



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

<https://www.disit.org/>

Paolo Nesi, paolo.nesi@unifi.it

Big Data Architectures

<https://www.snap4City.org>

<https://www.Km4City.org>

Parte: 0
(2020)





Agenda

- Laboratorio DISIT
- Tematiche del corso
- Struttura del corso
- Infrastruttura del DISIT Lab
- Modalità dell'esame





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DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

Distributed Data Intelligence and Technologies Lab Distributed Systems and Internet Technologies Lab

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

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



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DISIT
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AND INTERNET
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DISIT Lab

- Researchers: 18
- Current Active Projects: 20
- Project in the last 4 years: 45
- Research Budget (last 2 years): 1.5M€
- Foreseen Research Budget (next 2 years): 2.2M€
- SpinOff: 2





*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

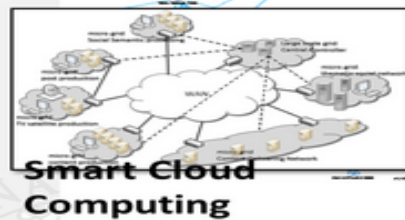
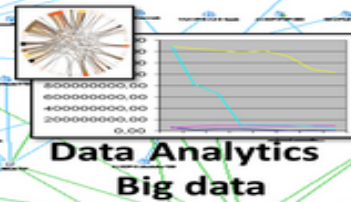
root Uscire

Mostra Modifica Log Translate Devel

DISIT LAB OVERVIEW

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

Text and Web Mining



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*

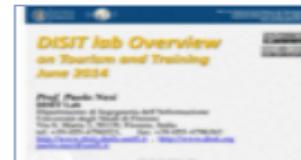
ROOT

- ▶ Gruppi
- Cerca Utenti
- Contenuti ed attività non lette relative ai tuoi gruppi
- Crea la matrice di tassonomia
- Forum
- Invite a colleague
- Issues
- Keyword cloud
- Messaggi e Sottoscrizioni
- Mio MatchMaking
- My issues
- ▶ News Blog
- Salva informazioni del cluster
- Workflow summary

<http://www.disit.org>

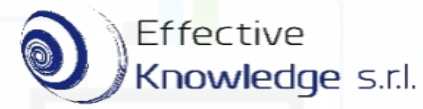
DISIT lab and research group is active since 1994. It is one of the most active ICT labs of the University of Florence, metropolitan Tuscany area. DISIT successfully developed a relevant number of International and National research, development and innovation projects. DISIT provides an infrastructure oriented and distributed environment. It has covered the role of partner, and also coordinating scientific and technical WP and performing activities of dissemination and assessment. DISIT has received a relevant number of awards and is directly involved into top level international conferences, advisory boards, and committees.

DISIT research areas: big data, artificial intelligence, natural language





Con chi lavoriamo



Some DISIT Projects

Herit Data: Tourism and Mng. <https://herit-data.interreg-med.eu/>

Snap4City: IOT/IOE smart city www.snap4city.org

Trafair: CEF project with several Cities <http://trafair.eu/>

Mosaic: Mobility and transport model

Km4City: <http://www.km4city.org>

REPLICATE H2020, SCC1, EC flagship

<http://replicate-project.eu/>

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

Feedback: retail and GDO Big Data analytics

5G with 3G-Wind, Open Fiber, Estra

Coll@bora Social Innovation, MIUR:

<http://www.disit.org/5479>

RESOLUTE H2020, EC:

<http://www.resolute-eu.org>

TRACE-IT, RAISSS, TESYSRAIL, ...

Mobile Emergency:

<http://www.disit.org/5404>



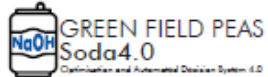
TESYS RAIL



RAISSS



Main running projects



- Sii-Mobility → mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFair → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart Garda Lake → Castelnuovo del Garda
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant
- SmartBed (laid) → smart health
- Green Field Peas (soda) → Industry 4.0, Chemical plant
- PISA MobiMart and Agreement → data aggregation, Living Lab
- Lonato del Garda → smart parking, environment
- Herit Data → tourism, culture and management
- MobiMart → mobility and transport
- ISPRA JRC → site management and services



Sii-Mobility

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

- Experimentations and validation in Tuscany
- Integration with present central station and subsystems
- DISIT lab, Università di Firenze, is the tech-scientific coordinator



