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Km4City: una soluzione aperta per erogare servizi Smart City

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<http://www.km4city.org> , <http://www.disit.dinfo.unifi.it> , paolo.nesi@unifi.it





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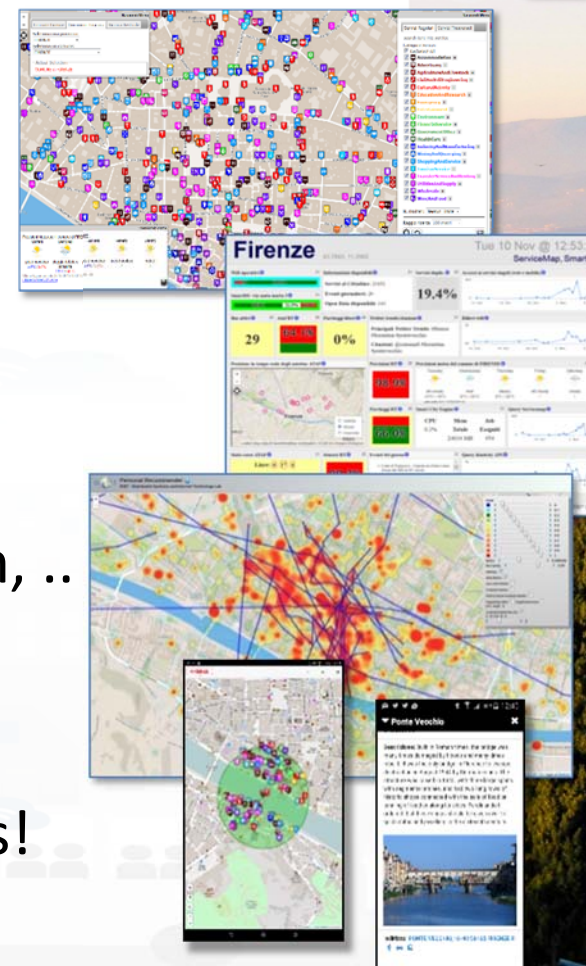
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Km4City: Integrated Urban Platform



- **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



Transport systems
Mobility, parking



Public Services
Govern, events, ...



Sensors, IOT
Cameras, ...



Environment,
Water, energy



Shops, services,
operators



Social Media
WiFi, network

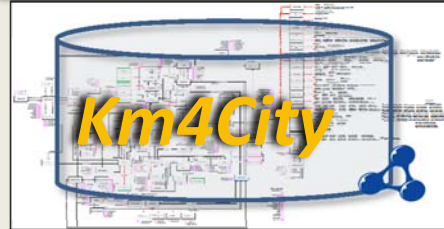


Static, Slow and Real Time data flows

DISCES -- Distributed and parallel architecture on Cloud



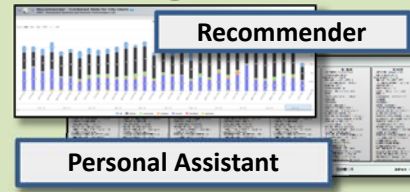
Km4City Smart City Engine



Big Data Analytics



Smartening Tools



Development Tools



Km4City Smart City API

City Operators and Decision Makers

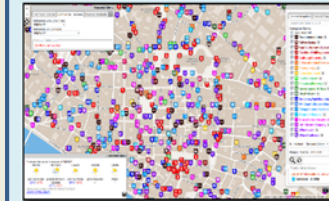
Dashboards



Smart Decision Support



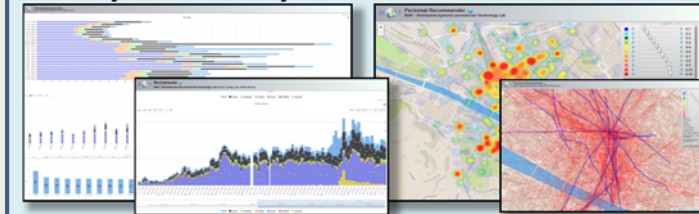
ServiceMap browser



Twitter Vigilance

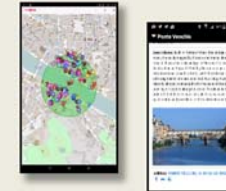


Analyzers of City User Behavior



Tools for Final Users

Mobile e Web Apps



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
- 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 IOT

http://servicemap.km4city.org

Services 16858



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, snow, ...
 - humidity, temperature, ...
 - water level in rivers
 - Status of underpass and bridges
 - Seismic sensors
- **Public Light Pillars**
 - Traffic flows, people flow,
 - 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, ...
- **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.





