Smart City and Km4City for Beginners 2016

Parte 11 of the University of Florence, DISIT lab course: Knowledge Management and Protection Systems (KMaPS)

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…verso le città

- Si assiste ad una ***migrazione verso le città***,
  - nel 2050 arriveranno ad ospitare oltre il 75% della popolazione mondiale
  - dovuto principalmente alle ***maggiori opportunità lavorative ma anche ai servizi***

- Si aprono scenari di ***competizione fra città «fra pubbliche amministrazioni, PA»***

- → le città, devono adeguarsi alle crescenti necessità cercando di
  - garantire ***elevati livelli di qualità della vita***
  - fornire ***nuovi servizi***
  - ***limitando i costi***, aumento di efficienza
  - strutture decisionali adeguate
- → Enti di valutazione

- ***per una la crescita sostenibile da vari punti di vista***

- I ***cittadini «imparano»*** a vivere in città più tecnologiche → in ambienti:
  - **interattivi**: si aspettano azioni dagli utenti
  - **proattivi**: agiscono in riferimento al contesto: movimenti o ad altro
  - **collaborativi**: fra persone e sistemi
- ***Servizi intelligenti – suggeriscono!***

- *Per esempio:*
  - *riconoscimento della persona quando accede ai servizi pubblici, in banca, al supermercato, entra in casa*
  - *parcheggi che conoscono i posti liberi*

- *Il loro uso può implicare un certo grado di comprensione cognitiva da parte dei cittadini*

- «Nascondono», sfruttano…
  - ***sensori ed attuatori***
  - *Internet delle Cose, IOT*

- *Per esempio:*
  - *Condizioni meteo, ambiente,*
  - *flussi delle auto, presenza di pedoni*
  - *contatori intelligenti*
  - *Lampioni intelligenti, etc..*

Privati Statici

- Codice fiscale
- Foto non condivise
- Aspetti legali
- Cartella clinica
- ..

- Movimenti personali non pubblicati
- Relazioni personali non pubblicate

Pubblici statici (open data)

statistiche: incidenti, censimenti, votazioni

- Statistiche accessi alla ZTL
- Strutture pubbliche UNIFI

posizione dei punti di interesse

- Musei
- Strutture della città
- Servizi attivi

- comportamenti
- social media
- contributi
- consumi

- Traffico personale
- Posizione mezzi,
- Meteo
- Parcheggi
- Posizione taxi
- Code ai musei
- Posizione CarSharing …

- Info traffico
- video camere
- Info Meto
- Info Ambiente
- Terremoti
- Parcheggi

- Stato accessi alla ZTL
- Stato dei servizi

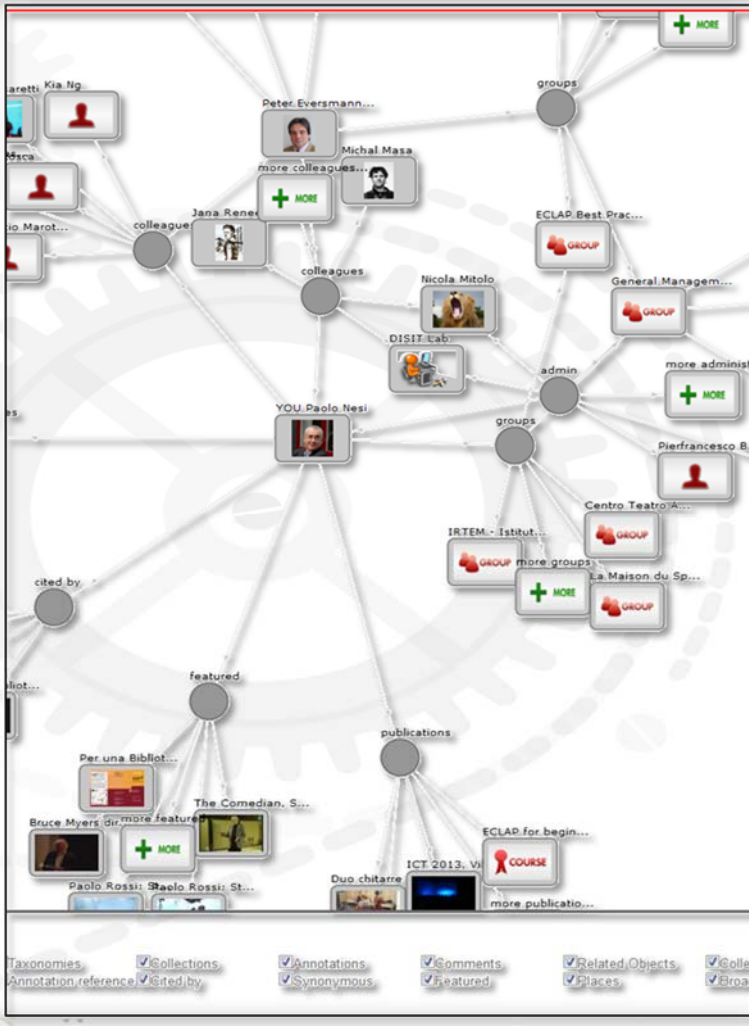
- **Privati Tempo reale**

Pubblici Tempo reale (open data)

Relatore **Paolo Nesi**
Ordinario di Sistemi di elaborazione delle informazioni

I profili degli utenti

- ***Gli utenti possono:***
  - fornire informazioni preziose sulla citta come «***sensori intelligenti»*** per tenere sotto controllo il livello dei servizi della città e/o nuove necessità
  - **essere profilati per ricevere dei servizi personalizzati, benefici diretti**
- Informazioni anonime:
  - *velocità degli spostamenti: auto a piedi, code e flussi cittadini, temperature, meteo*
  - *Uso dei servizi*
- private in consenso informato, statistiche e attuali:
  - *Azioni e dati personali*
  - *Relazioni con altre persone*
  - *Movimenti puntuali*



Le buone pratiche "Smart city"

- *forniscono nuovi servizi e valutano sulla base della risposta del cittadino*

- Le PA, per stare al passo con la competizione ***aprono canali di comunicazione ed ascolto:***
  - ***media tradizionali*** sono validi per propagare l'informazione
  - ***canali basati su internet***, come social network, mobile,.. per la raccolta di informazioni dalla popolazione, e per informare
  - ***canali specifici***: interviste dirette, totem interattivi, etc.
- Stabilire un processo di miglioramento virtuoso:
  - ***Informare*** su disservizi o problemi, e vederli risolti:
    - le buche nella strada, i muri sporchi dei palazzi, la nettezza sulla strada, gli uffici che presentano poco personale, infrastrutture non accessibili, …
  - ***In certi casi, le informazioni utili possono essere ricompensate con bonus/sconti su: taxi, entrate in ZTL, parcheggi, etc.***

Scenari che da fantascientifici diventano reali…

Grazie a infrastrutture che..

- ***Raccolgono dati e statistiche su***
  - Ambiente & energia
  - Trasporti & mobilità
  - Commercio & Turismo
  - Servizi al cittadino
  - Comportamento e stato della popolazione nel rispetto della privacy, anonymity
- ***Producono analisi, previsioni e deduzioni*** su base
  - Statistica, analitica, logica…
  - sporadiche e/o in tempo reale

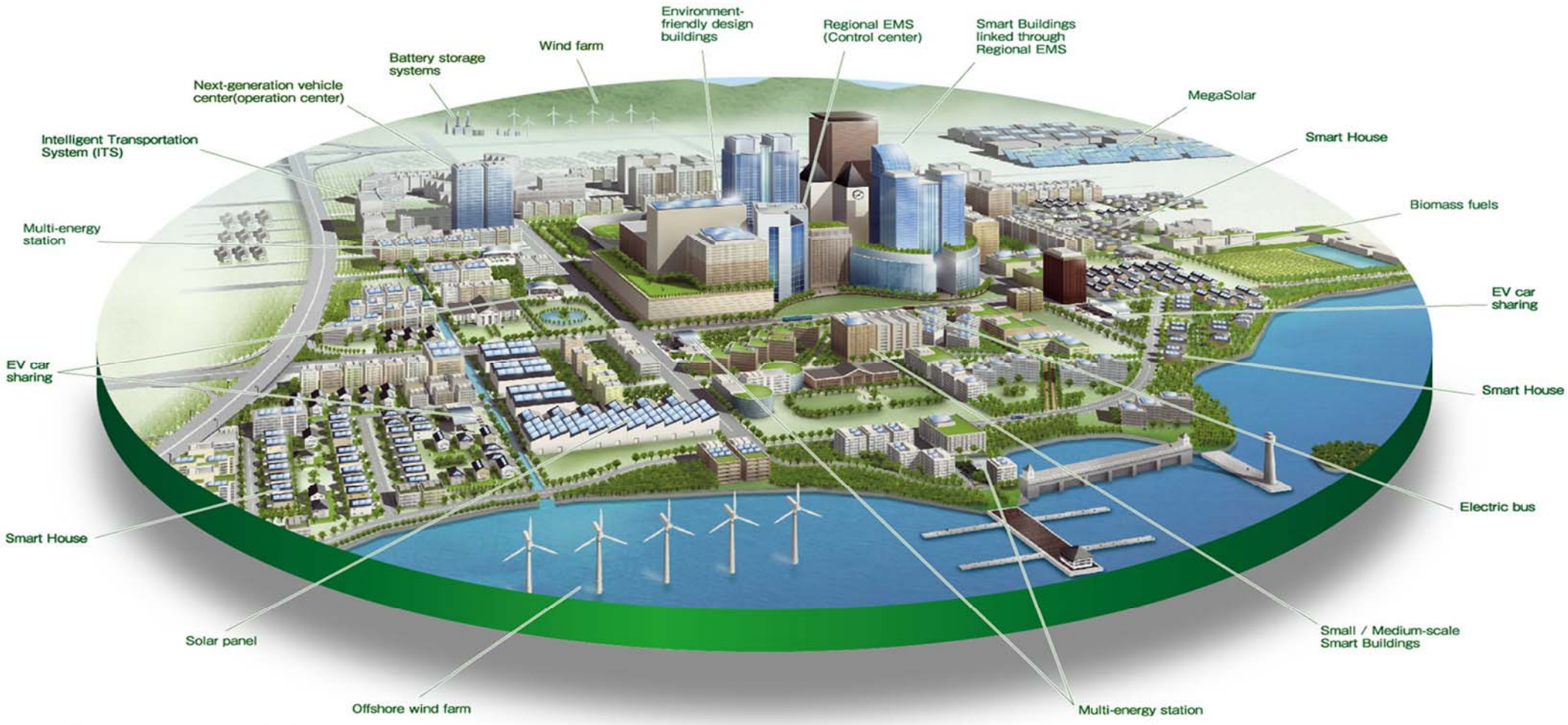
possiamo dire che

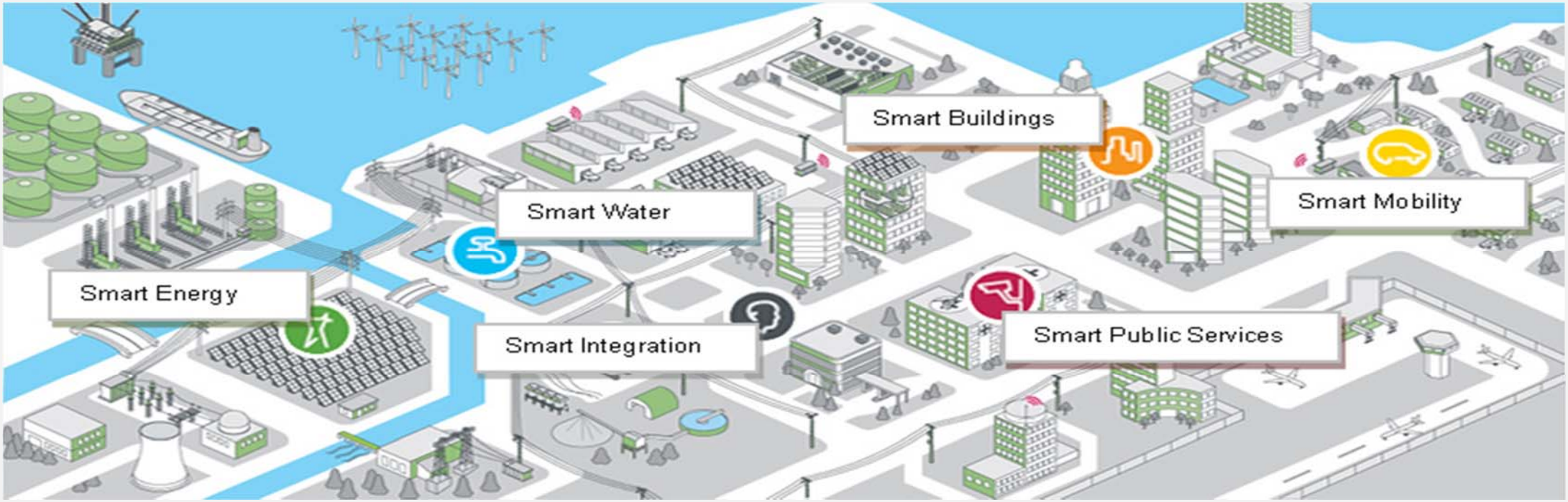
- *Gli utenti dovrebbero consumare la loro energia quando le industrie non lo fanno…*
- *Le auto elettriche dovrebbero essere ricaricate vicino alla generazione di energia*
- *Ora: vi sono 34 posti liberi in Piazza Stazione*
- *Ora: Il #4 arriva alla fermata in 3 minuti*

Relatore Paolo Nesi
Ordinario di Sistemi di elaborazione delle informazioni

Motivations

- **Societal challenge**
  - We see a strong increment of population of our cities, since in the cities the life is simple and of higher quality in term of services and working opportunities
  - The cities needs to be adapted to the increment of population, to new evolving ages, to the new technologies and expectations of population
- → Sustainability of the growth


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
Solar panel
Small / Medium-scale Smart Buildings
Offshore wind farm
Multi-energy station


Smart Buildings
Smart Water
Smart Mobility
Smart Energy
Smart Integration
Smart Public Services

Sustainability of the Growth

- To be **planned and managed** with respect to increment of population and their needs
  - increment of efficiency:
    - compensation of the increments of costs
  - Increment of quality of life:
    - compensation of the decrement of quality of life
  - provisioning of new services:
    - compensation of the inadequacy of 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

Smartness, smart city needs 6 features

- Smart Health
- Smart Education
- Smart Mobility
- Smart Energy
- Smart Governmental
  - Smart economy
  - Smart people
  - Smart environment
  - Smart living
- Smart Telecommunication

Smart health

(can be regarded as smart governmental)

- Online accessing to health services:
  - booking and paying
  - selecting doctor
  - access to EPR (Electronic Patient Record)
- **Monitoring** services and users for,
  - learn people behavior, create collective profiles
  - personalized health
  - Inform citizens to the risks of their habits
  - Improve efficiency of services
  - redistribute workload, thus reducing the peak of consumption

Smart Education

(can be regarded as smart governmental)

- Diffusion of ICT into the schools:
  - LIM, PAD, internet connection, tables, ..
- Primary and secondary schools → university → industry & services
- **Monitoring** the students and quality of service,
  - learn student behavior, create collective profiles,
  - personalized education
- suggesting behavior to
  - Informing the families
  - moderate the peak of consumption
  - increase the competence in specific needed sectors, etc.
  - Increase formation impact and benefits

Smart Mobility

- Public transportation:
  - bus, railway, taxi, metro, etc.,
- Public transport for services:
  - garbage collection, ambulances,
- Private transportation:
  - cars, delivering material, etc.
- New solutions (public and/or private):
  - electric cars, car sharing, car pooling, bike sharing, bicycle paths
- Online:
  - ticketing, monitoring travel, infomobility, access to RTZ, parking, etc.

Smart Mobility and urbanization

- **Monitoring** the city status,
  - learn city behavior on mobility
  - learn people behavior
  - create collective profiles
  - tracking people flows
- **Providing Info/service**
  - personalized
  - **Info** about city status to
  - help moving people and material
  - education on mobility,
  - moderate the peak of consumption
- **Reasoning to**
  - make services sustainable
  - make services accessible
  - Increase the quality of service

Smart Energy

- **Smart building:**
  - saving and optimizing energy consumption, district heating
  - renewable energy: photovoltaic, wind energy, solar energy, hydropower, etc.
- **Smart lighting**:
  - turning on/off on the basis of the real needs
- **Energy points for electric**: c
  - ars, bikes, scooters,
- **Monitoring** consumption, learn people/city behavior on energy consumption, learn people behavior, create collective profiles
- Suggesting consumers
  - different behavior for consumption: different time to use the washing machine
- Suggesting administrations
  - restructuring to reduce the global consumption,
  - moderate the peak of consumption

Smart Governmental Services

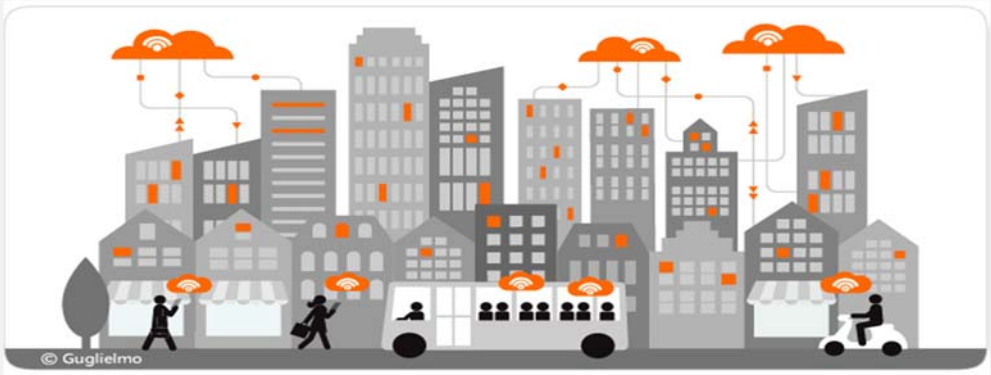
- Service toward citizens:
  - on-line services:
    - register, certification, civil services, taxes, use of soil, …
  - Payments and banking:
    - taxes, schools, accesses
  - Garbage collection:
    - regular and exceptional
  - Quality of air:
    - monitoring pollution
  - Water control:
    - monitoring water quality, water dispersion, river status

Smart Governmental Services

- **Service toward citizens**:
  - **Cultural Heritage**: ticketing on museums,
  - **Tourism**: ticketing, visiting, planning, booking (hotel and restaurants, etc.)
  - **social networking:** getting service feedbacks, monitoring
- **Social sustainability of services**:
  - crowd services
- **Social recovering** of infrastructure,
  - New services, exploiting infrastructures
- **Monitoring** consumption and exploitation of services, learn people behavior, create collective profiles
  - Discovering problems of services,
  - Finding collective solutions and new needs…

Telecommunication, broadband

- **Fixed Connectivity**:
  - ADSL or more, fiber,
- **Mobile Connectivity**:
  - Public wifi, Services on WiFi, HSPDA, LTE
- **Monitoring** communication infrastructure
- Providing information and formation on:
  - how to exploit the communication infrastructure
  - Exploiting the communication for the other services,
  - moderate the peak of consumption



Smart-City

- ***Main Aim***
  - Provide a platform able to ingest and take advantage a large number of the above data, big data:
    - ***Exploit data integration and reasoning***
    - ***Deliver new services and applications to citizens,***
      Leverage on the ongoing Semantic Web effort
- ***Problems & Challenges***
  - Data are provided in many different formats and protocols and from many different institutions, different convention and protocols, a different time, …. !
  - Data are typically not aligned (e.g., street names, dates, geolocations, tags, …). That is, they are n**ot semantically interoperable**
  - resulting a big data problem: volume, velocity, variability, variety, …..

Challenges: Requests and Deductions

Public Admin.

Pub. Admin: detection of critical conditions, improving services

Mobility Operators

Tune the service, reselling data and services , prediction

Retails

Commercial: customers prediction and profiles, promotions via ads

Tourism Museums

Tune the service, prediction

API for SME

Smart City Solution

User profiling
Collective profiles
User segmentation

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

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

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, ..

0 – Km4City Open Urban Platform Overview

www.Km4City.org

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KM 4 CITY

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KM4CITY FROM DATA TO SERVICES FOR SENTIENT CITIES

Home | Sentient City Control Room | City Users' Tools | Back Office and Dev Tools | Info and Docs

Km4City Open Urban Platform

- **Produce value from data enabling** to
  - ***Stimulate virtuous behavior, influence City Users!***
  - Increase efficiency in energy consumption
  - Reduce pollution and traffic congestion
  - Improve quality of service, quality of life
  - Create an ecosystem for innovation and punt in action any smart city solutions and services.
- **Perform integrated and unified data management and data analytics by a set of tools at service of city operators and city users, to**:
  - ***Perform predictions***, reasoning, business intelligence, city users behavior analysis, ..;
  - ***Control Room, Real Time Monitoring*** tools, ….
- **Aggregate & integrate data and streams of any urban system, operator, provider, user, ..**, exploiting
  - open data, IOT, sensors, internet of everything,
  - cloud, mobile devices, Wi-Fi, social media,
  - ; data analytics, ecc;


1 - Keep City under Control: services and users' behavior

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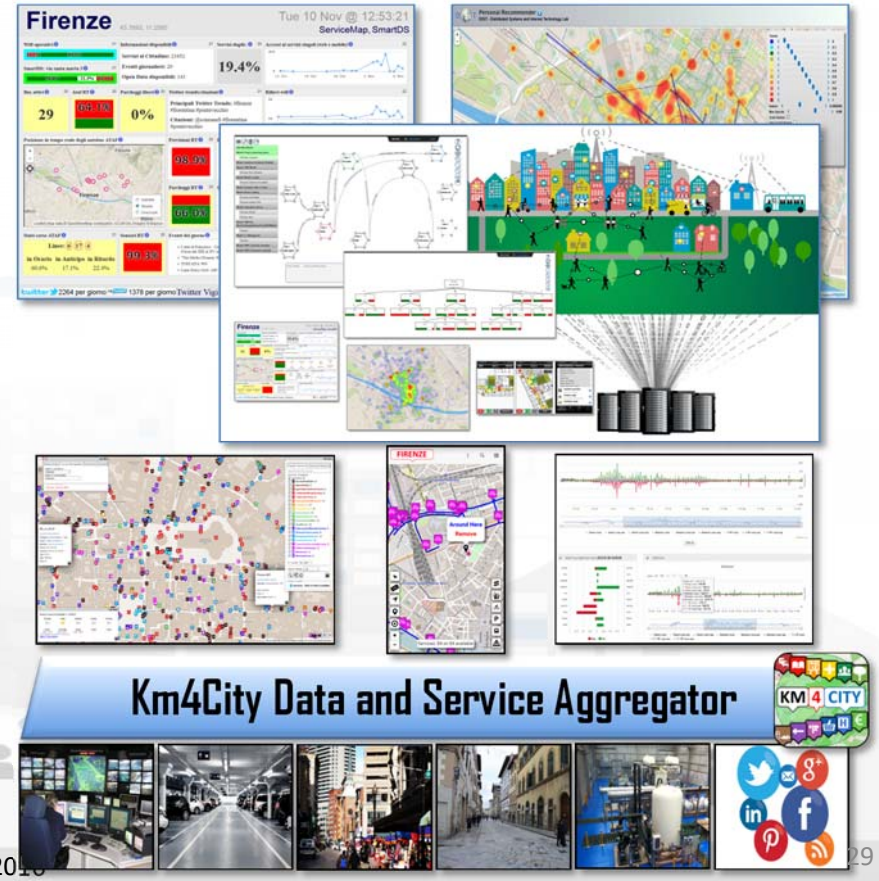
From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

1. keep city under control via personalized dashboards
   - transform data in value for the city,
   - influence city users
2. Technical details:
   - dashboard development
   - data aggregation
   - Projects contributing
3. improve city resilience, reducing risks and decision support

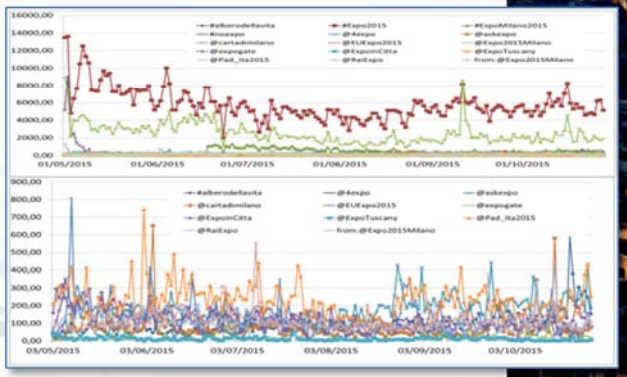


Sentient City Control Room

www.Km4City.org

city under control

- **monitoring services' status** of city operators
  - **Smart City Dashboards**
  - **Continuous Business Intelligence**
- **City users behaviour monitoring and analysis/influencing/engaging:**
  - **Sensors, traffic flow, people flows, mobiles, sensors, IOT, IOE**
  - **Wi-Fi, Tv-Cameras**
- **City users participation**
  - **social media** for city services and events, **Twitter Vigilance**
  - **Collecting contributions**: images, stars, comments



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Dashboards

Transport systems, Mobility, Parking

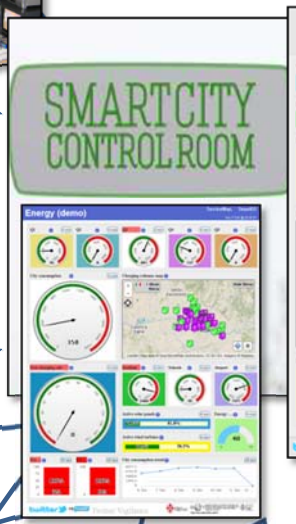
Sensors, IOT Cameras, ..

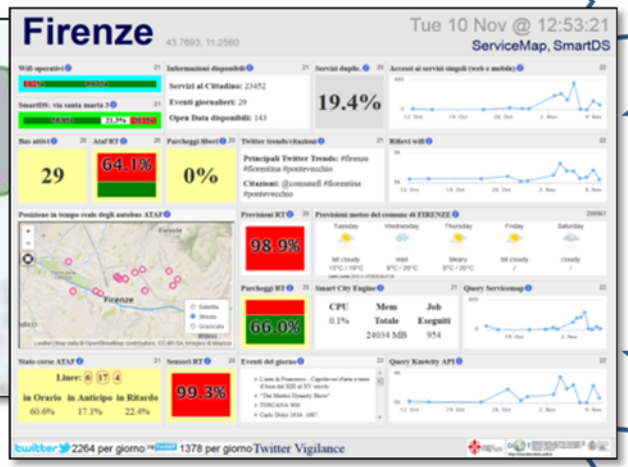
Public services, Govern, Events

Environment, Water, energy

Social Media, WiFi, Network

Shops, services, operators





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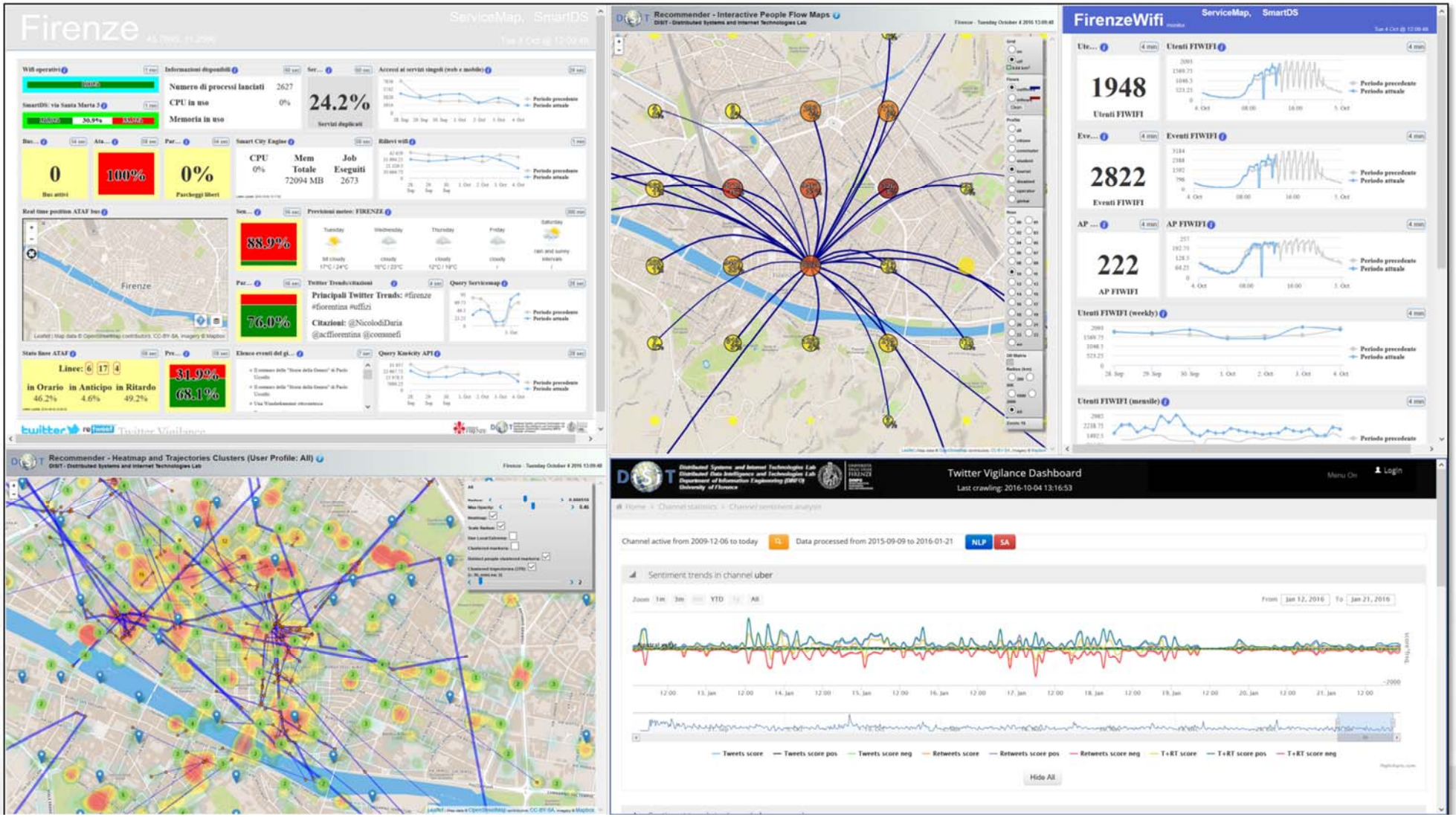
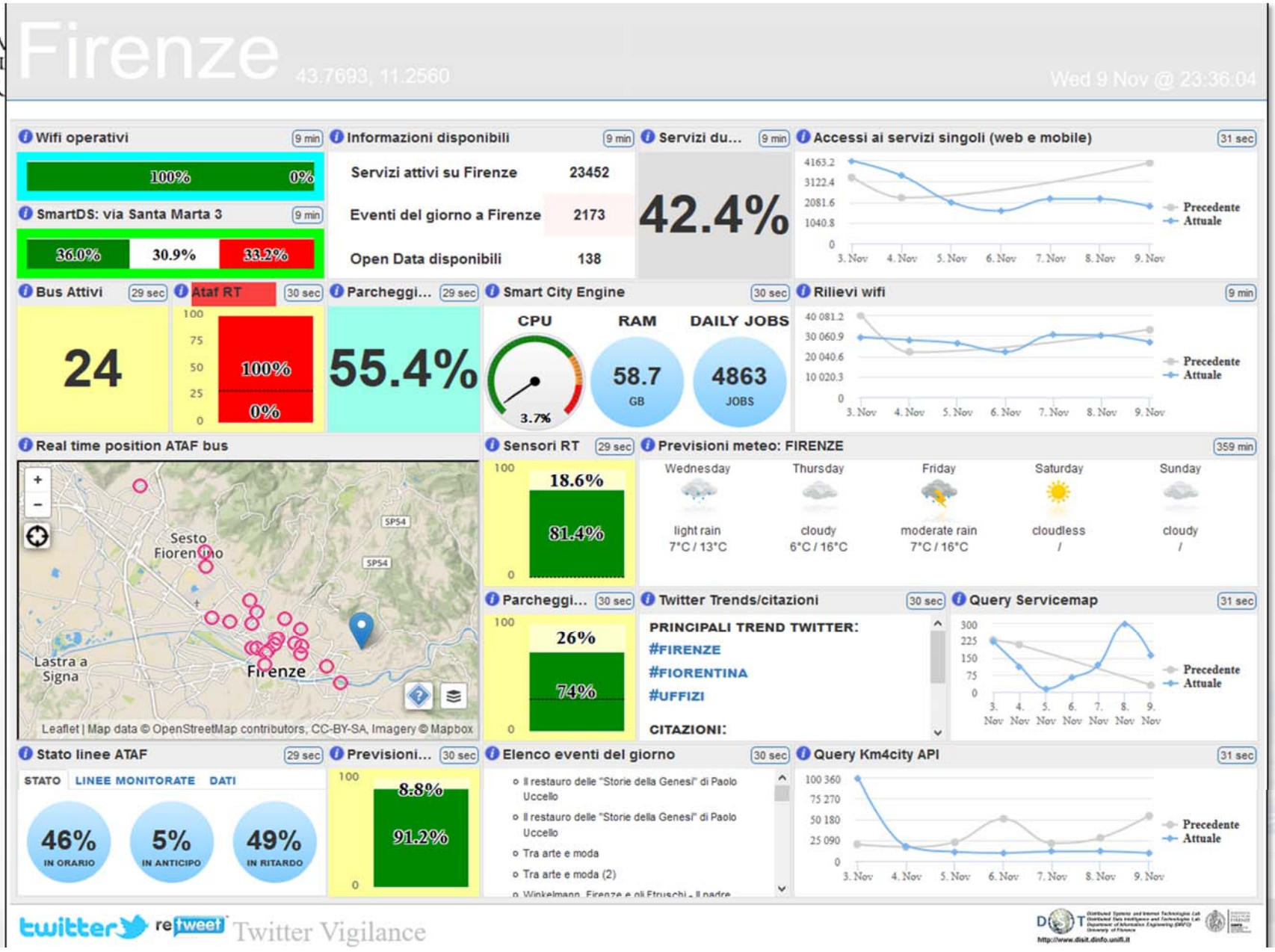
Smart City Dashboard




Firenze
43.7693, 11.2560
Wed 9 Nov @ 23:36:04
Wifi operativi
9 min
100%
0%
SmartDS: via Santa Marta 3
9 min
36.0%
30.9%
33.2%
Informazioni disponibili
9 min
Servizi attivi su Firenze
23452
Eventi del giorno a Firenze
2173
Open Data disponibili
138
Servizi du...
9 min
42.4%
Accessi ai servizi singoli (web e mobile)
31 sec
4163.2
3122.4
2081.6
1040.8
0
3. Nov
4. Nov
5. Nov
6. Nov
7. Nov
8. Nov
9. Nov
Precedente
Attuale
Bus Attivi
29 sec
24
Ataf RT
30 sec
100
75
50
25
0
100%
0%
Parcheggi...
29 sec
55.4%
Smart City Engine
30 sec
CPU
RAM
DAILY JOBS
3.7%
58.7
GB
4863
JOBS
Rilievi wifi
9 min
40 081.2
30 060.9
20 040.6
10 020.3
0
Precedente
Attuale
Real time position ATAF bus
Sesto Fiorentino
Lastra a Signa
Firenze
SP54
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox
Sensori RT
29 sec
100
18.6%
81.4%
0
Previsioni meteo: FIRENZE
359 min
Wednesday
light rain
7°C / 13°C
Thursday
cloudy
6°C / 16°C
Friday
moderate rain
7°C / 16°C
Saturday
cloudless
/
Sunday
cloudy
/
Parcheggi...
30 sec
100
26%
74%
0
Twitter Trends/citazioni
30 sec
PRINCIPALI TREND TWITTER:
#FIRENZE
#FIORENTINA
#UFFIZI
CITAZIONI:
Query Servicemap
31 sec
300
225
150
75
0
3. Nov
4. Nov
5. Nov
6. Nov
7. Nov
8. Nov
9. Nov
Precedente
Attuale
Stato linee ATAF
29 sec
STATO
LINEE MONITORATE
DATI
46%
IN ORARIO
5%
IN ANTICIPO
49%
IN RITARDO
Previsioni...
30 sec
100
8.8%
91.2%
0
Elenco eventi del giorno
30 sec
Il restauro delle "Storie della Genesi" di Paolo Uccello
Il restauro delle "Storie della Genesi" di Paolo Uccello
Tra arte e moda
Tra arte e moda (2)
Winkelmann. Firenze e gli Etruschi - Il padre
Query Km4city API
31 sec
100 360
75 270
50 180
25 090
0
3. Nov
4. Nov
5. Nov
6. Nov
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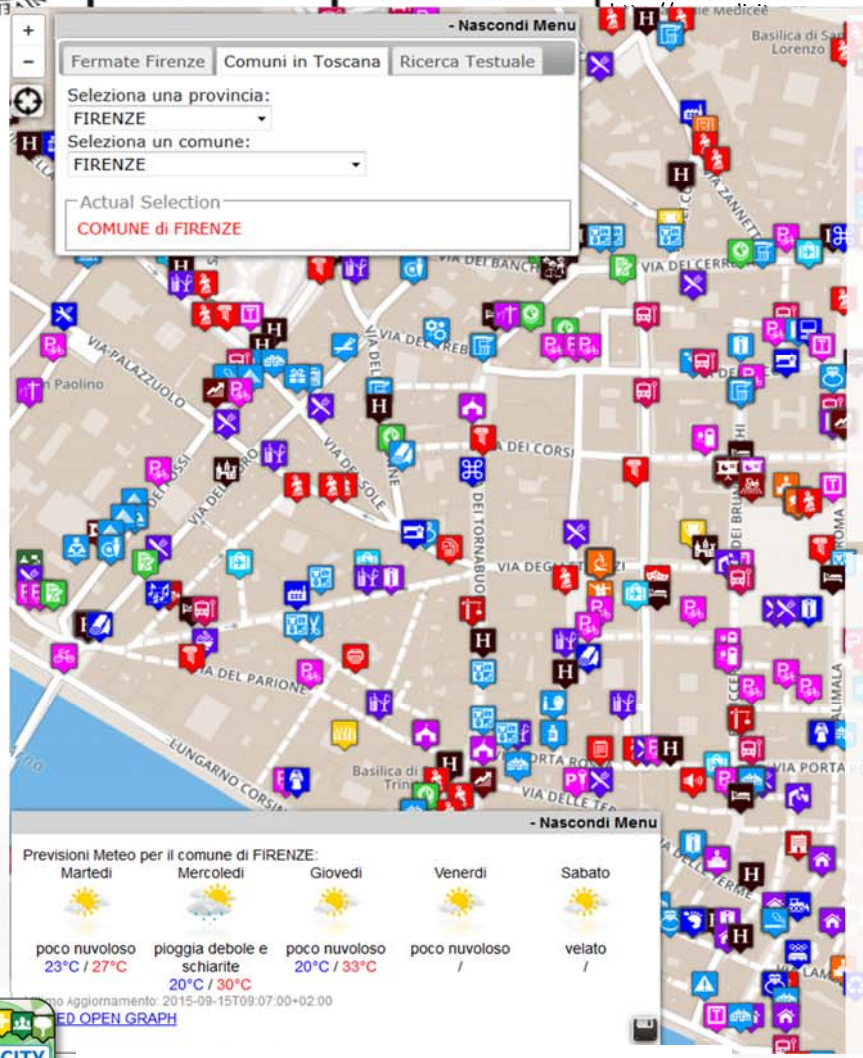
Precedente
Attuale
twitter
retweet
Twitter Vigilance
http://www.disit.dinfo.unifi.it



Road Graph (Tuscany region)

- 132,923 Roads
- 389,711 Road Elements
- 318,160 Road Nodes
- 1,508,207 Street Numbers

Services (20 cat, 512 cat.)
16 Pub. Transport Operators
21.280 Bus stops & 1081 bus lines
210 Parking areas
796 Traffic Sensors
Info on: points, paths, areas, etc.

Dynamic/real-time

- **bus lines: 144 updates X day X line**
- **parking status: 76 updates X day X sensor**
- **traffic Sensors: 288 updates X day X sensor**
- **weather: 2 updates X day for 285 areas**
- **events: about 60 new events X day**
- **Wi-Fi: > 350.000 measures X day**
- **mobiles: > 50.000 measures X day**
- **more than 35.000 distinct users X day**
- **From 600.000 to 4.5 M Tweets X day**
- **……many other sensors …. see next slide**

KM 4 CITY

http://servicemap.km4city.org

Other Sensors and Actuators, IOT

- Restricted Traffic Zone Gates
  - Passages, payment, alerts, Wi-Fi control, RFI control, etc.
- Road Direction manager: panel, red-light, etc.
  - Status and action
- Environmental Sensors:
  - Air quality, pollution, rain, allergens, temperature,
  - humidity,…
- Public Light Pillar
  - Traffic flows, environment,
  - Wi-Fi, Tv-Camera, BT servers, on/off, percentage of light, ..
- Waste Manager
  - Level, kind, status, on/off
- Recharge station, column
  - Free slots, consumption, next time slot, …

- **Environmental Sensors**:
  - Air, temperature, humidity,
  - water level in rivers
  - Status of underpass and bridges
- **Risk assessment**
  - Value of the buildings,
  - hydrogeological risk map,
  - earthquake risk map, …
  - people distribution and location
  - Position of recover places,
- **Traffic Zone Gates**
  - Passages, alerts,
  - Wi-Fi control,
  - RFID control,
  - etc.

