# 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**

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*"Smart Living through Computing"*

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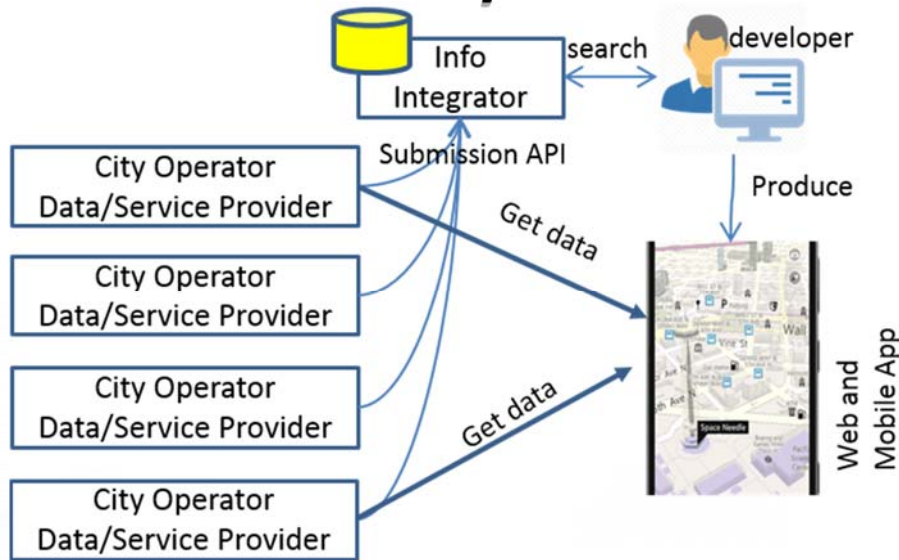http://www.disit.org

# 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**

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# 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**
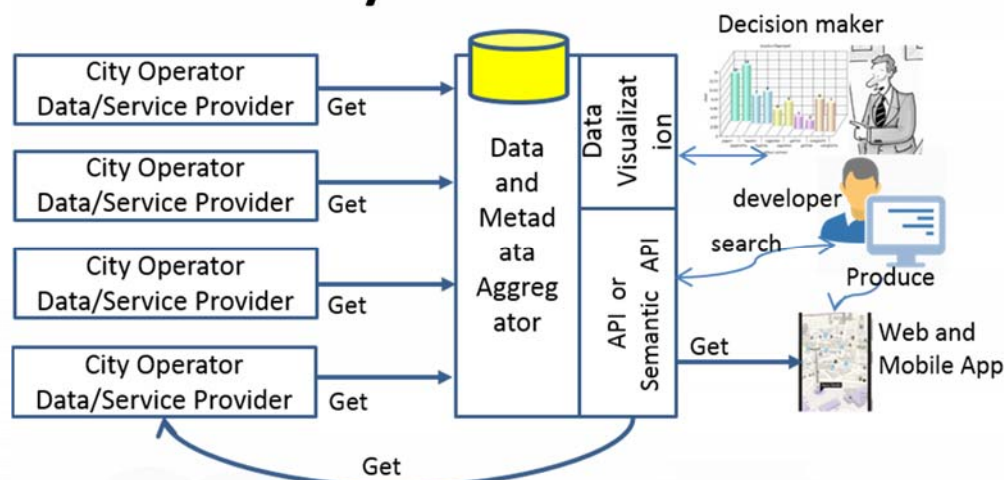


- Collects data and metadata information to index & aggregate them in a **common model**

- 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.

# 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
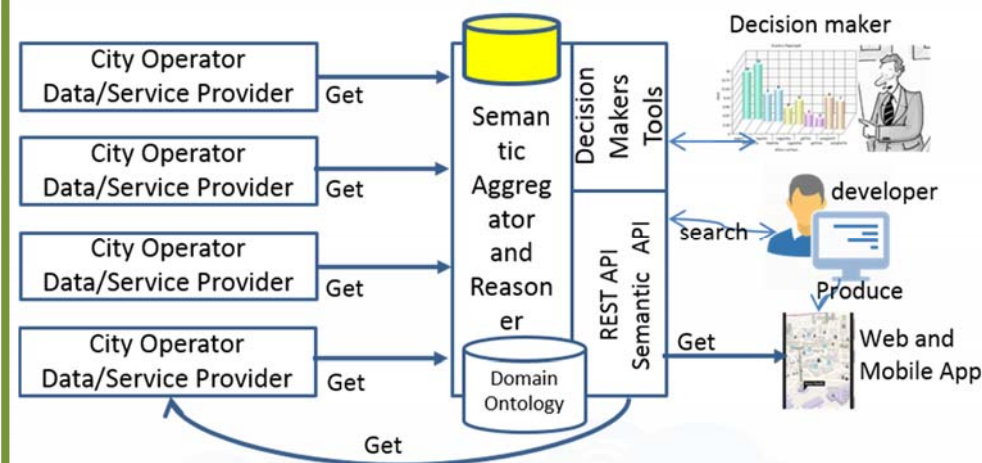


Examples: CitySDK (with some limitations), KM4City (covering all features)