Km4City Ontology - RDF Store

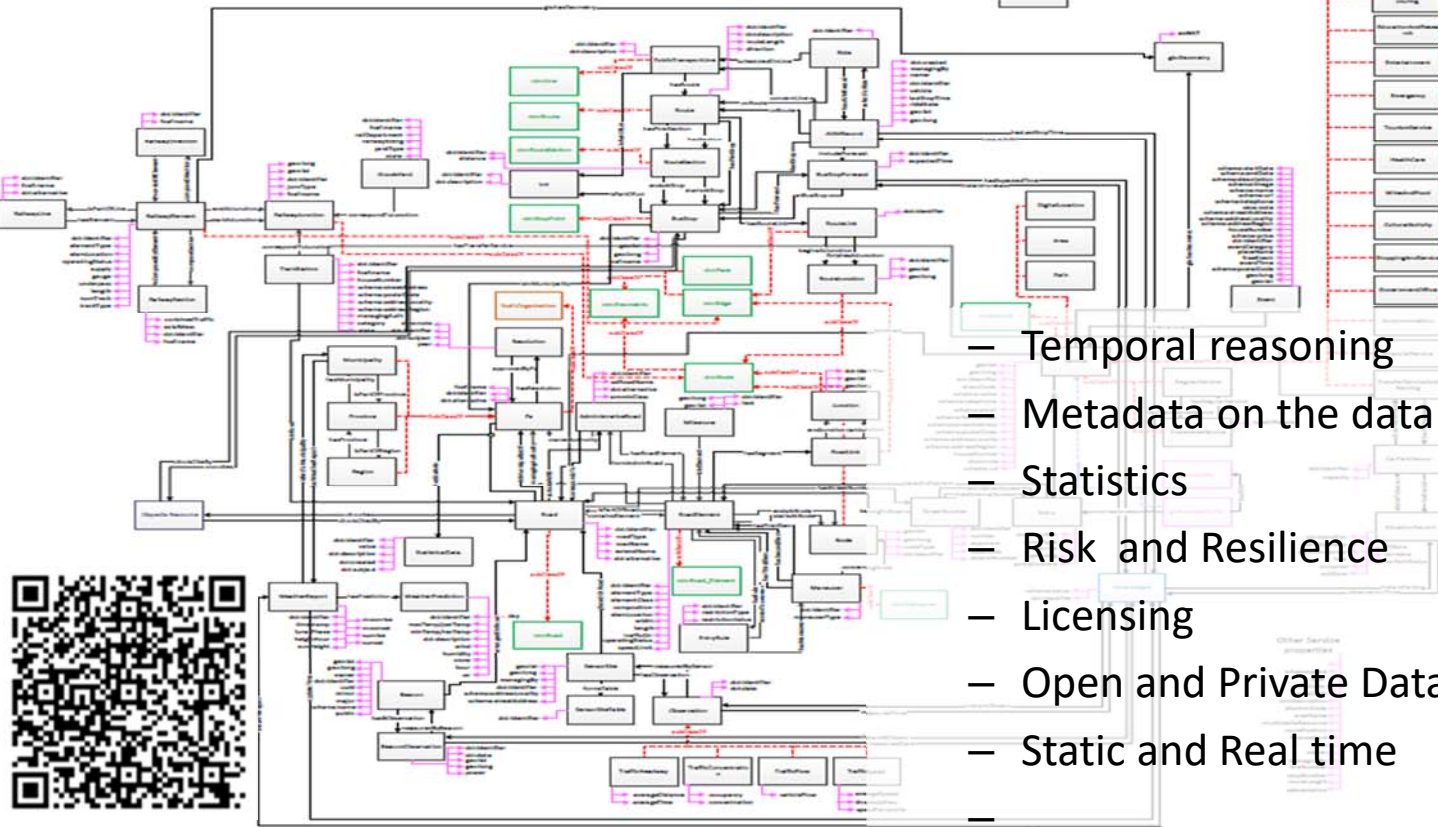


- >84 Classes
- >100 ObjectProperties
- >100 DataProperties

- 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>





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city under control



- **monitoring services' status**
of city operators

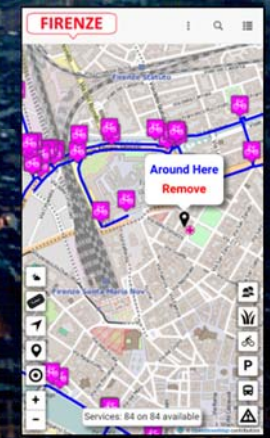
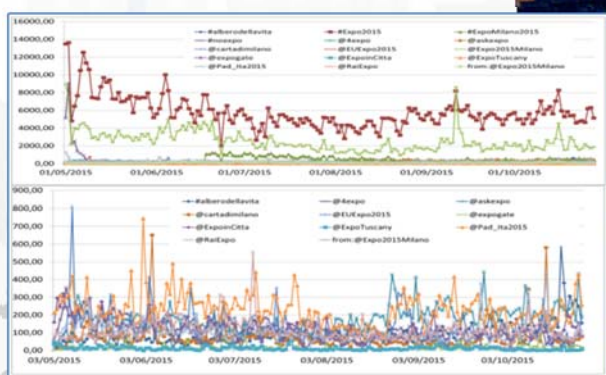
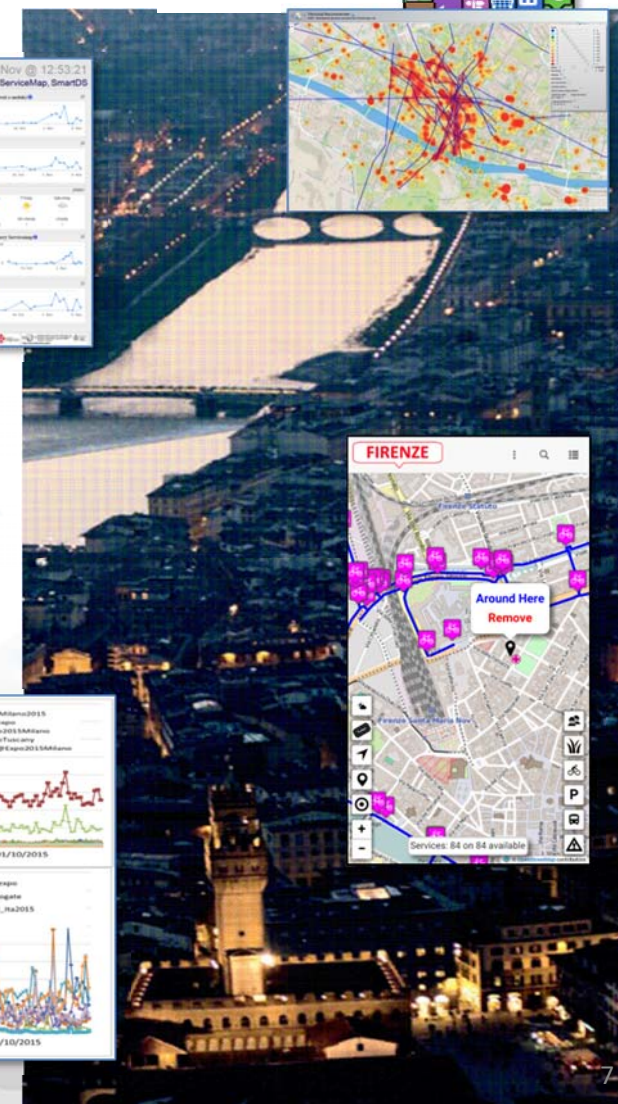
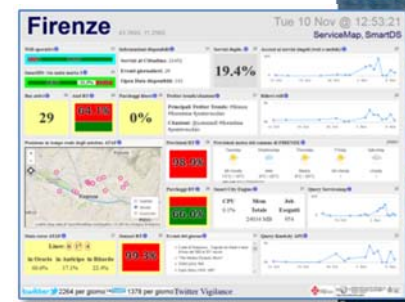
- Smart City Dashboards
- Continuous Business Intelligence

- **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



Sentient City Control Room



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

Real Time Monitoring Tools for Control Room Dashboards

Real Time Control Room Dashboard	Monitoring City Users by Wi-Fi (*)	Monitoring City Users Behaviour via Mobile App (*)	Monitoring Real Time Data on 3D (*)	Monitoring Parking Areas Status in Florence (*)	Monitoring Traffic Sensors in Tuscany Region (*)	Getting moods and alerts via Twitter Sentiment Analysis (*)	Early Warning and Prediction Tools	Smart Decision Support System, SmartDS (*)
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Smart City Control Room, Dashboard, Real Time Data

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Big Data Analytics Tools, Business Intelligence, Decision Support Tools

City Resilience Decision Support System, ResilienceDS (*)	City Risk & Vulnerability Analysis Tool	Assessing and Analysing Wi-Fi Coverage (*)	Origin Destination Matrix by Wi-Fi data (*)	City Users Recency and Frequency by Wi-Fi data (*)	City Users Origin Destination Matrix via Mobile App (*)	Heatmaps and Trajectories of City Users Tourists (*)	Analysing City Users' Behavior (*)	Social Media Twitter Vigilance (*)	Twitter Data Analysis Tool (*)
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www.Km4City.org



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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 Giard di Boboli, near the Grotta del Buontalenti, that is very masterpiece of the Mannerist architecture sculpture

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

ESERCITAZIONE MUGNONE 2016

MODALITÀ 2016
28 maggio 2016

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

Regione Toscana

Suggerimenti

Post

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>

Tutta la posta in un unico posto

Calendario Posta

Sereno 3° 11° 0'