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city under control

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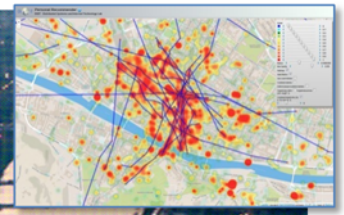
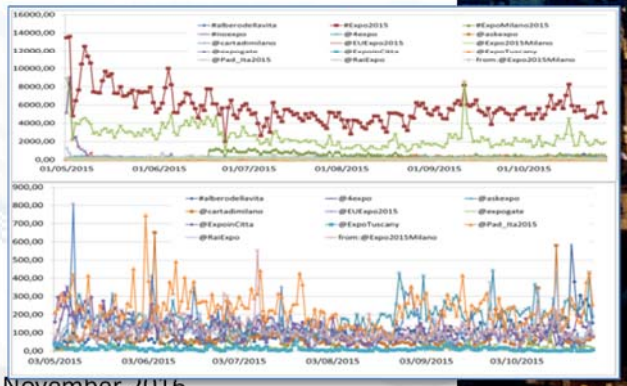
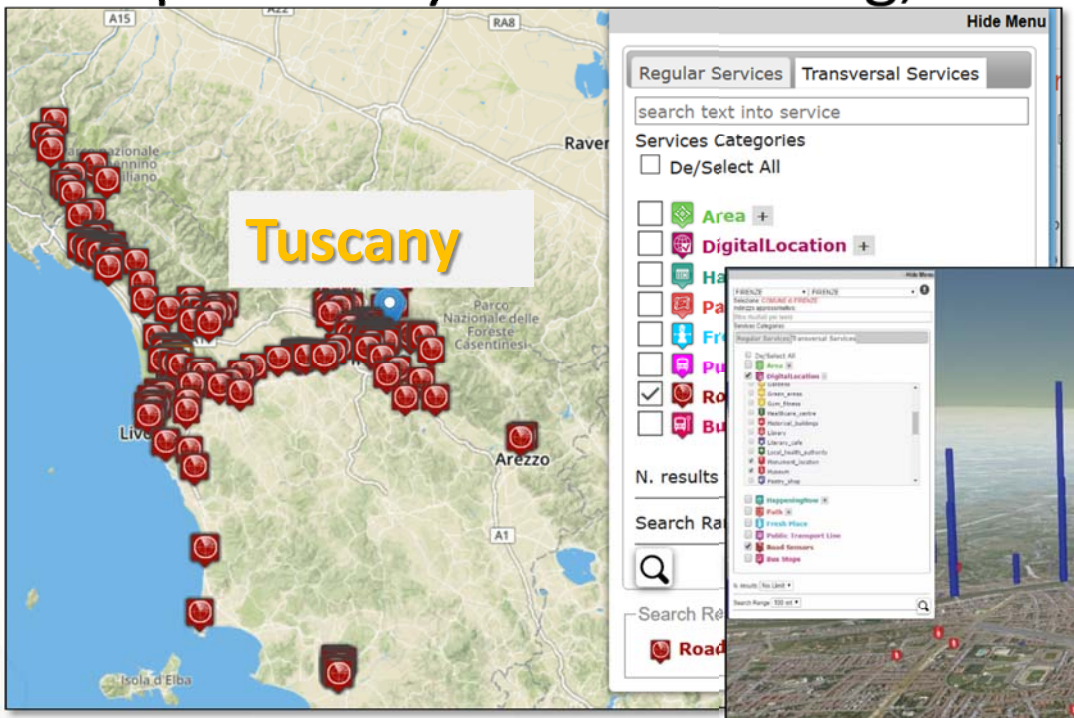
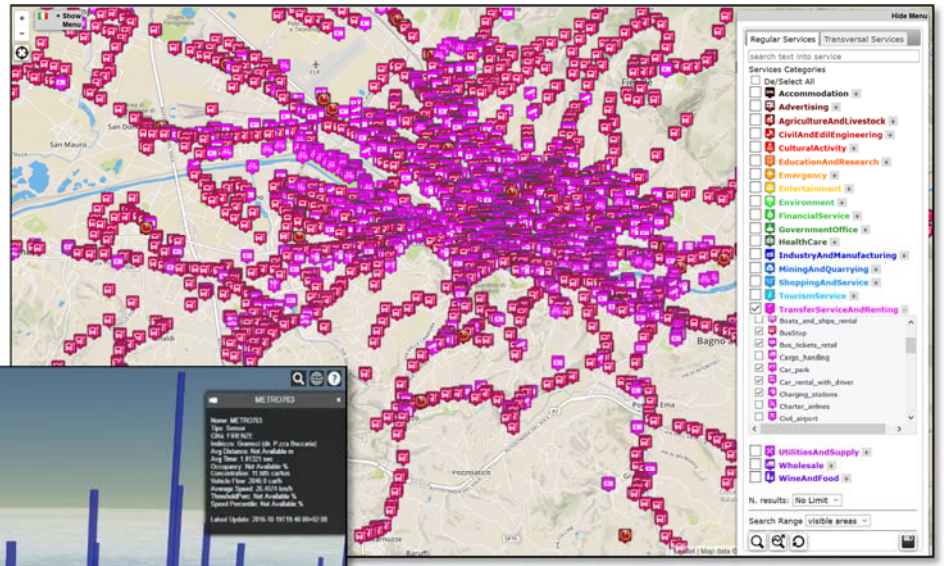


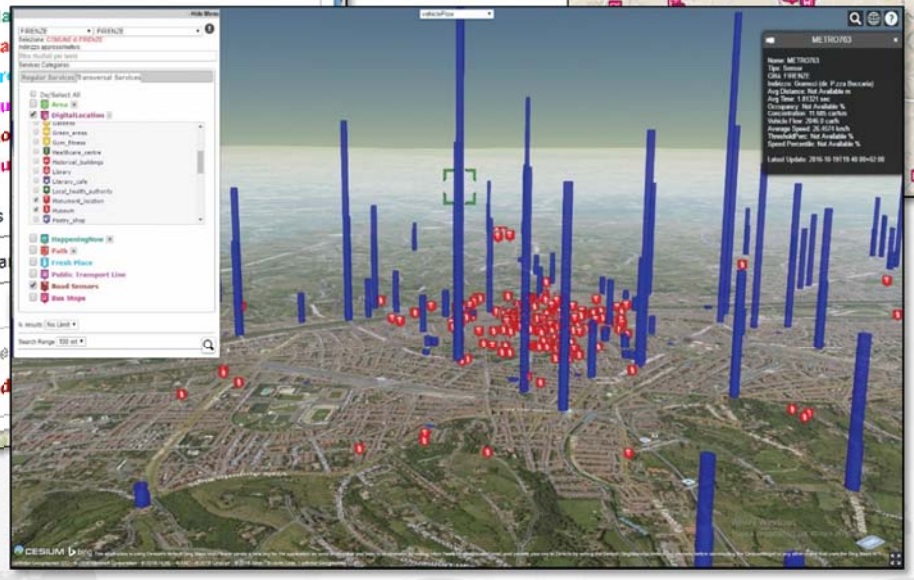


Traffic Flow Tools

- Spire and Virtual Spires (cameras), Bluetooth, ..
- Specifically located: along, around, ..

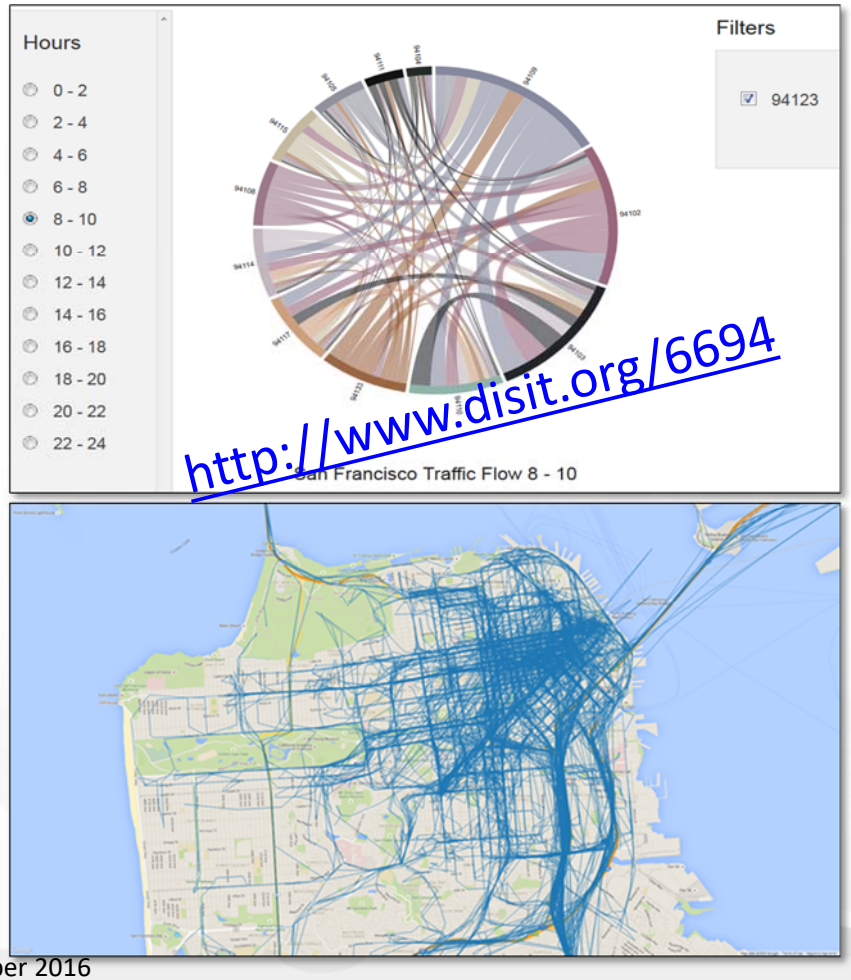






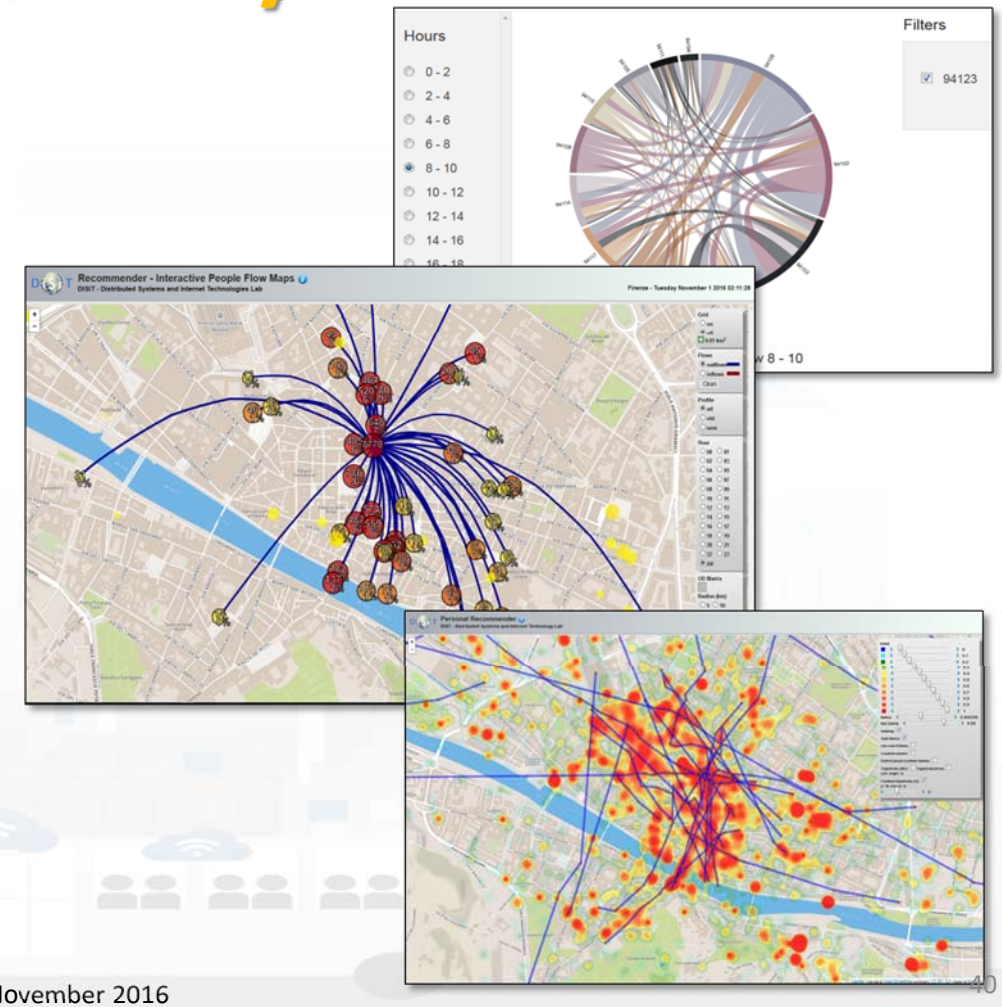
Traffic and People Flow Assessment

- **Origin Destination Matrix**
  - Specific Sensors, vehicle Kits, mobile App, Wi-Fi Access Points, etc.
- **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



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



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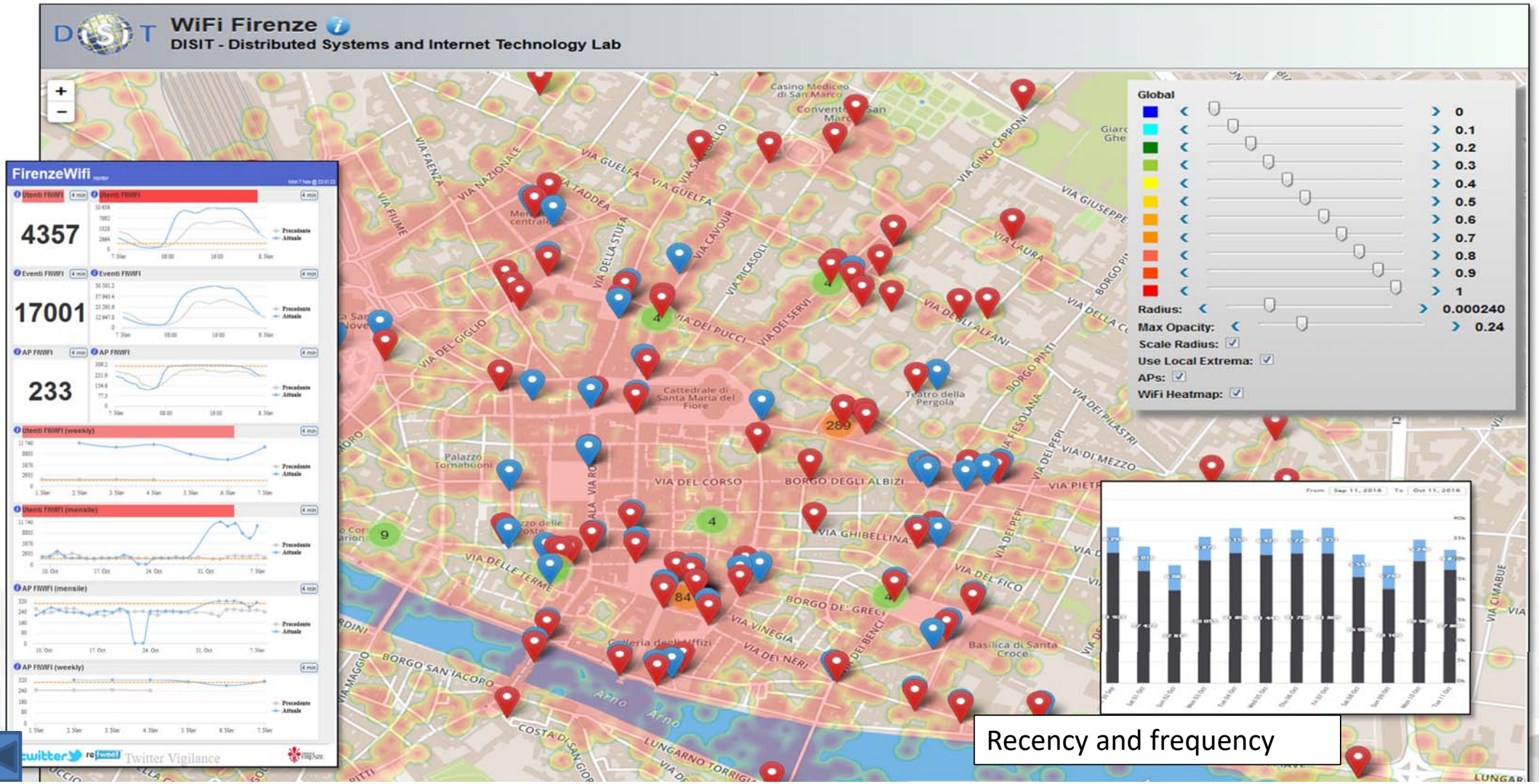
WiFi Monitor tool



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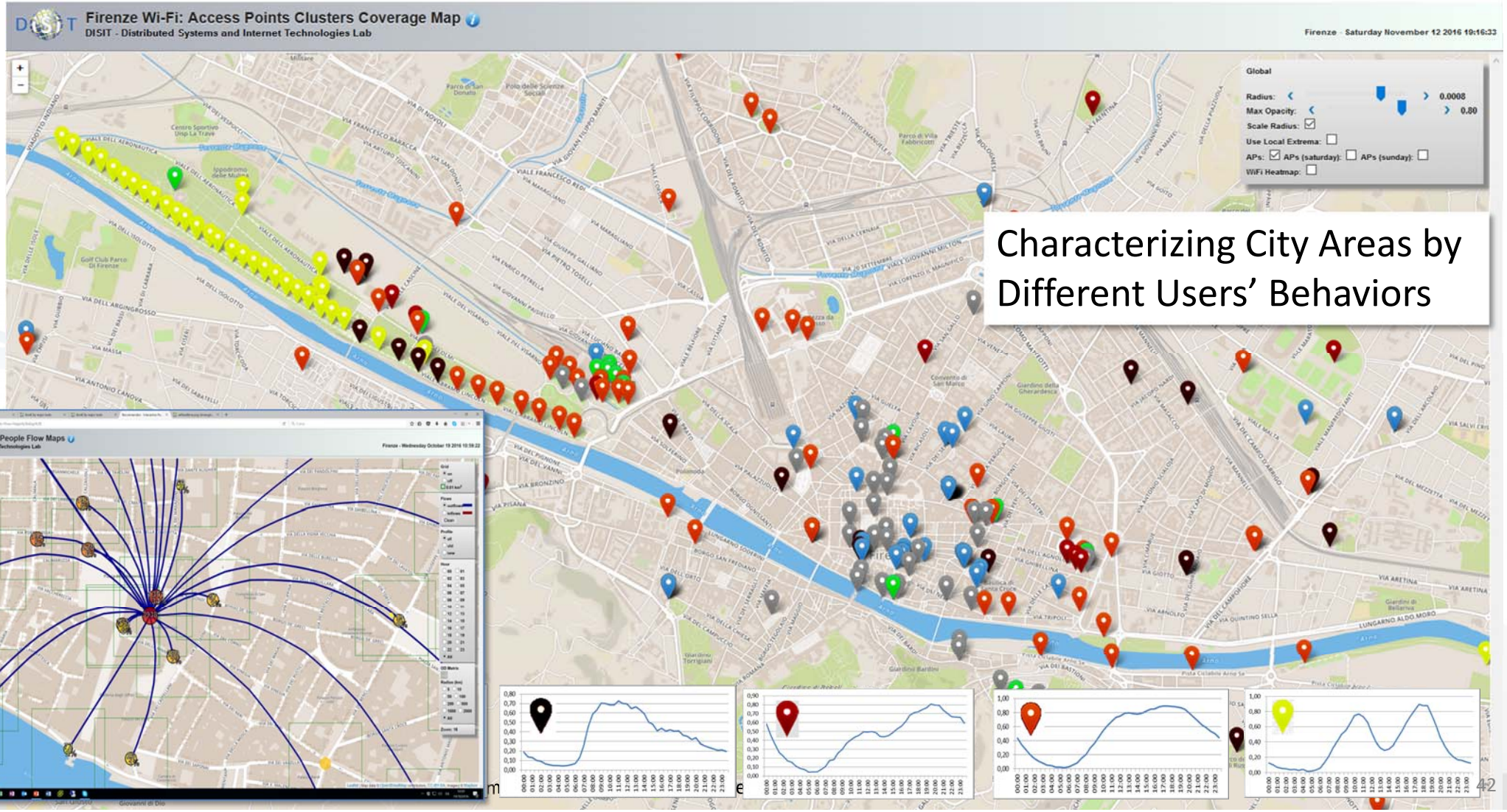
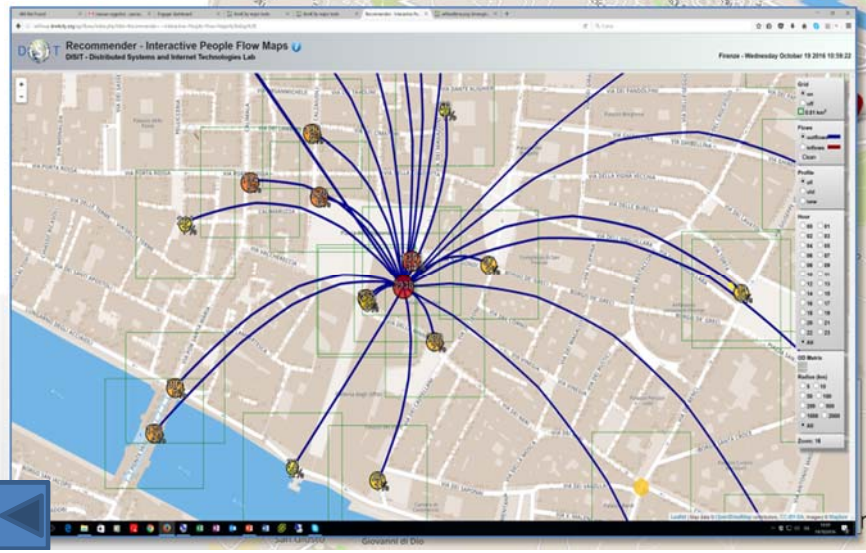
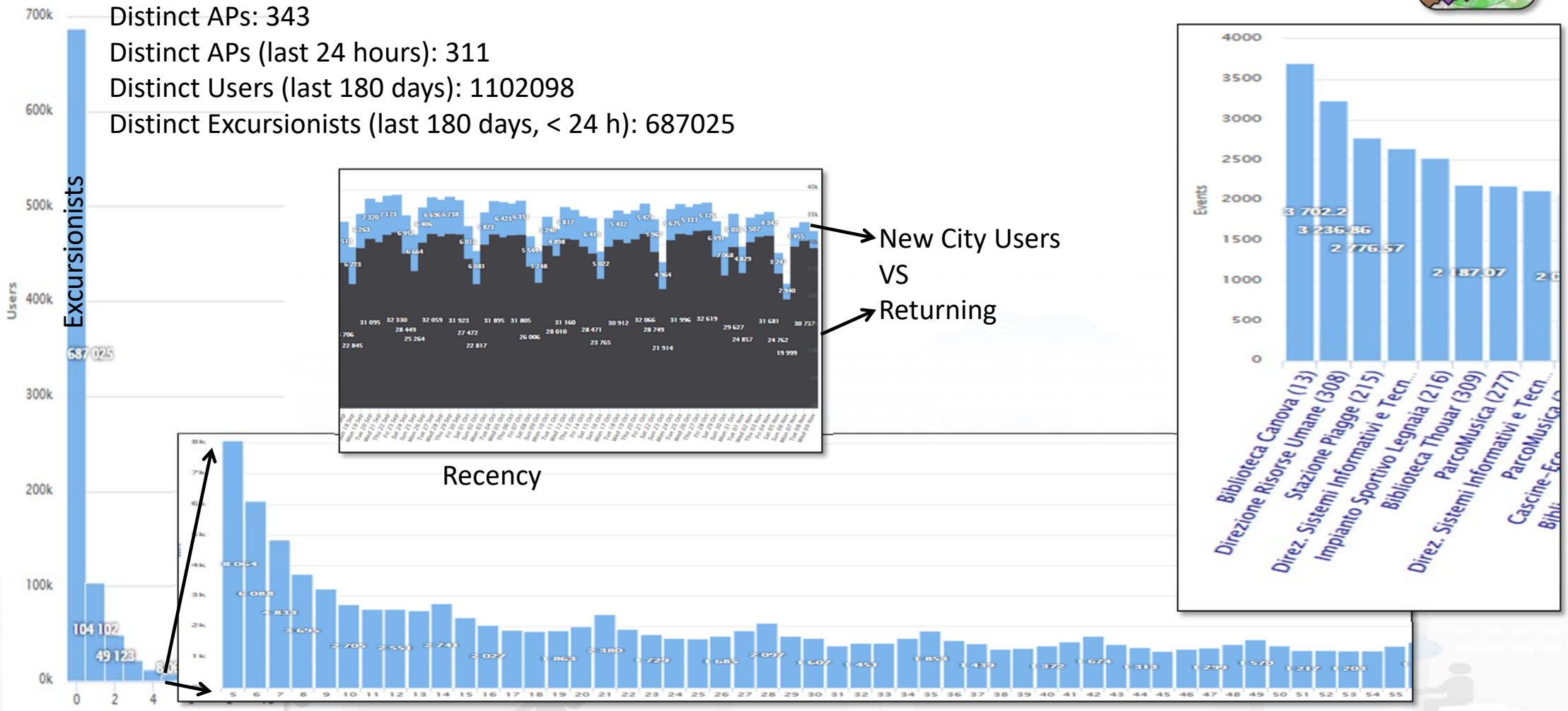
Characterizing City Areas





User Behavior Analysis



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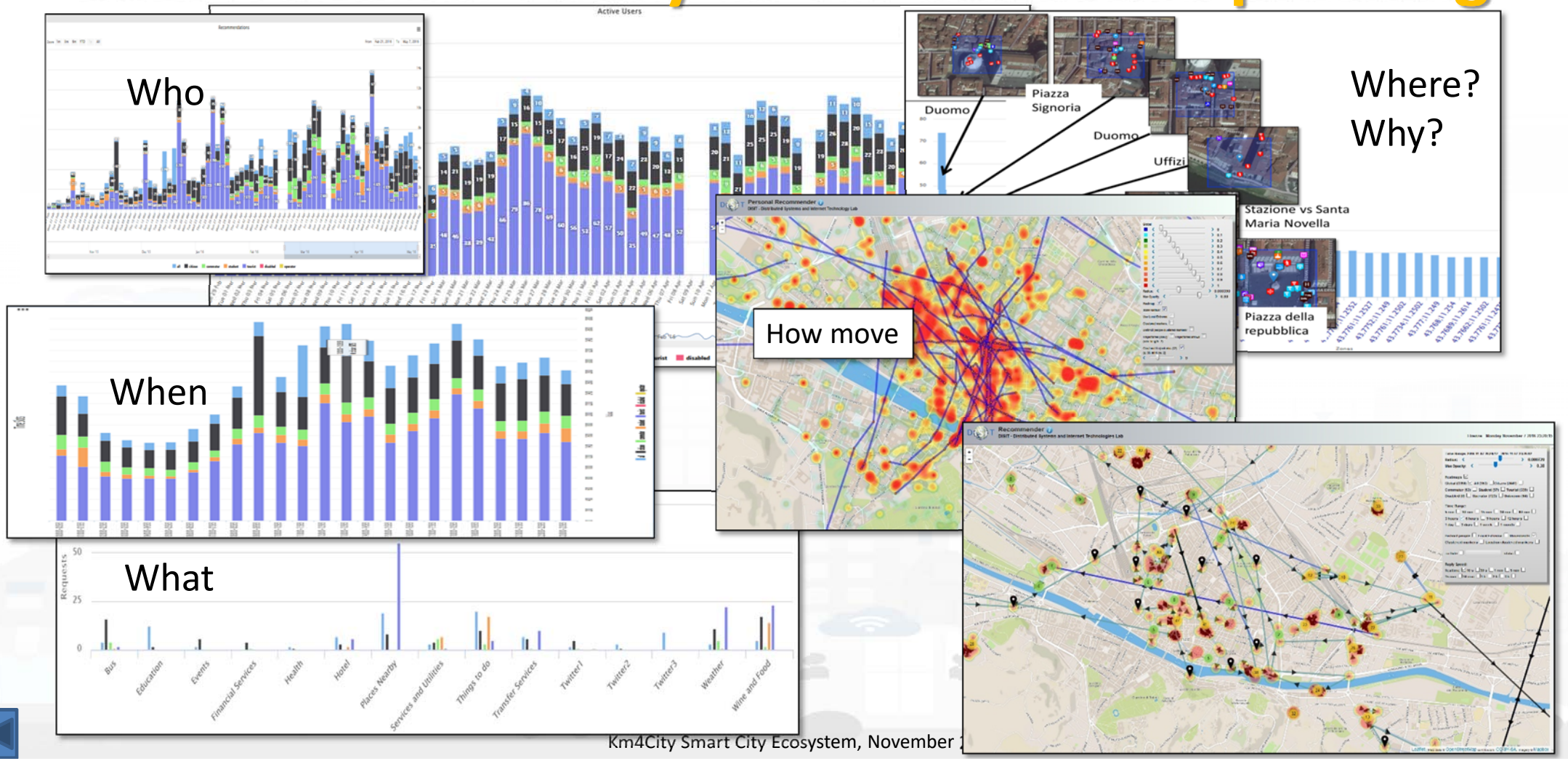
KM 4 CITY

User Behavior Analyzer for Collective profiling



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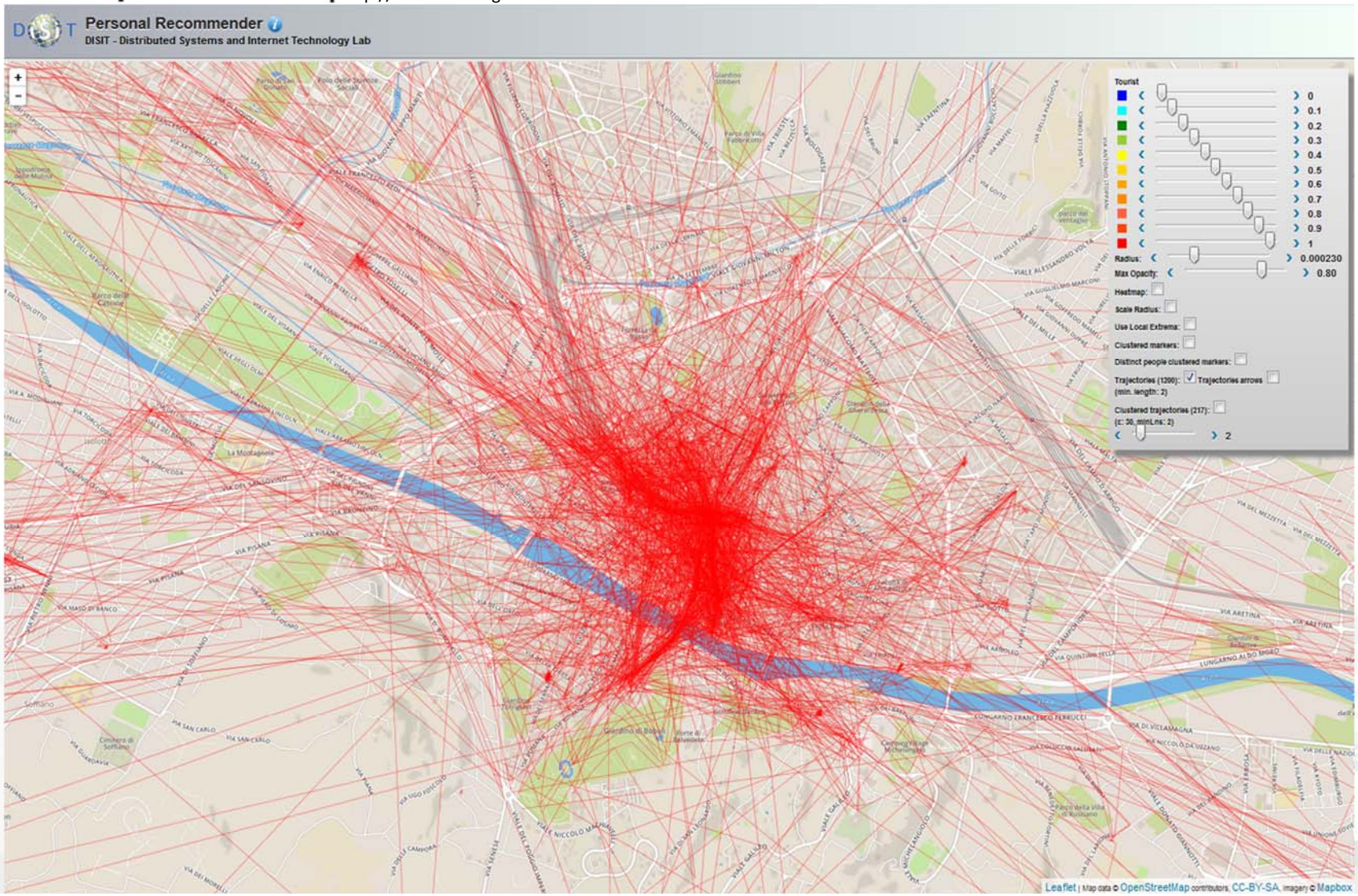
User Behavior Analyzer



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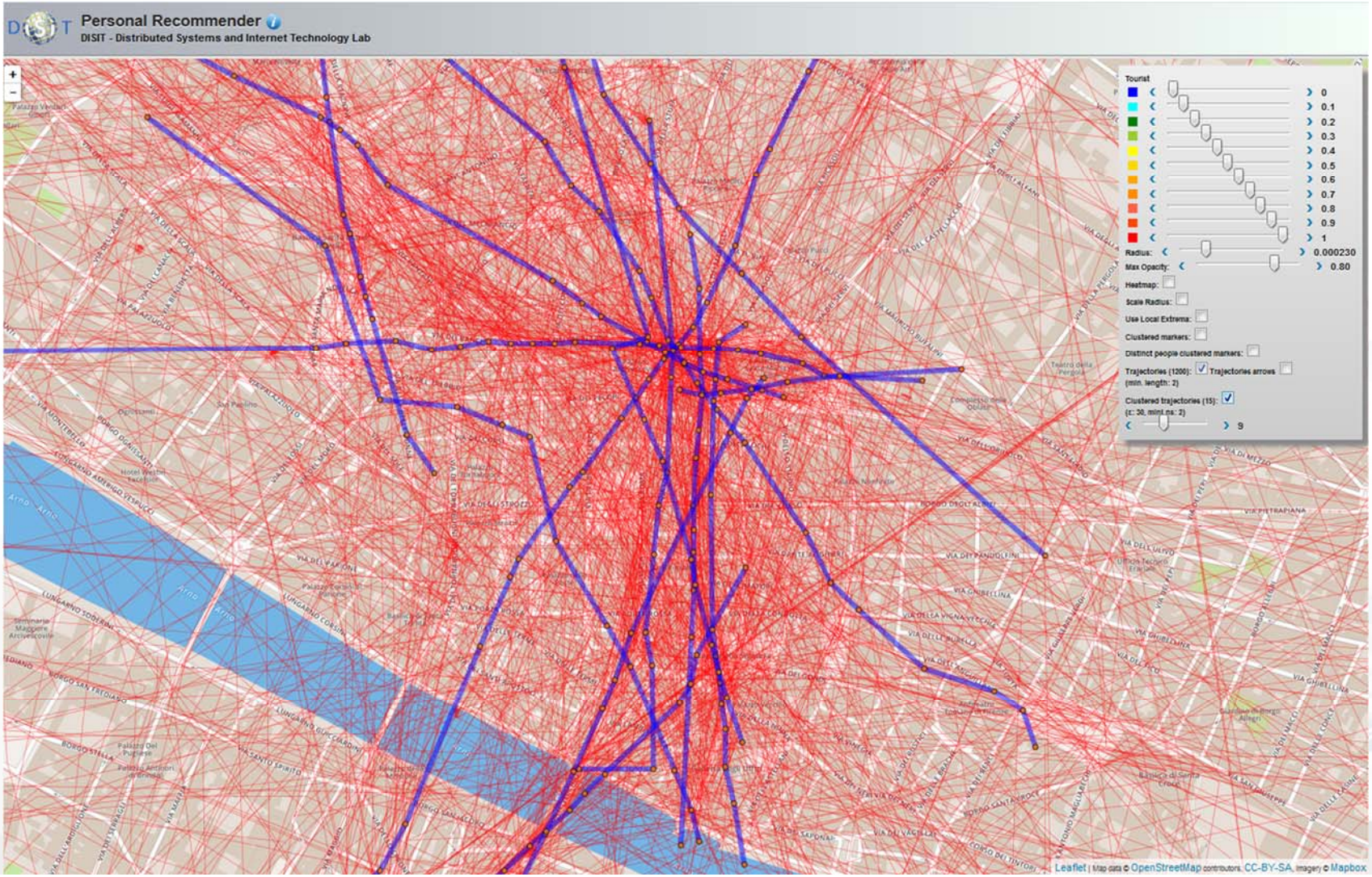
User Behavior Analyzer



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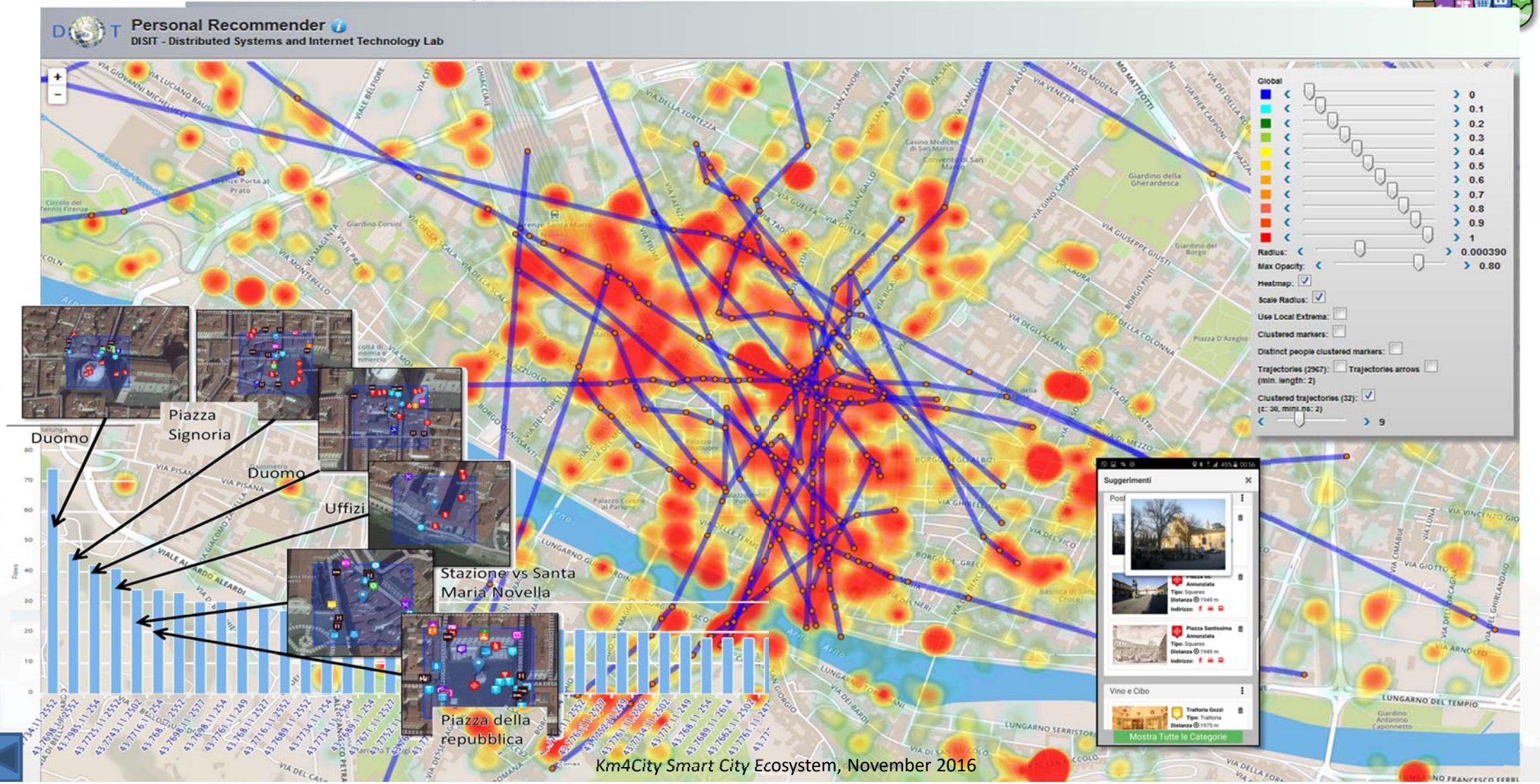
User Behavior Analyzer



