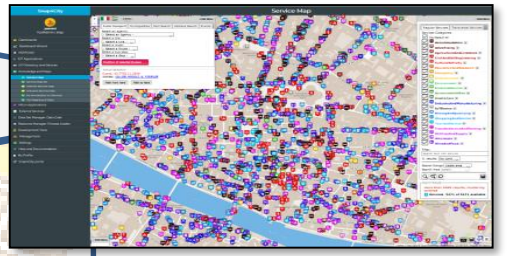
Data Analytics

Back Office Processes

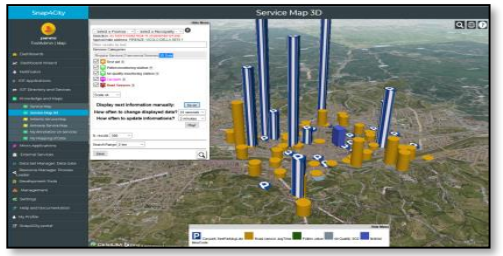


DISCES and back office management tools

Knowledge Base, Km4City



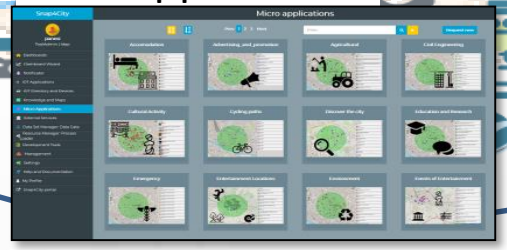
ServiceMap



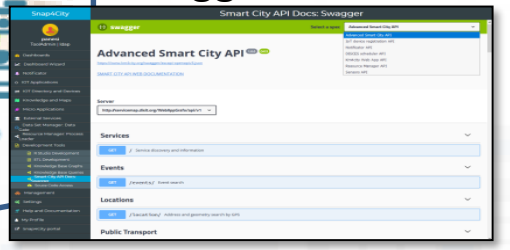
ServiceMap3D

Smart City API from Knowledge Base and other tools

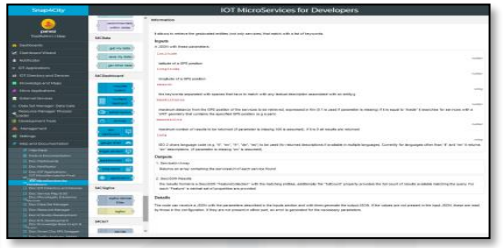
MicroApplications



Swagger



MicroServices

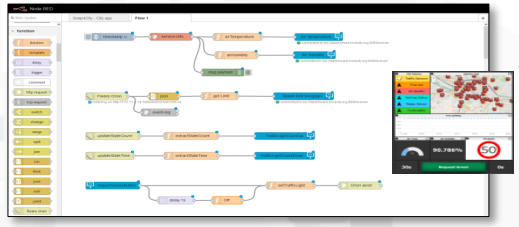




Resource Manager



Web and Mobile Apps



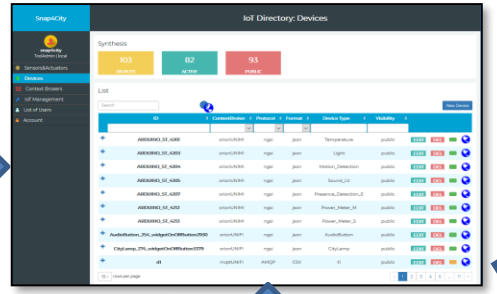
IOT Applications

IOT Network Manager vs Final User

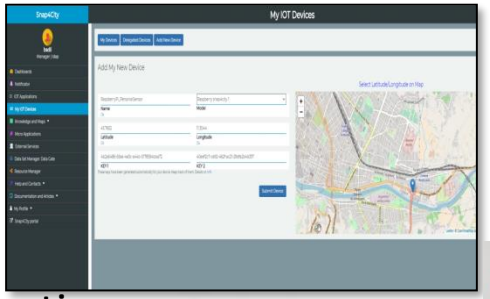
Network of IOT Brokers

IOT Broker

IOT Directory



My IOT Device



Register



IOT Network Manager



Registering

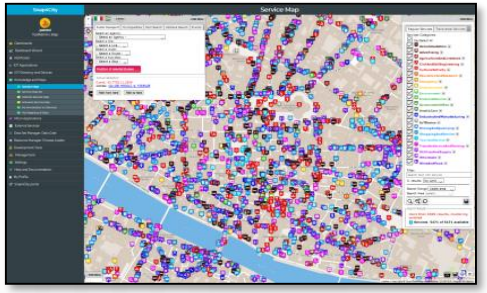