# 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

# Km4City Ontology

>84 Classes

>100 ObjectProperties

>100 DataProperties
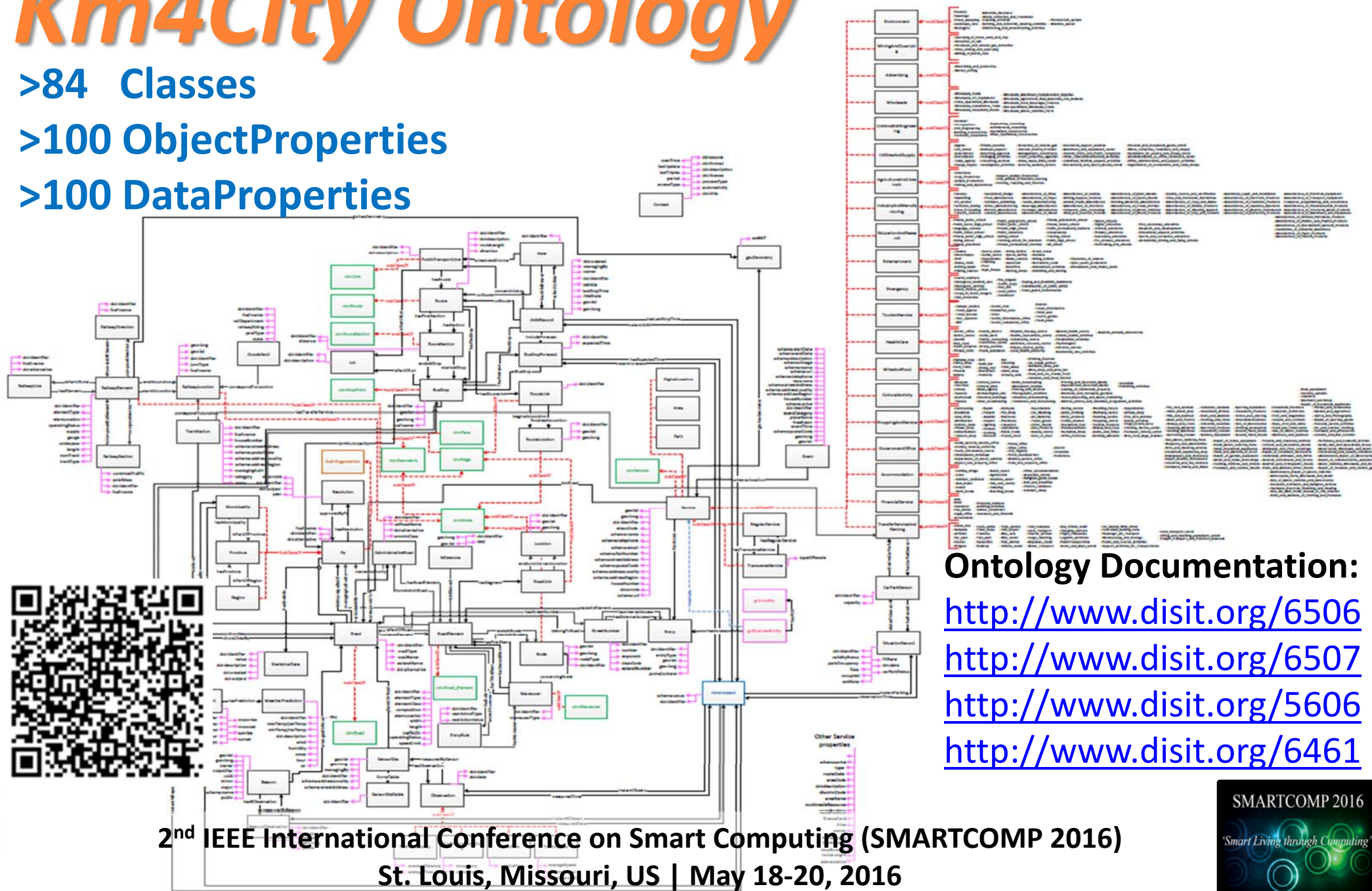


**Ontology Documentation:**
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

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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