- Autostrade
- SS Fi-Pi-Li
- SS Fi-Si
- Ferrovie (primarie)
- - - Area

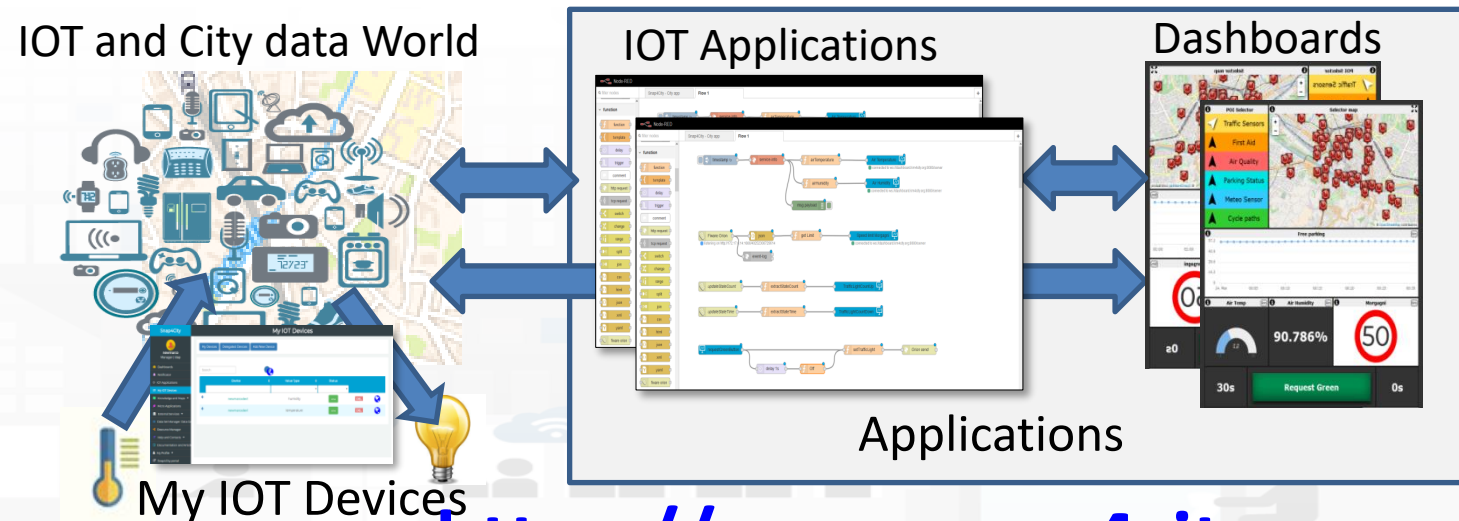
ECM; Swarco Mizar;
 Inveni In20; Geoin;
 QuestIT; Softec; T.I.M.E.;
 LiberoLogico; MIDRA
 (autostrade, motorola);
 ATAF; Tiemme; CTT
 Nord; BUSITALIA;
 A.T.A.M.; Effective
 Knowledge; eWings;
 Argos Engineering; Elfi;
 Calamai & Agresti;
 Project; Negentis



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

- 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

- enabling large-scale co-creation IOT/IOE applications for Helsinki, Antwerp:
 - Open source, standardized, data-driven, service-oriented, user-centric platform, robust, scalable, easy to use solution, co-creation of mixt data driven, stream and batch processing
- extending the powerful semantic reasoner of Km4City <https://www.km4city.org>, with IOT/IOE, GDPR, and city dashboards.
- validated in multiple devices (PC, Android, Raspberry, IOT Button,..), and domains: mobility and transport, tourism, health, welfare, social
- The innovation on semantic reasoning, IOT interoperability, microservices, automated dashboard production, .. thus





Horizon 2020
European Union Funding
for Research & Innovation

REnaissance of PLaces
with Innovative Citizenship
And TEchnology

<http://replicate-project.eu/>

- demonstrate Smart City technologies in energy, transport and ICT in districts in:
 - San Sebastian, Florence and Bristol,
 - 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
- 6 NILUFER BELEDIYESI NILUFER TURKEY
- 7 VILLE DE LAUSANNE LAUSANNE SWITZERLAND
- 8 IKUSI ANGEL IGLESIAS, S.A. IKUSI SPAIN
- 9 ENDESA ENERGÍA, S.A. ENDESA SPAIN
- 10 EUROHELP CONSULTING, S.L. EUROHELP SPAIN
- 11 ILUMINACION INTELIGENTE LUIX, S.L. LUIX SPAIN
- 12 FUNDACION TECNALIA RESEARCH & INNOVATION TECNALIA SPAIN
- 13 EUSKALTEL, S.A. EUSKALTEL 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
- 23 TECHNOMAR TECHNOMAR GERMANY
- 24 UNIVERSITY OF BRISTOL UOB UNITED KINGDOM
- 25 UNIVERSITY OF OXFORD UOXF UNITED KINGDOM
- 26 BRISTOL IS OPEN, LTD BIO UNITED KINGDOM
- 27 ZEETTA NETWORKS ZEETTA UNITED KINGDOM
- 28 KNOWLE WEST MEDIA CENTRE, LGB KWMC UNITED KINGDOM
- 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



<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

Understanding Traffic Flows to Improve Air quality

- **Objective:**

- to develop a service that **combines traffic data on air quality**, weather conditions, and traffic flows in order to allow citizens and municipalities to estimate the level of pollution resulting from varying traffic flow conditions.