Microsoft Edge Roma

Anteprima Sk... Tuneln Radio Twitter

NETFLIX

Xbox

80&A

DISPONIBILE SU
Google play

Scarica da
App Store

Scarica da
Windows Store



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



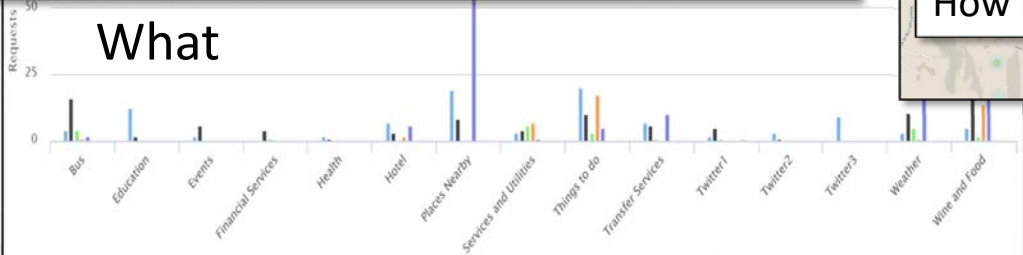
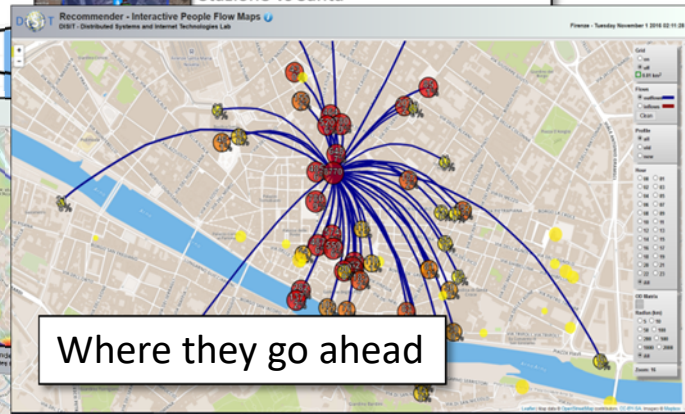
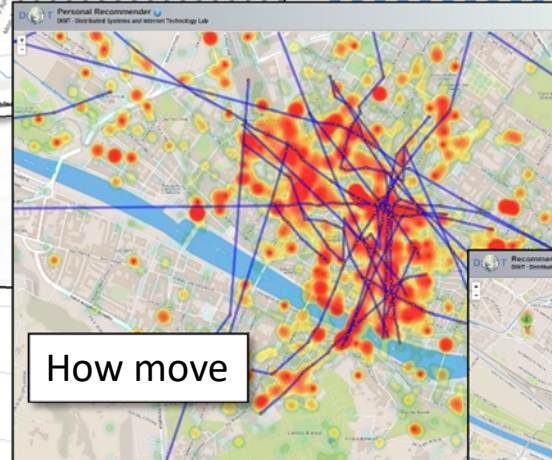
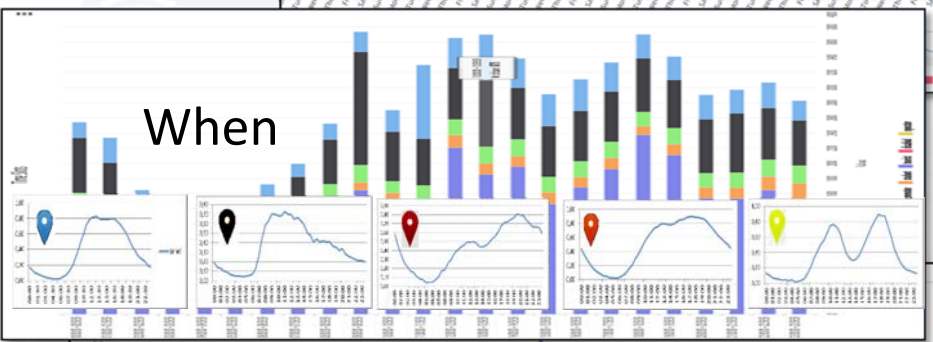
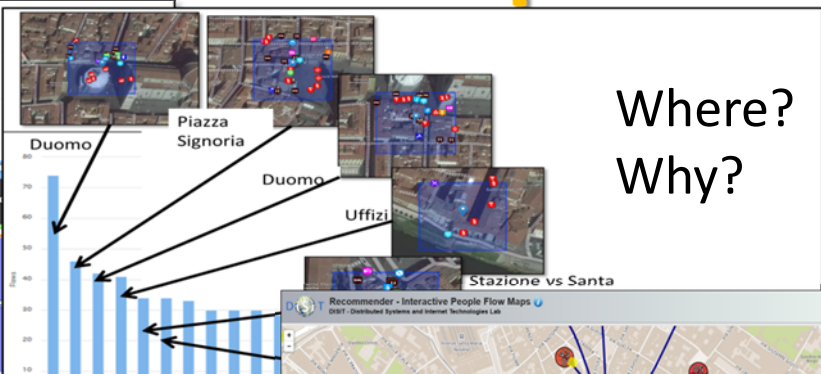
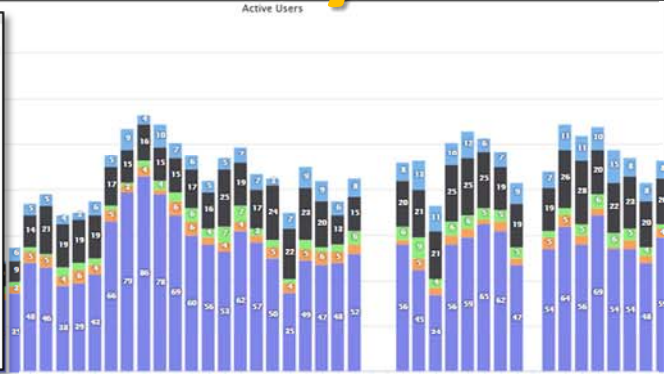
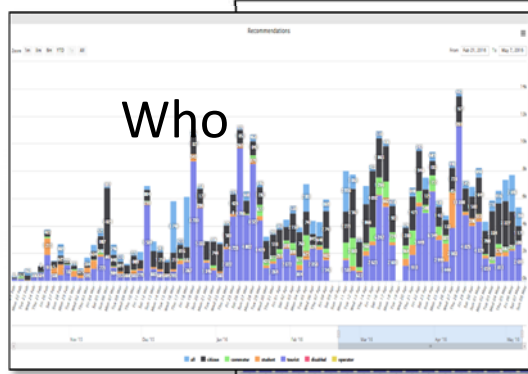
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User Behavior Analyzer for Collective profiling