Discovering

Knowledge Base, Km4City



Knowledge and Storage Data from the Field and City

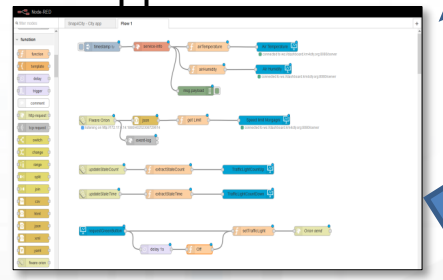
Browsing



ServiceMap Knowledge Base

Discovering

IOT Application



Final user Manager





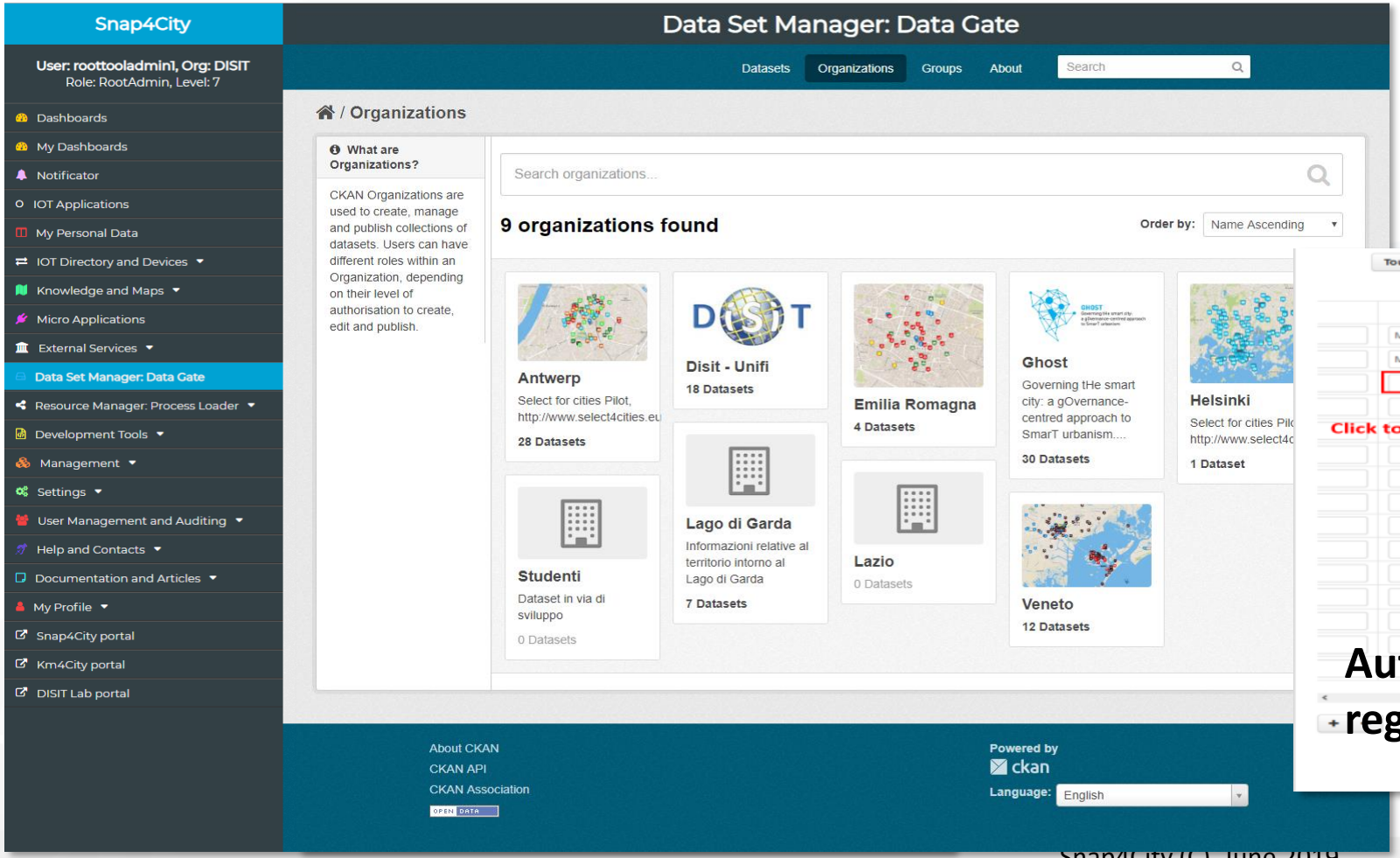
Dashboard Wizard

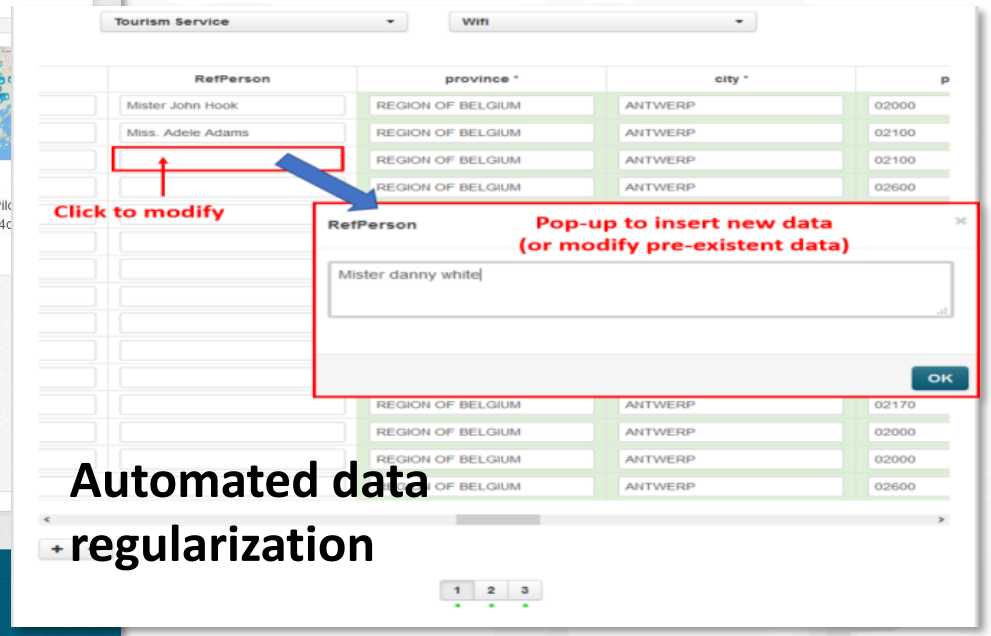


Integrated DataGate/CKAN
Static open data ingestion

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

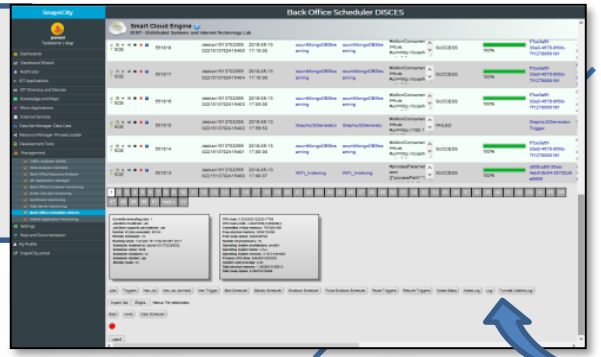
Distributed Back Office

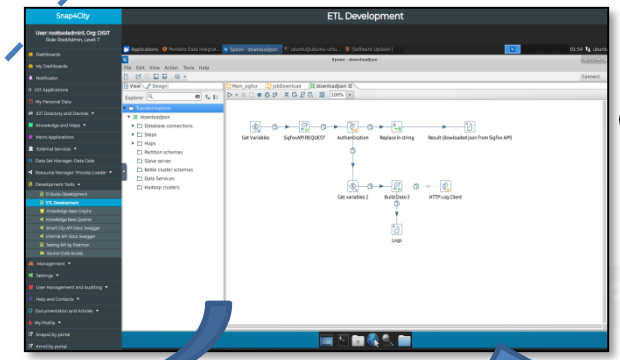
DISCES scheduler production

ETL Development Environment

Data sources

ETL Process







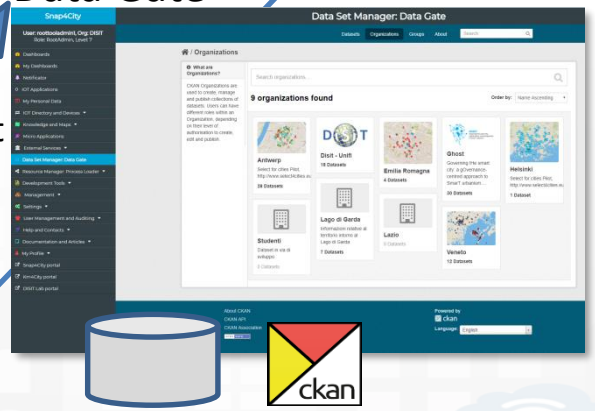
Data Gate

Knowledge Base, Km4City



Knowledge and Storage Data from the Field and City

Data Set Saving / Sharing



