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KM 4 CITY

Km4City Smart City API: an integrated support for mobility services

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2nd IEEE International Conference on Smart Computing (SMARTCOMP 2016)

St. Louis, Missouri, US | May 18-20, 2016

KM4City Ontology and APIs

- The effective deploy of smart services is viable by exploiting the semantic integration of Open/Private data, Static/Real Time data
- The semantic aggregation of data is unfeasible without a common ontology, data are produced:
  - by different institutions
  - by using different formats and aims,
  - by using different references to geographical elements, different standards in different moments
- Aggregated data can be exploited to implement a large number of **services** and **applications** by structuring the **Smart City Architecture** and the corresponding **Smart City APIs**

Smart City API Architectures

- Different kinds of Smart City APIs can be set up with the aim of enabling Smart City Services and Applications, and their corresponding Architectural solutions
- Three main approaches can be presented:
  - **Info Integrator**
  - **Data and Metadata Aggregator**
  - **Semantic Aggregator and Reasoner**

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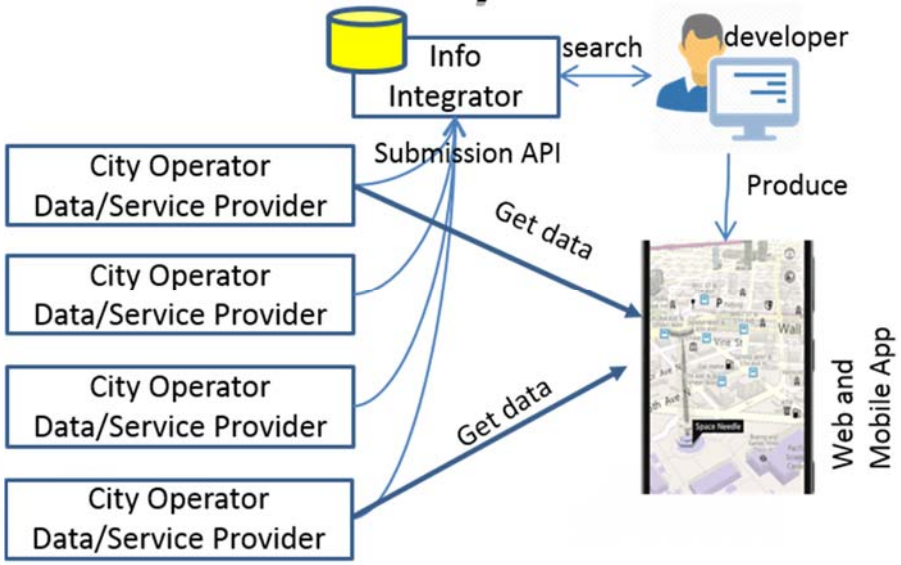
CASE A)

Smart City API Architectures: **Info Integrator**



- Collects information about APIs provided by different data and/or service providers (including authentication and licensing)
- Provides a common place to access at the exposed API services and data

- Data & Services are NOT integrated each other
- APIs and data are not semantically interoperable
- The problems in managing the semantic integration of data and services are left in the hands of developers

Example:
EO15 Digital Ecosystem

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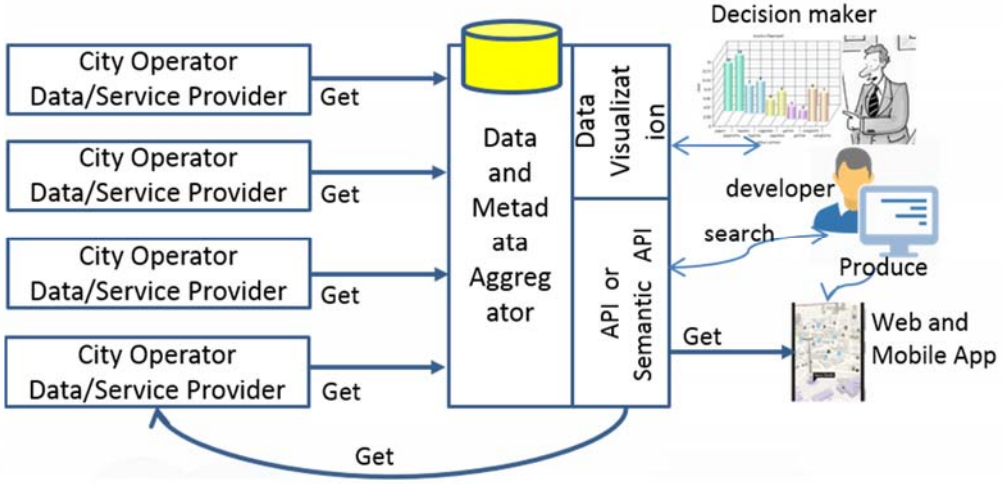
CASE B)

Smart City API Architectures: **Data & Metadata Aggregator**



- Collects data and metadata information to index & aggregate them in a **common model**
- The aggregated data are made accessible to web and mobile App via some automatically generated APIs
- In some cases, graphic rendering is provided via data visualization tools

- The **common model** produced does not lead to a satisfactory semantic interoperable data service
- The data are not re-conciliated each other, and maintain the same quality of the original
- The resulting database is typically a set of tables with traditional MySQL capabilities. Thus, the provided APIs are not supported by a domain-oriented ontology

Example:
CKAN, ArcGIS OpenData, etc.

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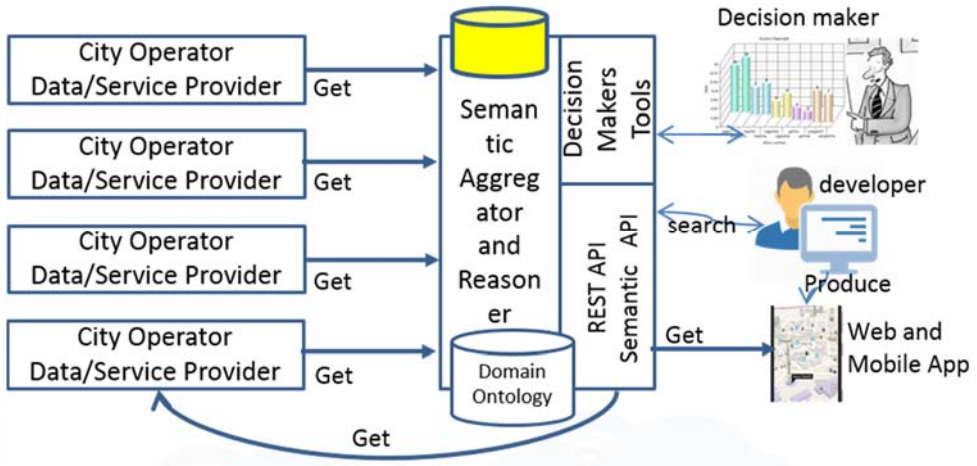
CASE C)

Smart City API Architectures: **Semantic Aggregator & Reasoner**

- Collects data and services to aggregate and integrate them in a unified and semantically interoperable model based on a multi-domain ontology
- Allows data re-conciliation
- The model defines semantics relationships enabling the inferential processes in the RDF Graph Database
- The obtained KB can be used for: creating strategies, data quality improvement, setting up algorithms and reasoning about the several aspects and services



