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

SNAP4CITY

Powered by KM4CITY

Snap4City: Smart City IOT/IOE Platform

scalable Smart aNalytic APplication builder for sentient Cities

https://www.snap4City.org https://www.Km4City.org

Nicola Mitolo

nicola.mitolo@unifi.it

https://www.disit.org/

EUROCITIES KSF
22-24 October 2018

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- **Snap4City has been created in response to Select4Cities PCP** (http://www.select4cities.eu/) call as an open, standardized, data-driven, service-oriented, user-centric platform enabling large-scale co-creation IOT/IOE applications and services for Helsinki, Copenhagen and Antwerp.
- **Snap4City is 100% open source:**
  - robust, scalable, easy to use solution, provides tools for co-creation of mixt data driven, stream and batch processing, GDPR, and city dashboards.
  - extending with IOT/IOE the semantic reasoner of Km4City https://www.km4city.org
- The innovation is mainly related to semantic reasoning, IOT interoperability, microservices, automated dashboard production, .. thus
- ***setting up smart city solutions in a*** SNAP

Requirements and Objectives

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

SNAP4CITY

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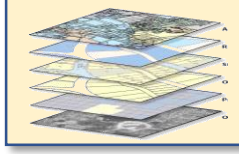
Open Data

GIS + Map Data



Personal Data

IoT/IoE

Sensors

Actuators

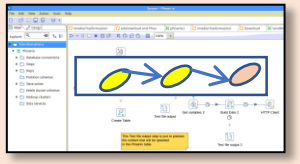
Industry 4.0

Social Media

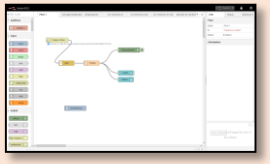
Static, Quasi static and Real Time data flows

