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DISIT
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AND INTERNET
TECHNOLOGIES LAB



DISIT Lab

Overview on Data Analytics

Seminar for University of San Diego Delegation at DISIT lab

Prof. Paolo Nesi (lab chair)

Distributed [Systems and internet | Data Intelligence and] Technologies Lab

Dipartimento di Ingegneria dell'Informazione (DINFO),

Università degli di Studi di Firenze

Fax: 0039-055-2758570, tel: 0039-3355668674

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

DISIT lab overview, January 2017, Florence



Overview

- **DISIT Lab Overview** ←
- Research Areas

- **Smart City**

- **Social Media**

- **Mobile Computing**

- **Smart Cloud**

- **Main Projects**

- **Conclusions**

With Case Studies



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DISIT Lab

- **DISIT is active since 2001 as lab**
- **Researchers:**
 - 3 main, 4 post doc, 4 PhD stud, ass., contractor...
- **Currently Active Research Projects: 10**
- **Projects in the last 4 years: 27**
- **Research Budget (last 4 years): 2.0M€**
- **Foreseen Research Budget (next 2 y): 2.2M€**
- **DISIT data center and parallel computing infrastructure**
- **DISIT Lab spaces**
- **Spin-Off:** Effective Knowledge s.r.l. <http://www.effective-knowledge.com/>



DISIT Lab, <http://www.disit.dinfo.unifi.it>



Distributed Systems and Internet Technologies Lab
Distributed Data Intelligence and Technologies Lab
Department of Information Engineering (DINFO)
University of Florence



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

qualsiasi tipo deep search

HOME ABOUT RESEARCH INNOVATION CORSI E TESI COME FARE EVENTI MIO PROFILO

root Uscire

Mostra Modifica Log Translate Devel

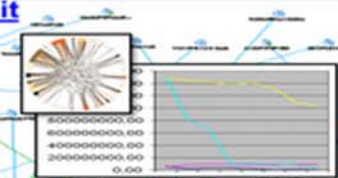
DISIT LAB OVERVIEW

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

Text and Web Mining



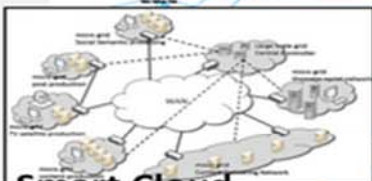
Data Analytics Big data



Social Media, e-learning



Smart Cloud Computing



Mobile Computing



Smart Cities



DISIT lab and research group is active since 1994. It is one of the most

CONTENUTI

- *Ultime Attività*
- *In primo piano*
- *Più visti*
- *Most Viewed (last 500)*
- *Most Viewed All (last 500)*
- *Ultimi caricati*
- *Più votati*
- *Mie collezioni pubblicate*
- *Miei contenuti*
- *Carica un nuovo contenuto*

ROOT

- ▶ Gruppi
- Cerca Utenti
- Contenuti ed attività non lette relative ai tuoi gruppi
- Crea la matrice di tassonomia
- Forum
- Invita a colleghi



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DISIT lab mission

- **Research and Innovation** projects founded by:
 - European Commission
 - Italian Ministry of Research, It. Min. of Innovation and Development
 - Foundations
 - Tuscany Region
 - Direct commitment with the industries for technology transfer
 - **Currently with more than 60 Partners** at national and international levels
- **Didactical** support to Univ. Firenze Courses, mainly
- **Management** of infrastructures:
 - **ECLAP (social network), ApreToscana, Km4City (Smart City)**





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National and International Connections

- **DISIT is:**
 - ICT reference lab for the Smart City of Florence metropolitan area
 - Aggregator for Europeana, European Digital Library <http://www.europeana.eu/>
 - Member of ISO MPEG standardization body
 - NEM: Network and Media group in Europe
 - ETSI: standardization body
 - Node of the CINI National Lab on Big Data, + on Smart City, + on CyberSecurity
 - Member of National Cluster on Transport System, + on Smart Communities
 - Member of CNIT: Consorzio nazionale interuniversitario Telecomunicazioni
- **Stable agreements** with: LAMMA, IBIMET CNR, Regional Mobility Center, several universities, ...
- IOT lab: Intel, Fluctus, UDOO, ...
-
- [See for all the list http://www.disit.org/5486](http://www.disit.org/5486)



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Didactical Actives

- **DISIT lab provides support for Courses, stage, thesis, PhD courses**
- **Engineering and Science Courses**
 - Distributed Systems (information engineering and science)
 - Knowledge Management and Protection
 - Operative Systems
- **Master in Big data and Business Intelligence:**
 - Knowledge Engineering
 - Big Data: noSQL databases, parallel architecture, data analytics
- **Specialization School on National Security (data security)**



Main Basic Research Topics

- **Semantic Computing:**
 - Knowledge Engineering, ontology building, experts systems, decision support systems, ontological reasoners
- **Artificial Intelligence:**
 - Data Analytics, Data Mining, Machine Learning
 - Natural Language Processing
 - Mixed statistical and operating research approaches
- **Big Data Computing:**
 - From data warehouse to decision support
 - Distributed and Parallel Computing, Cloud computing
 -
- **Formal Models, Software Engineering**



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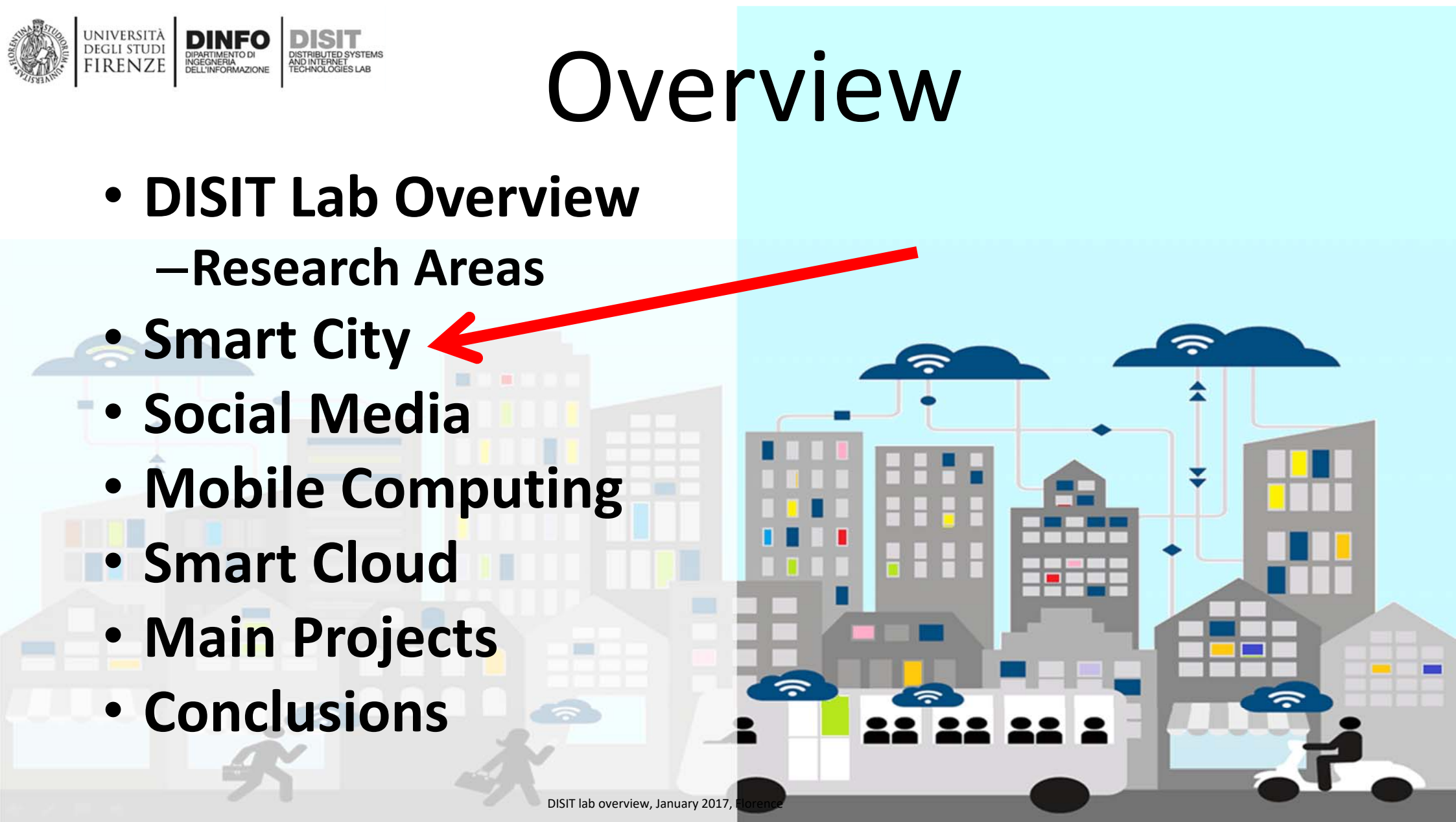
Main Research Sectors

- **Smart City:** data management, mobility, user engagement, ...
- **Social Media and Media:** collaborative work, Twitter Vigilance
- **Mobile Computing:** mobile application, user behavior analysis
- **Smart Cloud:** cloud simulation, optimization
- **Smart manufacturing:** Industry 4.0, Factory 4.0, e-factory
- **Smart Retail:** user behavior analysis, engagement, ..
- **Autonomous drivers:** operators, high speed trains, driverless
- projects: <http://www.disit.org/5501>



Overview

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- **Social Media**
- **Mobile Computing**
- **Smart Cloud**
- **Main Projects**
- **Conclusions**





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Smart City

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fo.unifi.it

- **Smart City of Florence Metropolitan Area**
- **Km4City:** <http://www.km4city.org>
- **RESOLUTE H2020, EC:**
 - <http://www.resolute-eu.org>
- **REPLICATE H2020, SCC1, EC flagship**
 - <http://replicate-project.eu/>
- **Sii-Mobility SCN MIUR:**
 - <http://www.sii-mobility.org>
- **Coll@bora Social Innovation, MIUR:**
 - <http://www.disit.org/5479>
- **TRACE-IT, RAISSS, TESYSRAIL,**
- **Mobile Emergency:**
 - <http://www.disit.org/5404>



Trace-IT
RAISSS





Smart City

- **Problems:**

- Smart Services Challenges
- Lower costs, lower energy,
 - Ecosystem for the city
- Risk and resilience
- Control Room: decision support

- **Solutions:**

- Sustainable mobility
- Managing Big amount of data, IOT, open data....etc.
- Prediction and Early Warning
- Prediction of city users' presences
- Changing the city user behaviour, Engagment planning for target reaching

- **Technologies for solutions:**

- Data ware house: reconciliation, data mining
- Indexing and Search semantic computing, full text, etc.
- Predictive models and algorithms
- City User behavior understanding prediction :
 - How move, where, why, when, at which time, etc...
 - Clustering, trajectory, OD matrix
 - Preferences on functionalities, Preferences on menu
 - their locations, traces, OD, etc..
 - Tourism analysis
 - Social media assessment
- Electronic Wallet, bonus, single and multiple values
- Early warning for alerting, anomaly detection
- Quality of service, assessment, product assessment feedback



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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





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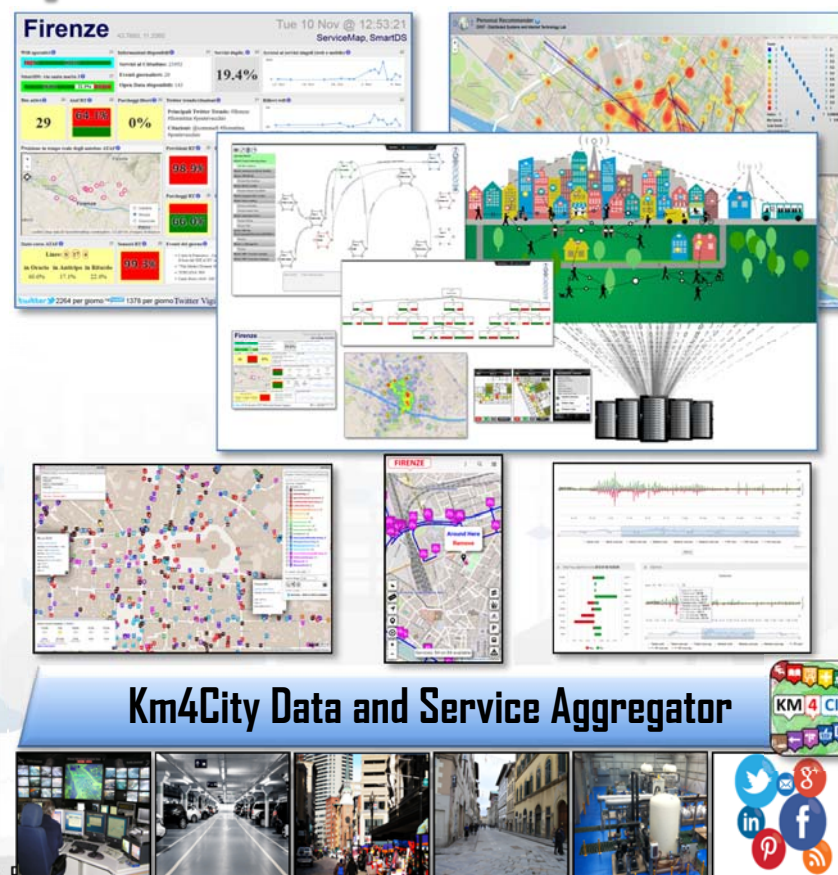
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From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

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



Sentient City Control Room

www.Km4City.org



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GET IT ON
Google play

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App Store

Download from
Windows Phone Store



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: traffic and parking (*) ⓘ	 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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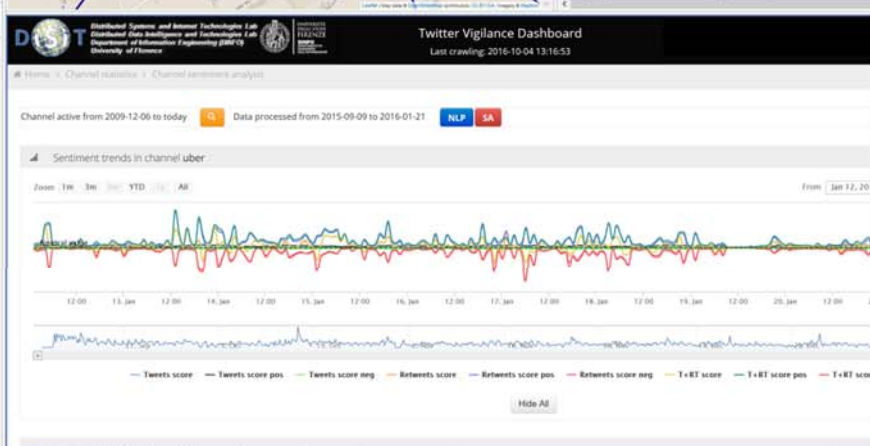
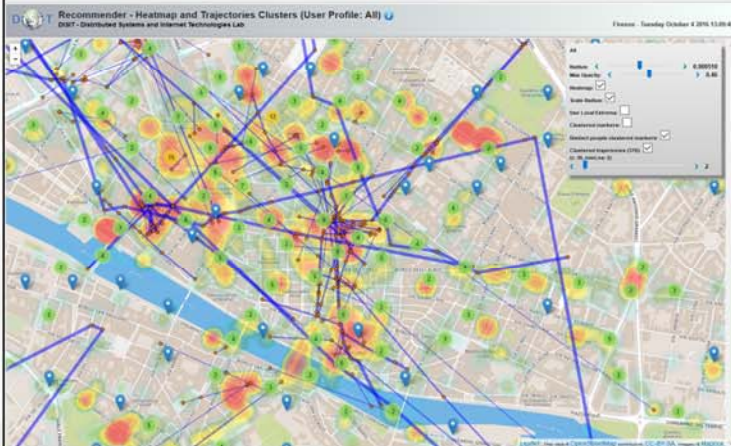
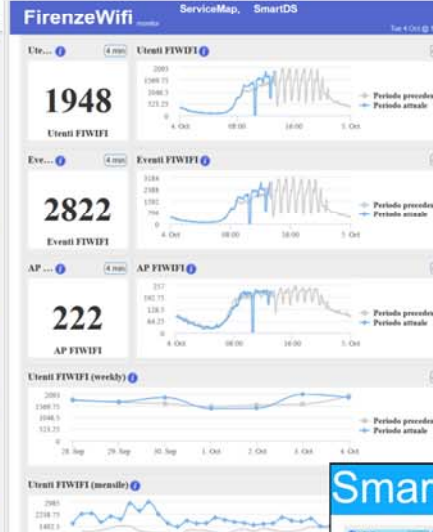
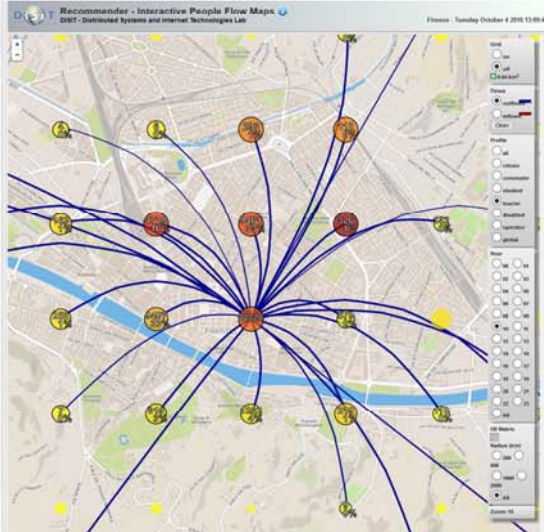
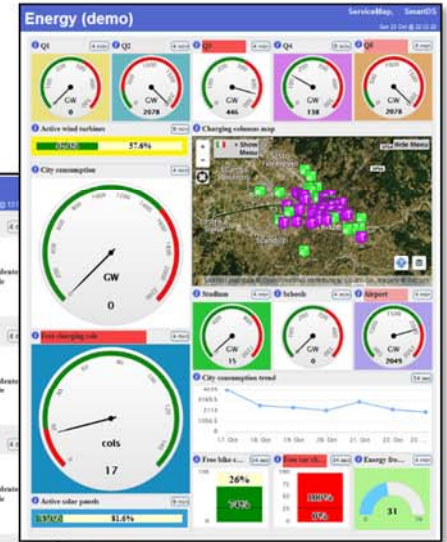
Smart City Control Room, Dashboard, Real Time Data

The dashboard displays a variety of real-time data visualizations, including: a main overview with a 42.4% metric and a 120/44.7% gauge; a list of 21, 20, 27, and 41 items; a 'Km4City' section with 1790 items; a 'SmartCity' section with 4392, 16915, and 225 items; a 'SmartCity Processes' section with 1, 76, and 40 items; and a 'Service app Users' section.

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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Smart City Dashboard



DISIT lab overview, January 2017, Florence



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43.7693, 11.2560

Wed 9 Nov @ 23:36:04



Horizon 2020
European Union Funding
for Research & Innovation

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

Bus Attivi 29 sec

24

Ataf RT 30 sec

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

Real time position ATAF bus

Sensori RT 29 sec

100

18.6%

81.4%

Previsioni meteo: FIRENZE 359 min

Day	Weather	Temp
Wednesday	light rain	7°C / 13°C
Thursday	cloudy	6°C / 16°C
Friday	moderate rain	7°C / 16°C
Saturday	cloudless	/
Sunday	cloudy	/

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%

Elenco eventi del giorno 30 sec

- 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

Parcheggi... 30 sec

100

26%

74%

Twitter Trends/citazioni 30 sec

PRINCIPALI TREND TWITTER:

#FIRENZE

#FIORENTINA

#UFFIZI

CITAZIONI:

Query Servicemap 31 sec

twitter retweet Twitter Vigilance

D... <http://www.dit.delfi.unifi.it>

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.

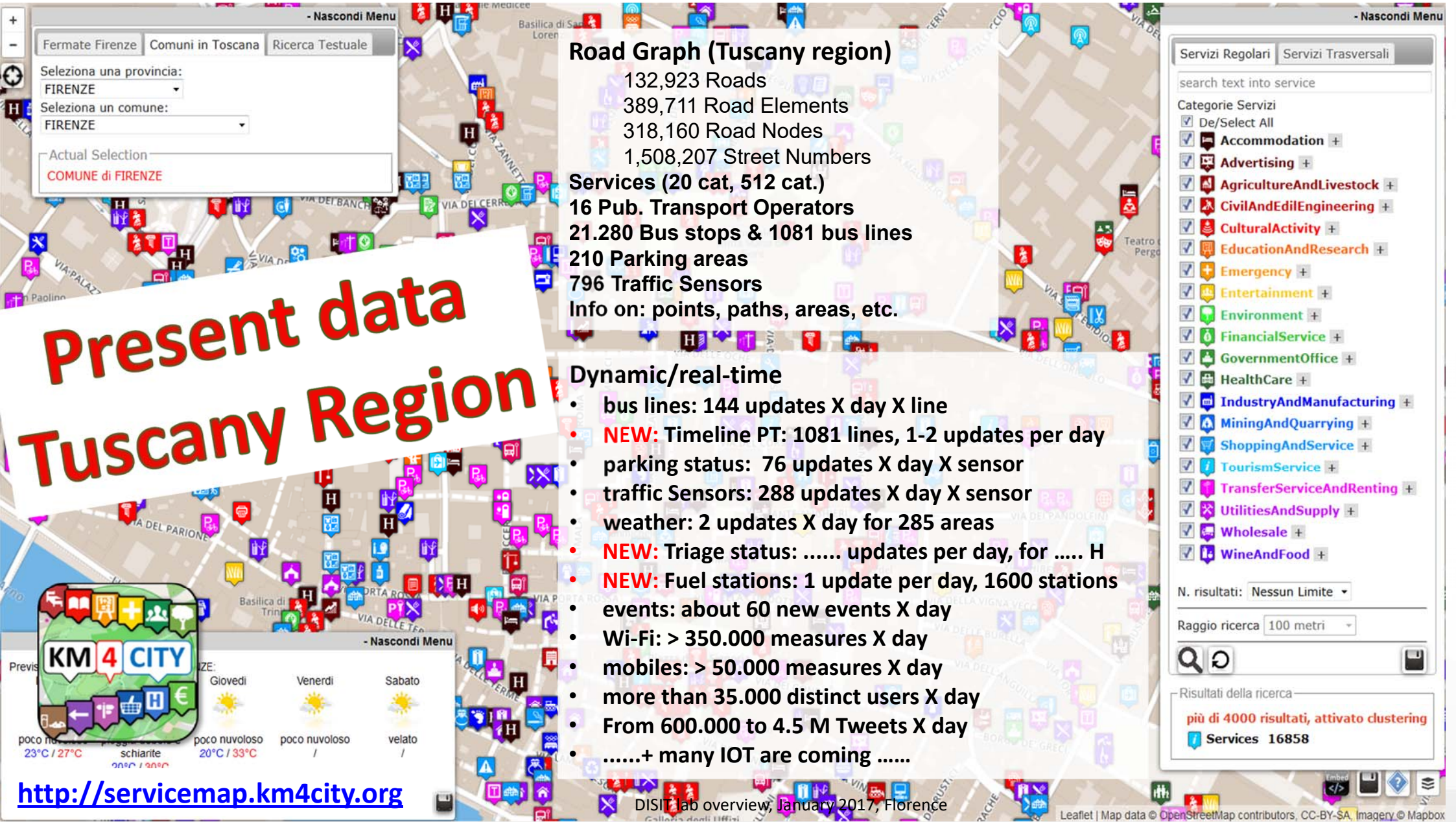
Dynamic/real-time

- 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: updates per day, for H
- **NEW:** Fuel stations: 1 update per day, 1600 stations
- 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

<http://servicemap.km4city.org>

DISIT lab overview, January 2017, Florence

Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox





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.