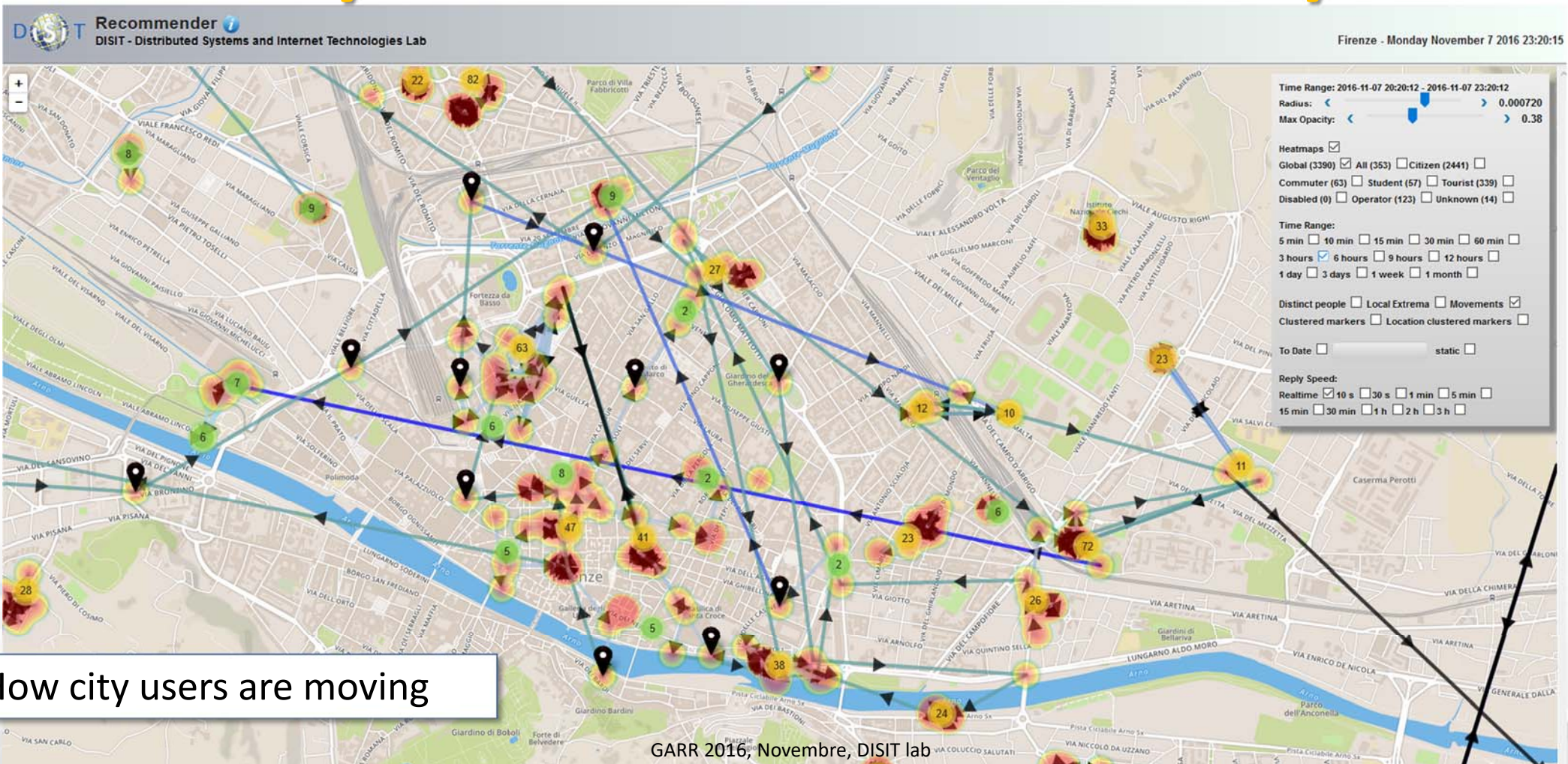
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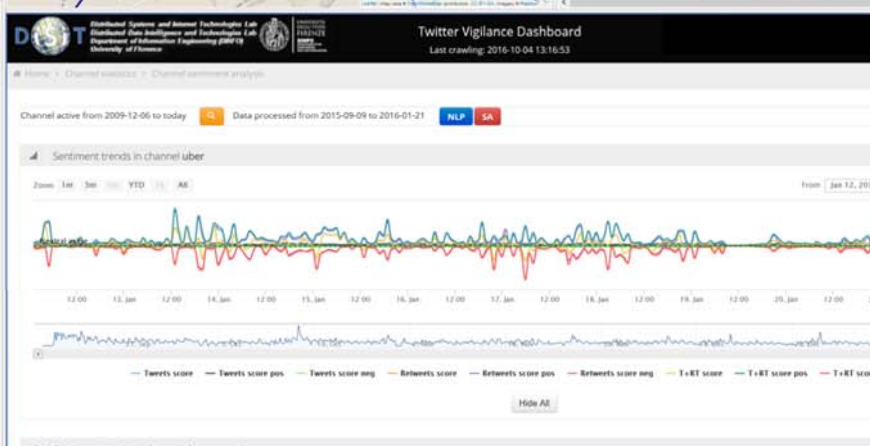
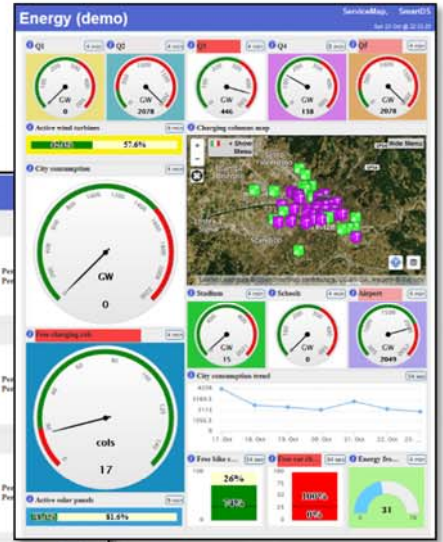
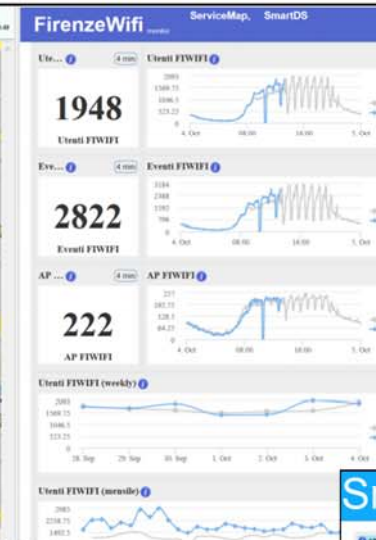
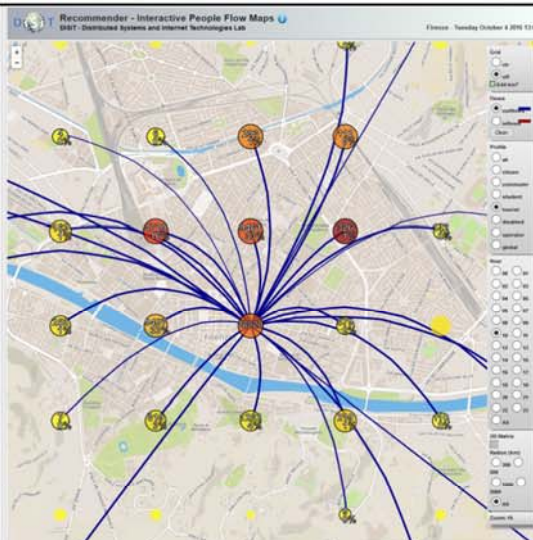
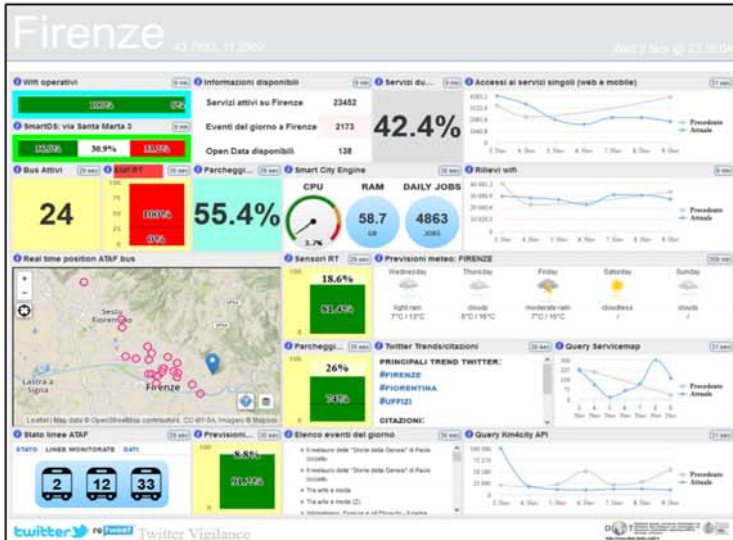