Data Processing Tools

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



ETL Processes

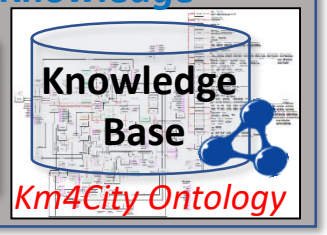


IoT/IoE Applications

Elastic Management of Containers

Big Data Storage Knowledge

Phoenix, Hbase + indexing



Km4City Ontology

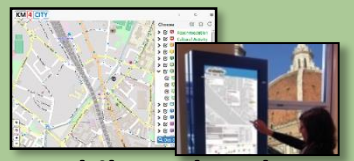
Smart City Cloud Infrastructure

Km4City Smart City API

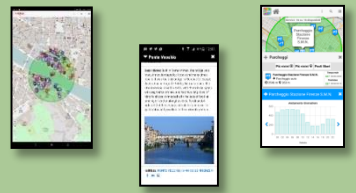
Final Users' Tools

Dashboards

IOT / IOE Apps

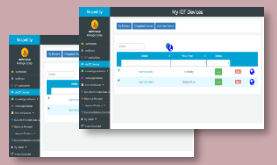


Mobile and Web Apps



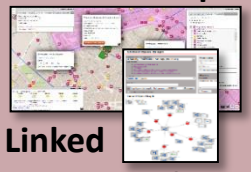
Development and Management Tools

Management



IOT Directory

ServiceMap



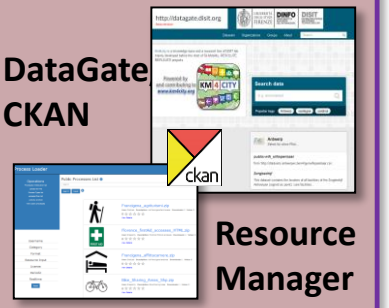
Linked Open Graph

Data Flow Analysis

DevDash

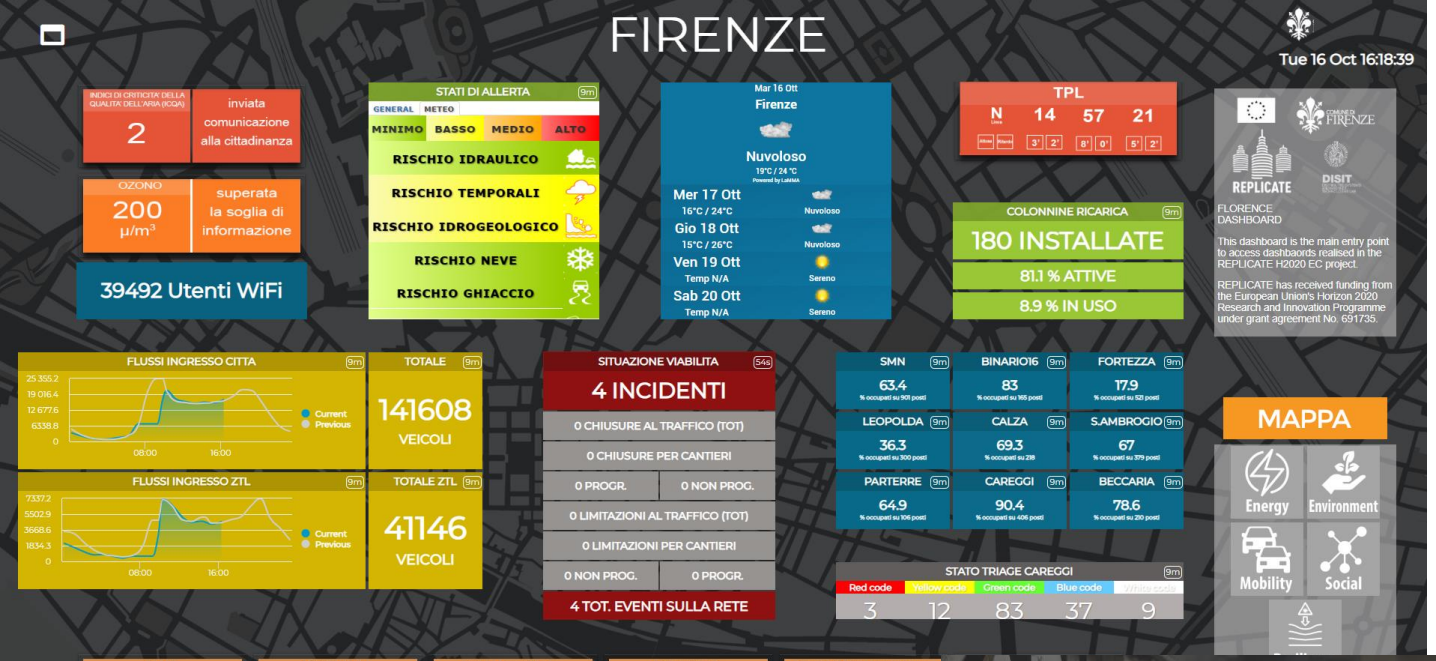
AMMA

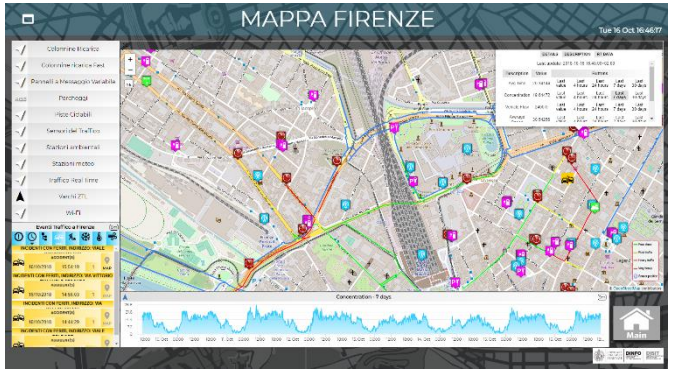
DataGate CKAN

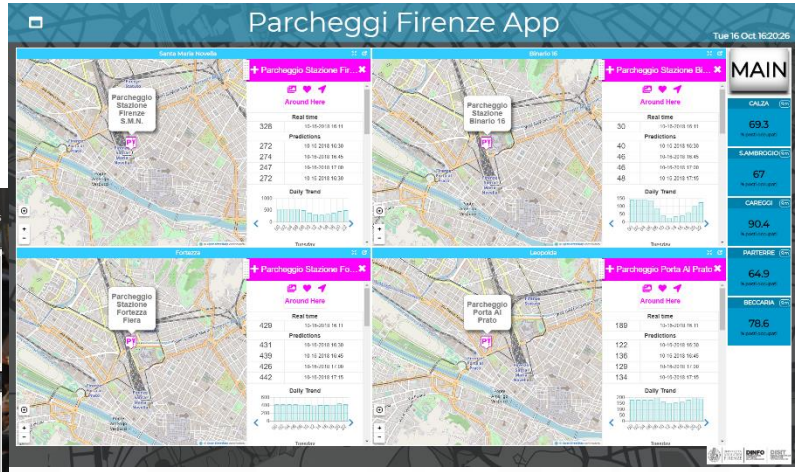


Resource Manager

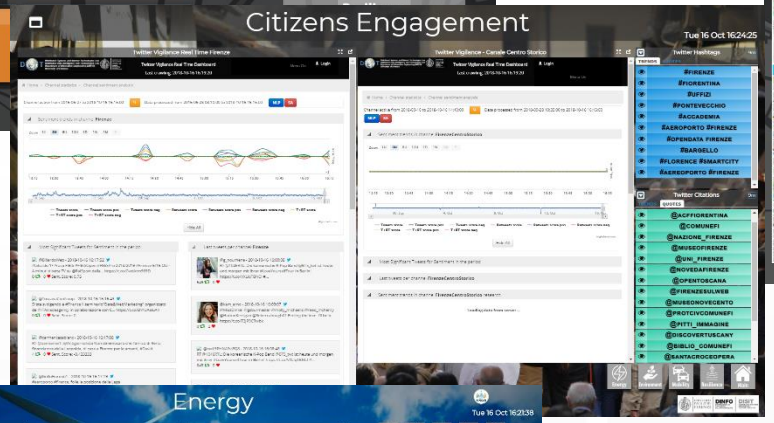
Authentication, Authorization, GDPR, Security Assessment


FIRENZE
Tue 16 Oct 16:18:39
INDICI DI CRITICITA' DELLA QUALITA' DELL'ARIA (ICQA)
2
inviata comunicazione alla cittadinanza
OZONO
200 µ/m³
superata la soglia di informazione
39492 Utenti WiFi
STATI DI ALLERTA
GENERAL METEO
MINIMO BASSO MEDIO ALTO
RISCHIO IDRAULICO
RISCHIO TEMPORALI
RISCHIO IDROGEOLOGICO
RISCHIO NEVE
RISCHIO GHIACCIO
Mar 16 Ott
Firenze
Nuvoloso
19°C / 24 °C
Mer 17 Ott 16°C / 24°C Nuvoloso
Gio 18 Ott 15°C / 26°C Nuvoloso
Ven 19 Ott Temp N/A Sereno
Sab 20 Ott Temp N/A Sereno
TPL
N 14 57 21
COLONNINE RICARICA
180 INSTALLATE
81.1 % ATTIVE
8.9 % IN USO
REPLICATE
DISIT
FLORENCE DASHBOARD
This dashboard is the main entry point to access dashboards realised in the REPLICATE H2020 EC project.
REPLICATE has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 691735.
FLUSSI INGRESSO CITTA
TOTALE
141608
VEICOLI
FLUSSI INGRESSO ZTL
TOTALE ZTL
41146
VEICOLI
SITUAZIONE VIABILITA
4 INCIDENTI
0 CHIUSURE AL TRAFFICO (TOT)
0 CHIUSURE PER CANTIERI
0 PROGR.
0 NON PROG.
0 LIMITAZIONI AL TRAFFICO (TOT)
0 LIMITAZIONI PER CANTIERI
0 NON PROG.
0 PROGR.
4 TOT. EVENTI SULLA RETE
SMN 63.4
BINARIO16 83
FORTEZZA 17.9
LEOPOLDA 36.3
CALZA 69.3
S.AMBROGIO 67
PARTERRE 64.9
CAREGGI 90.4
BECCARIA 78.6
STATO TRIAGE CAREGGI
Red code Yellow code Green code Blue code White code
3 12 83 37 9
MAPPA
Energy
Environment
Mobility
Social
PM10
26
superamenti/anno
Riciclo rifiuto
56%
Rifiuto per abitante
0,629
t/pers/anno
PIL residenti
23.606
euro/pers
Tasso di disoccupazione
6,8%


MAPPA FIRENZE
Tue 16 Oct 16:46:17


Parcheggi Firenze App
Tue 16 Oct 16:20:26
MAIN

First aids overview - Firenze
Service status of main first aids
Tue 16 Oct 16:20:53


Citizens Engagement
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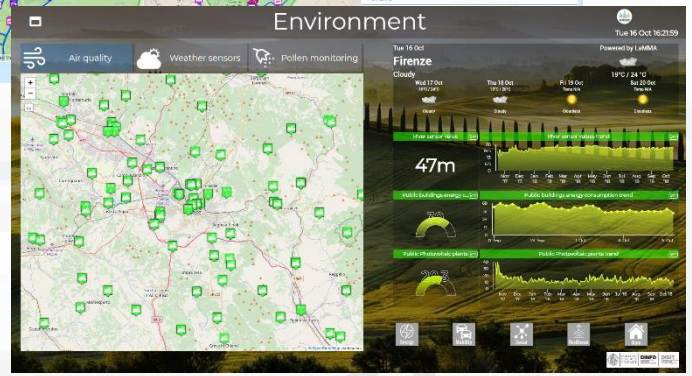
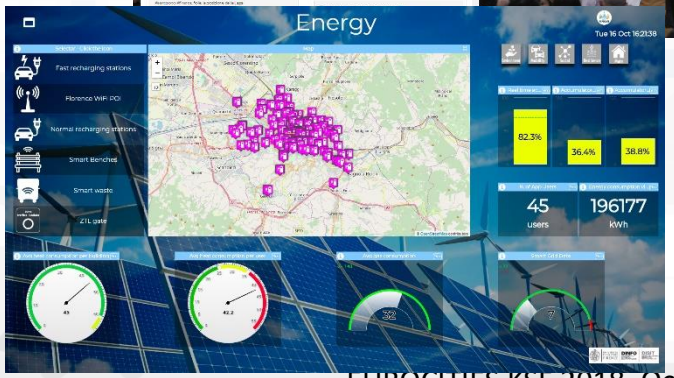
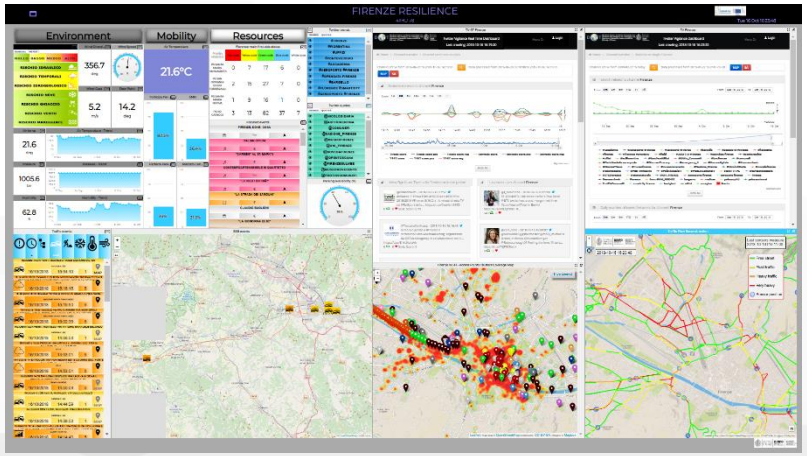

Environment
Air quality
Weather sensors
Pollen monitoring
Tue 16 Oct 16:21:59
Firenze
47m


Energy
Tue 16 Oct 16:21:38
45 users
196177 kWh


FIRENZE RESILIENCE
Environment
Mobility
Resources

FIRENZE

Tue 16 Oct 16:18:39

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

OZONO	
200 µ/m³	superata la soglia di informazione

39492 Utenti WiFi

STATI DI ALLERTA 9m

GENERAL | METEO

MINIMO	BASSO	MEDIO	ALTO

RISCHIO IDRAULICO

RISCHIO TEMPORALI

RISCHIO IDROGEOLOGICO

RISCHIO NEVE

RISCHIO GHIACCIO

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

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

TPL

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

COLONNINE RICARICA 9m

180 INSTALLATE

81.1 % ATTIVE

8.9 % IN USO

REPLICATE

DISIT

FLORENCE DASHBOARD

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

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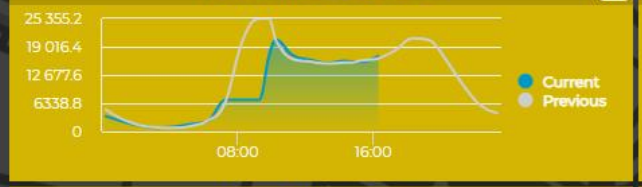
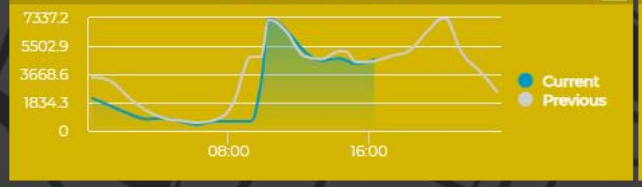
FLUSSI INGRESSO CITTA 9m



TOTALE 9m

141608 VEICOLI

FLUSSI INGRESSO ZTL 9m



TOTALE ZTL 9m

41146 VEICOLI

SITUAZIONE VIABILITA 54s

4 INCIDENTI

0 CHIUSURE AL TRAFFICO (TOT)	
0 CHIUSURE PER CANTIERI	
0 PROGR.	0 NON PROG.
0 LIMITAZIONI AL TRAFFICO (TOT)	
0 LIMITAZIONI PER CANTIERI	
0 NON PROG.	0 PROGR.