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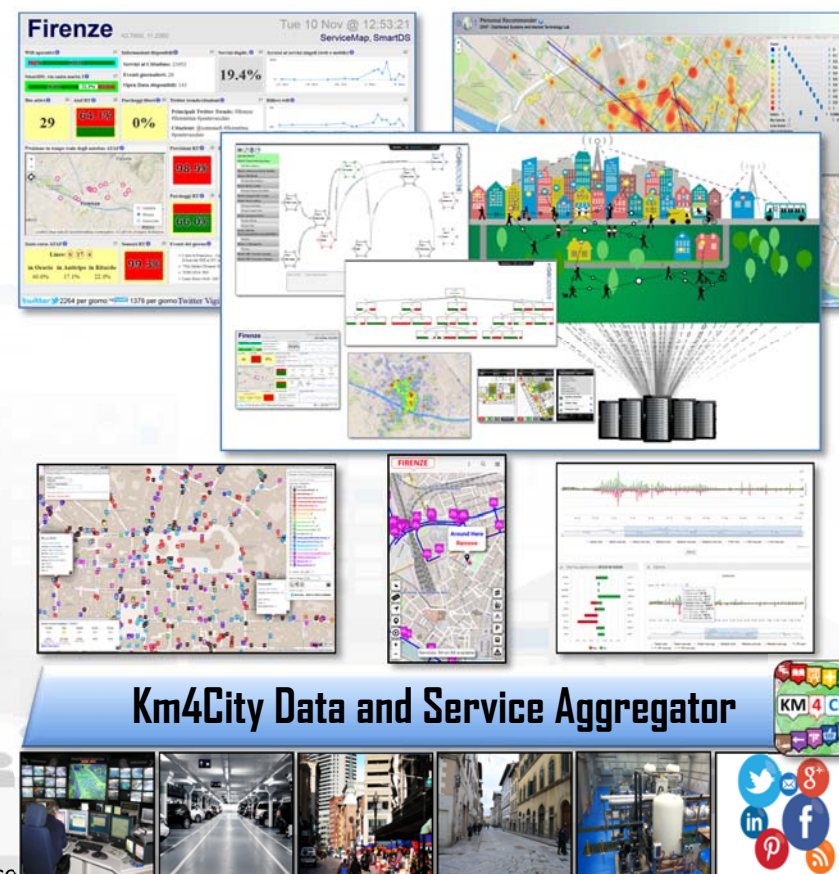
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From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

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2. transform data in value for the city, influence city users
3. Technical details: dashboard development and data aggregation
4. improve city resilience, reducing risks and decision support





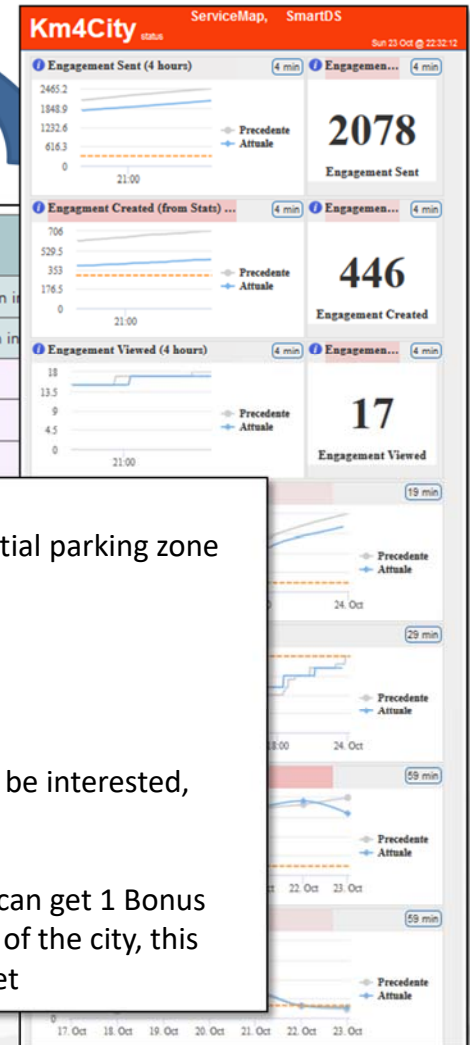
User influencing, engaging, monitoring & Follow Up



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 on in
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%)			



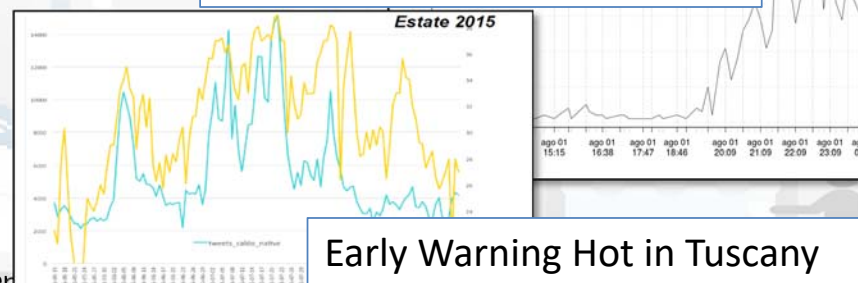
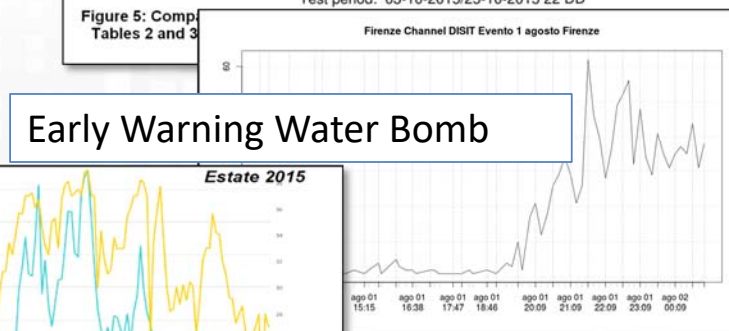
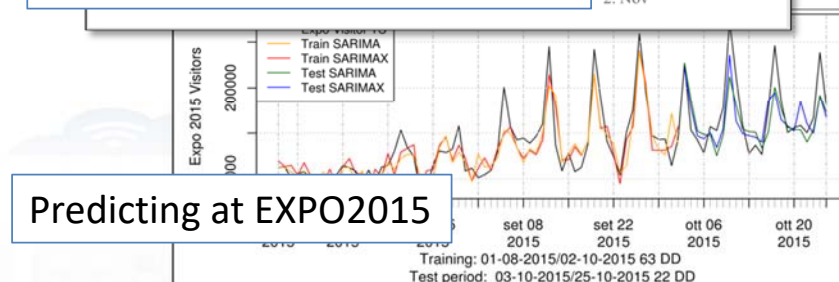
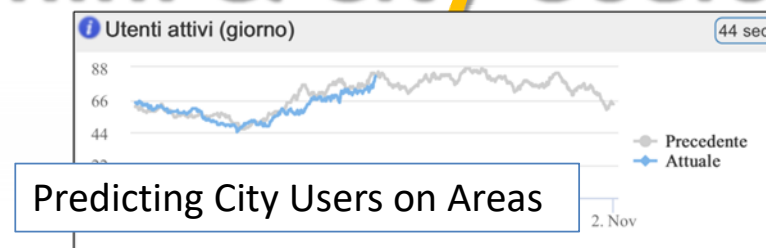
Any Mobile and Web App

- 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 buy a bus ticket



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)





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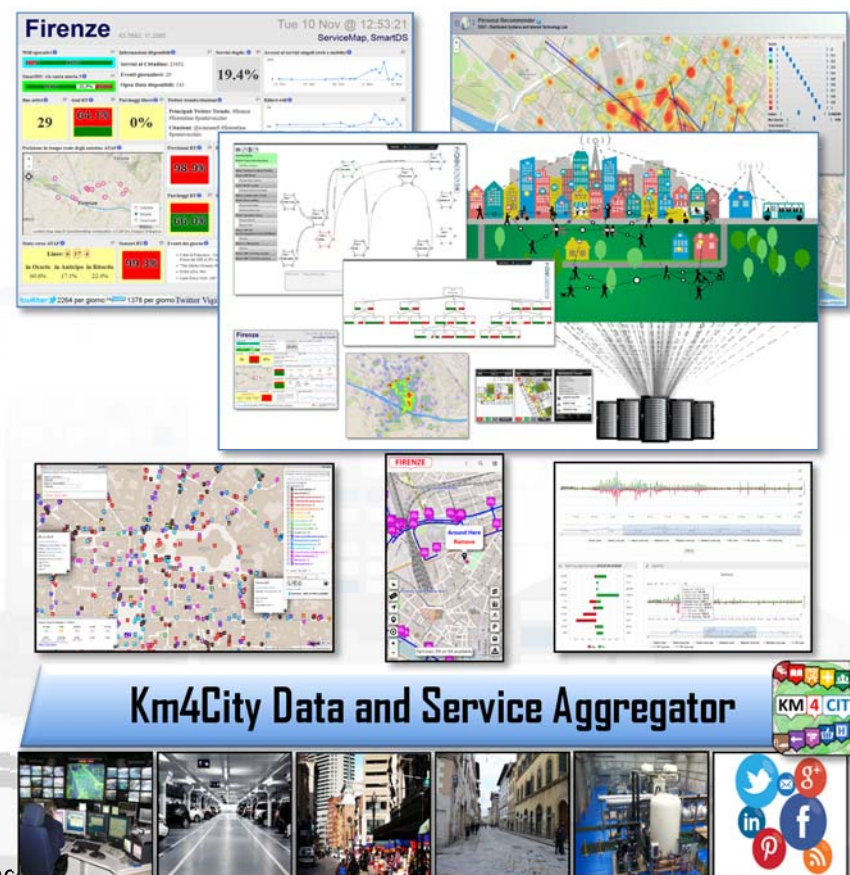
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Dashboard Builder

Dashboards Overview

Name	Title	Creation Date	Status
12	Dashboard Data	2016-07-27 11:35:13	OK

Sources Management

DataSources Overview

ID	URI
KindCityApp	jbtc.mysp://redborg.3306
KindCityApparc	jbtc.mysp://192.168.0.20.3306
KindCityRCS	http://192.168.0.206.8080/WebAppGratioparc
KindCityRecommender	jbtc.mysp://192.168.0.55.3306
KindCityServiceMap	jbtc.mysp://192.168.0.72.3306
KindCitySikability	jbtc.mysp://192.168.0.72.3306
privat	jbtc.mysp://redborg.3306
SmartOS	jbtc.mysp://192.168.0.25.3306
TwitterTv	jbtc.mysp://192.168.0.50.3306

Add new Widget

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

Metric: Add

Metric Description: Description: Description of Data Details: 40000 Metric: Celsius Performance: OK Data Area: 00000 Data Source: Observations Reported per 4 Minutes per 1 Transaction Refresh Rate: 10 sec Status: Active

Control:

Type Widget: Max. Y. Metrics:

Selected Metric:

Link:

Information: Percentage of total servers undergoing data writing or monitoring is low instead of the day. The number of jobs per day is high on the percentage of non-faulting the greater part selected in the other sites.

Widget Parameters: Title: Background color: Time Interval: Refresh rate (sec): Rows number: Columns number:

Modifica Widget

Id Widget:

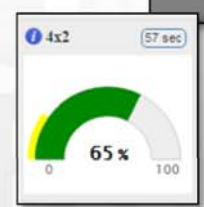
Type:

Min. Columns number: Max. Columns number:

Min. Rows number: Max. Rows number:

n. metrics: Color:

Close Modify



BarContent - 2x4 9 min

14.2% 85.8%

Button 2x1 Button 2x2 Button 4x2 Button 4x4

PARK 59 sec

parccheggio162_I

SUCCESS

2016-11-09 23:09:25

4x2 56% 44%

5x2 28% 72%

6x2 24% 76%

4x3 4x6 5x5 5x5 4x2

CPU Load RAM Daily jobs CPU Load RAM Daily jobs

100% 35.2 GB 212 JOBS 100% 35.2 GB 212 JOBS

35.0% 65.0%

Q1 15 sec Q2 15 sec Q3 15 sec Q4 5 min Q5 15 sec

GW 223 GW 1462 GW 481 GW 138 GW 1462

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ServiceMap Dev Tool



Search around a GPS point

Search along a line

Regular Services Transversal Services

Search Results: 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

Services: 2231 of 2231 available

Smart City API call generation

Web App HTML5

Mobile Apps

Embed into Web pages

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Distributed Data Intelligence and Technologies Lab
Department of Information Engineering (DINFO)
University of Florence
<http://www.disit.dinfo.unifi.it>

KM4CITY SERVICE MAP EMBEDDED

DISPONIBILE SU

Scarica da

Scarica da



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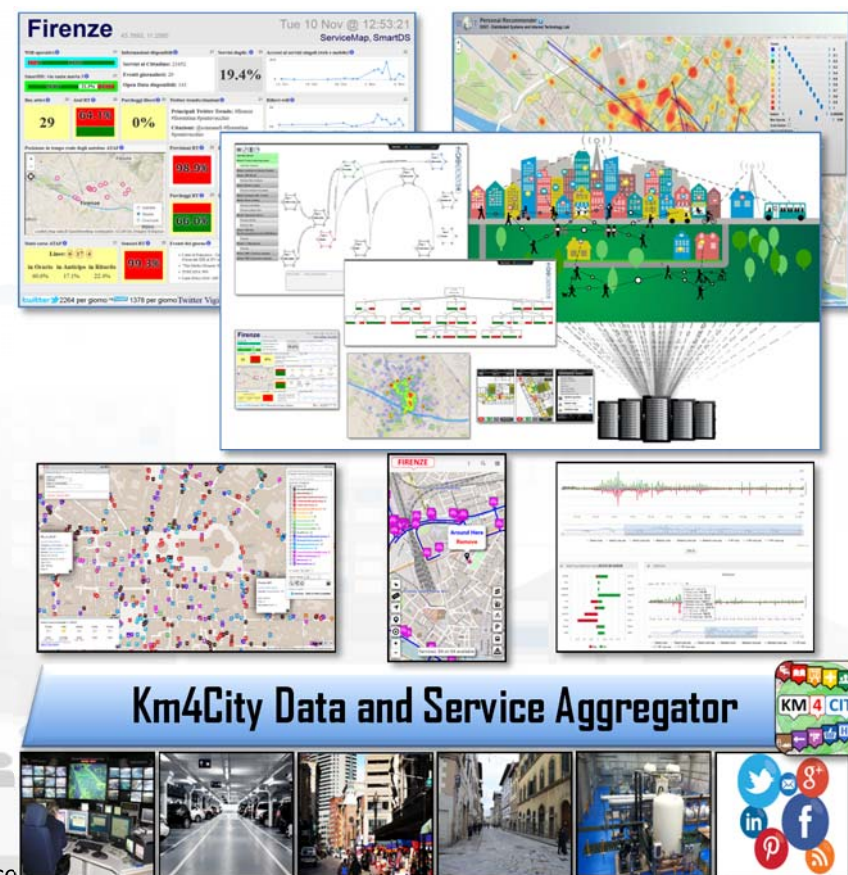
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From Data to Services for the Sentient Cities

Open Source and inter-operable tools to

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





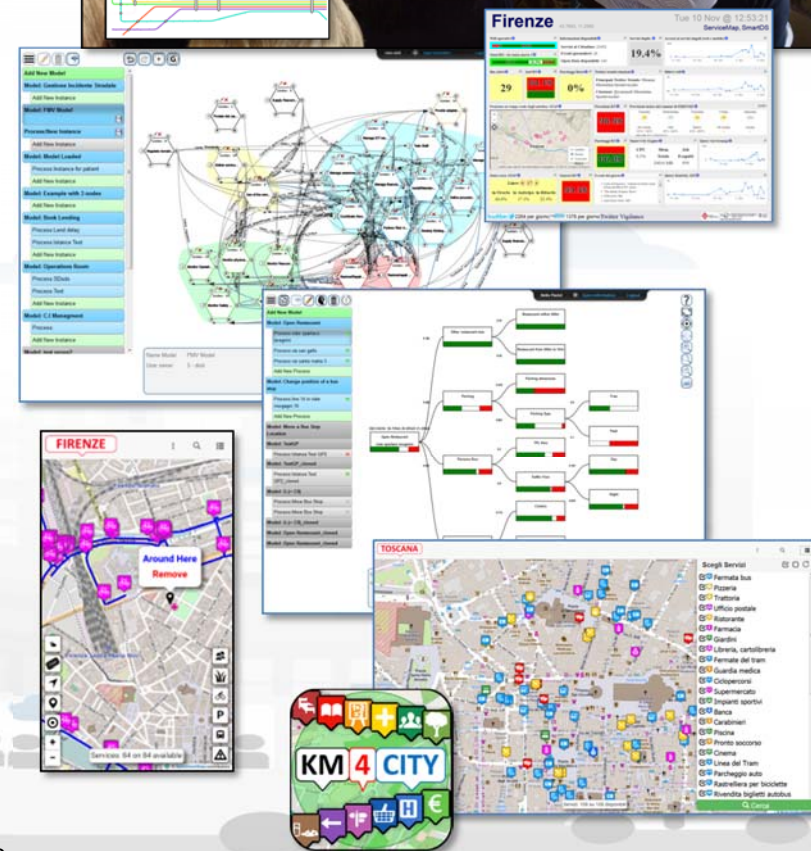
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Improve city resilience, reducing risks and decision support

- 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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Dashboarding city resilience

The dashboard, titled "Firenze" (Florence), displays various metrics and data visualizations:

- Map:** A geographical map of Florence with red lines indicating network connections or service areas.
- Network Diagram:** A complex network graph showing relationships between different city services and departments, with nodes labeled "Linker" and various service names like "Provide adapt...", "Manage KT me...", "Train Staff", etc.
- Mobile App:** A smartphone interface showing a list of services with status indicators (green/red bars) and a "KM 4 CITY" logo.
- Desktop Dashboard:** A comprehensive overview of city data including:
 - Operational Status:** "29" (64.1%) and "29" (64.1%) indicators.
 - Service Metrics:** "98.9%", "66.0%", and "99.3%" performance indicators.
 - Resource Utilization:** "CPU 0.1%", "Mem 24034 MB", "Job 954".
 - Weather and Social Media:** Weather forecast for Firenze and social media engagement (Twitter).

Red arrows illustrate the data flow: from the network diagram to the desktop dashboard, from the desktop dashboard to the mobile app, and from the mobile app back to the network diagram. A separate "Data and Service Aggregator" interface is also shown at the bottom right.



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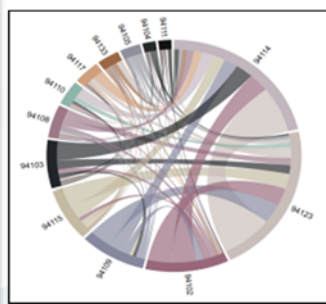
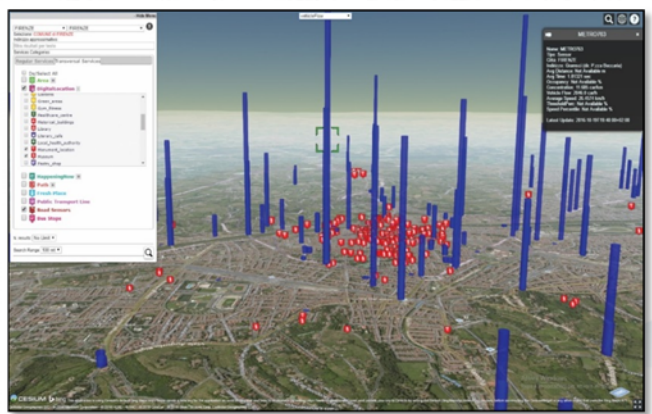
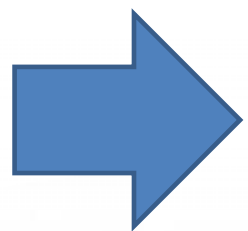
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Case Study A

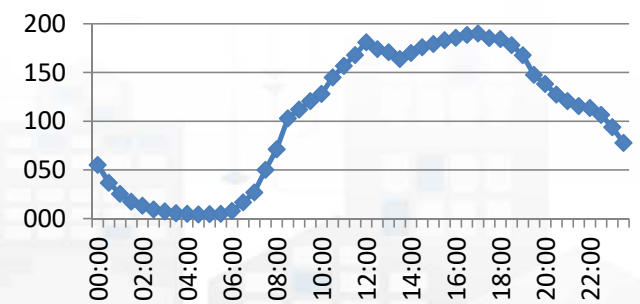


Predicting City users movements

- **Issue:**
 - How they move: vehicles, pedestrian, bike, ferry, metro,
 - Where they go....
- **Impact:**
 - Tuning the services: cleaning, police, control, security
- **Several metrics related to**
 - Knowledge of the city
 - Monitoring traffic and people flow
 -



- Daily trends
- OD matrices
- Trajectories
- Prediction models





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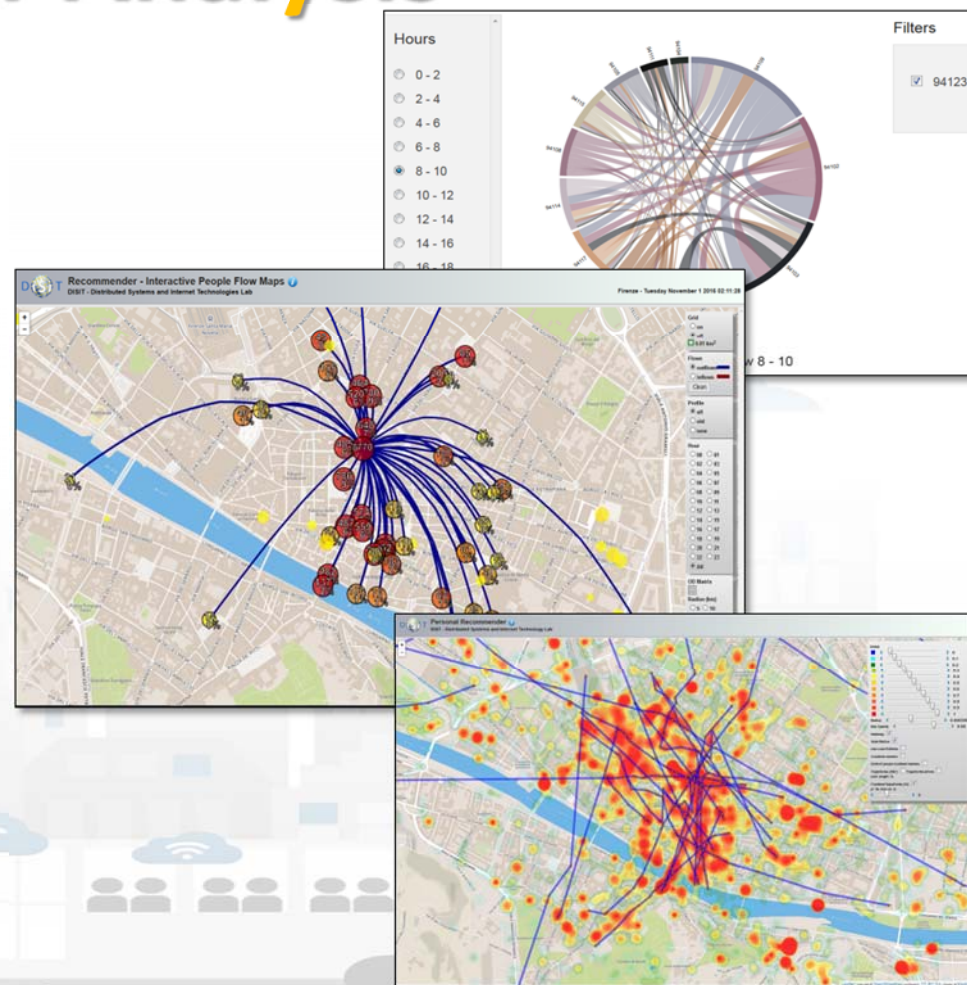
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User Behaviour Analysis

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



Traffic Flow Tools

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

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Monitoring City usage via Wi-Fi Case Study A

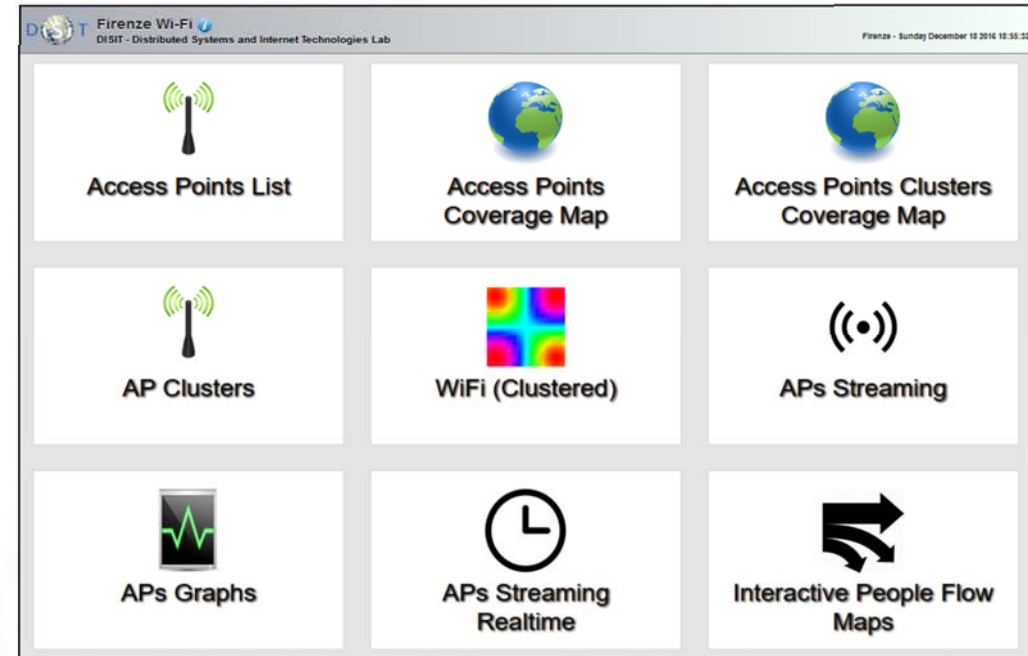


- **Instrumenting Wi-Fi**

- 1500 AP → 345 instrumented
- Stream from AP to DISIT Lab
- Real time monitoring → dashboard

- **Data Analytics**

- heat maps
- Analysis of user behavior
- Clustering user behavior
- Predictive models about user behavior
- Identification of critical conditions, anomalies