Data Set Loading/ Downloading

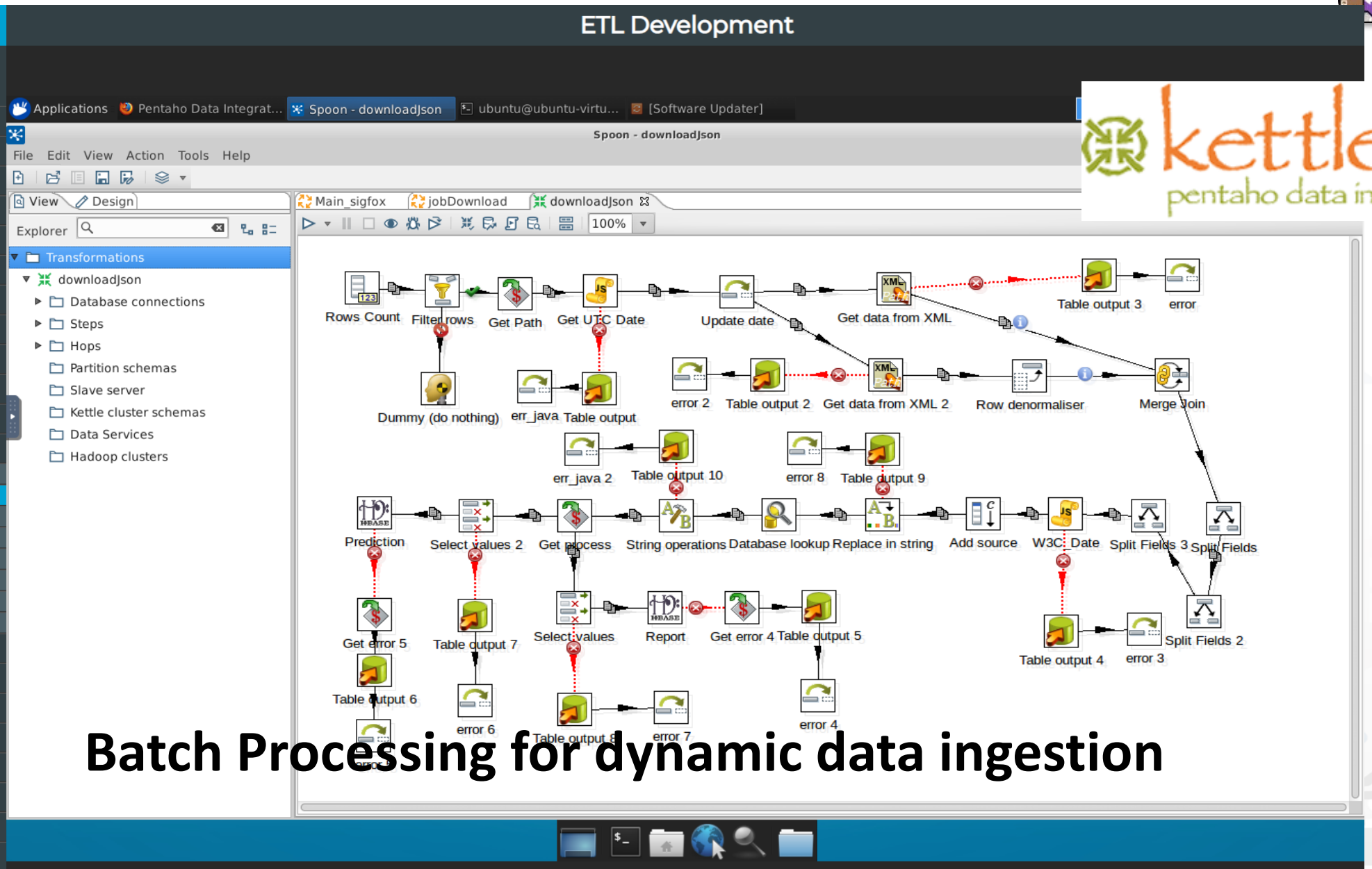
Saving / Sharing reusing



Resource Manager

Schedule Execute

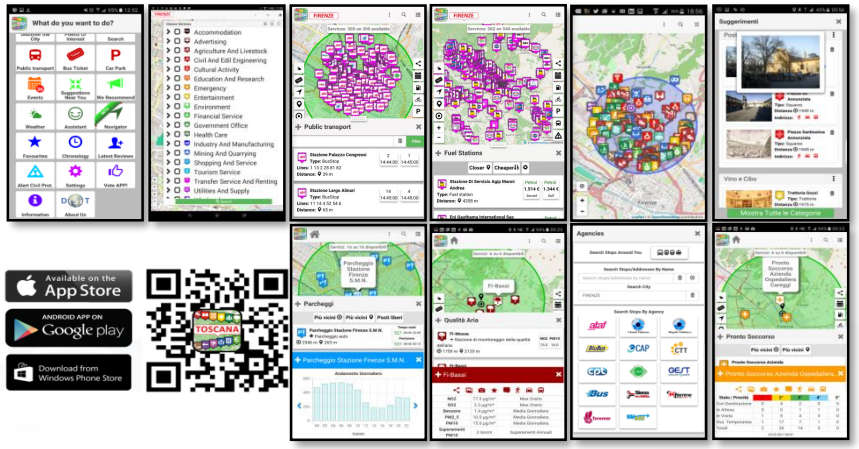
Load data or prepare for data ingestion



Batch Processing for dynamic data ingestion

Web and Mobile App Developers

Mobile Apps



Web App HTML5



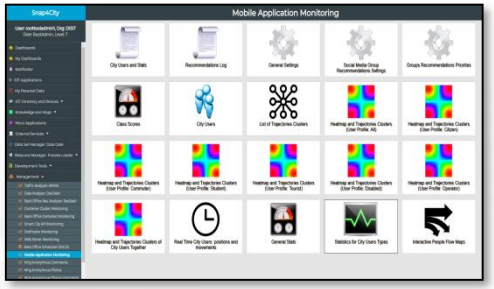
Embed into Web pages



City User



Advanced Smart City API

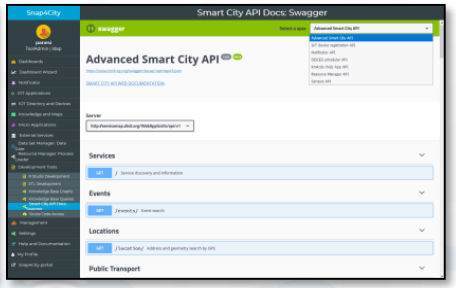


Mobile Application Monitoring Administrator

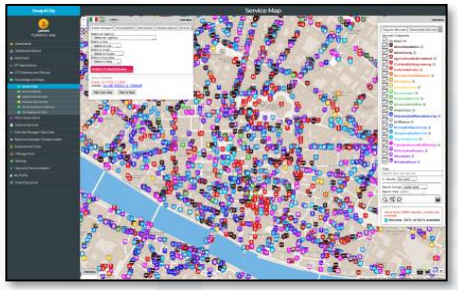




Km4City Open Source development tool kit



Swagger



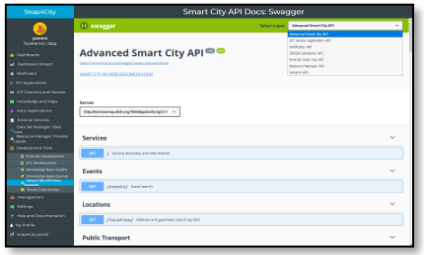
ServiceMap

Developer

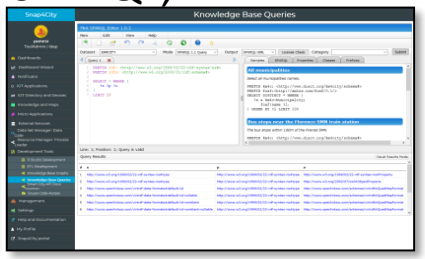


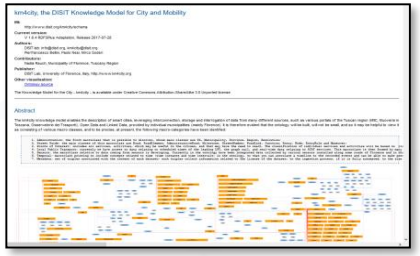
Data Analytics Dev. in R Studio and/or Tensor Flow

Swagger