4 TOT. EVENTI SULLA RETE

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

STATO TRIAGE CAREGGI 9m

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

MAPPA

Energy | Environment | Mobility | Social | Resilience

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

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT

Environment
Tue 16 Oct 16:21:59
Air quality
Weather sensors
Pollen monitoring
Tue 16 Oct
Firenze
Cloudy
Powered by LaMMA
19°C / 24 °C
Wed 17 Oct
Thu 18 Oct
Fri 19 Oct
Sat 20 Oct
River sensor value
47m
River sensor values trend
Public buildings energy c...
Public buildings energy consumption trend
Public Photovoltaic plants
Public Photovoltaic plants trend

Energy Dash

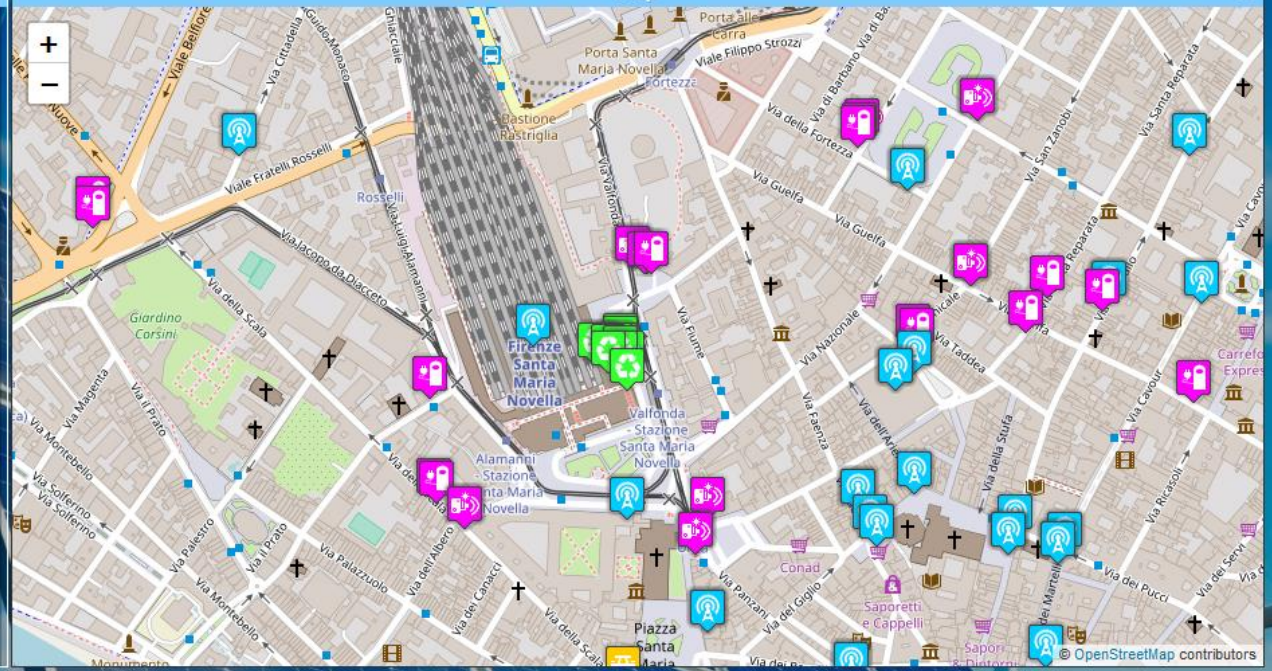
Pilot dashboard

Sun 8 Jul 11:59:06

Selector - Click the icon

- Fast recharging stations
- Florence WiFi POI
- Normal recharging stations
- Smart Benches
- Smart waste
- ZTL gate