# 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 | Transport API | 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 | 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
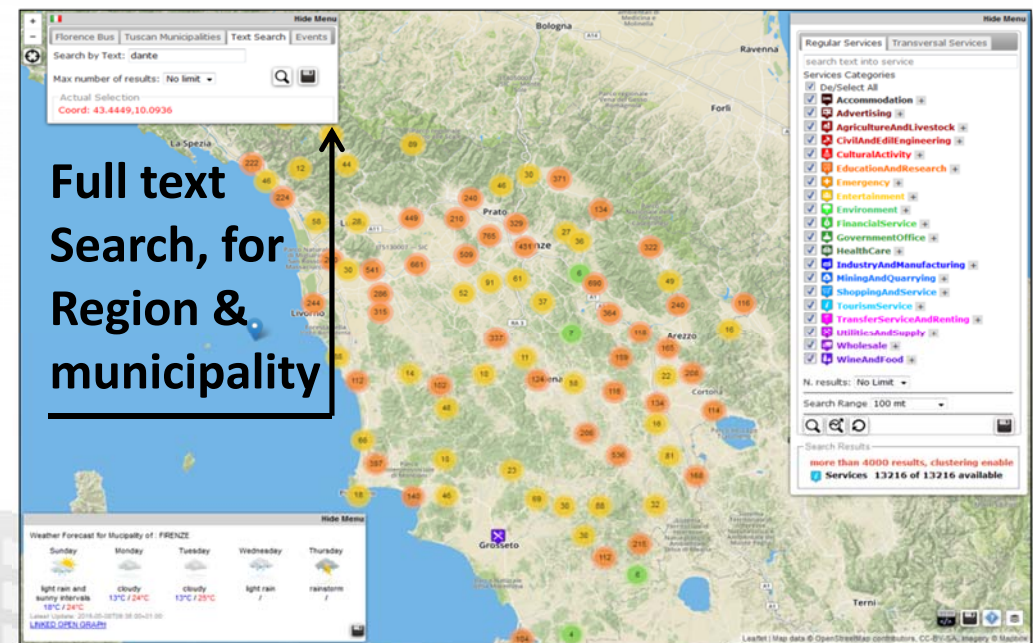
**Full text Search, for Region & municipality**