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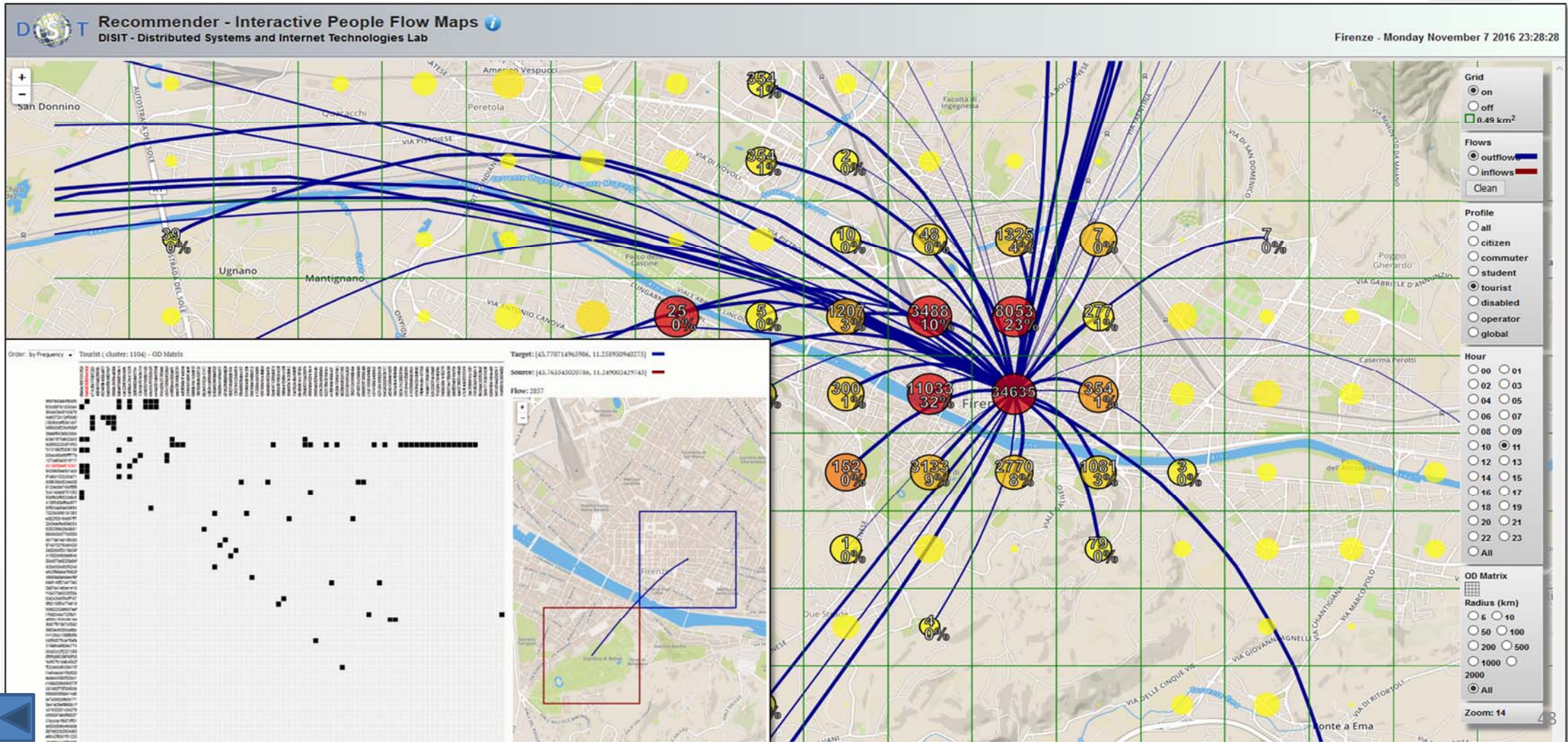
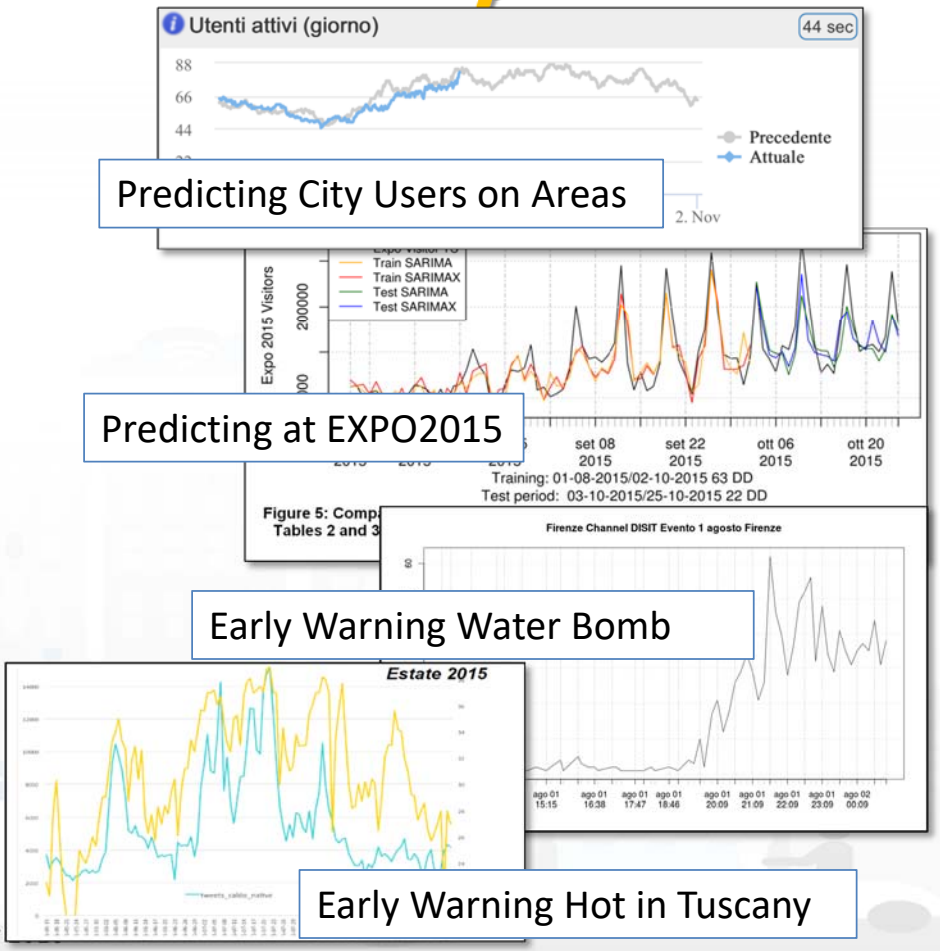
OD Matrix scalabile



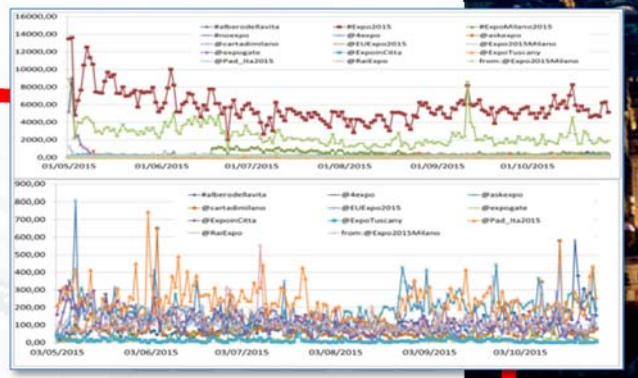
Predicting Models for Admin. & City Users

- Aiming at improving
  - quality of service,
  - distributing workload
  - early warning
- Traffic Flows & People Flows
  → crowd , #number of people
- Parking Status → free slots
- Weather Forecast (LAMMA)



city under control

- **monitoring services' status** of city operators
  - **Smart City Dashboards**
  - **Continuous Business Intelligence**
- **City users behaviour monitoring and analysis/influencing/engaging:**
  - **Sensors, traffic flow, people flows, mobiles, sensors, IOT, IOE**
  - **Wi-Fi, Tv-Cameras**
- **City users participation**
  - **social media** for city services and events, **Twitter Vigilance**
  - **Collecting contributions**: images, stars, comments



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Km4CityMobile App

web application

http://www.km4city.org

DISPONIBILE SU Google play

Scarica da App Store

Scarica da Windows Store

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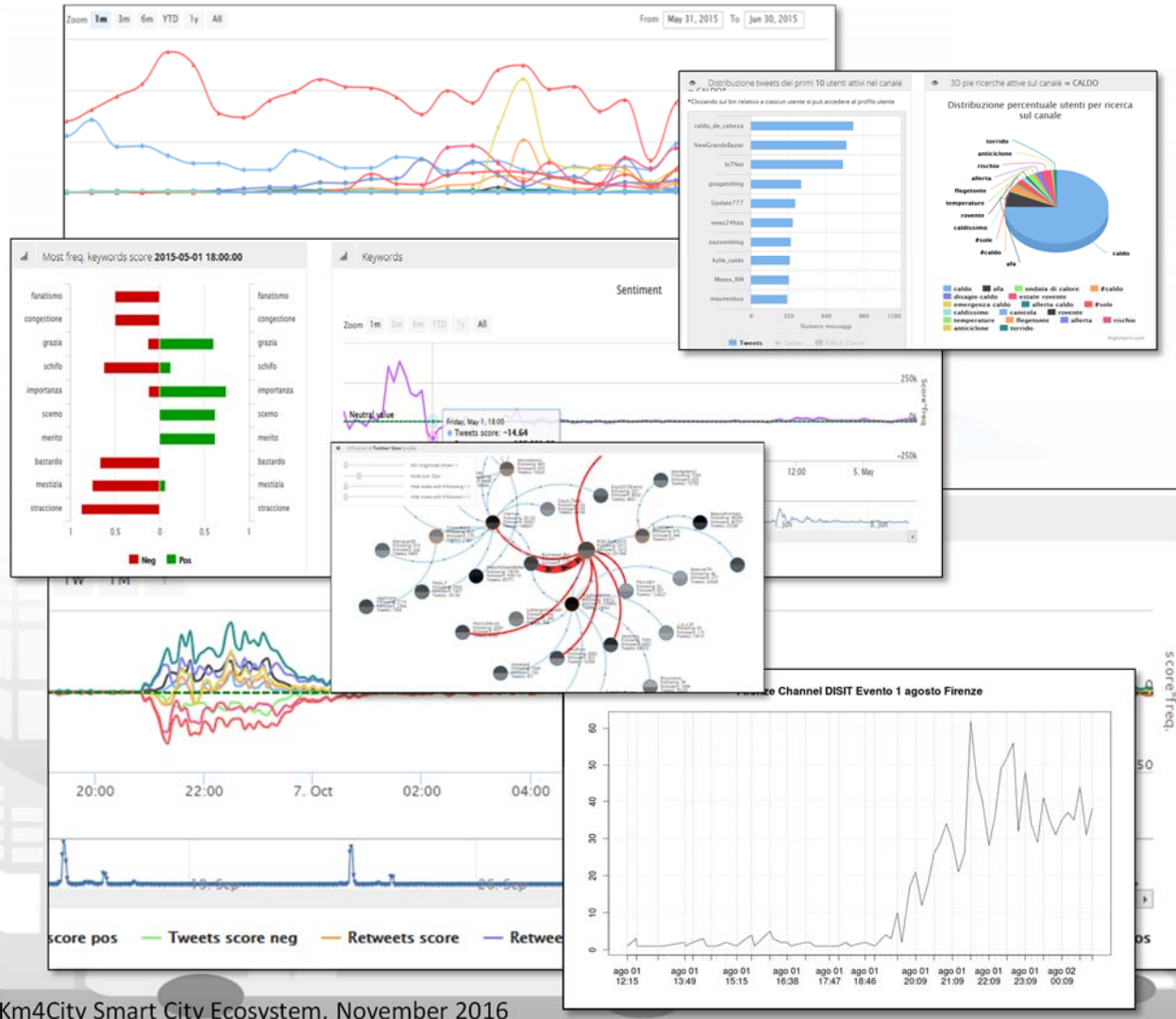
Twitter Vigilance

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



Twitter Vigilance

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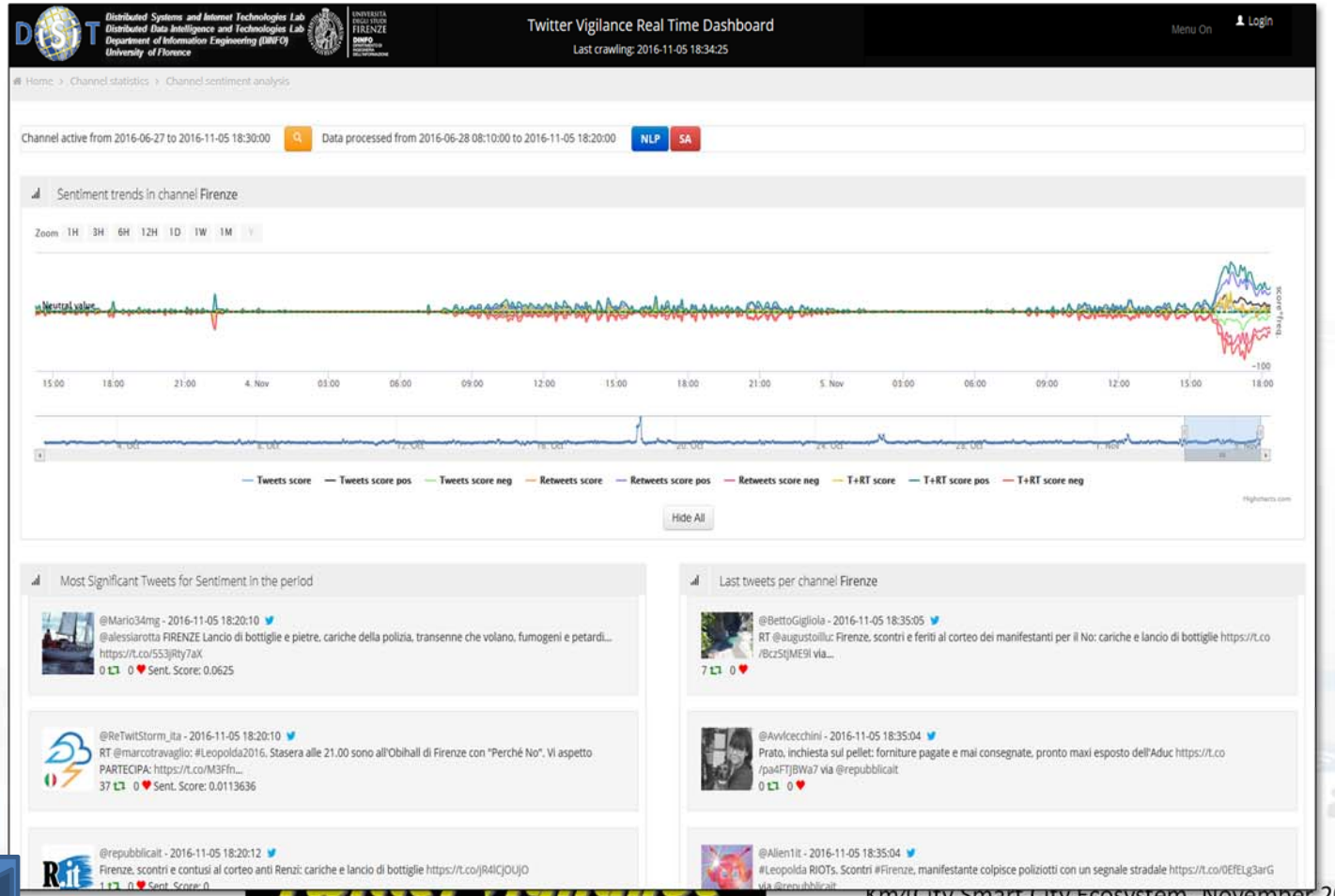
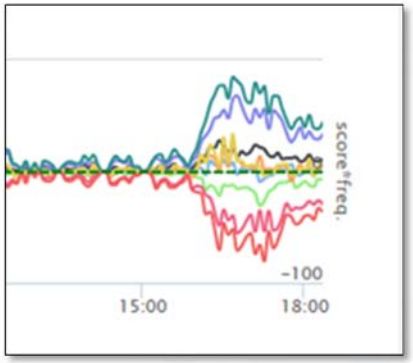
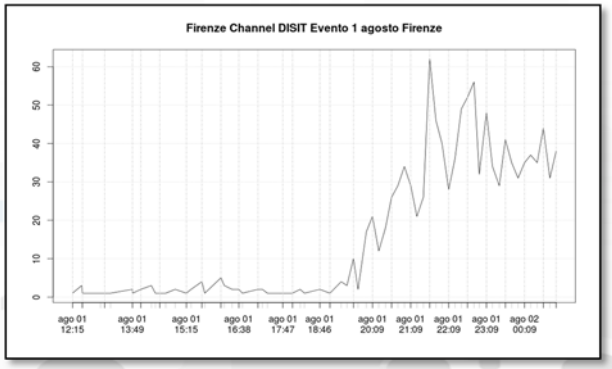
Twitter Vigilance

Real Time Twitter Vigilance, Early Warning



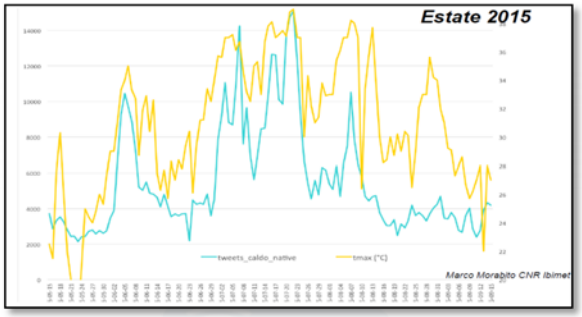
Sentiment Analysis





Prediction/Assessment

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



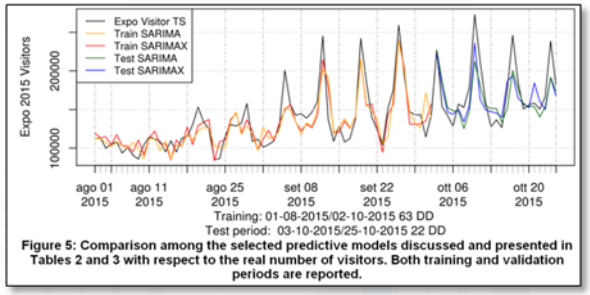
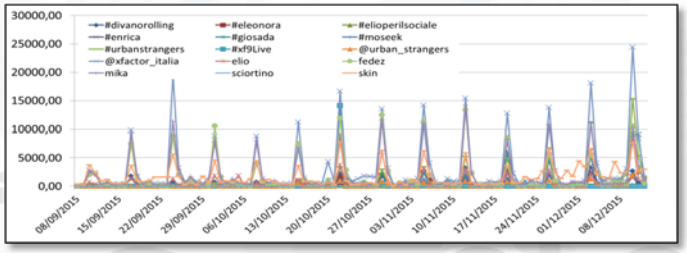


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.



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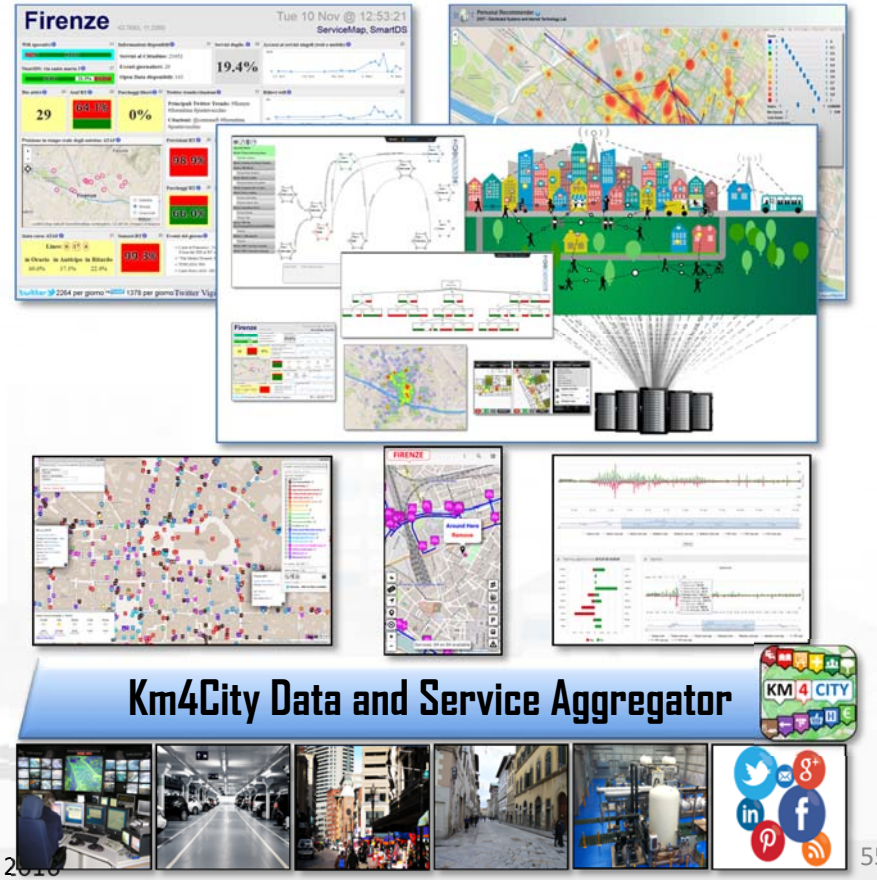
From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

1. keep city under control via personalized dashboards
   - transform data in value for the city,
   - influence city users
2. Technical details:
   - dashboard development
   - data aggregation
   - Projects contributing
3. improve city resilience, reducing risks and decision support



Strategies Implementation via Engagement

- **Produce value from data enabling** to
  - ***Stimulate virtuous behavior,***
  - ***influence engage City Users!***
  - Increase efficiency in energy consumption
  - Reduce pollution and traffic congestion
  - Improve quality of service, quality of life
- **Create an ecosystem for innovation** and put in action any smart city solutions and services.

Engagement & Assisstant Rules

- **Detecting** city users' habits about mobility
  - Private cars → **stimulating Bus Usage & Bikes**
  - Private cars parking → usage of **peripheral parking-lot + bus**
  - Leave the car and take the bus twice → by using **bonus, tickets**..
  - ….. → different solutions for moving…
- **Assisting by notifying** when one is
  - parking out of the residential parking zone
  - parking in a zone subjected to cleaning in the next two days
  - entering in the restricted traffic zone
- **Suggesting** you about
  - Events, **Civil Protection Alerts**, …..
  - **Closer free parking** …
- **Administering** questionnaires
  - Getting assessment about services, city experience
  - ….
- **Requesting** ranking, photo and/or comments

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Suggestion on demand service

- Personalized menu on the basis of User Category
- **Automated Suggestions personalized**:
  - taking into account user profile and behavior, dislikes, requests, queries, etc.
- **Engagement**
  - Engine and Rule Editor
- **Advertising**
  - Engine and Rule Editor

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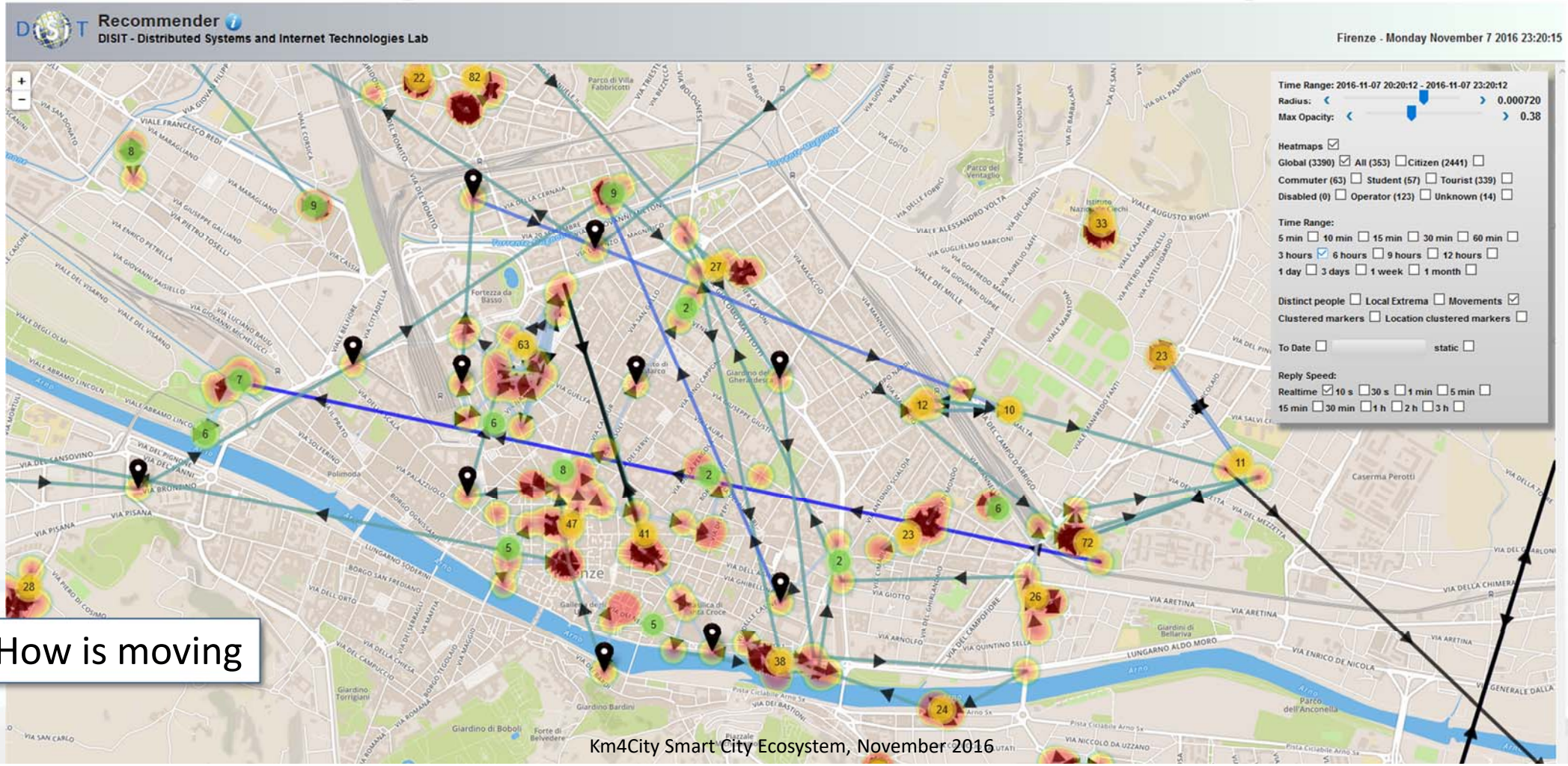
Anonymous User Behavior Analysis



How is moving

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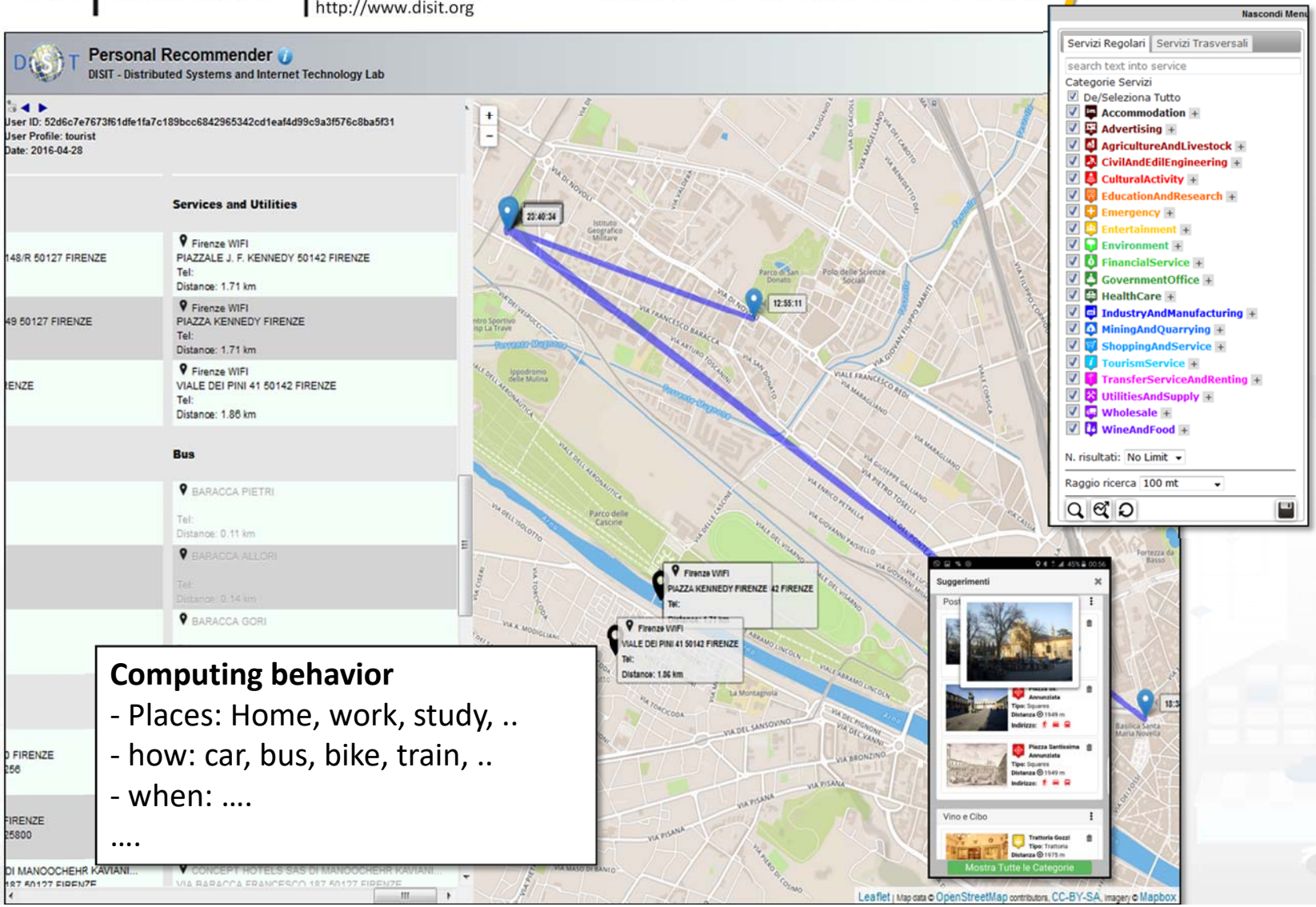
User Behavior Analyzer



Computing behavior

- Places: Home, work, study, ..
- how: car, bus, bike, train, ..
- when: ….

….

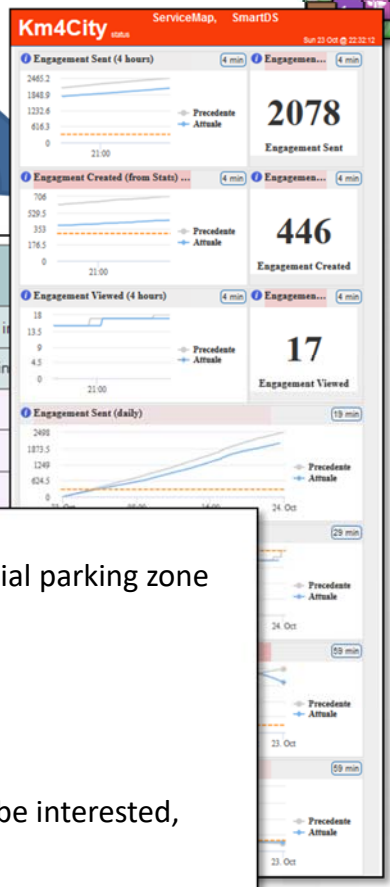
User influencing, engaging, monitoring & Follow Up

City Operators

Strategy Editor Engager

Any Mobile and Web App

Rule name	Type	#sent	#viewed	#viewed on #sent	Description
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%	Suggest (in german) an event currently on i
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%	Suggest (in english) an event currently on in
	- commuter	5 (0.29%)	0 (0%)	0 (0%)	
	- student	14 (0.81%)	0 (0%)	0 (0%)	
	- tourist	1462 (85%)	25 (35.71%)	25 (1.71%)	
	- citizen	113 (6.57%)			
	- operator	0 (0%)			
	- disabled	0 (0%)			
	- all	119 (6.92%)			
daily_event_es	ENGAGEMENT	6 (0.01%)			
daily_event_fr	ENGAGEMENT	6 (0.01%)			
daily_event_it	ENGAGEMENT	5459 (6.73%)			
parking_en	ASSISTANCE	141 (0.17%)			
parking_es	ASSISTANCE	3 (0%)			
parking_it	ASSISTANCE	187 (0.23%)			
shoot_a_photo_de	ENGAGEMENT	68 (0.08%)			



Inform

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 your may be interested, etc..

Provide Bonus

Since you have parked here you we can get 1 Bonus
We suggest you to leave the car out of the city, this bonus can be used to by a bus ticket

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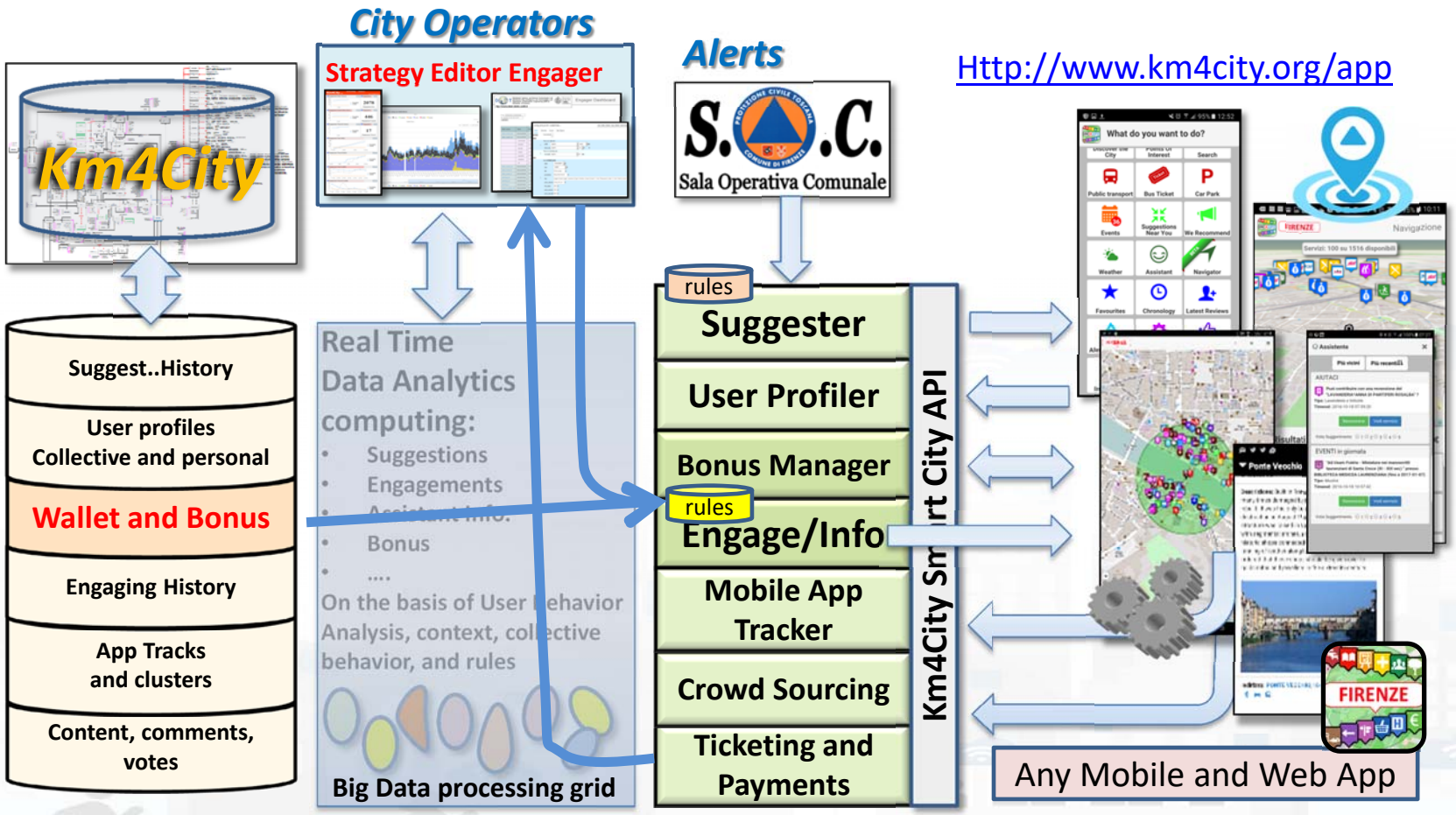
Listening and Engaging City Users




The Anatomy
of a Smart City

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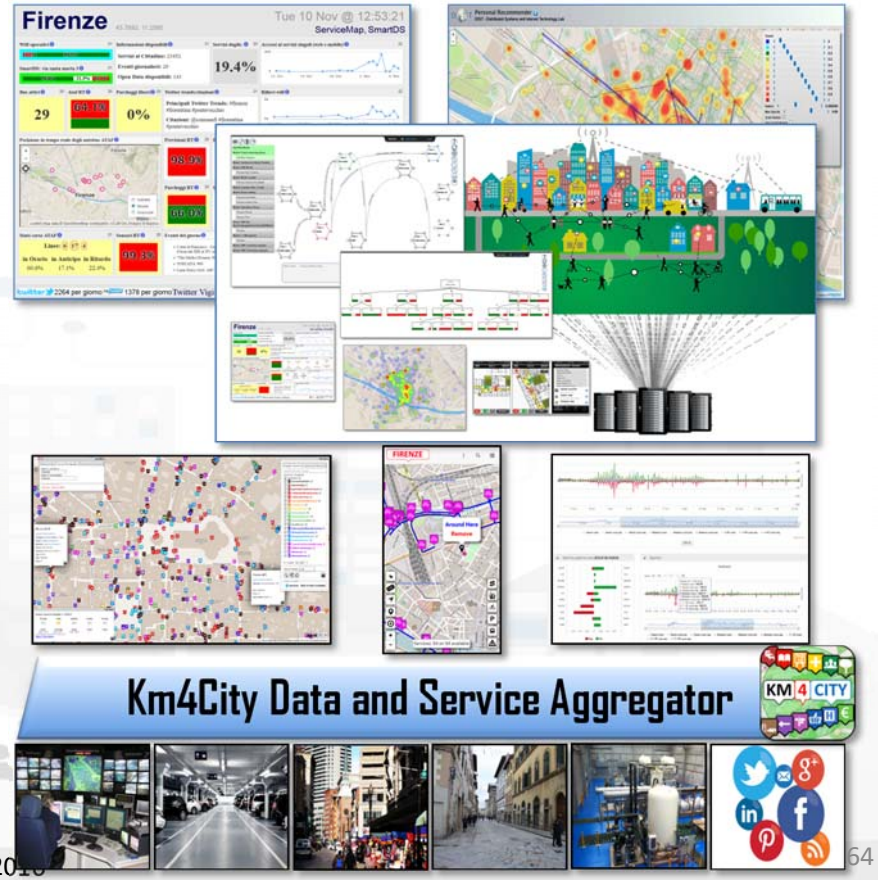

Back Office and Dev Tools

www.Km4City.org

Development tools

- **Dashboard builder**
  - Creating personalized dashboards in few clicks
- **aggregating multi-domain data and services** for SMEs and city operators
  - **Data /Service Aggregator**: open, flexible and suitable access
- **development tool** for fast and low cost implementation of business and service oriented Apps
  - access to aggregated data → **Smart City API**
  - ServiceMap → **Smart City API**