Map



Real time ac... 6m

Accumulato... 6m

Accumulato... 6m

N. of App Users 6m

40

users

Energy consumption vi... 6m

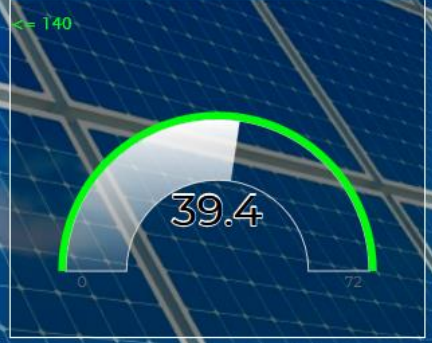
122770

kWh

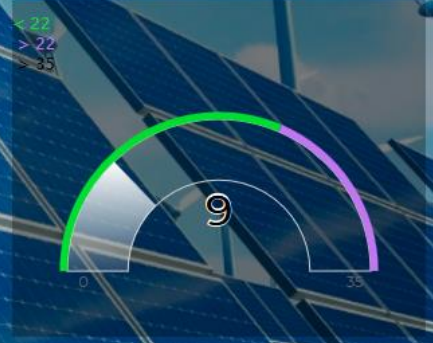
Avg heat consumption per buildi... 6m

Avg heat consumption per user 6m

Avg gas consumption 6m



Smart Grid Data 6m



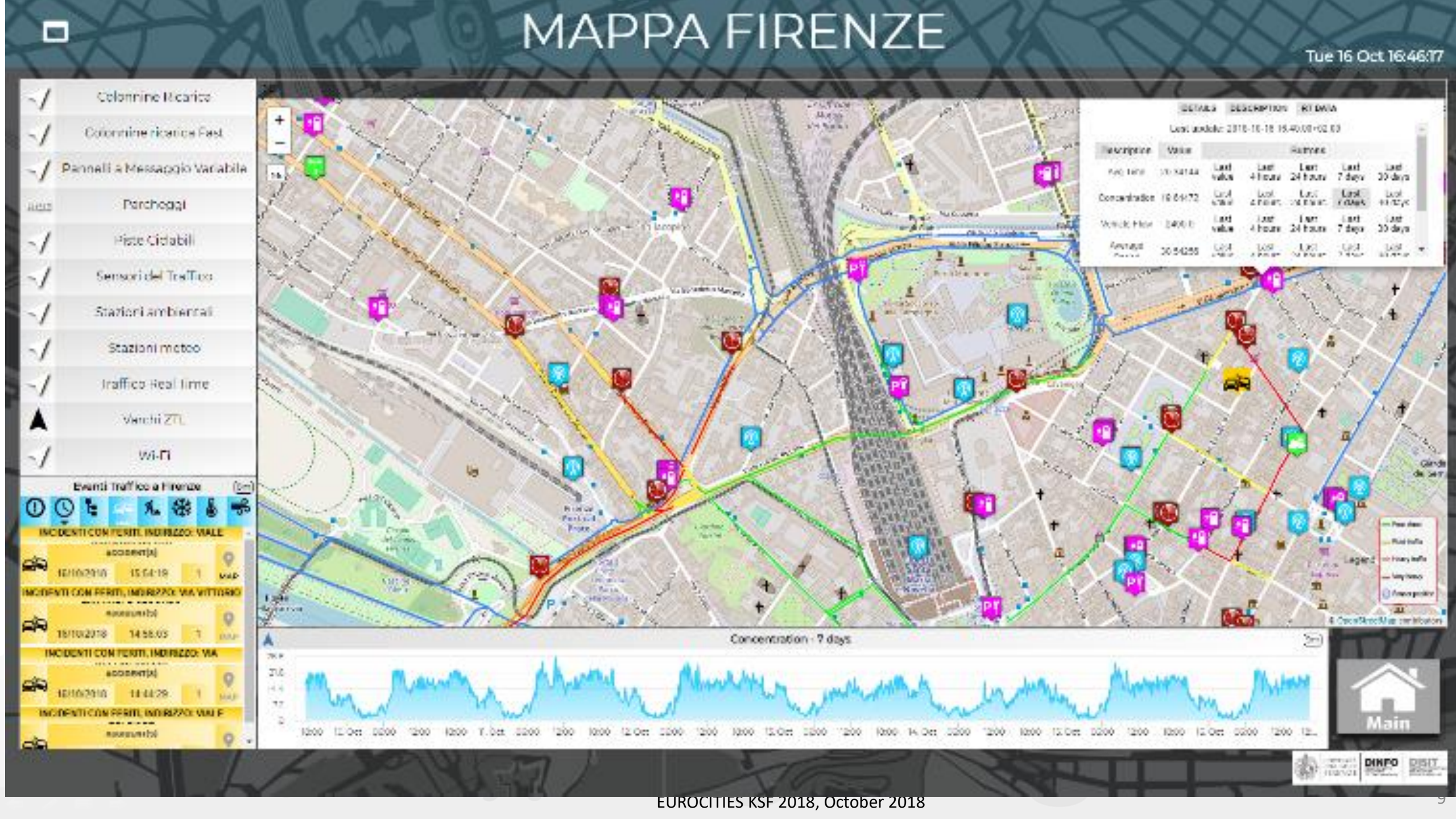
Web site status 6m

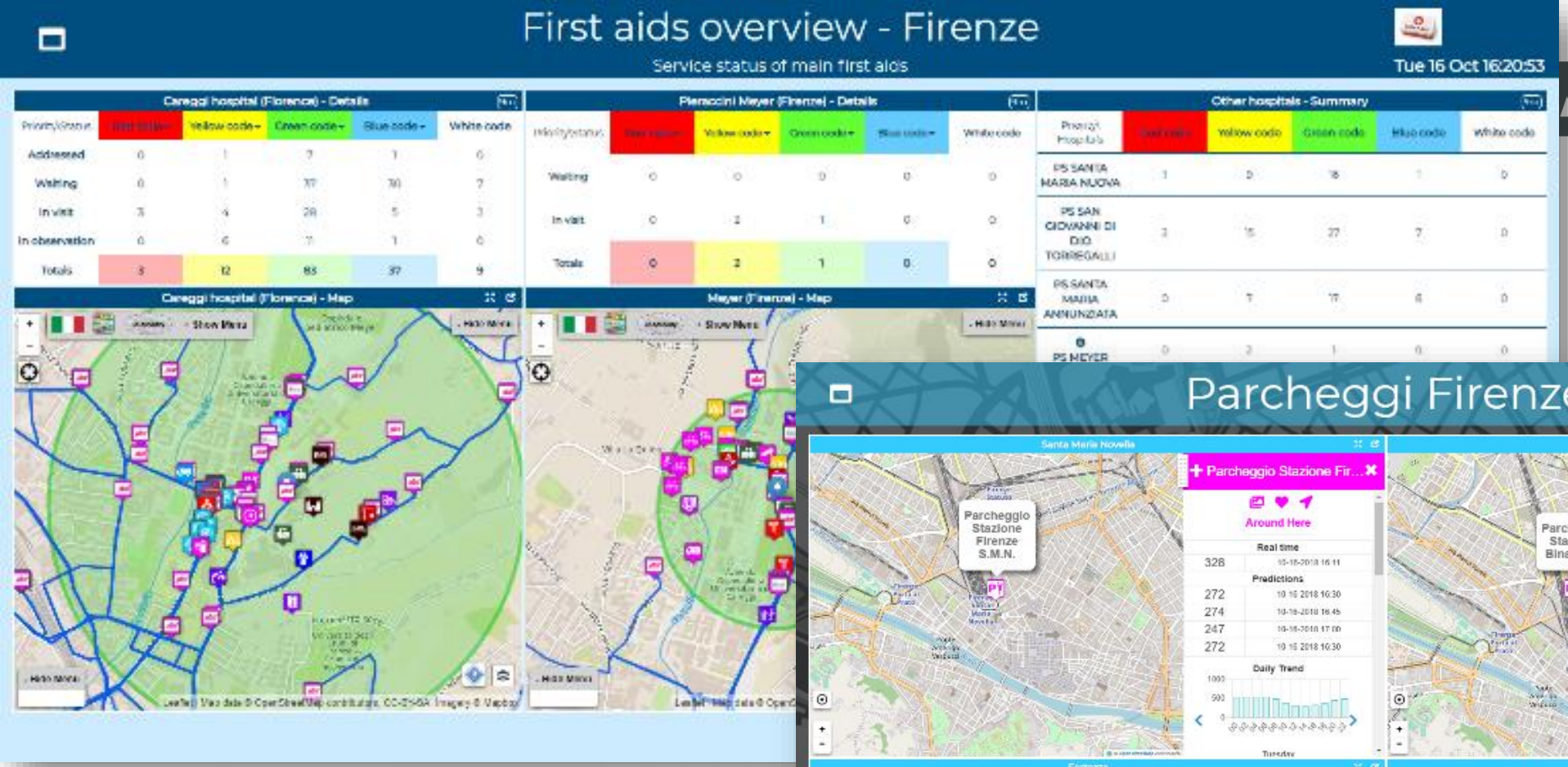
SNAP4CITY

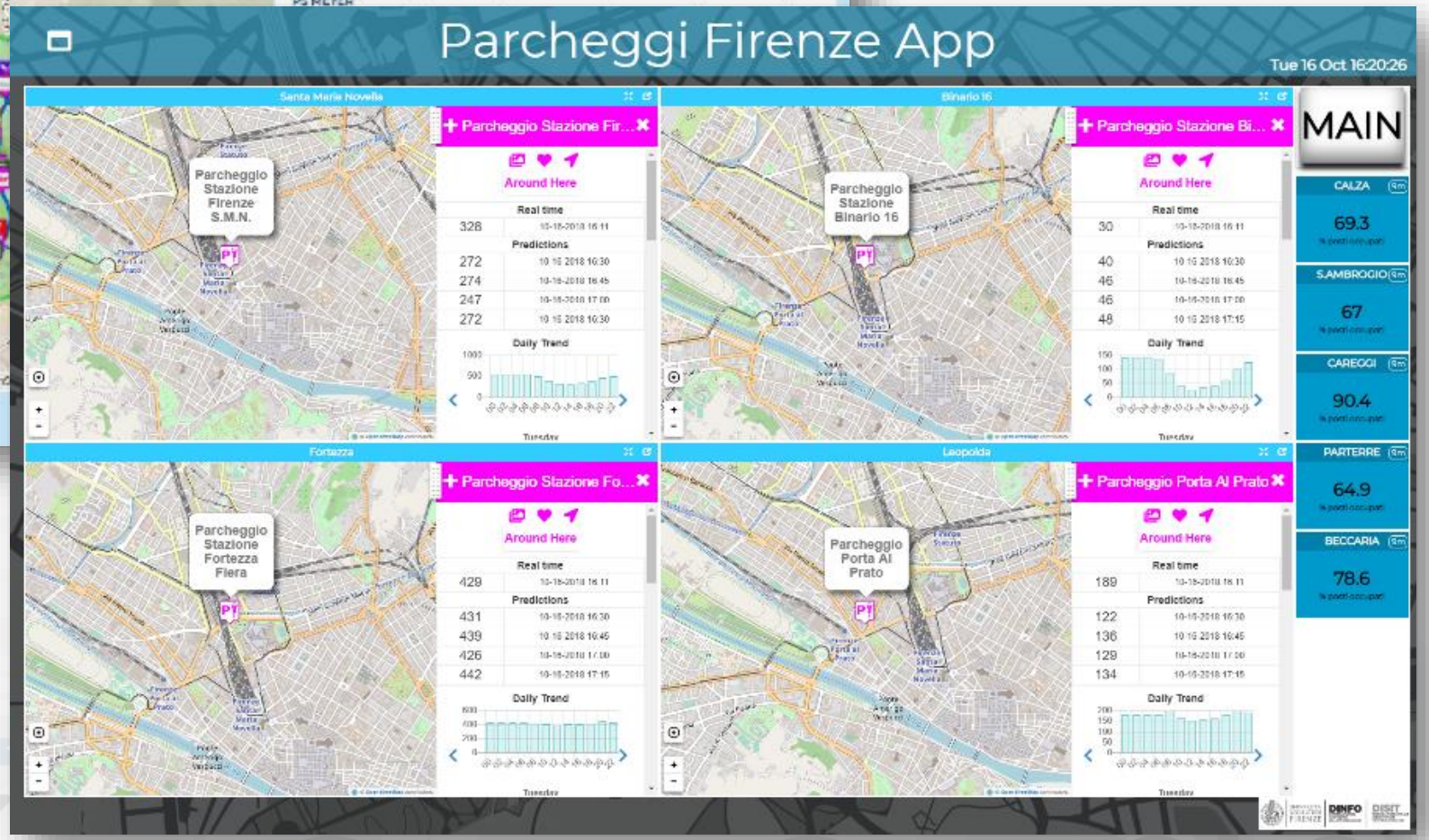
TOKEN FOUND

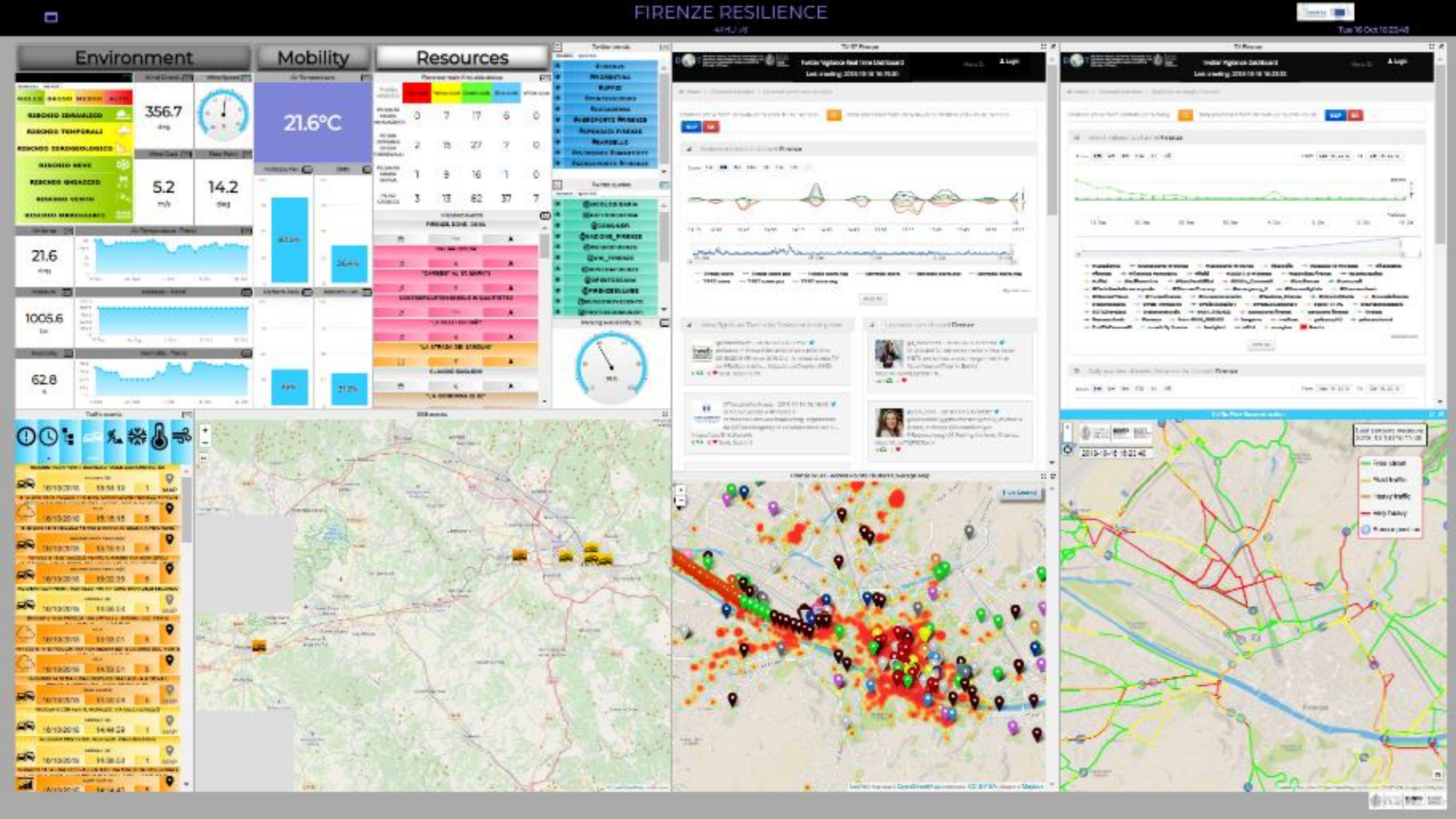
2018-07-08 11:51:37

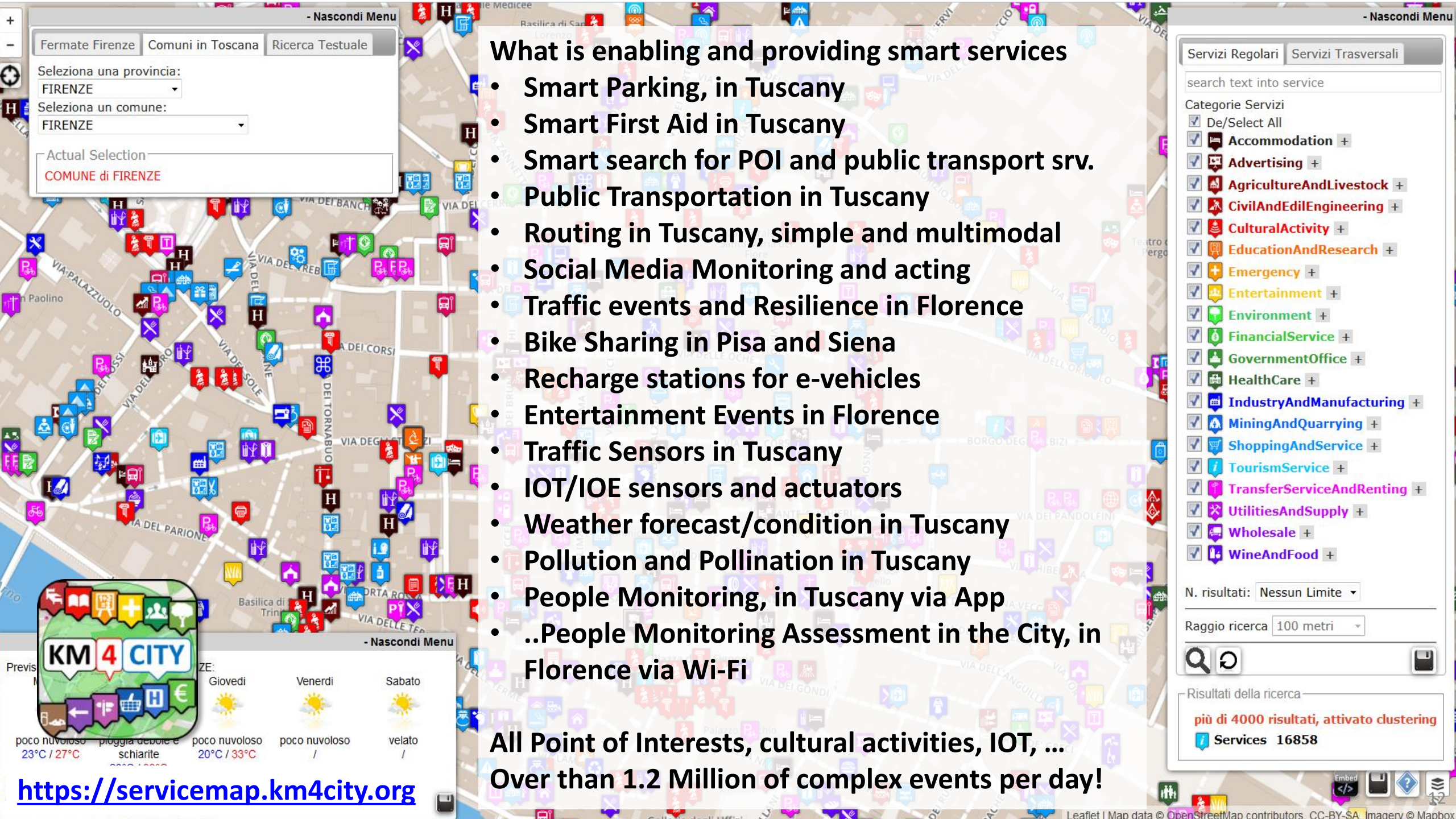
MAPPA FIRENZE




First aids overview - Firenze
Service status of main first aids
Tue 16 Oct 16:20:53
Careggi hospital (Florence) - Details
Meyer (Florence) - Details
Other hospitals - Summary
Careggi hospital (Florence) - Map
Meyer (Florence) - Map


Parcheggi Firenze App
Tue 16 Oct 16:20:26
Santa Maria Novella
Binario 16
Fortezza
Leopolda
MAIN
Around Here
Real time
Predictions
Daily Trend


FIRENZE RESILIENCE
Environment
Mobility
Resources
356.7
21.6°C
5.2
14.2
21.6
1005.6
62.8



What is enabling and providing smart services

- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart search for POI and public transport srv.
- Public Transportation in Tuscany
- Routing in Tuscany, simple and multimodal
- Social Media Monitoring and acting
- Traffic events and Resilience in Florence
- Bike Sharing in Pisa and Siena
- Recharge stations for e-vehicles
- Entertainment Events in Florence
- Traffic Sensors in Tuscany
- IOT/IOE sensors and actuators
- Weather forecast/condition in Tuscany
- Pollution and Pollination in Tuscany
- People Monitoring, in Tuscany via App
- ..People Monitoring Assessment in the City, in Florence via Wi-Fi

All Point of Interests, cultural activities, IOT, …

Over than 1.2 Million of complex events per day!