Anonymous User Behaviour Analysis



How city users are moving

Smart City Dashboard





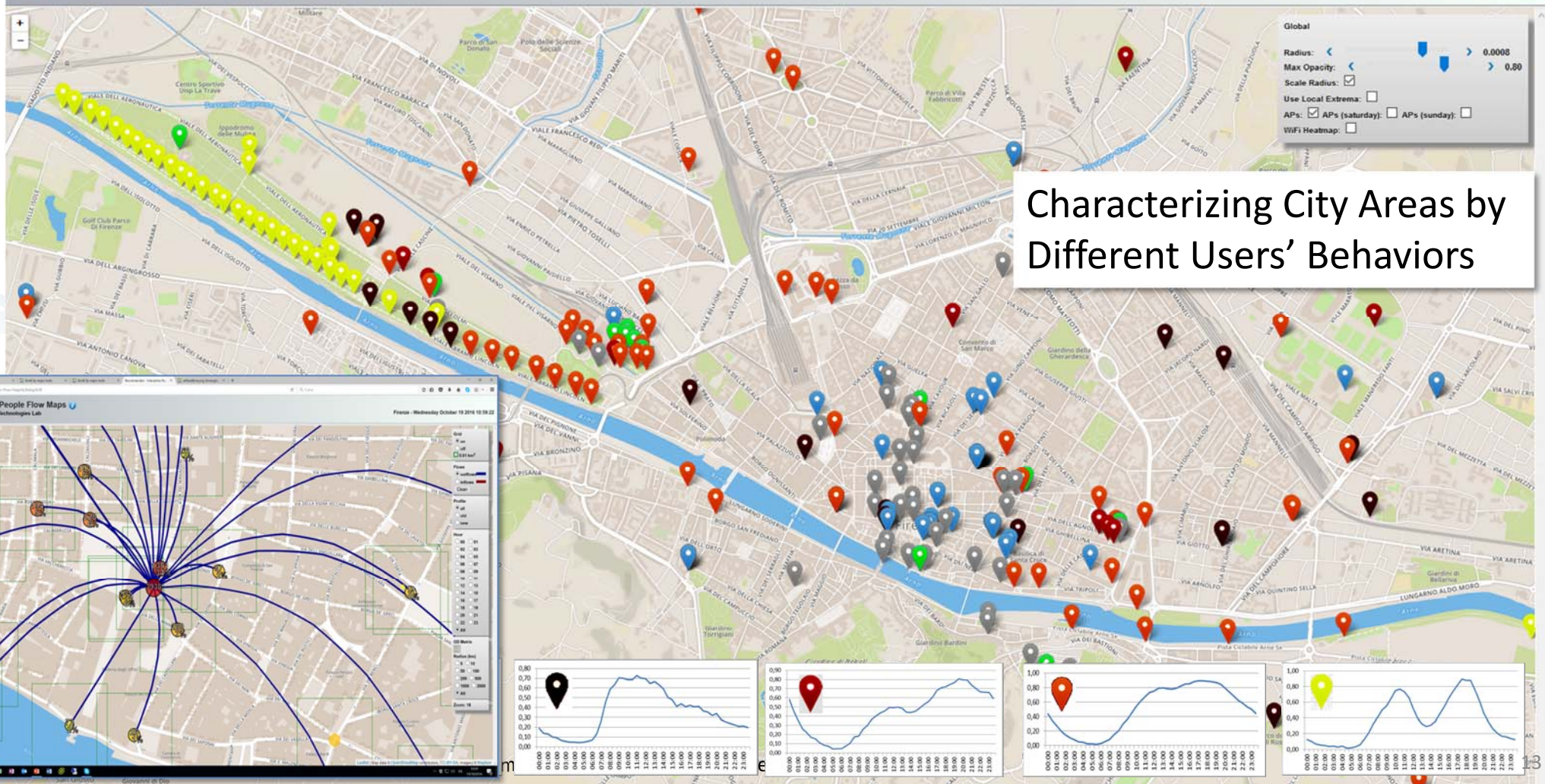
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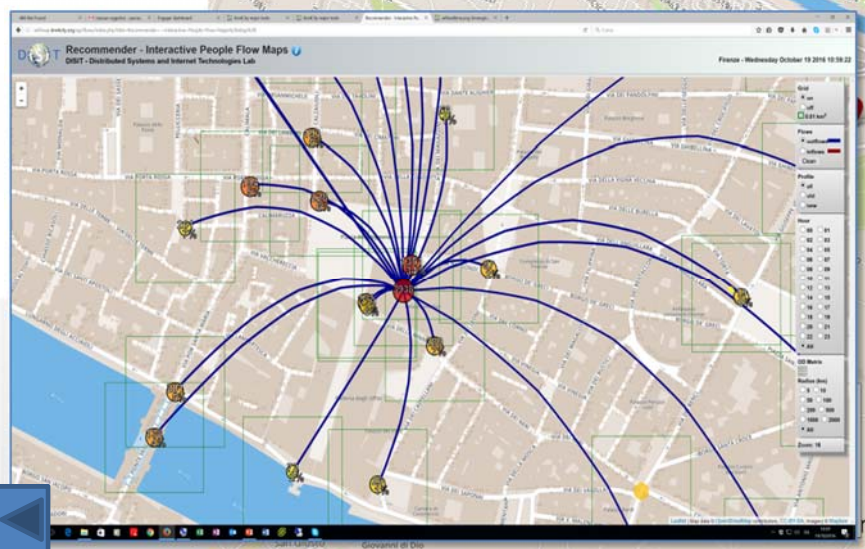
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Characterizing City Areas

Firenze Wi-Fi: Access Points Clusters Coverage Map
 DISIT - Distributed Systems and Internet Technologies Lab
 Firenze - Saturday November 12 2016 10:16:33