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# ServiceMap



Search around a GPS point

Search along a line

Search for Geo Located Services

Get Events in the city

Search in an area

Get weather forecast

Get Real Time data (public busses, car parks, sensors, traffic flows)
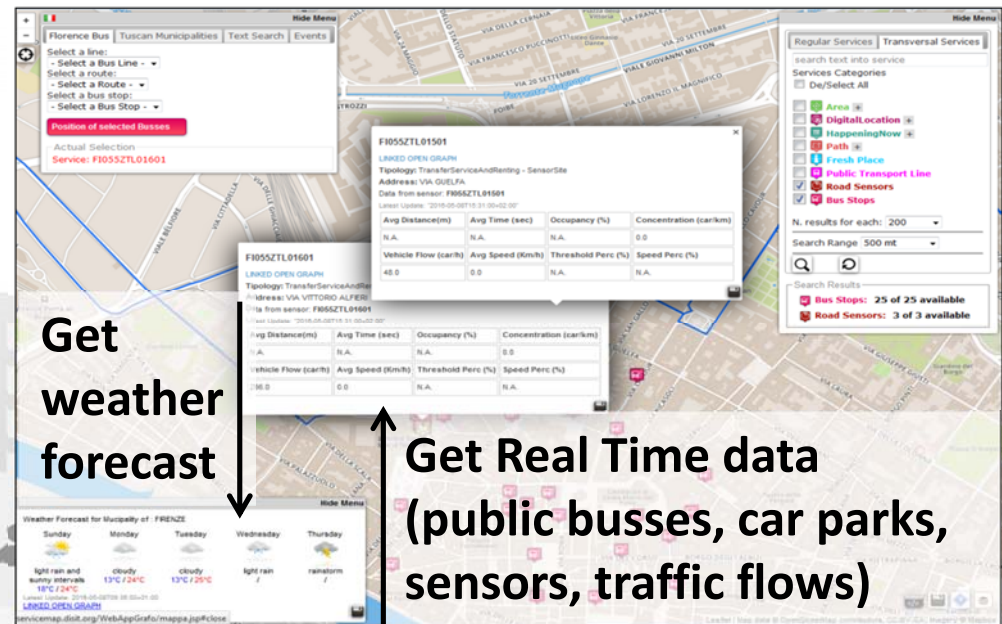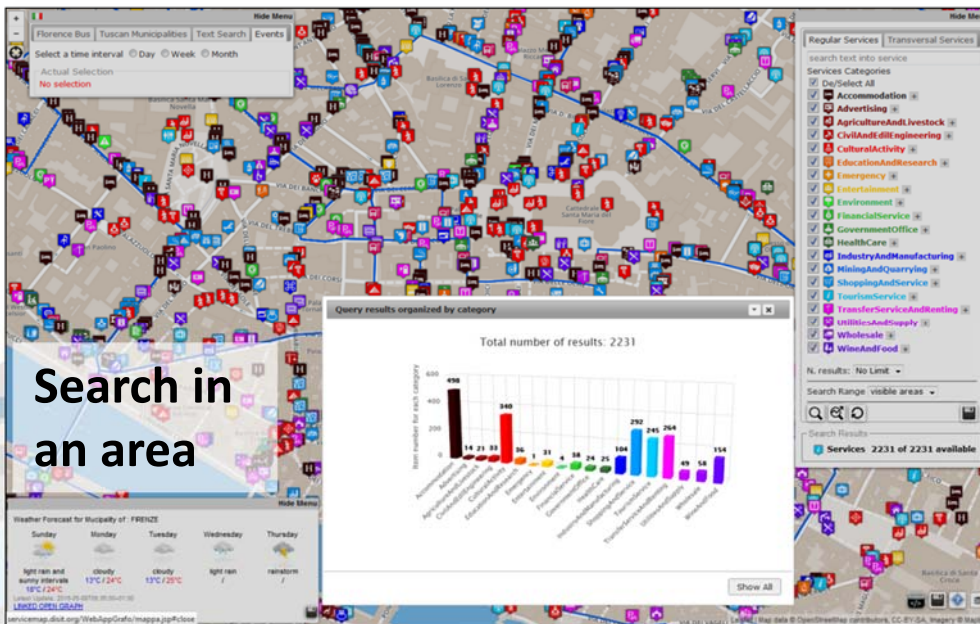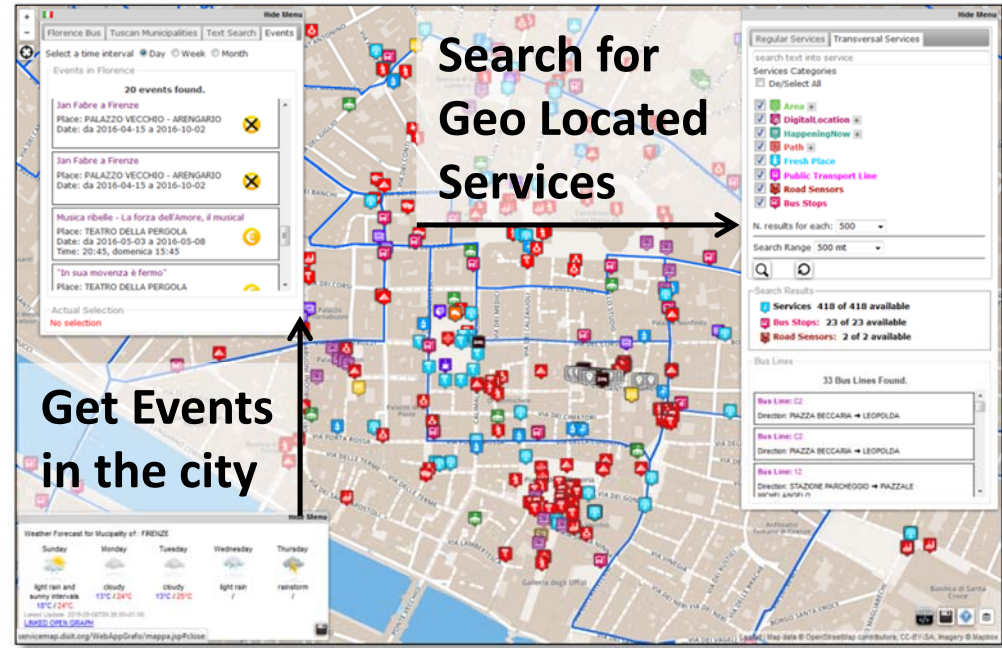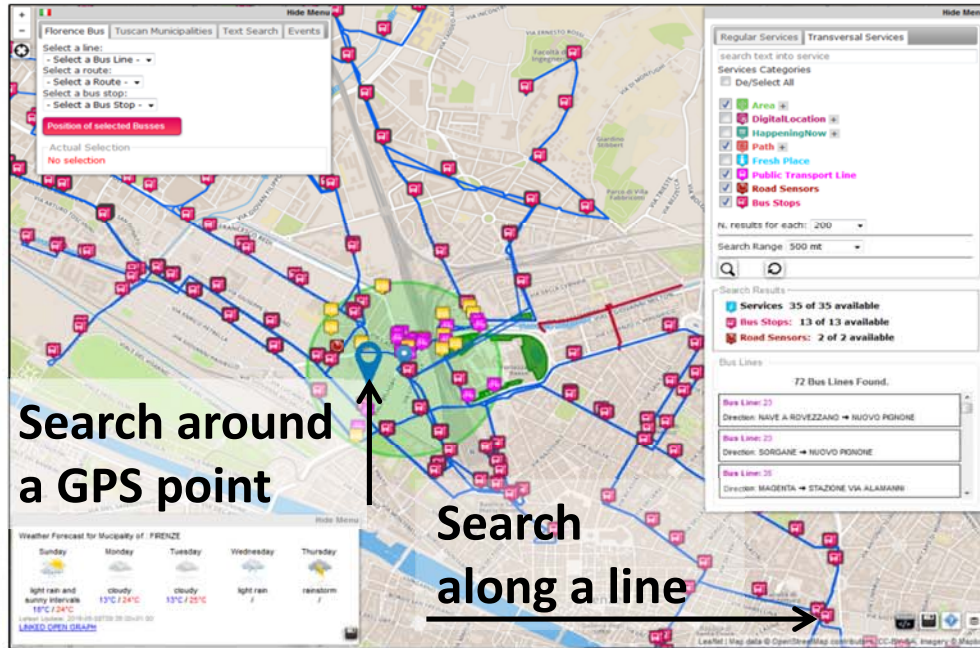