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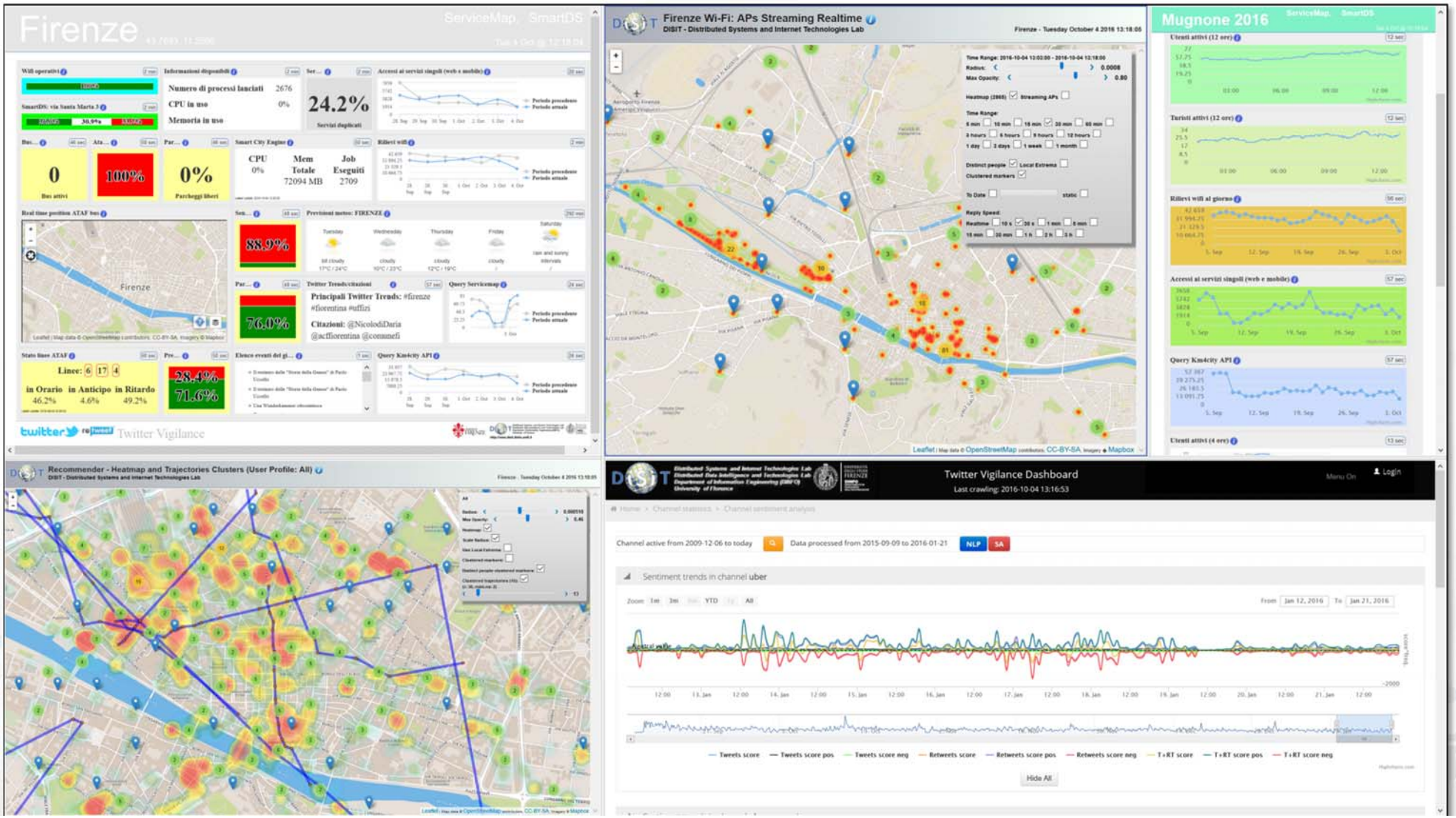
Higher level Dashboard



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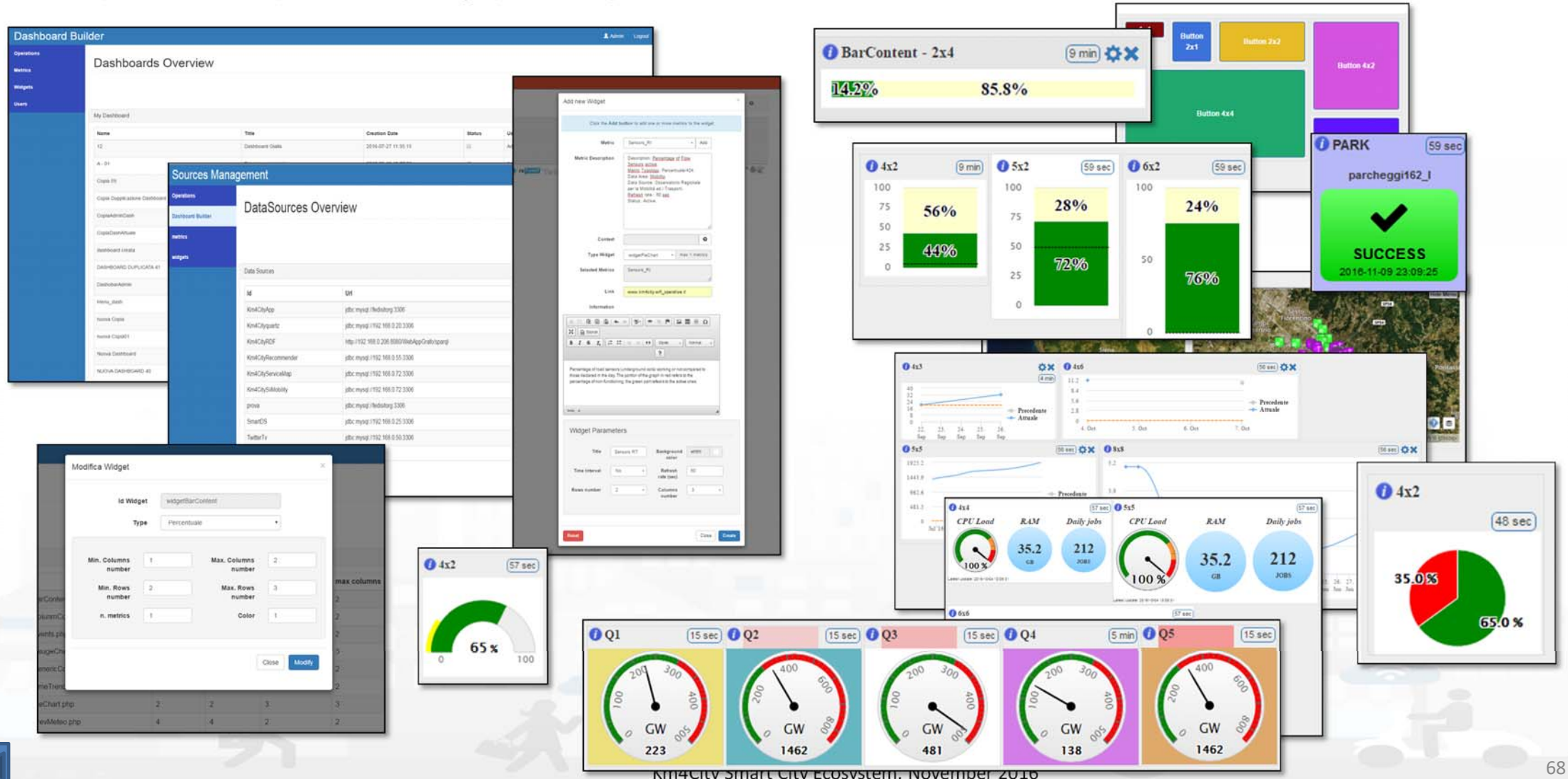
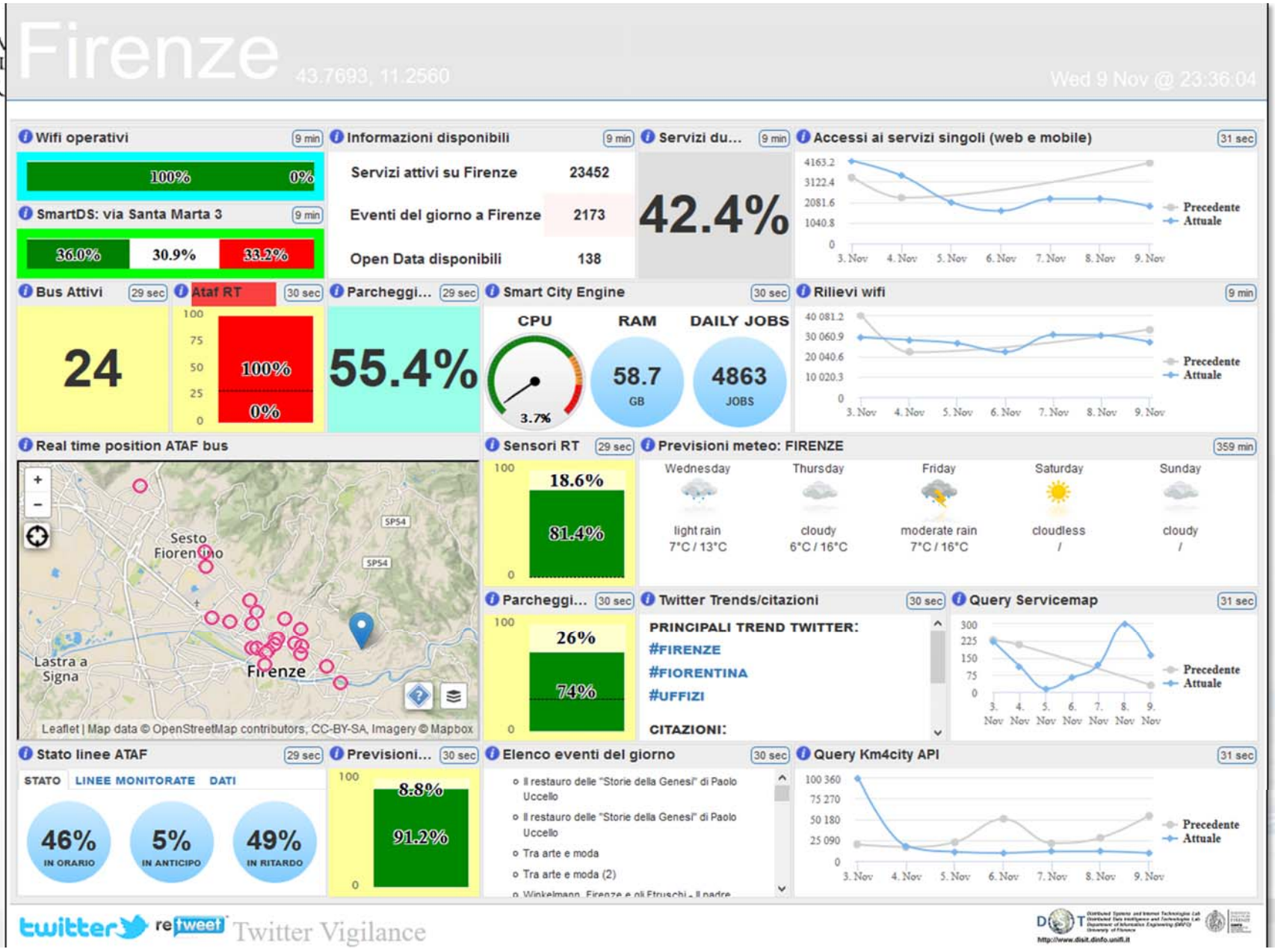
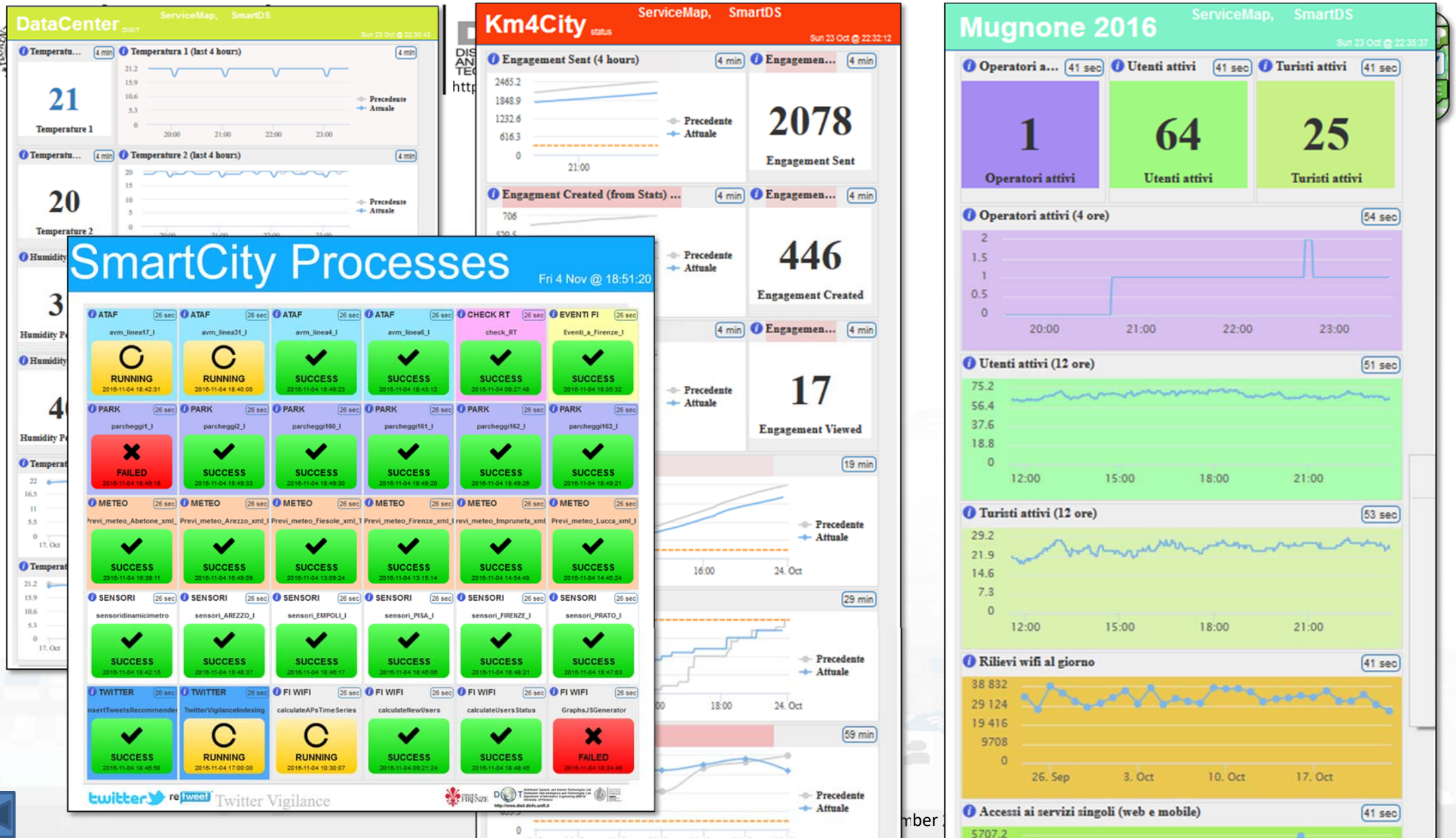
Dashboard Builder




Firenze
43.7693, 11.2560
Wed 9 Nov @ 23:36:04
Wifi operativi
9 min
100%
0%
SmartDS: via Santa Marta 3
9 min
36.0%
30.9%
33.2%
Informazioni disponibili
9 min
Servizi attivi su Firenze
23452
Eventi del giorno a Firenze
2173
Open Data disponibili
138
Servizi du...
9 min
42.4%
Accessi ai servizi singoli (web e mobile)
31 sec
4163.2
3122.4
2081.6
1040.8
0
3. Nov
4. Nov
5. Nov
6. Nov
7. Nov
8. Nov
9. Nov
Precedente
Attuale
Bus Attivi
29 sec
24
Ataf RT
30 sec
100
75
50
25
0
100%
0%
Parcheggi...
29 sec
55.4%
Smart City Engine
30 sec
CPU
3.7%
RAM
58.7
GB
DAILY JOBS
4863
JOBS
Rilievi wifi
9 min
40 081.2
30 060.9
20 040.6
10 020.3
0
Precedente
Attuale
Real time position ATAF bus
Sesto Fiorentino
Lastra a Signa
Firenze
SP54
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox
Sensori RT
29 sec
100
18.6%
81.4%
0
Previsioni meteo: FIRENZE
359 min
Wednesday
light rain
7°C / 13°C
Thursday
cloudy
6°C / 16°C
Friday
moderate rain
7°C / 16°C
Saturday
cloudless
/
Sunday
cloudy
/
Parcheggi...
30 sec
100
26%
74%
0
Twitter Trends/citazioni
30 sec
PRINCIPALI TREND TWITTER:
#FIRENZE
#FIORENTINA
#UFFIZI
CITAZIONI:
Query Servicemap
31 sec
300
225
150
75
0
3. Nov
4. Nov
5. Nov
6. Nov
7. Nov
8. Nov
9. Nov
Precedente
Attuale
Stato linee ATAF
29 sec
STATO
LINEE MONITORATE
DATI
46%
IN ORARIO
5%
IN ANTICIPO
49%
IN RITARDO
Previsioni...
30 sec
100
8.8%
91.2%
0
Elenco eventi del giorno
30 sec
Il restauro delle "Storie della Genesi" di Paolo Uccello
Il restauro delle "Storie della Genesi" di Paolo Uccello
Tra arte e moda
Tra arte e moda (2)
Winkelmann. Firenze e gli Etruschi - Il padre
Query Km4city API
31 sec
100 360
75 270
50 180
25 090
0
3. Nov
4. Nov
5. Nov
6. Nov
7. Nov
8. Nov
9. Nov
Precedente
Attuale
twitter
retweet
Twitter Vigilance
http://www.disit.dinfo.unifi.it


DataCenter
ServiceMap, SmartDS
Temperatura 1 (last 4 hours)
21
Temperature 1
Temperatura 2 (last 4 hours)
20
Temperature 2
Km4City status
ServiceMap, SmartDS
Sun 23 Oct @ 22:32:12
Engagement Sent (4 hours)
2078
Engagement Sent
Engagment Created (from Stats) ...
446
Engagement Created
17
Engagement Viewed
SmartCity Processes
Fri 4 Nov @ 18:51:20
ATAF
RUNNING
SUCCESS
CHECK RT
EVENTI FI
PARK
FAILED
METEO
SENSORI
TWITTER
FI WIFI
twitter
retweet
Twitter Vigilance
Mugnone 2016
ServiceMap, SmartDS
Sun 23 Oct @ 22:35:37
Operatori a...
1
Operatori attivi
Utenti attivi
64
Utenti attivi
Turisti attivi
25
Turisti attivi
Operatori attivi (4 ore)
Utenti attivi (12 ore)
Turisti attivi (12 ore)
Rilievi wifi al giorno
Accessi ai servizi singoli (web e mobile)

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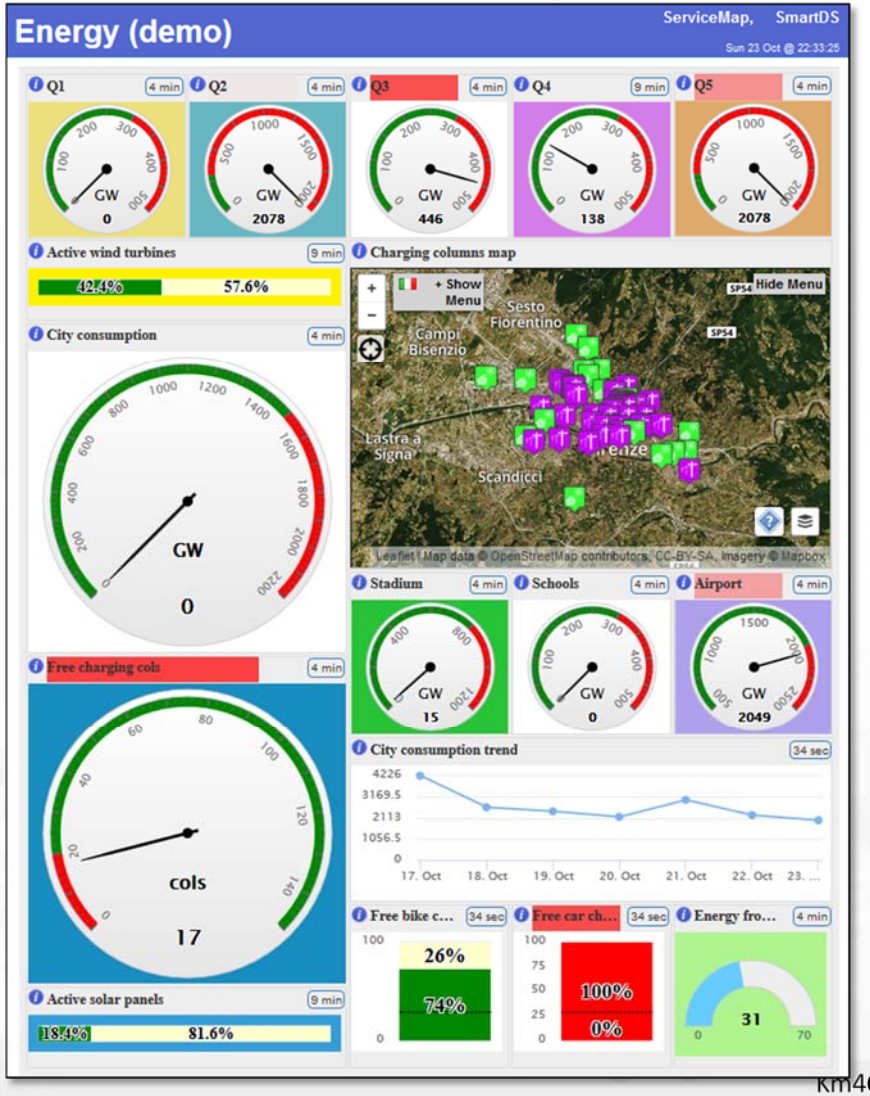
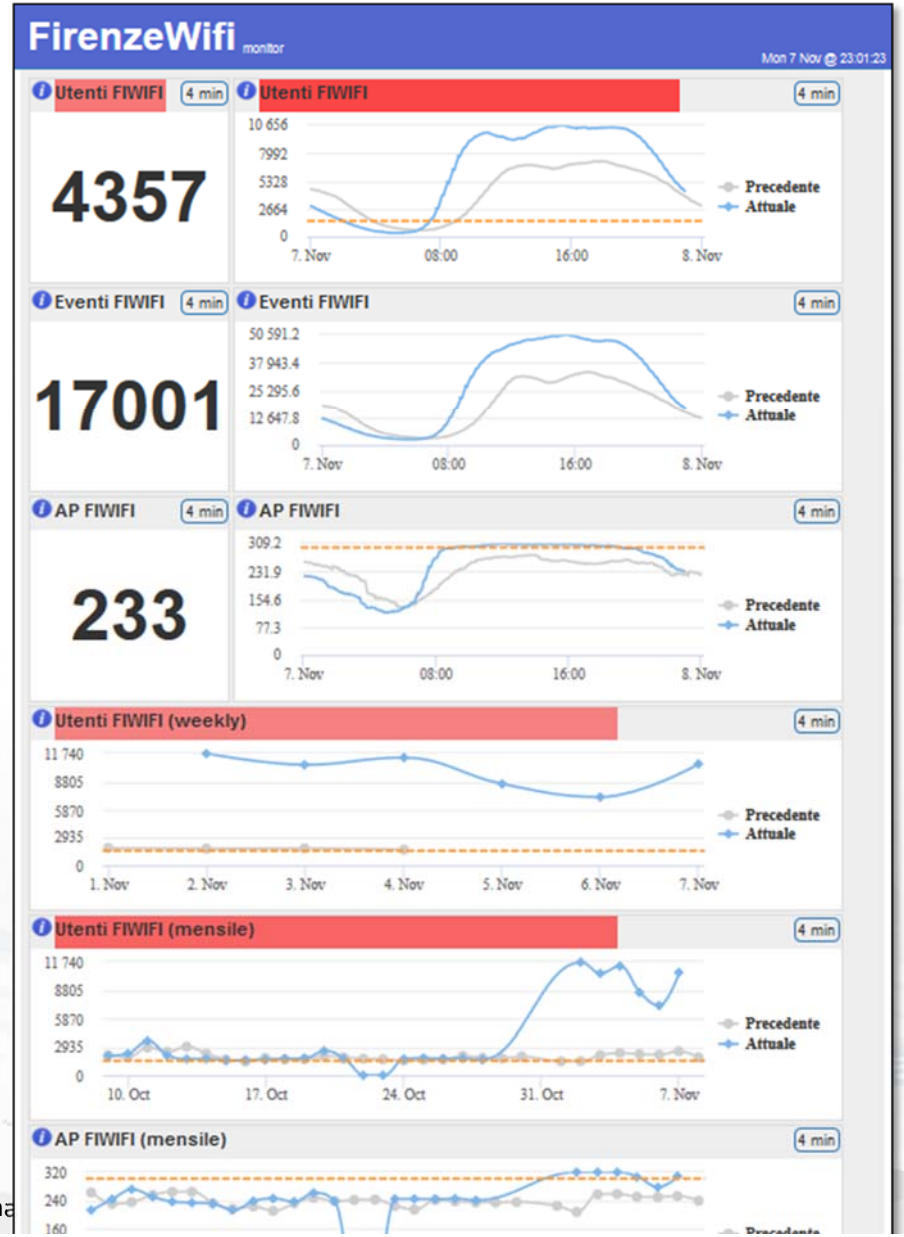
http://www.disit.org





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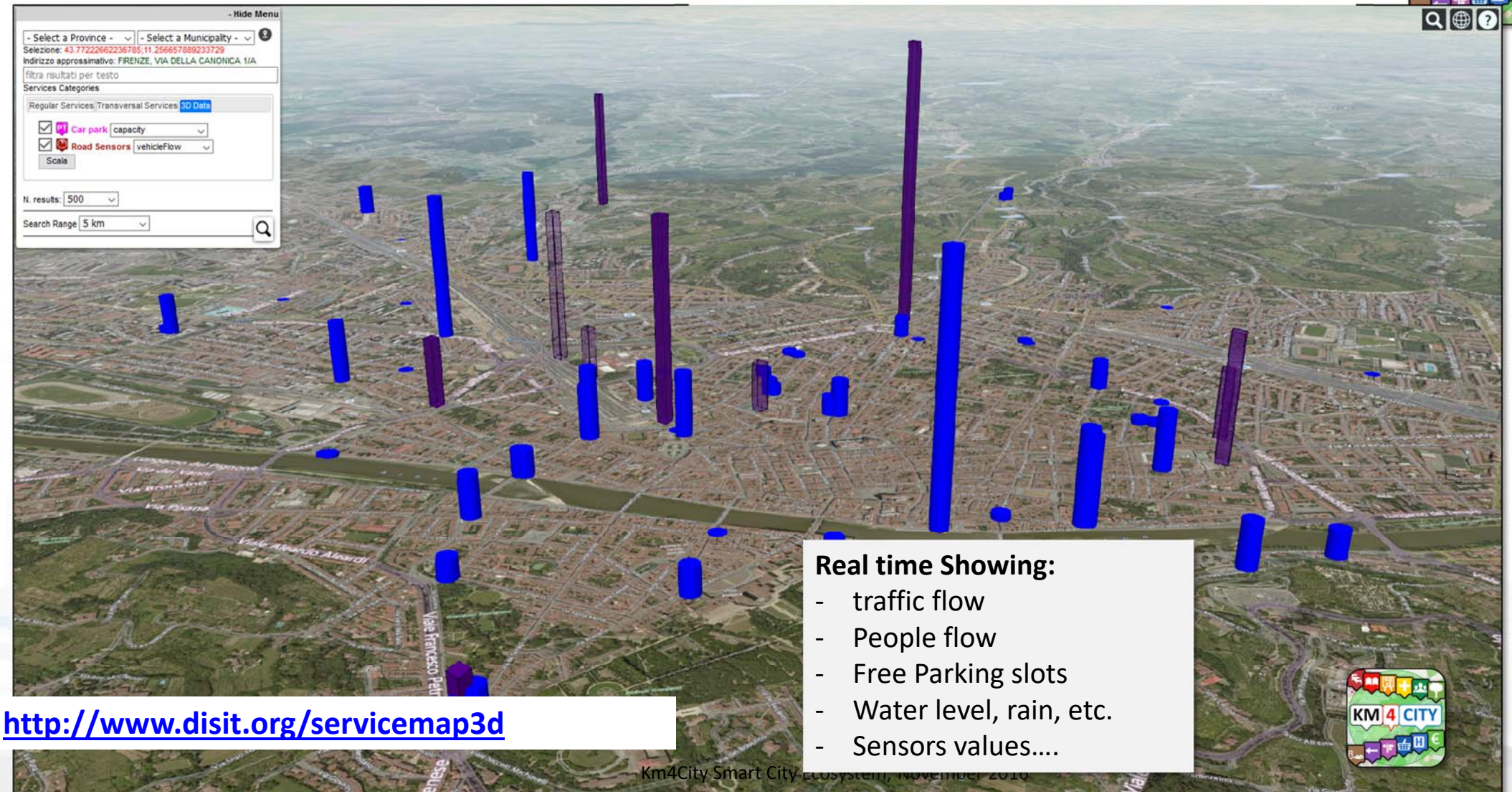
RealTime Values 3D



Real time Showing:

- traffic flow
- People flow
- Free Parking slots
- Water level, rain, etc.
- Sensors values….

http://www.disit.org/servicemap3d

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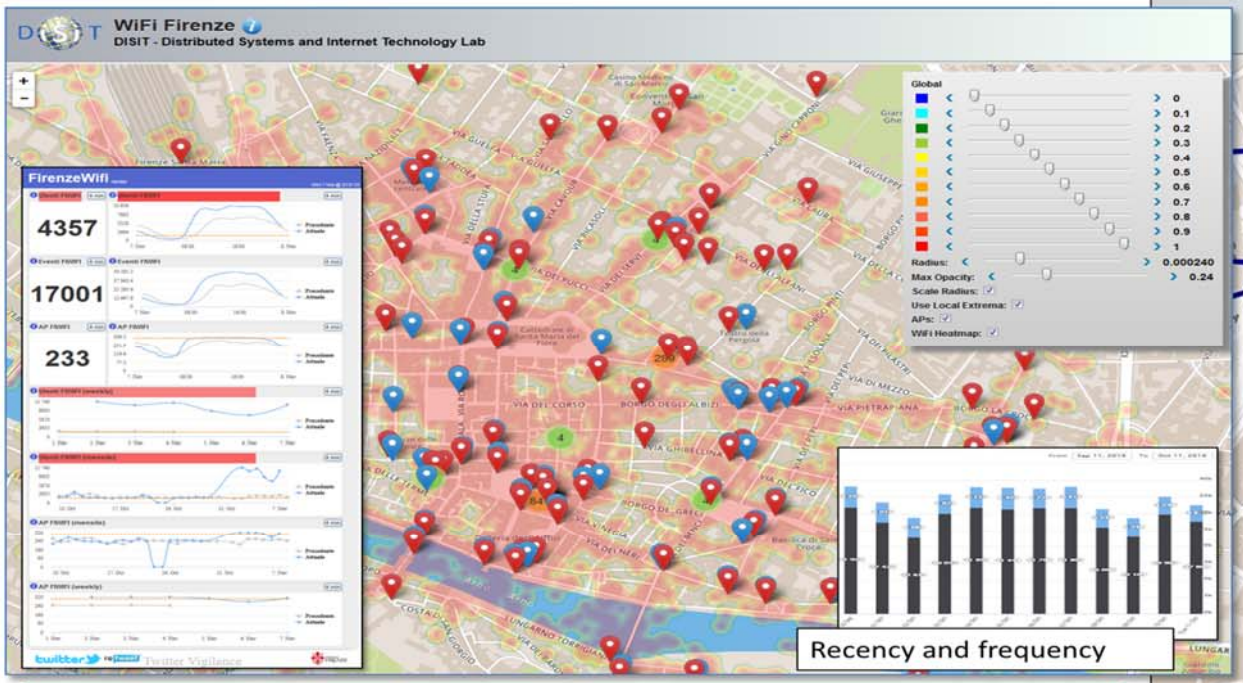
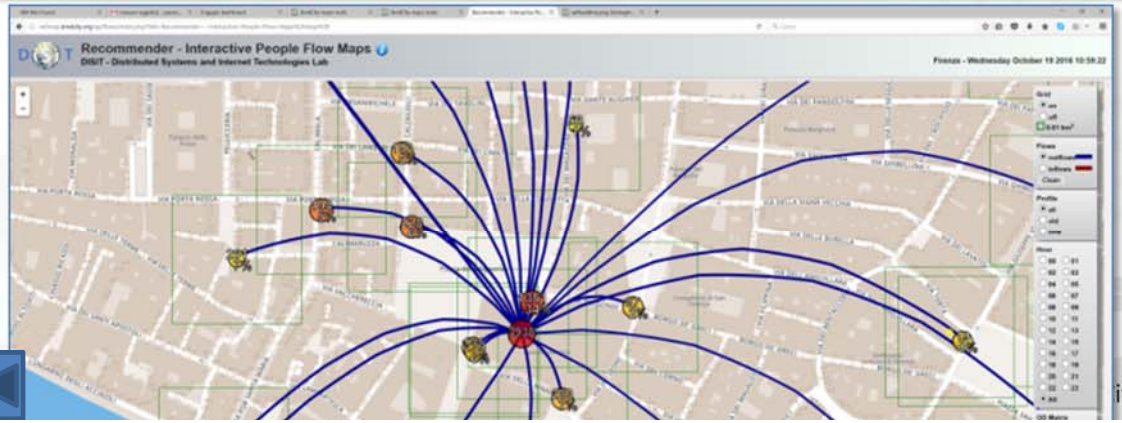
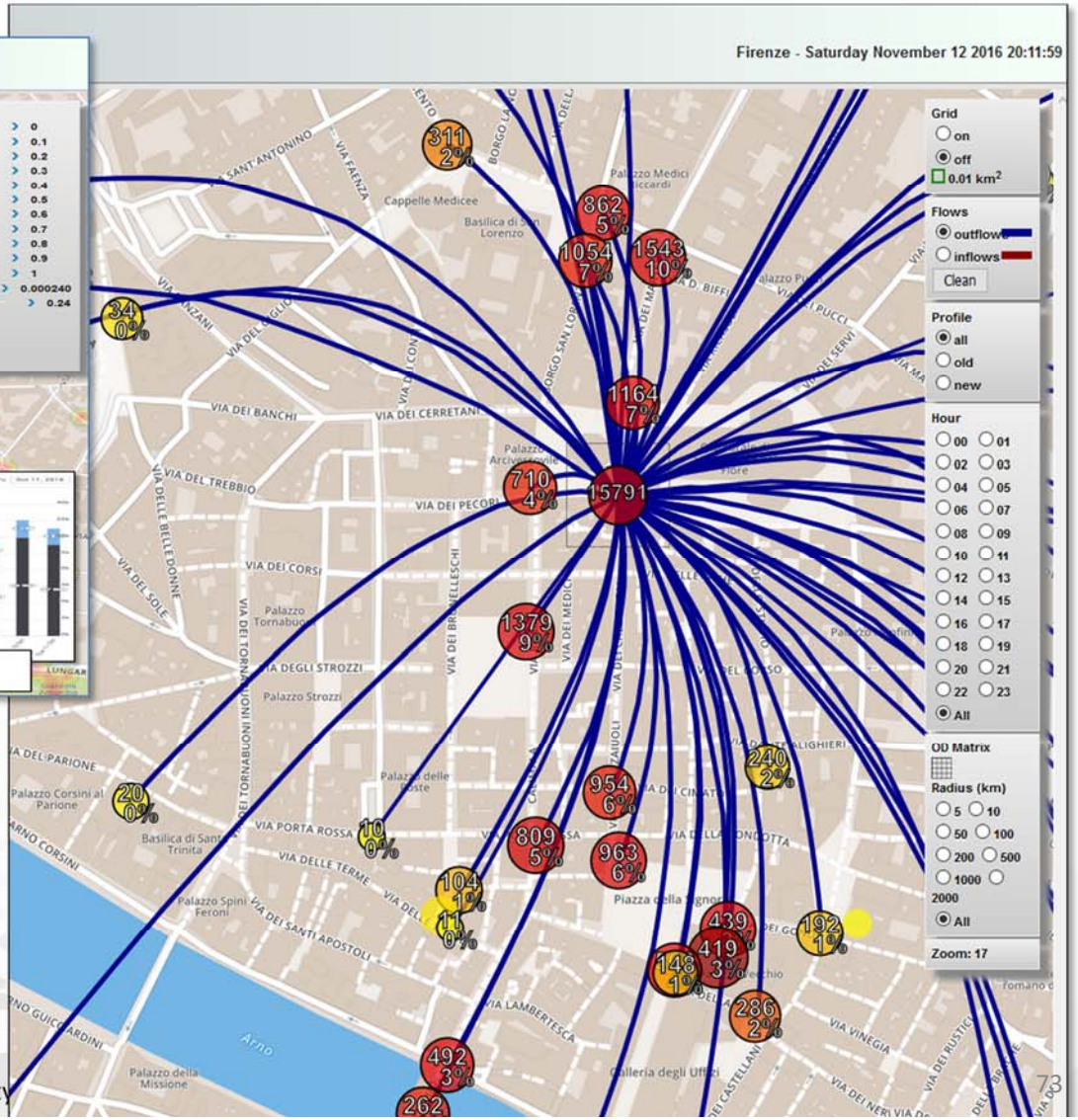
Wi-Fi OD estimation.

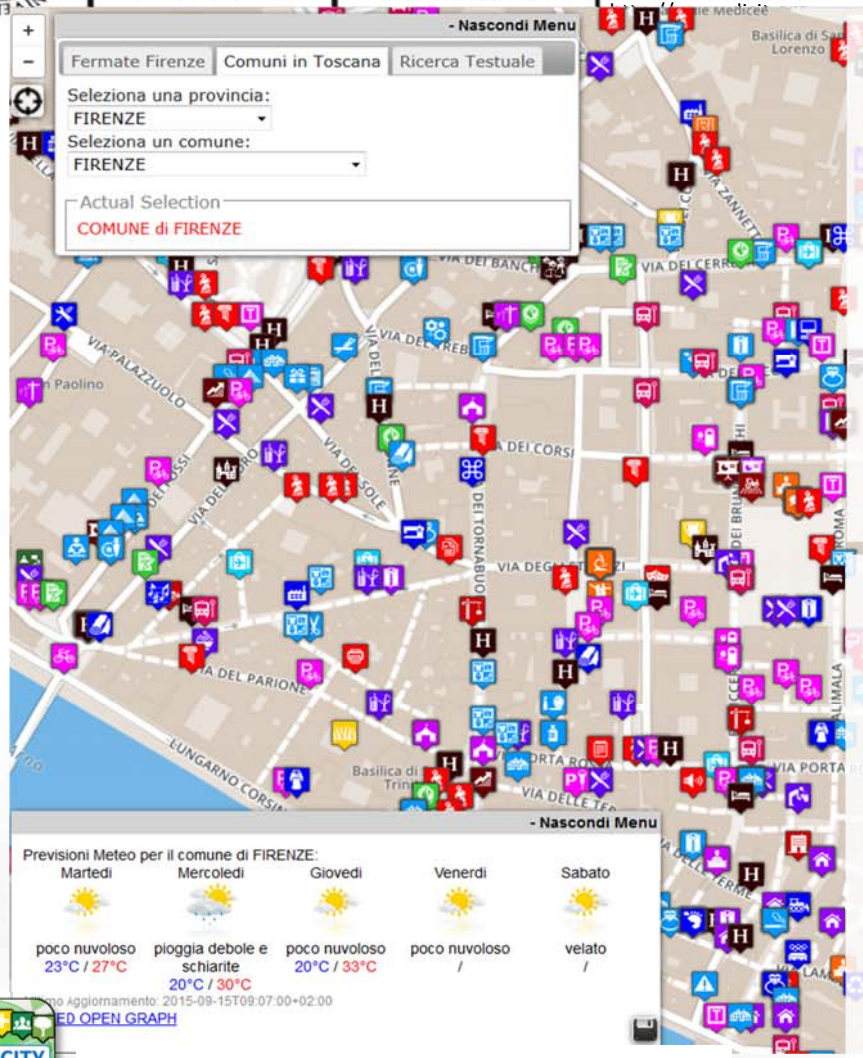






Development tools

- **Dashboard builder**
  - Creating personalized dashboards in few clicks
- **aggregating multi-domain data and services** for SMEs and city operators
  - **Data /Service Aggregator**: open, flexible and suitable access
- **development tool** for fast and low cost implementation of business and service oriented Apps
  - access to aggregated data → **Smart City API**
  - ServiceMap → **Smart City API**



Road Graph (Tuscany region)

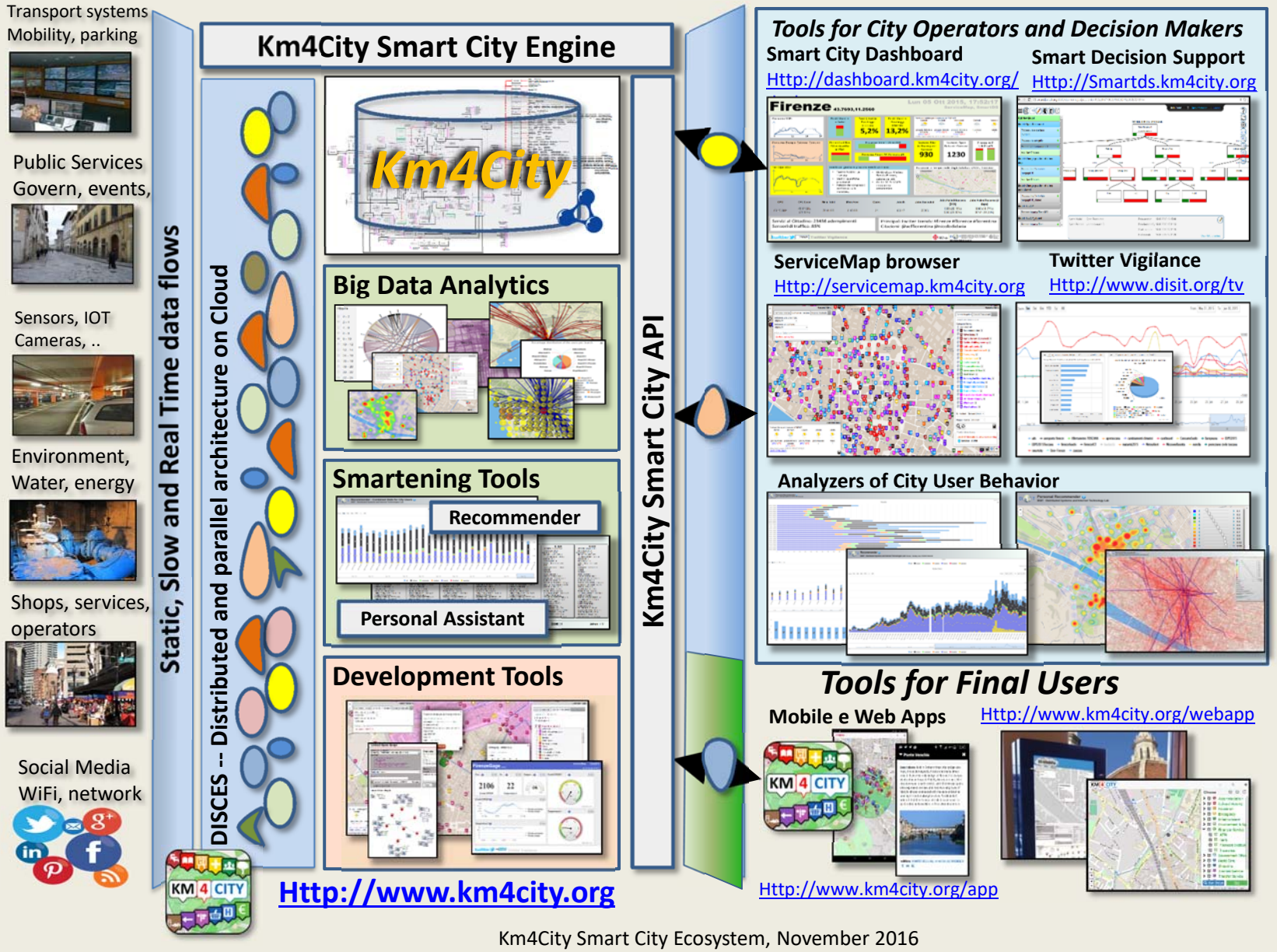
- 132,923 Roads
- 389,711 Road Elements
- 318,160 Road Nodes
- 1,508,207 Street Numbers

Services (20 cat, 512 cat.)
16 Pub. Transport Operators
21.280 Bus stops & 1081 bus lines
210 Parking areas
796 Traffic Sensors
Info on: points, paths, areas, etc.