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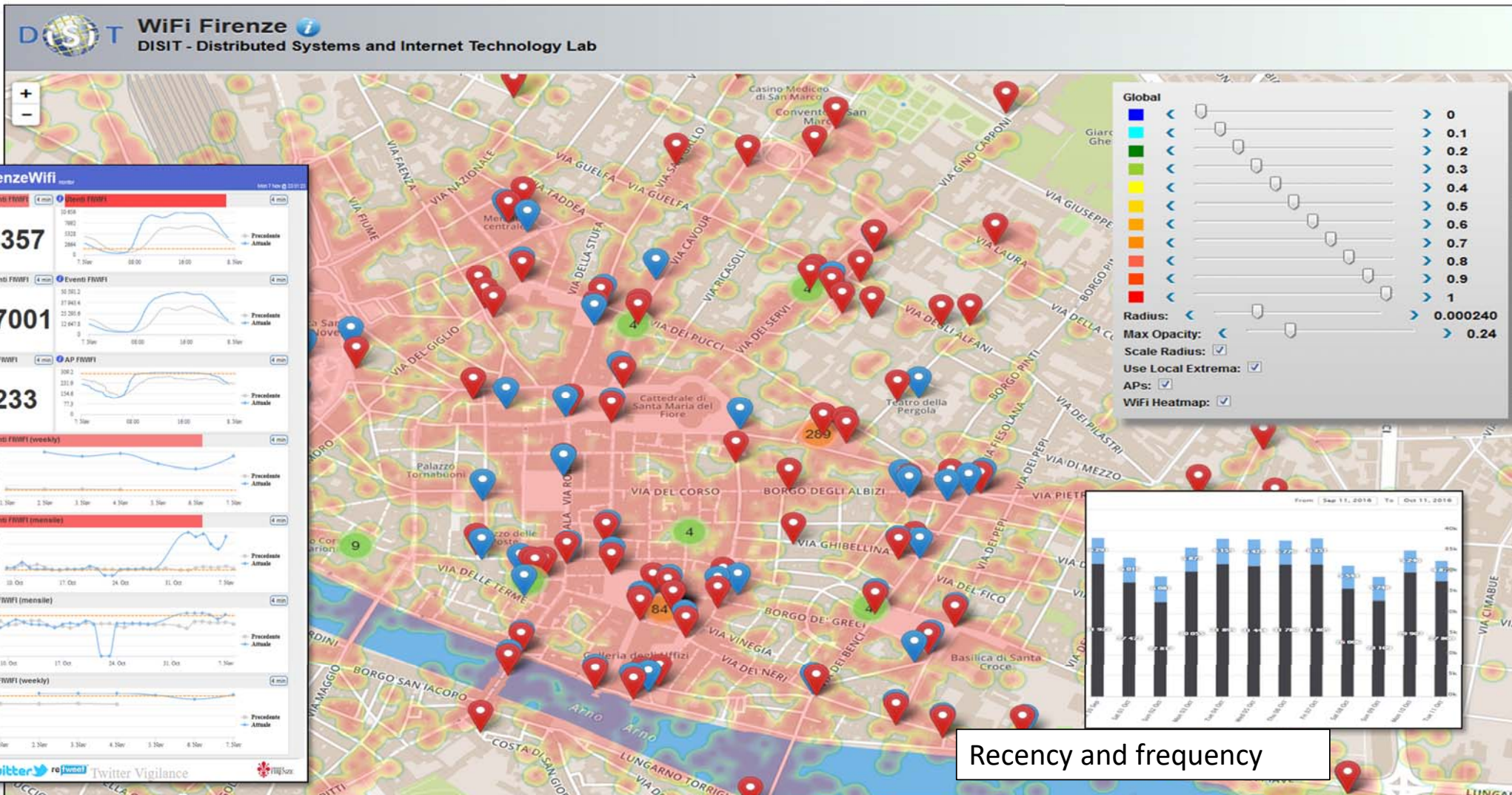
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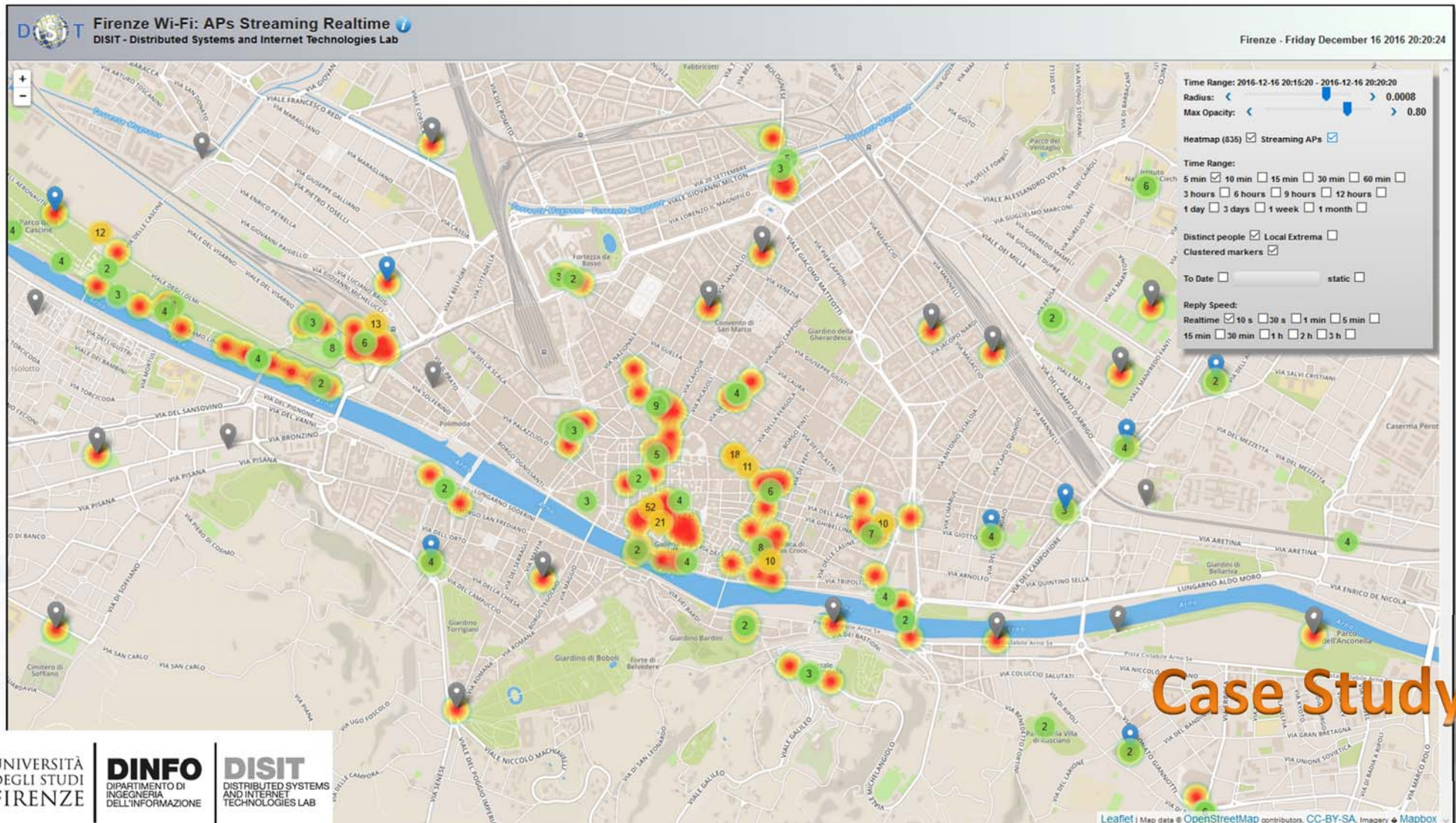


Wi-Fi Monitor tool Case Study A



Recency and frequency

Real Time Monitoring of Wi-Fi network



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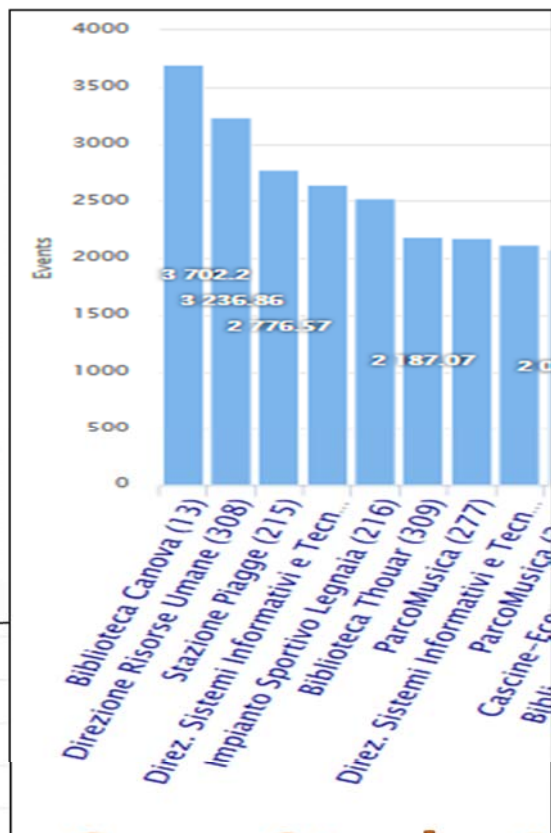
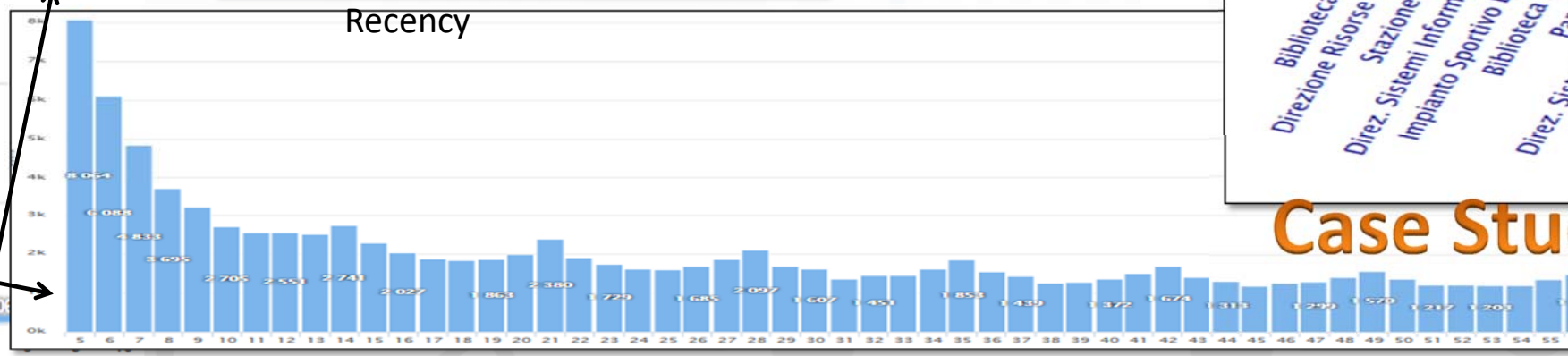
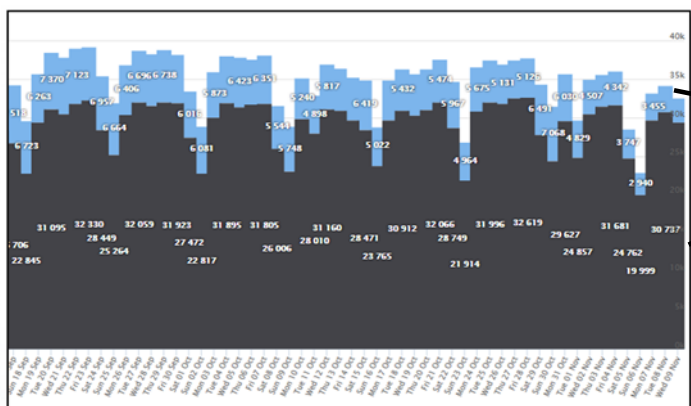
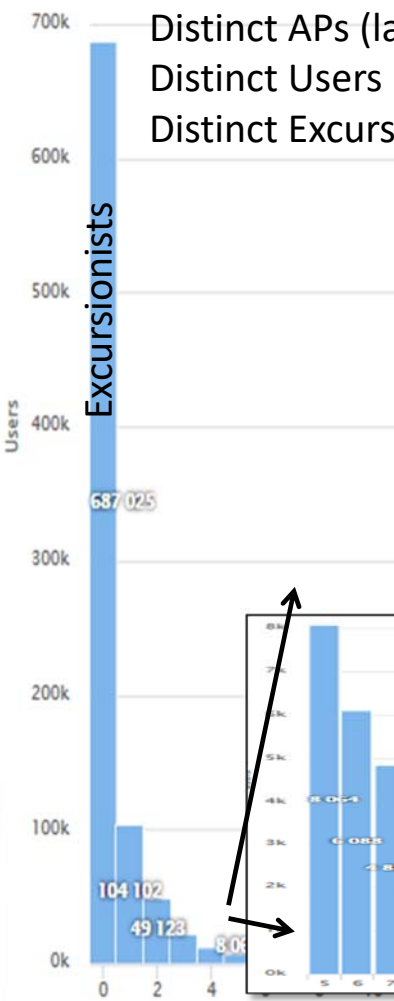
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User Behavior Analysis



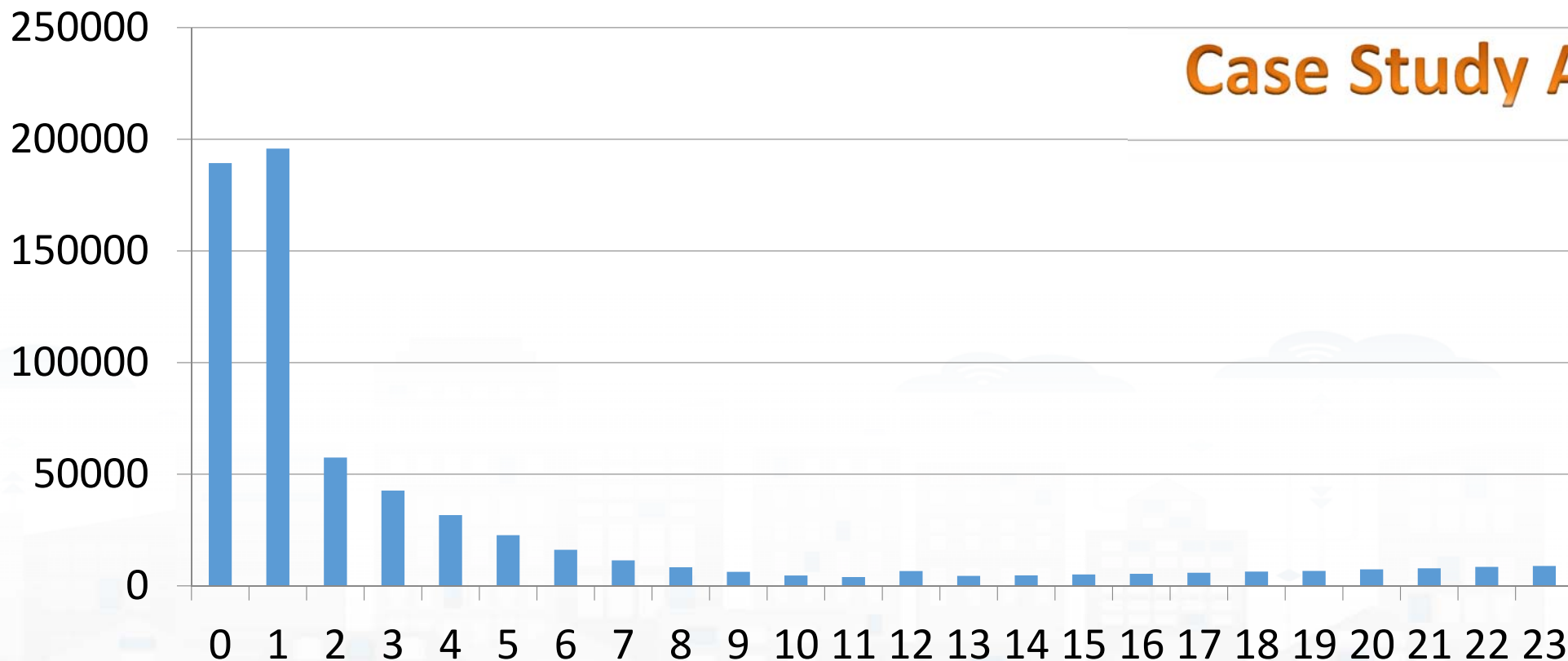
Distinct APs: 343
 Distinct APs (last 24 hours): 311
 Distinct Users (last 180 days): 1102098
 Distinct Excursionists (last 180 days, < 24 h): 687025



Case Study A

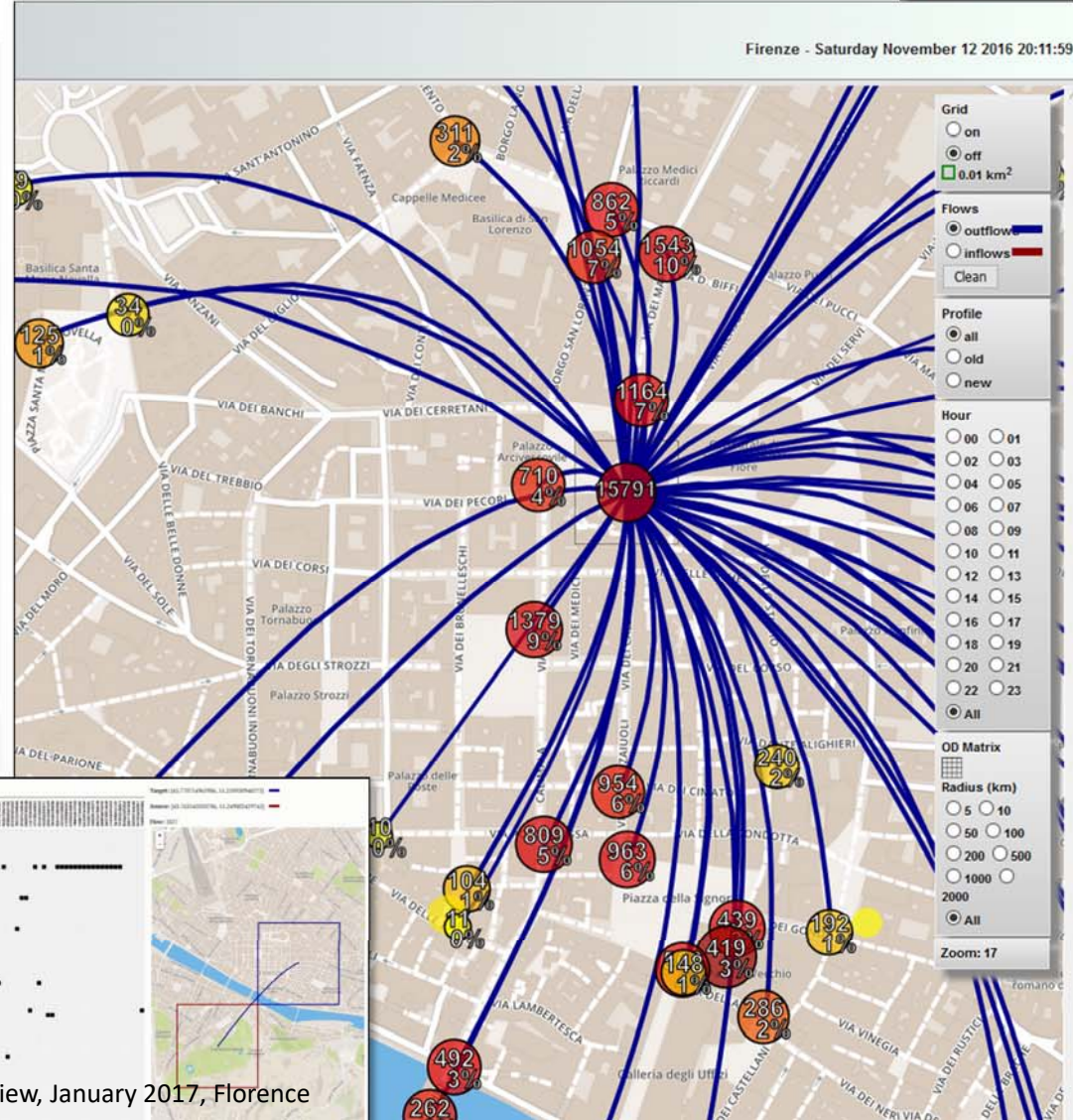
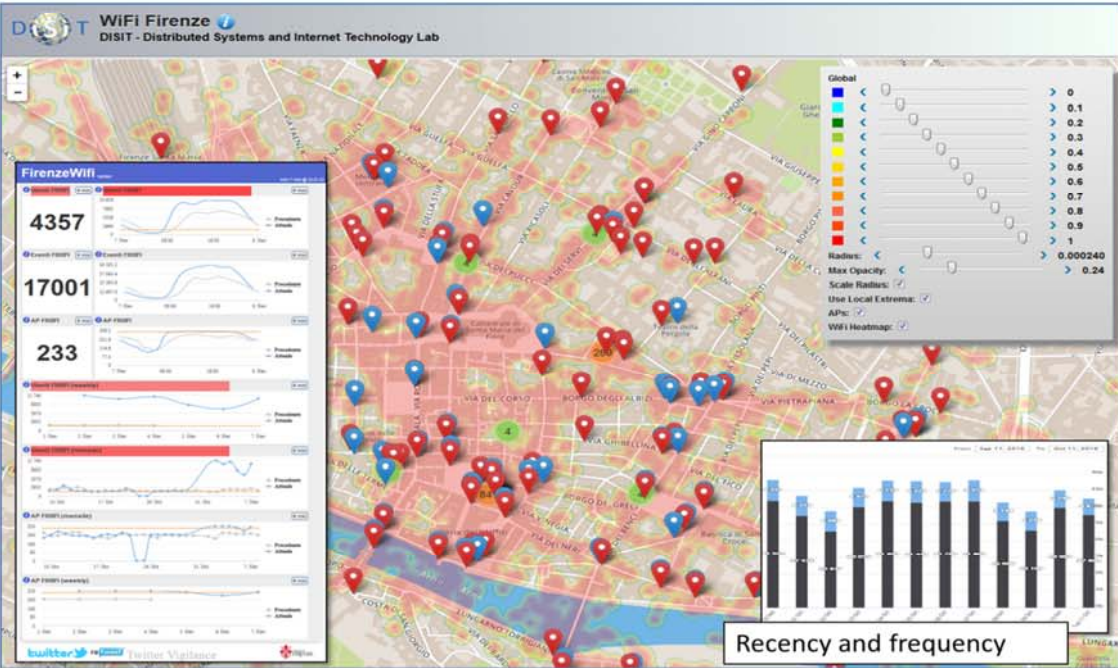
Distribution in the first 24 hours

Case Study A

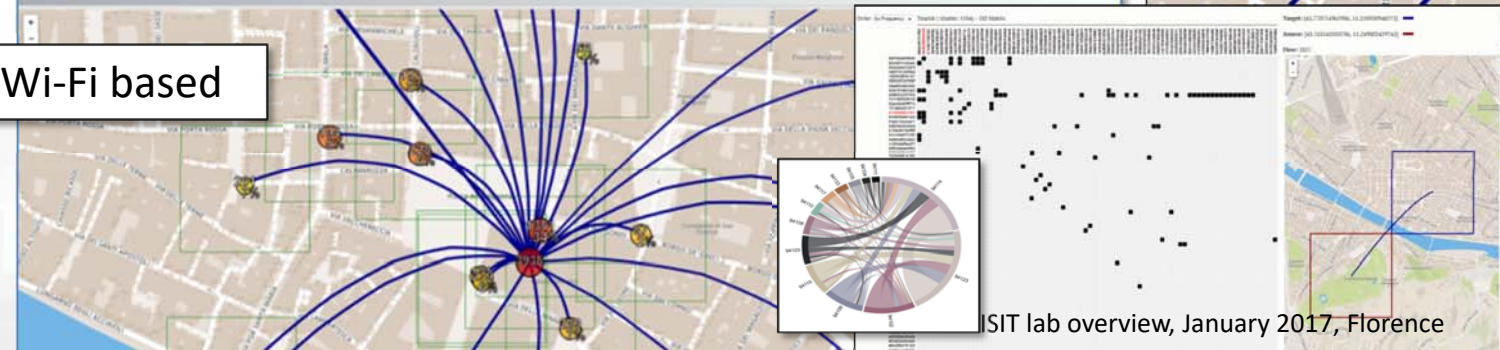


4 means: permanence for more than 3 hours and less than 4 hours

Origin Destination Matrix Estimation



Wi-Fi based



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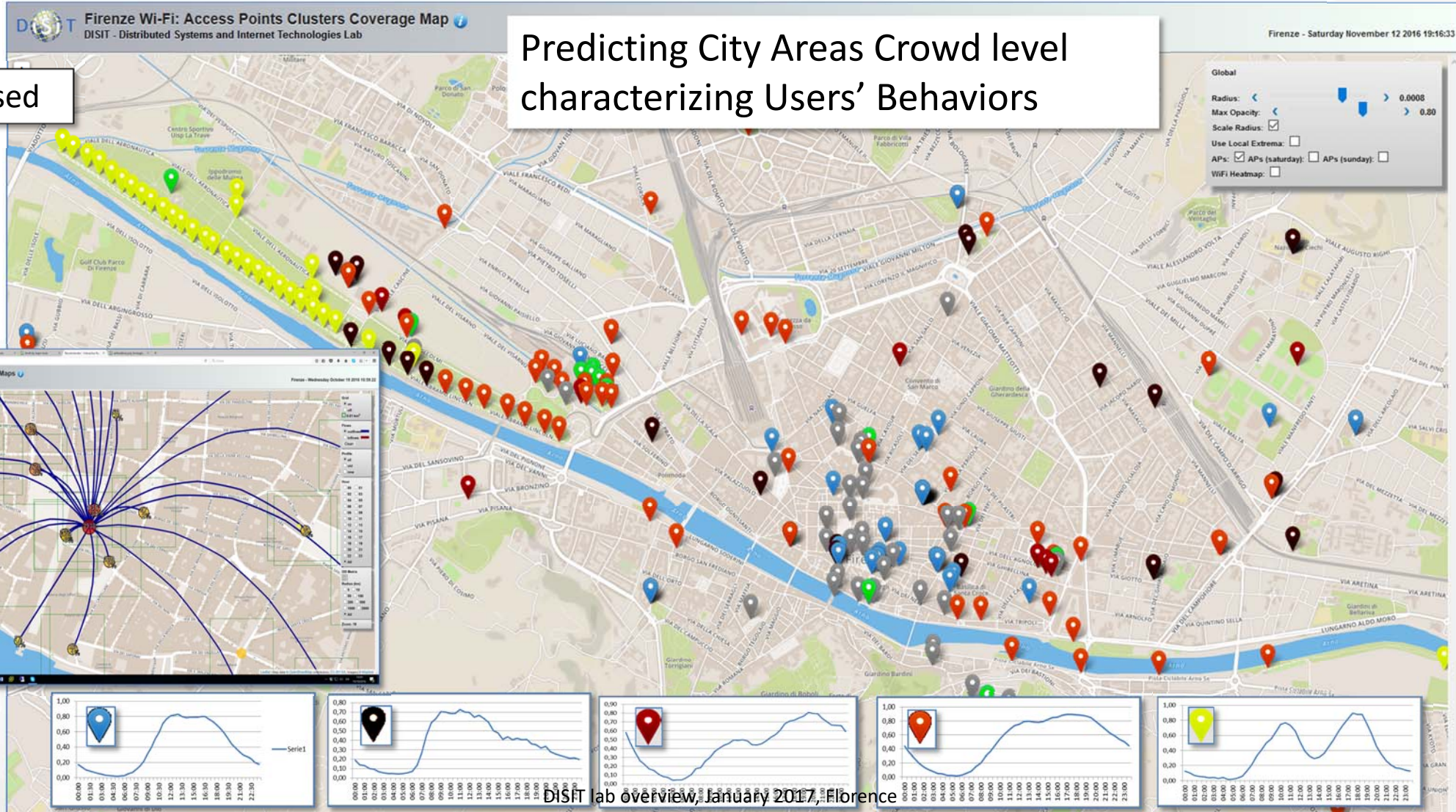
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Characterizing City Areas



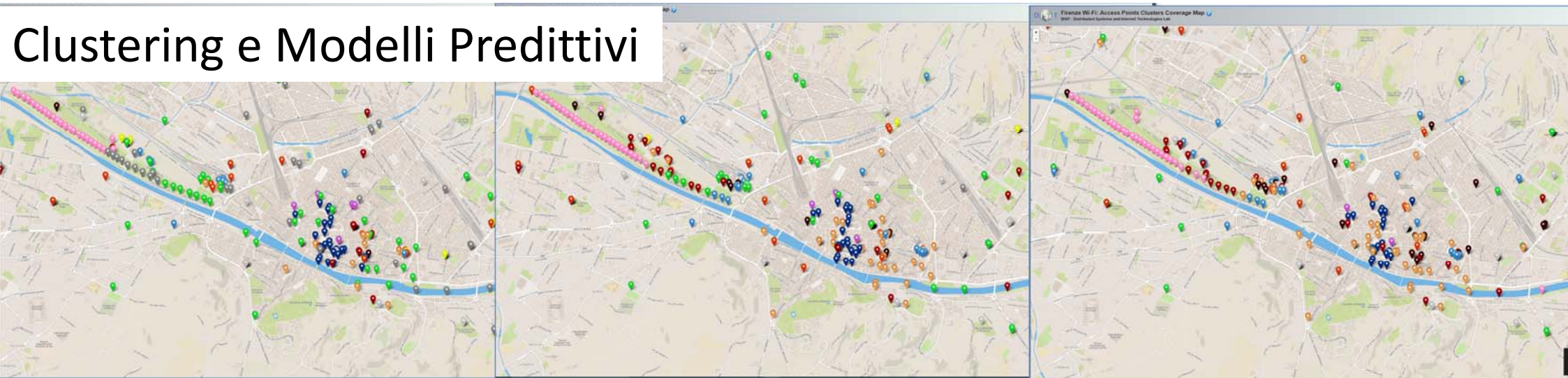
Wi-Fi based

Predicting City Areas Crowd level
characterizing Users' Behaviors



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Clustering e Modelli Predittivi