Characterizing City Areas by Different Users' Behaviors



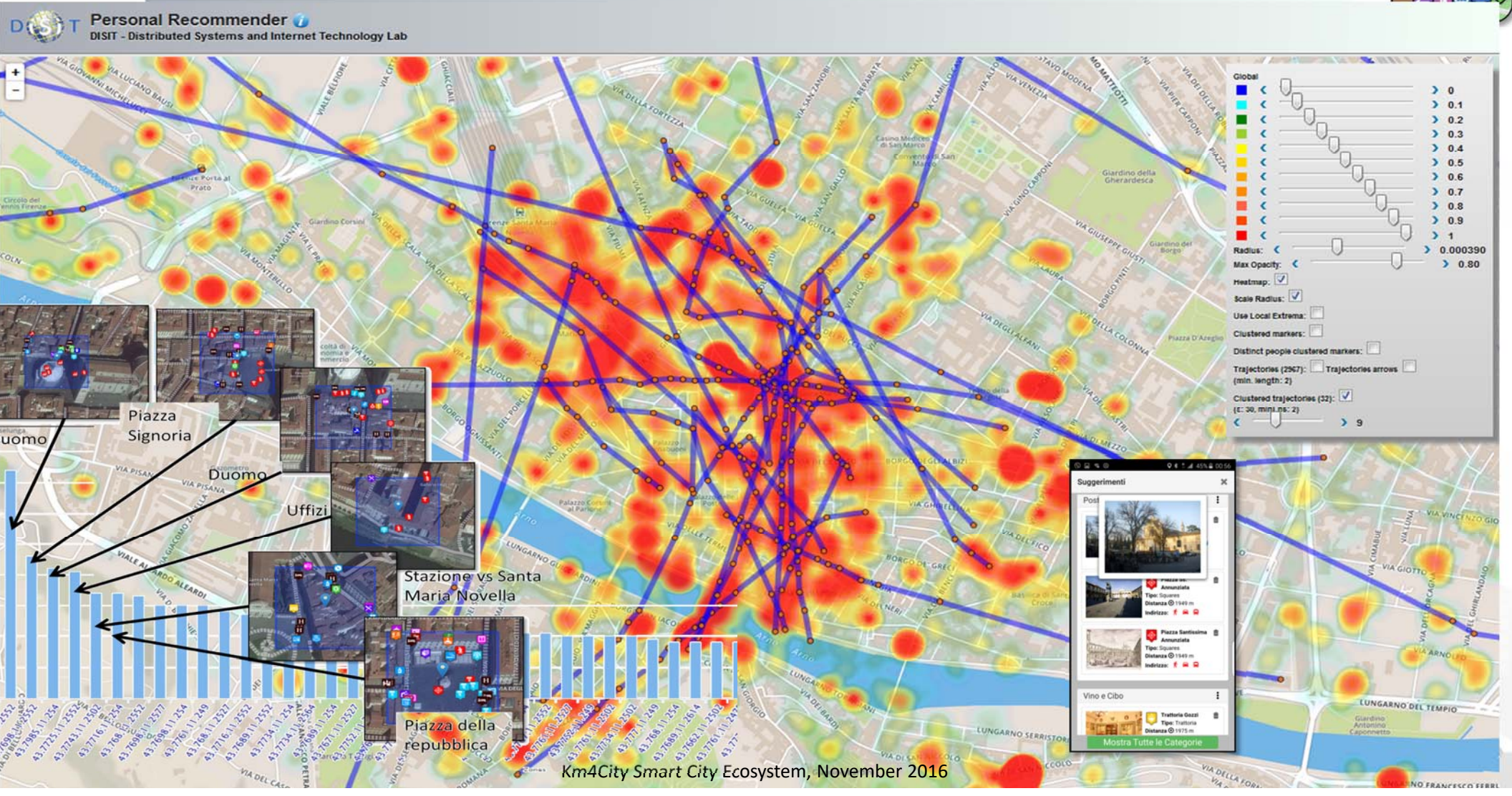


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User Behavior Analyzer





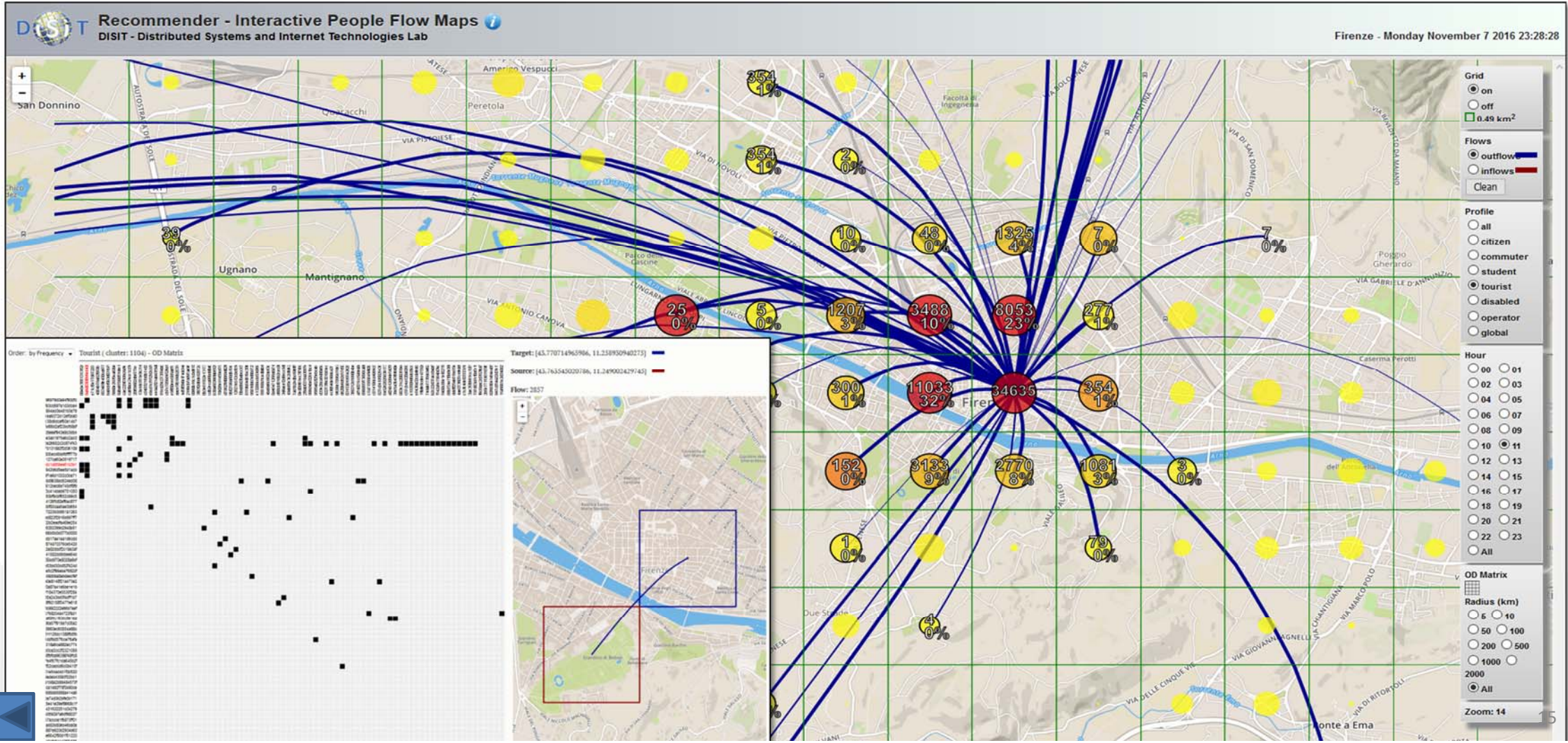
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OD Matrix scalabile





Data Analytics, Big Data..... ma perche'?

