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Big Data vs Smart City vs IOT

<http://www.disit.org/km4city>

www.Km4City.org

Paolo Nesi, paolo.nesi@unifi.it



@DataBeersTus

6° April 2017
Firenze





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Km4City: Integrated Urban Platform



- **Aggregate & integrate data**

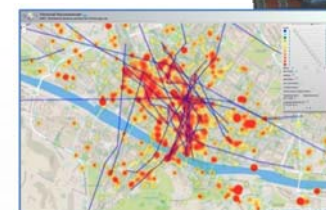
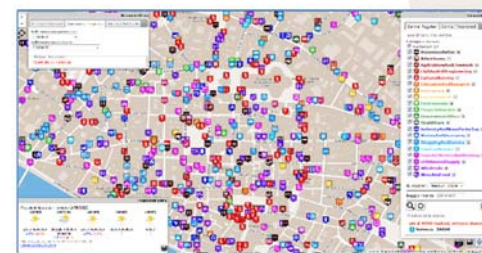
- Multiple protocols from urban operators,
- open data, IOT, sensors, internet of everything, cloud, mobile devices, Wi-Fi, social media, ...

- **Data Exploitation performing**

- predictions, reasoning, business intelligence, ..
- users behavior analysis, decision support system, ..
- Control Room, Real Time Monitoring tools,

- **Produce value from data enabling to**

- Stimulate virtuous behavior, influence City Users!
- Put in action CITY Strategies





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Sentient Urban Platform for Smart City

- Set up an ICT based Urban Platform integrated and unified data management among services, city operators and city users:
 - **Control Room, Real Time Monitoring**
 - decision support, assessing and monitoring risk and resilience
 - **Data analytics and business intelligence**
 - predictions, reasoning, city users behavior analysis,
 - **Reading the city: data, users behavior and needs, ...**
 - IOT, Open data sensors, private data, static and real time data.
 - **City Strategies: stimulate virtuous behavior of City Users**
 - participation, totem, twitter, Apps, etc.
 - **Transform Data into value**
 - Put in action smart city innovative solutions and services, development tools



Transport systems
Mobility, parking



Public Services
Govern, events, ...



Sensors, IOT
Cameras, ...



Environment,
Water, energy



Shops, services,
operators



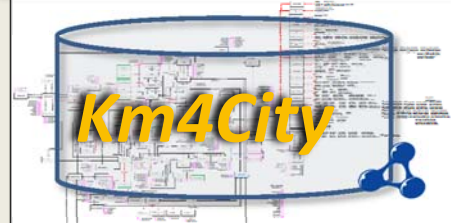
Social Media
WiFi, network



Static, Slow and Real Time data flows

Km4City Smart City Engine

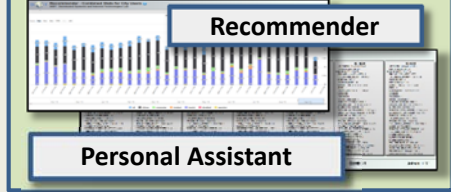
DISCES -- Distributed and parallel architecture on Cloud



Big Data Analytics



Smartening Tools



Development Tools



Km4City Smart City API

City Operators and Decision Makers

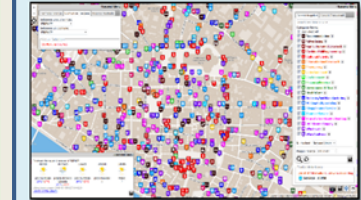
Dashboards



Smart Decision Support



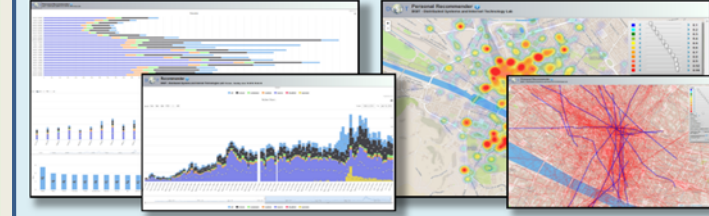
ServiceMap browser



Twitter Vigilance

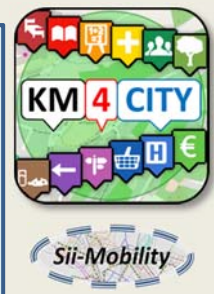


Analyzers of City User Behavior



Tools for Final Users

Mobile e Web Apps



[Http://www.km4city.org](http://www.km4city.org)

Present data Tuscany Region

Road Graph (Tuscany region)

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

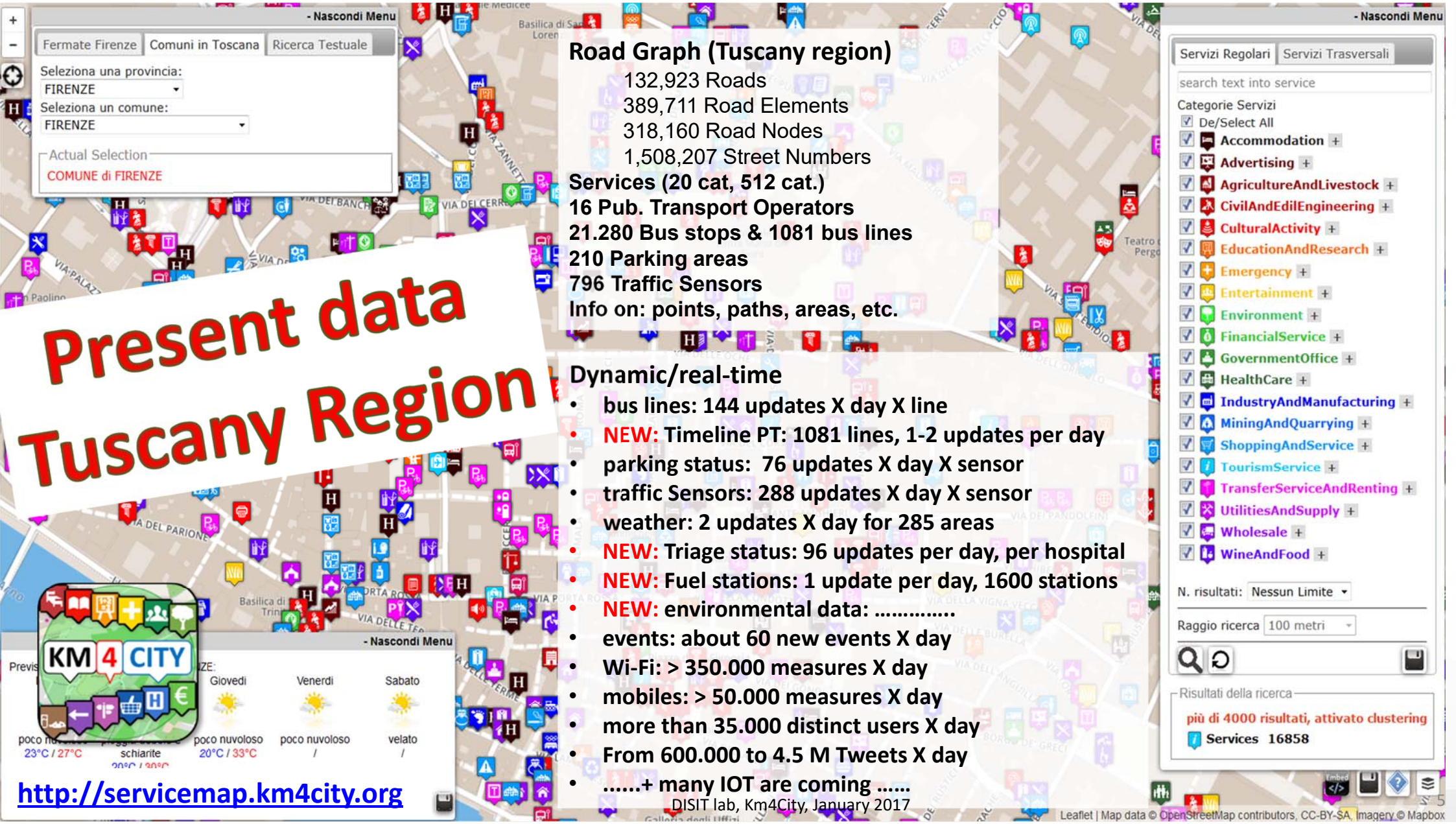
- Services (20 cat, 512 cat.)
- 16 Pub. Transport Operators
- 21.280 Bus stops & 1081 bus lines
- 210 Parking areas
- 796 Traffic Sensors
- Info on: points, paths, areas, etc.