Examples: CitySDK (with some limitations), KM4City (covering all features)

Smart City API Architectures: Comparison

	Case A) Info Integrator	Case B) Data and Metadata Aggregator	Case C) Semantic Aggregator and Reasoner
Addressing Open Data	Y	Y	Y
Addressing Private Data	Y	Y	Y
Addressing Real Time Data	Y	Y	Y
Addressing Services	Y	N	Y
Providing Data Search	N	Y	Y
Providing Metadata Search	Y	Y	Y
Providing Space Reasoning	N	(partially)	Y
Providing Time Reasoning	N	(partially)	Y
Providing Integrated Authenticated Access to data	Only metadata	Y	Y
Providing Syntactic Interoperable Data/Services	N	Y	Y
Providing Semantic Interoperable data/Services	N	N	Y
Independent from the Data model changes	N	N	Y
Providing REST API on data	N	Y	Y
Providing SPARQL API on data	N	(partially)	Y
Providing inference support on Data	N	N	Y
Providing Data Visualization	N	Y	Y
Providing Decision Maker Support	N	(partially)	Y

- Case C) mainly differ from Case B) for the presence of a real ontological model
- Case C) has to cope with Graph Database collecting huge amount of data (Big Data)
- Main difference perceived by City Users and Decision Makers in case C):
  - Number of smart and cross domain services

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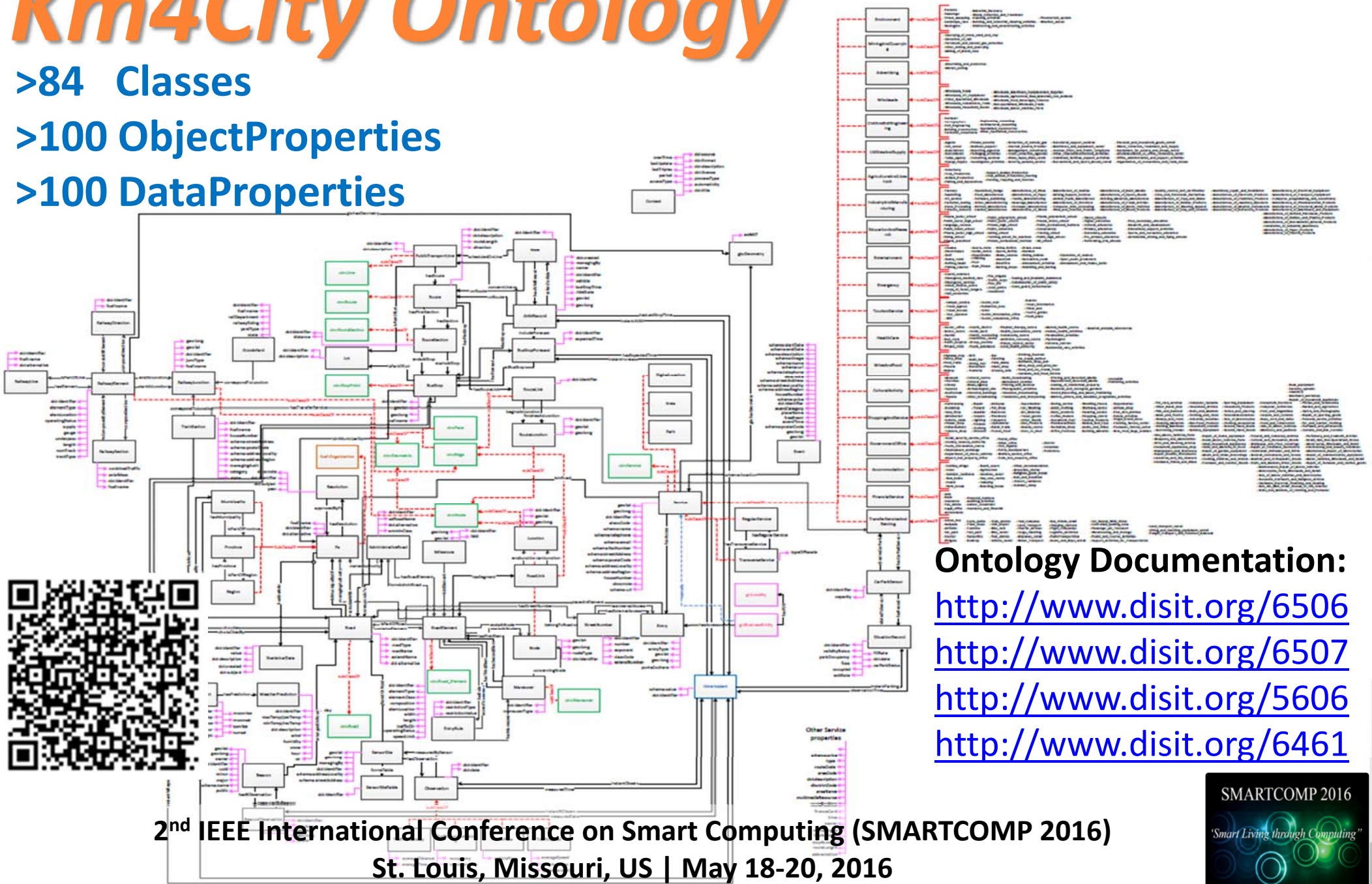
Km4City Ontology

>84 Classes

>100 ObjectProperties

>100 DataProperties



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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KM4 City APIs & other API of case C)

- Comparison in terms of:
  - Service Search,
  - Mobility
  - Environment, Sensors and Actuators
  - User Participation and Awareness
  - Personal Assistant
  - Smart City Interoperability and Dashboard
  - Domains of Geo Located Services
  - API Kind of Call

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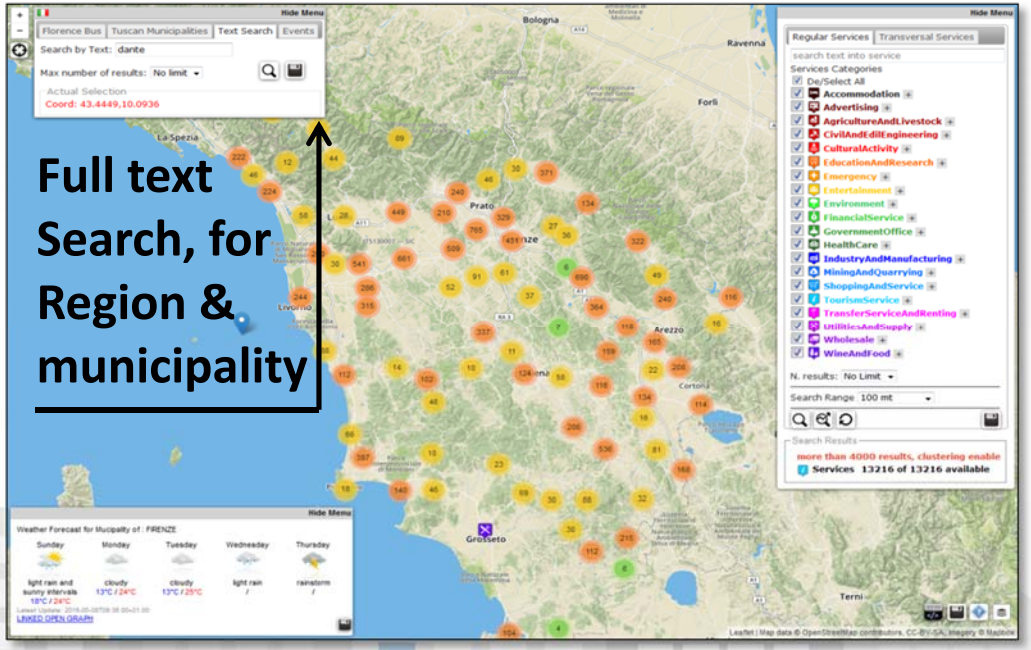
APIs: Service Search & Mobility