Lunedì-Venerdì

Sabato

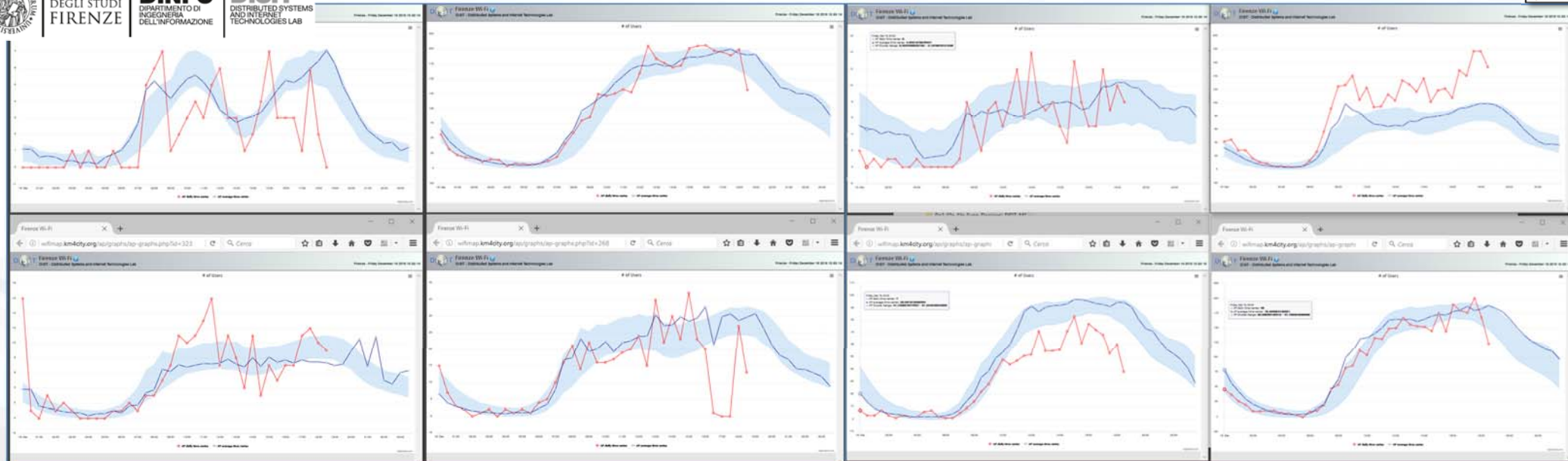
Domenica



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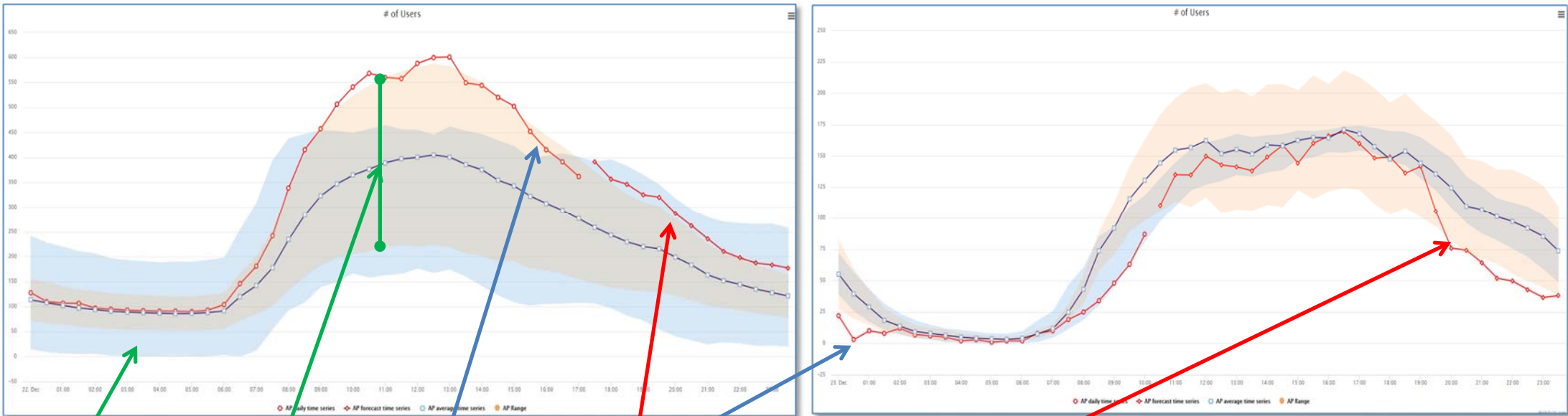
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Predizione e identificazione anomalie



Guessing number of users of Wi-Fi Access Points



Cluster confidence

AP average and confidence

Actual AP trend for today

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

Case Study A



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Overview

- **DISIT Lab Overview**
 - Research Areas
- **Smart City**
- **Social Media** ←
- **Mobile Computing**
- **Smart Cloud**
- **Main Projects**
- **Conclusions**



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Department of Information Engineering (DINFO)
<http://www.disit.dinfo.unifi.it>

Social Media and Media

- **Twitter Vigilance**
 - [Http://www.disit.org/tv](http://www.disit.org/tv)
- **ECLAP, CIP PSP EC**
 - <http://www.eclap.eu>
- **AXMEDIS:**
 - <http://www.axmedis.org>
- **Samsung Smart TV:**
 - <http://www.disit.org/6534>
- **ApreToscana:**
 - <http://www.apretoscana.org>
- **Content Organizer:...**
- **Others: VARIAZIONI, SMNET, etc.**





Social Media and Media

- **Problems:**

- Increase presence on the media
- Increase connectivity and cohesion in the SN
- Efficient advertising

- **Solutions:**

- High appreciation and quality of service
- Return to the Media and SM, increment of interactions

- **Technologies for Solutions:**

- Social network analysis: centrality, etc...
- Quality of service, assessment, product assessment feedback
 - Indexing of cross media, content based indexing,
- Engagement solutions
 - Recommendations, suggestions, newsletters, blogs, communities, posting, cross posting, collaborations, suggestions, etc.
- User behavior assessment on web pages
 - Preferences on functionalities, menu, users,
 - Effectiveness of users and their relationships

- **Problems:**

- Collecting moods of people vs a product or service
- Prediction of audience, presences
- Early warning for alerting: flue, emergence, politics, etc..
- Assessing advertising

- **Solutions:**

- Analysis of the SM data, posts, users profiles..

- **Technologies for Solutions:**

- Real time sentiment analysis
- Predictive models
- Early warning models
- Multilingual NLP analysis
- Predicting virality
- Understanding SN user relationships
-

Twitter in Numbers

Followers receive some notification connected to the actions performed by the users they follow.

- 350,000 Tweets are sent every minute
- In 2016, Twitter has 310 million monthly active users (*almost the same as the U.S. population*)
- A total of 1.3 billion accounts have been created
- Of those, 44% made an account and left before ever sending a Tweet



Hashtags # represent codified keywords

Twitter Users, Mentions and Citations @

Typical actions → to get reactions:

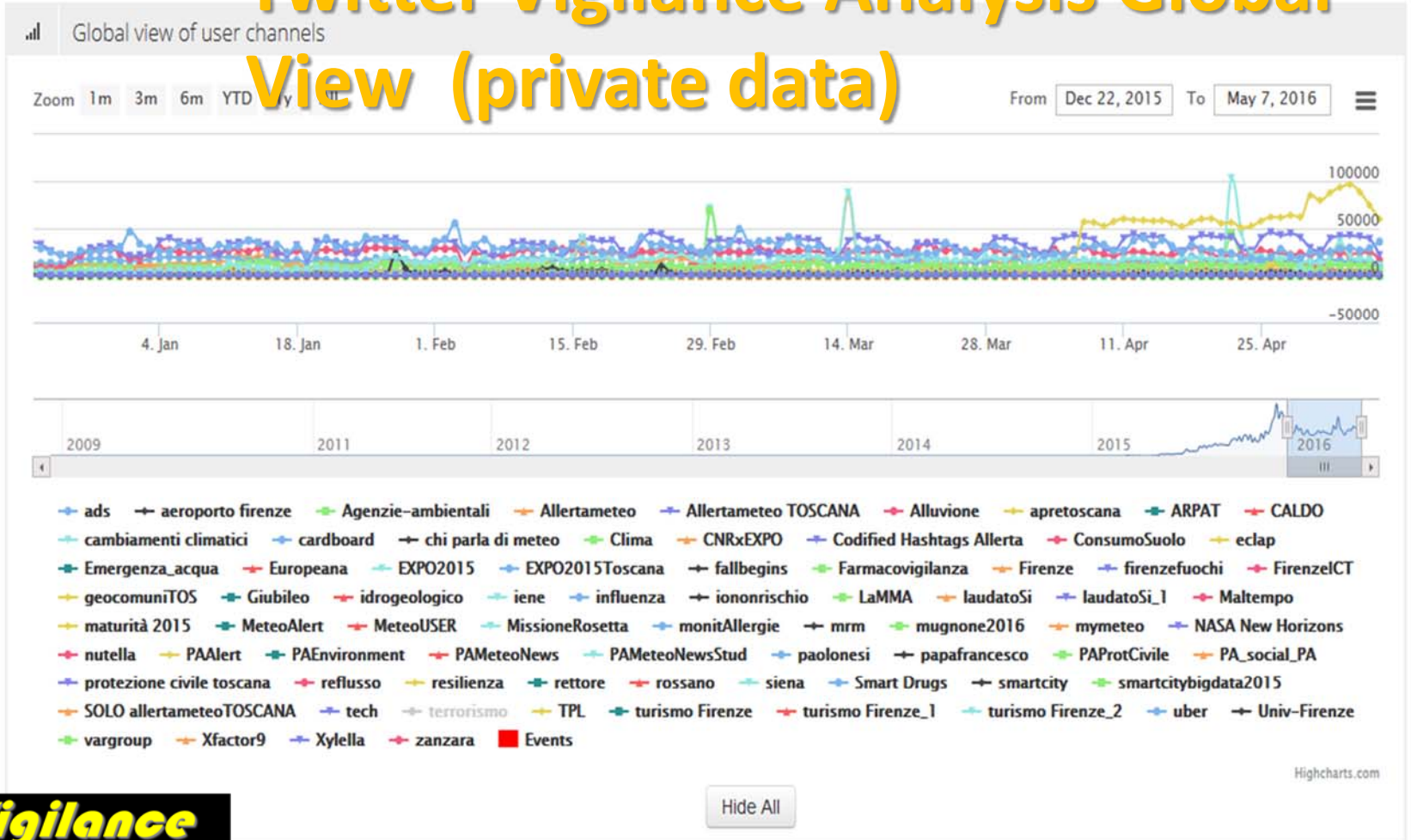
- ❖ *Compose a new tweet*
- ❖ *Comment*
- ❖ *Like / Favourite*
- ❖ *Retweet*



- Search parameters
- Crawler Statistics
- Config Twitter API
- Data analysis 3
- Channel Statistics**
- Search statistics
- Retweet Statistics
- Twitter Users statistics
- Sentiment analysis 1
- LOGS 9
- Processes
- INFO

Home > Channel statistics

Twitter Vigilance Analysis Global View (private data)



Twitter Vigilance





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Twitter Vigilance

in Numbers

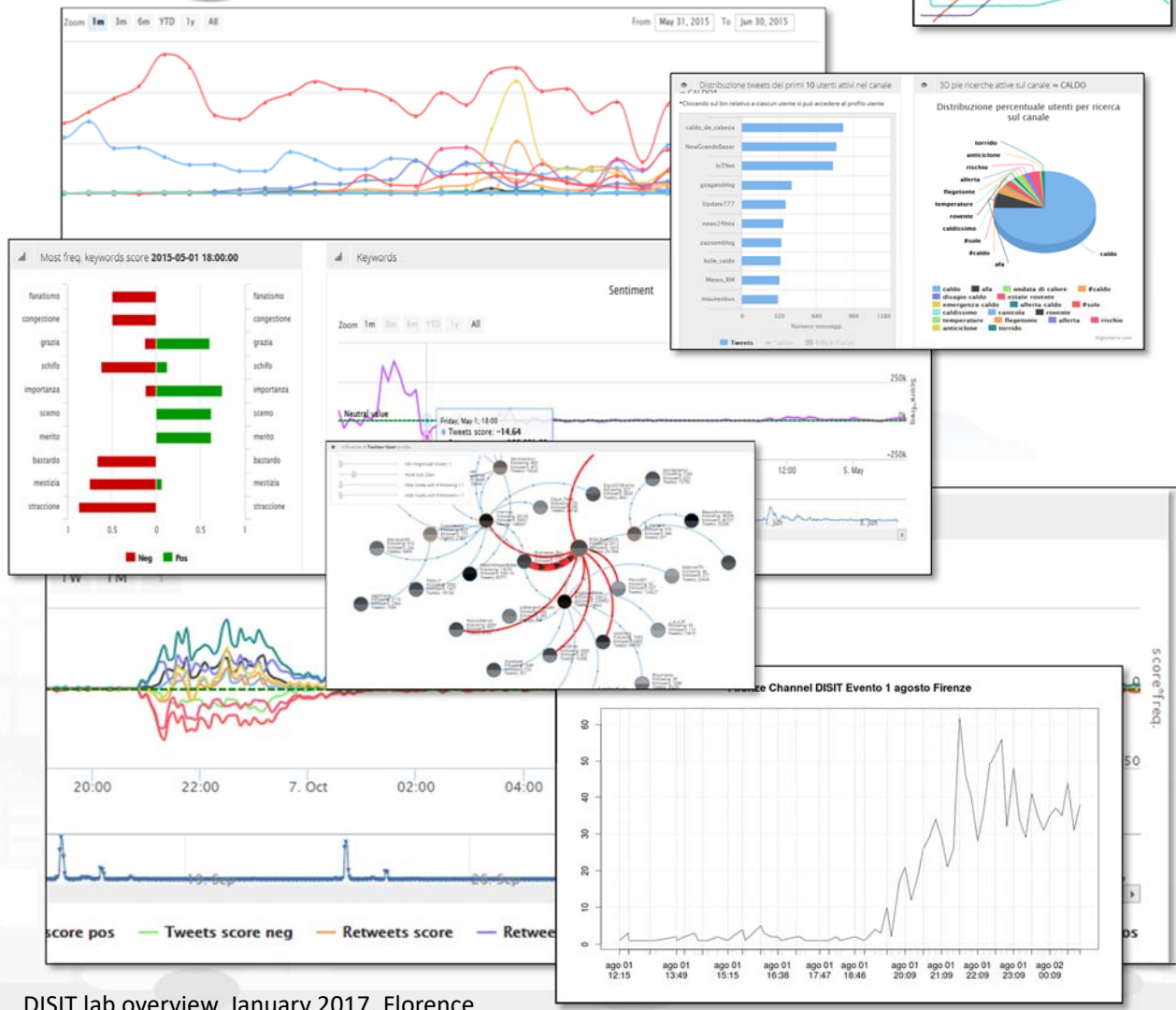
- **Used by several users:**
 - UnivFirenze, LAMMA, IBIMET, ARPAT, Master on Big Data, ...
- **Active since** Aprile 2015
- **3 platforms for automated:**
 - Daily collection: statistical direct analysis and sentiment analysis
 - Real time collection and statistical, sentiment analysis
 - Full faceted indexing: thus enabling search on collected tweets
- **All: precomputation of basic metric opening the activities of deep analysis**
- More than 240 million of tweets in the storage: ready on Hadoop cluster
- More than 150 channels
- More than 450 search activities daily
- From 400.000 to 4 Million of tweets per day.



Twitter Vigilance

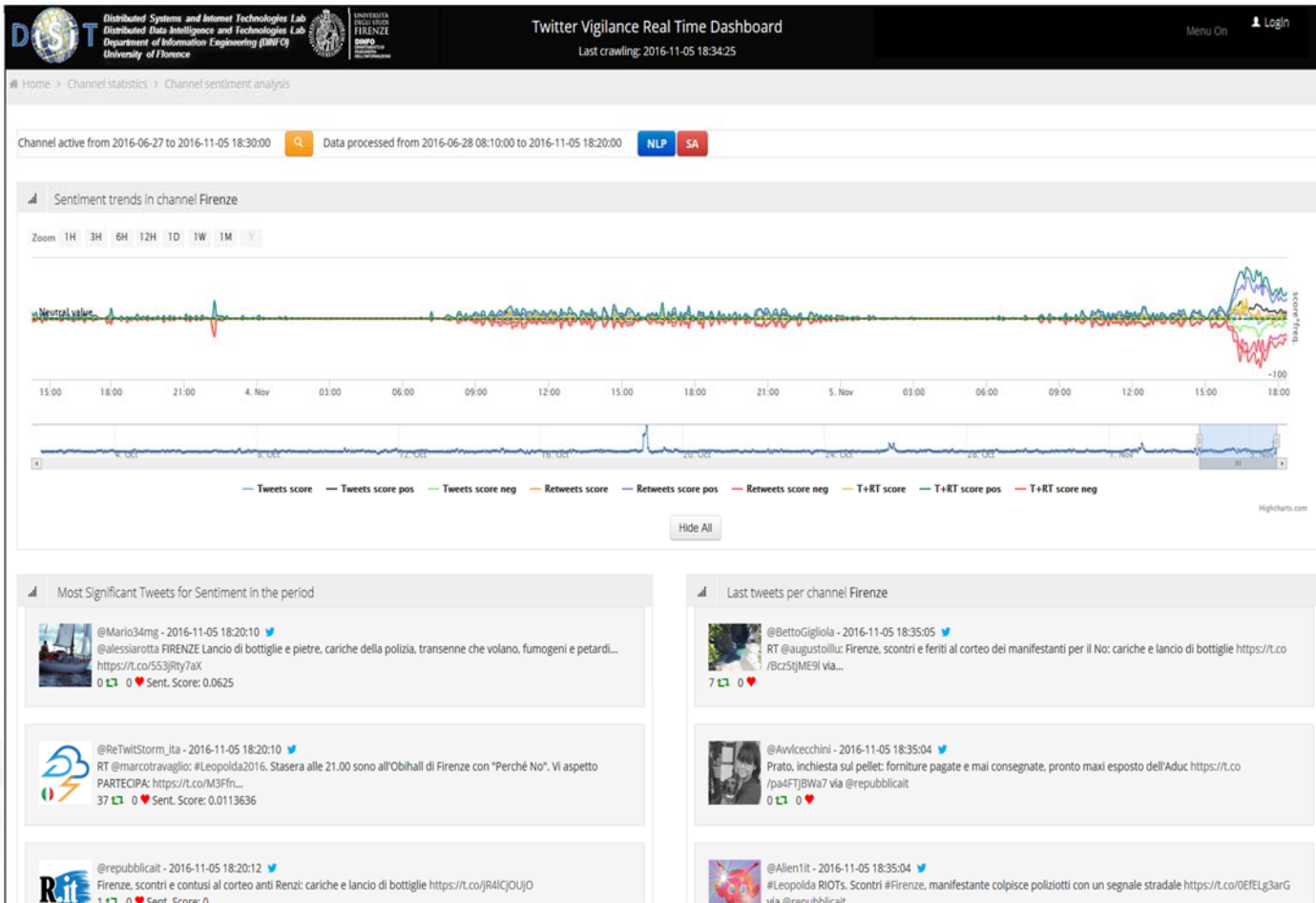


- <http://www.disit.org/tv>
- <http://www.disit.org/rttv>
- Citizens as sensors to
 - Assess sentiment on services, events, ...
 - Response of consumers wrt...
 - Early detection of critical conditions
 - Information channel
 - Opinion leaders
 - Communities
 - Formation
 - Predicting volume of visitors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

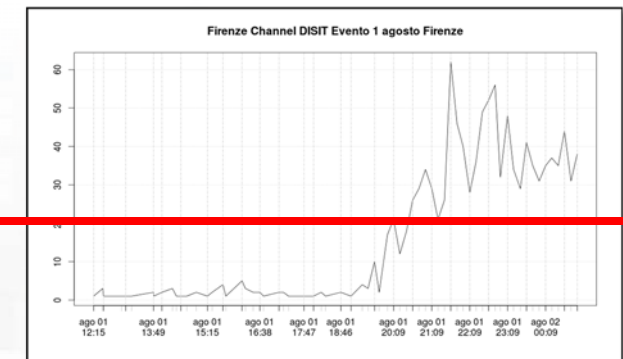
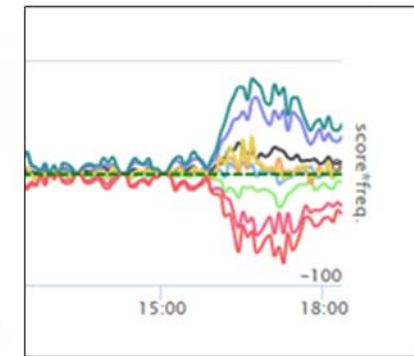


Twitter Vigilance

Real Time Twitter Vigilance, Early Warning



Sentiment Analysis



Twitter Vigilance

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Prediction/Assessment



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

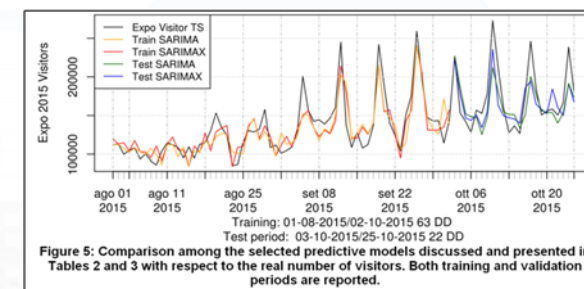
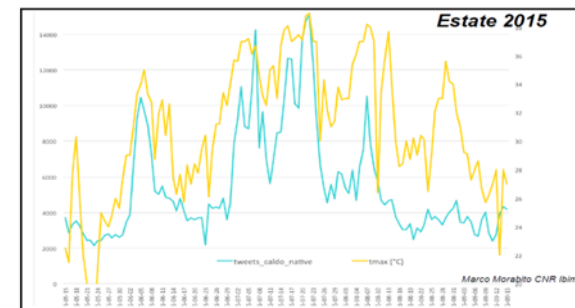
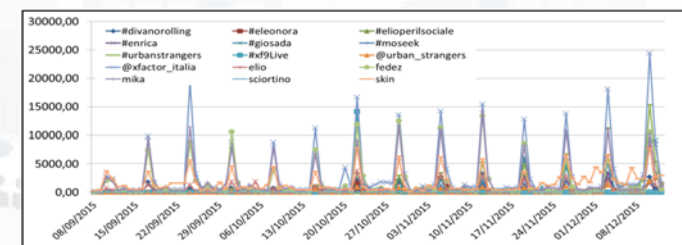


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.



Case Study B

Predicting Audience on Social intensive TV show

- **Issue:**
 - How to predict the number of people following a TV reality show in life
- **Impact:**
 - Making Advertising, promotion
 - Valorizing advertising
 - Adjusting the show
- **Several metrics related to**
 - Structure of volume of TW, RTW
 - Features of the tweet authors
 - Relationships



- Periodic events
- Specific rules
- Strong influence and user engagement
- Audience can vote
- Audience express appreciation and rejects
- .. Similar to the presence at large and long terms event, such as EXPO2015

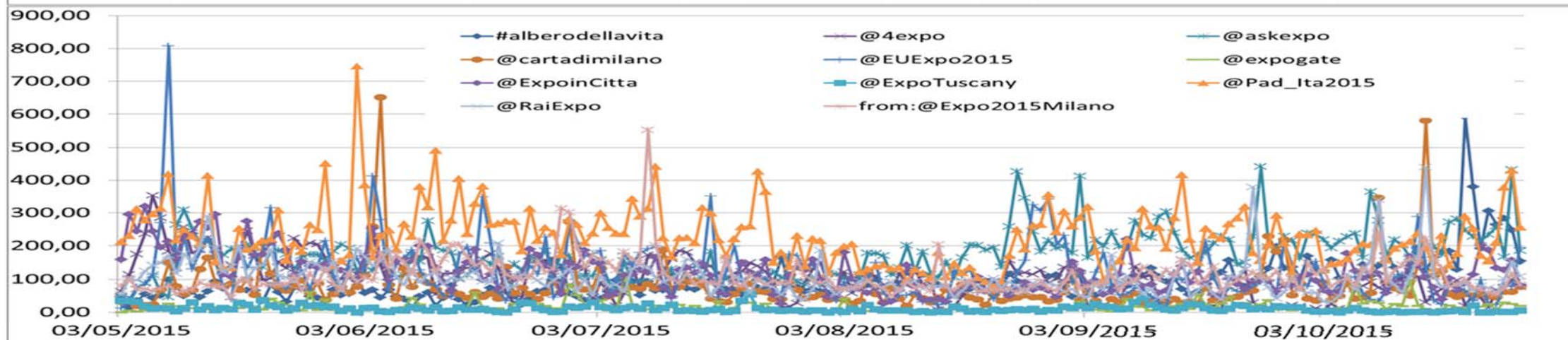
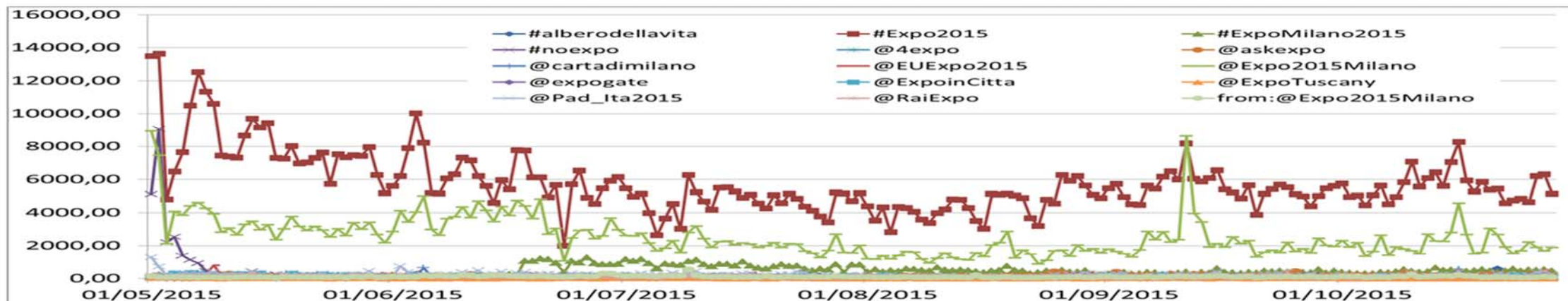


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Predicting EXPO2015



Twitter Vigilance on EXPO2015 channel

Twitter Vigilance

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Case Study B2



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Case Study B2

Twitter Metrics

- TW: Number of Tweets per **Search/Channel** (as called Volume) , per day, per hour
- RTW: Number of ReTweets per **Search/Channel**, per day, per hour
- NRT/TW: ratio from ReTweets and Tweets per **Search/Channel**, per day, per hour
- NumSearch: number of Tweets including the Search per **Channel**, per day, per hour
- Sentiment Analysis Score per **Search/Channel**, per day, per hour
- Num of xxxxx