- **Where:**

- **Zaragoza, Florence, Modena, Livorno, Santiago de Compostela, and Pisa**

- Università degli studi di Modena e Reggio Emilia (UNIMORE) -- Italy
- **Università degli Studi di Firenze – DISIT DINFO -- Italy**
- Universidade de Santiago de Compostela (USC) - Spain
- Comune di Modena (CMO) - Italy
- Regione Toscana (TR) - Italy
- Concello de Santiago de Compostela (CSC) - Spain
- Fundación Pública Gallega Centro Tecnológico de Supercomputación de Galicia (Fundacion CESGA) - Spain
- Universidad de Zaragoza (UNIZAR) - Spain
- Lepida S.p.A. (LP) - Italy

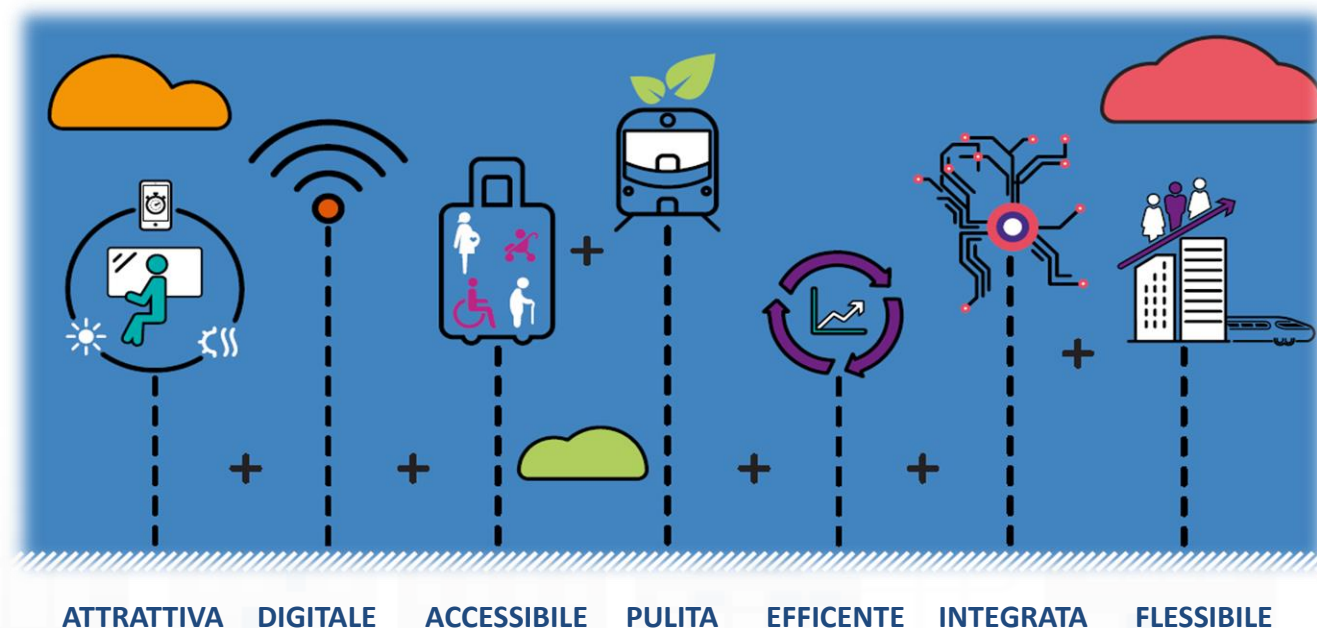




MObility 4.0 for SmArt (i) City

Tools for Mobility operators

- Demand Analysis
- Prediction on Parking
- Connected Drive
- Offer Analysis
- Simulation of Mobility
- Etc.



Where: in Tuscany



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WEEE: Waste from Electrical and Electronic Equipment

- **maximize the collection of WEEE** in Tuscany through a new governance model based on the involvement of SMEs and awareness raising activities towards citizens and its **replication in Andalucía**.
- **Actions:**
 - Improve the regional governance
 - Support municipalities in capacity building of public officials and improving services to citizens.
 - Develop a system of **services and incentives for SMEs**
 - Develop IT tools for companies and citizens: a **software and guidelines** for the simplification of administrative and bureaucratic activities and an **App** to easily locate collection sites.
 - Develop an awareness raising **information campaign** to increase public attention on the topic.
 - Test the **replicability and transferability** of project results through the implementation of actions in the Region of Andalucía.