Dynamic/real-time

- bus lines: 144 updates X day X line
- **NEW:** Timeline PT: 1081 lines, 1-2 updates per day
- parking status: 76 updates X day X sensor
- traffic Sensors: 288 updates X day X sensor
- weather: 2 updates X day for 285 areas
- **NEW:** Triage status: 96 updates per day, per hospital
- **NEW:** Fuel stations: 1 update per day, 1600 stations
- **NEW:** environmental data:
- 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 IOT are coming

DISIT lab, Km4City, January 2017

<http://servicemap.km4city.org>



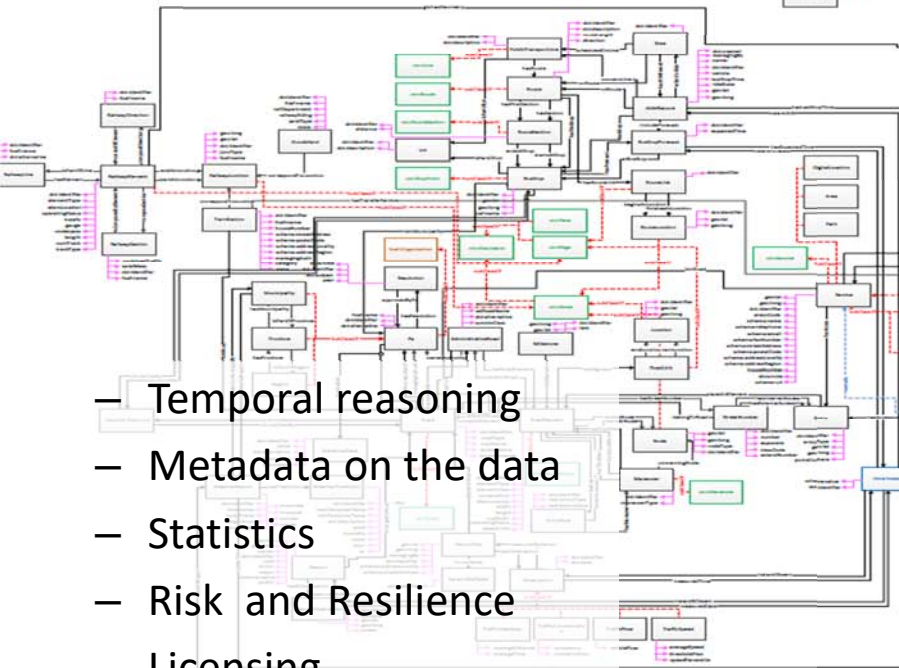


Km4City Ontology - RDF Store



Km4City is a new generation of Urban Platforms

- 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
- ..