Twitter Vigilance



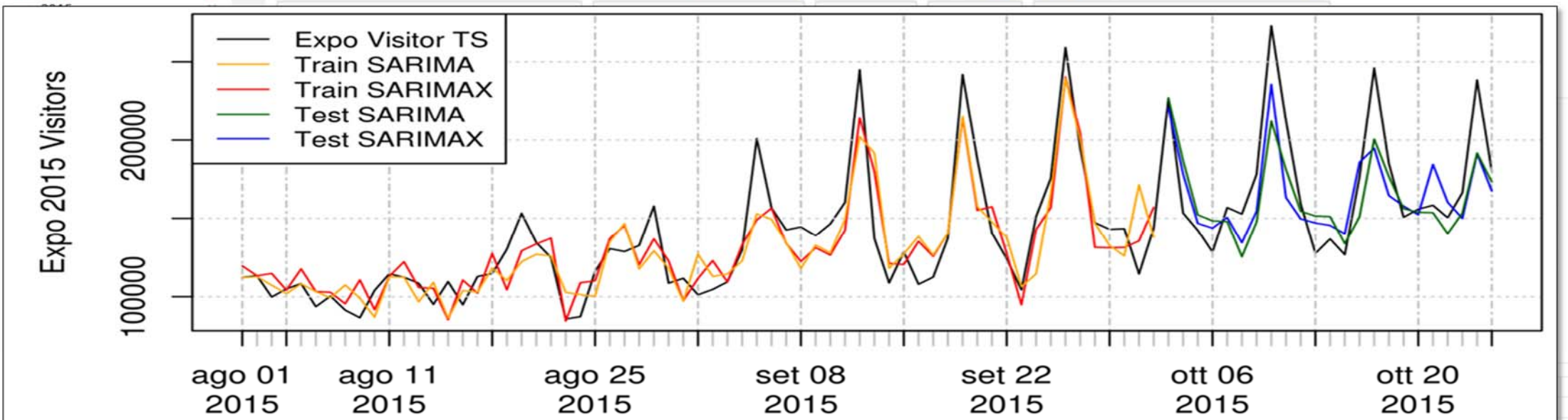
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Twitter Vigilance

monitoring and predictions



Predizioni al 90%

Training: 01-08-2015/02-10-2015 63 DD
Test period: 03-10-2015/25-10-2015 22 DD

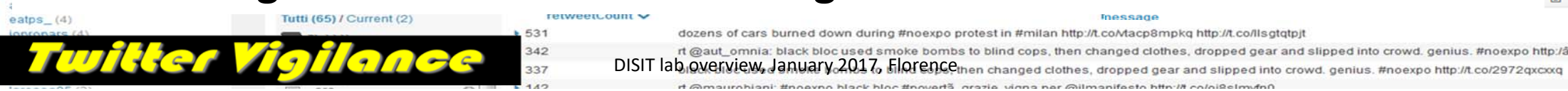
Twitter Vigilance on EXPO2015 channel

Case Study B2

Predicting volume of visitors for tuning the services

Twitter Vigilance

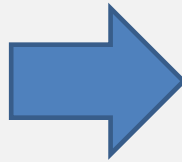
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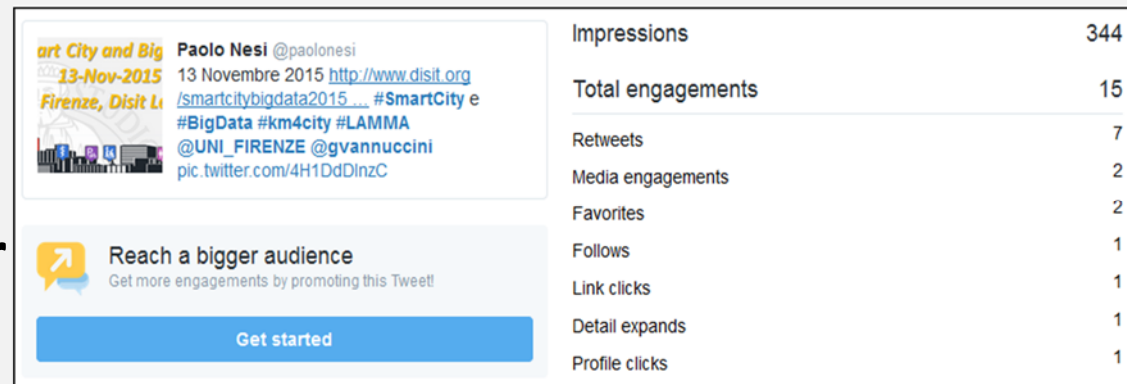
Case Study C

Predicting the reTweet Proneness

- **Issue:**
 - How to understand if a tweet has a good probability of being retweeted?
- **Impact:**
 - Advertising, promotion, training
- **Several metrics related to**
 - Structure of the tweet
 - Features of the tweeting author
 - Relationships



Twitter Analytics



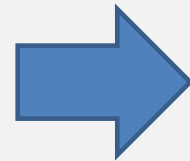
Case Study D

Early warning, detection



City Resilience

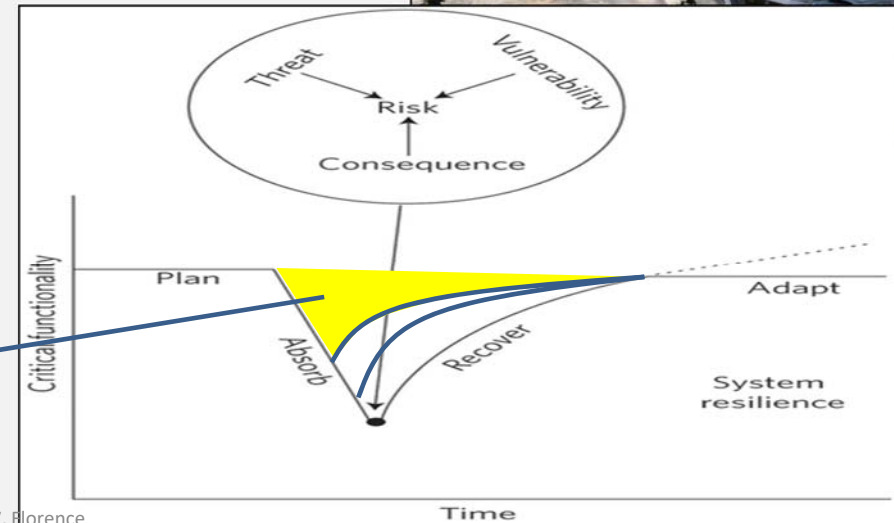
- **Issue:**
 - Detection of critical condition
 - Not easily detected with other means
- **Impact:**
 - Early warning, faster reaction
 - Increased resilience
- **Several metrics related to**
 - Volume of retweets
 - Sentiment analysis



Prepare
Absorb
Recover
Adapt



damage





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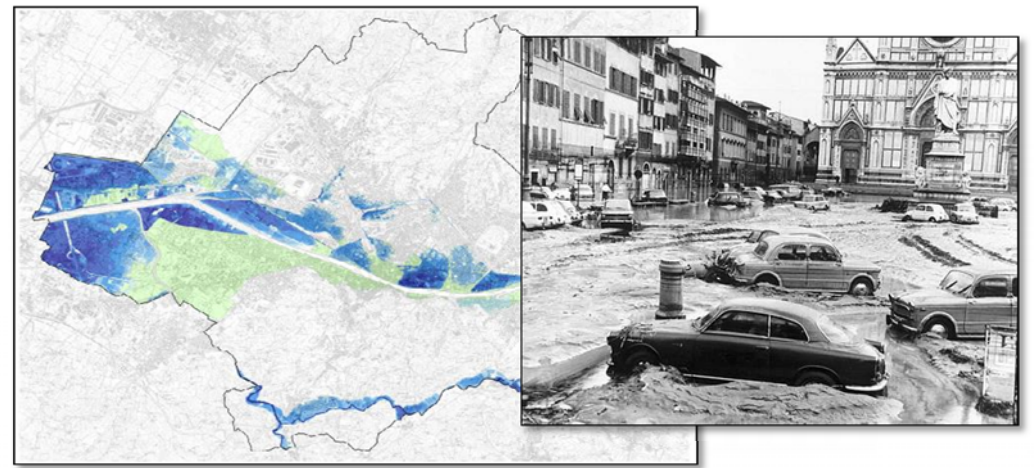
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<http://www.disit.org>

City Resilience ERMG



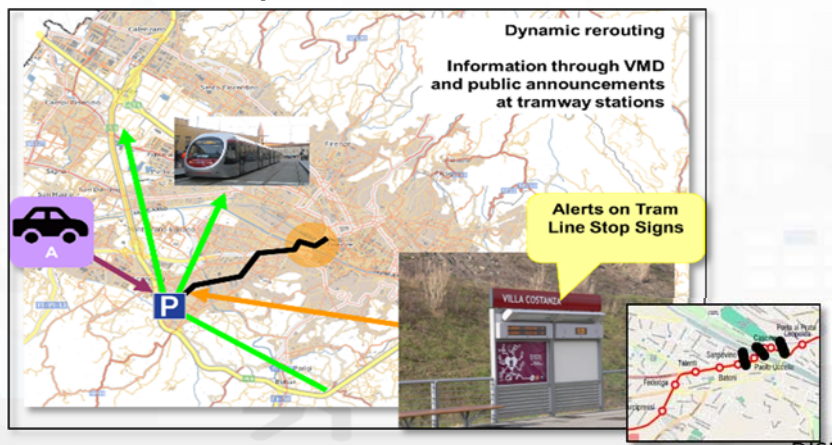
200 years probability Arno flooding



30 years probability Arno flooding



Arno Flood Impact on Tram Line & Traffic



Water bomb (down burst) in South Florence



DISIT lab overview, January 2017, Florence

Case Study D



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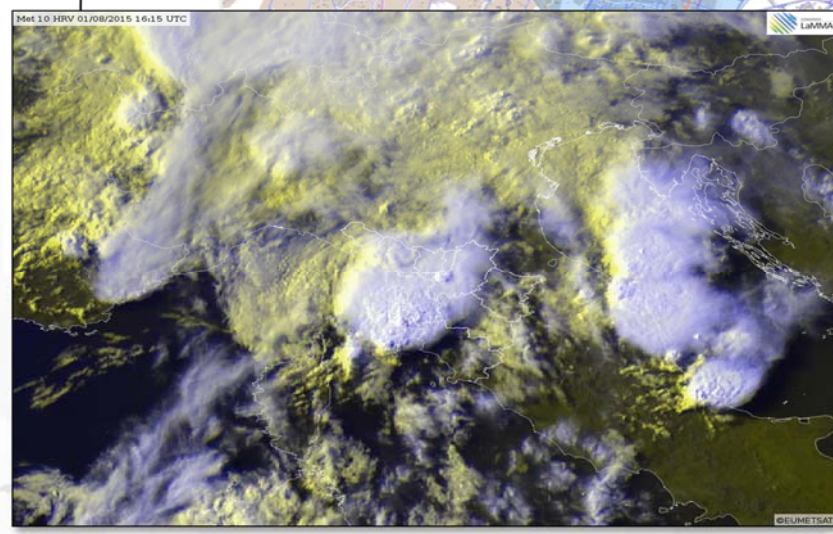
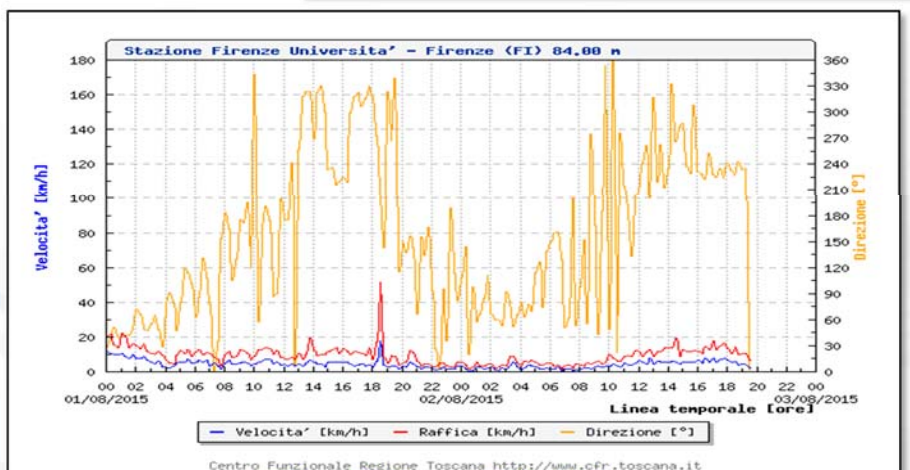
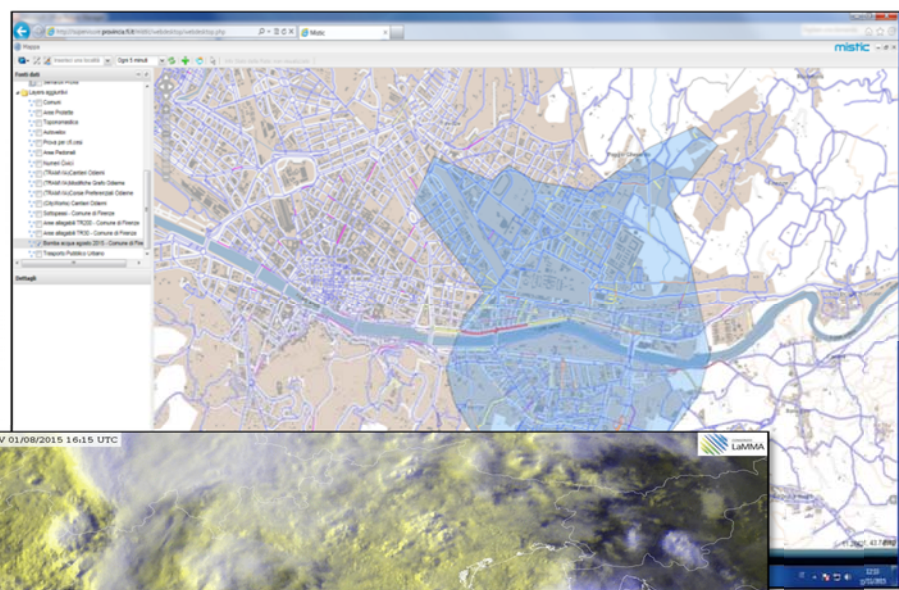
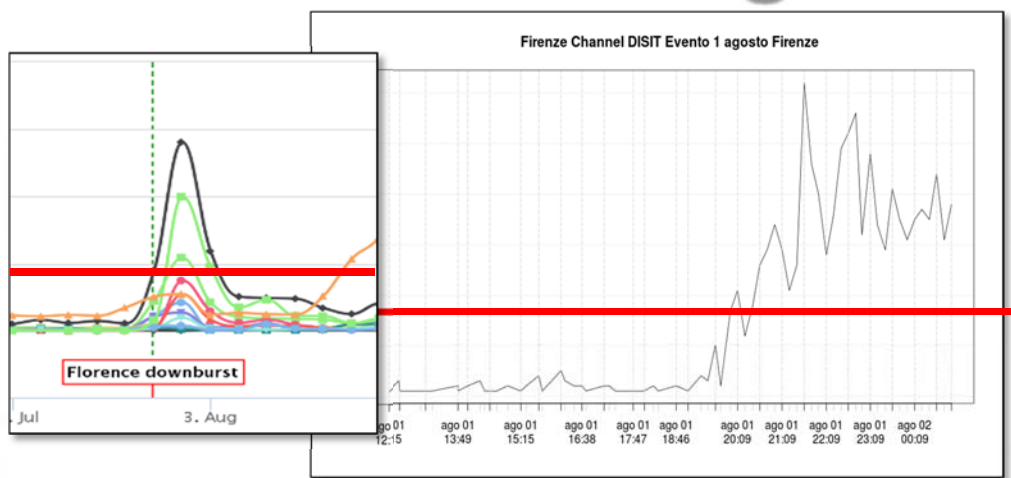
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Early Warning Twitter Vigilance and Water Bomb



Twitter Vigilance and Water Bomb



Twitter Vigilance

DISIT lab overview, January 2017, Florence

Case Study D



Overview

- **DISIT Lab Overview**

- **Research Areas**

- **Smart City**

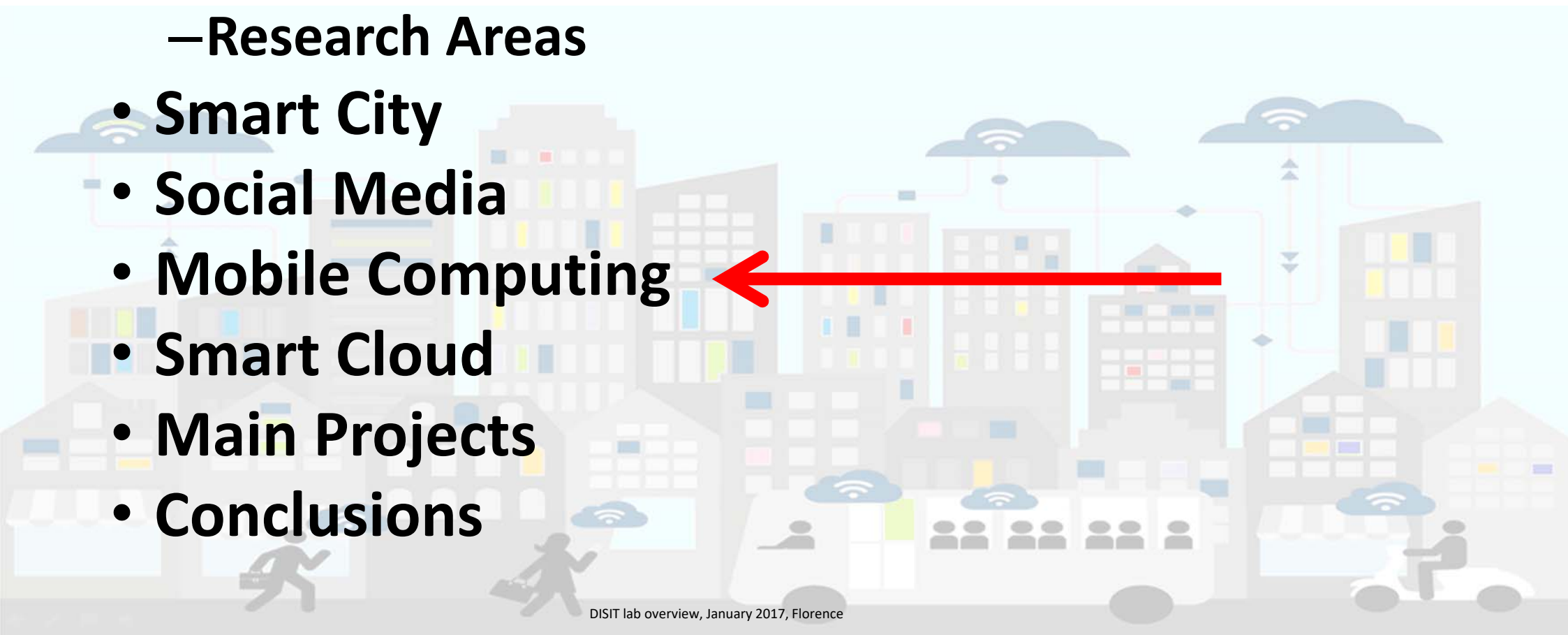
- **Social Media**

- **Mobile Computing**

- **Smart Cloud**

- **Main Projects**

- **Conclusions**





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Distributed Systems and Internet Technologies
Department of Information Engineering (DINFO)
<http://www.disit.dinfo.unifi.it>

Mobile Computing

- **Km4City:** Smart City mobile applications
 - [Http://www.km4city.org/app](http://www.km4city.org/app)
- **Content Organizer:** Media Distribution and Social Support, e-learning
- **Mobile Emergency:** navigation and collaborative emergency management
 - <http://www.disit.org/5500>
- **Mobile Medicine:** <http://mobmed.axmedis.org>
- **Coll@bora:** support for impaired people
- **FODD 2015:** <http://www.disit.org/6593>
- **Other:** Monitoring Cloud, monitoring camper, ...



Mobile Computing

• Smart City Problems:

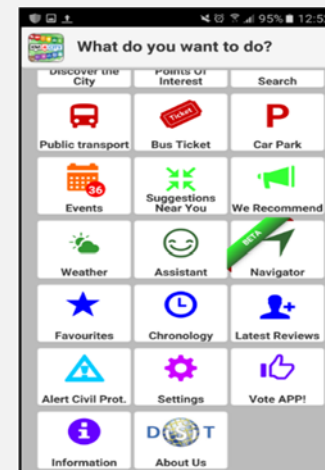
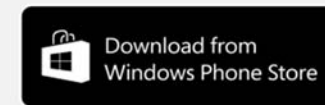
- Reaching the users
- Understanding the user preferences and behavior
- Understanding how they move, where they go, etc..

• Solutions:

- Monitoring the activities on the mobile device
- Monitoring the activities of user in the environment

• Technologies for Solutions:

- Assessing the usage of Smart city and services
- Integrated Indoor/outdoor navigation
 - Routing, multimodal routing
- Content distribution: e-learning
- User networking and collaboration
- OS: iOS, Android, Windows Phone, etc.
- Tech: IOT, iBeacons, NFC, QR,

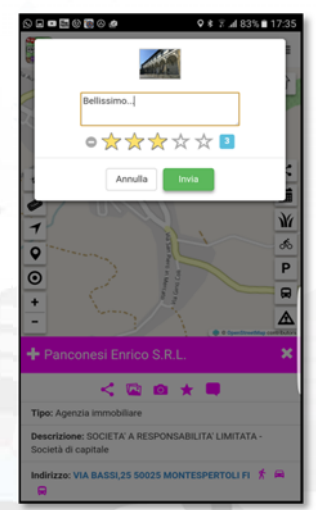
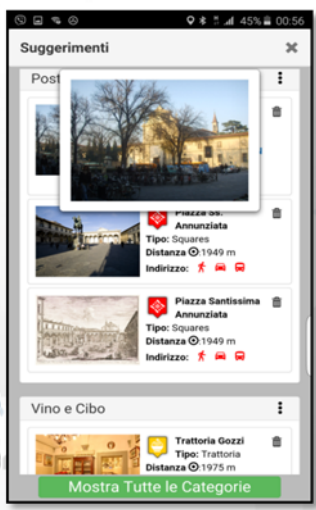
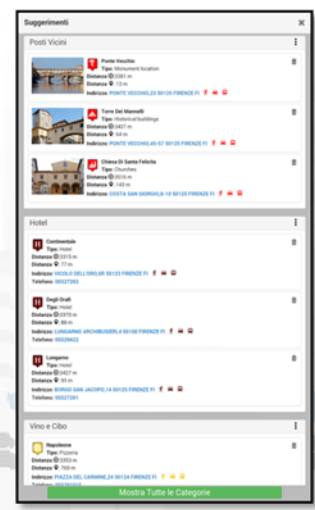
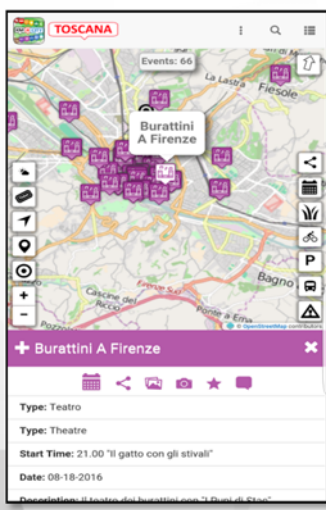
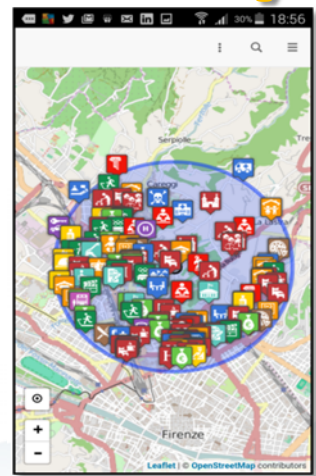
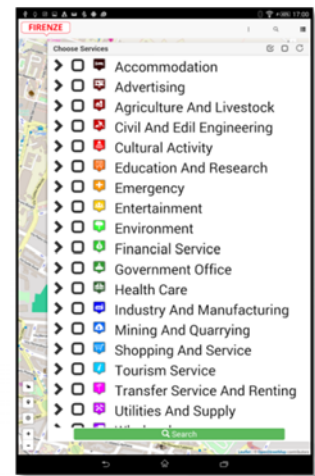




Km4City APP, features 1/3



- **5 languages:** IT, EN, SP, DE, FR
- **city users:** citizens, commuter, students, Tourists, etc..
- **Profiled menu for POI,** different for different City users
- **Personalized main menu**
- **Search Textual**
- **Search for POI,** POI kind, etc..
 - Close to you, close to a point
- **Direct searches**
 - Events, green areas, public transport,
 - Cycling paths, Parking (NEW: triage, fuel station)
 - Etc.
- **POI sharing and contributing**
 - Preferred, Social icon connection
 - Ranking, Comments, images



Km4City APP, features 2/3

- **Mobility**

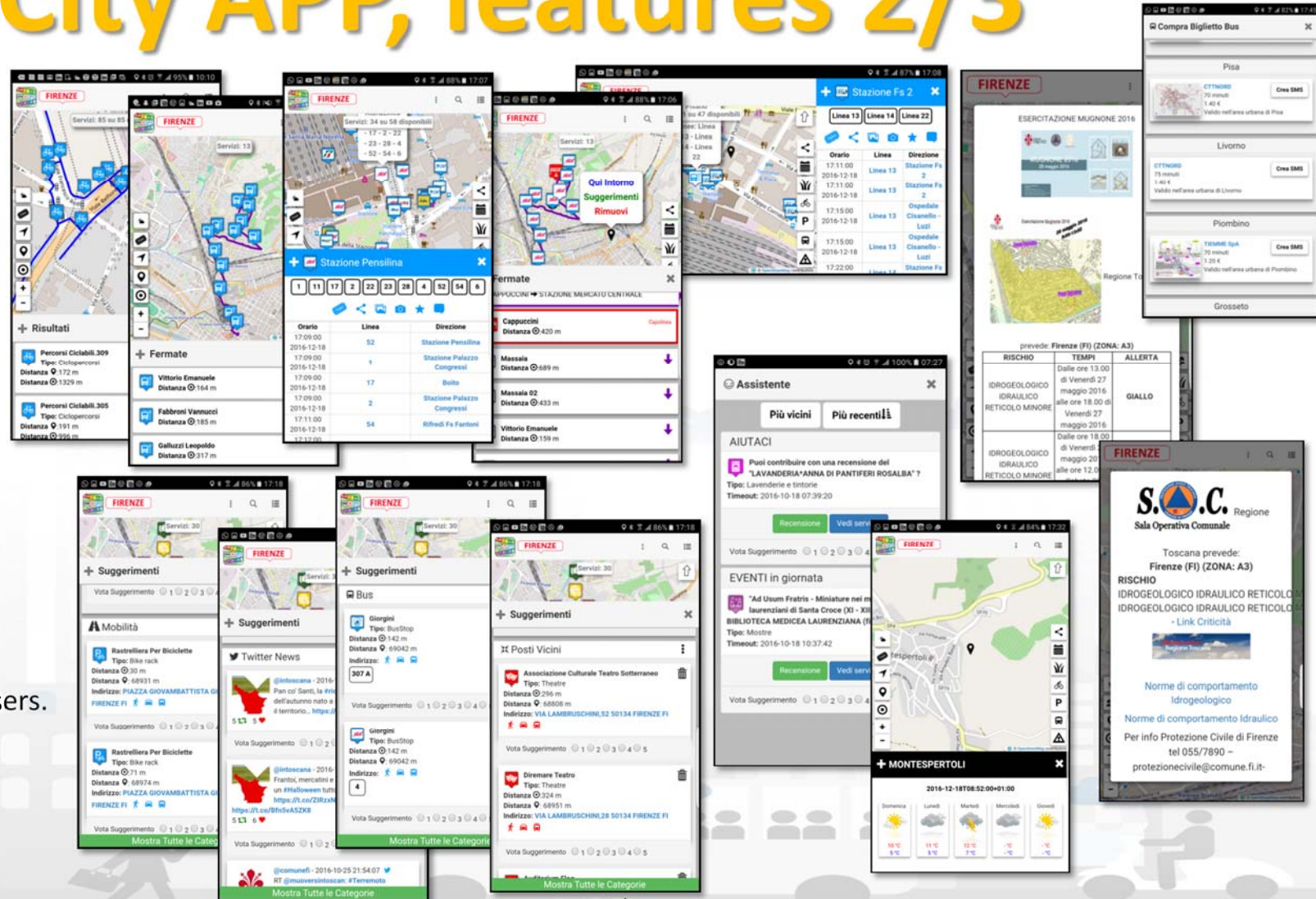
- Lines, bus stops, schedule
- Parking status
- Tickets for Busses
- Cycling paths
- Fuel stations