# Km4city ServiceMap Km4City API
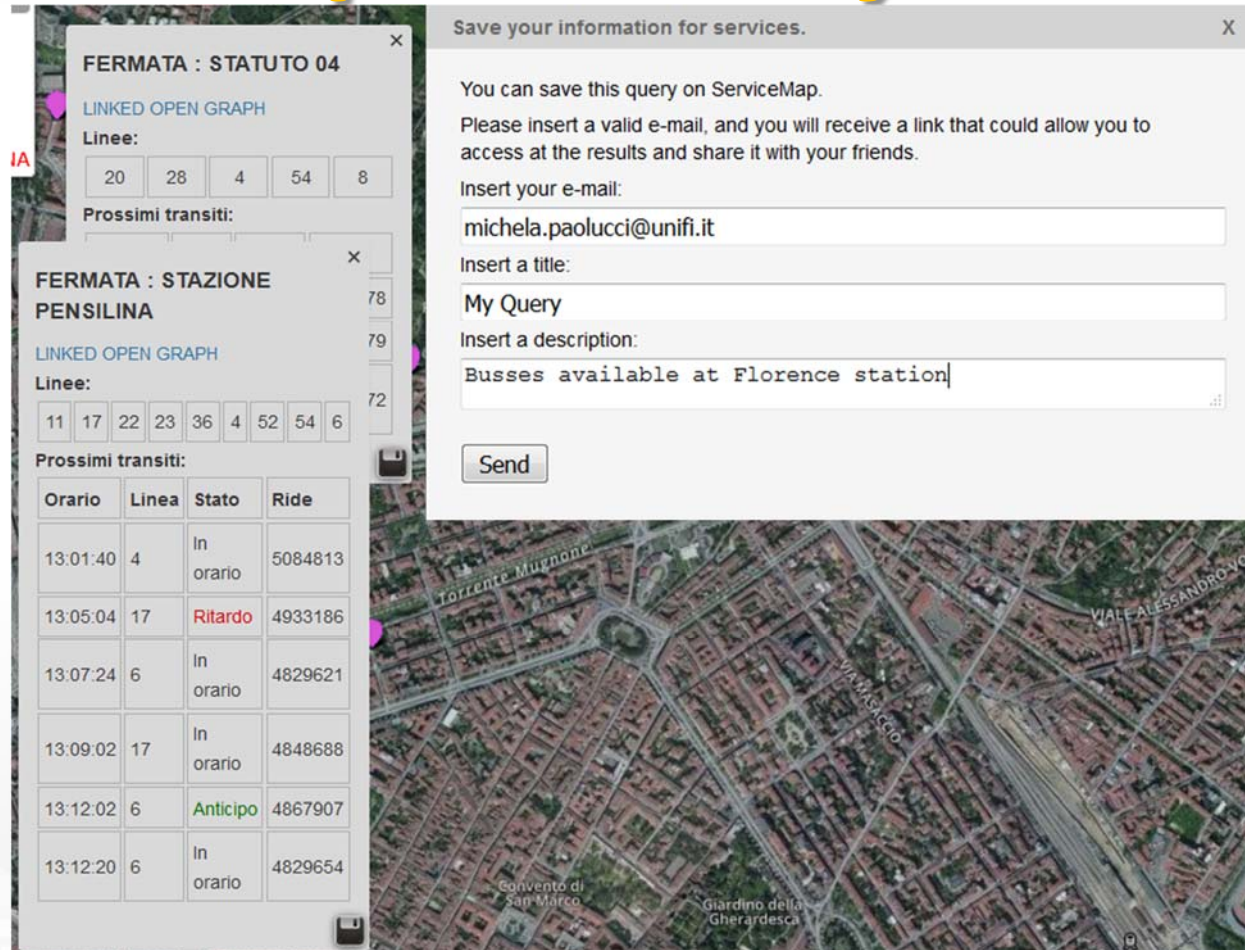
- http://www.disit.org/6597
  - REST API: serviceURI or Selection or GPS
  - REST API: Query ID
  - Receive an email
  - Get a JSON, HTML, …
- EMBED facility in third party web pages
- Developers may use the ServiceMap tool to:
  - compose geographical and textual queries
  - THEN request an e-mail containing the calls (same results in JSON and/or in HTML)