Big Data Tools



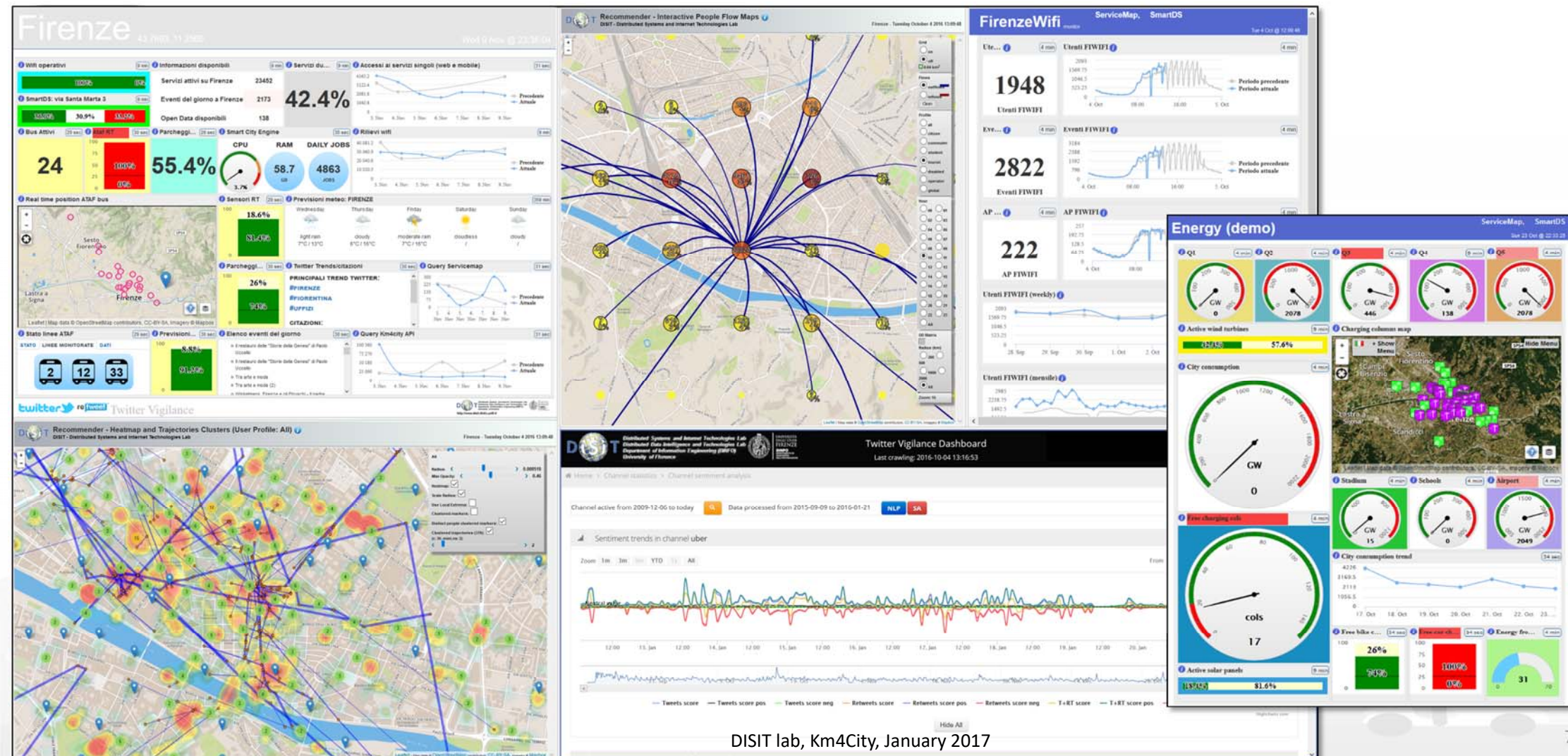
LOD and reasoners



Smart City Dashboard



Horizon 2020
European Union Funding
for Research & Innovation



DISIT lab, Km4City, January 2017



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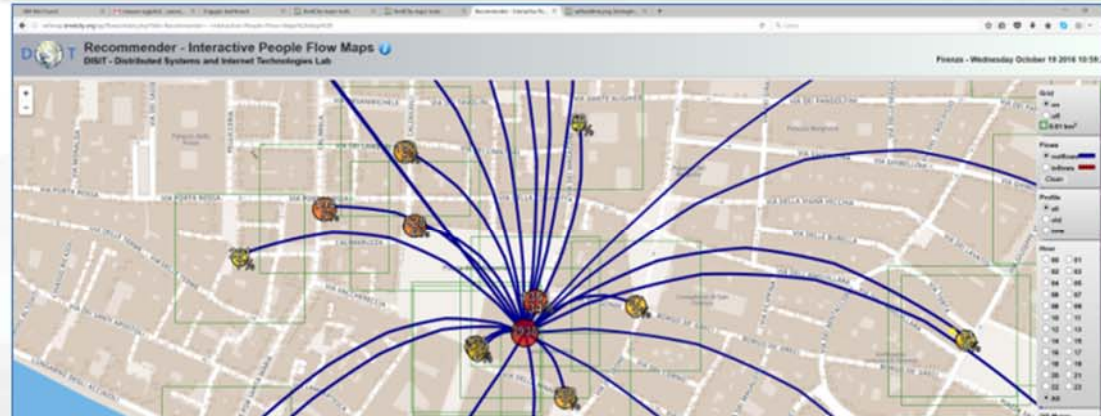
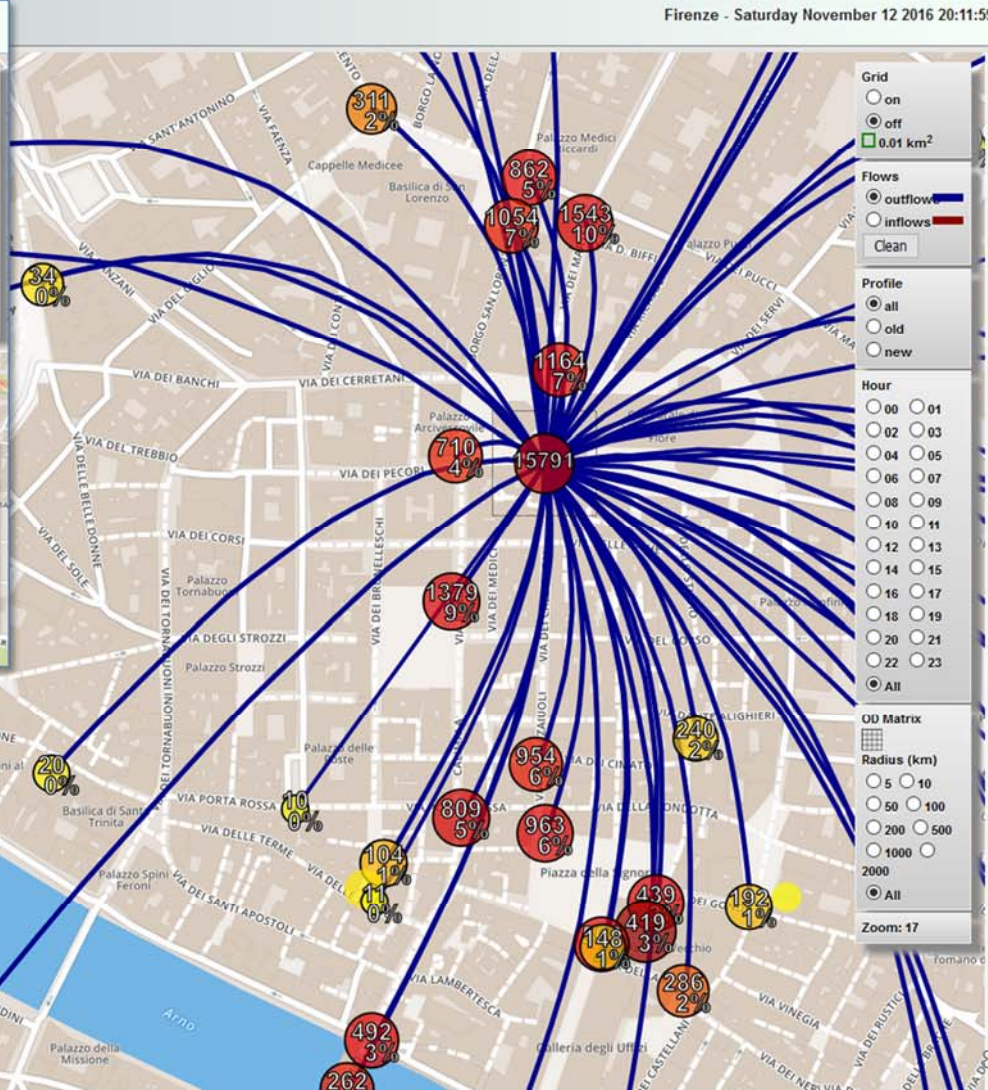
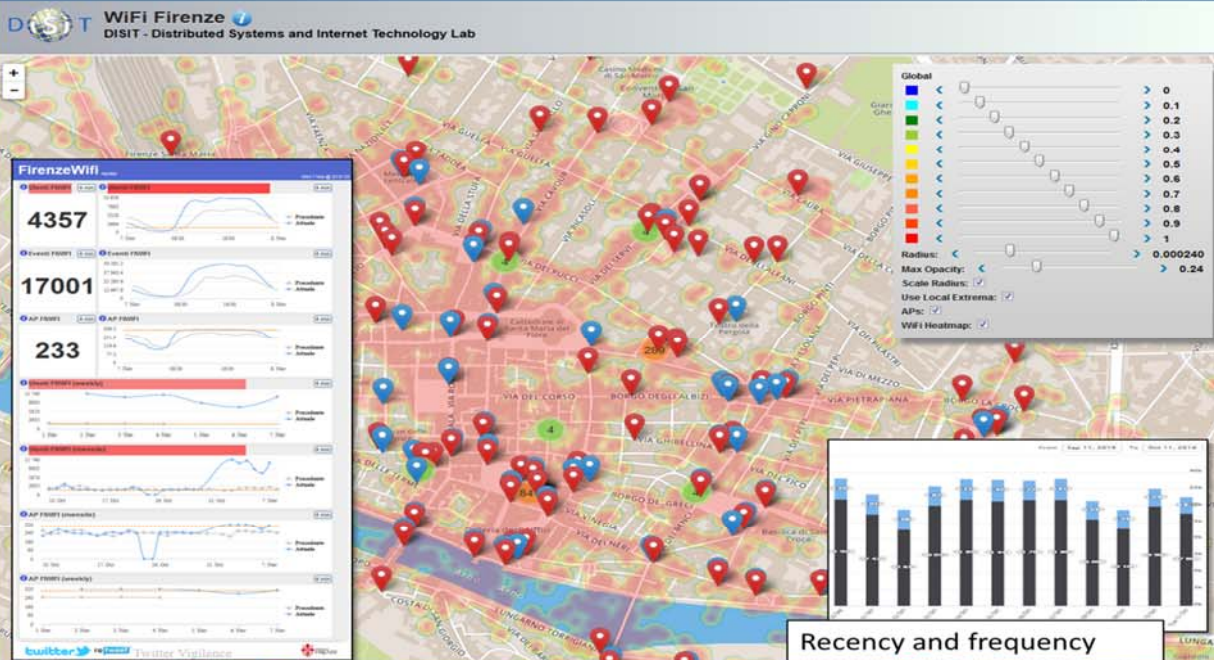
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Wi-Fi OD estimation.