Front end Smart City API domains to provide services to management smart city applications, and to web and mobile applications.	CitySDK	ECIM	TransportAPI	Navitia.io	Km4City
API: Service Search					
Search Full Text	x2	x2		X	X
Search around a GPS point	X	X	X	X	X
Search along a line, polyline	X				X
Search in an area, set of points	X			X	X
Search for region, municipality, etc.				X	X
API: Mobility					
Get Real time delay of Public Busses	X		X	X	X
Get Traffic Flows Status	X	X	X	X	X
Get Parking Status	X	X		X	X
Get a Routing (multi stop planning)	X	X	X		(x)
Get an Intermodal Routing	X	X	X	X	
Get an Integrated Ticketing		X	X	X	(x)
Get a Routing for Good Delivering	X		X		
API: Environment, Sensors and Actuators					
Get Weather Forecast	X			X	X
Get Sensor/Actuator Value/Status	X	X		X	X

ServiceMap

http://servicemap.disit.org



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ServiceMap

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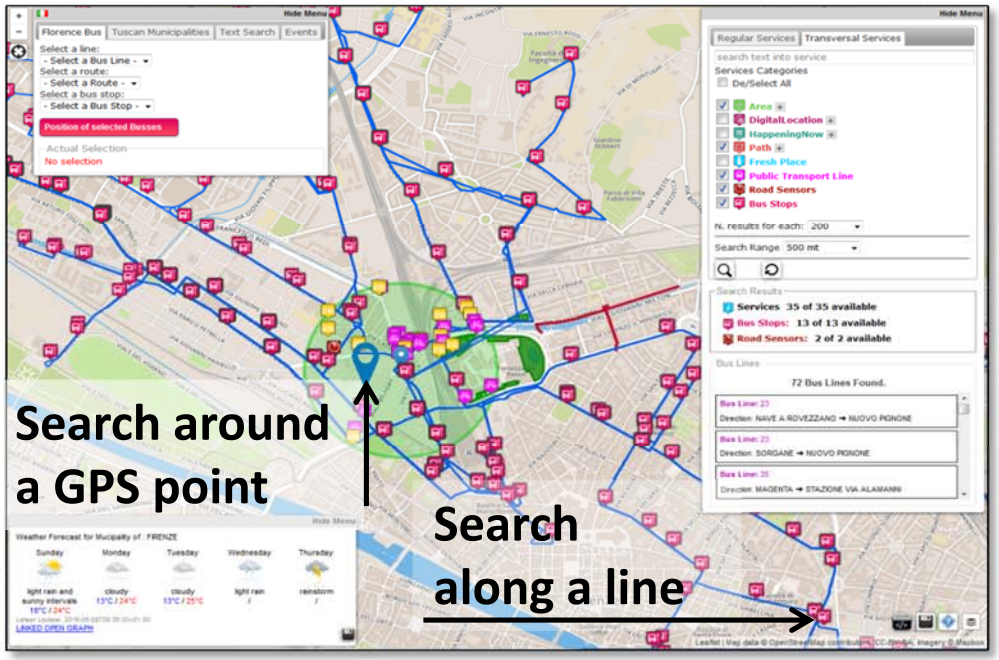