SPARQL, FLINT





Ontology Schema



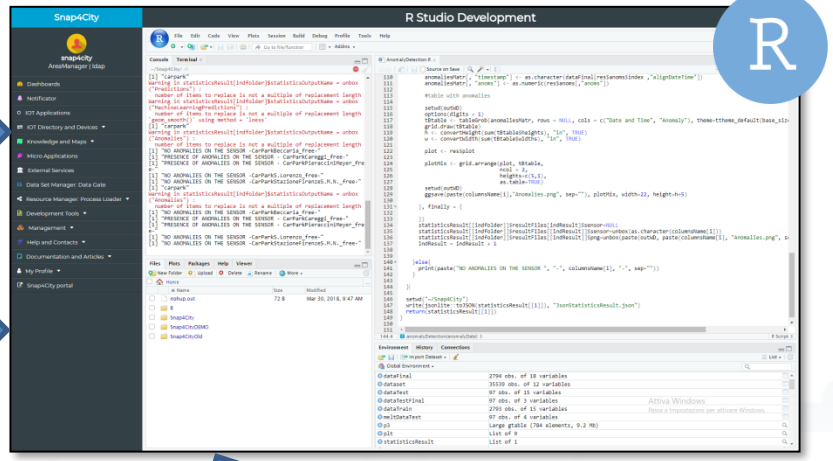
LOG.disit.org

Knowledge Base, Km4City



Big Data Store Facility

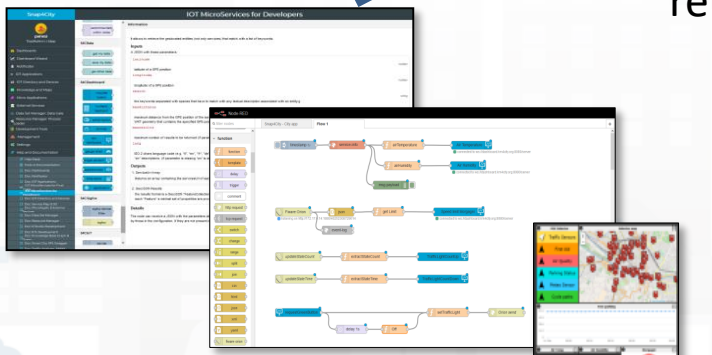
Smart City API from Knowledge Base and other tools



R Studio



Creating MicroServices



Using them into IOT Applications

Saving / Sharing reusing



Resource Manager



Data Protection, Personal Data vs GDPR



ARC

INDEX

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
- …

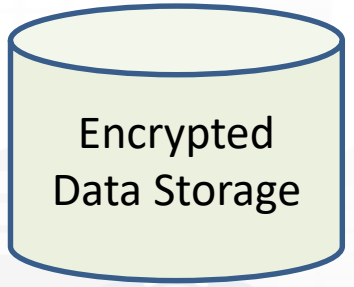
GDPR: General Data Protection Regulation

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

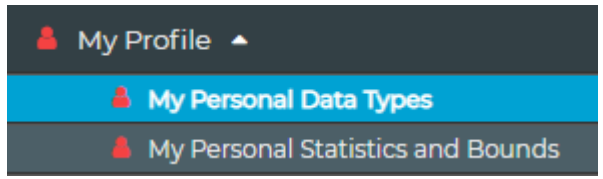
- the data are **released anonymously**,
  → also in this case they can be **revoked at any time**:

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.