- **Personal Assistant**

- Info and help
- Engagement
- Civil protection, alerts
- Hospital triage status

- **Suggestions:**

- Personalized and adaptive: banned & profiles for each users.
- POI, Twitter hints, Events,
- Weather forecast
-



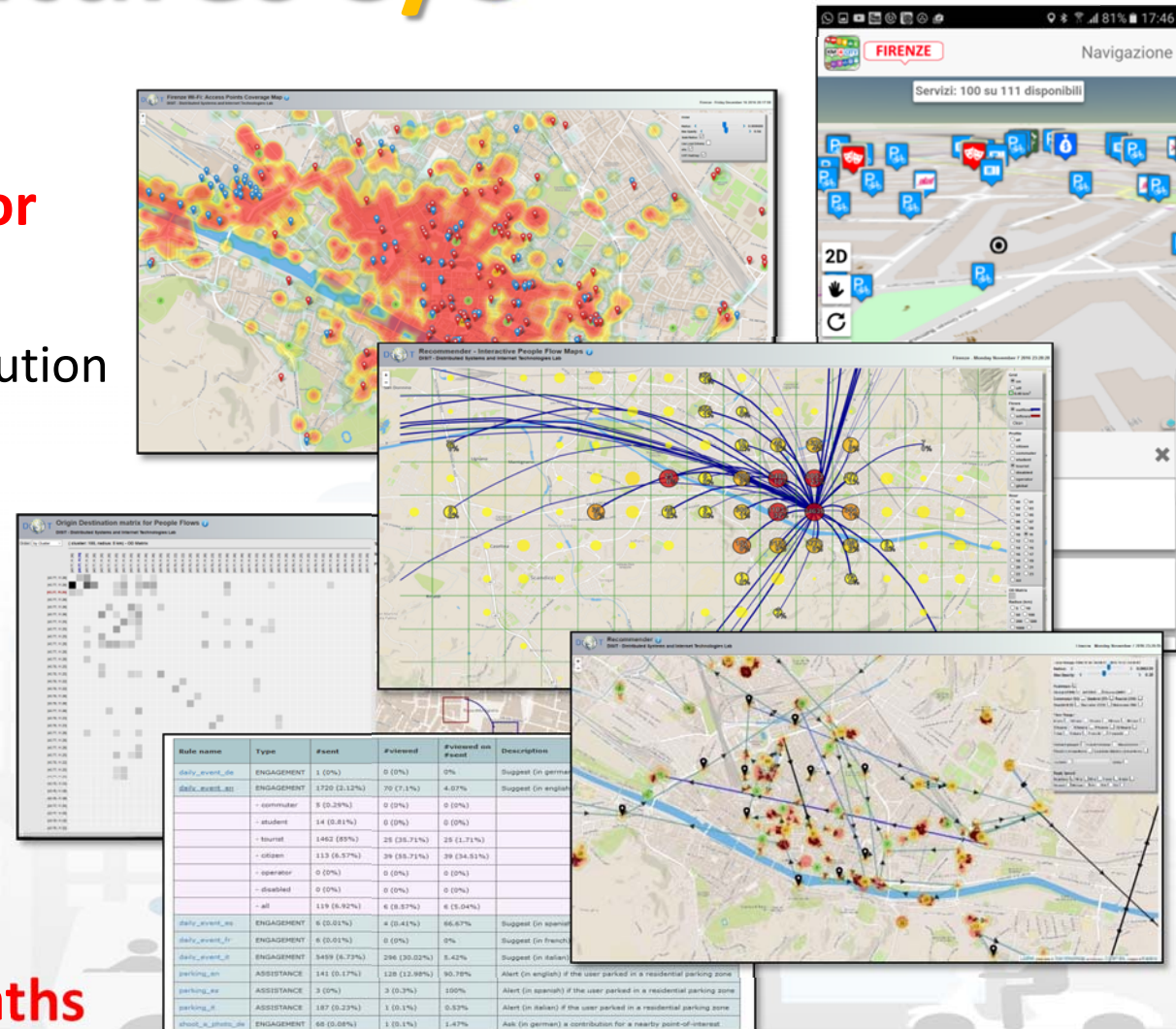
DISI lab overview, January 2017, Florence

Km4City APP, features 3/3

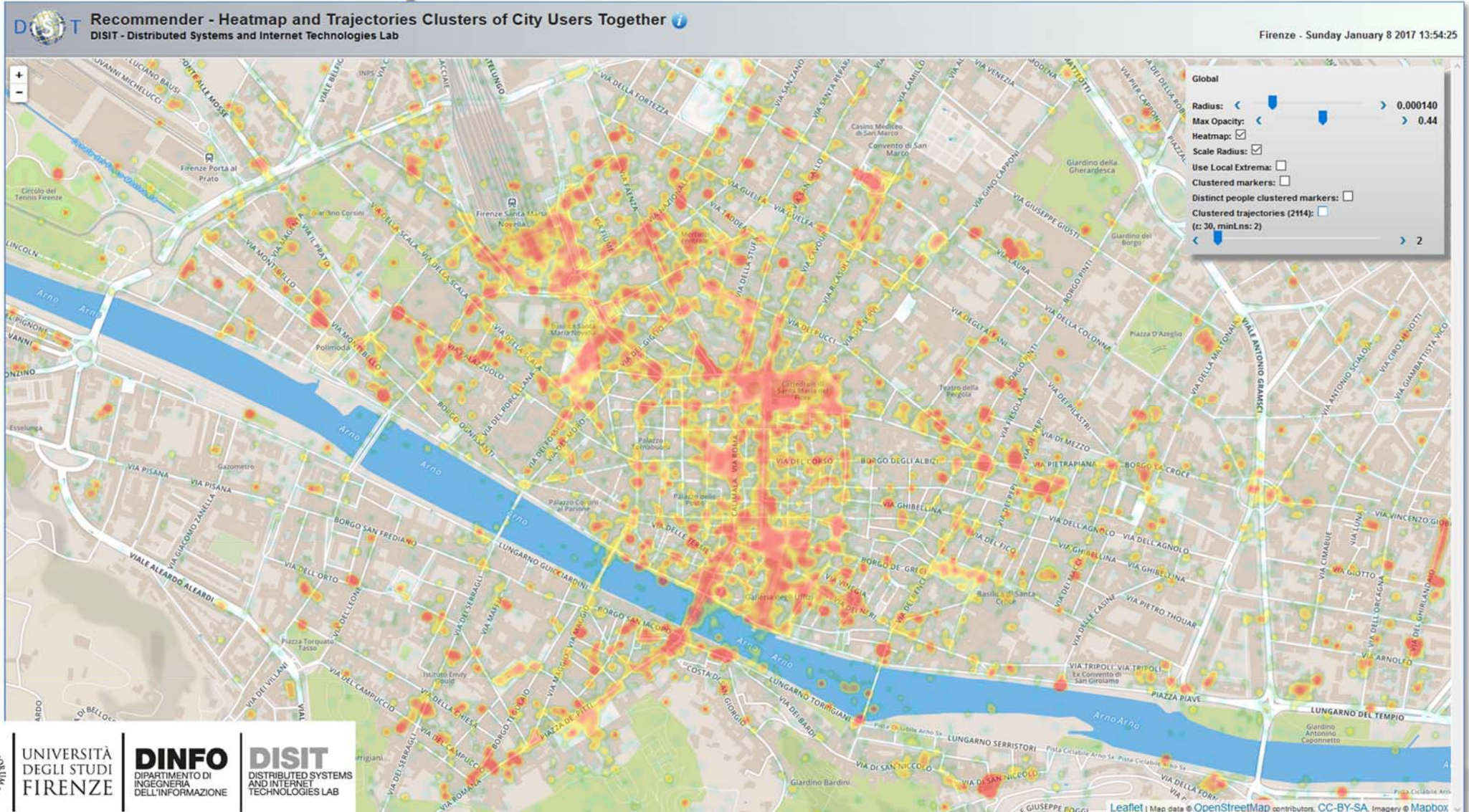
Case Study E



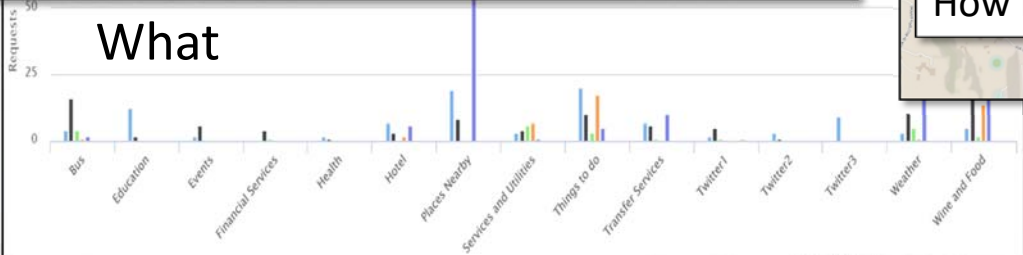
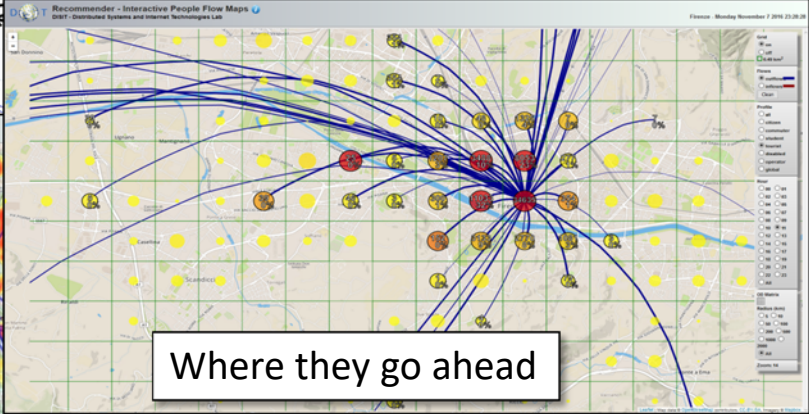
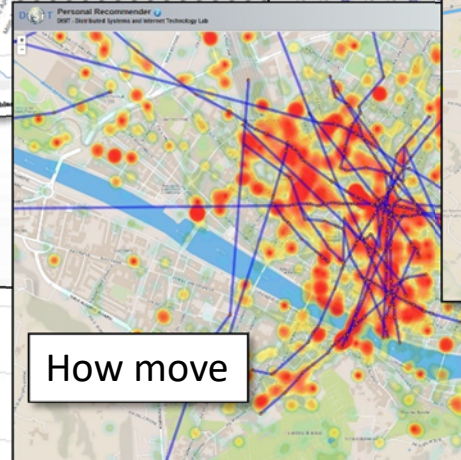
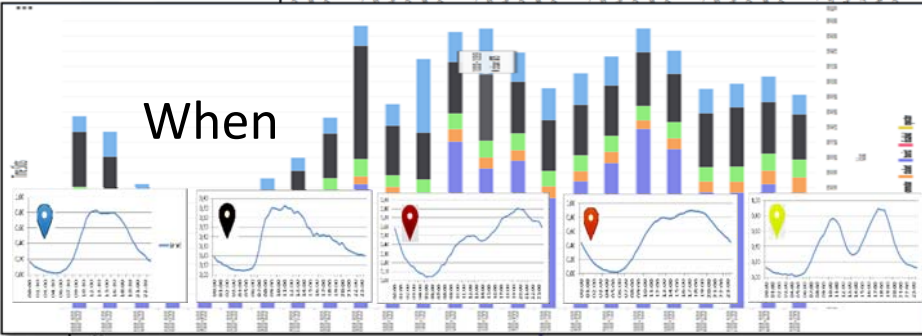
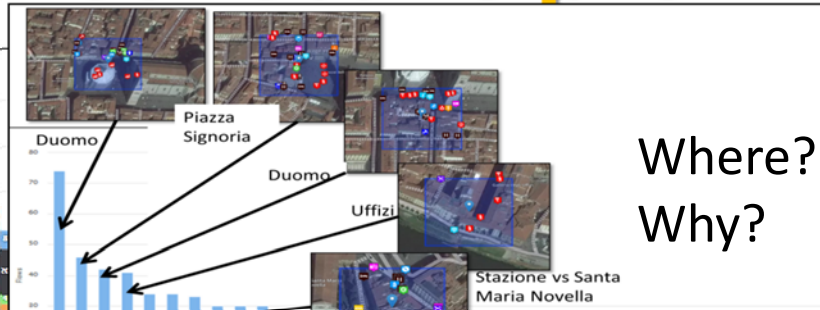
- **Navigation 3D (BETA)**
- **App as a tool for city user behavior analysis**
 - Measuring Wifi status: power distribution of Free Wi-Fi AP
 - Detection and measure of Beacon
 - Computing User Behavior
 - Fluxes of people via APP, GPS:
 - OD matrix
 - Fluxes out of Tuscany and more
- **Producing Engagements**
- **Producing Multimodal Routing paths**



Heat Map from Mobile: users as sensors

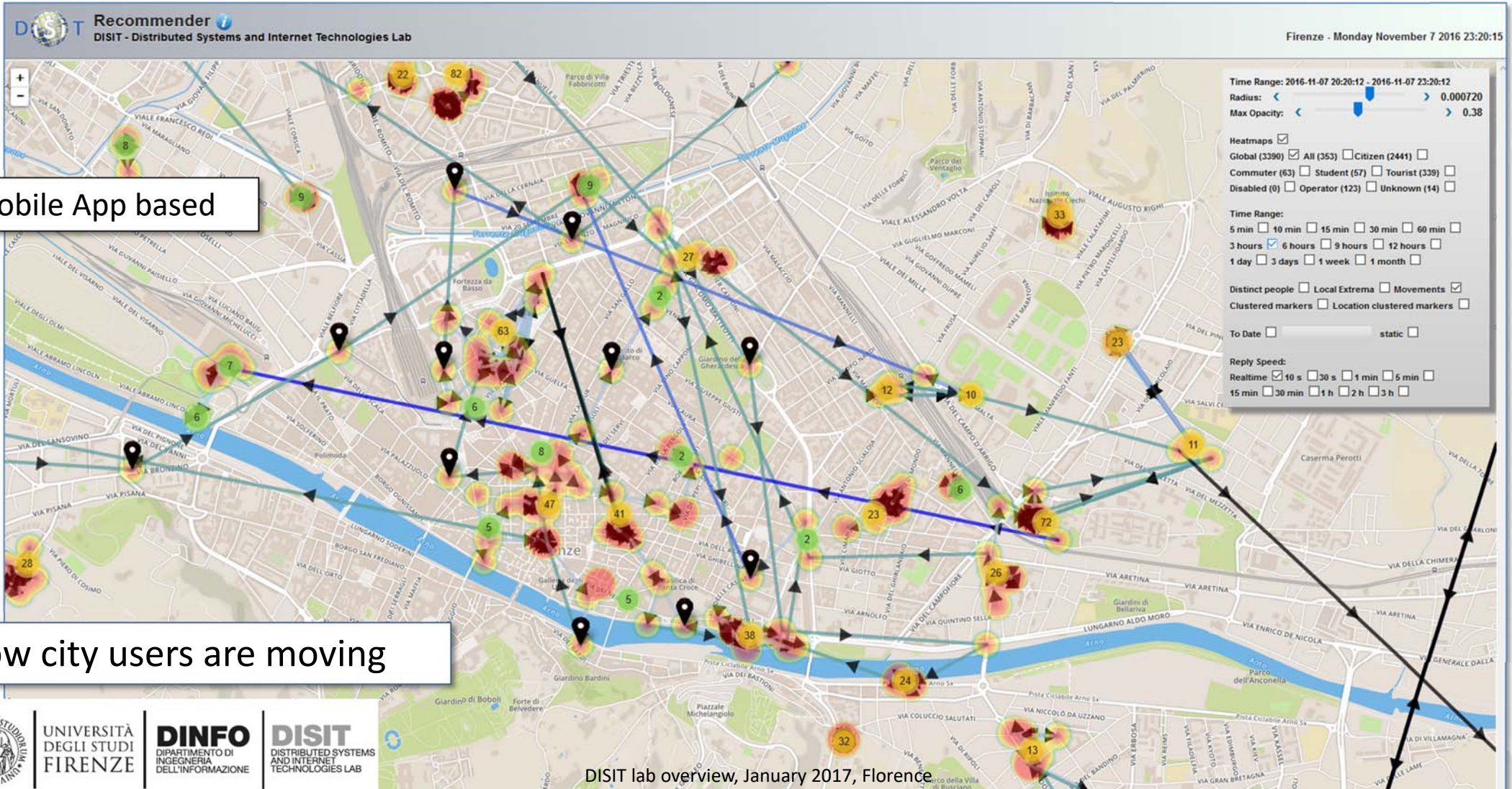


User Behavior Analyzer for Collective profiling



Anonymous User Behavior Analysis

Case Study E



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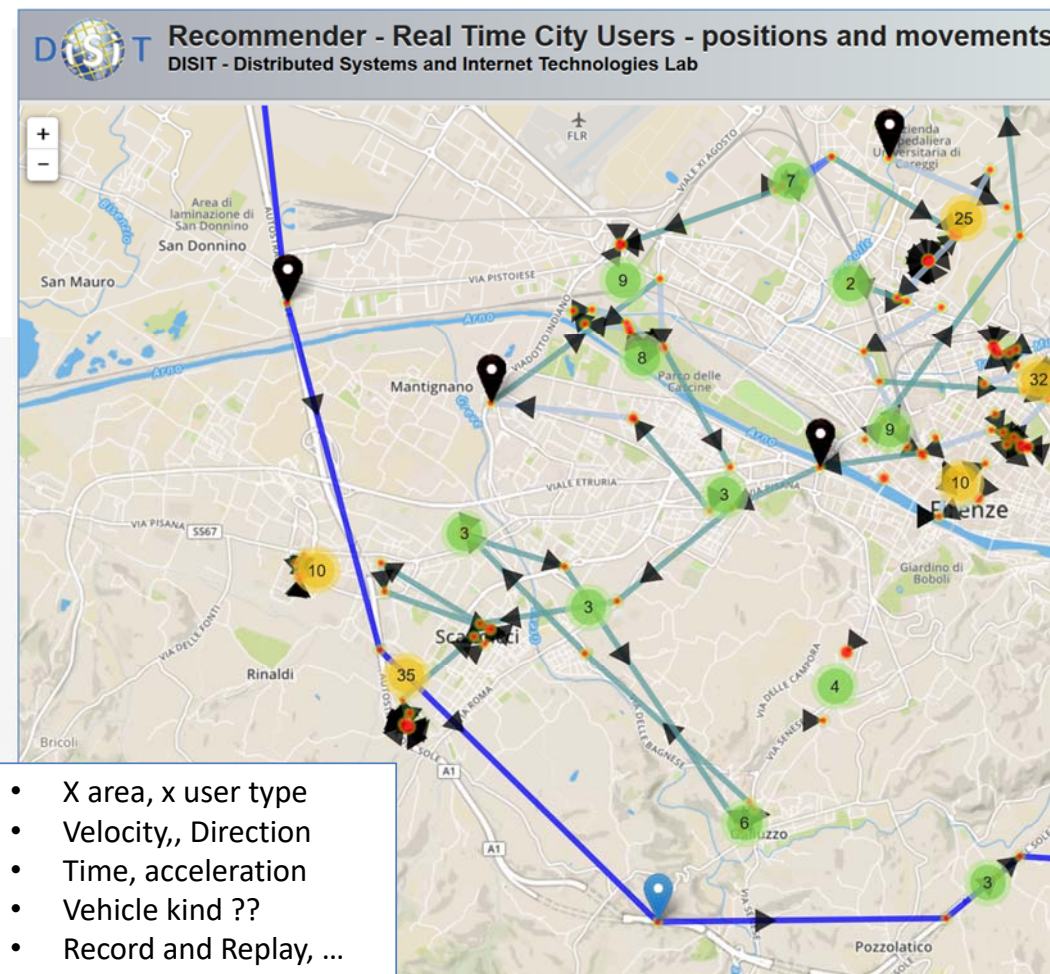
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Problems of Trajectories from Apps

- **From mobile app:**
 - Resolving GPS location: GPS, cells, wifi-network, ..mixt
 - Noisy, different kind of devices, ..
 - Smart algorithm on devices for location acquisition
 - Anonymized data, terms of use on mobile
- **Issues and Filtering**
 - Gps Accuracy, kind of measure (GPS, mixt)
 - Jump in time, space, velocity
 - General noise (diff. devices)
 - Knowledge of precision map
- **Clustering:** time, space, user kind, etc.