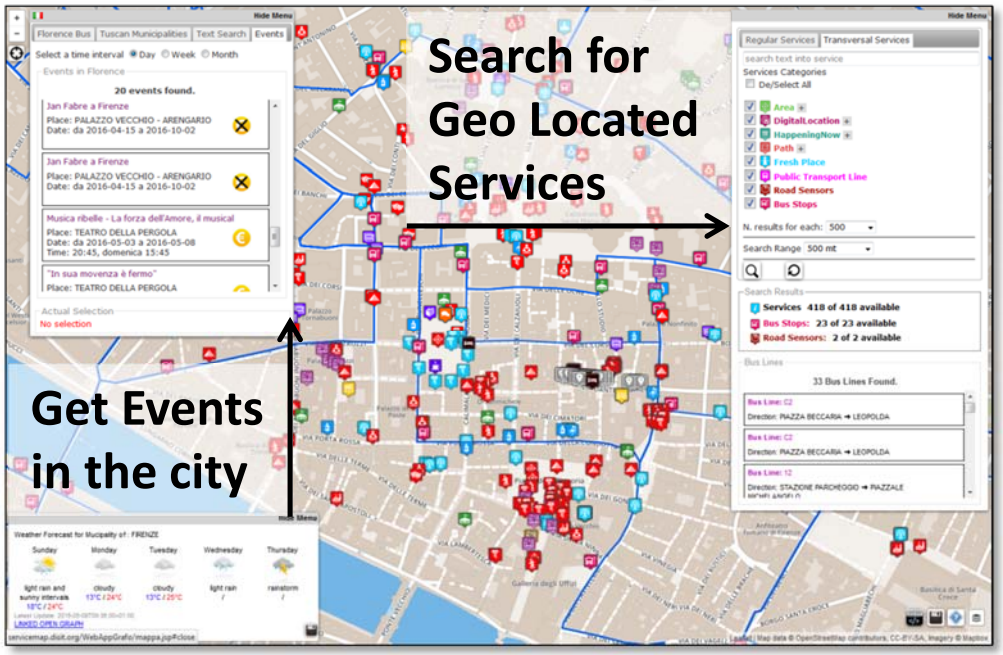

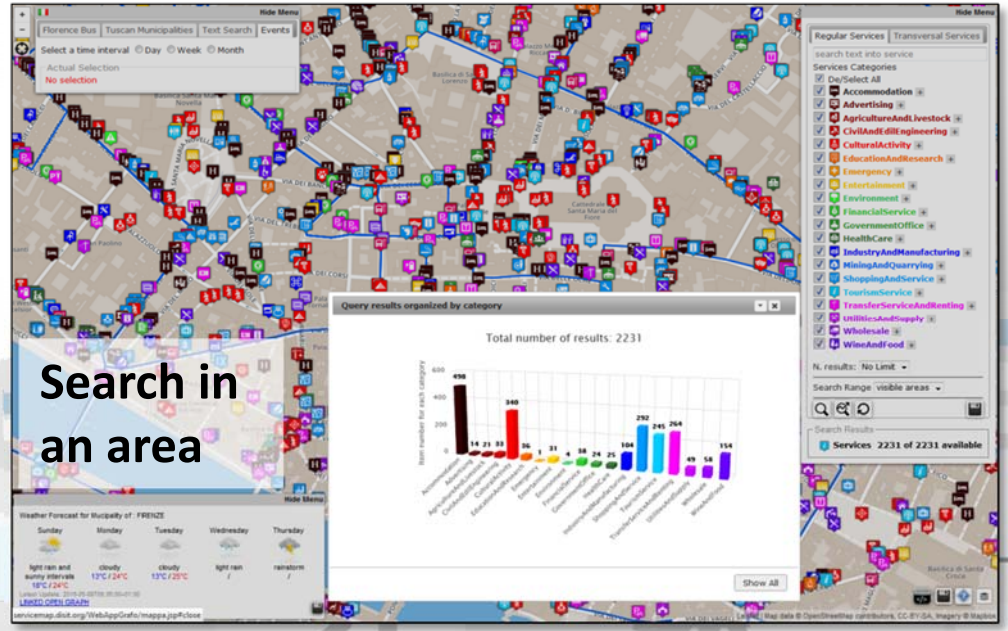

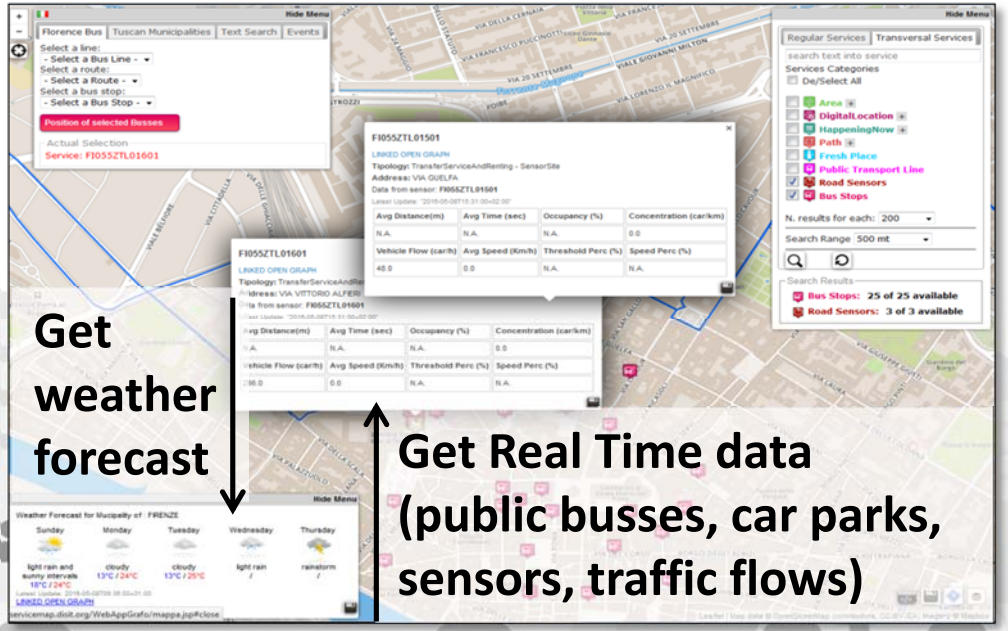

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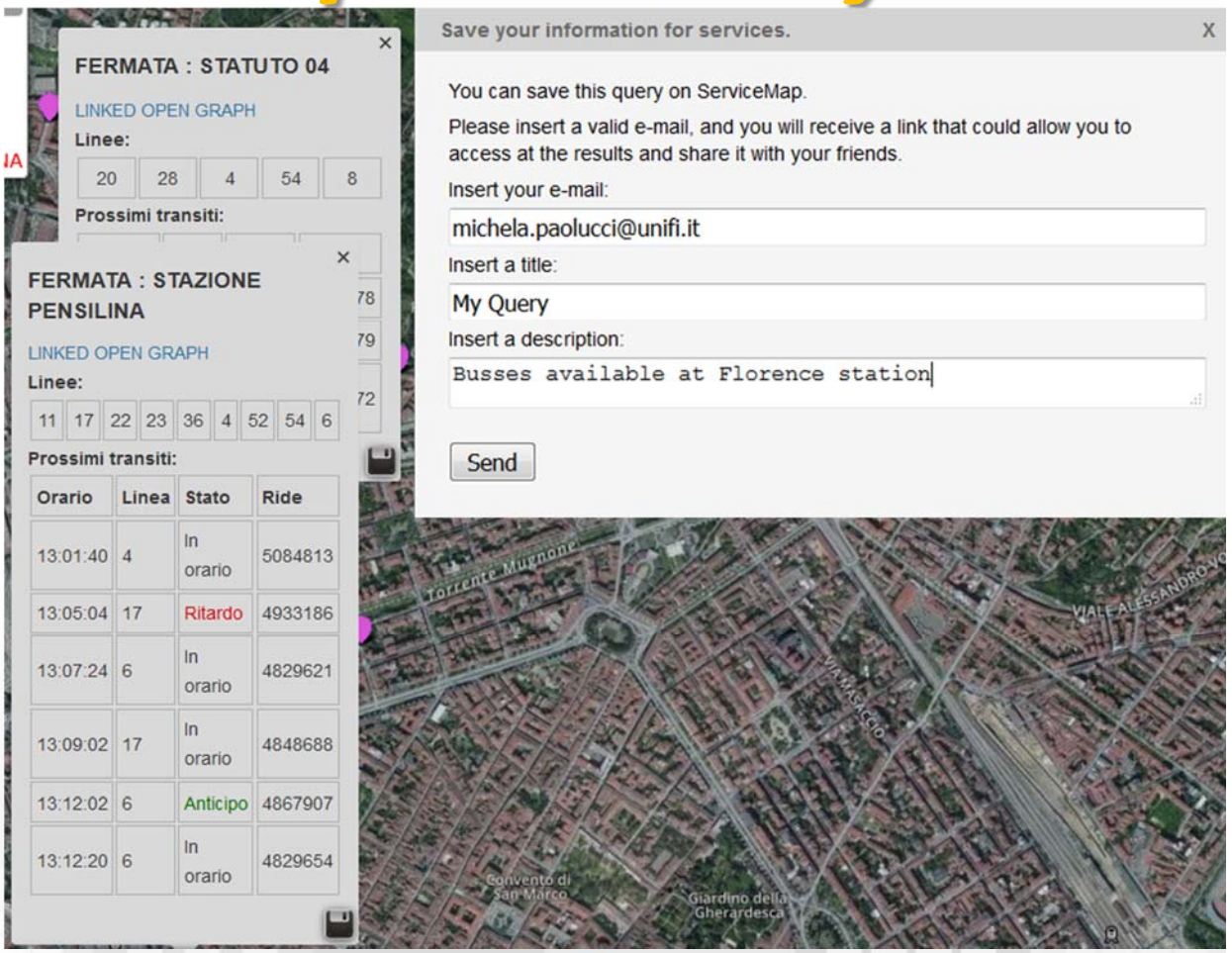
Km4city ServiceMap Km4City API

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



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APIs: User Participation, Awareness Personal Assistant, Geo Located Services