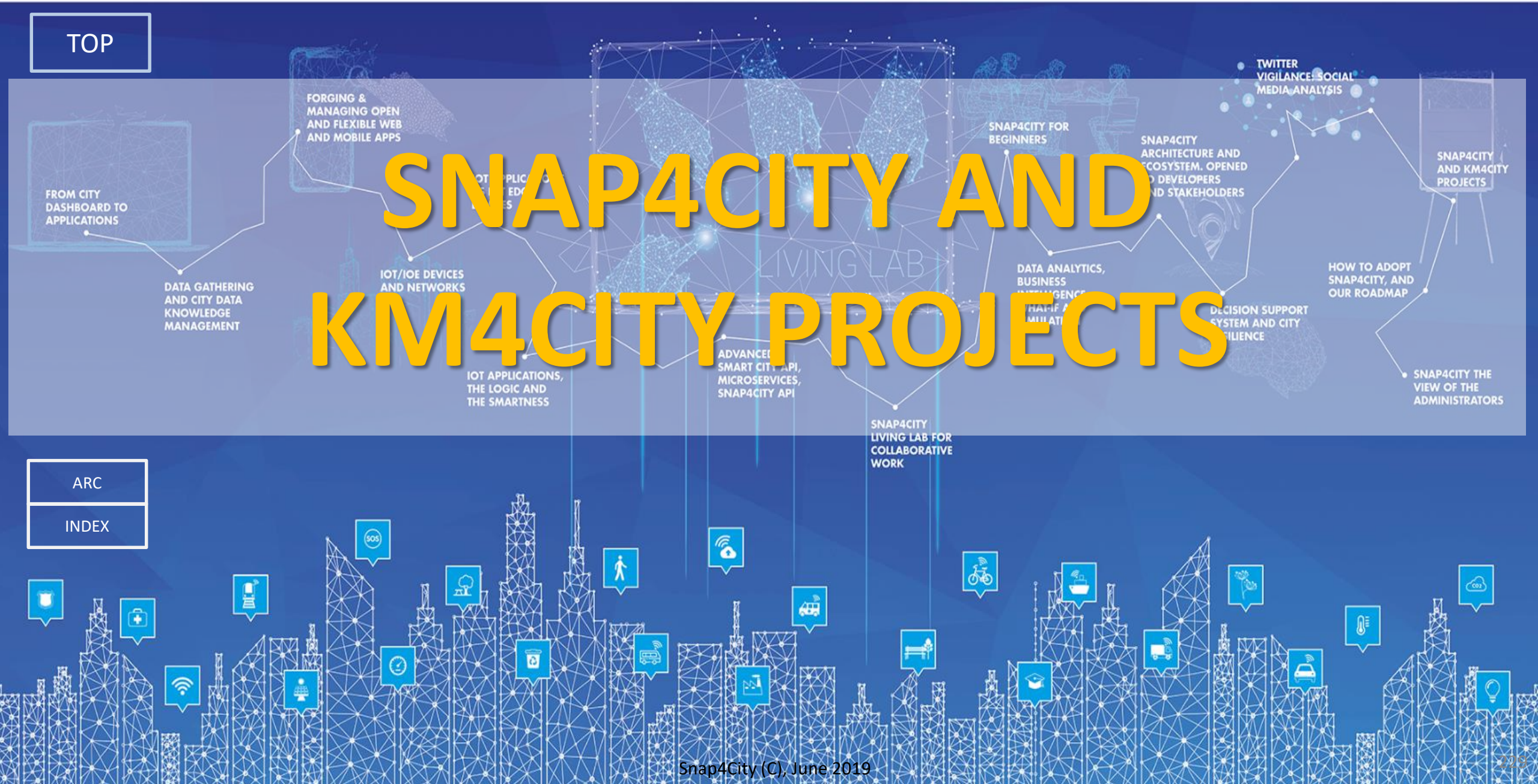
- My profile data and Blogs
  - to manage your user profile data (name, email,): view, edit, delete
- My Personal Statistics and Bounds: daily or Monthly
  - to access at your statistics about the data access and volume of resources use
    that may depend on the Organization at which one belong and 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

Acknowledgements



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

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

Km4City 1.4

2015

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

Km4City 1.5

2016

(2016-19) MIUR

SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

Km4City 1.6.2

- Smart Energy
- Sustainable Mobility
- Control Room Dashboard

(2015-18) resolute H2020

(2016-21) H2020 REPLICATE

2017

(2017-20) life weee

- Smart Waste

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

(2016-19) MIUR

GHOST SIR

- Sardinia Region Smart City Strategies and plan

Km4City 1.6.4

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

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

2018

SNAP4CITY SELECT for Cities H2020 (2017-19)

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

Km4City 1.6.6
IOT/IOE

MOSAiC (2018-20)

- Mobility Demand / Offer Analytics and Strategy

…2021

2019

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution

5G (2018-21)

5G tech
Energy
Industry 4.0

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Main running projects



- Snap4City → The platform!
- Sii-Mobility → DISIT (mobility and transport)
- REPLICATE → DISIT (ICT, Energy, IOT)
- RESOLUTE → DISIT (Resilience, ICT, Big Data)
- GHOST → UNICA, UNIFI (strategies, smart city)
- TRAFAIR → UNIMORE, DISIT (environ. & transport)
- MOSAIC → DISIT (mobility and transport)
- WEEE Life → DISIT (waste, environment)
- Smart Garda Lake → Castelnuovo del Garda
- 5G → DISIT (Industry 4.0 vs SmartCity)
- Green Impact → DISIT (Industry 4.0, Chemical)
- PISA Agreement → data aggregation