Firenze - Saturday November 12 2016 20:11:59





Risk Assessment

Decision Support Systems

Flood Event Flood Observation Traffic Observation Damage analysis Layers panel Vulnerability info Service Observation

Aerial with labels Save Analysis Export Configuration

Colonica

SAVIGNANO A COLONICA

Limite

Colonnata

Montonoli Stazione

La Fabbrica

Castello di Torre Decima

Serravalle

San Martino alla Palma

Relevant Services

Min asset value: 50

Street

| Street | Type | Value |
|---------------------------------|-----------------|-------|
| VIALE MAZZINI GIUSEPPE, FIRENZE | Public_hospital | 16 |
| VIA FOSCOLO UGO, FIRENZE | Public_hospital | 16 |
| VIA INCONTRE, FIRENZE | Public_hospital | 16 |
| VIA DEI BASSI, FIRENZE | Public_hospital | 16 |

SERVICE

NAME: villa maria teresa hospital...

ADDRESS: VIA DELLA CERNAIA, FIRENZE

FIRENZE

SERVICE TYPE: http://www.dist.org/km4city/schema/Public_hospital

SERVICE CLASS: <http://www.dist.org/km4city/schema/Health-Care>

SERVICE: <http://www.dist.org/km4city/service/7ab1bc458437b727d657f6081d2db>

VALUE: 100

WKT DESCRIPTION: POINT (11.2561 43.7668)

Traffic observations:

| From | Date | km/h | car/km | car/h |
|---------------------------|---------------------|------|--------|-------|
| VIA DELLA MATTIOLA | 2016-10-10 18:01:08 | 58 | 15 | 2438 |
| LANGARNO AMERIGO VESPUCCI | 2016-10-10 18:01:08 | 18 | 65 | 1842 |
| VIA CARMELO CAVOUR | 2016-10-10 18:01:08 | 81 | 12 | 2009 |
| VIA VALFOCCA | 2016-10-10 18:01:08 | 27 | 53 | 2307 |
| VIA VITTORIO ALFIERI | 2016-10-10 18:01:08 | 23 | 58 | 2798 |
| VIA SENESE | 2016-10-10 18:01:08 | 27 | 54 | 3218 |
| VIA GUELFA | 2016-10-10 18:01:08 | 68 | 3 | 420 |
| VIA DELLA SCALA | 2016-10-10 18:01:08 | 60 | 13 | 2157 |
| PIAZZA DI SAN FELICE | 2016-10-10 18:01:08 | 62 | 10 | 1887 |
| BORGIO SAN FREDIANO | 2016-10-10 18:01:08 | 57 | 17 | 2000 |
| VIA VITTORIO ALFIERI | 2016-10-10 18:01:08 | 10 | 78 | 186 |
| VIA DEL CAMPOLUOGO | 2016-10-10 18:01:08 | 60 | 13 | 2157 |
| VIA DEI BENI | 2016-10-10 18:01:08 | 22 | 59 | 2679 |
| PIAZZALE DI PORTA ROMANA | 2016-10-10 18:01:08 | 54 | 8 | 1361 |

Draw region to analyze: On

Load predefined region: Firenze

Mean precipitation: 14.333333333333334

GetObservations Analyze

Relevant Services

Open Information Logout

Add New Model

Model: Open Restaurant

- Process: viale spartaco lavagnini
- Process: via san gallo
- Process: via santa marta 3

Add New Process

Model: Change position of a bus stop

- Process: line 14 in viale morgagni 10

Add New Process

Model: Move a Bus Stop

Location

Model: TestGP

- Process: Istanza Test GP2

Model: TestGP_cloned

- Process: Istanza Test GP2_cloned

Model: G (= C8)

- Process: Move Bus Stop
- Process: Move Bus Stop

Model: G (= C8)_cloned

Model: Open Restaurant_cloned

Model: Open Restaurant_cloned

Decision tree diagram showing various models and processes with associated values and bar charts.

DECISION: 58.75163 59.82518 21.38162

Name Model: Open Restaurant

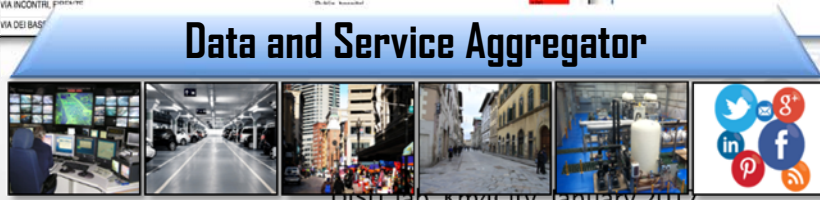
Name Process: viale spartaco lavagnini

Date creation: 15-06-2015 15:58:23

Date last update: 15-06-2015 16:54:07

Assessing Risk

- hydraulic
- Seismic

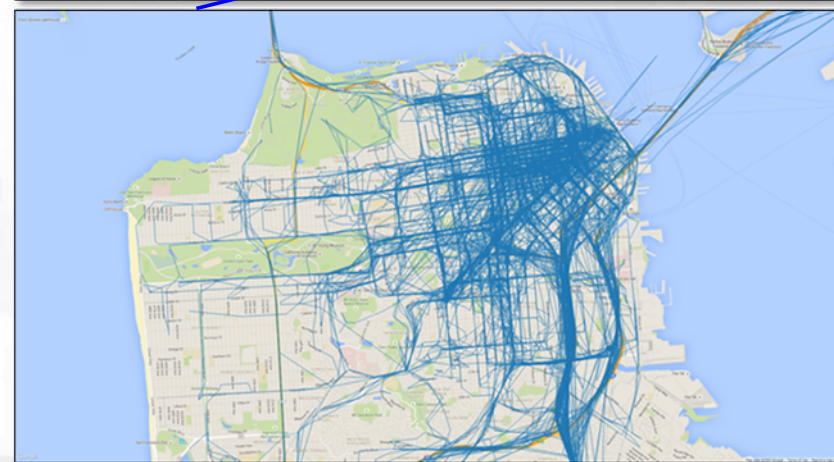
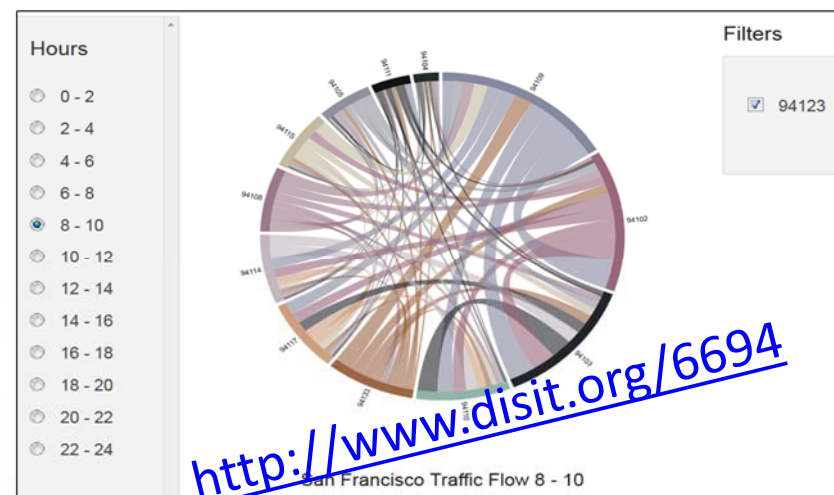