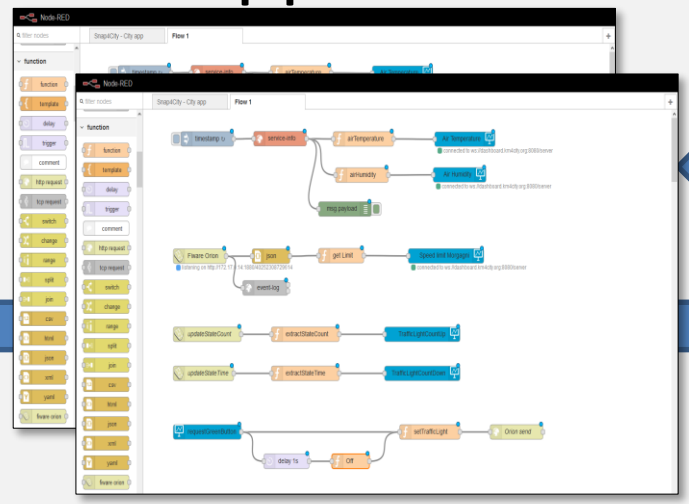
Level 4 users: dashboard with intelligence App

- Dashboards with IOT Applications for enforcing smart and intelligence into them.

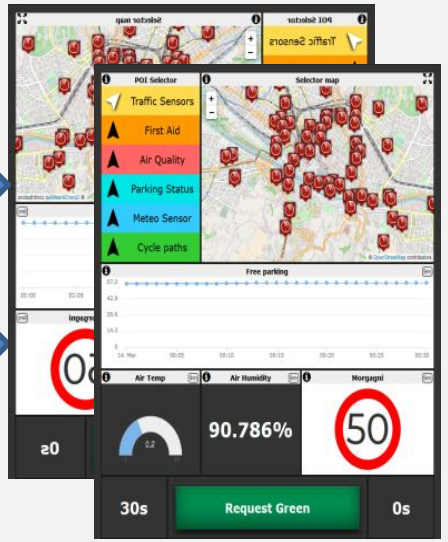
Dashboard-IOT App

IOT and City data World

IOT Applications



Dashboards



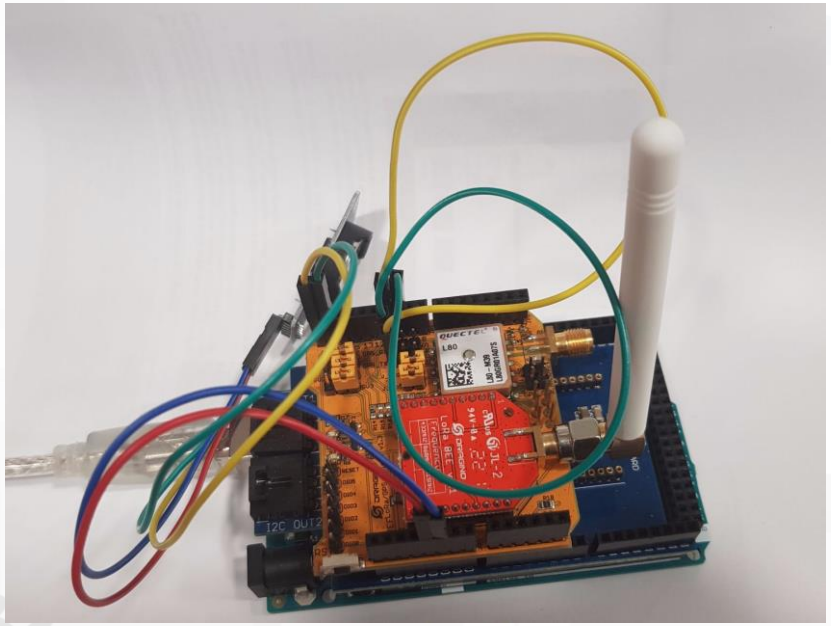
Applications

Custom IOT Edge, and IOT Devices

SigFOX
Arduino

Sensors/
Actuators

LoraWAN + Arduino + I2C



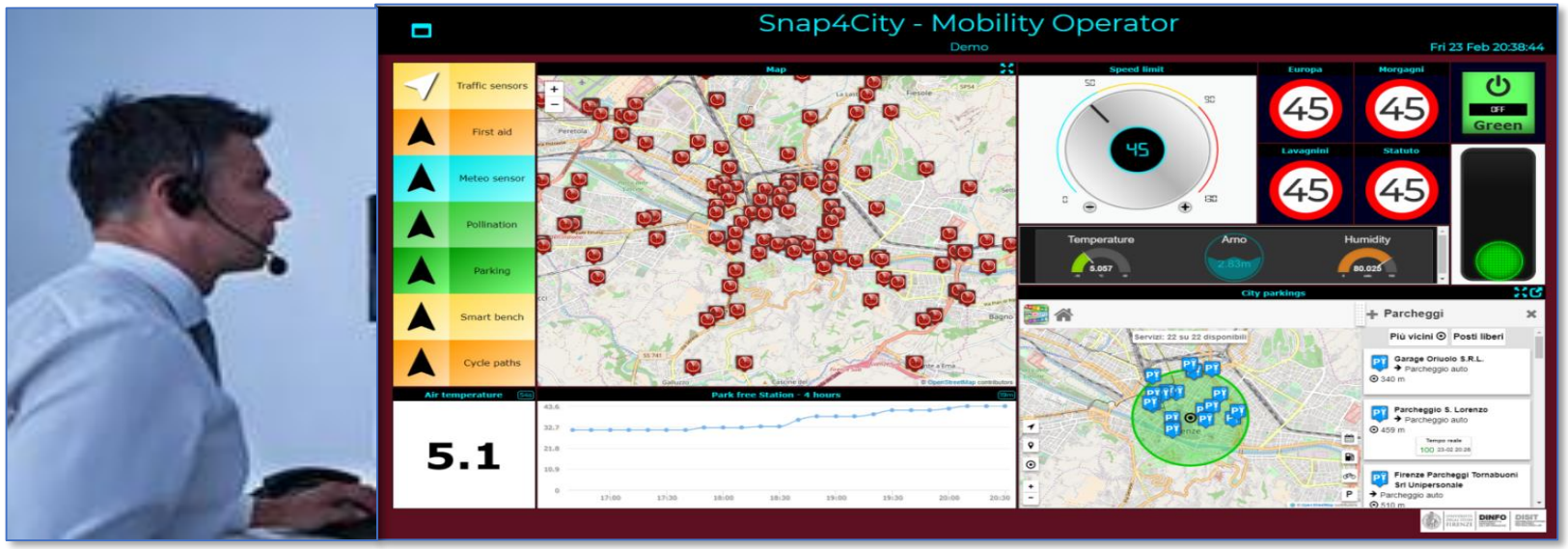
IOT Edge NodeRED:
Raspberry

City Dashboard + IOT App

Control Room Operator

Would like to:

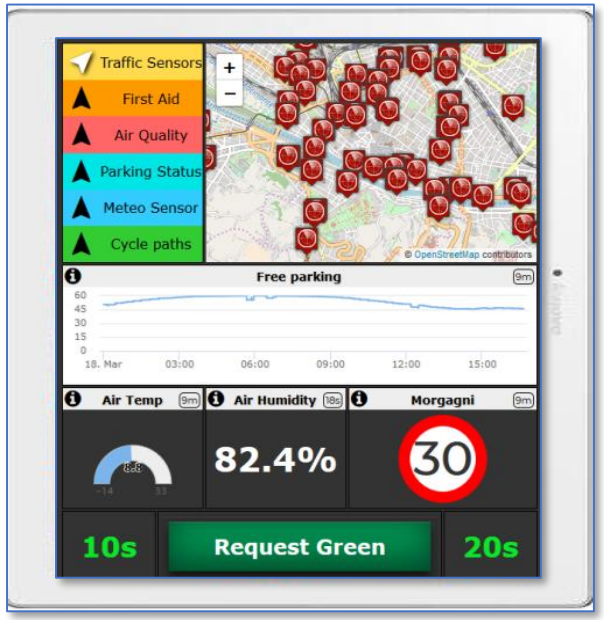
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., ..
- **Act and** monitor Dynamic Plates
- **Act and** monitor red lights