- **Calcolo offline e/o in tempo reale di:**

- Comportamento dell'utente, velocità, traiettorie, mezzo di trasporto più probabile, predizione movimenti, ...
 - Mappe di Origine Destinazione: mezzi e persone
 - Flussi mezzi e persone: Traiettorie e cluster
 - Modelli di comportamento clusterizzati x utenti
 - Suggerimenti, Assistenza, Coinvolgimento per utenti mobili:
 - Stimolo di comportamenti virtuosi, etc.
 - Algoritmi di ottimizzazione, routing: modale, multimodale, etc..
 - Algoritmi predittivi sui flussi e posizioni mezzi: tuning del servizio
 - Algoritmi per la stima di Early Warning
 - Stime del rischio e della resilienza
 -
- supporto alle decisioni**



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Dashboarding city resilience

Firenze 43,7693, 11,2580 Tue 10 Nov @ 12:53:21 ServiceMap, SmartDS

Informazioni disponibili: 23452
Servizi al Cittadino: 23452
Eventi giornalieri: 20
Open Data disponibili: 143

29 64.1% 98.9% 66.0% 99.3%

2264 per giorno 1378 per giorno Twitter Vigili

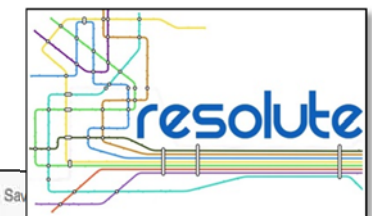
Data and Service Aggregator

resolute

GARR 2016, Novembre, DISIT lab



Risk Assessment



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

Aerial with labels

Flood sensors observations:

<input checked="" type="checkbox"/>	From	Data	mm/h
<input checked="" type="checkbox"/>	Firenze Genio Civile	2016-04-11T15:59:00	12
<input checked="" type="checkbox"/>	Firenze Peretola	2016-04-11T15:59:00	20.5
<input checked="" type="checkbox"/>	Firenze Universita	2016-04-11T15:59:00	10.5

Threshold:

From:

To:

Draw region to analyze: On

Load predefined region:

Mean precipitation:

SERVICE

NAME: villa maria teresa hospital...

ADDRESS: VIA DELLA CERNAIA, FIRENZE, FIRENZE

SERVICE TYPE: http://www.disit.org/km4city/schema#Public_hospital

SERVICE CLASS: <http://www.disit.org/km4city/schema#HealthCare>

SERVICE: <http://www.disit.org/km4city/resource/77ab1bc45b84357b727d67fe6081d2db>

VALUE: 100

WKT DESCRIPTION: POINT (11.2561 43.7866)

Traffic observations:

<input type="checkbox"/>	From	Date	km/h	car/km	car/h
<input type="checkbox"/>	VIA DELLA MATTONAIA	2016-10-10 18:01:08	58	15	2435
<input type="checkbox"/>	LUNGARNO AMERIGO VESPUCCI	2016-10-10 18:01:08	18	65	1842
<input type="checkbox"/>	VIA CAMILLO CAVOUR	2016-10-10 18:01:08	61	12	2009
<input type="checkbox"/>	VIA VALFONDA	2016-10-10 18:01:08	27	53	3307
<input type="checkbox"/>	VIA VITTORIO ALFIERI	2016-10-10 18:01:08	23	58	2798
<input type="checkbox"/>	VIA SENESE	2016-10-10 18:01:08	27	54	3216
<input type="checkbox"/>	VIA GUELFA	2016-10-10 18:01:08	68	3	420
<input type="checkbox"/>	VIA DELLA SCALA	2016-10-10 18:01:08	60	13	2167
<input type="checkbox"/>	PIAZZA DI SAN FELICE	2016-10-10 18:01:08	62	10	1697
<input type="checkbox"/>	BORGO SAN FREDIANO	2016-10-10 18:01:08	57	17	2090
<input type="checkbox"/>	VIA VITTORIO ALFIERI	2016-10-10 18:01:08	10	74	195
<input type="checkbox"/>	VIA DEL CAMPUCCIO	2016-10-10 18:01:08	60	13	2157
<input type="checkbox"/>	VIA DEI BENCI	2016-10-10 18:01:08	22	59	2679
<input type="checkbox"/>	PIAZZALE DI PORTA ROMANA	2016-10-10 18:01:08	64	8	1361

Relevant Services

Min asset value:

<input checked="" type="checkbox"/>	Service	Street	Type	Value
<input checked="" type="checkbox"/>	villa delle terme case di cura	VIALE MAZZINI GIUSEPPE, FIRENZE	Public	100
<input checked="" type="checkbox"/>	villa dei pini srl	VIA FOSCOLO UGO, FIRENZE	Public	100
<input checked="" type="checkbox"/>	Poggio Secco	VIA INCONTRI, FIRENZE	Public_hospital	100

Assessing Risk

- hydraulic
- Seismic



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ServiceMap Dev Tool



Search around a GPS point

Search along a line

Regular Services Transversal Services

Search Range: 500 m

N. results for each: 200

Services: 35 of 35 available

Bus Stops: 13 of 13 available

Road Sensors: 2 of 2 available

72 Bus Lines Found.

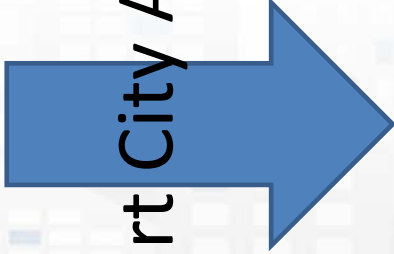
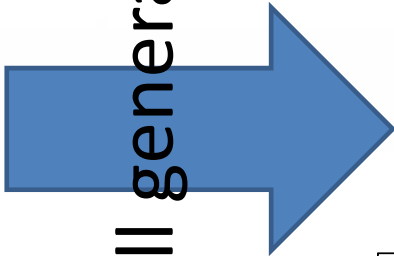
Search results organized by category

Total number of results: 2231

N. results: No Limit

Services: 2231 of 2231 available

Smart City API call generation



Web App HTML5

Mobile Apps

Embed into Web pages

DISPONIBILE SU Google play

Scarica da App Store

Scarica da Windows Store

Indirizzo: VIALE DELLA MERIDIANA, 5 FIRENZE FI

http://www.disit.dinfo.unifi.it

KM4CITY SERVICE MAP EMBEDDED



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Dashboard Builder

Dashboards Overview

Name	Title	Creation Date	Status
12	Dashboard Data	2016-07-27 11:35:11	OK

Sources Management

DataSources Overview

ID	URL
Kin4CityApp	jbtc.mysp/Redsburg.3306
Kin4CityApp2	jbtc.mysp/1192.168.0.20.3306
Kin4CityApp3	http://192.168.0.206.8880/WebAppGratiopend
Kin4CityApp4	jbtc.mysp/1192.168.0.55.3306
Kin4CityServiceApp	jbtc.mysp/1192.168.0.72.3306
Kin4CitySMAbility	jbtc.mysp/1192.168.0.72.3306
priv4	jbtc.mysp/Redsburg.3306
SmartOS	jbtc.mysp/1192.168.0.25.3306
TwitterTv	jbtc.mysp/1192.168.0.50.3306

Add new Widget

Click the Add button to add new metrics to the widget.