Dynamic/real-time

- **bus lines: 144 updates X day X line**
- **parking status: 76 updates X day X sensor**
- **traffic Sensors: 288 updates X day X sensor**
- **weather: 2 updates X day for 285 areas**
- **events: about 60 new events X day**
- **Wi-Fi: > 350.000 measures X day**
- **mobiles: > 50.000 measures X day**
- **more than 35.000 distinct users X day**
- **From 600.000 to 4.5 M Tweets X day**
- **……many other sensors …. see next slide**

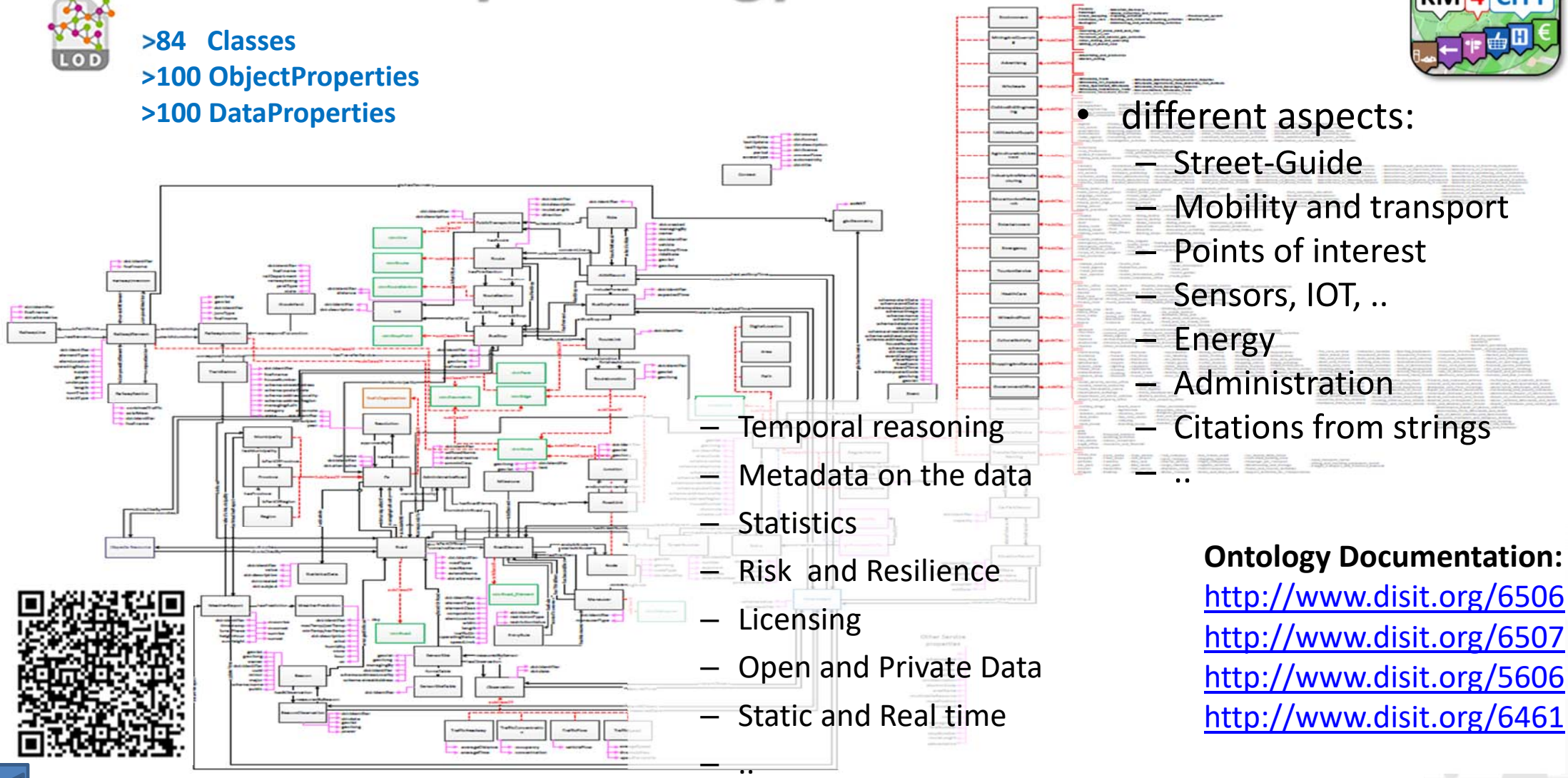
http://servicemap.km4city.org



Km4City Smart City Ecosystem, November 2016

Km4City Ontology - RDF Store

>84 Classes
>100 ObjectProperties
>100 DataProperties

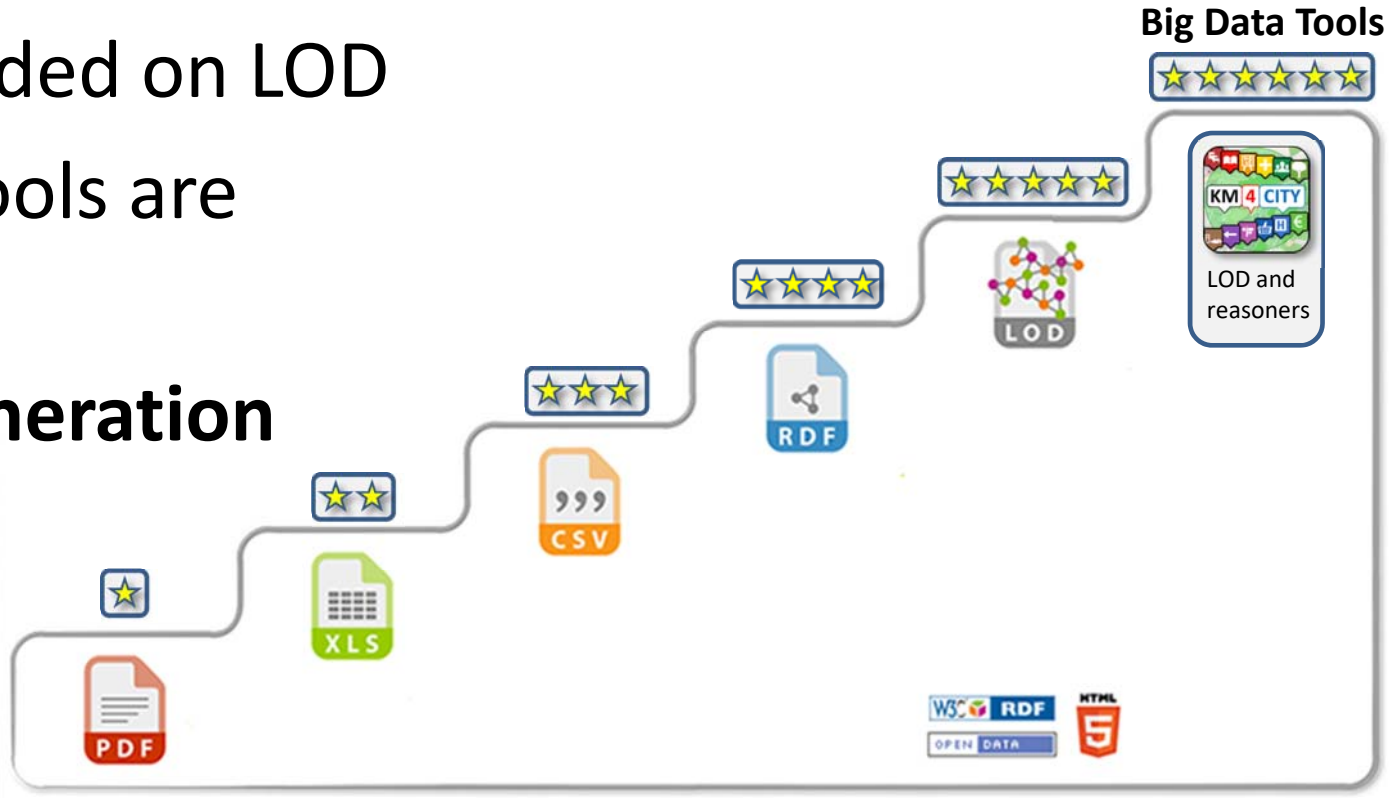


- different aspects:
  - Street-Guide
  - Mobility and transport
  - Points of interest
  - Sensors, IOT, ..
  - Energy
  - Administration
  - Citations from strings
  - ..
- Temporal reasoning
- Metadata on the data
- Statistics
- Risk and Resilience
- Licensing
- Open and Private Data
- Static and Real time
- ..

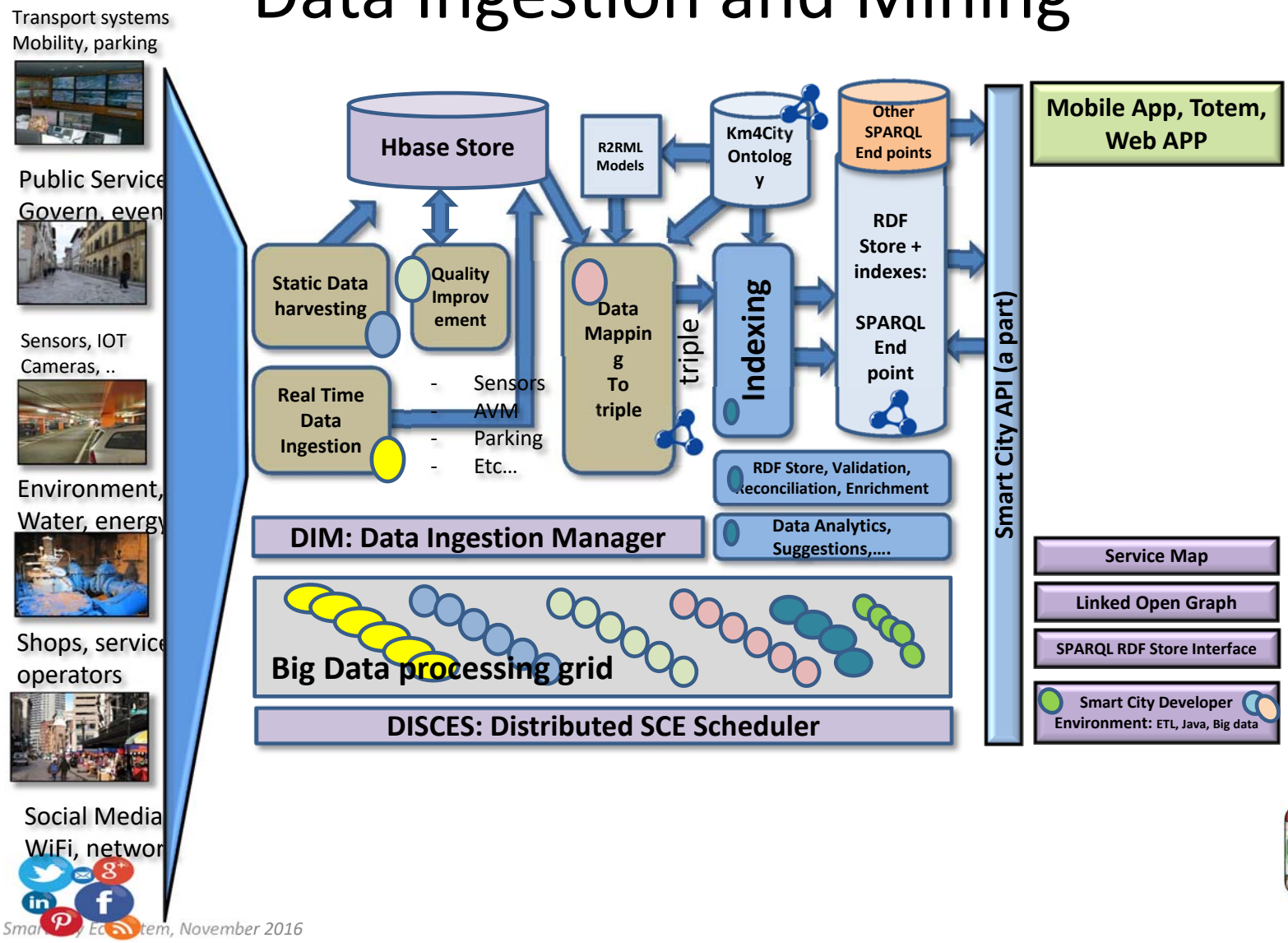
Ontology Documentation:
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

Km4City is Six Stars Linked Open Data

- Smart City API are grounded on LOD
- Service map is grounded on LOD
- Km4City reasoners tools are smartening the city
- **Km4City is a new generation of Urban Platforms**



Data Ingestion and Mining



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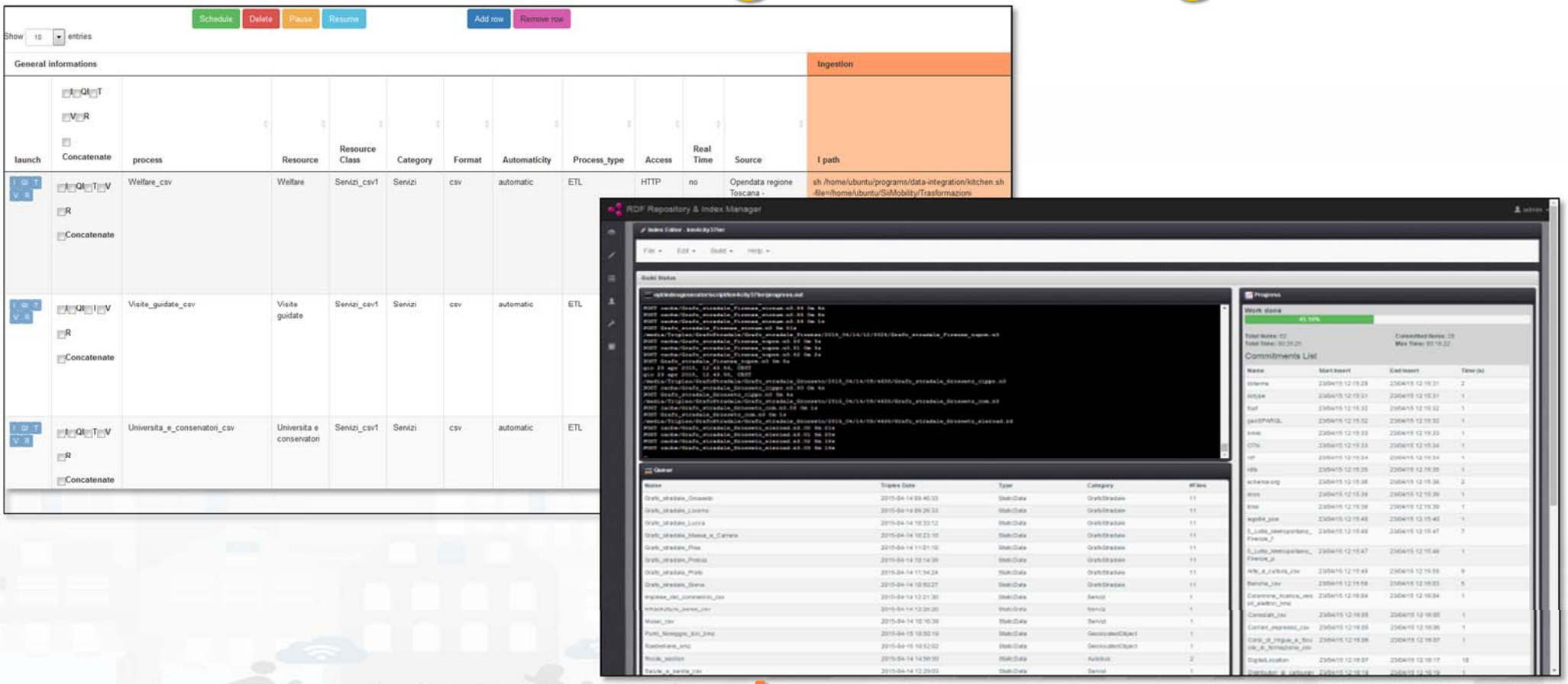
KM4CITY

DIM: Data Ingestion Manager



RIM RDF Index Manager

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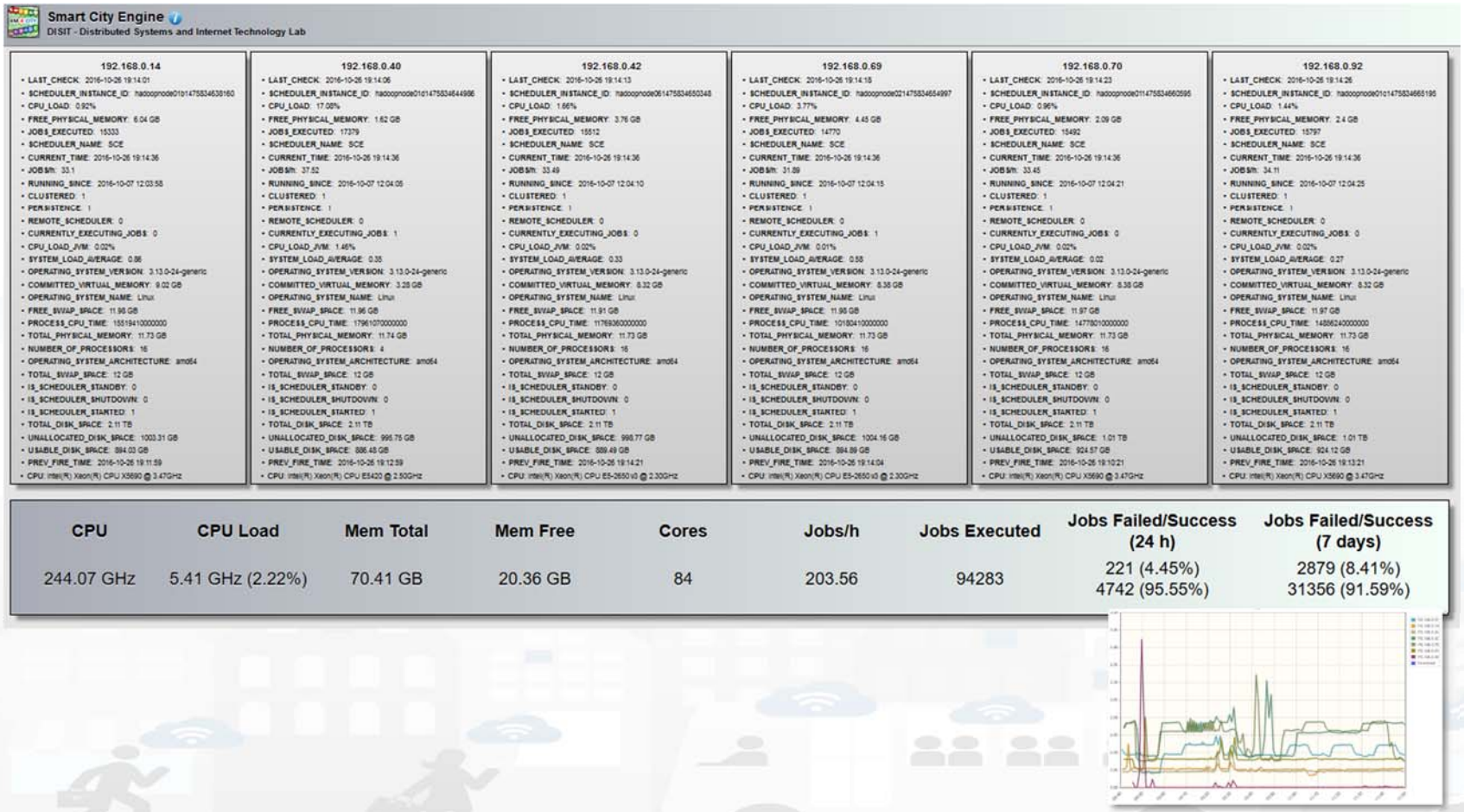
Distributed SCE Scheduler



Distributed SCE Scheduler

Smart Cloud Engine
DISIT - Distributed Systems and Internet Technology Lab

SCHEDULER NAME	ID	FIRE INSTANCE ID	DATE	JOB NAME	JOB GROUP	JOB DATA	STATUS
SCE	297230	hadoopnode01d14183077042351418307705019	2014-12-15 15:25:33	sensori47_A	sensori47	#processParameters=[{"processPath":"/ho	RUNNING
SCE	297229	hadoopnode06c14183076279641418307629359	2014-12-15 15:25:33	sensori44_A	sensori44	#processParameters=[{"processPath":"/ho	RUNNING
SCE	297228	hadoopnode02141830838738214183083917 58	2014-12-15 15:22:39	ZTL_notturna_shp_I	ZTL_notturna_shp	#processParameters=null; #isNonConcurrent=t	SUCCESS
SCE	297227	hadoopnode02141830838738214183083917 57	2014-12-15 15:22:39	ZTL_notturna_kmz_I	ZTL_notturna_kmz	#processParameters=null; #isNonConcurrent=t	SUCCESS
SCE	297226	hadoopnode01c14183085186101418308520365	2014-12-15 15:21:49	sensori45_A	sensori45	#processParameters=[{"processPath":"/ho	RUNNING
SCE	297225	hadoopnode06141830832370214183083258 68	2014-12-15 15:21:49	sensori40_A	sensori40	#processParameters=[{"processPath":"/ho	RUNNING
SCE	297224	hadoopnode01b14183075646221418307566749	2014-12-15 15:21:49	sensori46_A	sensori46	#processParameters=[{"processPath":"/ho	RUNNING
SCE	297223	hadoopnode02141830838738214183083917 56	2014-12-15 15:21:37	ZTL_notturna_kmz_I	ZTL_notturna_kmz	#processParameters=null; #isNonConcurrent=t	SUCCESS
SCE	297222	hadoopnode02141830838738214183083917 55	2014-12-15 15:21:00	sensori31_C	sensori31	#processParameters=[{"processPath":"/ho	SUCCESS
SCE	297221	hadoopnode06c14183076279641418307629358	2014-12-15 15:21:00	sensori30_C	sensori30	#processParameters=[{"processPath":"/ho	SUCCESS
SCE	297220	hadoopnode02141830838738214183083917 54	2014-12-15 15:18:58	ZTL_notturna_shp_I	ZTL_notturna_shp	#processParameters=null; #isNonConcurrent=t	SUCCESS
SCE		hadoopnode01c14183				#processParameter	

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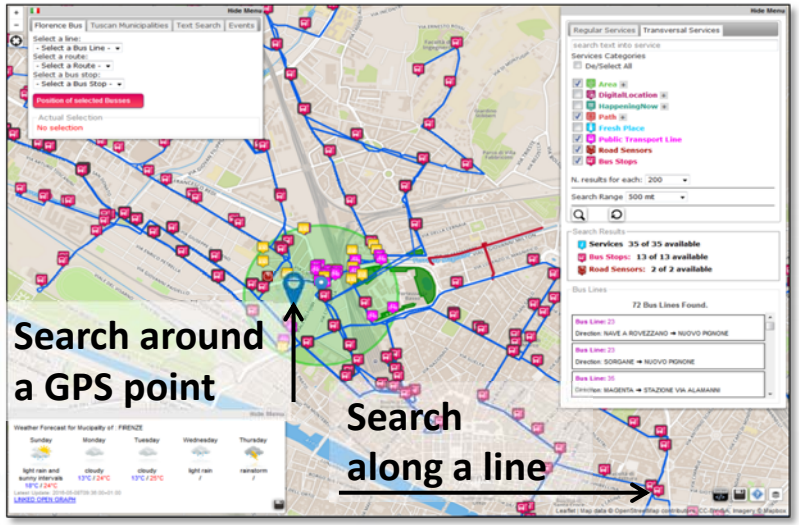
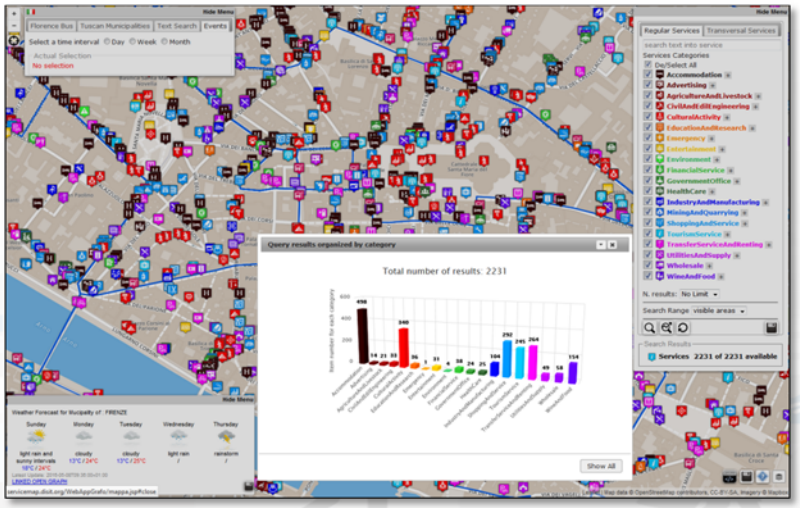
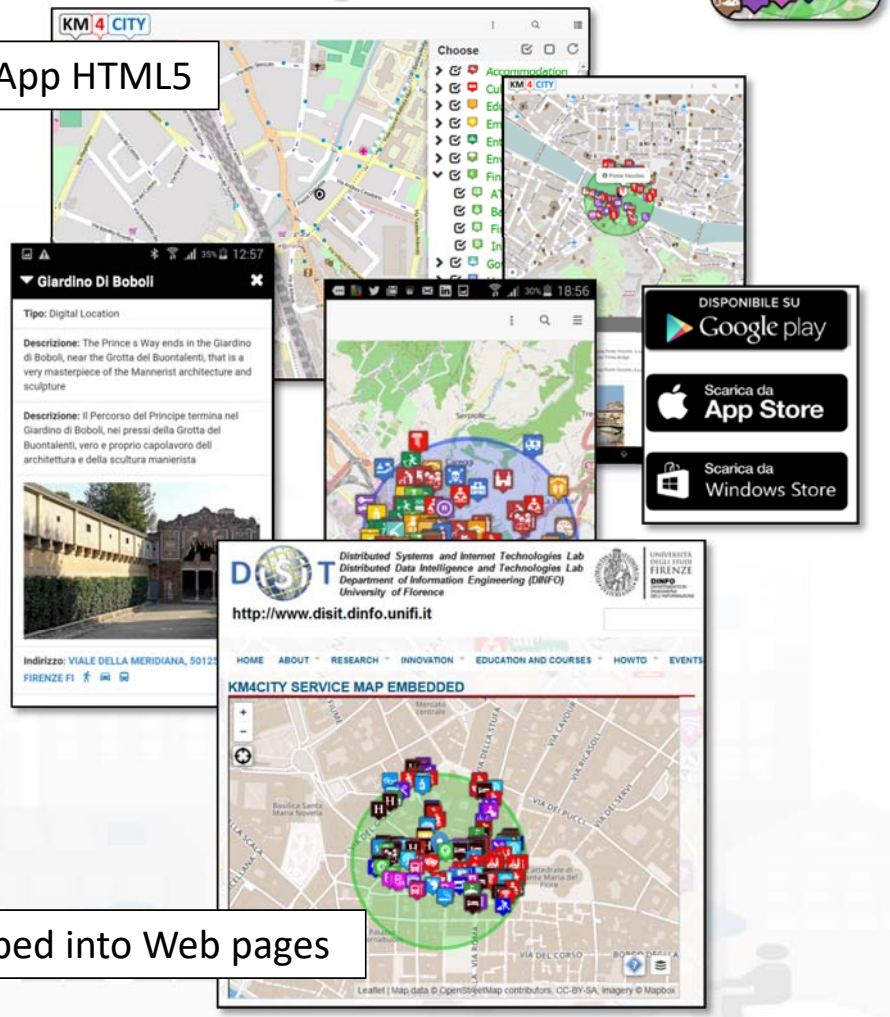
ServiceMap





Smart City API call generation

Web App HTML5



Embed into Web pages

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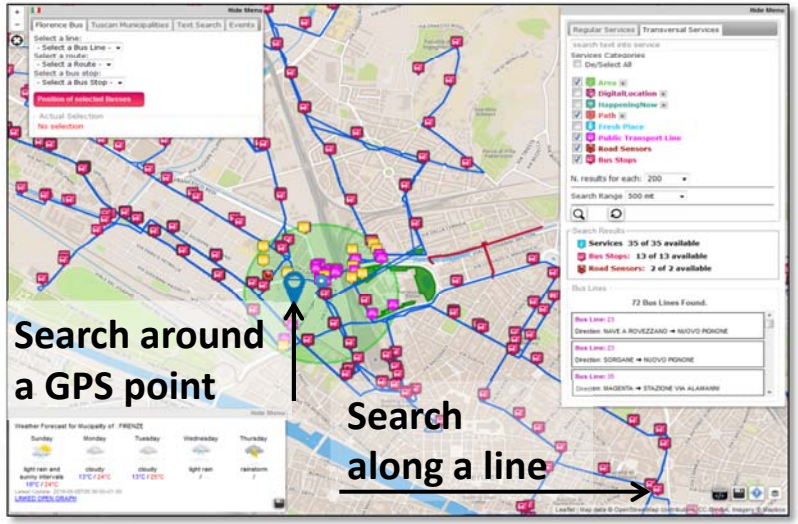
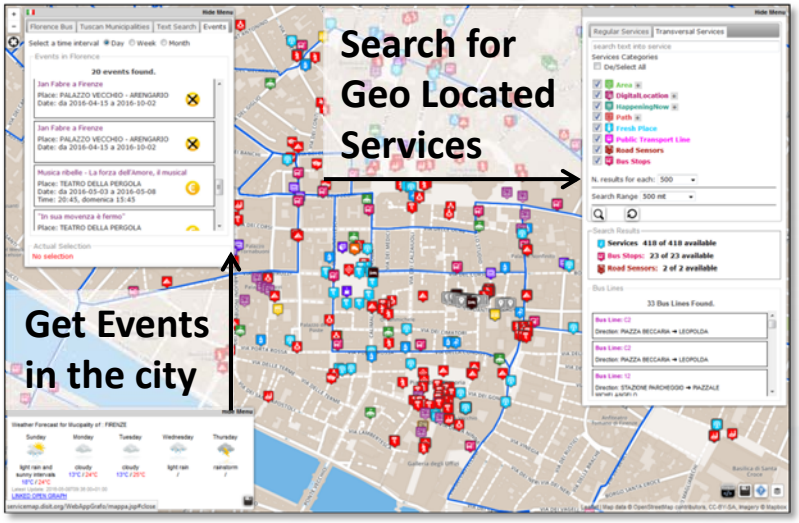
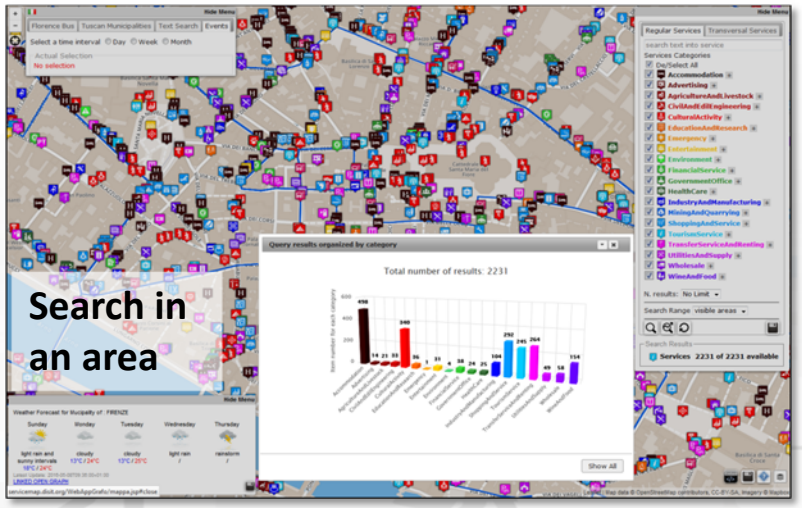
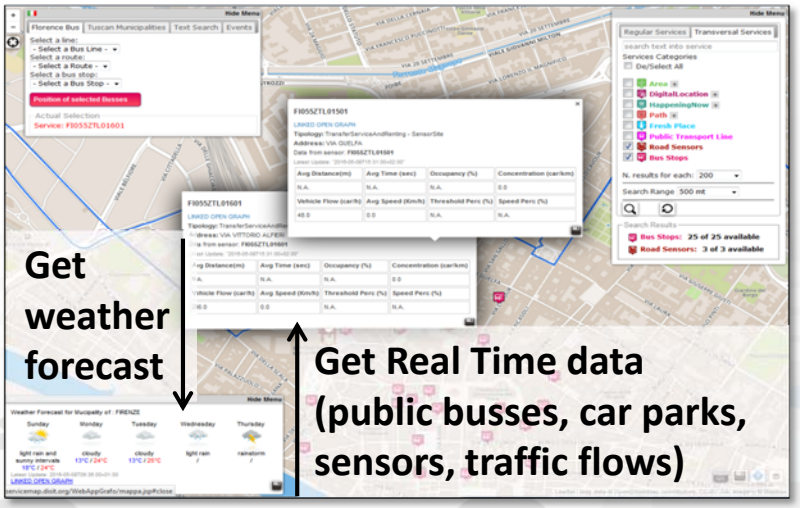
ServiceMap









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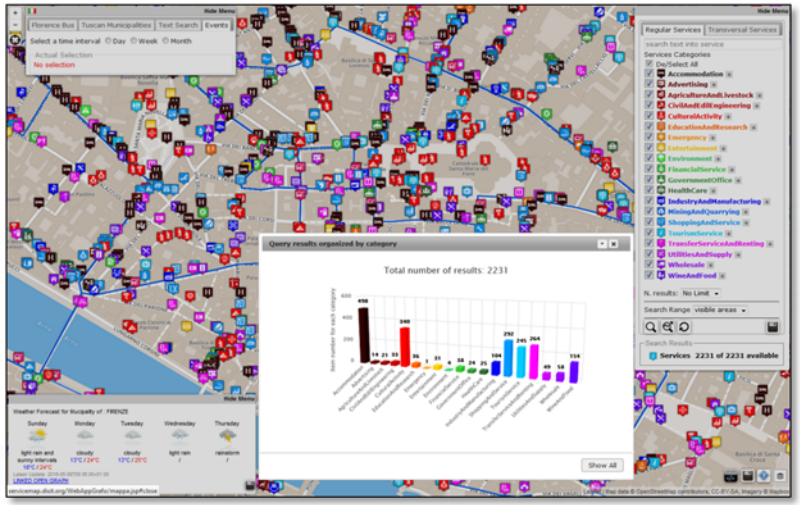
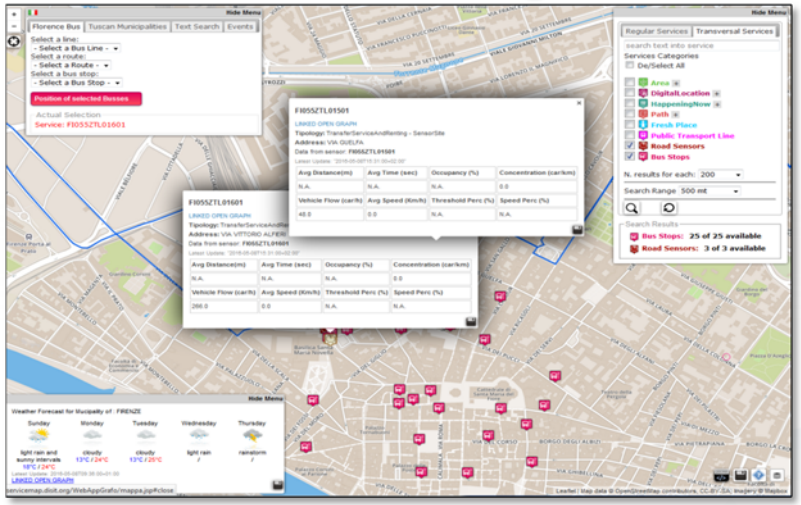
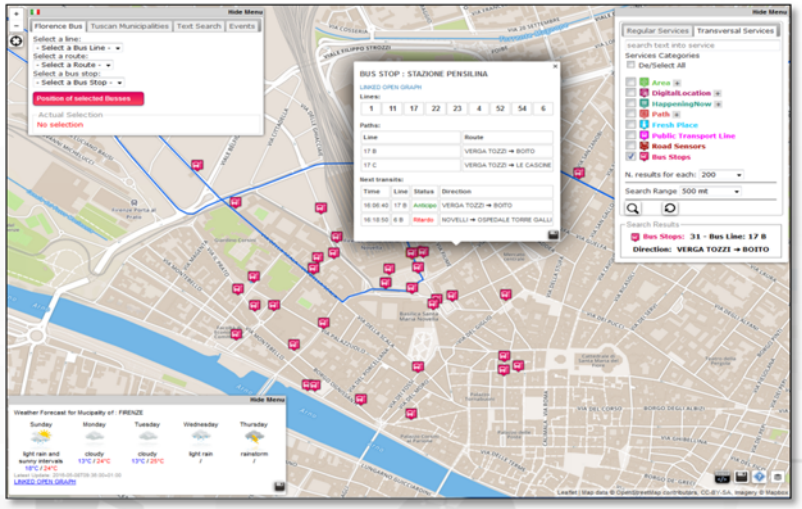
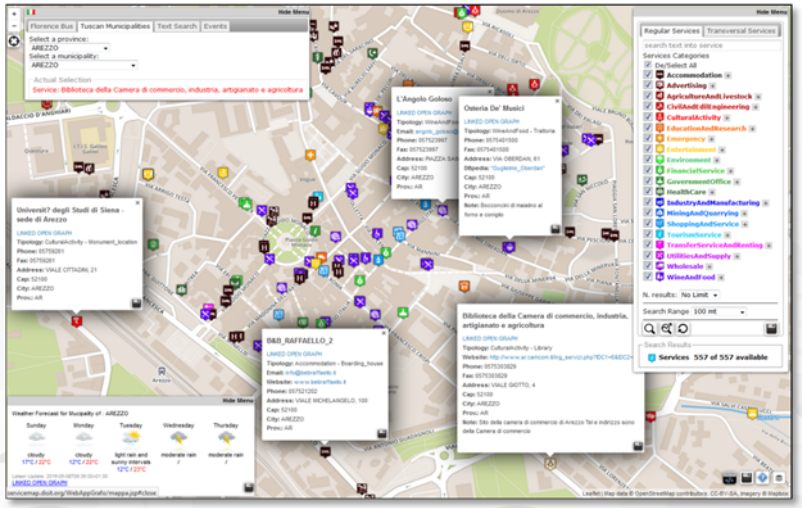
ServiceMap