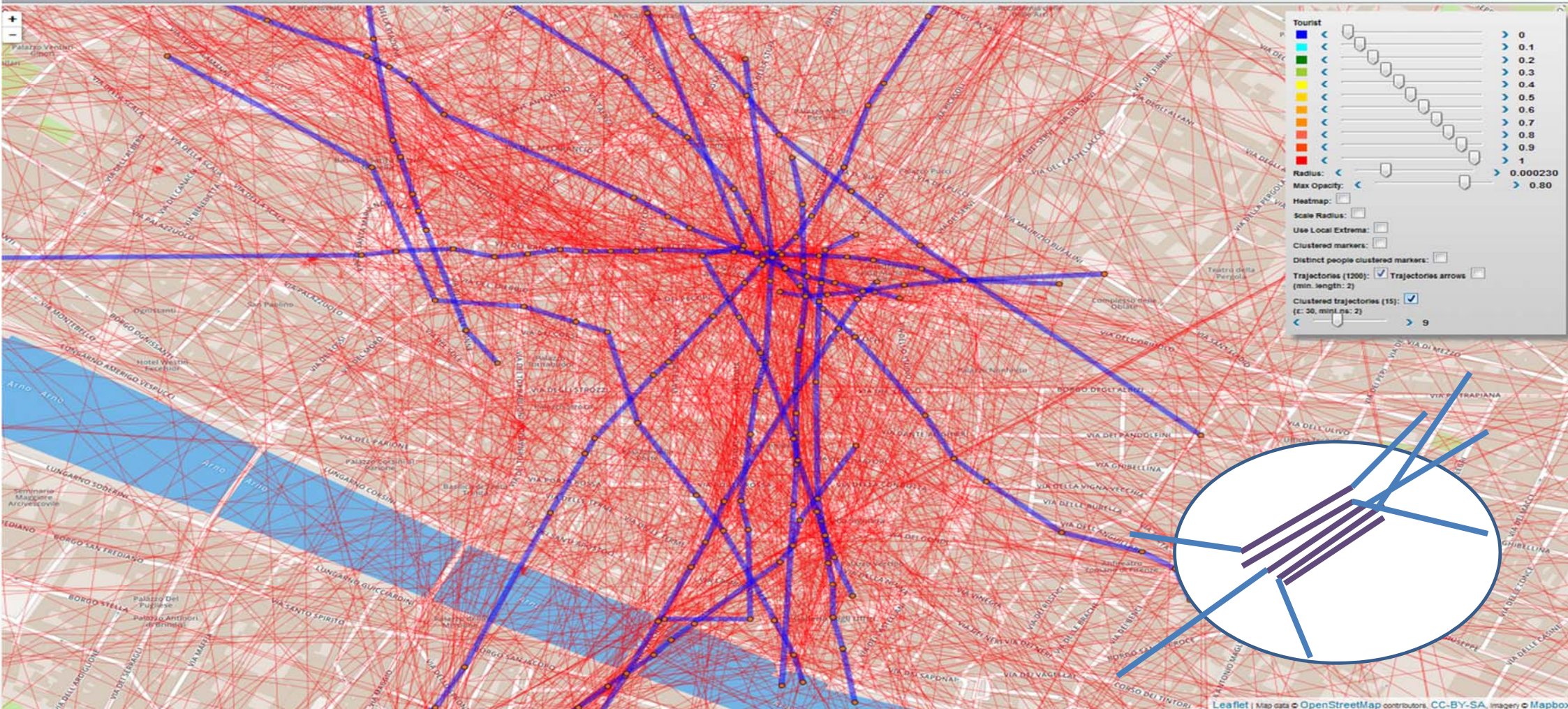




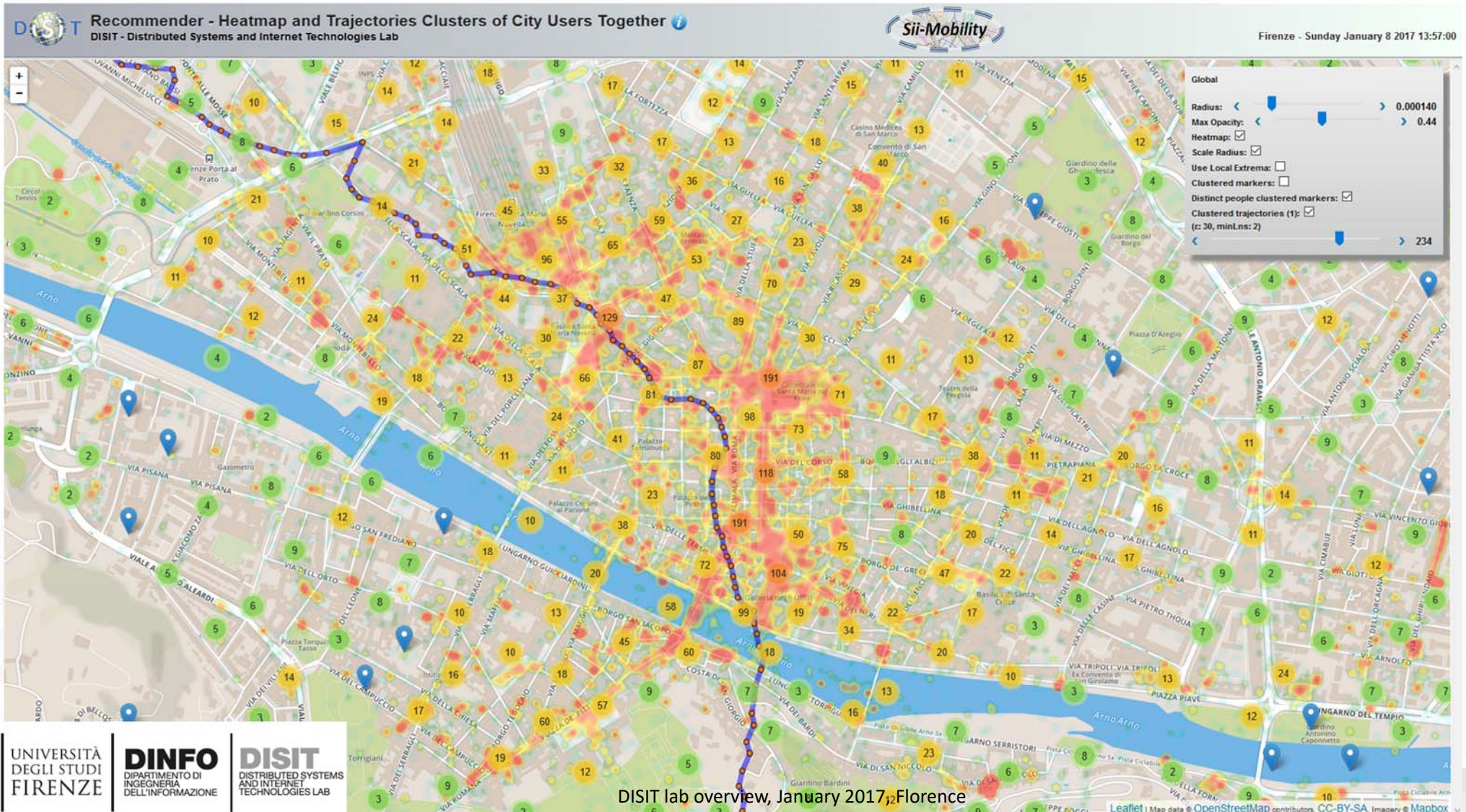
Cluster di Trajectories



Personal Recommender
DISIT - Distributed Systems and Internet Technology Lab



Heat Map from Mobile: users as sensors Case Study E



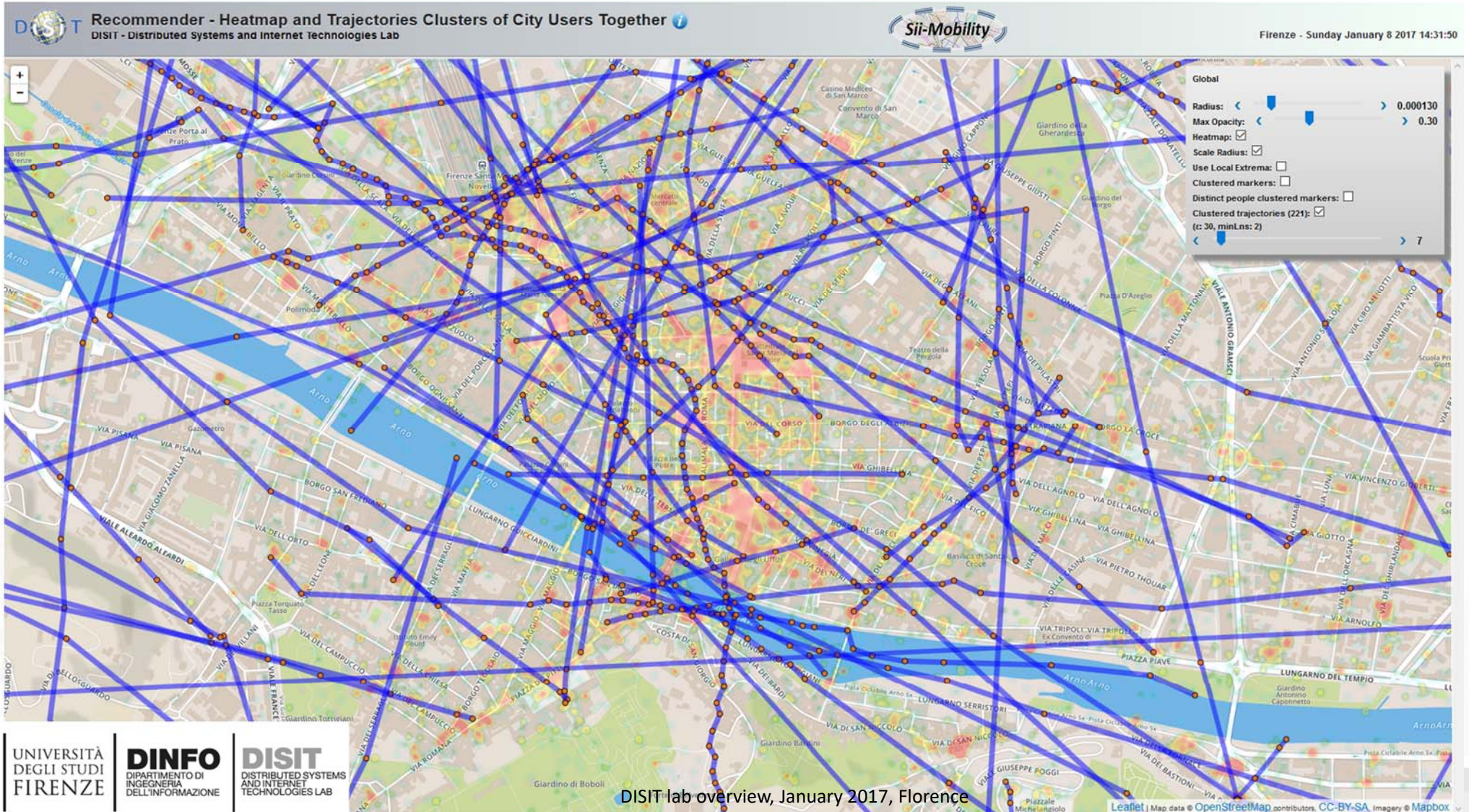
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Heat Map from Mobile: users as sensors

Case Study E



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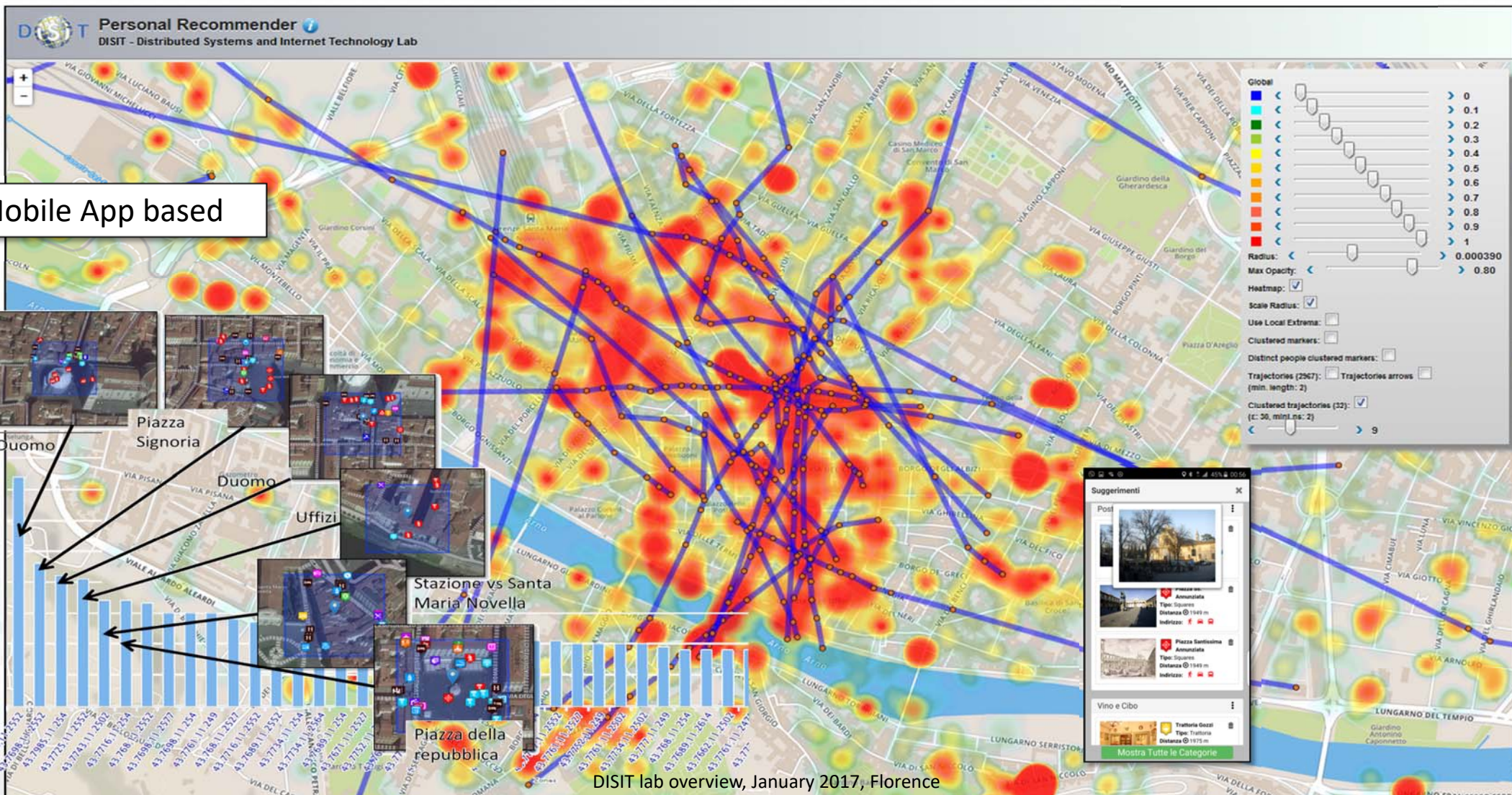


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User Behavior Analyzer Case Study E



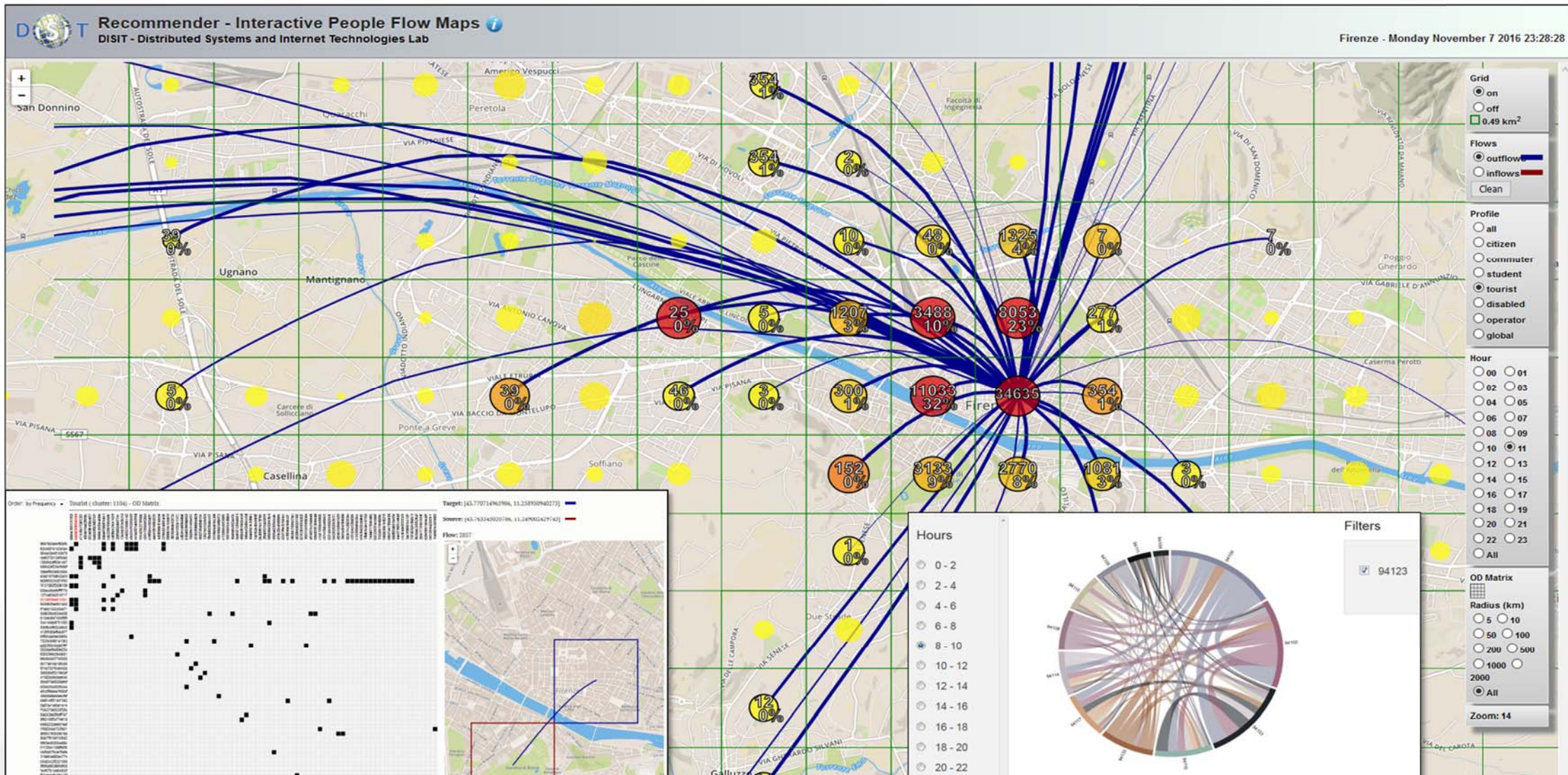


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OD Matrix scalabile Case Study E





Overview

- **DISIT Lab Overview**

- **Research Areas**

- **Smart City**

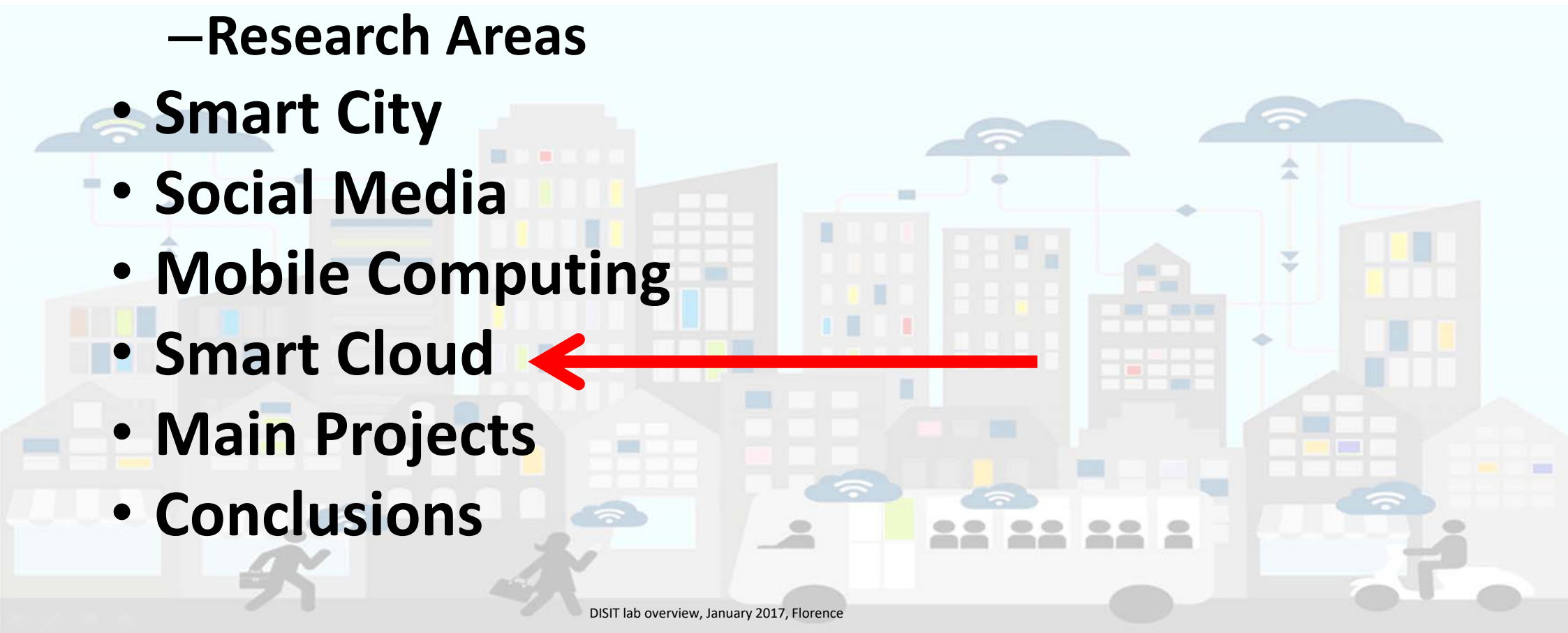
- **Social Media**

- **Mobile Computing**

- **Smart Cloud**

- **Main Projects**

- **Conclusions**





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Smart Cloud

- **ICARO Smart Cloud**

- <http://www.disit.org/5482>
- <http://www.cloudicaro.it>



- **ICLOS: Cloud Simulator**

- **DISCES: Distributed Scheduler**

- **TV Crawling**

- **AXCP Media Grid: Distributed Computing for media**





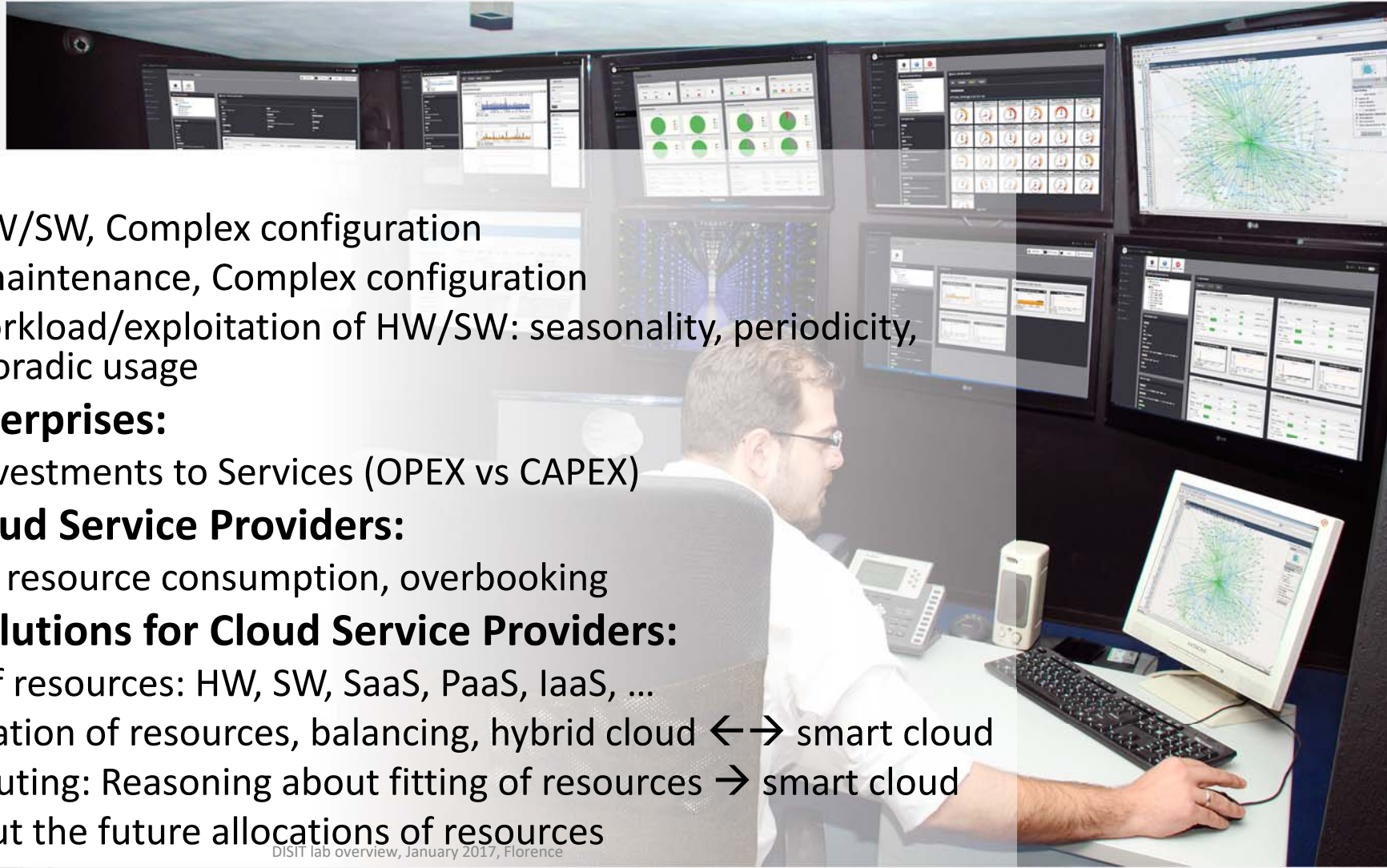
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Smart Cloud

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• Problems:

- high costs of HW/SW, Complex configuration
- High costs for maintenance, Complex configuration
- Not uniform workload/exploitation of HW/SW: seasonality, periodicity, aperiodicity, sporadic usage

• Solutions for Enterprises:

- Passing from Investments to Services (OPEX vs CAPEX)

• Solutions for Cloud Service Providers:

- Optimization of resource consumption, overbooking

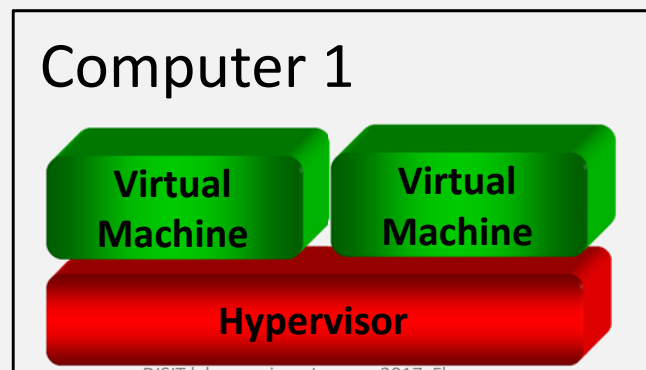
• Technological Solutions for Cloud Service Providers:

- Virtualization of resources: HW, SW, SaaS, PaaS, IaaS, ...
- optimized allocation of resources, balancing, hybrid cloud \leftrightarrow smart cloud
- Semantic computing: Reasoning about fitting of resources \rightarrow smart cloud
- Simulation about the future allocations of resources

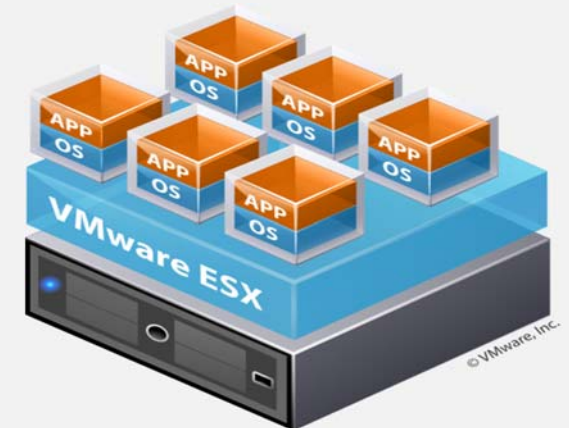
DISIT lab overview, January 2017, Florence

Virtual Machine, Virtualization

- **Virtual Machine:**
 - An image of an operating system that can be put in execution into a real host/computer creating a virtual computer that exploits a part of all of the host resources
 - E.g.: Host may be Linux-like while the VM may be Window, Mac, Linux, ...
- **Virtualization**
 - Transforming a physical computer into a VM, virtual machine, hosted on some Host computer
- **Hypervisor** (VM Monitor) to manage the several VMs on the host



DISIT lab overview, January 2017, Florence



Controlling and limiting VM Resources

- **VM Resources** (CPU, Mem, HD, net.) consists also in providing support for:



- Dynamically providing resources over the reserved values that can be negotiated into the SLA/ contract.

- **Controlling and limiting** access and the exploitation of HW resources:
 - A limit on the number of CPUs
 - A limit on the number of Cycles, over of a reserved number of cycles
 - A limit on the maximum size of the RAM, over of the reserved number of Mbytes
 - A limit on the size of the HD, SAN/NAS access
 - A limit on the number of network cards, number of Mbps, etc.