Green Impact

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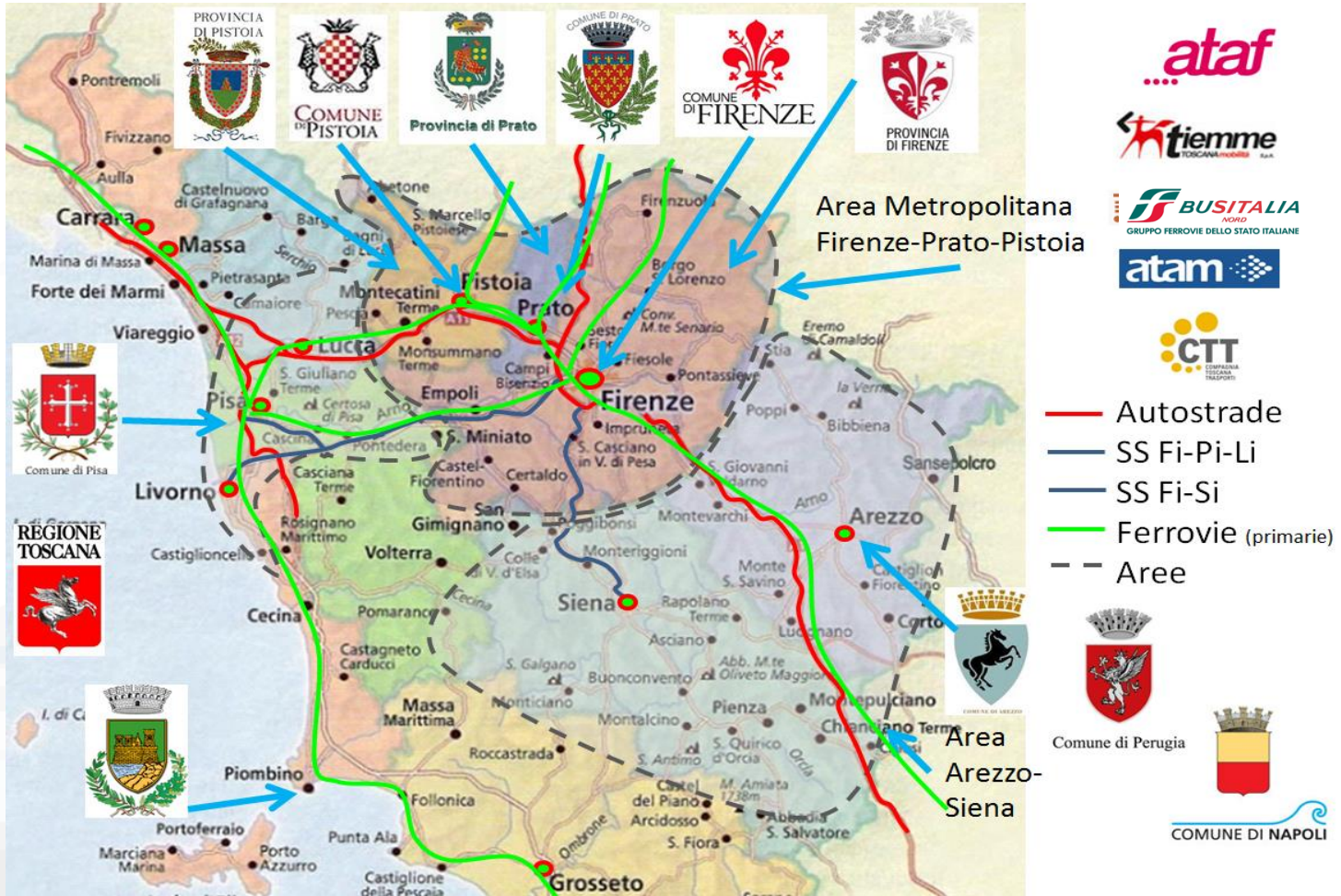
Sii-Mobility

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

Monitoraggio traffico, autostrade







Varchi Telematici, ZTL

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

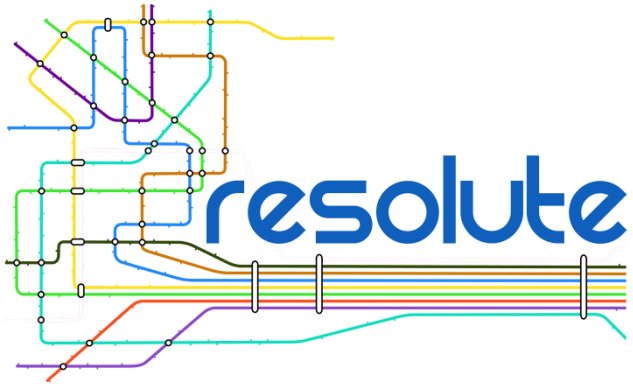
Replicate project

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

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

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

http://trafair.eu/

TRAFAIR

Understanding Traffic Flows to Improve Air quality

- **Objective:**
  - 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**

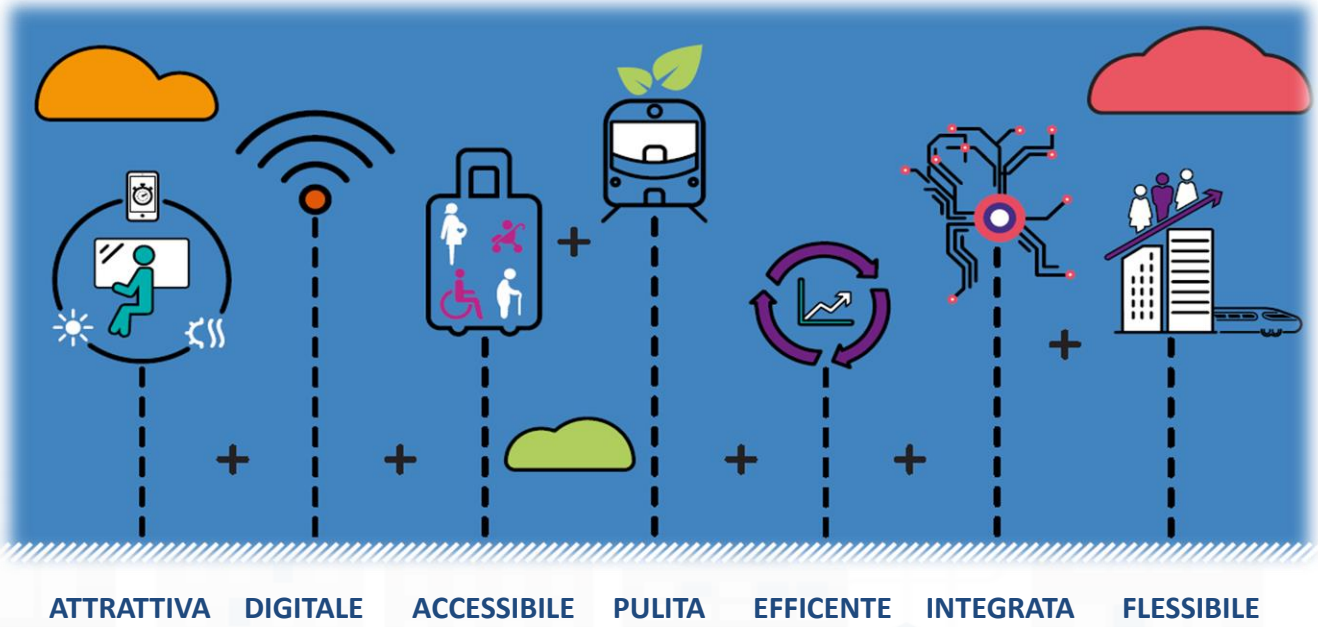
- Università degli studi di Modena e Reggio Emilia (UNIMORE) -- Italy
- **Università degli Studi di Firenze – DISIT DINFO -- Italy**
- Universidade de Santiago de Compostela (USC) - Spain
- Comune di Modena (CMO) - Italy
- Regione Toscana (TR) - Italy
- Concello de Santiago de Compostela (CSC) - Spain
- 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