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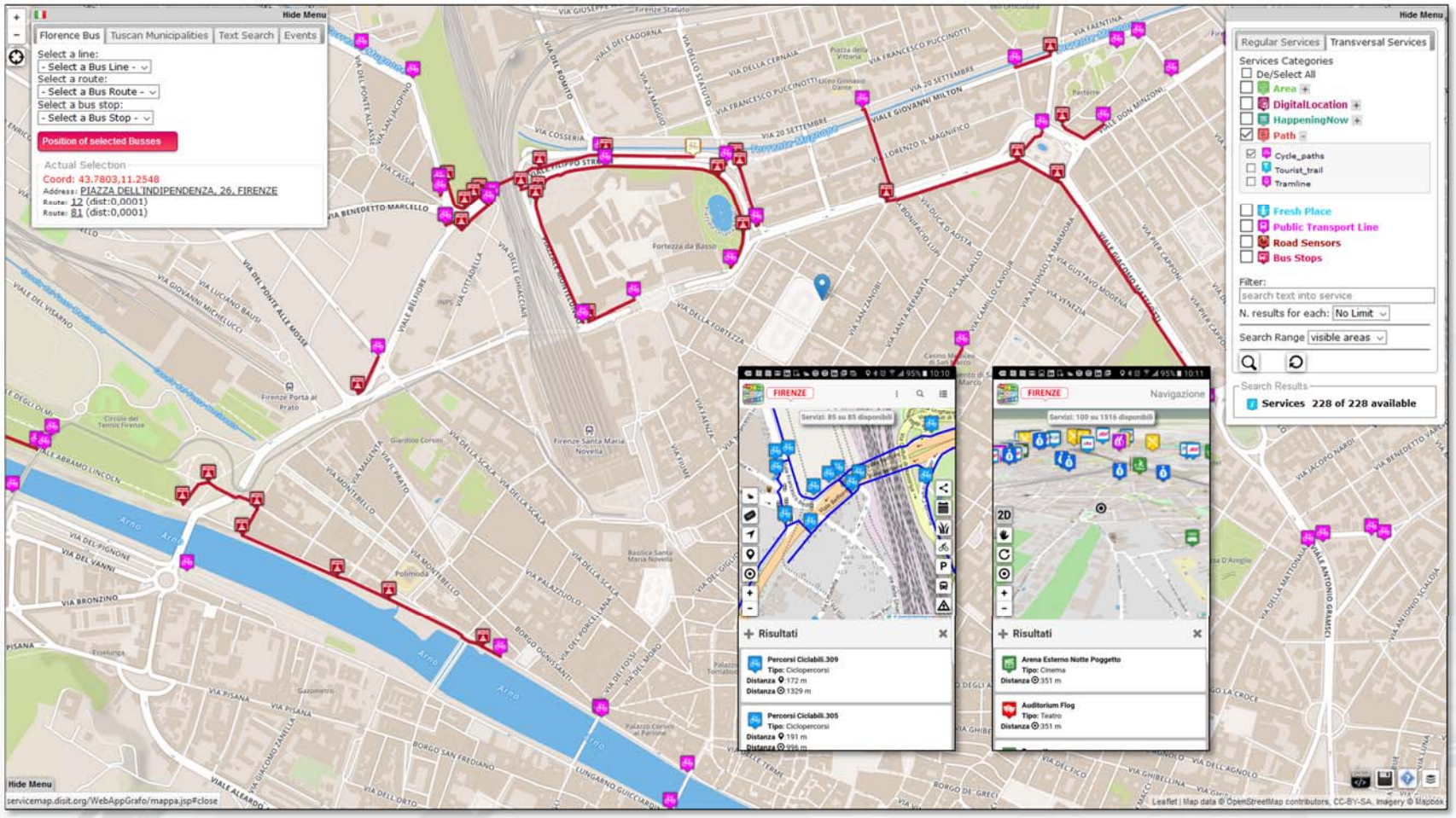
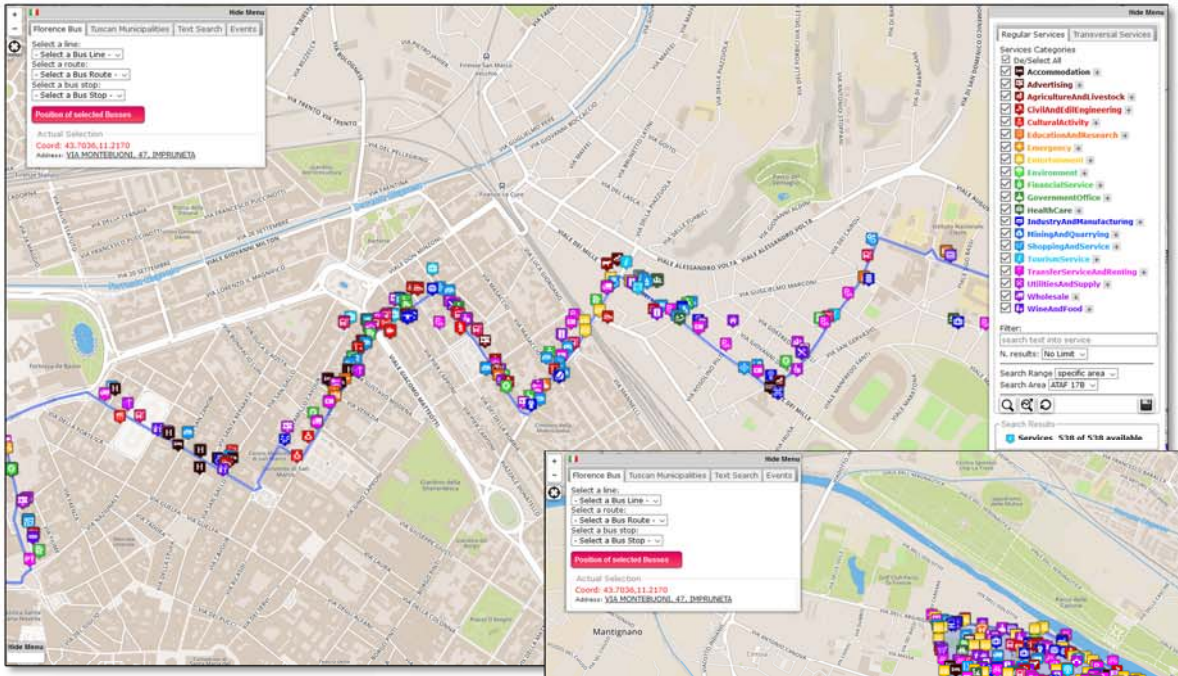
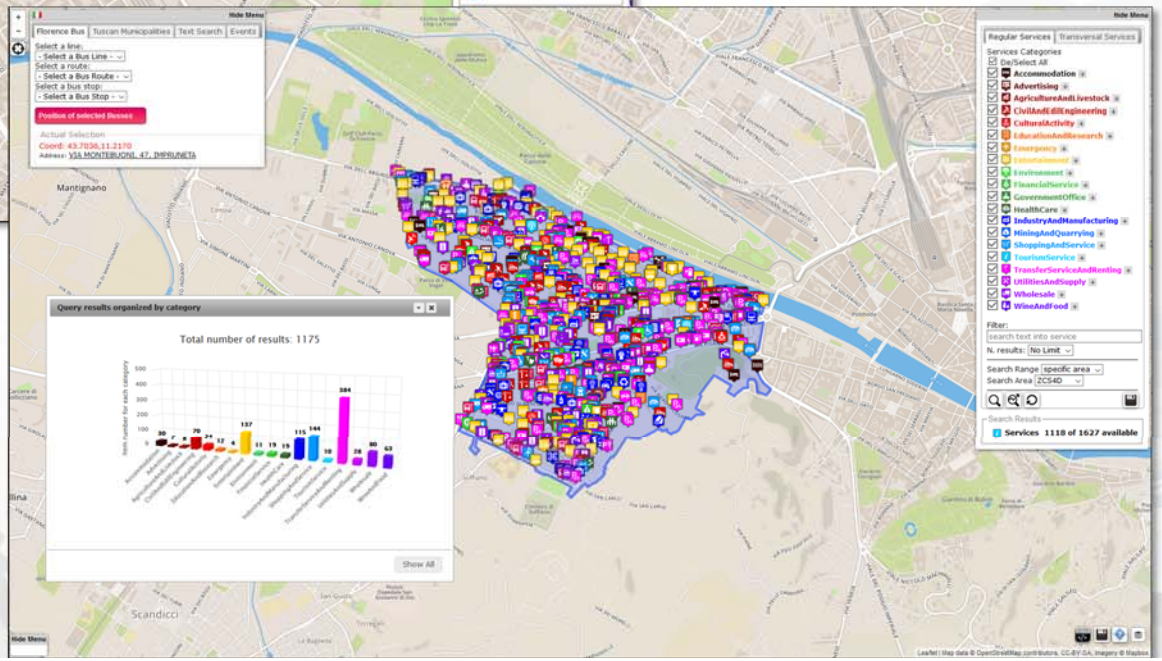
Cycling Paths



Along a Line



Into an Area



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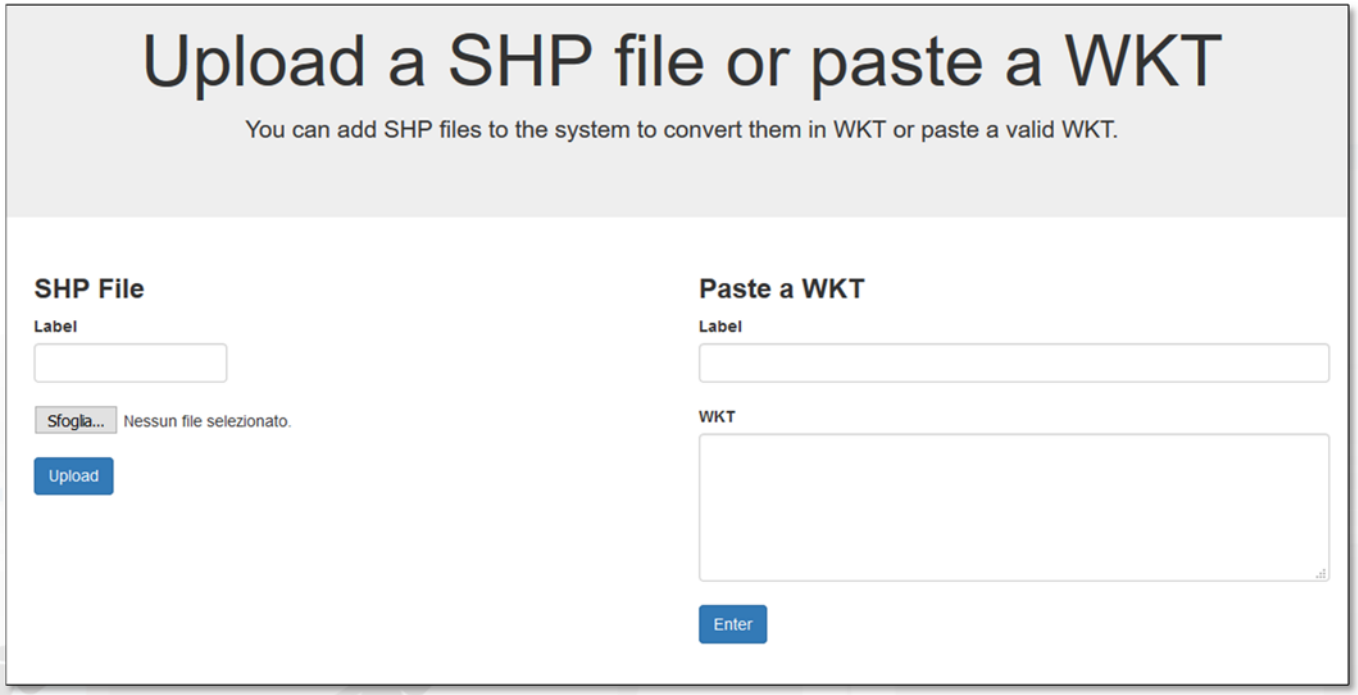
KM4CITY

Extracting data on Complex Polylines

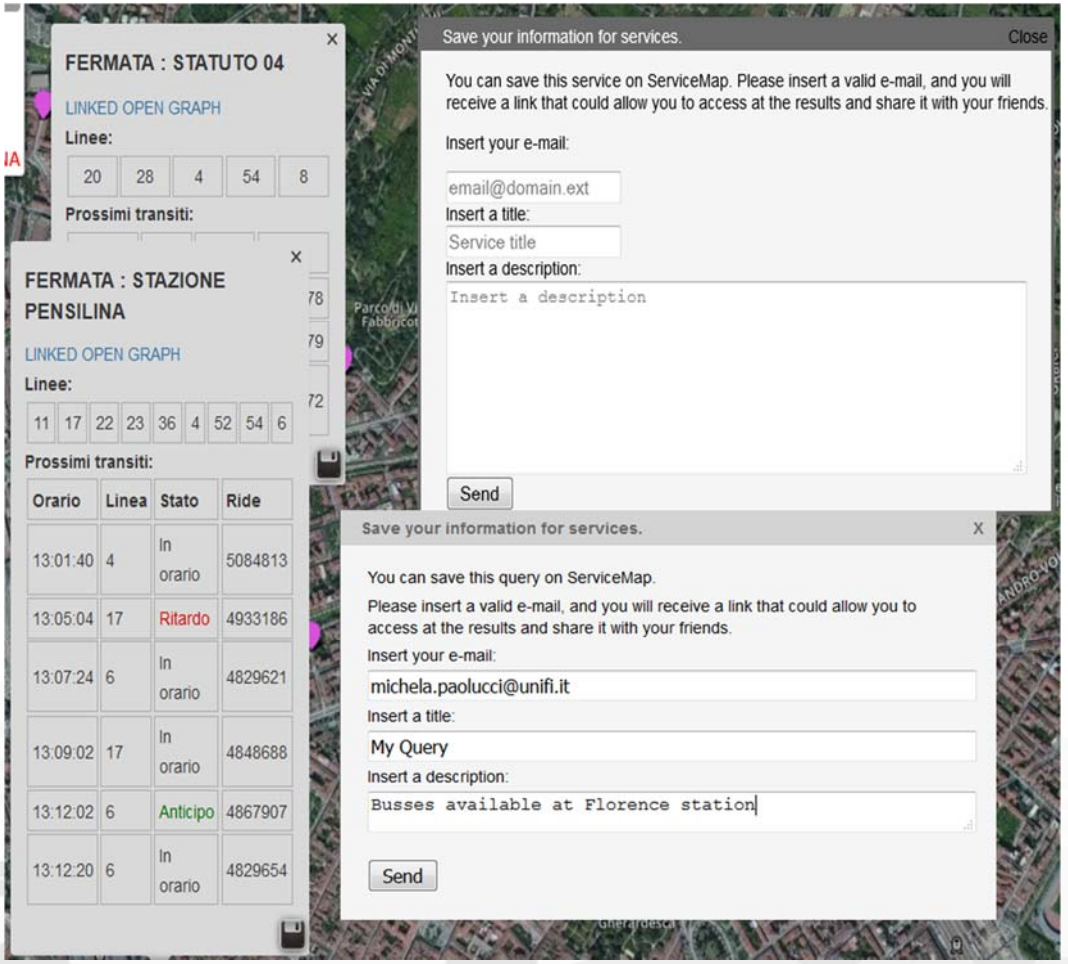
Shape loader

- http://www.km4city.org/wkt/
- http://arthur-e.github.io/Wicket/sandbox-gmaps3.html



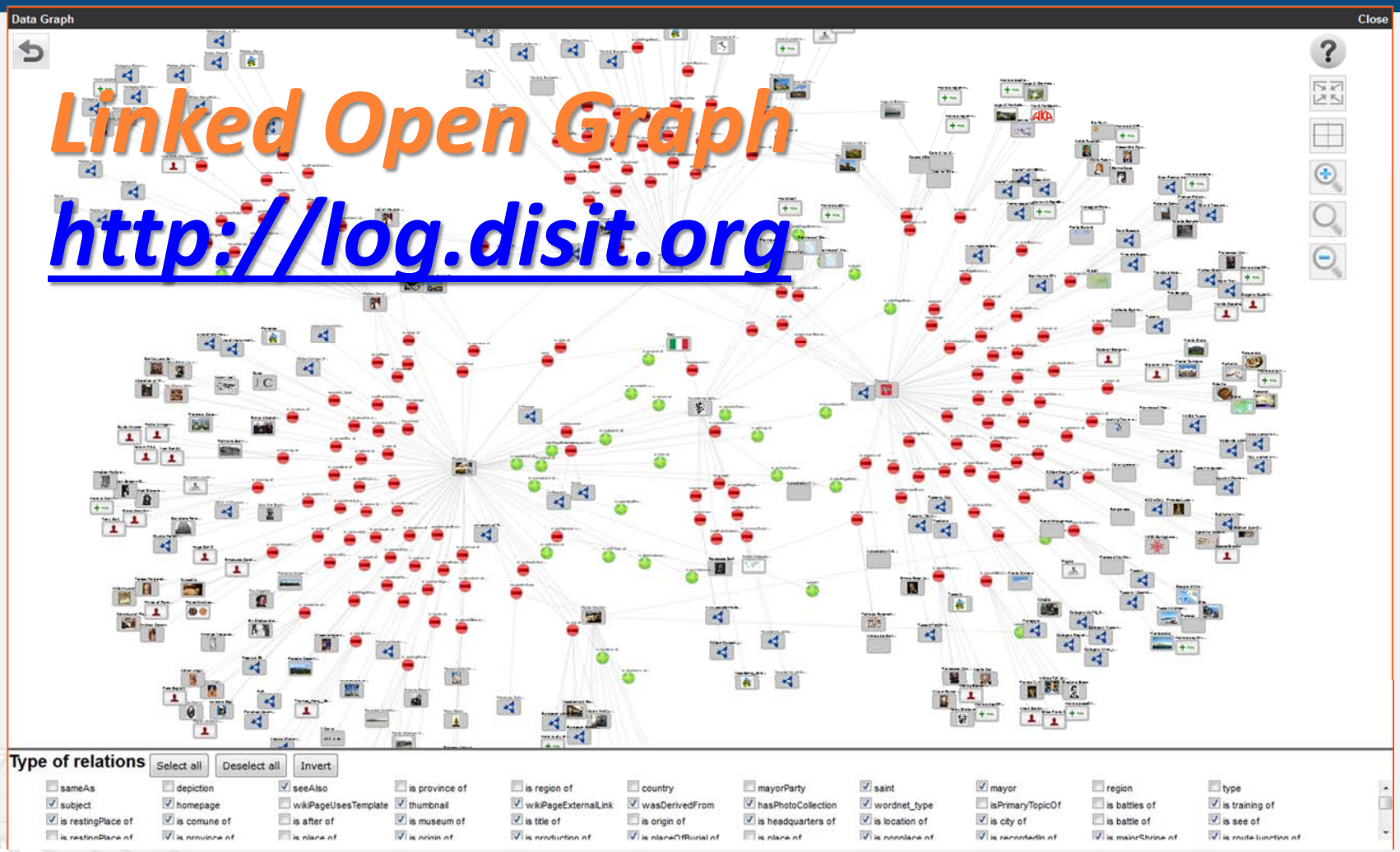
Km4city ServiceMap Km4City API

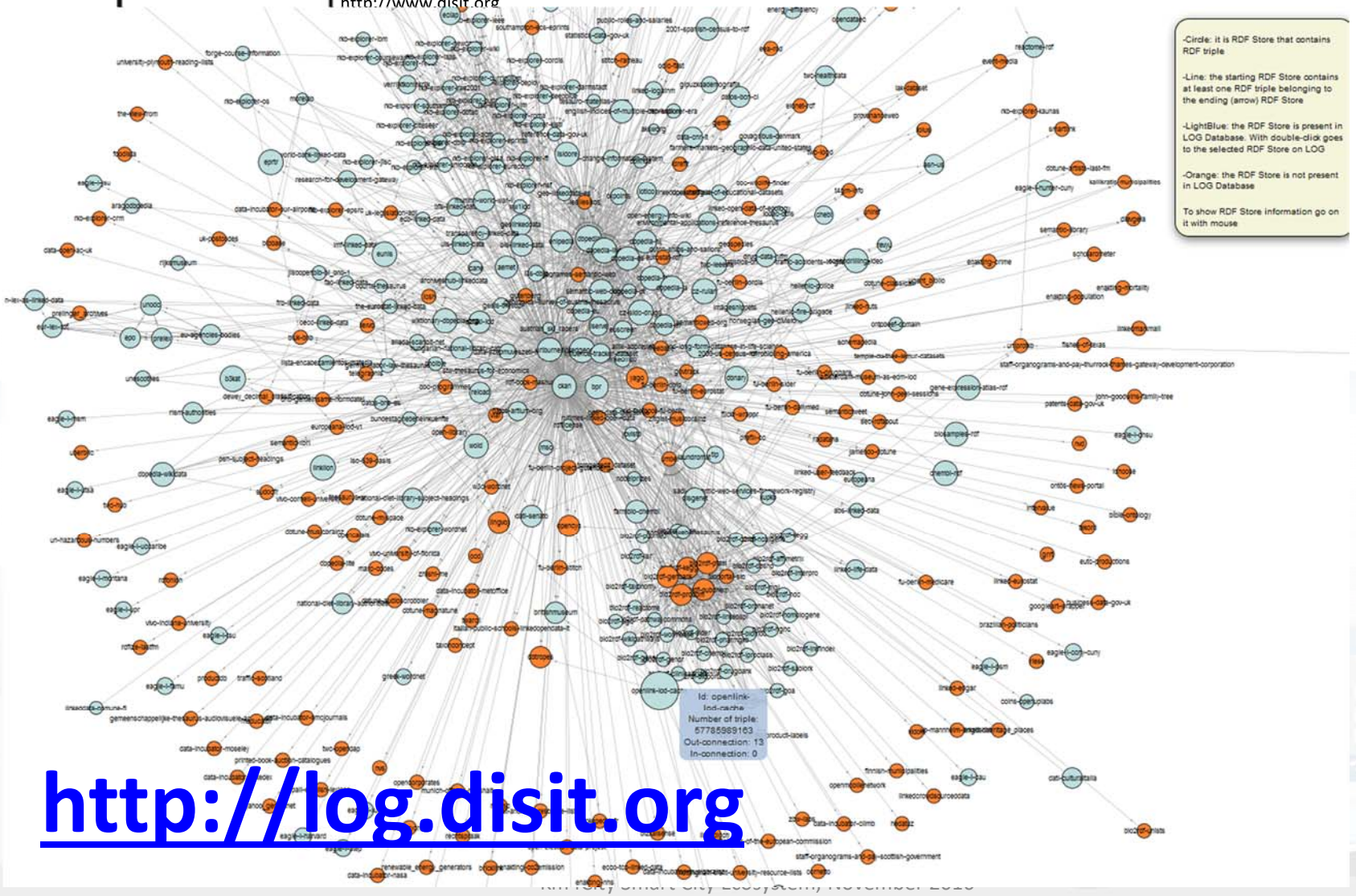
- http://www.disit.org/6597
  - REST API: serviceURI or Selection or GPS
  - REST API: Query ID
  - Receive an email
  - Get a JSON, HTML, …
- EMBED facility in third party web pages
- Developers may use the ServiceMap tool to:
  - compose geographical and textual queries
  - THEN request an e-mail containing the calls (same results in JSON and/or in HTML)



Major Requirements Smart City API

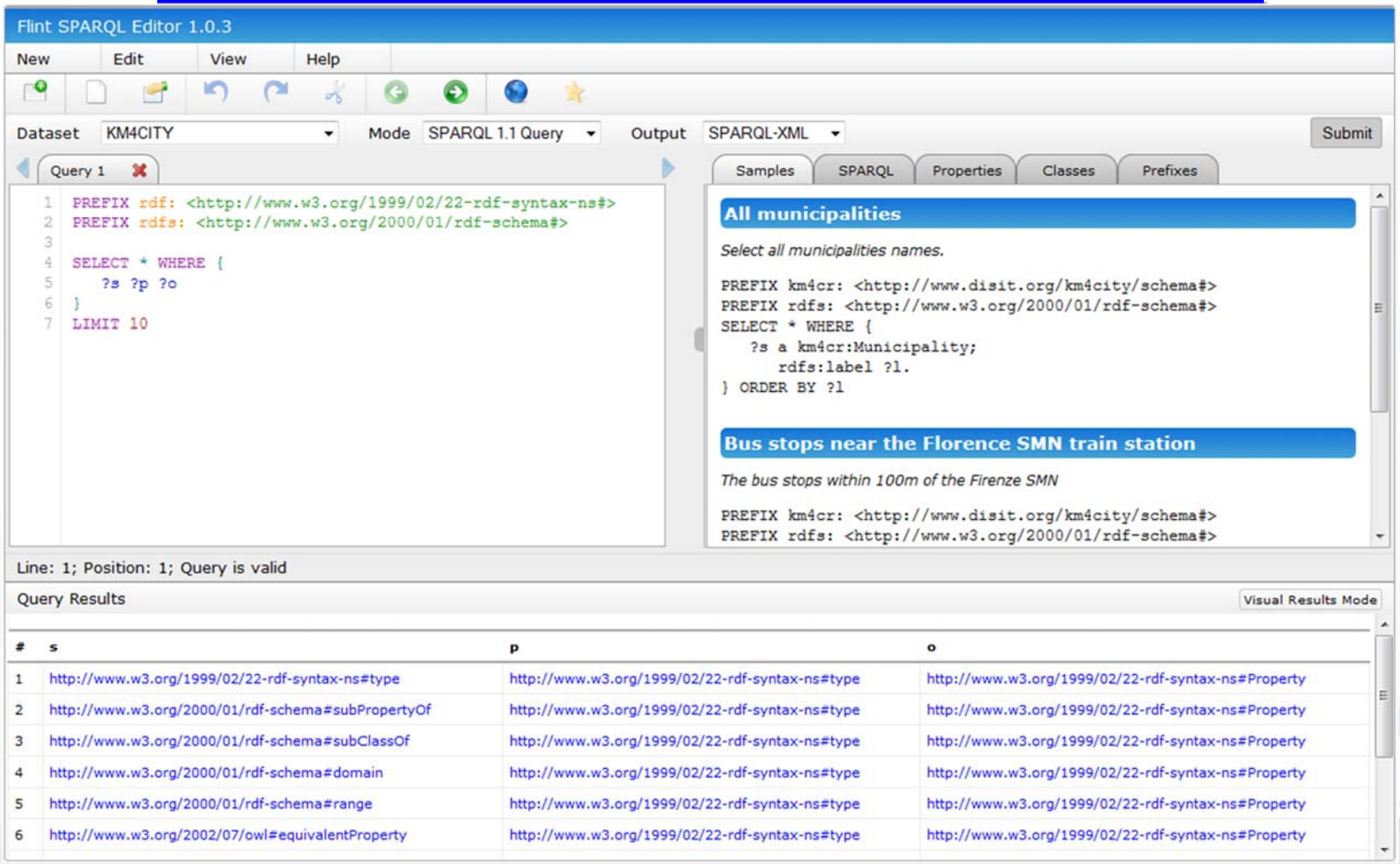
- Five Stars Linked Open Data, RDF Stores
- Towards Urban Platform, over simple OD collection
- Integrated Services
  - Search: text, geo/point, time, line, polyline, near a point, …
  - Specific Domain Support: mobility, energy, environment, commercial, POI, edu, gov, etc.
  - User Participation and Awareness
  - Personal Assistant, suggestion on demand, pushing, ..
  - Smart City Interoperability and Dash Board
  - Multilevel API modes: SPARQL, REST, Query ID
  - Enabled Inference and Ontology


Data Graph
Close
Linked Open Graph
http://log.disit.org
Type of relations
Select all
Deselect all
Invert
sameAs
depiction
seeAlso
is province of
is region of
country
mayorParty
saint
mayor
region
type
subject
homepage
wikiPageUsesTemplate
thumbnail
wikiPageExternalLink
wasDerivedFrom
hasPhotoCollection
wordnet_type
isPrimaryTopicOf
is battles of
is training of
is restingPlace of
is comune of
is after of
is museum of
is title of
is origin of
is headquarters of
is location of
is city of
is battle of
is see of



http://log.disit.org

http://log.disit.org/spqlquery/



#	s	p	o
1	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
2	http://www.w3.org/2000/01/rdf-schema#subPropertyOf	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
3	http://www.w3.org/2000/01/rdf-schema#subClassOf	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
4	http://www.w3.org/2000/01/rdf-schema#domain	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
5	http://www.w3.org/2000/01/rdf-schema#range	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
6	http://www.w3.org/2002/07/owl#equivalentProperty	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property

APIs: Kind of Call, Non functional

Front end Smart City API domains to provide services to management smart city applications, and to web and mobile applications.	CitySDK	ECIM	Transport.API	Navitia.io	Km4City
API kind of Call					
SPARQL Query					X
SPARQL Query with Inference					X
REST	X	X	X	X	X
Query ID					X
Non Functional					
Direct API Authentication	X	X	X	X	X
API Authentication via Social Media		X			
Data Licensing Control	X		X	X	X

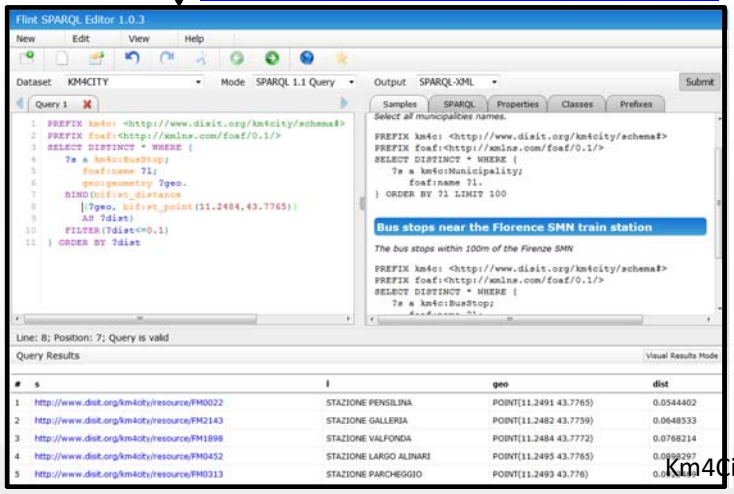
http://servicemap.disit.org/WebAppGrafo/api/v1/?**queryId**=9e5662a352d90ad4bc77690277a371ab&format=html

Query ID

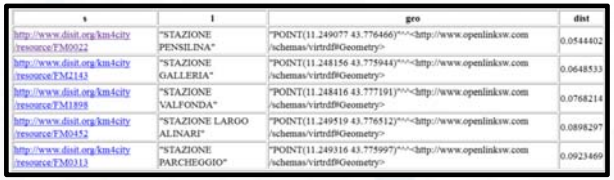
SPARQL on Virtuoso

SPARQL

http://log.disit.org/spqlquery



http://servicemap.disit.org/WebAppGrafo/sparql?query=…



http://servicemap.disit.org/WebAppGrafo/sparql?query=…&format=JSON

RDF Triples generated

DISIT Lab, Distributed Data Intelligence and Technologies
Distributed Systems and Internet Technologies
Department of Information Engineering (DINFO)
http://www.disit.dinfo.unifi.it

Macro Class	Static Triples	Reconciliation Triples	Real Time Triples Loaded	Total on 1.5 months
Administration	2.431	0	--	2.431
Metadata of DataSets	416	0	--	416
Point of Interest (35.273 POIs in Tuscany)	471.657	34.392	--	506.049
Street-guide (in Tuscany)	68.985.026	0	--	68.985.026
Local Public Transport (<5 lines of FI)	644.405	2.385	135.952 per line per day, to be filtered, read every 30 s, they respond in minutes	(static) 646.790
Sensors (<201 road sensors, 63 scheduled every two hours)	--	4.240	102 per sensor per read, every 2 hours, they are very slow in responding	51.111.078
Parking (<44 parkings, 12 scheduled every 30min)	--	1.240	7920 per park per day, 3 read per hour, they respond in seconds	
Meto (286 municipalities, all scheduled every 6 hours)	--	--	185 per location per update, 1-2 updates per day	
Temporal events, time stamp	--	--	6 for each event	1.715.105
Total	70.103.935	42.257		122.966.893

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From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

1. keep city under control via personalized dashboards
   - transform data in value for the city,
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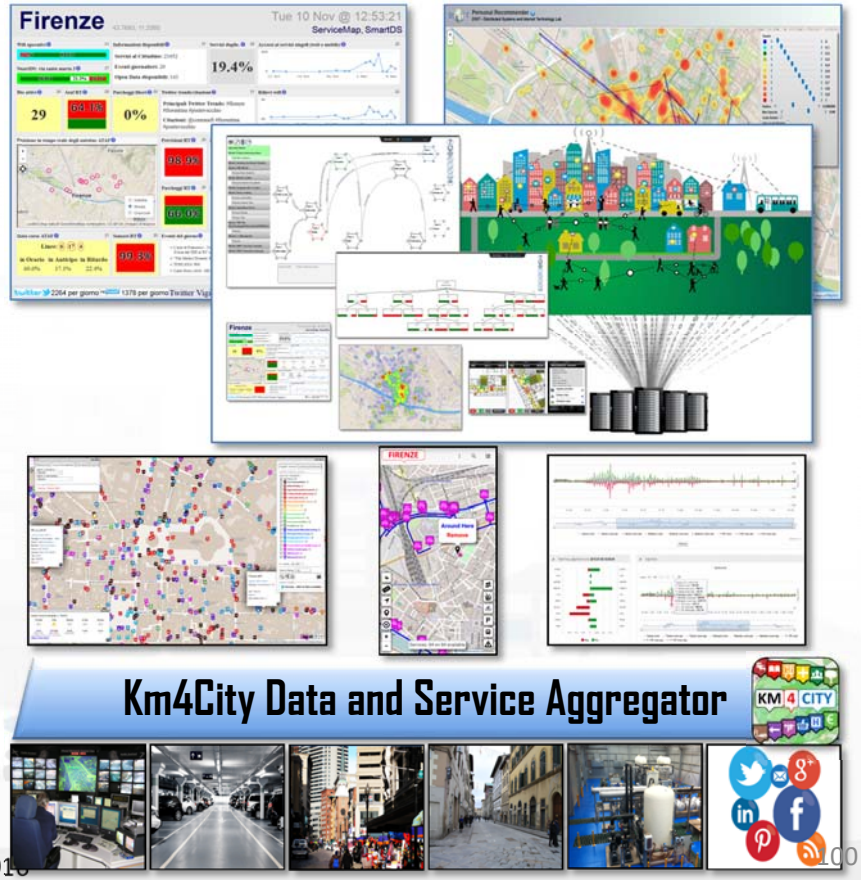
2. Technical details:
   - dashboard development
   - data aggregation
   - Projects contributing
3. improve city resilience, reducing risks and decision support



Info and Docs

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KM 4 CITY

GET IT ON Google play

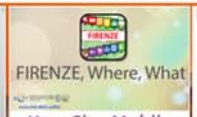
Download on the App Store

Download from Windows Phone Store

Home | Sentient City Control Room | City Users' Tools | Back Office and Dev Tools | Info and Docs

Km4City Information, Documentation, Tutorial, Training

Km4City Flyer PDF



Km4City Mobile App Video

Km4City Slides

Web Page: Projects exploiting & contributing to Km4City

Web Page: Km4City Information & Documentation page

Web Page: DISIT Lab (who we are)

Km4City Video 2015

Web Page: Km4City related Articles

Web Page: Data Ingestion Training and tools; ETL programming Develoment Environment

Web Page: GitHub Link Open Source Code

Roadmap of development

www.Km4City.org

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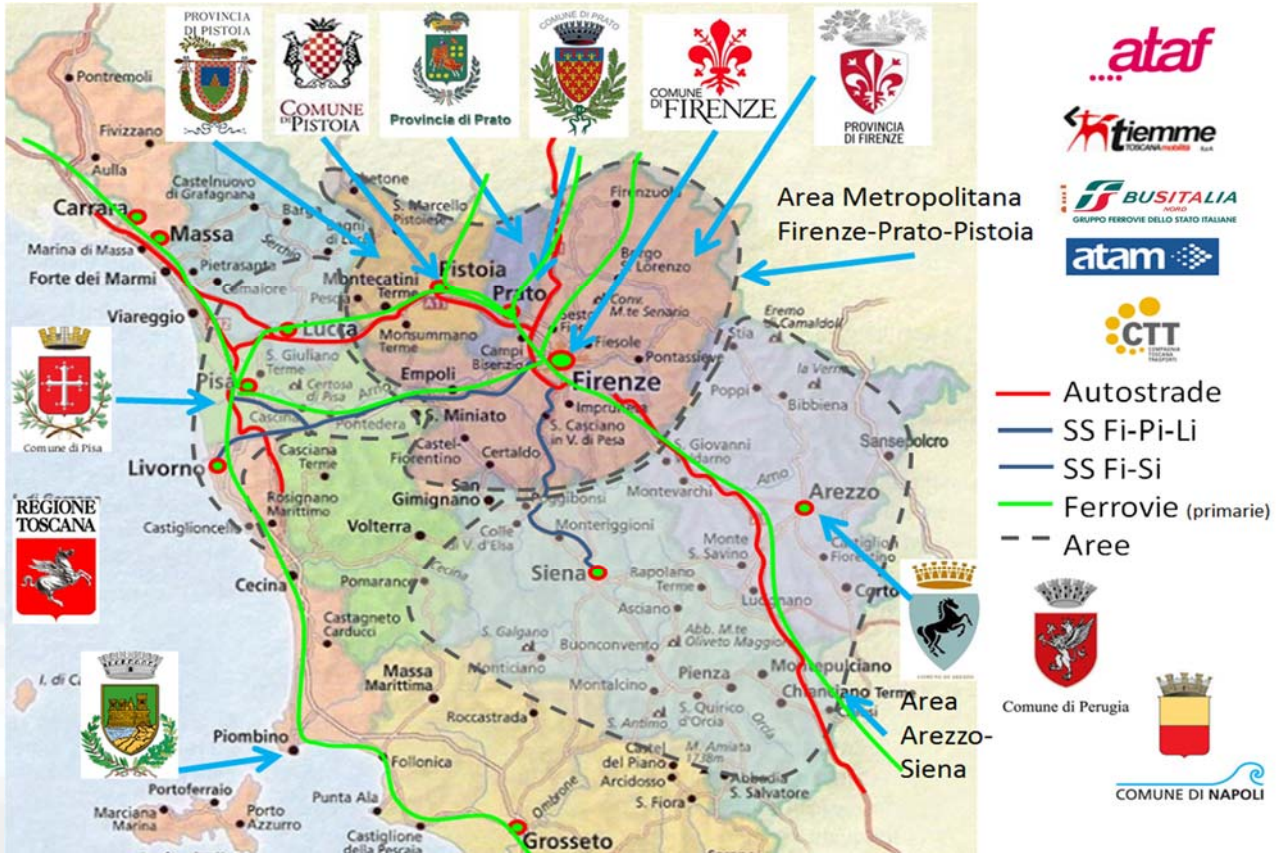
http://www.disit.org

Sii-Mobility

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

■ *http://www.Sii-Mobility.org*



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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Sii-Mobility

MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITÀ E DELLA RICERCA

KM 4 CITY

Commenti dei cittadini, Social Media

AVM trasporto Pubblico

Merci

Sensori su trasporto Privato

Sensori, sistema monitoraggio

Sensori Parcheggi

UTC

Infomobility

Varchi Telematici, ZTL

Monitoraggio traffico, autostrade

Rete Ferroviaria

Parametri ambientali

Servizi ed enti

Ordinanze: eventi, lavori pubblici, ..