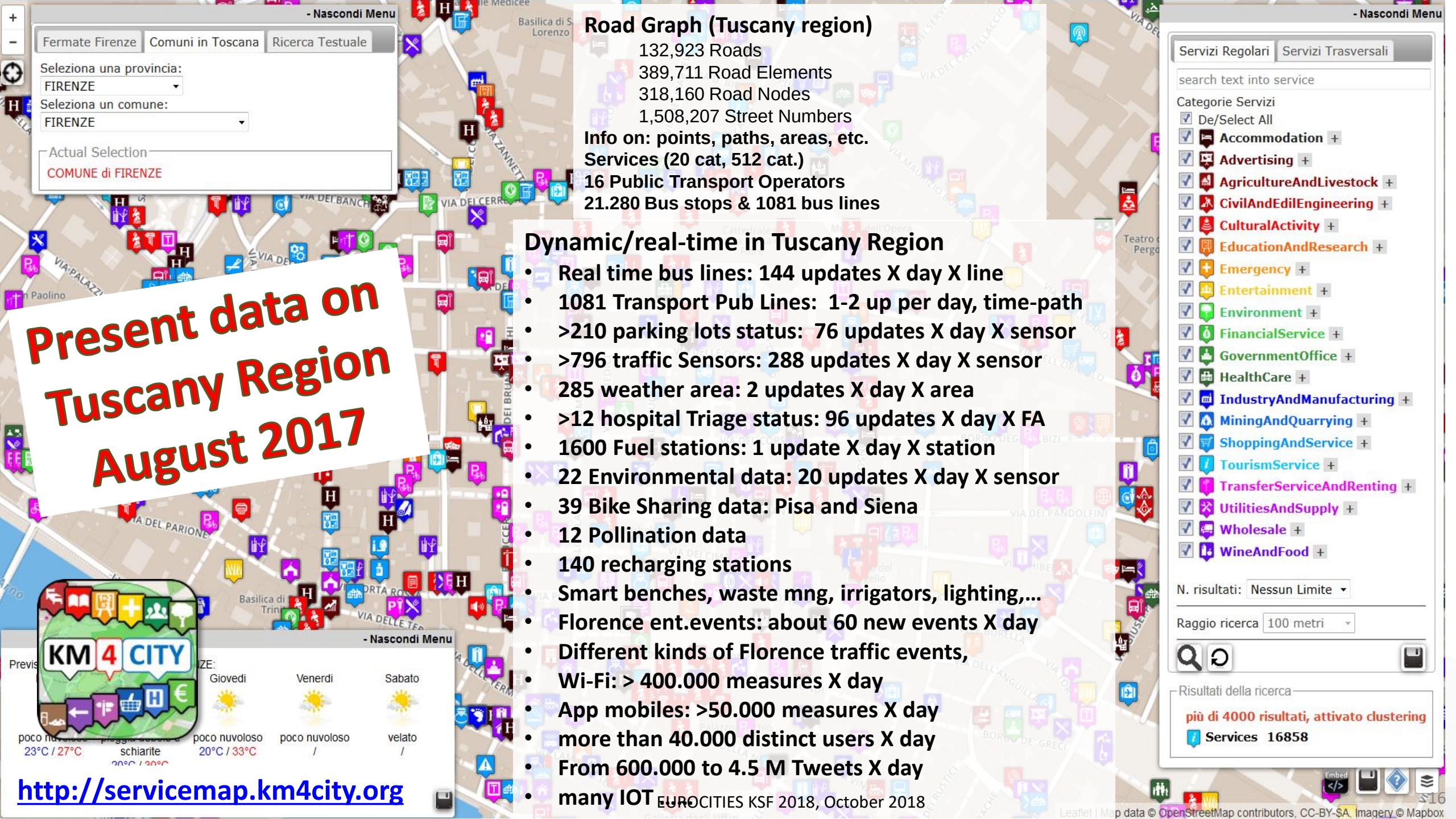


Driver, Policeman

Would like to:

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





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 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**
- **1600 Fuel stations: 1 update X day X station**
- **22 Environmental data: 20 updates X day X sensor**
- **39 Bike Sharing data: Pisa and Siena**
- **12 Pollination data**
- **140 recharging stations**
- **Smart benches, waste mng, irrigators, lighting,…**
- **Florence ent.events: about 60 new events X day**
- **Different kinds of Florence traffic events,**
- **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**

Using and Contributing Km4City/Snap4City

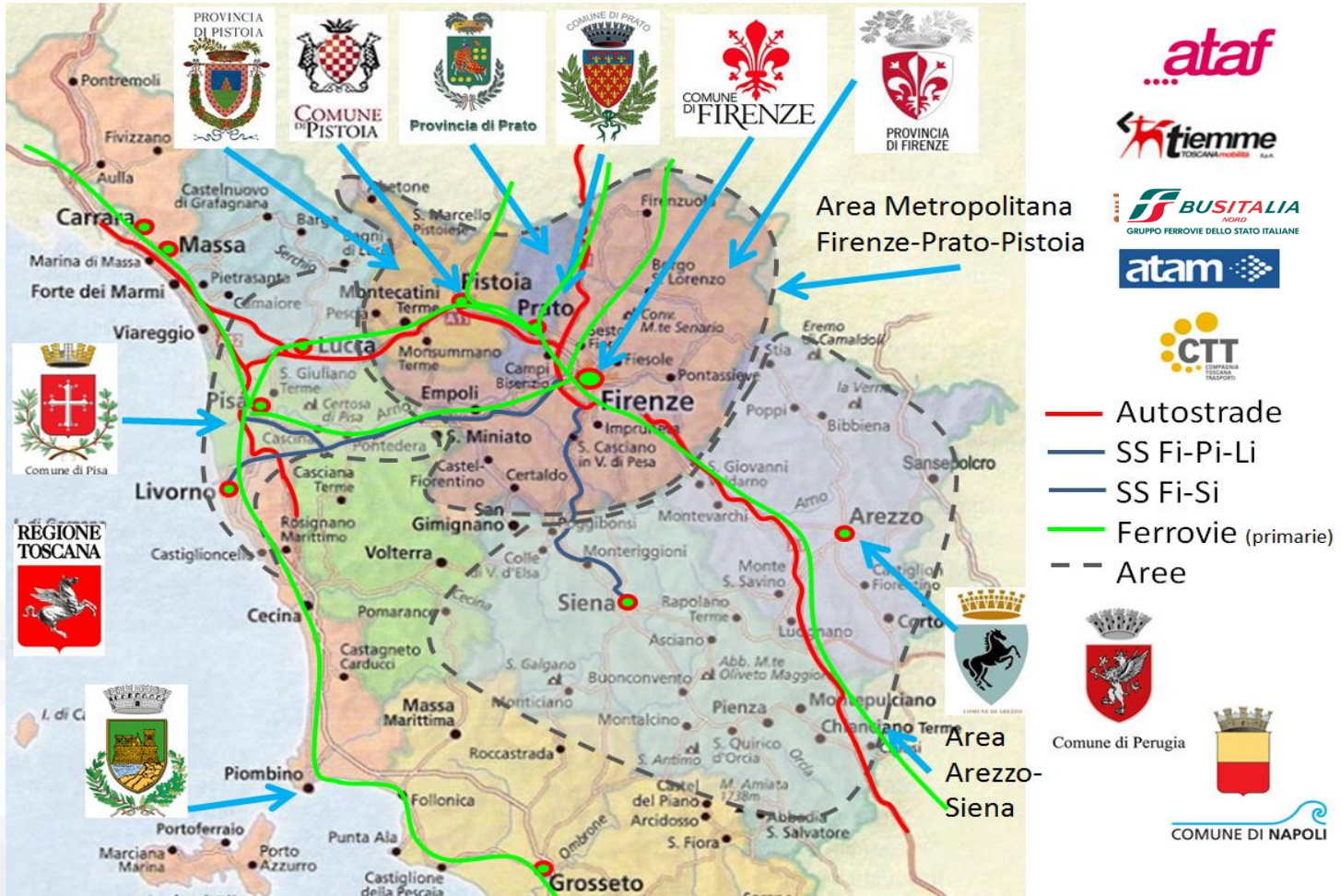
UNIVERSITÀ DEGLI STUDI FIRENZE
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

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

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

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MIUR MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITÀ E DELLA RICERCA