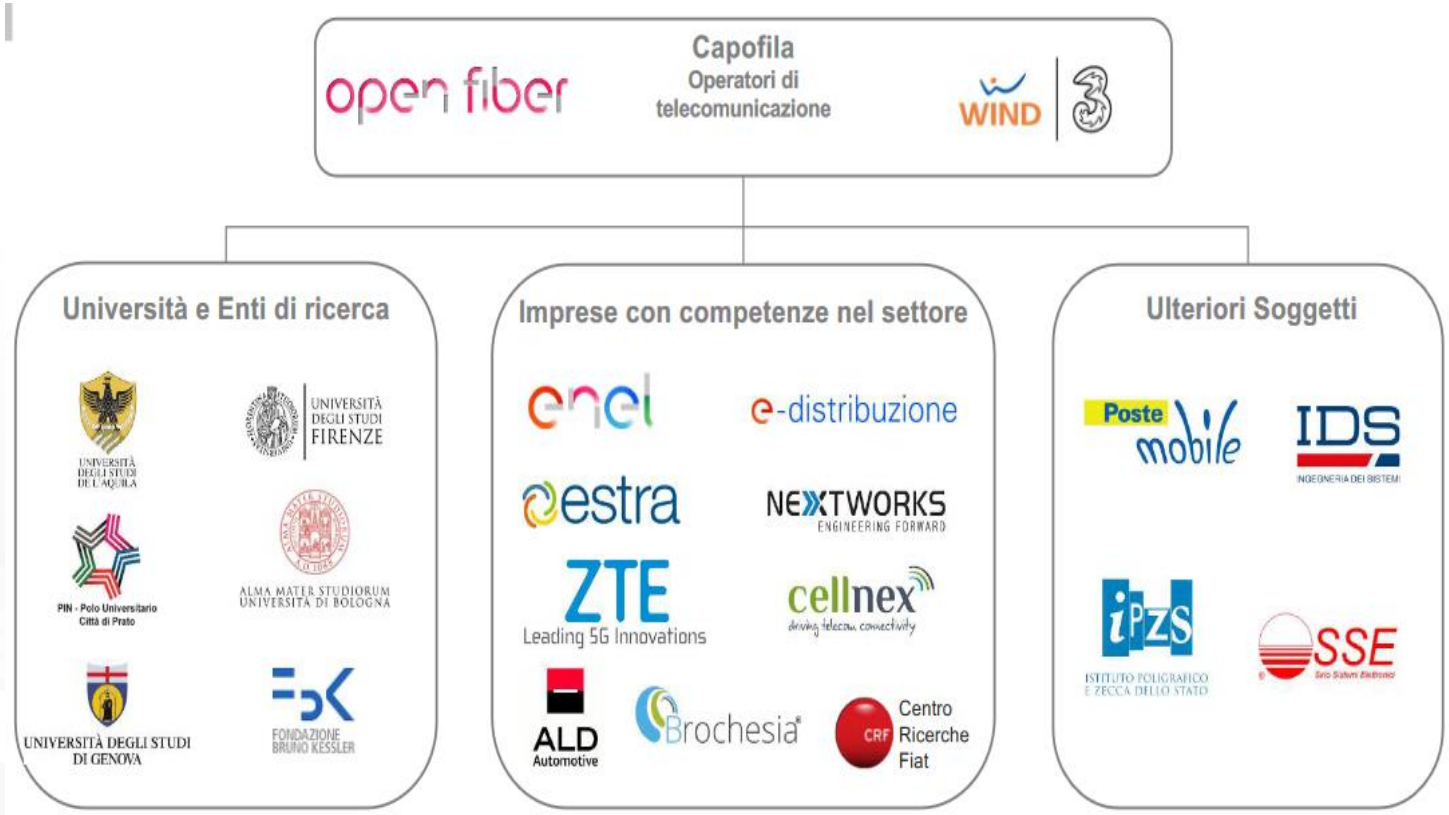
Fields:

- 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

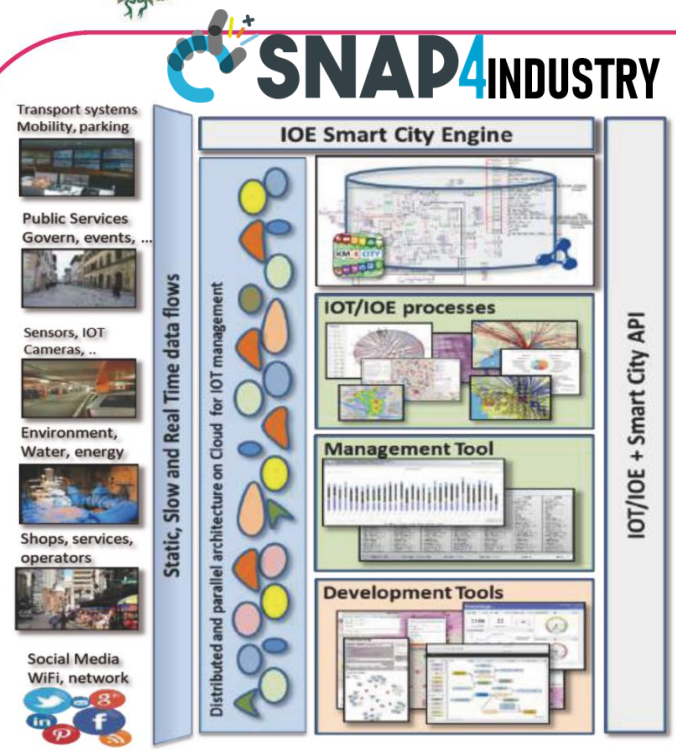
Partners:



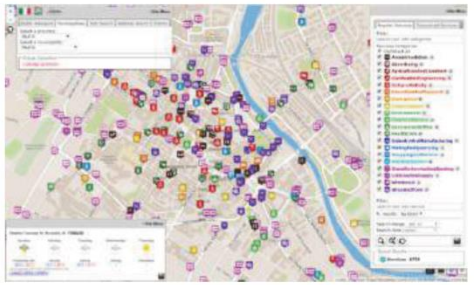
SENSORI E IOT - PRATO

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

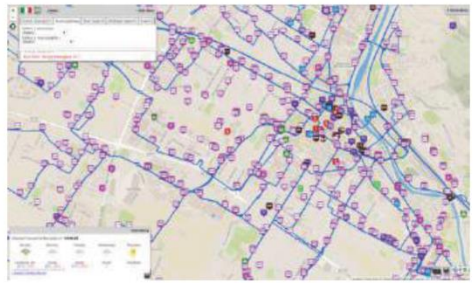
- Smart City management (in ottica Smart City)
- monitoraggio utenze in modo smart
- industrial automation (in ottica Industria 4.0)







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 Qualcomm, Interporto della Toscana Centrale, Unione Industriale Pratese Confindustria Prato, centria Reti Gas, Publiacqua, GIDA, Programma Ambiente

Green Impact Capacity (GIC)





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



Supporto Collaborativo Protetto per Genitori e Operatori di Disabili

Tema primario: **Tecnologie Welfare e Inclusione**

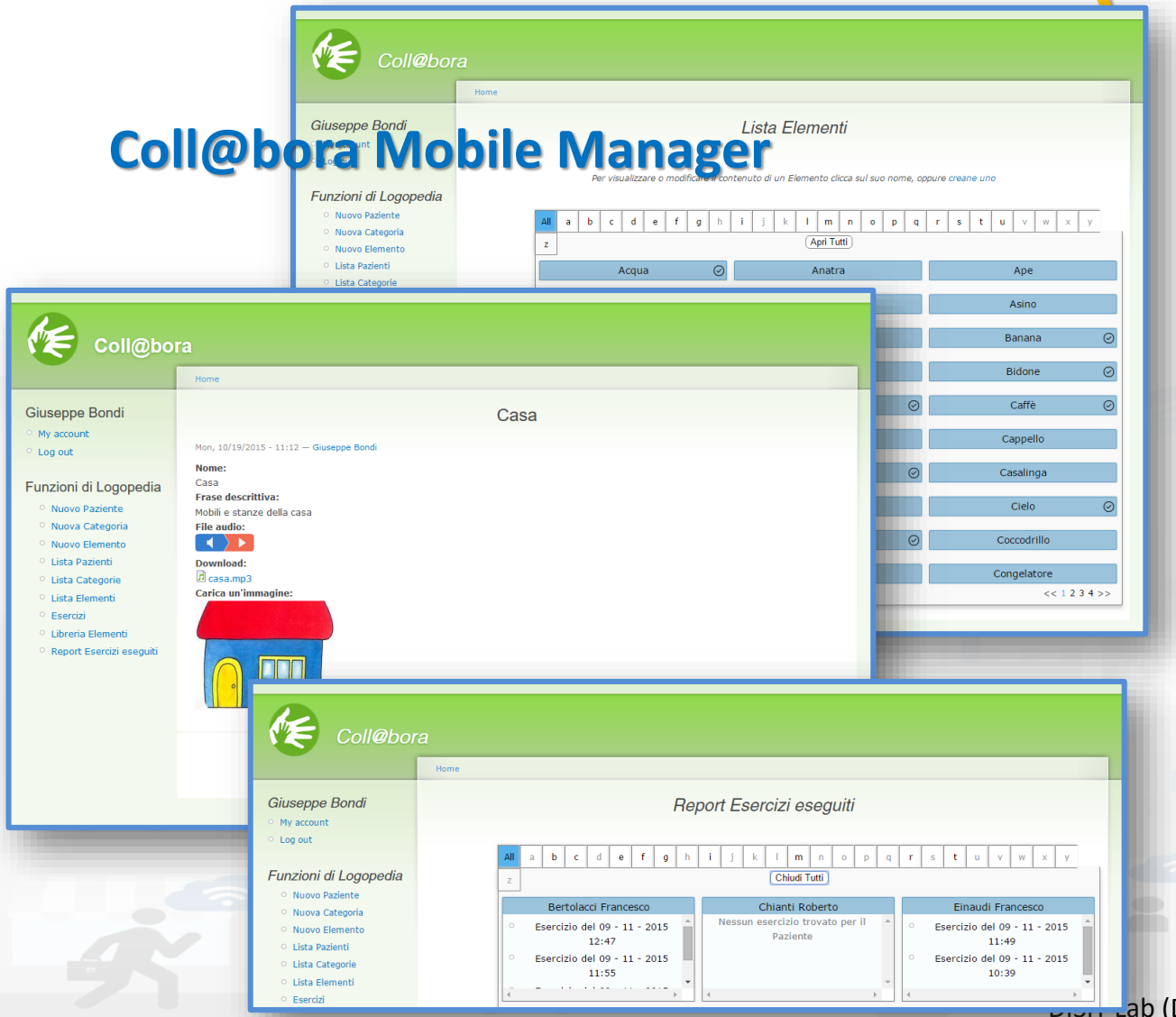
Tema Secondario: **Salute**

Nicola Mitolo, DISIT Lab, UNIFI

Evaristo Ricci, Associazione Modi di Dire

Collabora Mobile (DEMO)

Coll@bora Mobile Manager





Coll@bora Mobile App

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- 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/
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- **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.*















TOP





Be smart in a SNAP!

ARC

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CONTACT

DISIT Lab, DINFO: Department of Information Engineering
Università degli Studi di Firenze - School of Engineering

Via S. Marta, 3 - 50139 Firenze, ITALY
https://www.disit.org

www.snap4city.org

Email: snap4city@disit.org

Office: +39-055-2758-515 / 517
Cell: +39-335-566-86-74
Fax.: +39-055-2758570