Emergenze, polizia, 118

General Objectives

- 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**

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

RESOLUTE Architecture

RESOLUTE RESILIENCE Dashboard

Presentation& Visualization

User guidance

RESOLUTE Mobile APPs

FRAM → ResilienceDS

CRAMSS

FRAM operalization

ITS DSS

Smart DS

Evacuation DSS

Application framework

Algorithms and models

Decision support system

Data Integration APIs

User Profiler APIs

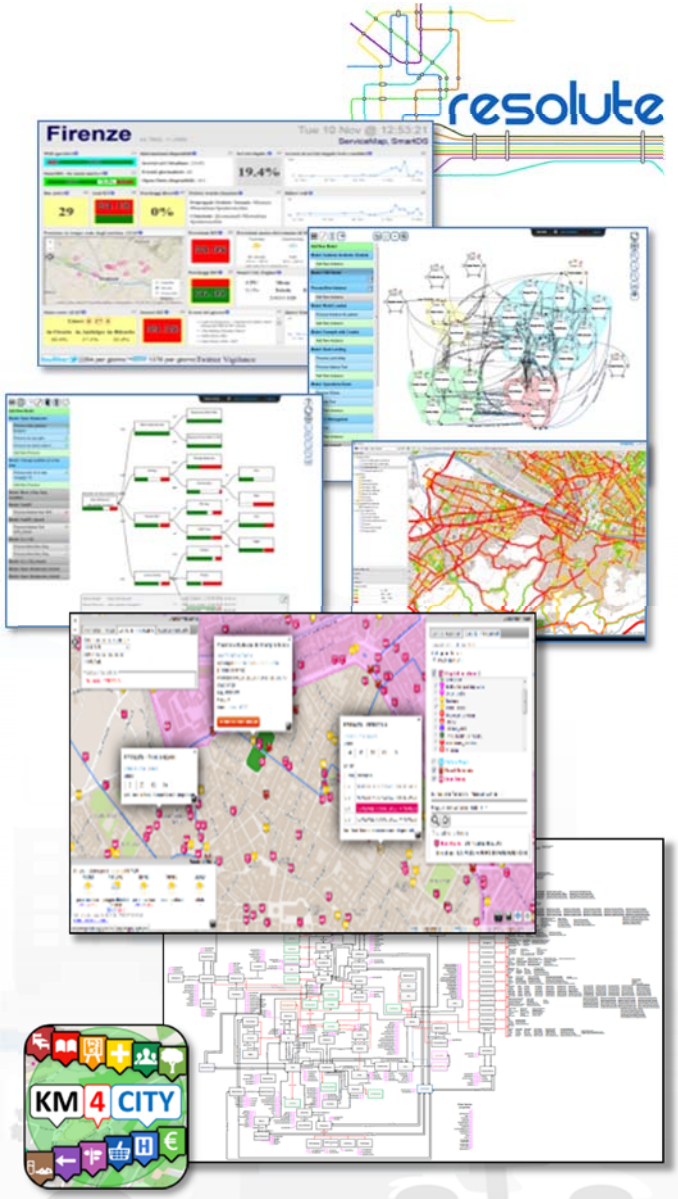
User profiler

Integration framework

Data and Service Aggregator





- 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*

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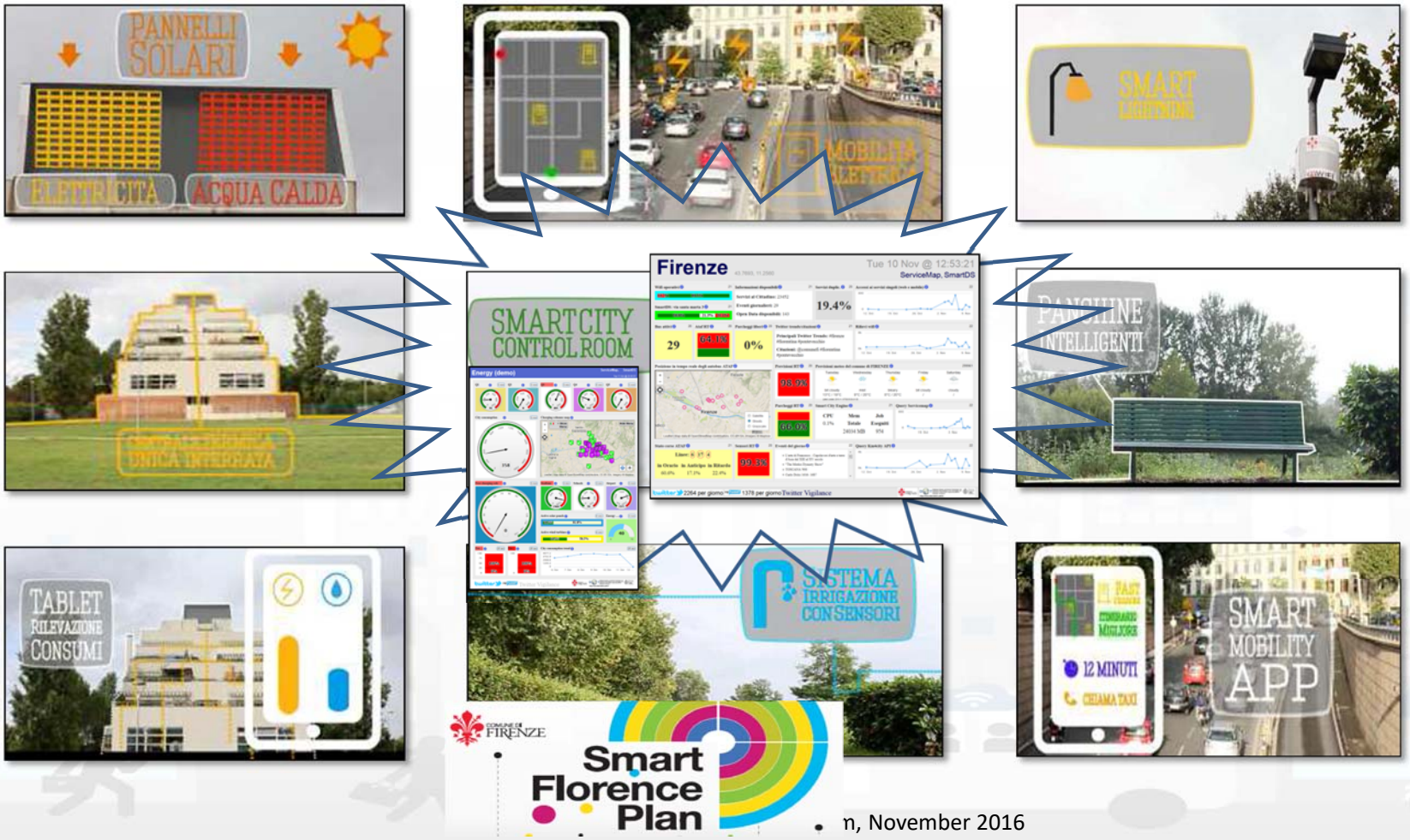
REPLICATE

Horizon 2020 European Union Funding for Research & Innovation

REPLICATE in Firenze: Energy, ICT & Mobility



n, November 2016

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

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

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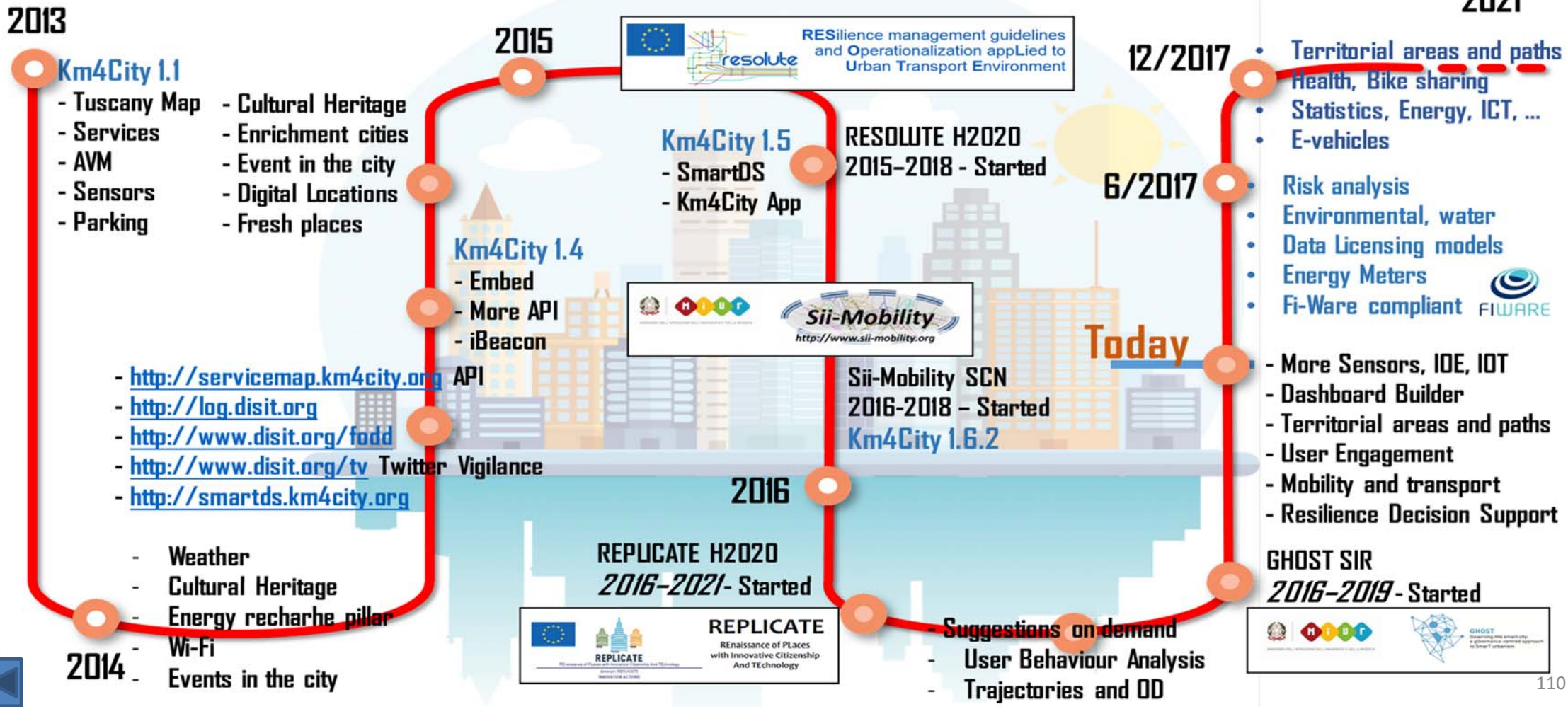
Km4City Roadmap




3 - improve city
resilience,
reducing risks and
decision support

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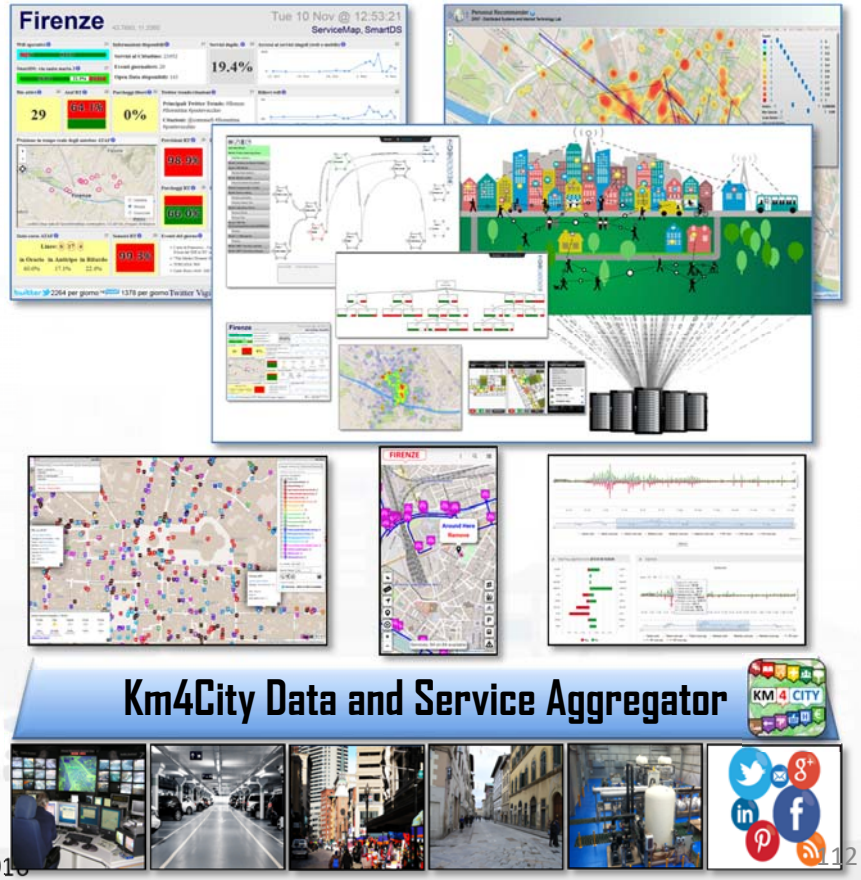
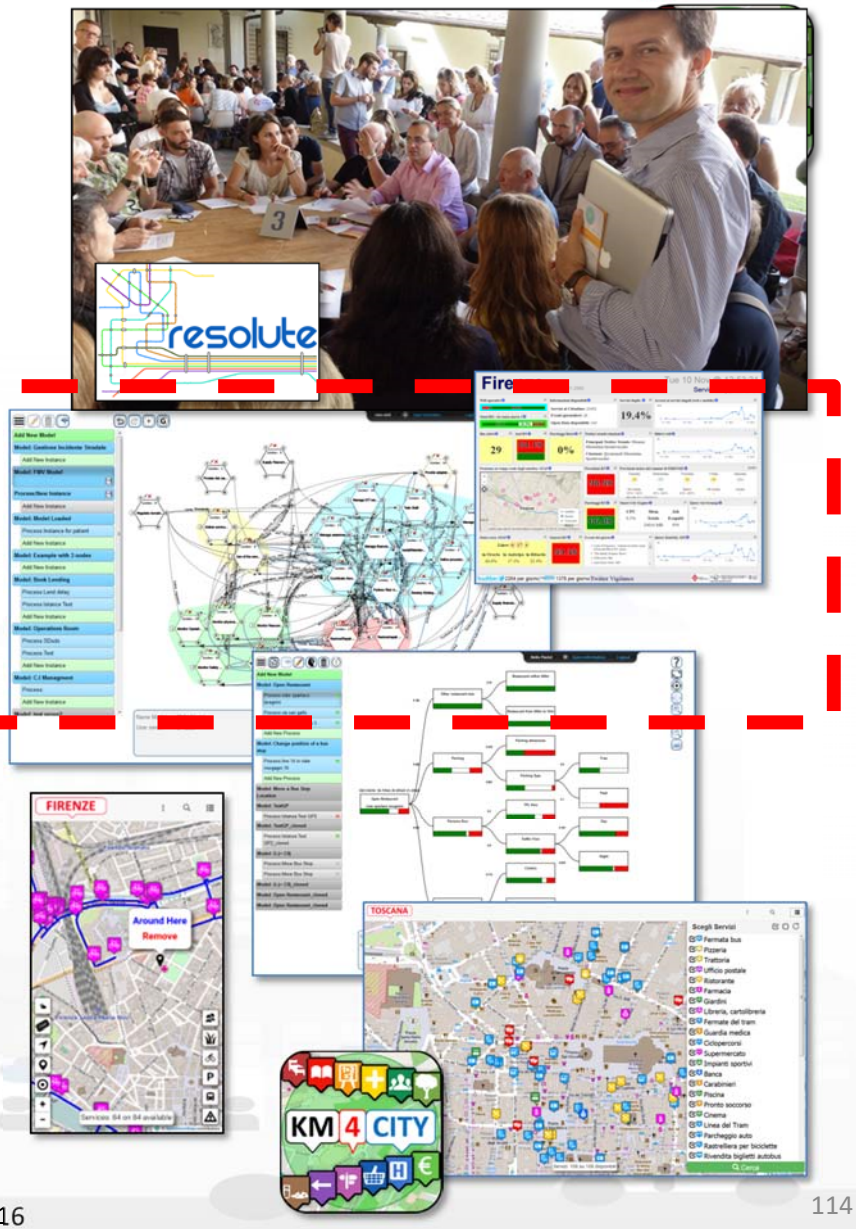


Sentient City Control Room

www.Km4City.org

Improve city resilience, reducing risks and decision support

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



Problems and issues

- Cities include critical infrastructures strongly related / depended each other:
  - Transport, energy, communication, cyber, health...
- Risks for these Critical Infrastructure (safety and security) may be due to natural and/or human made events.
- UTS, Urban Transport System, is one of the most challenging since UTS is the via by which many problems may propagate but also the path used by solutions and the recovery actions.

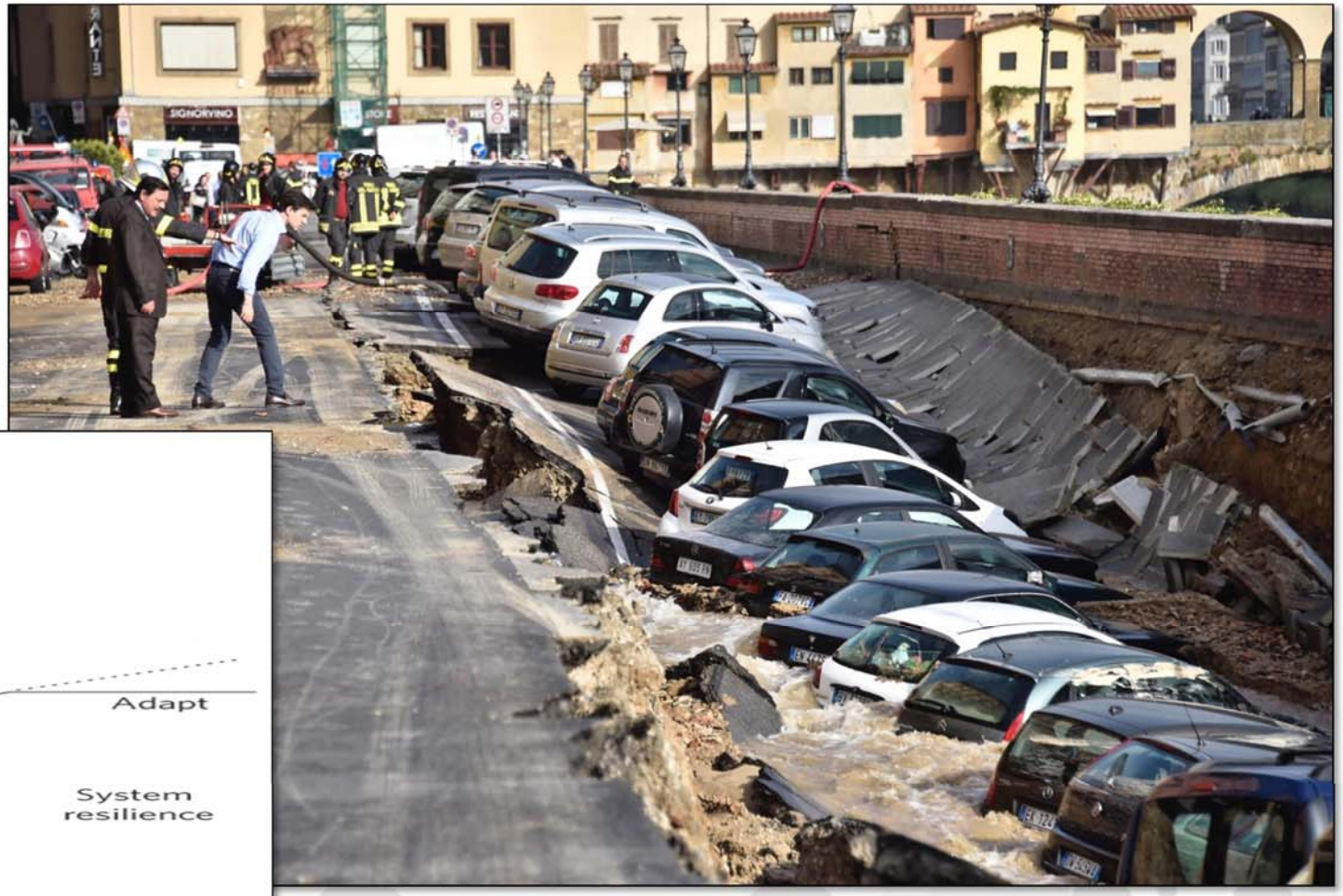
City Resilience

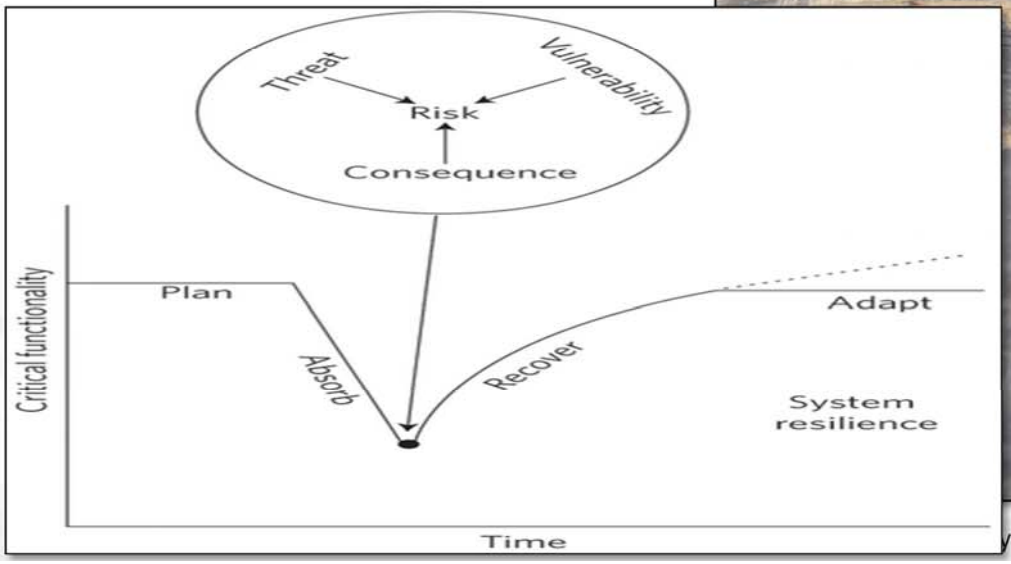
Prepare

Absorb

Recover

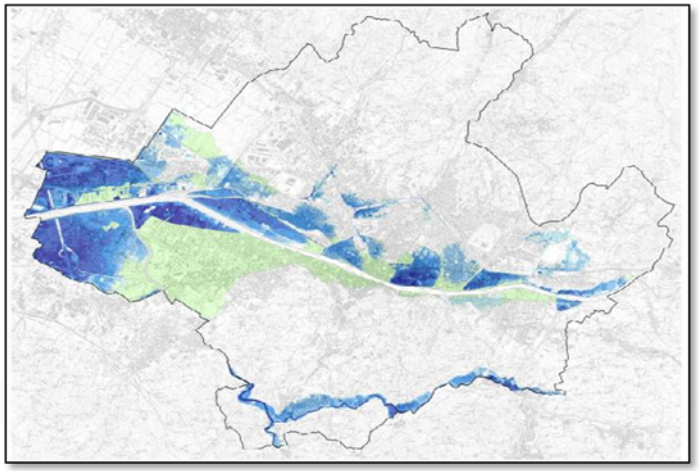
Adapt



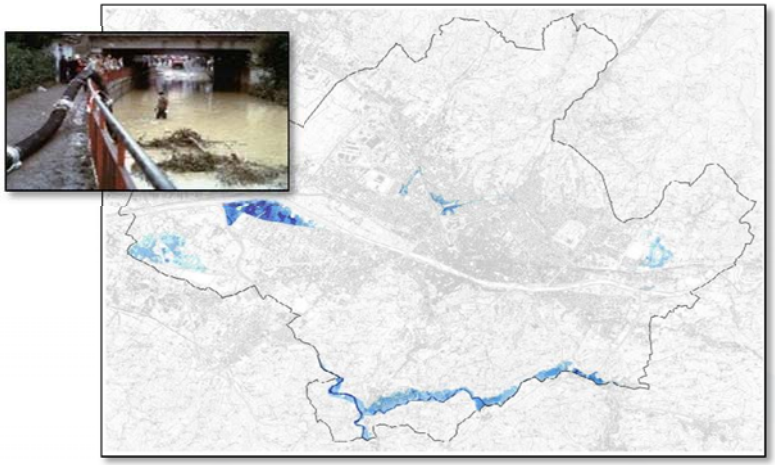


City Resilience ERMG

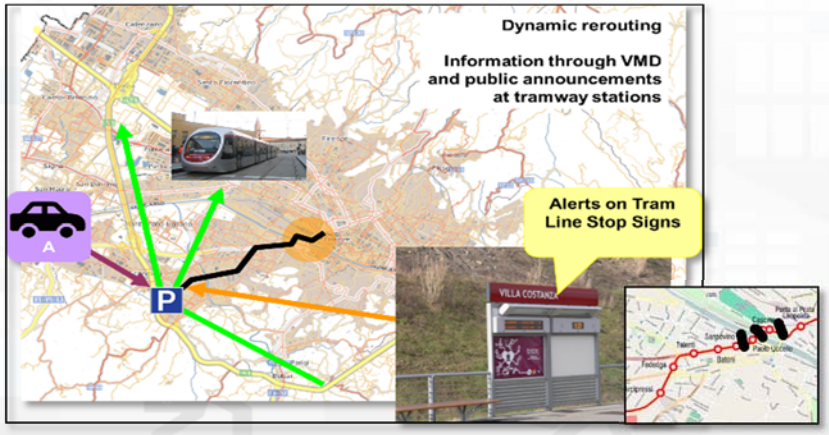
200 years probability Arno flooding



30 years probability Arno flooding



Arno Flood Impact on Tram Line & Traffic



Water bomb in South Florence

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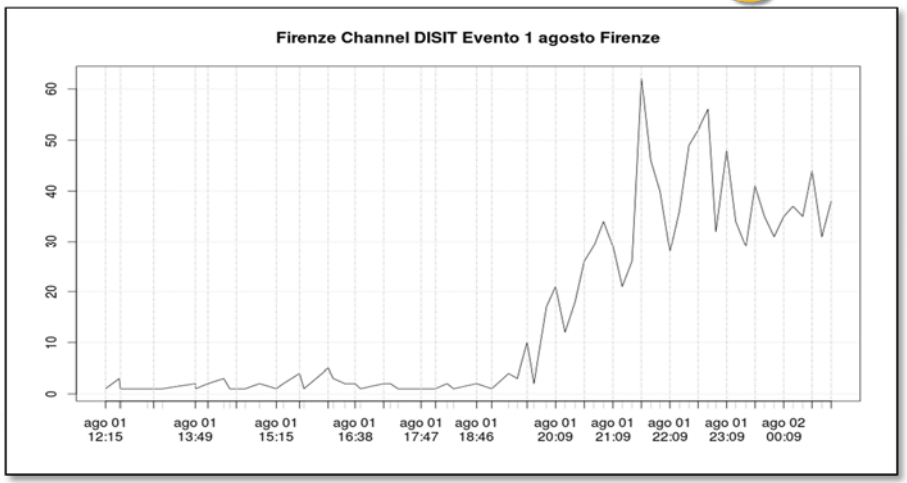
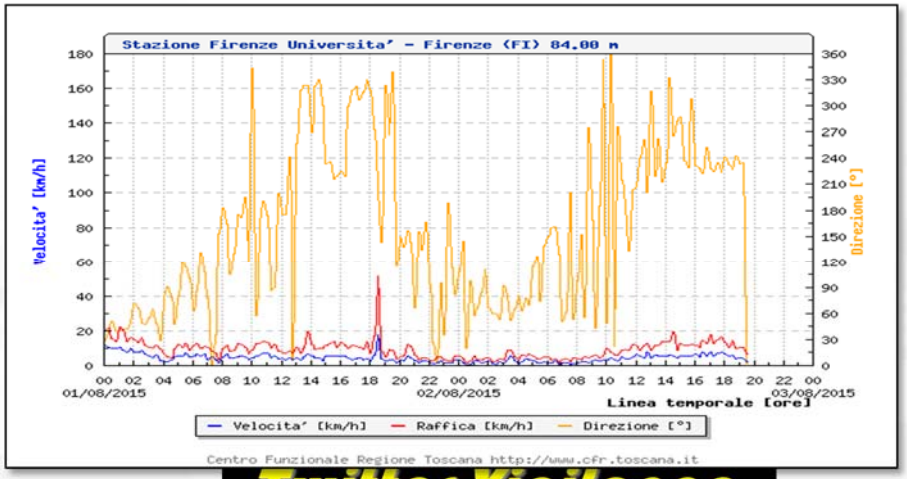
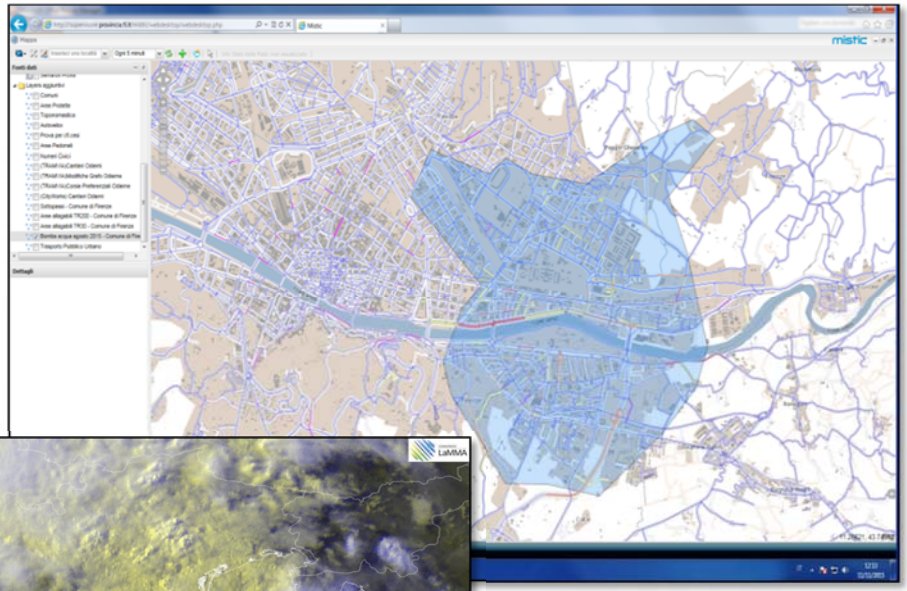
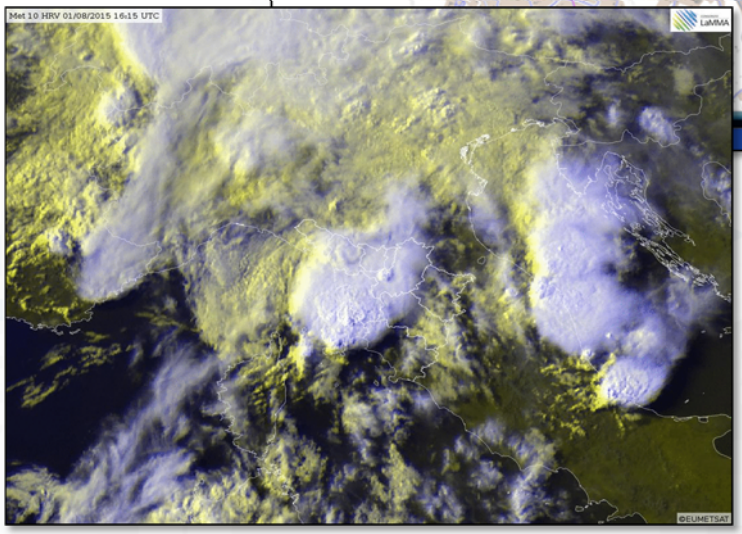
Early Warning
Twitter Vigilance and Water Bomb





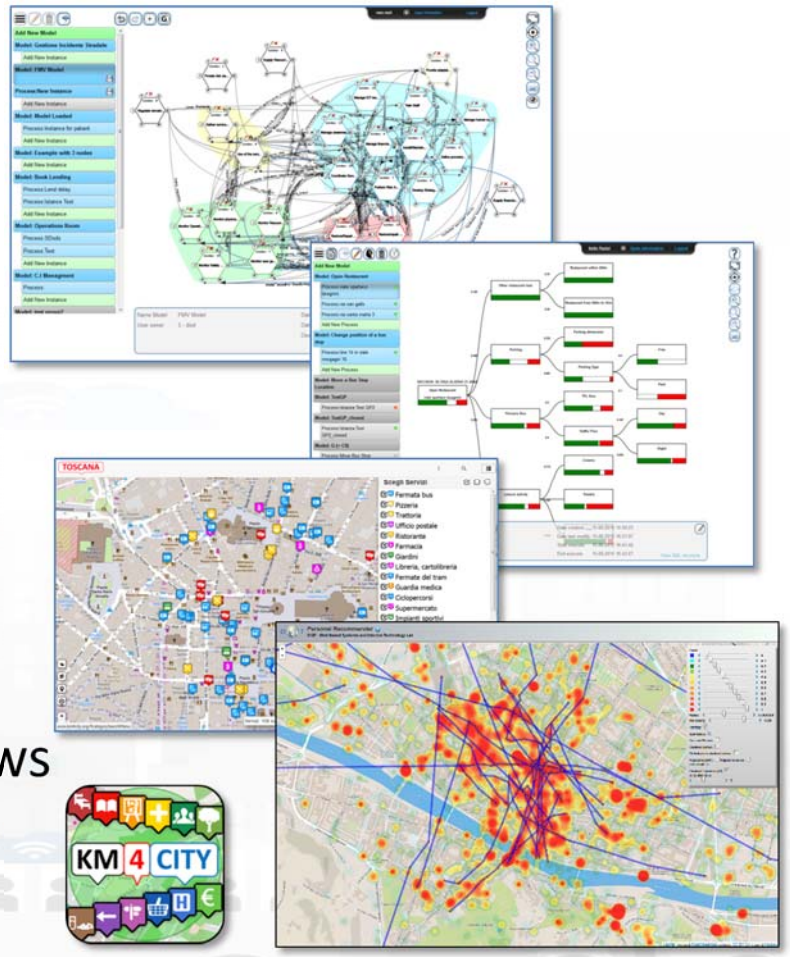




Twitter Vigilance

Main Approach

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



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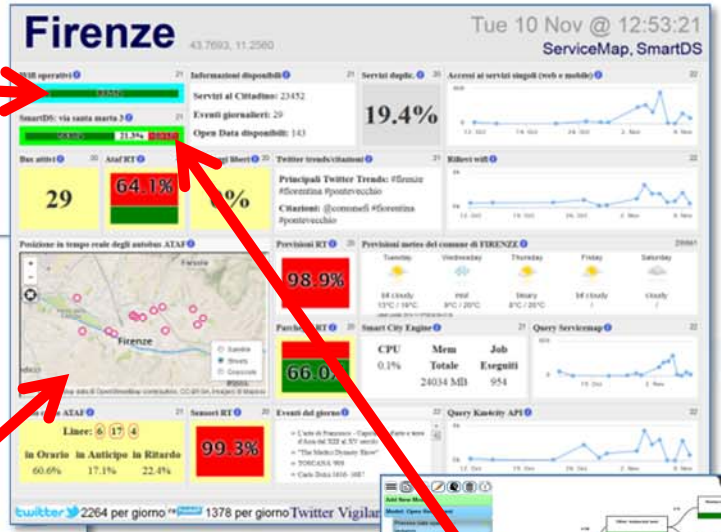
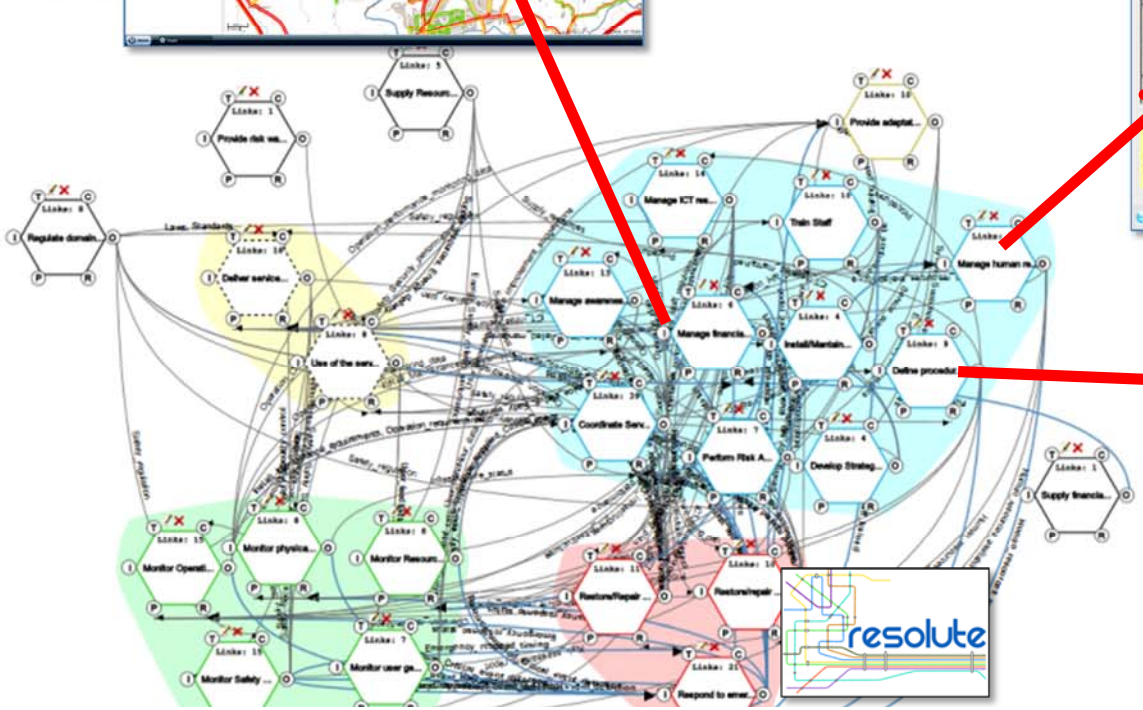
KM 4 CITY

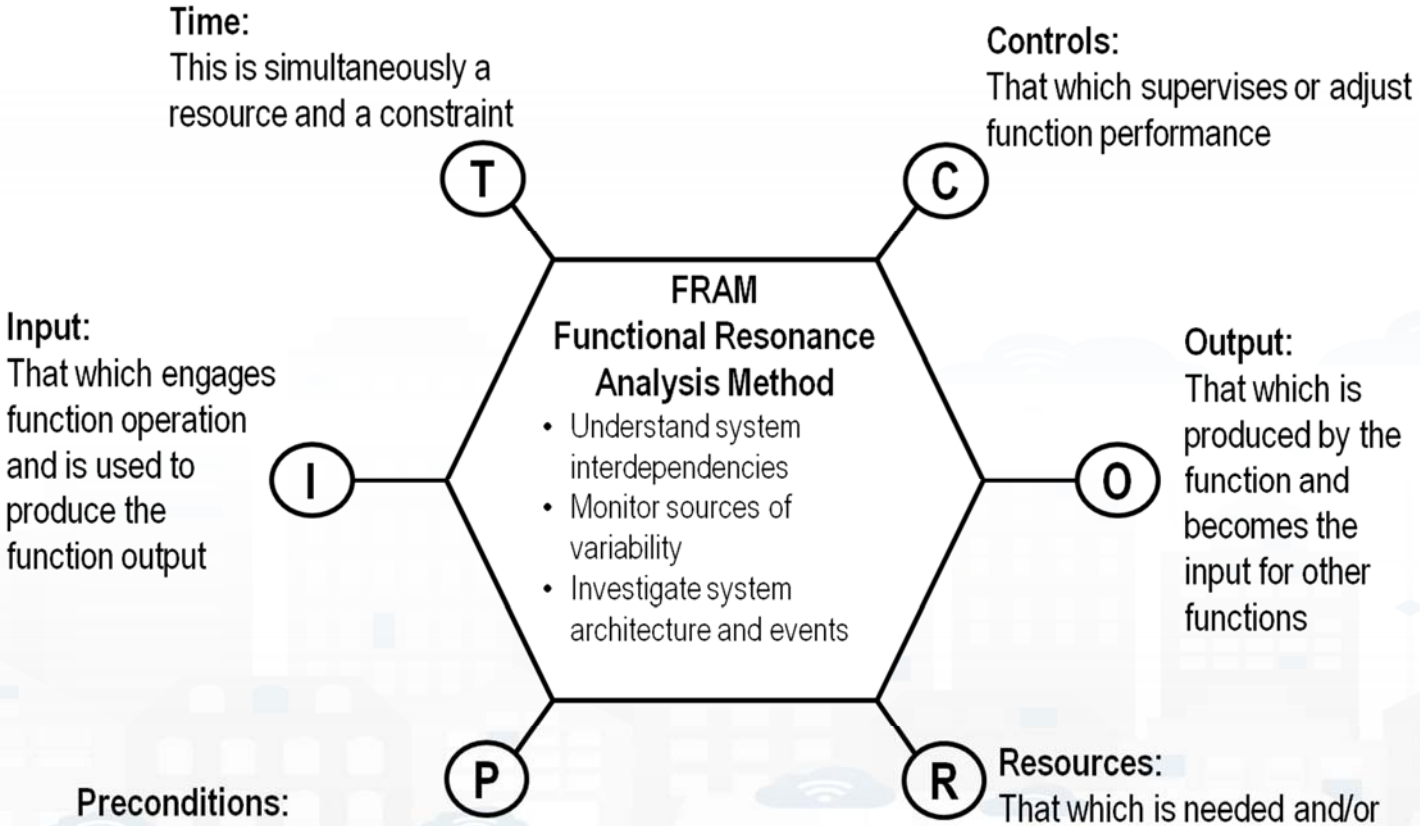
Dashboarding city resilience





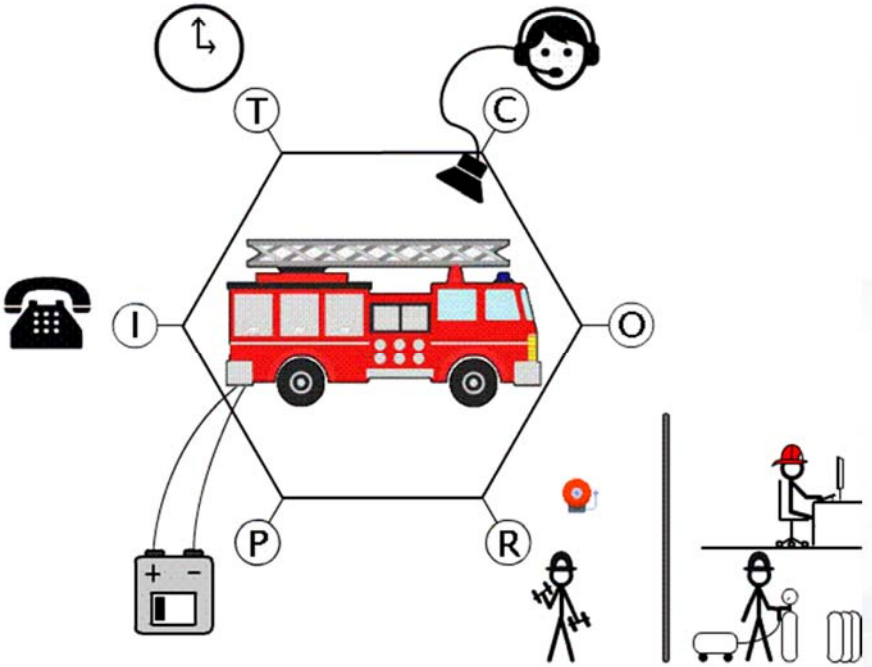
er 2016

Functional Resonance Analysis Method



Functional Resonance Analysis Method

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



resolute

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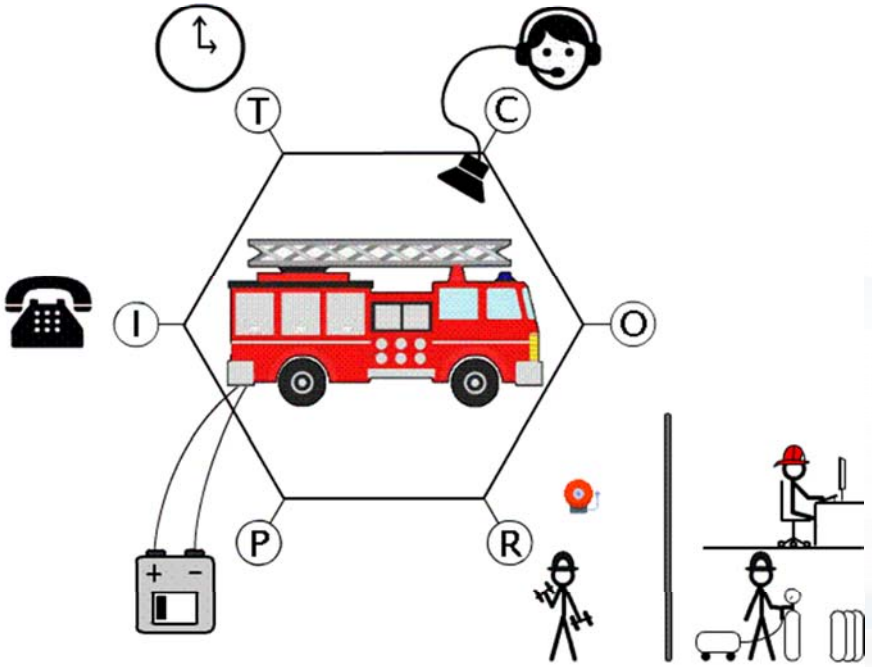