Front end Smart City API domains to provide services to management smart city applications, and to web and mobile applications.	CitySDK	ECIM	Transport.API	Navitia.io	Km4City
API: User Participation and Awareness					
Get Social Media Monitoring Info			X		X
Save Crowd Sourcing Comments	x1		X		X
Save Crowd Sourcing Votes	X	X	X		X
Save Crowd Sourcing Media	X	X	X		X
Get Events in the city/area	X				X
API: Personal Assistant					
Save User Profile	(x)	(x)		(x)	X
Get Suggestions on Demand					X
Get Civil Protection in Push					X
Save Mobile Sensors Status	X	X		X	X
API: Domains of Geo Located Services					
Culture and Tourism	X	X			X
Point of Interest	X	X	X	X	X
Mobility and transport, parking, flow	X	X	X	X	X
Education and training	X	X			X
Government and Pub Services	X	X			X
Commerce and Industry	X	X			X
Health and personal	X	X			X
Public Energy, Energy and home	X	X			X
Energy and Mobility	X	X	X		X

Km4CityMobile App

Video

Florence where, what. Km4City

DISPONIBILE SU Google play

Scarica da App Store

Scarica da Windows Store

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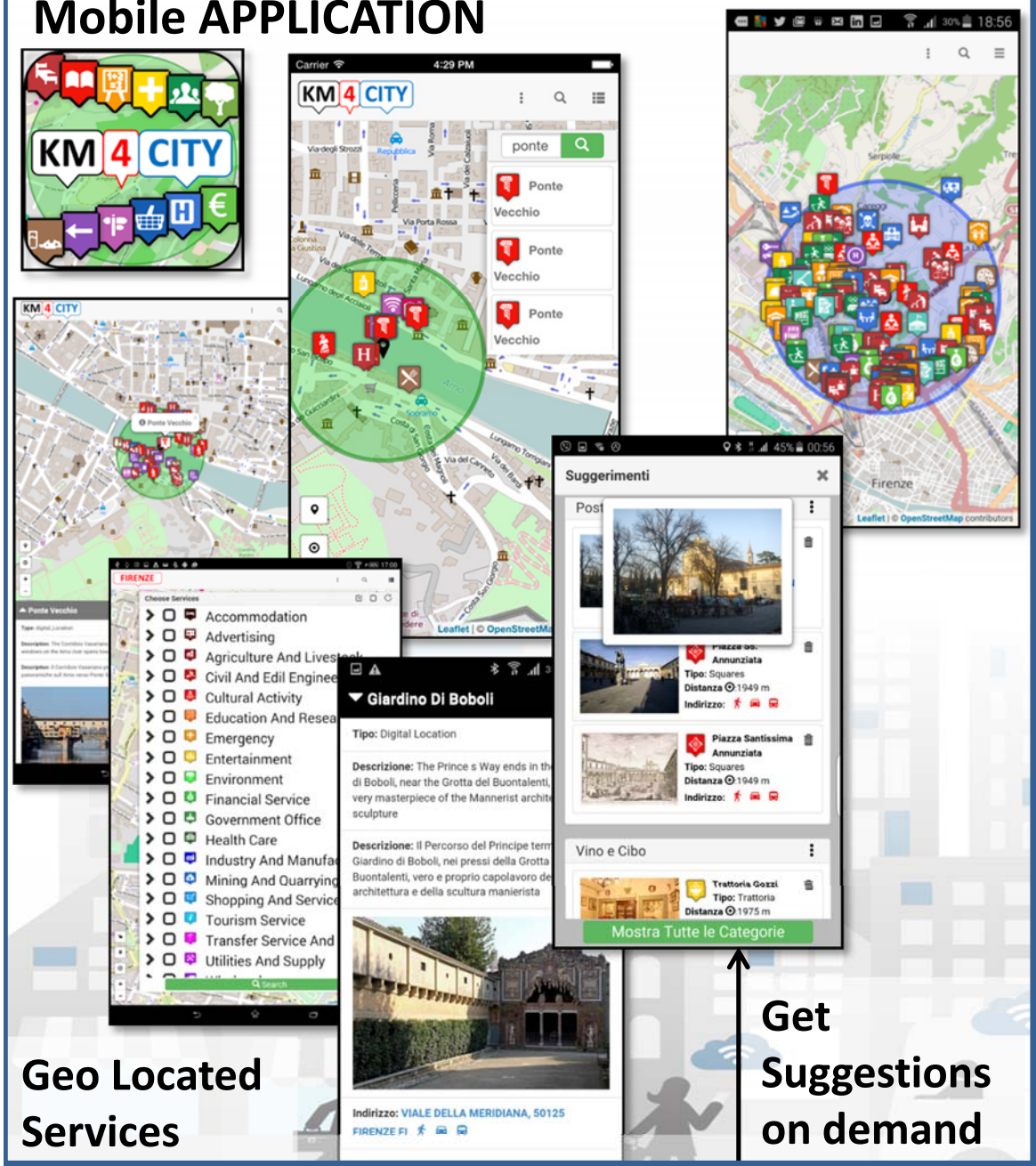
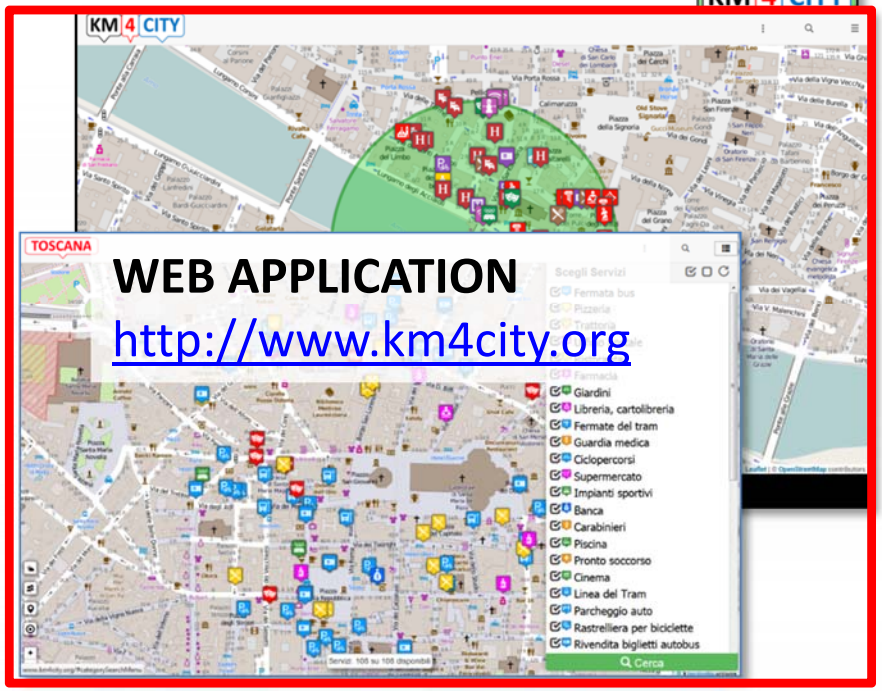
Mobile APPLICATION