Creating and activating

- Decision Support models

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





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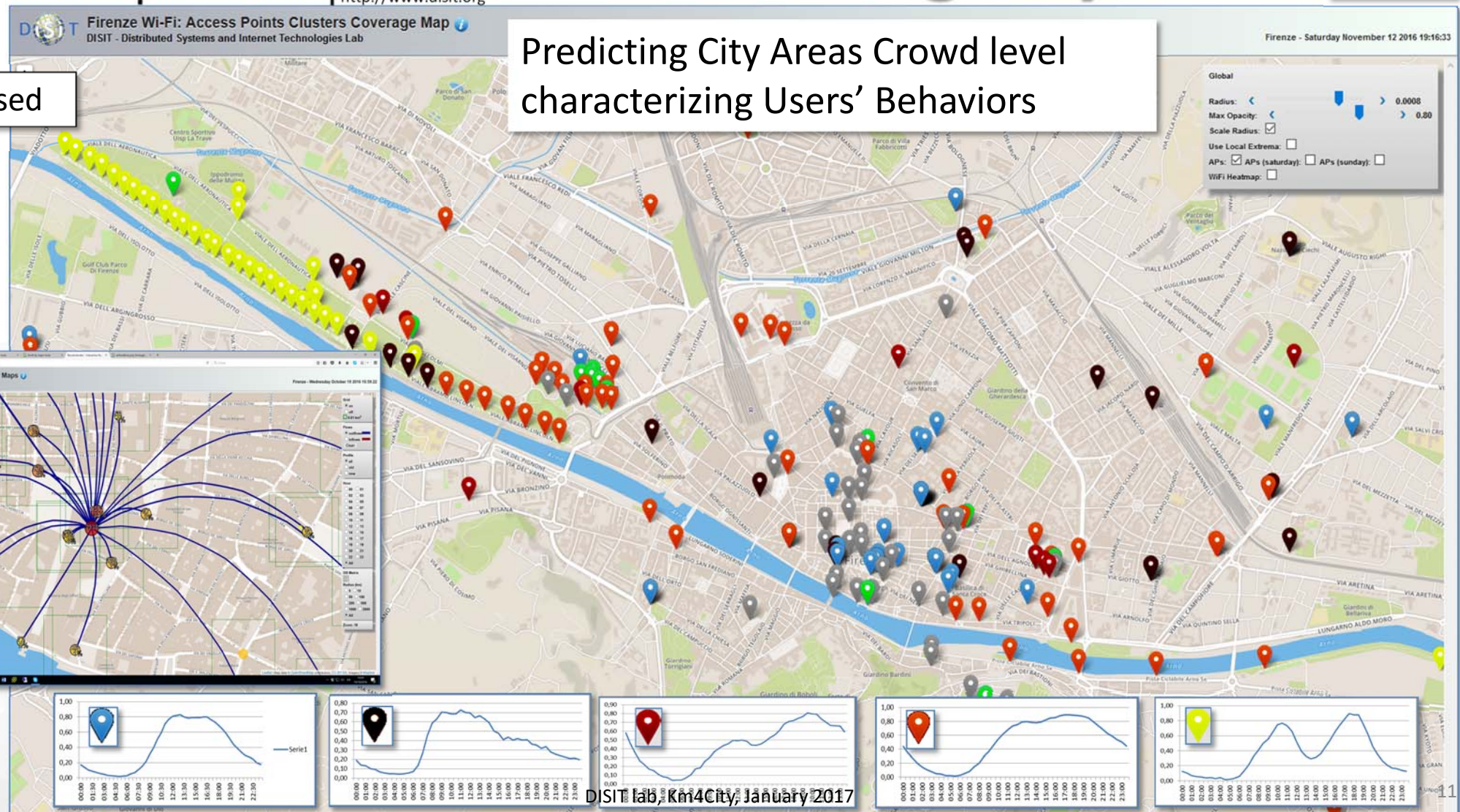
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Characterizing City Areas



Wi-Fi based

Predicting City Areas Crowd level
characterizing Users' Behaviors





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Km4CityMobile App



What do you want to do?

- Discover the City
- Points Of Interest
- Search
- Public transport
- Bus Ticket
- Car Park
- Events
- Suggestions Near You
- We Recommend
- Weather
- Assistant
- Navigator
- Favourites
- Chronology
- Latest Reviews
- Alert Civil Prot.
- Settings
- Vote APP!
- Information
- About Us

Choose Services

- Accommodation
- Advertising
- Agriculture And Livestock
- Civil And Edil Engineering
- Cultural Activity
- Education And Research
- Emergency
- Entertainment
- Environment
- Financial Service
- Government Office
- Health Care
- Industry And Manufacturing
- Mining And Quarrying
- Shopping And Service
- Tourism Service
- Transfer Service And Renting

Giardino Di Boboli

Tipo: Digital Location

Descrizione: The Prince s Way ends in the Giardino di Boboli, near the Grotta del Buontalenti, that is a very masterpiece of the Mannerist architecture and sculpture

Descrizione: Il Percorso del Principe termina nel Giardino di Boboli, nei pressi della Grotta del Buontalenti, vero e proprio capolavoro dell'architettura e della scultura manierista

Map view showing various service icons overlaid on a city map of Florence.

Suggerimenti

Post

ESERCITAZIONE MUGNONE 2016

MODALITÀ 2016 18 maggio 2016

Sardegna Mugnone 2016 28 maggio 2016 08:00-12:00

REGIONE TOSCANA

prevede: Firenze (FI) (ZONA: A3)

| RISCHIO | TEMPI | ALLERTA |
|---|--|-----------|
| IDROGEOLOGICO IDRAULICO RETICOLO MINORE | Dalle ore 13.00 di Venerdì 27 maggio 2016 alle ore 18.00 di Venerdì 27 maggio 2016 | GIALLO |
| IDROGEOLOGICO IDRAULICO RETICOLO MINORE | Dalle ore 18.00 di Venerdì 27 maggio 2016 alle ore 12.00 di Sabato 28 maggio 2016 | ARANCIONE |

Annunziata
Tipo: Squares
Distanza: 1949 m
Indirizzo: 🚗 🚶 🚲

Piazza Santissima Annunziata
Tipo: Squares
Distanza: 1949 m
Indirizzo: 🚗 🚶 🚲

Trattoria Gozzi
Tipo: Trattoria
Distanza: 1975 m

Mostra Tutte le Categorie

web application
<http://www.km4city.org>

Windows Phone interface showing various apps like Calendar, Posta, Netflix, Microsoft Edge, Xbox, Anteprema Sk..., Tuneln Radio, and Twitter.