# 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**

Florence where, what. Km4City

DISPONIBILE SU Google play

Scarica da App Store

Scarica da Windows Store

**Mobile APPLICATION**

**WEB APPLICATION**
http://www.km4city.org

**Twitter Vigilance**
http://www.disit.org/tv
http://tvsolr.disit.org

**Geo Located Services**

**Get Suggestions on demand**
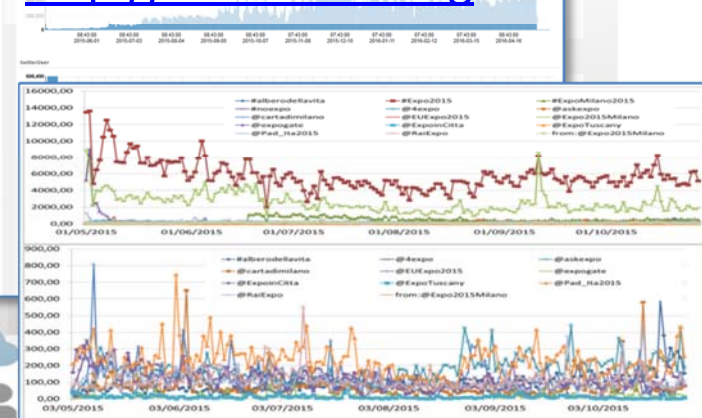
**Get Social Media Monitoring Info**

# Collecting contributions from city users

**Km4City**
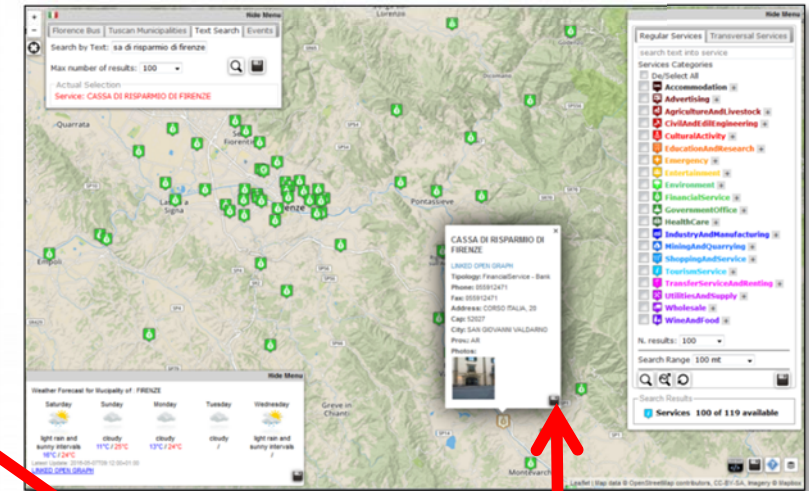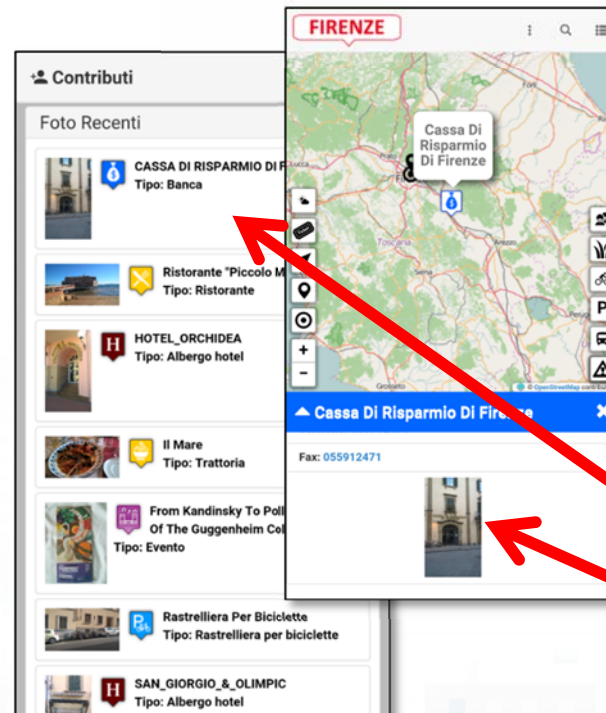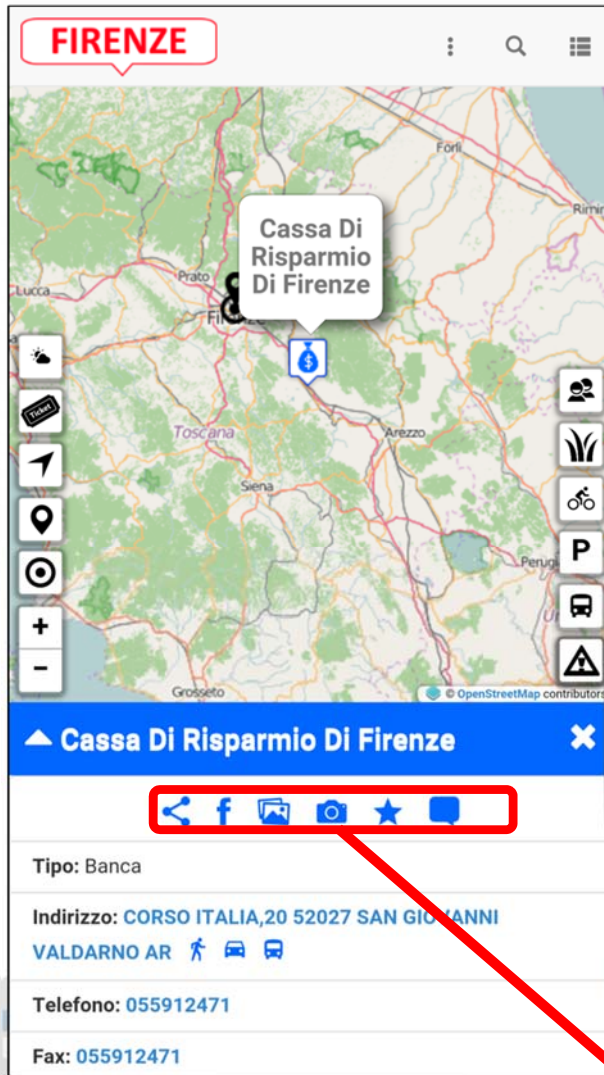
**Save Crowd Sourcing Media, votes, comments, status, …**
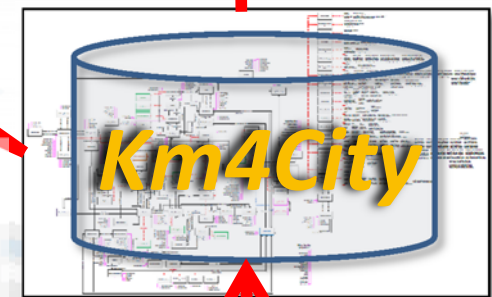
**Save User Profiles**