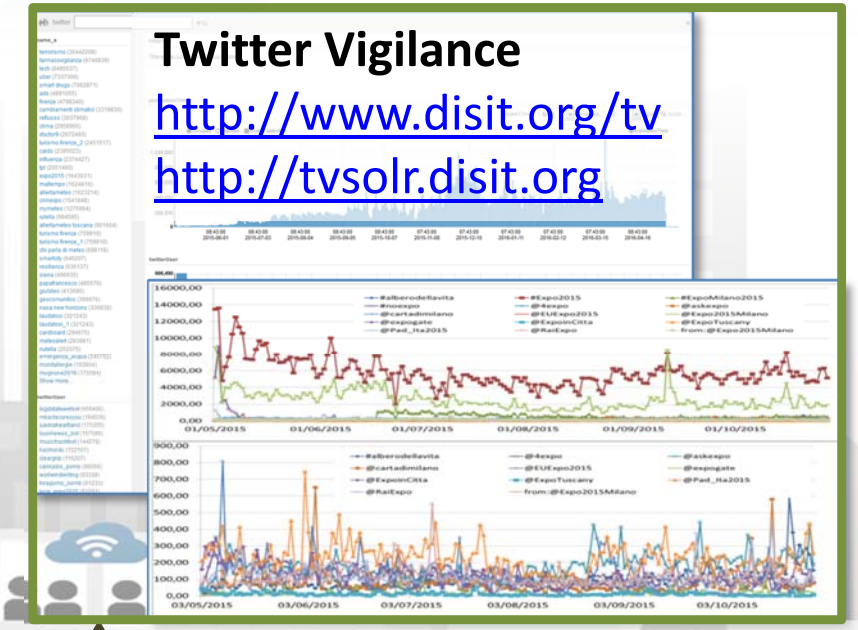
Geo Located Services

Get Suggestions on demand



WEB APPLICATION

http://www.km4city.org



Twitter Vigilance

http://www.disit.org/tv

http://tvsolr.disit.org

Get Social Media Monitoring Info

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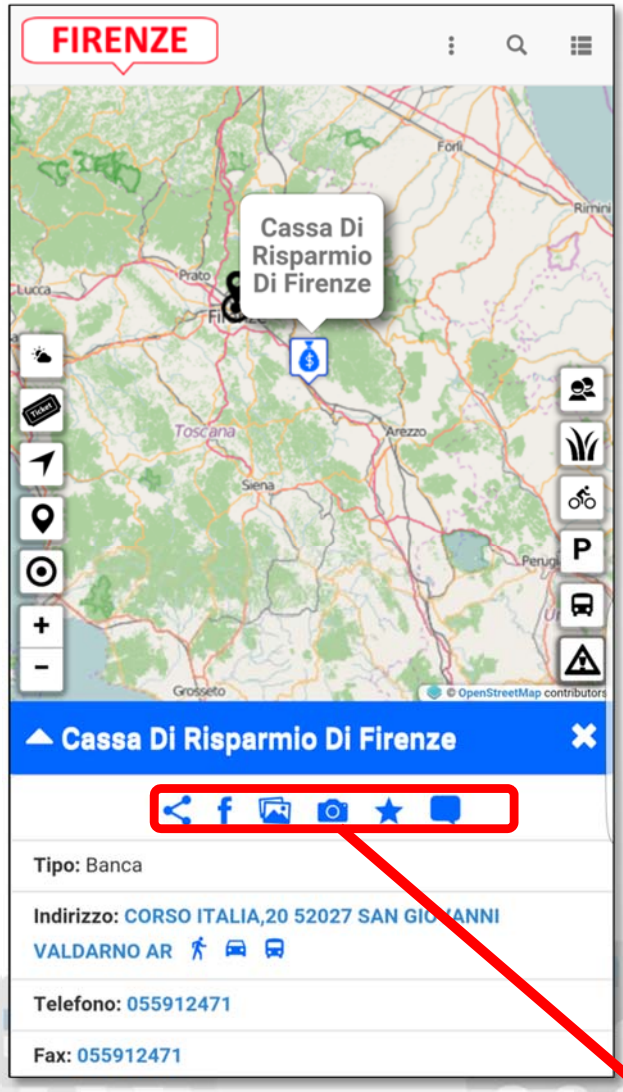
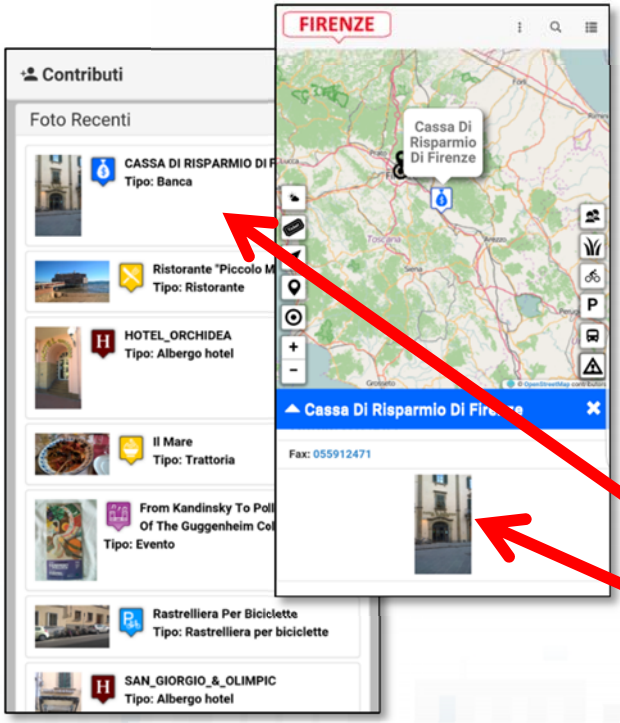
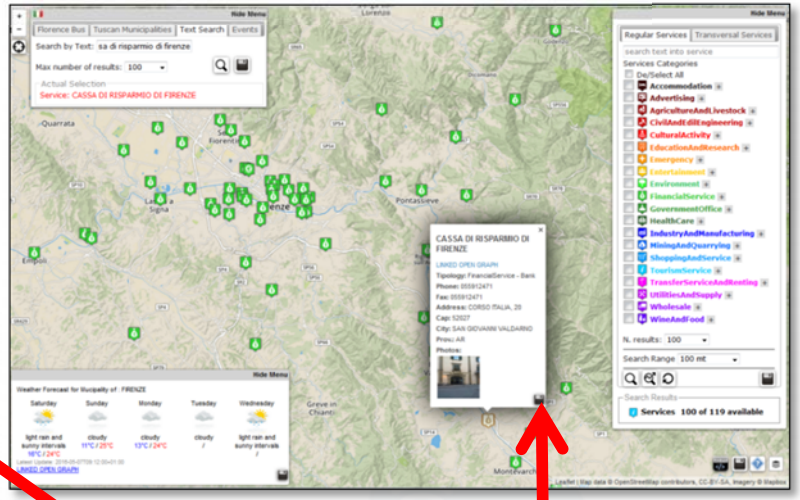
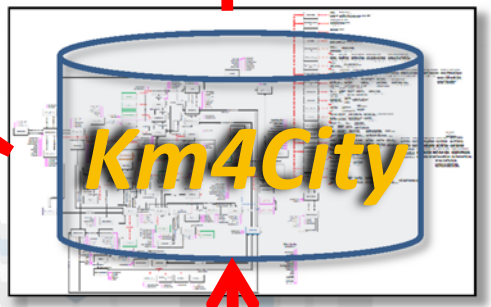
Collecting contributions from city users