DISPONIBILE SU
 Google play

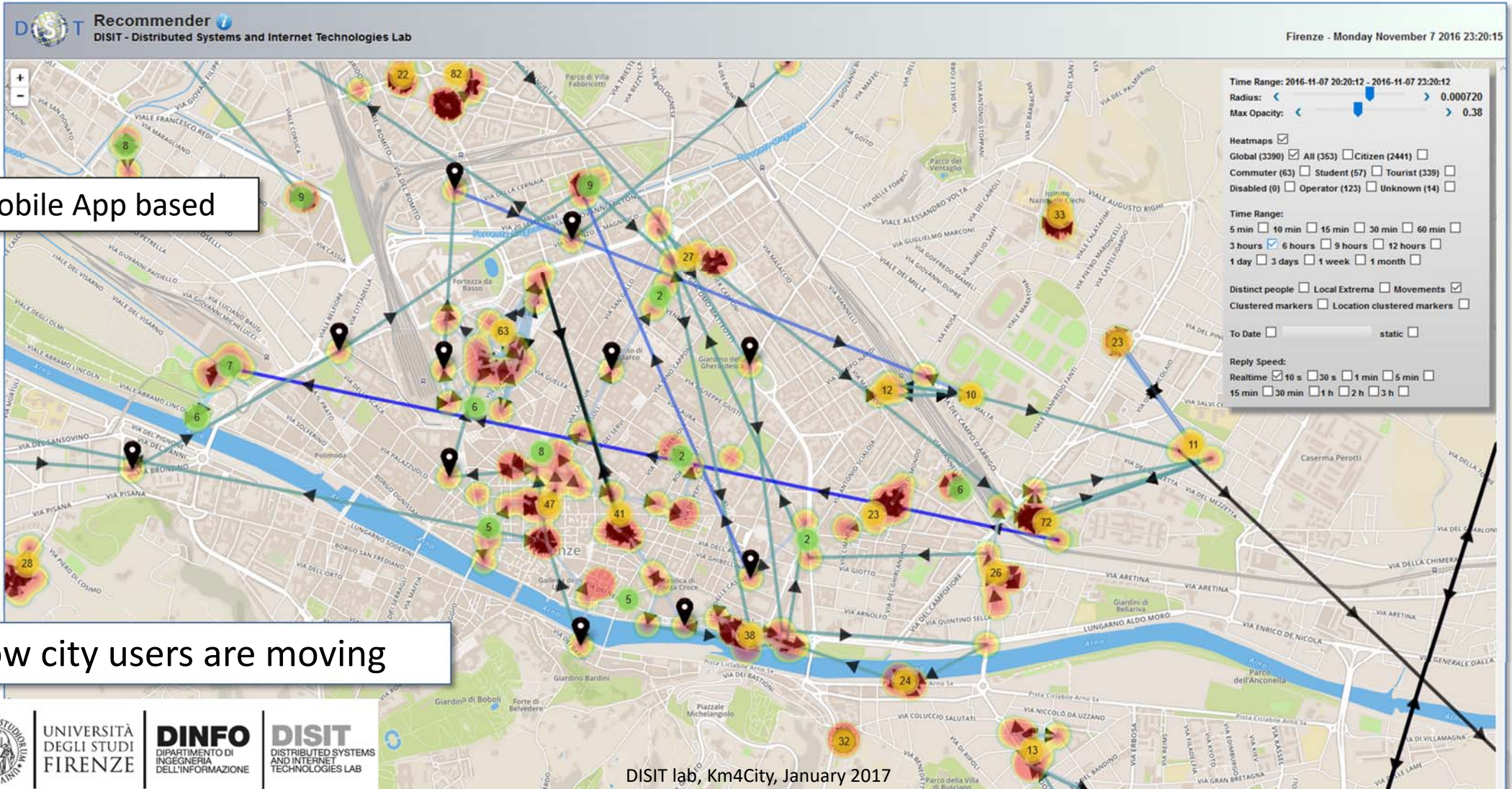
Scarica da
 App Store

Scarica da
 Windows Store



DISIT lab, Km4City, January 2017

Anonymous User Behavior Analysis



Mobile App based

How city users are moving

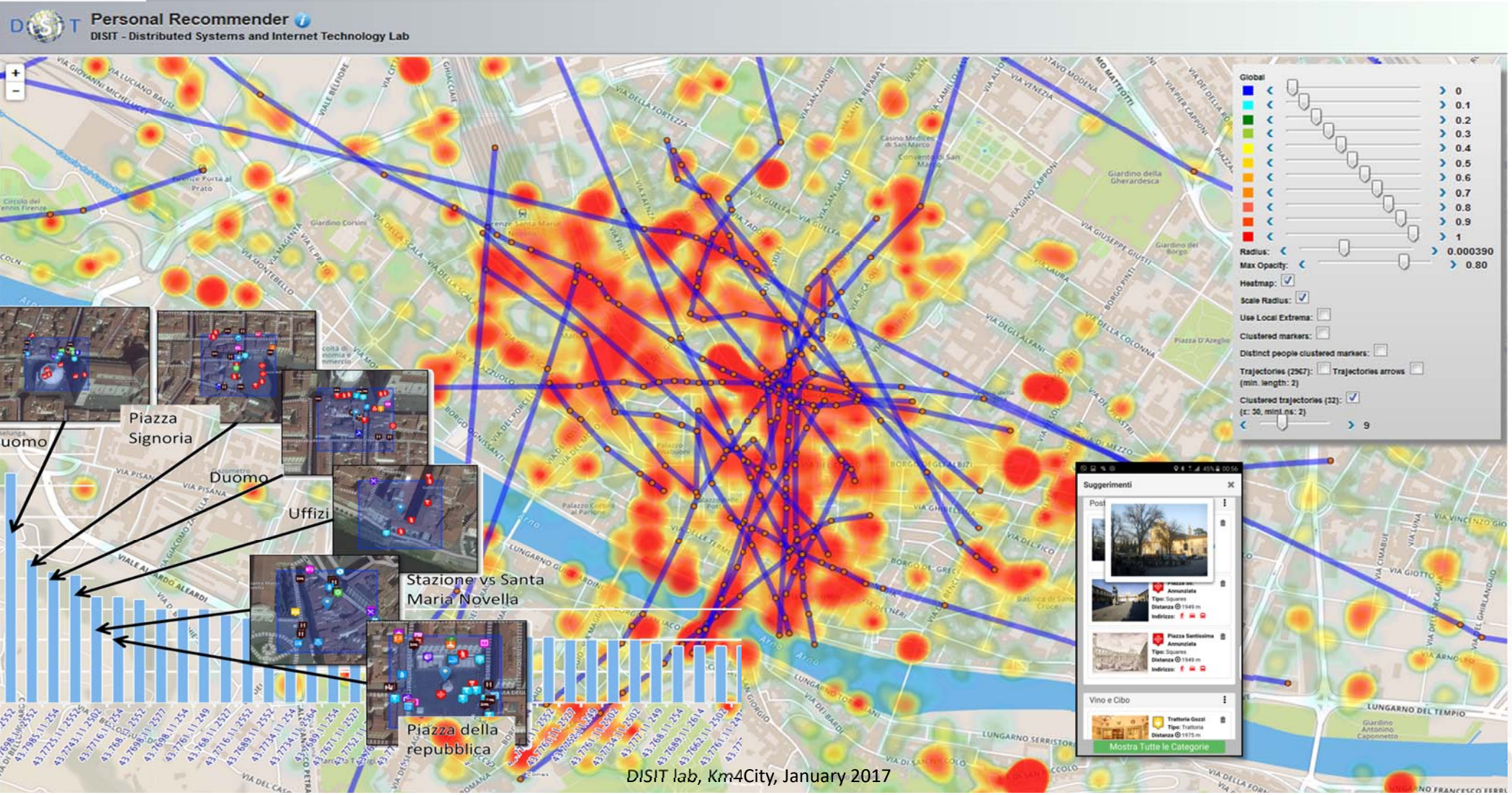


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User Behavior Analyzer



Engagement & Assistant 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



Twitter Vigilance su Firenze (sperimentale)