KM 4 CITY

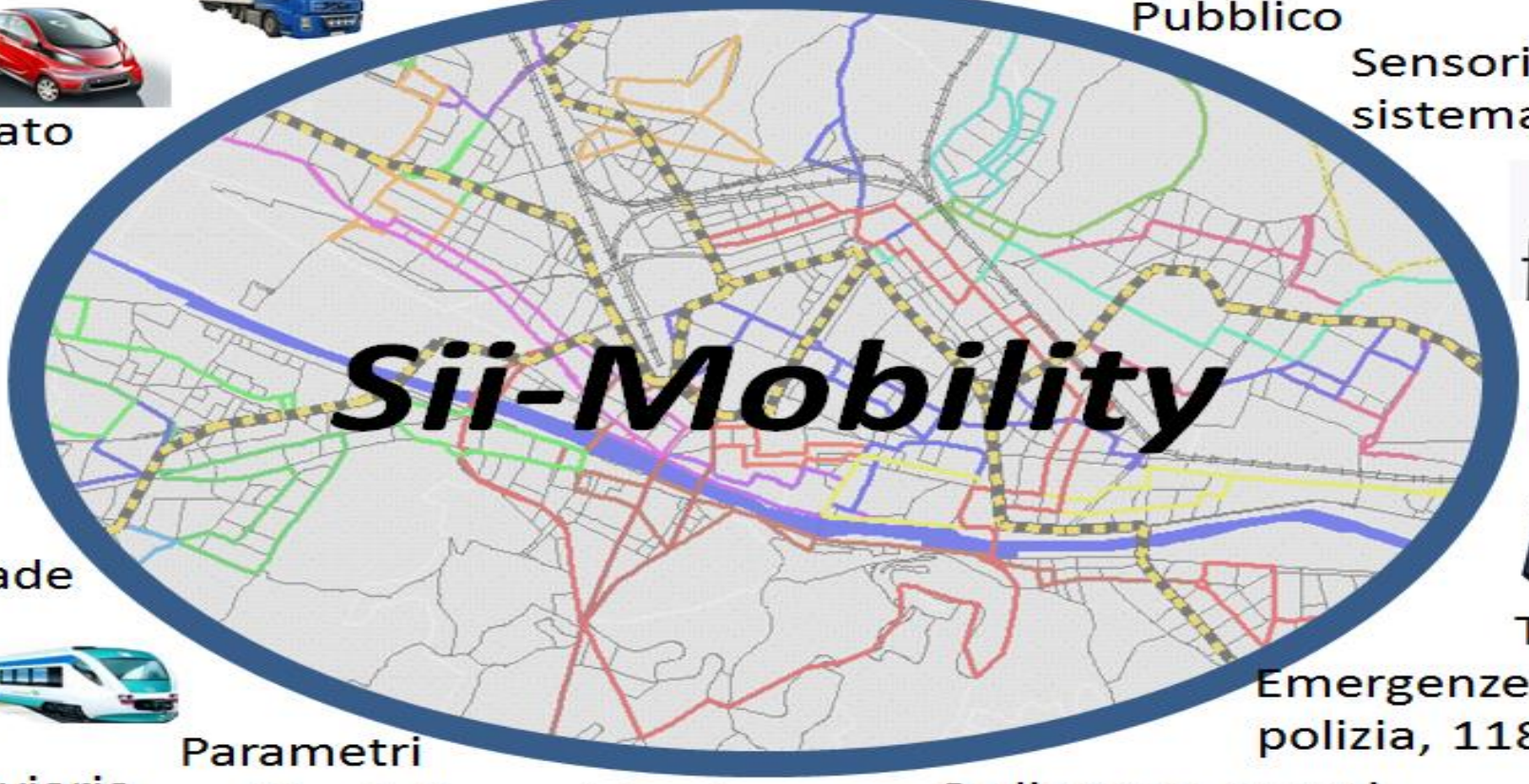
Commenti dei cittadini, Social Media

AVM trasporto Pubblico

Merci

Sensori su trasporto Privato

Sensori, sistema monitoraggio



Sensori Parcheggi

UTC

Infomobility

Varchi Telematici, ZTL

Monitoraggio traffico, autostrade

Rete Ferroviaria

Parametri ambientali

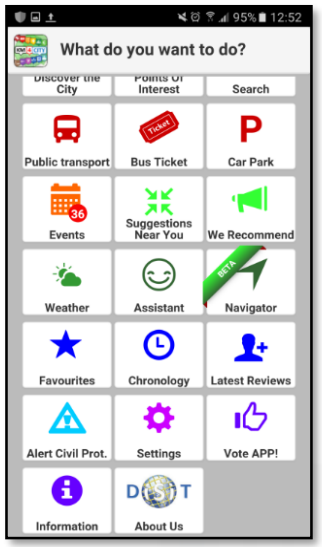
Servizi ed enti

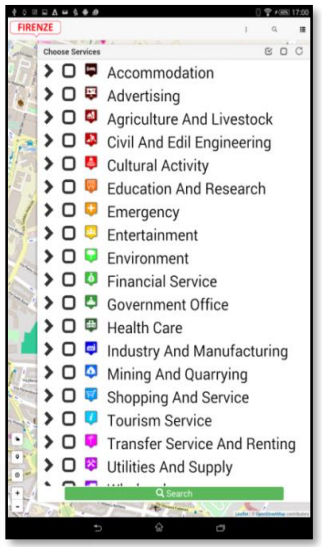
Ordinanze: eventi, lavori pubblici, ..

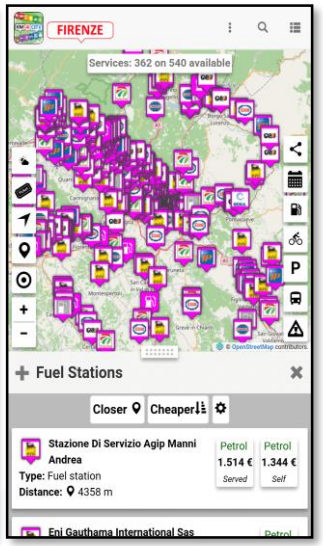
Emergenze, polizia, 118

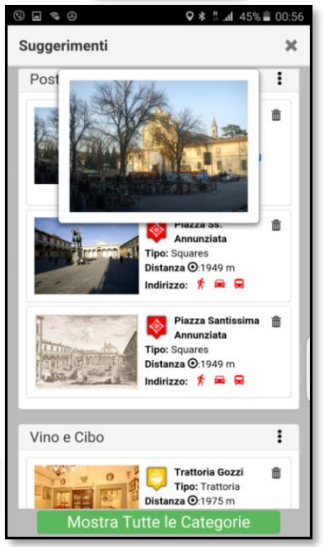
Km4City APP

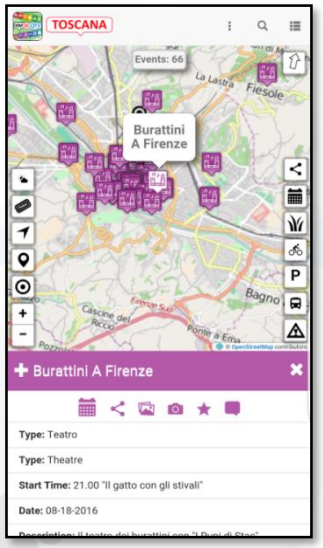
- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart Public Transportation in Tuscany
- Smart Fuel pricing in Tuscany
- Bike Sharing in Pisa
- Weather condition in Tuscany
- Pollution and Pollination in Tuscany
- Traffic Sensors in Tuscany
- Smart Routing in Tuscany
- Smart Transportation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

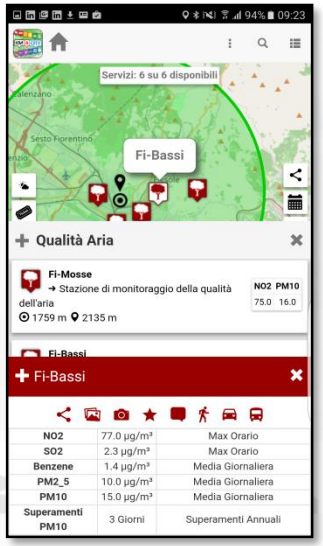


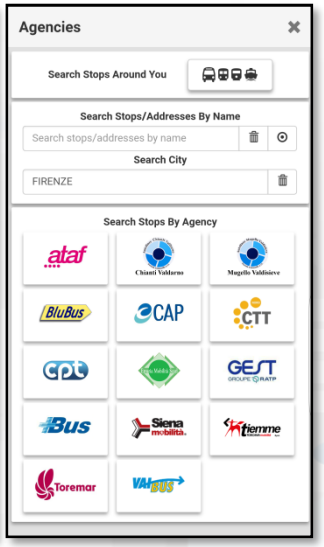












Available on the App Store

ANDROID APP ON Google play

Download from Windows Phone Store

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REPLICATE

Horizon 2020
European Union Funding
for Research & Innovation

REnaissance of PLaces
with Innovative Citizenship
And TEchnology

http://replicate-project.eu/

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

- ***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

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- **Km4City** is an open technology exploited by those projects and line of research of DISIT Lab. Some of the innovative solutions and research issues developed into the above mentioned projects are also compliant and contributing to the Km4City approach and thus are contributing to the open Km4City model of DISIT lab.