Save Crowd Sourcing Media, votes, comments, status, …

Save User Profiles

Photos uploaded from users

date submitted	service	photo	status
2016-04-26 18:55:08.0	CASSA DI RISPARMIO DI FIRENZE		validated
2016-04-25 18:21:06.0	Ristorante "Piccolo Mondo"		validated

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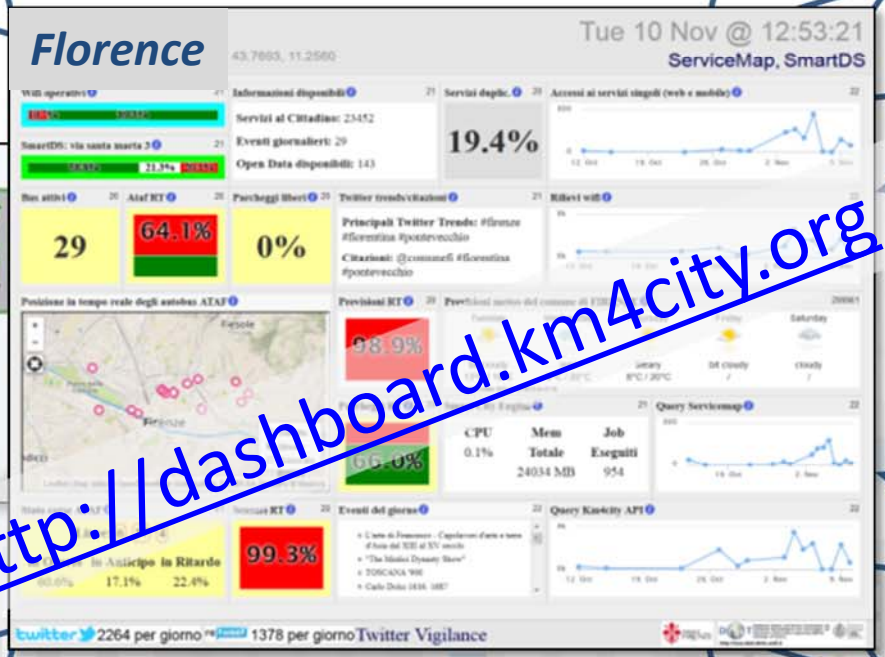
APIs: Smart City Interoperability & Dashboard

Front end Smart City API domains to provide services to management smart city applications, and to web and mobile applications.	CitySDK	ECIM	Transport.API	Navitia.io	Km4City
API: Smart City Interoperability and Dash Board					
Save Indicator Values (GPS, CompanyID)					X
Get Indicator Values (Company, ID)					X

Shops, services, operators

Transport systems, Mobility, Parking



http://dashboard.km4city.org

Sensors, IOT Cameras, ..

Public services, Govern, Events

Environment, Water, energy

Social Media, WiFi, Network

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APIs: Kind of Call, Non functional

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

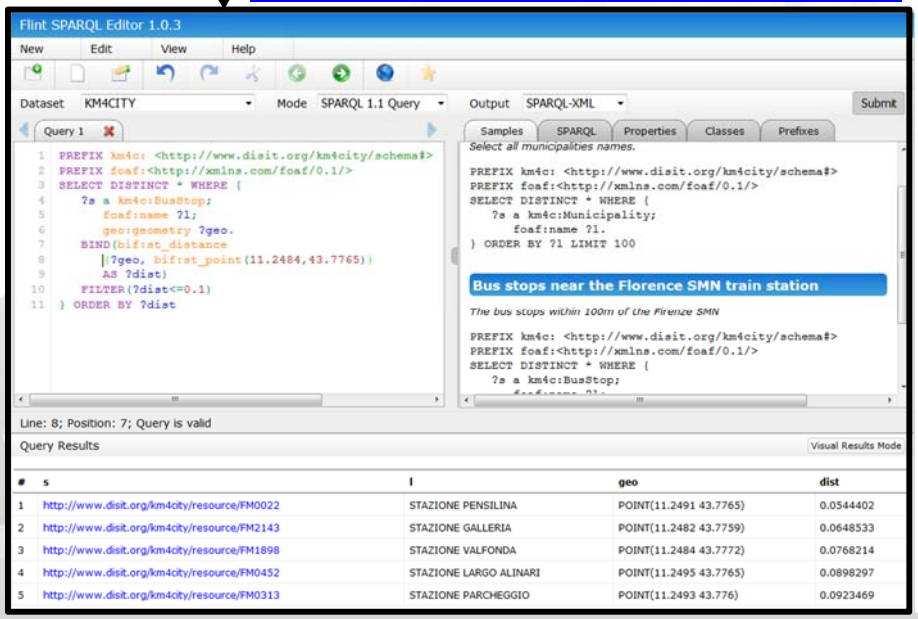
http://servicemap.disit.org/WebAppGrafo/api/v1/?**queryId**=9e5662a352d90ad4bc77690277a371ab&format=html

Query ID

SPARQL on Virtuoso

SPARQL

http://log.disit.org/spqlquery



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

s	l	geo	dist
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http://www.disit.org/km4city/resource/FM2143	"STAZIONE GALLERIA"	"POINT(11.248156 43.775944)"^^<http://www.openlinksw.com/schemas/virtrdf#Geometry>	0.0648533
http://www.disit.org/km4city/resource/FM1898	"STAZIONE VALFONDA"	"POINT(11.248416 43.777191)"^^<http://www.openlinksw.com/schemas/virtrdf#Geometry>	0.0768214
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http://servicemap.disit.org/WebAppGrafo/sparql?query=…&format=JSON

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Km4City Engine

Transport systems
Mobility, parking

Public Services
Govern, events,

Sensors, IOT
Cameras, ..