Twitter Vigilance Dashboard
Last crawling: 2016-12-24 12:34:51

Channel active from 2009-02-27 to today

Data processed from 2015-05-22 to 2016-12-02

Search related to channel **Firenze**

Zoom 1m 3m 6m YTD 1y All

26. Nov 30. Nov 4. Dec 8. Dec 12. Dec 16. Dec 20. Dec 24. Dec

- #Accademia
- #Aeroporto #Firenze
- #Aeroporto #Firenze
- #bargello
- #expo2015 #Firenze
- #fiorentina
- #firenze
- #Florence #smartcity
- #fodd
- #ODDIT15 #Firenze
- #opendata firenze
- #pontevecchio
- #uffizi
- @acfflorentina
- @BandieraiUffizi
- @Biblio_ComuneFi
- @bncfirenze
- @comunefi
- @DarioNardella aeroporto
- @DiscoverTuscany
- @emergency_fi
- @firenzedigitale
- @firenzesulweb
- @FirenzeTNews
- @museofirenze
- @museonovecento
- @Nazione_Firenze
- @NicolodiDaria
- @novedafirenze
- @opentoscana
- @Pitti_Immagine
- @PoloMusealeFi
- @ProtCivComuneFi
- @prov_FI_PC
- @santacroceopera
- @STEEPproject
- @storianaturale
- @UNL_FIRENZE
- aeroporto firenze
- aeroporto firenze
- Firenze
- firenze terremoto
- firenzesulweb
- Firenze
- from:PUNL_FIRENZE
- lungarno
- medicea
- palazzopitti
- palazzostruzzi
- ProtCivComuneFi
- smartcity firenze
- torrigiani
- uffizi
- voragine
- Events

Daily number of tweets/retweets for channel: **Firenze**

Zoom 1m 3m 6m YTD 1y All

24... 26. Nov 28. Nov 30. Nov 2. Dec 4. Dec 6. Dec 8. Dec 10. Dec 12. Dec 14. Dec 16. Dec 18. Dec 20. Dec 22. Dec 24...

ReTweets Tweets Events

Twitter Vigilance Real Time Dashboard
Last crawling: 2016-12-24 10:32:33

Channel active from 2016-06-27 to 2016-12-24 10:30:00

Data processed from 2016-06-28 08:10:00 to 2016-12-24 10:25:00

Sentiment trends in channel **Firenze**

Zoom 1H 3H 6H 12H 1D 1W 1M Y

07:30 07:45 08:00 08:15 08:30 08:45 09:00 09:15 09:30 09:45 10:00 10:15

Most Significant Tweets for Sentiment in the period

- @forealriesdaye - 2016-12-24 10:25:39
@Ahno_its_arno meh, I've only had average curry there
0 0 Sent. Score: 0.166667
- @esercizistorici - 2016-12-24 10:30:01
Stanotte Concerto di Natale di Peter Guth @ORT_Toscana in collaborazione con Conservatorio 'L.Cherubini' di Firenze...
https://t.co/uFeTp4wG1y
0 0 Sent. Score: 0
- @infoiterno - 2016-12-24 10:30:05
Firenze, un piano per un Natale sicuro (055firenze) https://t.co/vpqDASEspI https://t.co/2Bn5k3zoyv

Last tweets per channel **Firenze**

- @FormulaLatina - 2016-12-24 10:30:26
*** CAPODANNO LATINO Woodstock Club Firenze *** H. 21:00 >> GRAN BUFFET DI SAN SILVESTRO CON BRINDISI E...
https://t.co/cM84Gw65sO
0 0
- @MORINEMMANUELL2 - 2016-12-24 10:30:14
RT @NavyMat: Francesco #Salvati Carità,1543 #Manierisme Galleria degli Uffizi, @Giusepp...
6 0
- @infoiterno - 2016-12-24 10:30:12