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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

SMARTCITY CONTROL ROOM

**Florence**  43.7663, 11.2560  Tue 10 Nov @ 12:53:21  ServiceMap, SmartDS

Servizi al Cittadino: 23452
Eventi giornalieri: 29
Open Data disponibili: 143

19.4%

29   64.1%   0%

Principali Twitter Trends: #firenze #fiorentina #pontevecchio
Citazioni: @comunefi #fiorentina #pontevecchio

98.9%

CPU 0.1%   Mem Totale 24034 MB   Job Eseguiti 954

66.0%

99.3%

in Anticipo 17.1%   in Ritardo 22.4%

twitter 2264 per giorno  1378 per giorno Twitter Vigilance

http://dashboard.km4city.org

Sensors, IOT Cameras, ..

Public services, Govern, Events
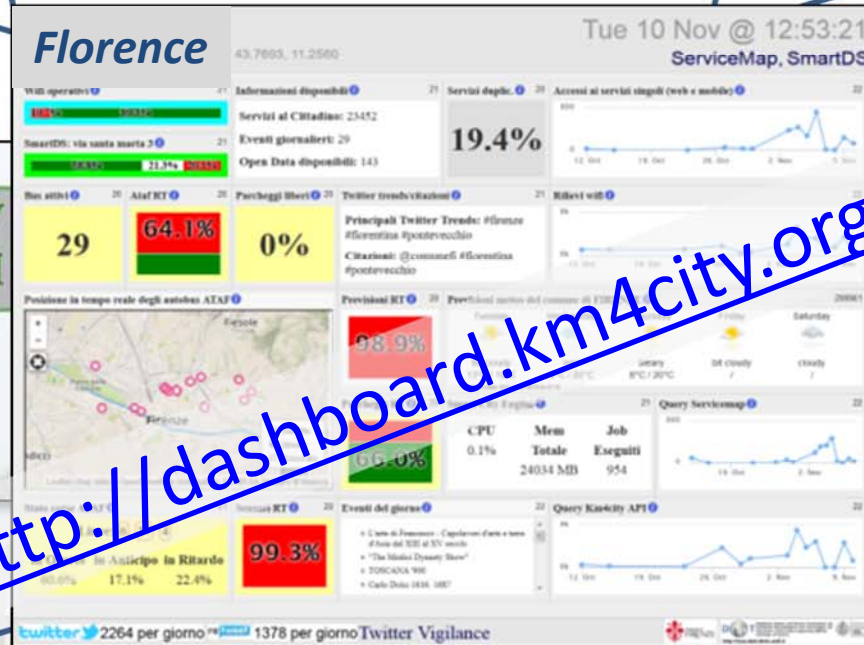
Social Media, WiFi, Network

Environment, Water, energy

# APIs: Kind of Call, Non functional

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

| 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 |

**Query ID**

**SPARQL on Virtuoso**

**SPARQL**

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

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

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

# Km4City Engine

**Km4City Smart City Engine**

*Km4City*

**User Profiling and Suggestions on Demand**

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

**Km4City Tools for Developers**

Transport systems Mobility, parking

Public Services Govern, events,

Sensors, IOT Cameras, ..

Environment, Water, energy

Shops, services, operators
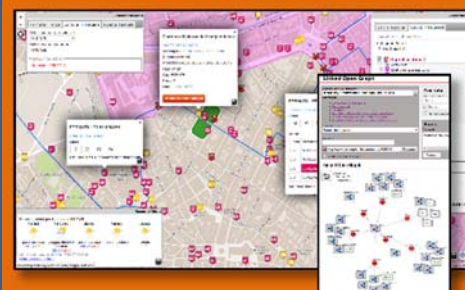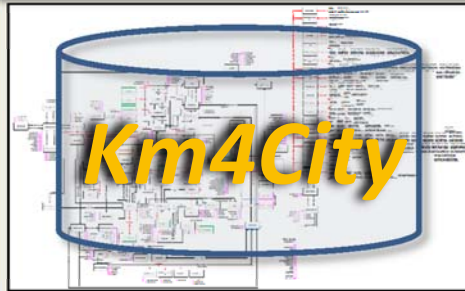
Social Media WiFi, network
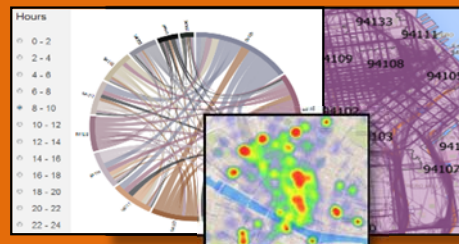
**Static, Slow and Real Time data flows**