Environment,
Water, energy

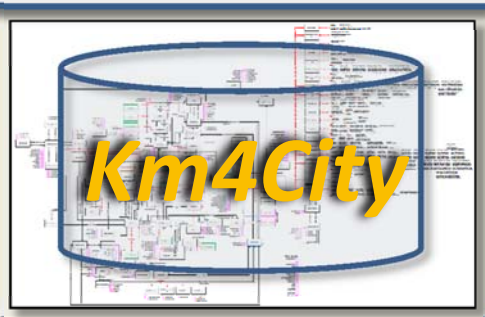
Shops, services,
operators

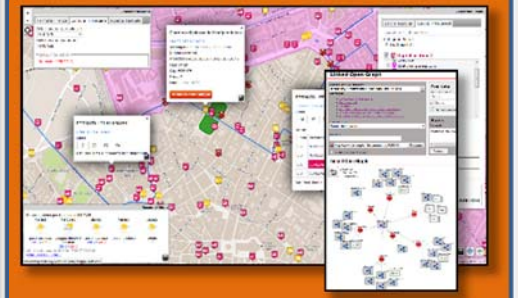
Social Media
WiFi, network

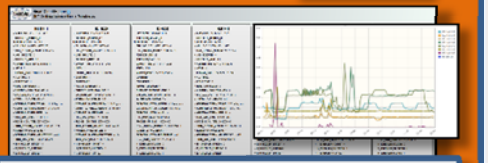
Static, Slow and Real Time data flows

DISCES -- Distributed and parallel architecture on Cloud

Km4City Smart City Engine

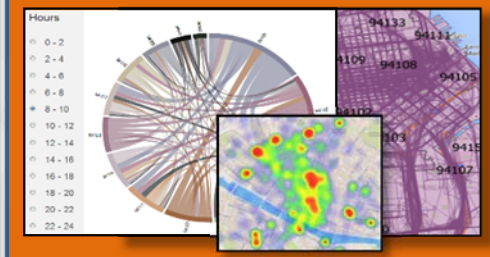






User Profiling and Suggestions on Demand

Flow and Origin Destination Matrix
Http://www.disit.org/odsf

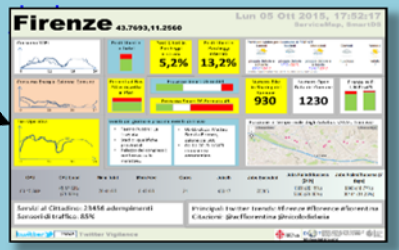


Km4City Tools for Developers

Km4City Smart City API

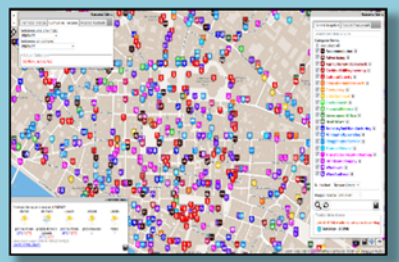
Tools for City Operators and Decision Makers

Smart City Dashboard
Http://dashboard.km4city.org/



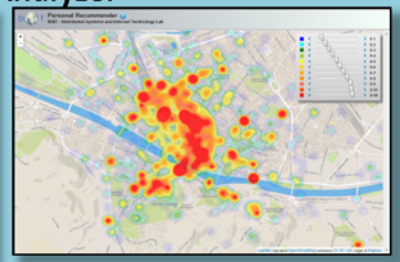
Smart Decision Support
Http://Smartds.km4city.org

Service map browser
Http://servicemap.km4city.org



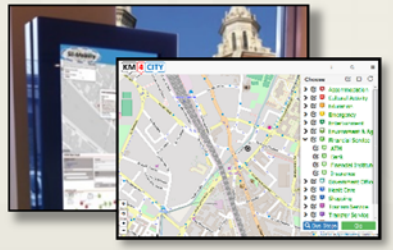
Twitter Vigilance
Http://www.disit.org/

Collective User behavior Analyzer



Tools for Final Users

Mobile e Web Apps
Http://www.km4city.org



Http://www.km4city.org/app

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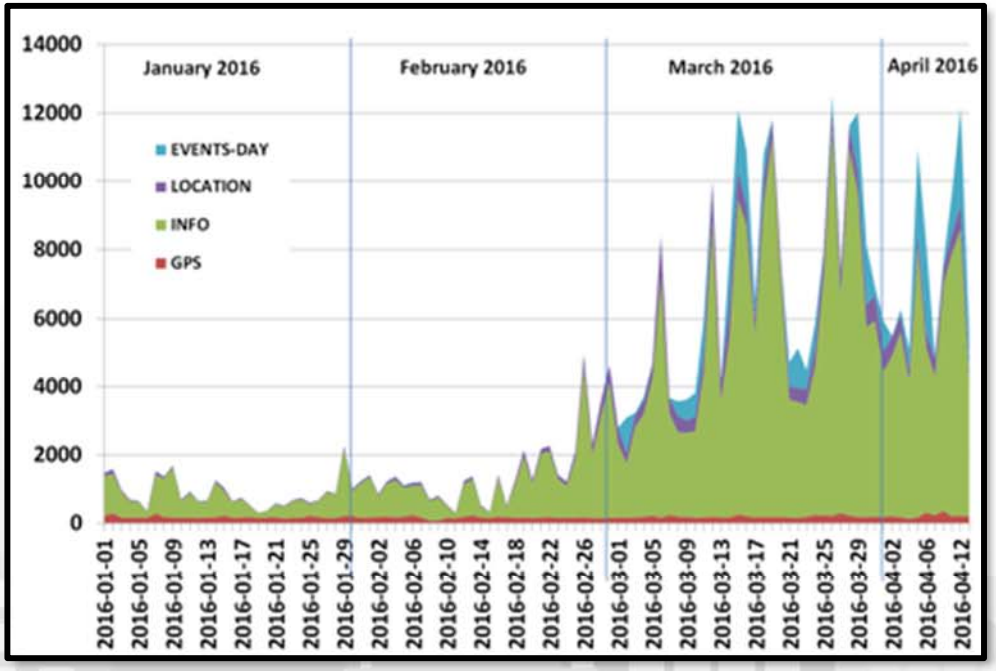
Data Results about KM4City

Received calls from applications to KM4City APIs

API mode	Jan.	Feb.	Mar.
api-service-info	21.118	36.826	173.303
api-services-by-gps	5.573	4.789	5.997
api-location	1.418	3.738	18.444
api-events-day	263	267	17,678
api-text-search	533	440	729
api-services	157	131	401
api-events-week	21	26	36
api-events-month	20	25	25
api-services-by-queryid	13	20	15
api-service-photo	10	5	11
api-services-by-municipality	2	13	3
api-service-stars	1	-	5
api-service-comment	1	-	4
total	**29.130**	**46.280**	**216.651**
format	**Jan.**	**Feb.**	**Mar.**
HTML (calls on servicesmap interface for developers)	179	157	444
JSON	28.939	46.118	216.187
total	**29.118**	**46.275**	**216.651**



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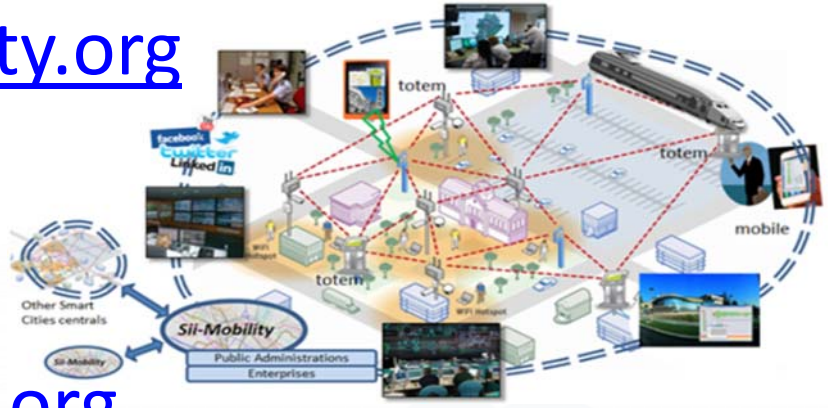
Projects based on KM4City

- Sii-Mobility, http://www.sii-mobility.org



- Resolute, http://www.resolute-eu.org

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- Replicate, http://www.disit.org/6778

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KM 4 CITY

Km4City Smart City API: an integrated support for mobility services

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