Twitter Vigilance

TRENDS QUOTES

- @NICOLODIDARIA
- @COMUNEFI
- @ACFFIORENTINA
- @NAZIONE_FIRENZE
- @SANTACROCEOPERA
- @MUSEONOVECENTO
- @FIRENZEDIGITALE

TRENDS QUOTES

- #FIRENZE
- #FIORENTINA
- #UFFIZI
- #PONTEVECCHIO

We suggest to use Chrome browser for better experience

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

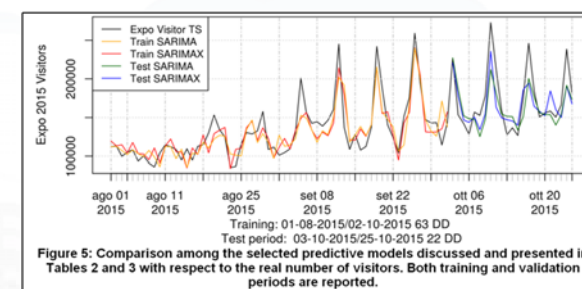
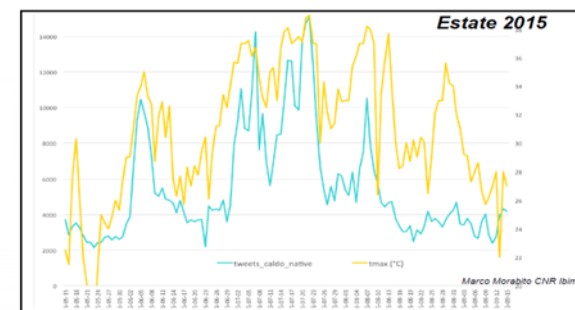
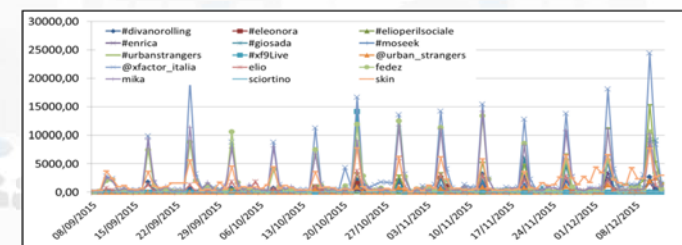
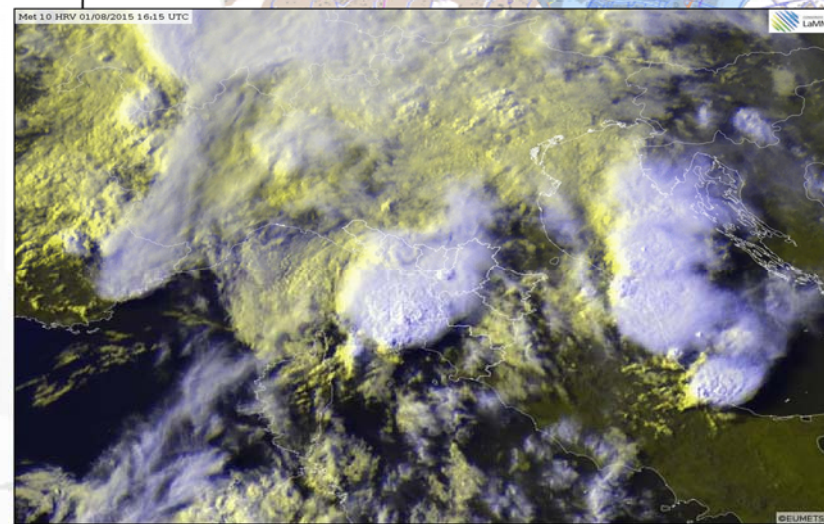
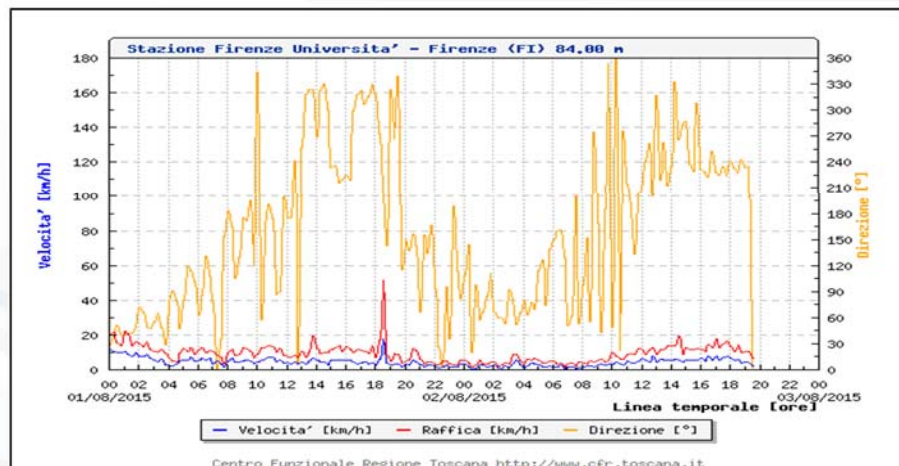
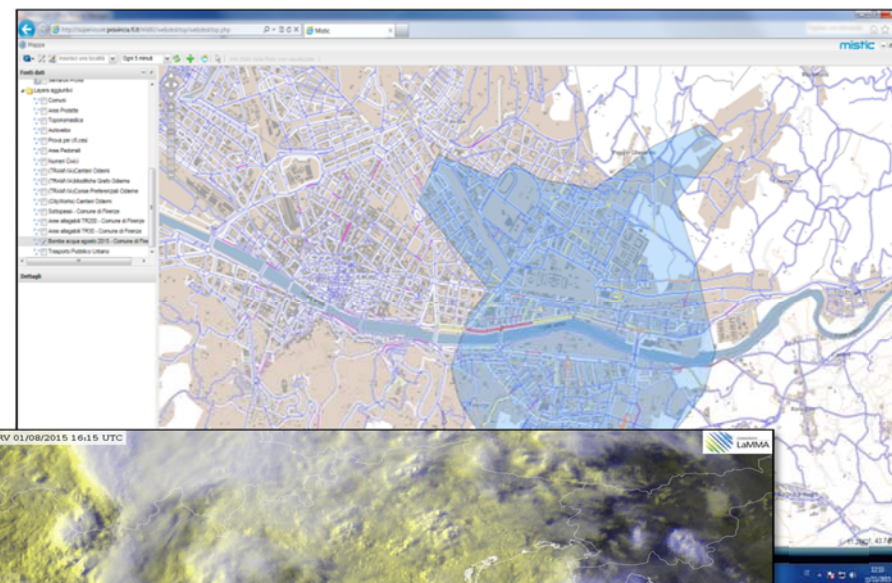
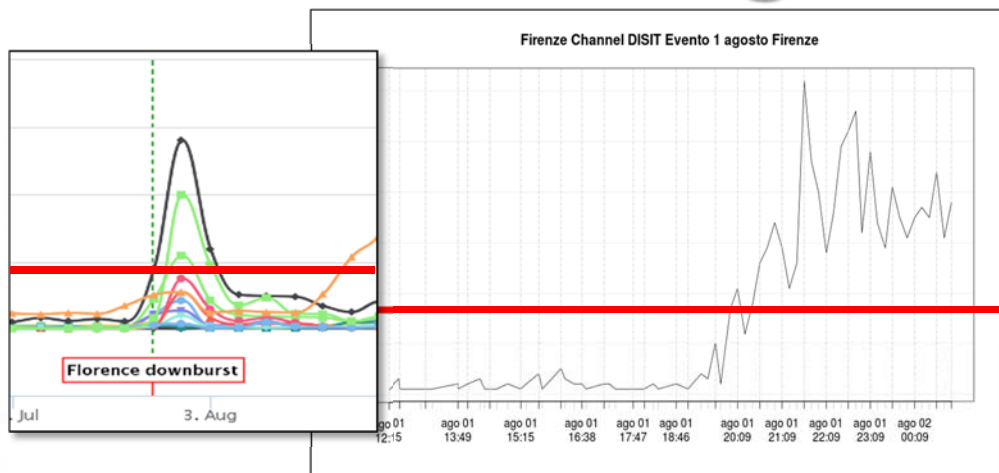


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.





Early Warning Twitter Vigilance and Water Bomb



Twitter Vigilance

Florence Open Data Day, Marzo 2017, Firenze

Case Study D



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Roadmap



2021

2013

Km4City 1.1

- Tuscany Map
- Services
- AVM
- Sensors
- Parking
- Cultural Heritage
- Enrichment cities
- Event in the city
- Digital Locations
- Fresh places

- <http://servicemap.km4city.org> API
- <http://log.disit.org>
- <http://www.disit.org/fodd>
- <http://www.disit.org/tv> Twitter Vigilance
- <http://smartds.km4city.org>

- Weather
- Cultural Heritage
- Energy recharge pillar
- Wi-Fi
- Events in the city

2014

2015

Km4City 1.4

- Embed
- More API
- iBeacon

RESilience management guidelines and Operationalization appLied to Urban Transport Environment

Km4City 1.5

- SmartDS
- Km4City App

RESOLUTE H2020
2015-2018 - Started

Sii-Mobility
<http://www.sii-mobility.org>

Sii-Mobility SCN
2016-2018 - Started
Km4City 1.6.2

2016

REPLICATE H2020
2016-2021- Started

REPLICATE
Renaissance of Places with Innovative Citizenship And TEchnology

- Suggestions on demand
- User Behaviour Analysis
- Trajectories and OD

Today

6/2017

12/2017

- Territorial areas and paths
- Health, Bike sharing
- Statistics, Energy, ICT, ...
- E-vehicles

- Risk analysis
- Environmental, water
- Data Licensing models
- Energy Meters
- Fi-Ware compliant

- More Sensors, IOE, IOT
- Dashboard Builder
- Territorial areas and paths
- User Engagement
- Mobility and transport
- Resilience Decision Support

GHOST SIR
2016-2019 - Started

GHOST
Governing the smart city: a governance system approach to Smart Urbanism