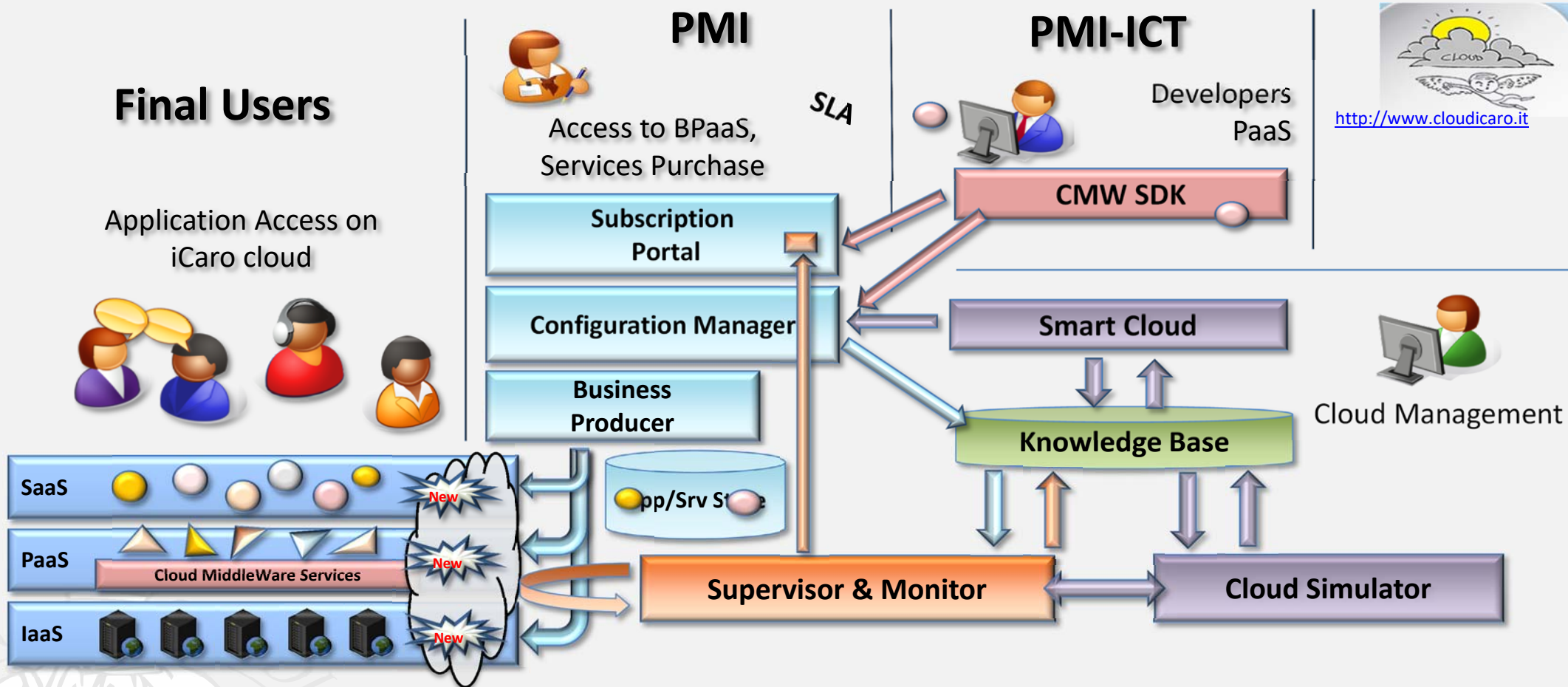
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Cloud ICARO Architecture





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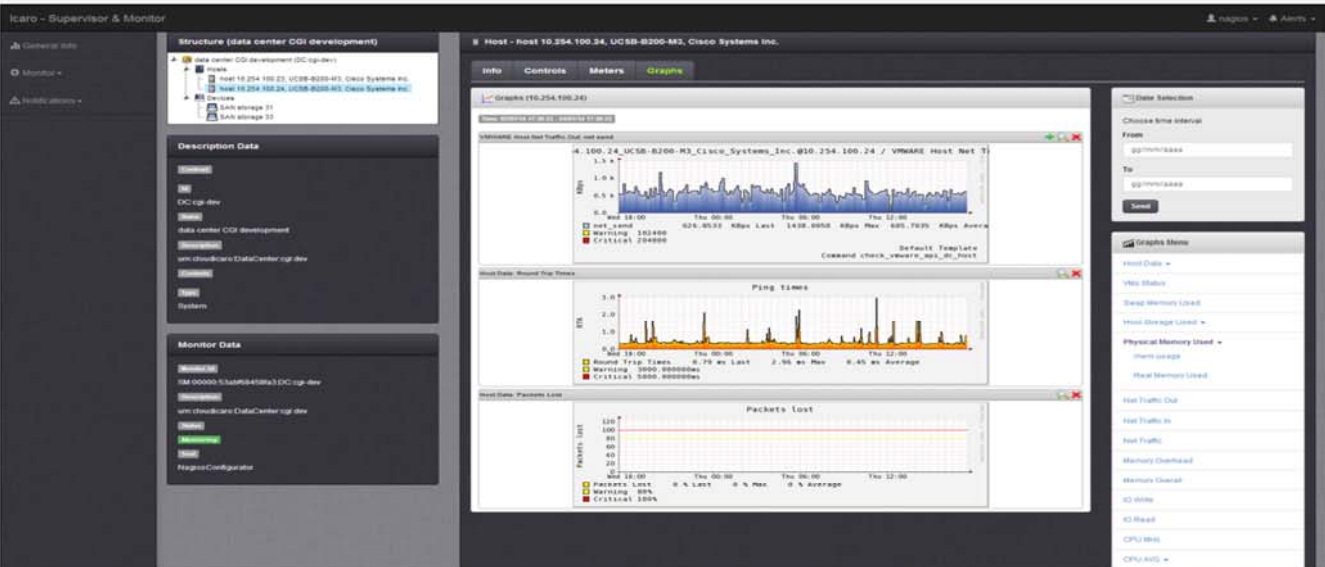
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Cloud Supervisor & Monitor



<http://www.cloudicaro.it>



- Monitoring real business configuration, SLA
- Uplayer wrt classical monitoring tools

DISIT lab overview, January 2017, Florence

Case Study F

Simulating Cloud Workload

• Issue:

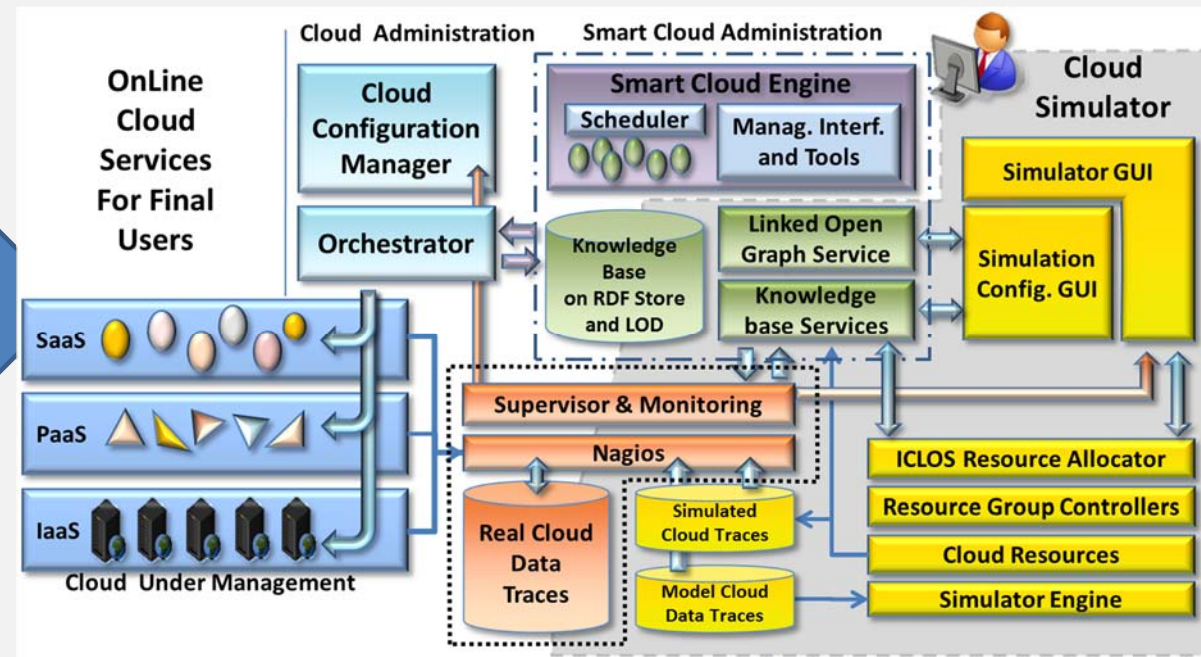
- Given a Cloud Status how to better allocate a number of VM according to their probable workload
- Probable workload profile

• Impact:

- Optimization of resource workload

• Several parameter related to

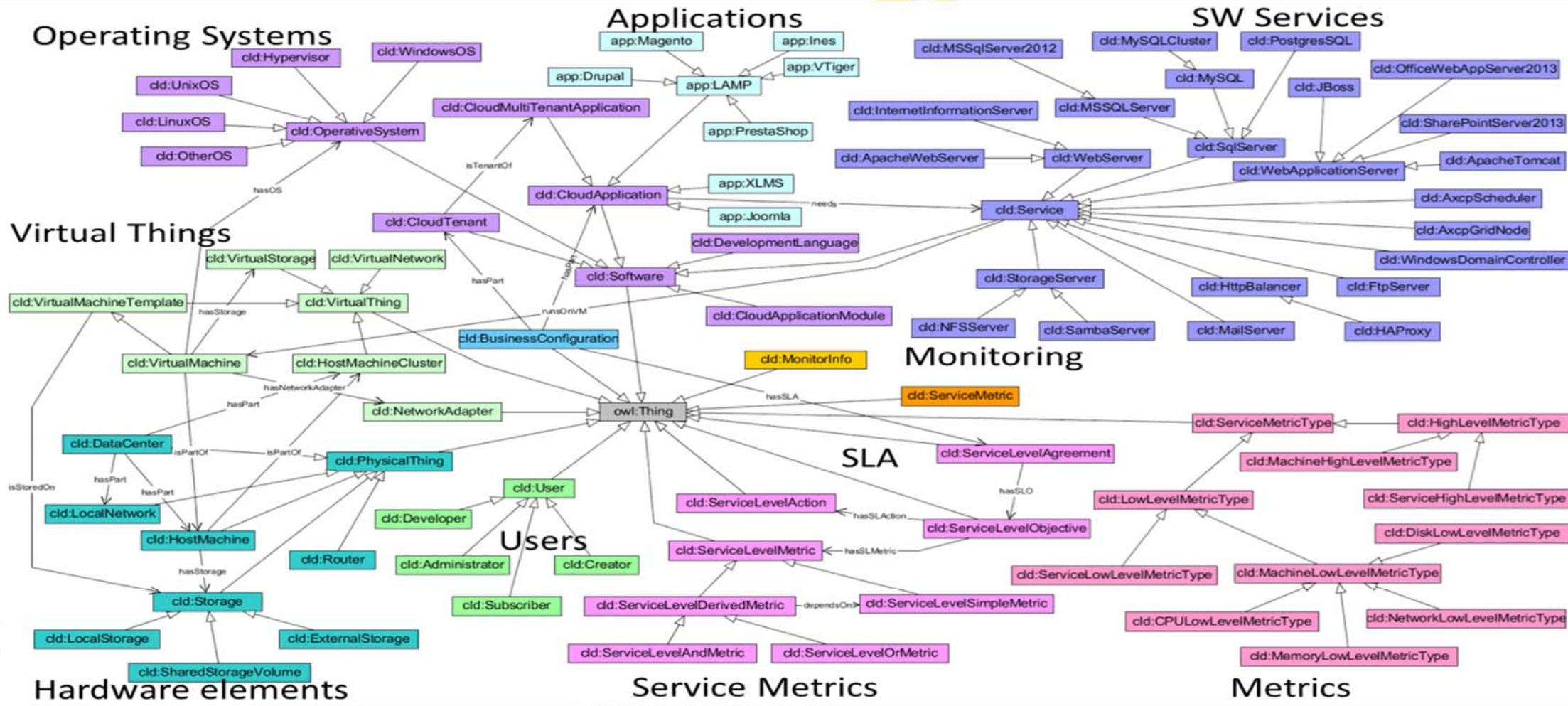
- Cloud status: hosts, resources, ...
- VM and their resources patterns
- Relationships among VM and resources
- Optimization models





Case Study F

Cloud Ontology model





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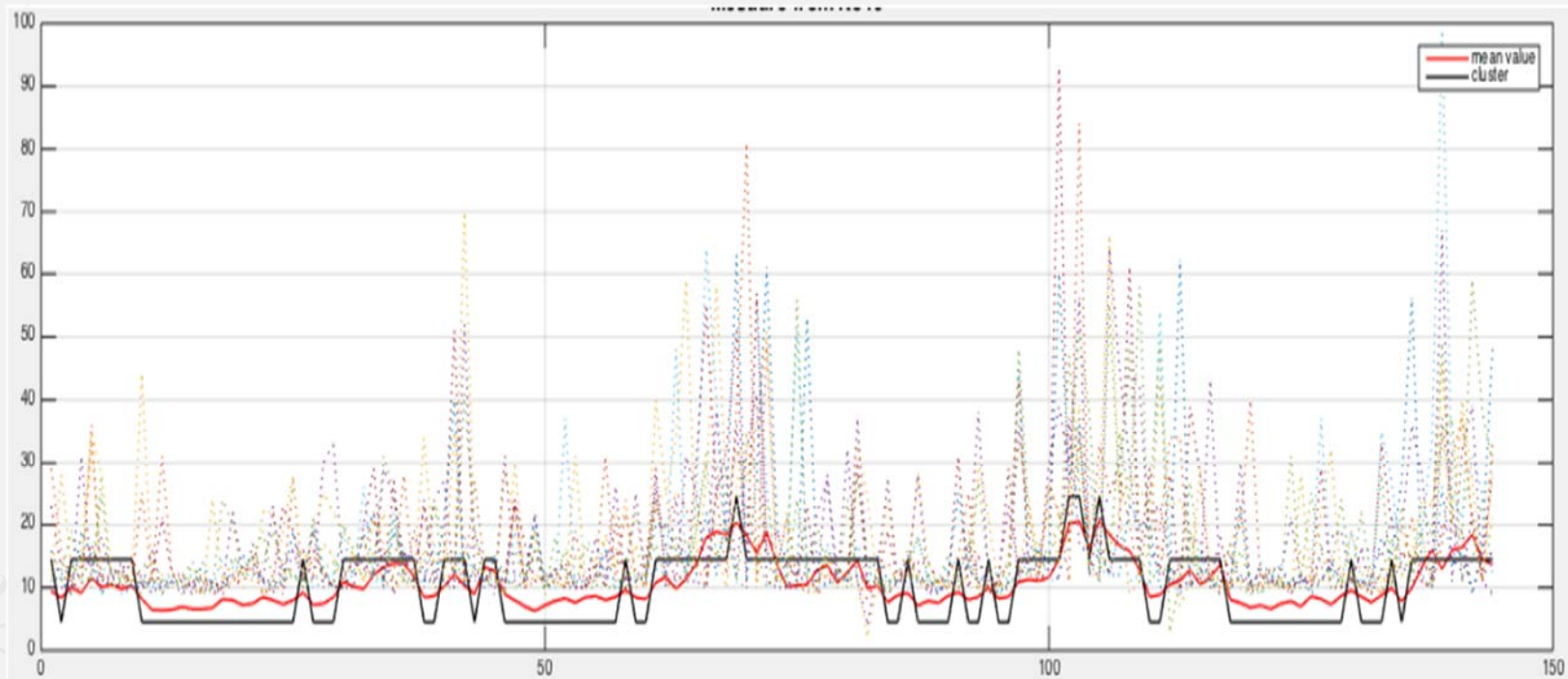
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Case Study F

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Normalizing Workload and creating patterns

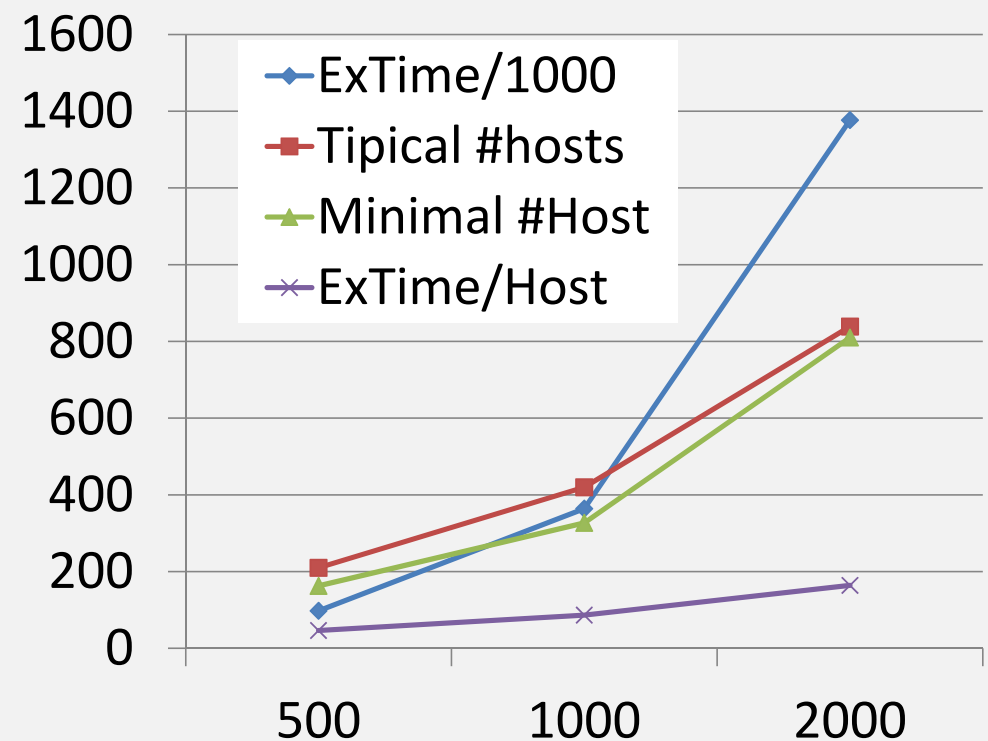
- Workload pattern For each category of VM and VM group
- Normalized for CPU, Memory, Storage, Network, etc..



DISIT lab overview, January 2017, Florence

Optimization & Allocation Models, 1 month

- Complex optimization with multiple constraints
- bin-packing algorithms :
 - Dot product
 - L2 Norm
 - FFD First Fit Decreasing Sum
 - **FFD First Fit Decreasing prod**





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Case Study F

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Optimization & Allocation Models, 1 month

Number of VM	494		998		2000		4000	
algorithms	Execution time in s	host number	Execution time in s	host number	Execution time in s	host number	Execution time in s	host number
Dot Product	49,36	37	169,89	75	708,64	150	3169,60	300
L2 Norm	43,62	38	163,88	77	739,93	153	3457,49	305
FFD Sum	2,95	37	14,84	75	59,09	150	266,38	300
FFD Prod	5,77	38	14,06	75	47,96	150	231,36	300





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- **Smart City**

- **Social Media**

- **Mobile Computing**

- **Smart Cloud**

- **Main Projects**

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Km4City Roadmap



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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

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

GHOST SIR
2016-2019 - Started

GHOST SIR
GHOST
Governing the smart city
with innovative services
in Smart Urbanism

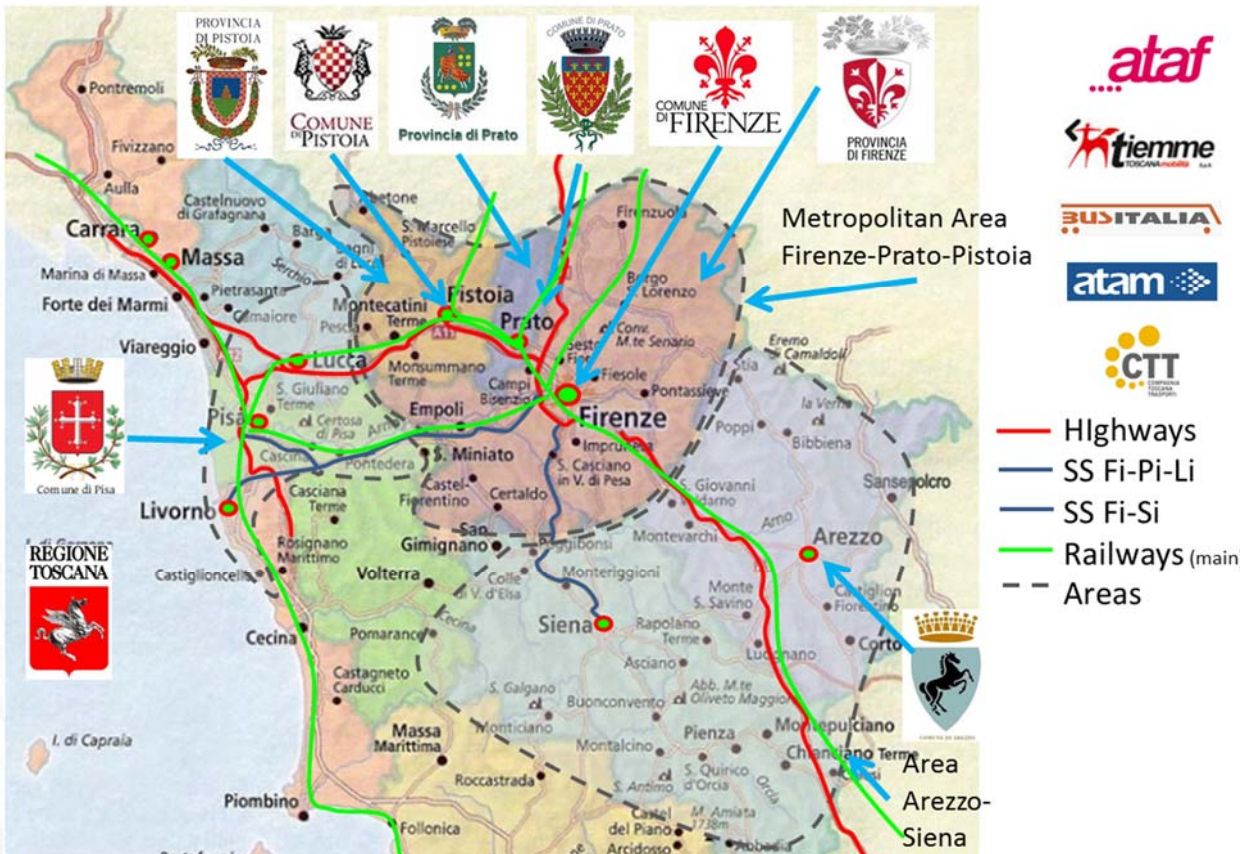


Sii-Mobility



- 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



MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITA' E DELLA RICERCA

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.
- **Testing on municipalities and provinces of Tuscany**
- **Contribute to the improvement of national and international standards**
- **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



Horizon 2020
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<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
<i>Consorzio Milano Ricerche</i>	CMR	IT



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- demonstrate Smart City technologies in energy, transport and ICT in districts in:
 - **San Sebastian (S), Florence (I) and Bristol (UK),**
 - 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**
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- 13 **EUSKAL TEL, S.A. EUSKAL TEL 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**
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- 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**



Overview

- **DISIT Lab Overview**

- **Research Areas**

- **Smart City**

- **Social Media**

- **Mobile Computing**

- **Smart Cloud**

- **Main Projects**

- **Conclusions**





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Department of Information Engineering (DINFO)
<http://www.disit.dinfo.unifi.it>

Conclusions

- **Smart City, Smart Cloud, Social Media,.... Mobile Computing**
- **Semantic Computing + Data Analytics + Big Data + distributed computing:**
 - Ontologies and reasoning tools, semantic indexing and search tool
 - Recommendations, suggestions,
 - user engagement for virtuous behavior stimulus
 - User behavior analysis, collective profiles, predictive models
 - predictive models, early warning/detection models
 - optimization models: allocation and simulation, ..
 - clustering for: user behavior, trajectories, ...
 - Indexing and search: faceted, similarities, ..
 - Computing: OD matrices, data warehouses, data aggregation, ...
 - Routing: multi-constrained routing, multimodal routing, ...
 - Etc. ..



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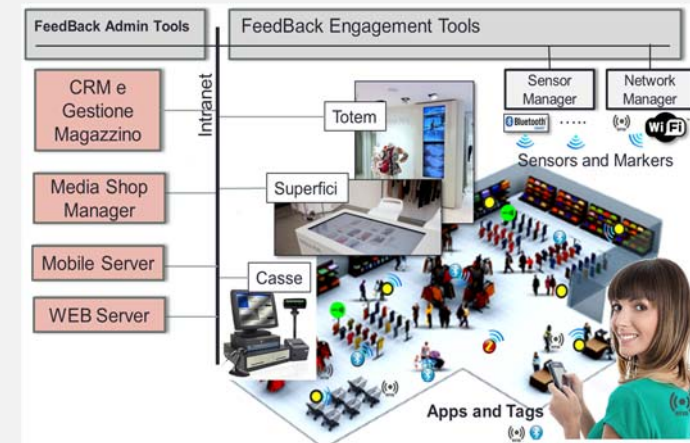
Smart Factory, Factory 4.0

- **Frontman (Novicrom)**
 - Improving efficiency into the production process via a set of heterogeneous numerical control machines
- **Green Capacity (ALTAIR)**
 - Optimizing chemical plant, automating maintenance and control in large chemical plant, dashboarding
- **Indoor/outdoor navigation system for maintenance**
- → → costs reduction, increase efficiency



Smart Retail

- **Feedback Project, from Feb 2017**
 - Flexible Advanced Engagement Exploiting User Profiles and Product/Production Knowledge
 - VAR, PatriziaPepe (Tessilform), DISIT, Effective Knowledge, SICE
 - Keywords: retail, GDO, ...
- **Goals and drivers:**
 - adaptive user engagement, customer experience
 - Advanced user profiling, user behavior analysis
 - Predictive models for engagement
 - IOT and instrumentation
 - Integrated incity customer experience





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High Safety for Railway Systems

- **Trace-IT (ECM)**



- Autonomous Driver for high speed train and driverless light railways

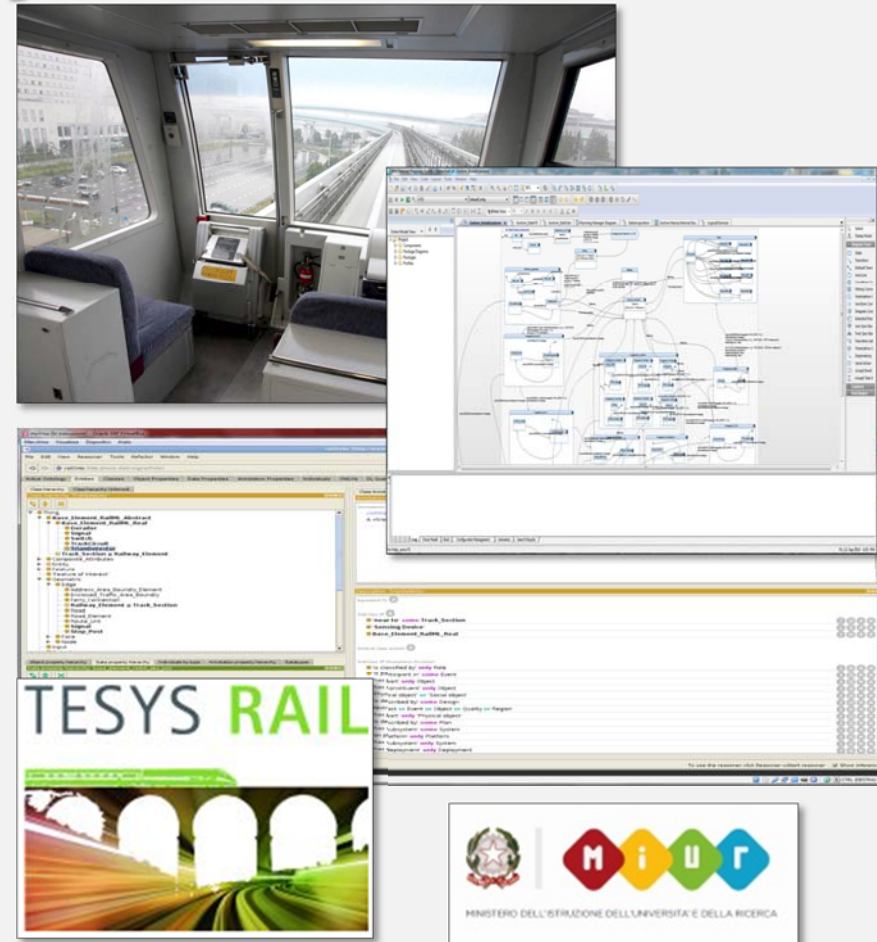
- **RAISSS (ECM)**



- Smart Interlocking system for railway station

- **TESYS RAIL MIUR cluster and project**

- National Cluster on Transport System



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





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