**DISCES -- Distributed and parallel architecture on Cloud**

**Km4City Smart City 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/
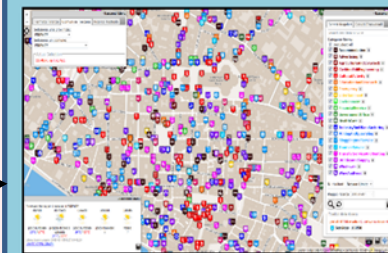
**Collective User behavior Analyzer**
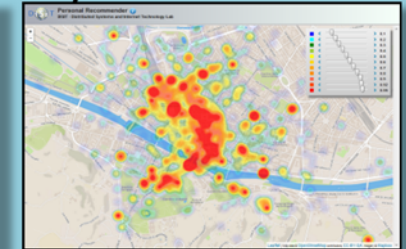
**Tools for Final Users**
**Mobile e Web Apps**

Http://www.km4city.org

Http://www.km4city.org/app
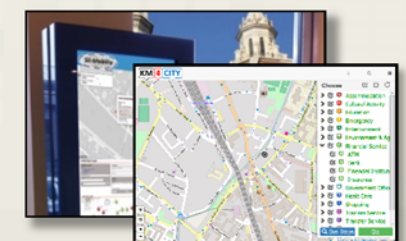
# Data Results about KM4City

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 |
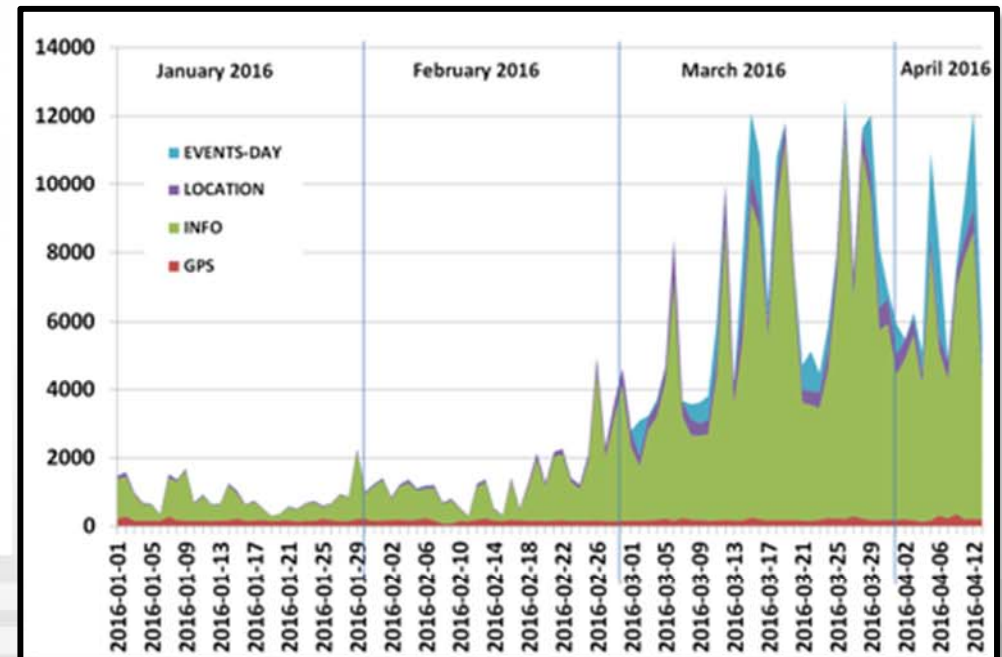
# Projects based on KM4City

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

- Resolute, http://www.resolute-eu.org
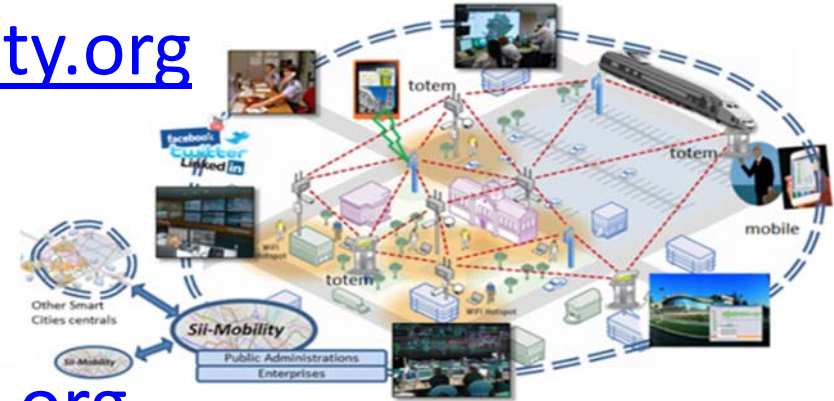
**RES**ilience management guidelines and **O**perationalization app**L**ied to **U**rban **T**ransport **E**nvironment

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

**REPLICATE**

**RE**naissance of **PL**aces with **I**nnovative **C**itizenship **A**nd **TE**chnology

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KM 4 CITY

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