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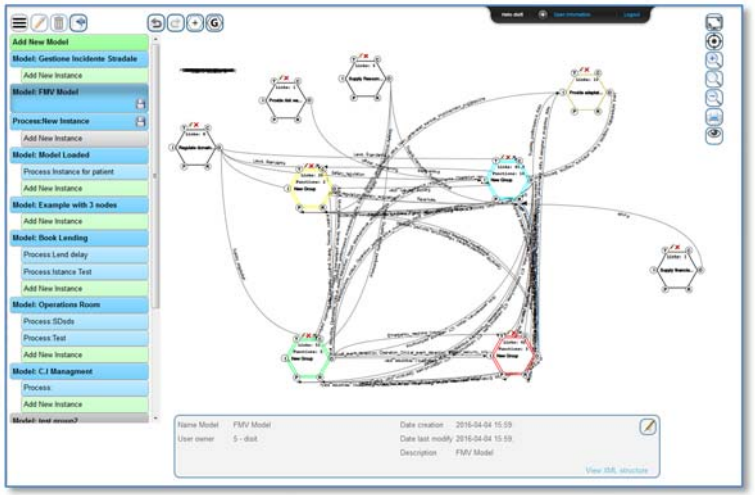
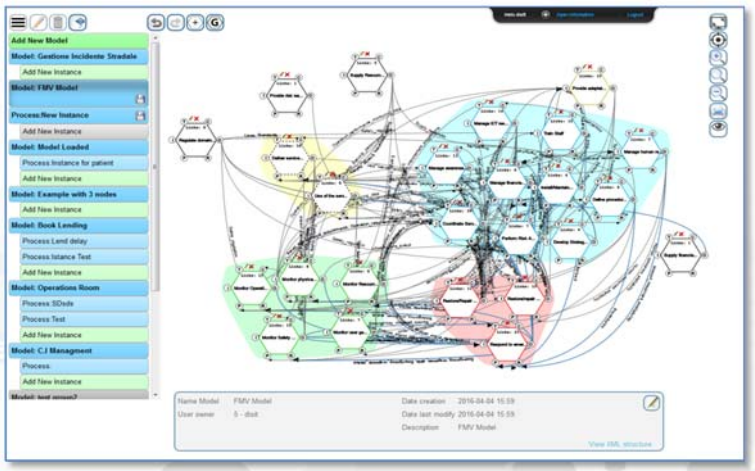
ResilienceDS tool

resolute

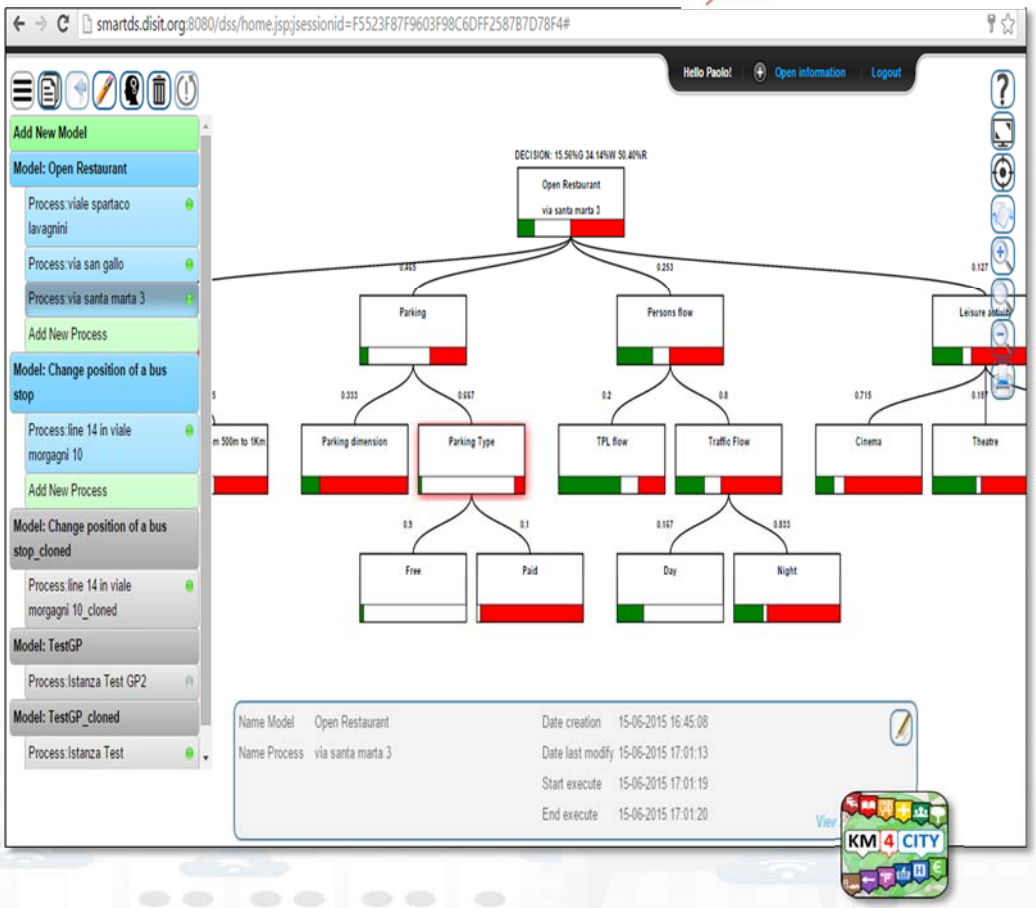
- FRAM Model
  - Macro FRAM processes
  - Metrics for Process complexity assessment
  - Operational Semantic for executing FRAM model
  - Connection with SmartDS
  - Connection with BigData open to multiple sources of data and workgroup results, Km4City
- Collaborative work
- Open for all
- Validated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



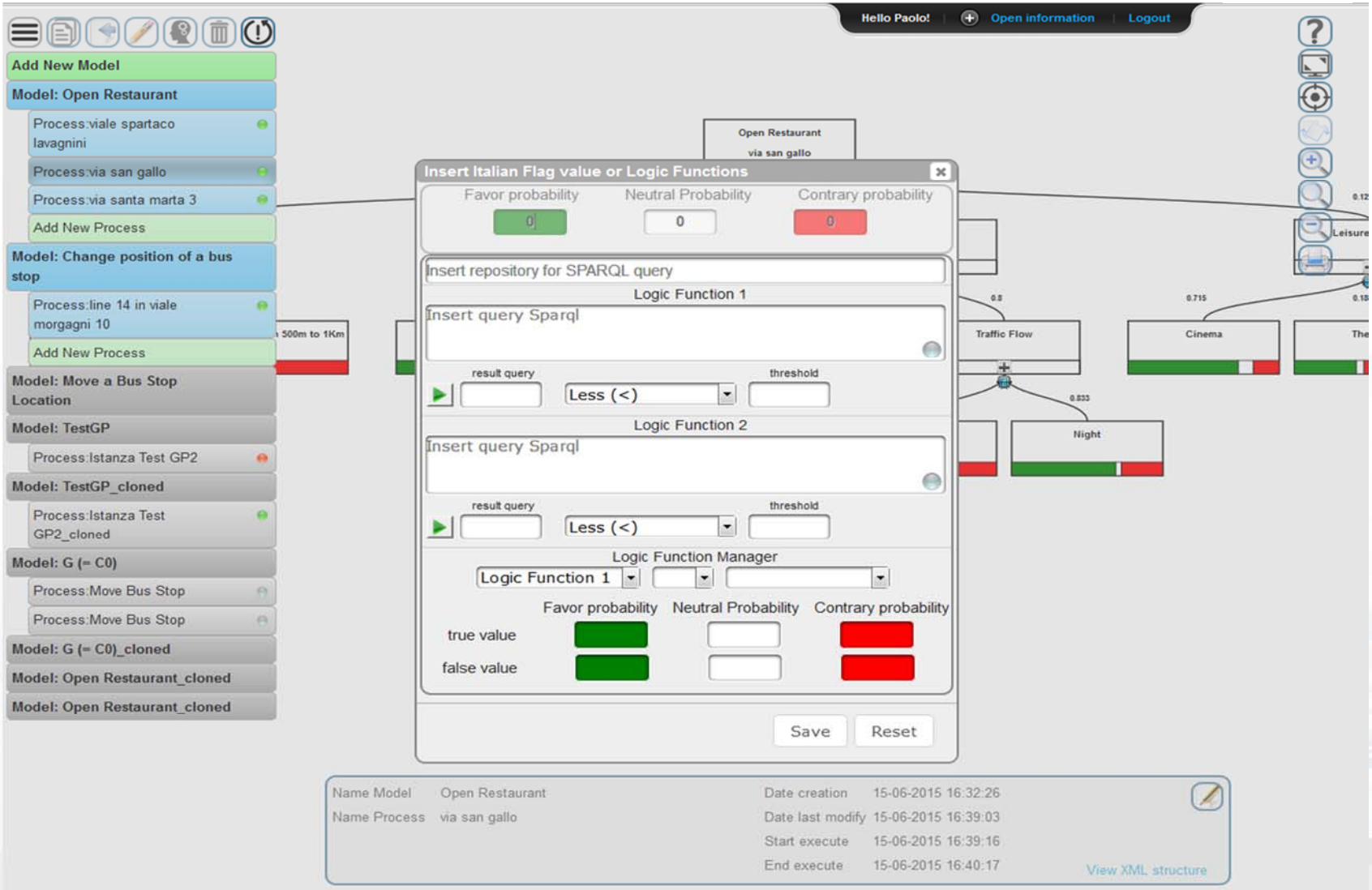


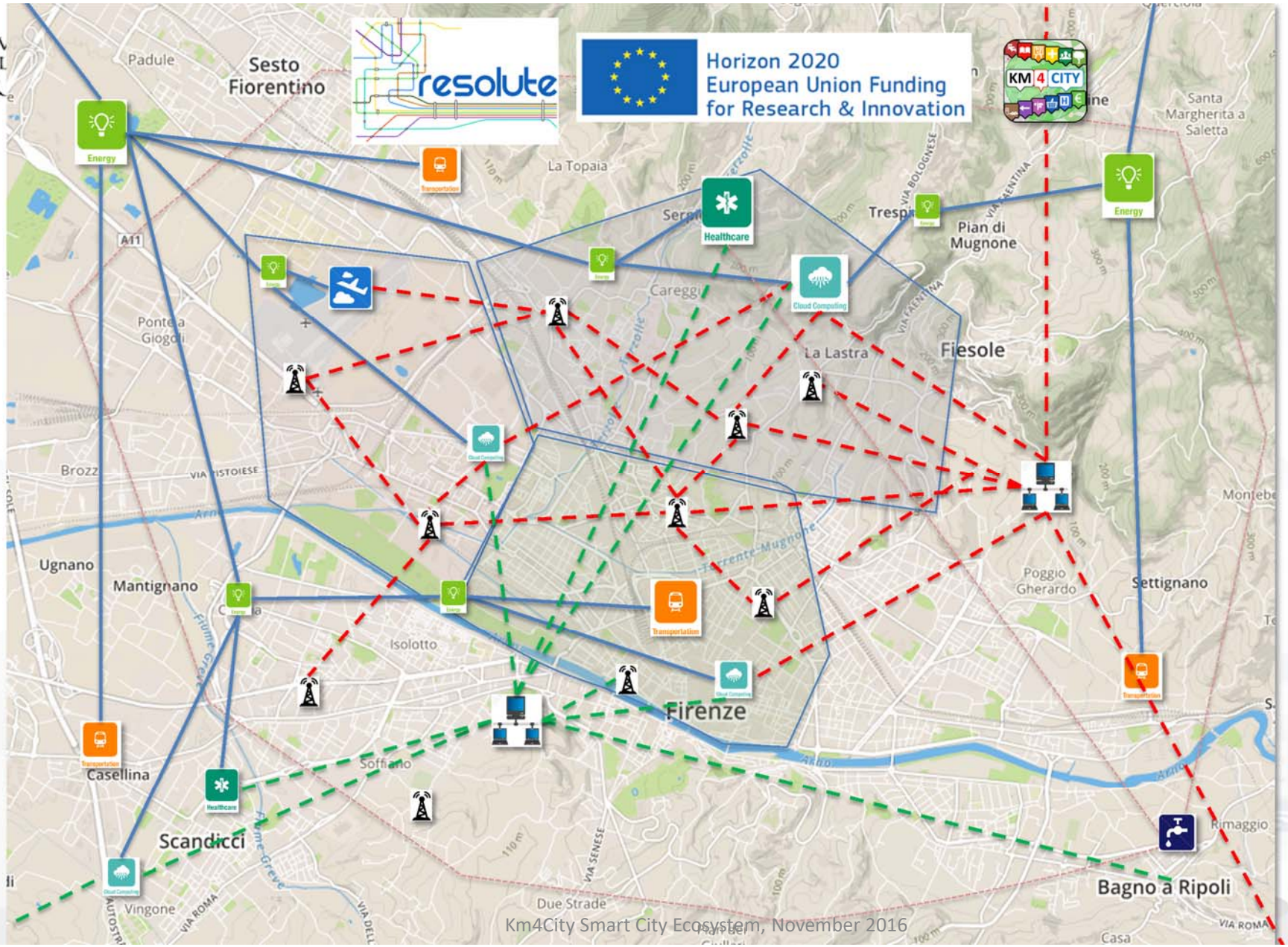
Smart Decision Support

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



Smart Decision Support

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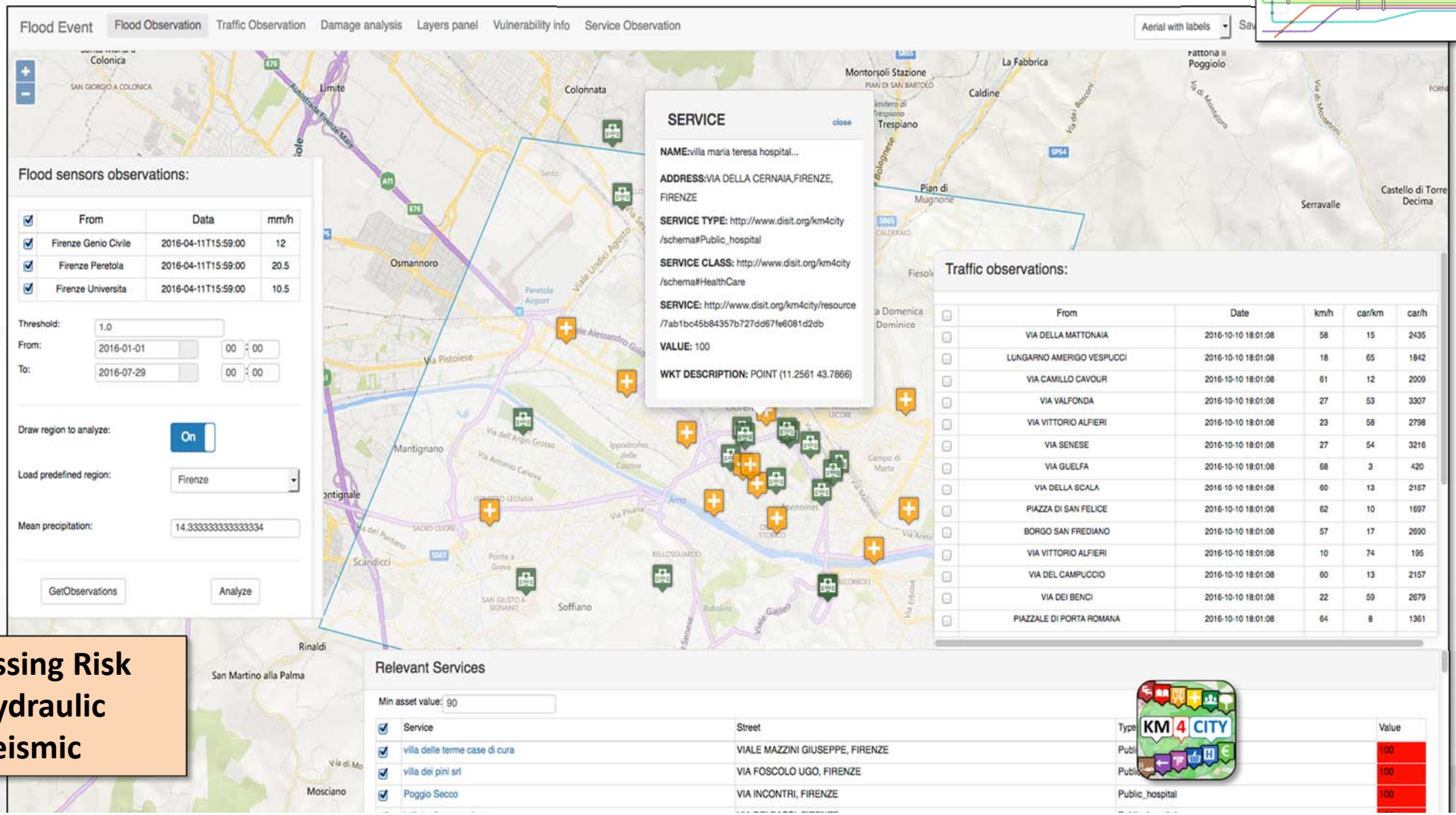
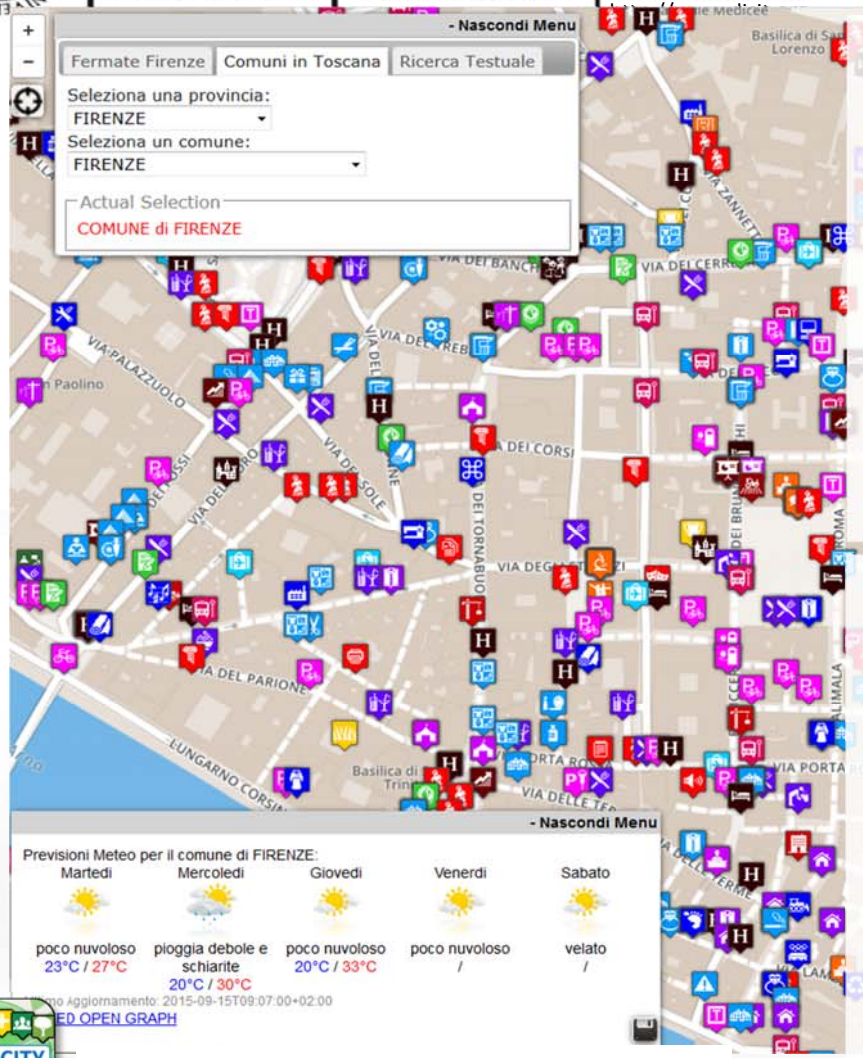
Risk Assessment



Assessing Risk

- **hydraulic**
- **Seismic**



Road Graph (Tuscany region)

- 132,923 Roads
- 389,711 Road Elements
- 318,160 Road Nodes
- 1,508,207 Street Numbers

Services (20 cat, 512 cat.)
16 Pub. Transport Operators
21.280 Bus stops & 1081 bus lines
210 Parking areas
796 Traffic Sensors
Info on: points, paths, areas, etc.

Dynamic/real-time

- **bus lines: 144 updates X day X line**
- **parking status: 76 updates X day X sensor**
- **traffic Sensors: 288 updates X day X sensor**
- **weather: 2 updates X day for 285 areas**
- **events: about 60 new events X day**
- **Wi-Fi: > 350.000 measures X day**
- **mobiles: > 50.000 measures X day**
- **more than 35.000 distinct users X day**
- **From 600.000 to 4.5 M Tweets X day**
- **…..many other sensors …. see next slide**

http://servicemap.km4city.org

Other Sensors and Actuators, IOT

- Restricted Traffic Zone Gates
  - Passages, payment, alerts, Wi-Fi control, RFI control, etc.
- Road Direction manager: panel, red-light, etc.
  - Status and action
- Environmental Sensors:
  - Air quality, pollution, rain, allergens, temperature,
  - humidity,…
- Public Light Pillar
  - Traffic flows, environment,
  - Wi-Fi, Tv-Camera, BT servers, on/off, percentage of light, ..
- Waste Manager
  - Level, kind, status, on/off
- Recharge station, column
  - Free slots, consumption, next time slot, …

- **Environmental Sensors**:
  - Air, temperature, humidity,
  - water level in rivers
  - Status of underpass and bridges
- **Risk assessment**
  - Value of the buildings,
  - hydrogeological risk map,
  - earthquake risk map, …
  - people distribution and location
  - Position of recover places,
- **Traffic Zone Gates**
  - Passages, alerts,
  - Wi-Fi control,
  - RFID control,
  - etc.

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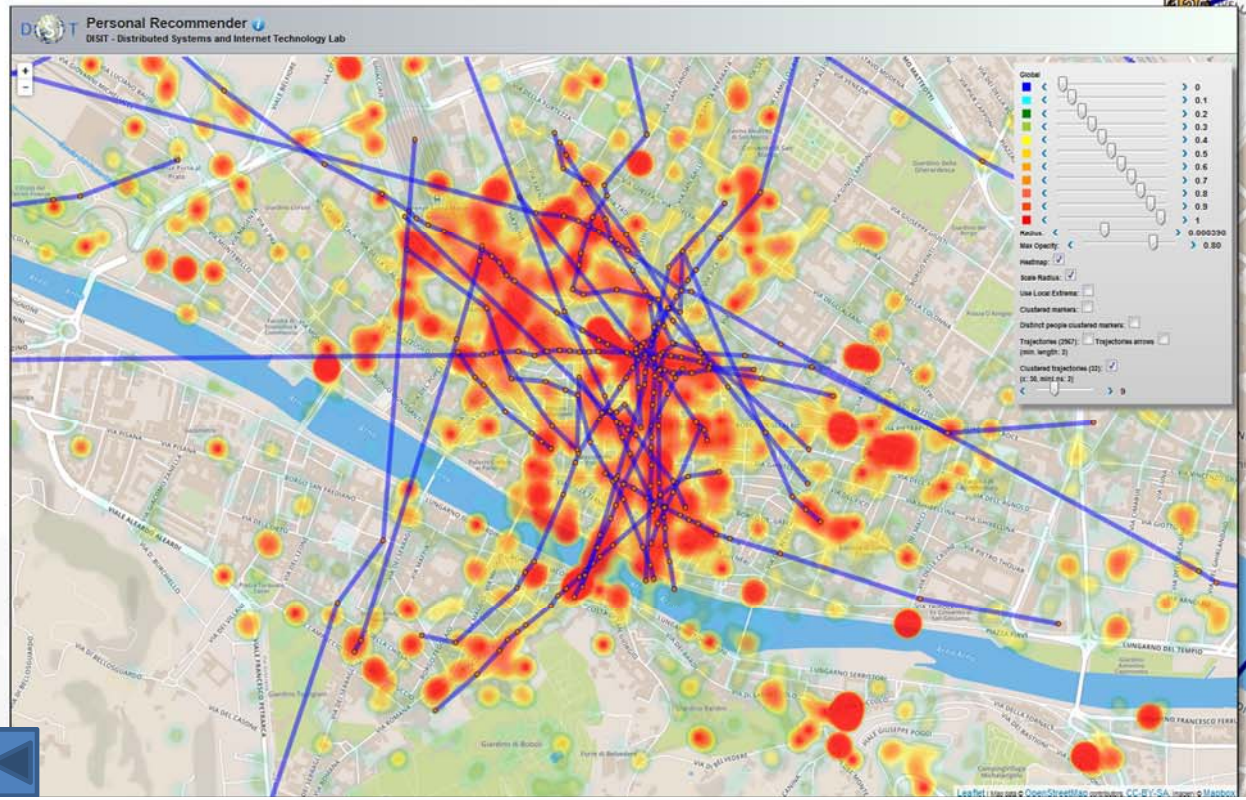
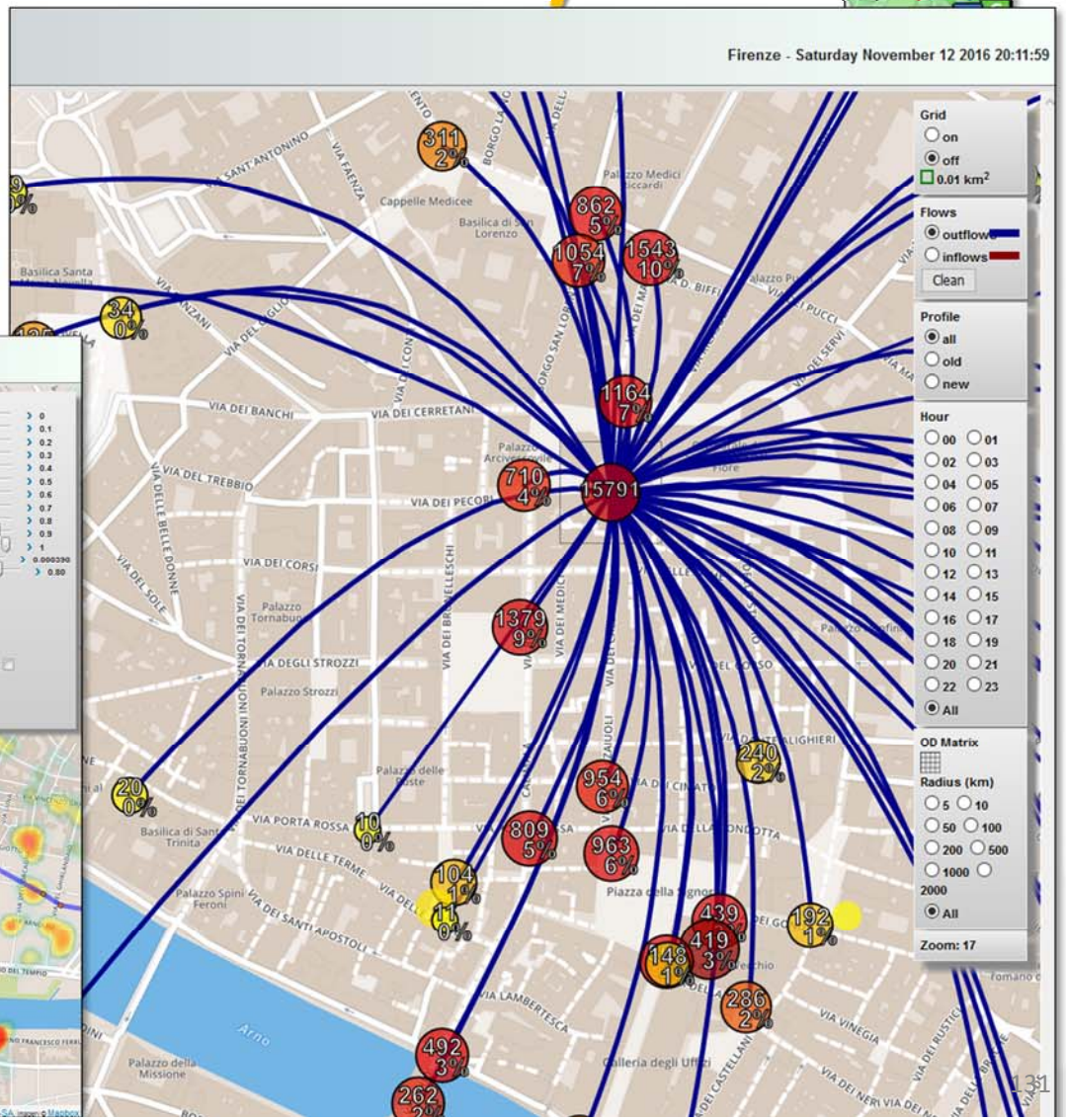
User Behavior Analyzer

- Heat maps
- Trajectories
- OD matrixes





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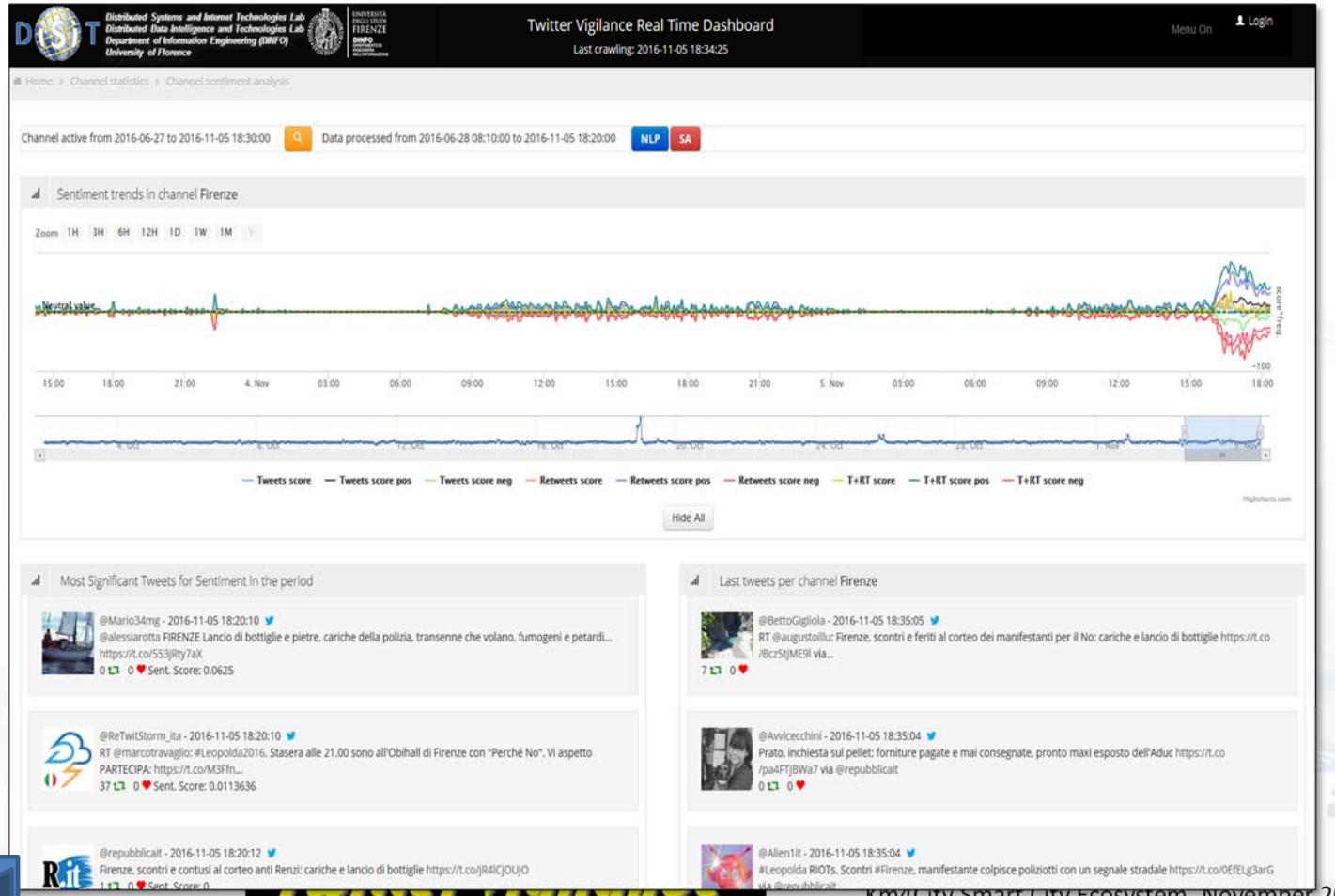
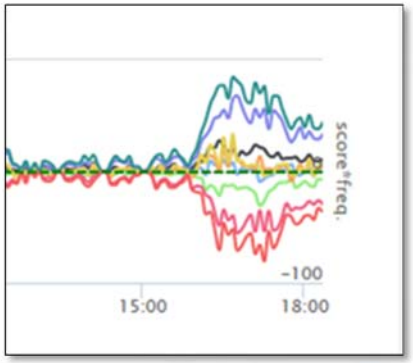
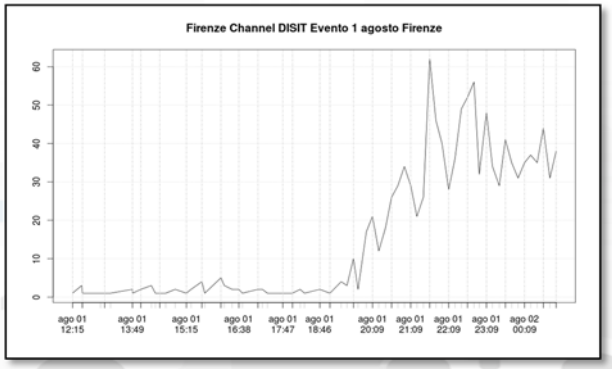
Twitter Vigilance

Real Time Twitter Vigilance, Early Warning



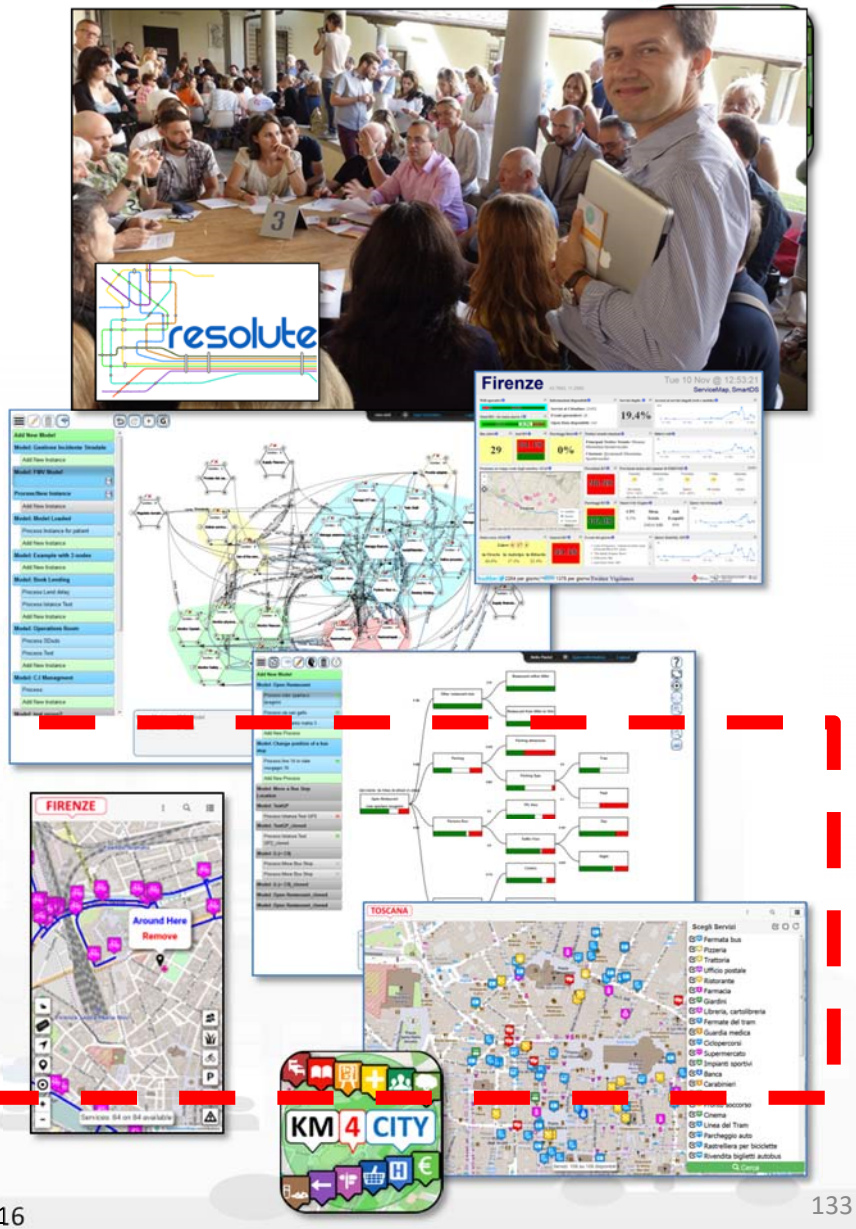
Sentiment Analysis





Improve city resilience, reducing risks and decision support

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



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Km4CityMobile App

web application
http://www.km4city.org

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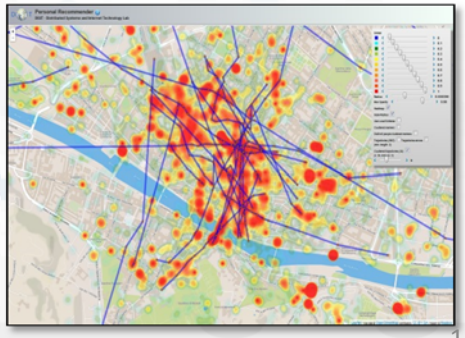
Mobile Emergency

- Personalized menu for Operators
- Providing information and suggestions to citizens
  - Civil Protection Page
  - Twitter Info
  - Geolocalized Info
- Tracking people and operators flows
- Collecting information from citizens
  - Comments
  - Images



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