Metric: Add

Metric Description: Description: Percentage of Data
Details: 4000
Metric: Celsius
Permissions: OK
Data Area: 0.0000
Data Source: Observations Reported per a Widget per 1 hour
Default: min: 00 sec
Status: Active

Control:

Type Widget: widgetPaChart | Max 1 metrics

Selected Metrics: Sensor_01

Link: www.unitysoft.com

Information: Percentage of real servers underground data using in comparison to those installed in the day. The greater the value in red color is the percentage of non functioning the greater part indicates the other side.

Widget Parameters: Title: Sensor_01, Background color: #fff, Time interval: No, Rows number: 2, Columns number: 3

BarContent - 2x4 (9 min)

14.2% 85.8%

Buttons: Button 2x1, Button 2x2, Button 4x2, Button 4x4

PARK (59 sec)

parccheggio162_I

SUCCESS

2016-11-09 23:09:25

4x2 (9 min): 56%, 44%

5x2 (59 sec): 28%, 72%

6x2 (59 sec): 24%, 76%

Modifica Widget

Id Widget: widgetBarContent

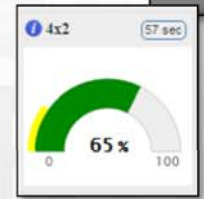
Type: Percentuale

Min. Columns number: 1, Max. Columns number: 2

Min. Rows number: 2, Max. Rows number: 3

n. metrics: 1, Color: 1

Close Modify



4x3 (4 min): Line chart

4x5 (59 sec): Line chart

5x5 (59 sec): Line chart

4x4 (57 sec): CPU Load, RAM, Daily jobs

5x5 (57 sec): CPU Load, RAM, Daily jobs

4x2 (48 sec): Pie chart (35.0%, 65.0%)

User influencing, engaging, monitoring & Follow Up

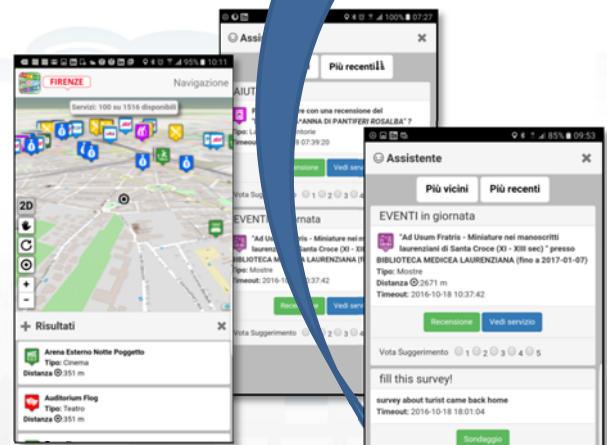
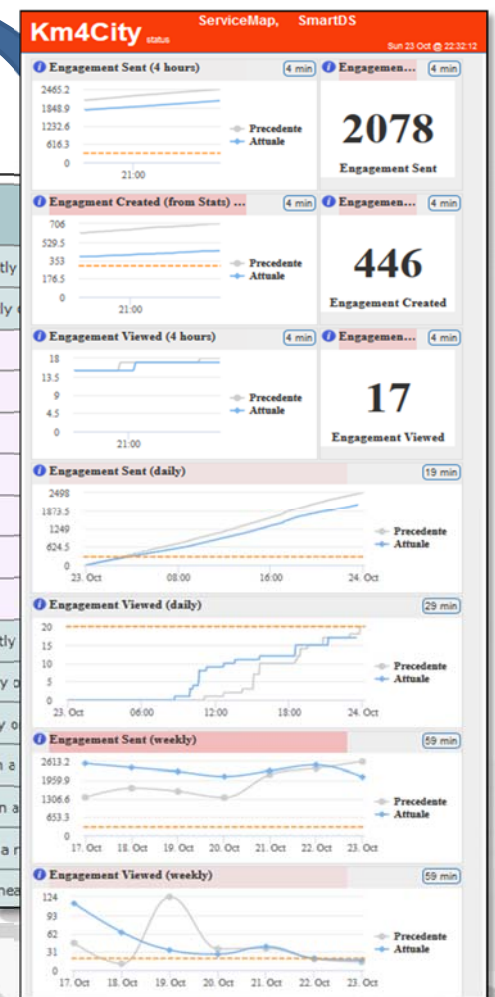


City & City Operators Strategy Editor



Rule name	Type	#sent	#viewed	#viewed on #sent	Description
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%	Suggest (in german) an event currently
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%	Suggest (in english) an event currently
- 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%)	39 (55.71%)	39 (34.51%)	
- operator		0 (0%)	0 (0%)	0 (0%)	
- disabled		0 (0%)	0 (0%)	0 (0%)	
- all		119 (6.92%)	6 (8.57%)	6 (5.04%)	
daily_event_es	ENGAGEMENT	6 (0.01%)	4 (0.41%)	66.67%	Suggest (in spanish) an event currently
daily_event_fr	ENGAGEMENT	6 (0.01%)	4 (0.41%)	66.67%	Suggest (in french) an event currently
daily_event_it	ENGAGEMENT	545 (6.57%)	21 (3.85%)	6.97%	Suggest (in italian) an event currently
parking_en	ASSISTANCE	141			
parking_es	ASSISTANCE	3 (0.04%)			
parking_it	ASSISTANCE	187			
shoot_a_photo_de	ENGAGEMENT	68			

- Inform
- Engage
- Stimulate / recommend
- Provide Bonus
- motivatinmg



Any Mobile and Web App

Strategy enforced



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INGEGNERIA
DELL'INFORMAZIONE

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

Km4City Roadmap



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

RESOLUTE
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

GARR 2016, Novembre, DISIT

2021

12/2017

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

6/2017

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

Today

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

GHOST SIR
2016-2019 - Started

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

www.Km4City.org



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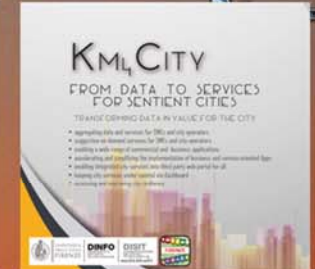
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Windows Phone Store



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



GARR 2016, Novembre, DISIT lab



Conclusions



Km4City: Open, Flexible, Scalable City Platform

- **Over the 5 stars data**
 - linked open data, RDF store + big data analytics
- **Open**
 - Open to any kind of customization → Open Source, license free
 - Open to any data source → Km4City DataWarehouse
- **Flexible**
 - multiple domains data and processes → Km4City Ontology and Tools
 - Ingesting data via any protocol and approach → Km4City DataWarehouse
- **Scalable**
 - Sustainable and affordable → Flexible and compoundable tools
 - providing support for decision support performing data analytics in real time → Km4City Scalable Back office for Big Data Analytics