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REGIONE
TOSCANA

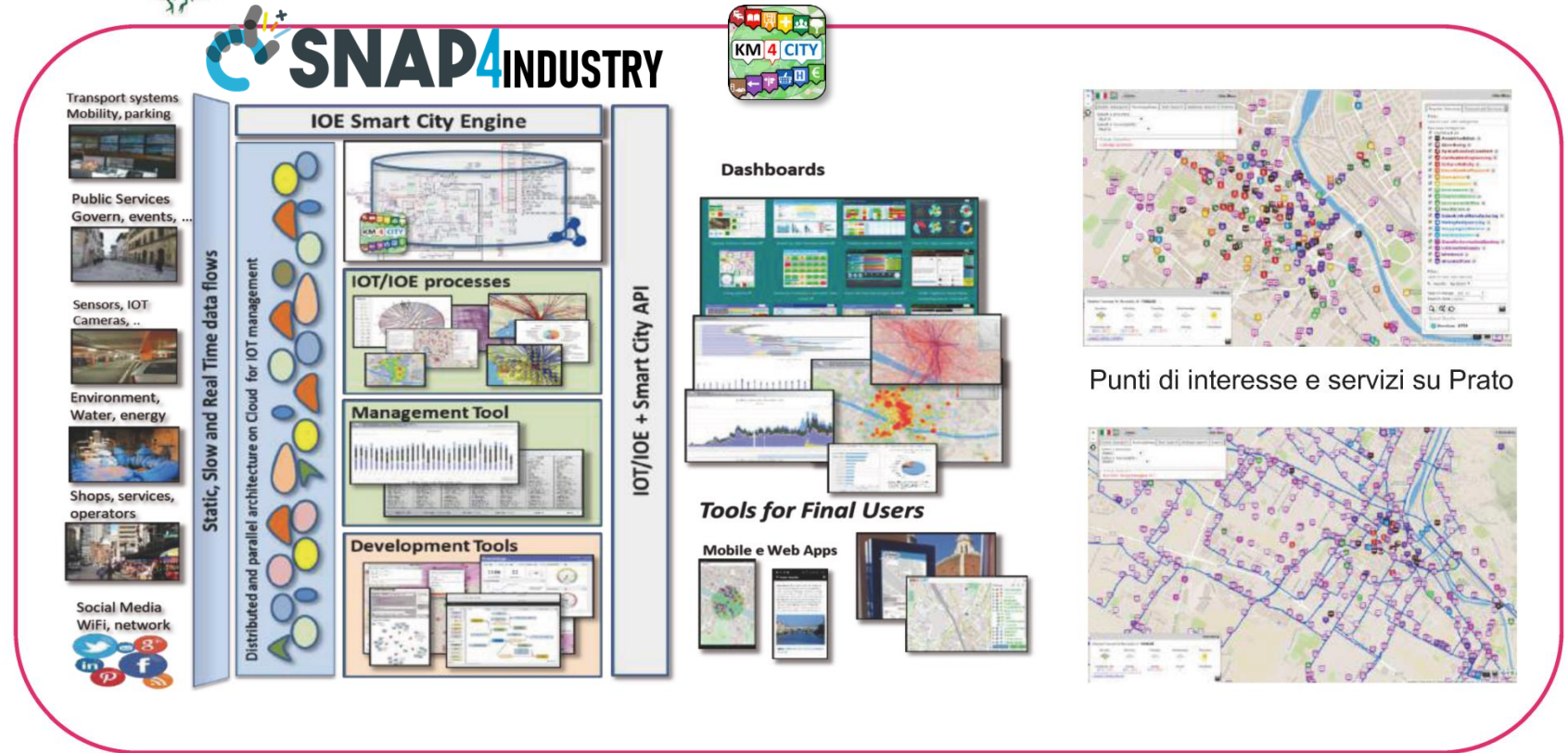


SENSORI E IOT - PRATO

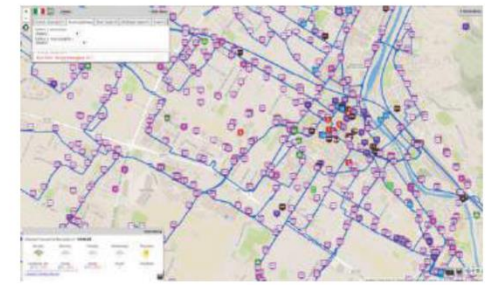


Piattaforma IoT/IoE abilitata dal 5G per applicazioni di:

- Smart City management (in ottica Smart City)
- monitoraggio utenze in modo smart
- industrial automation (in ottica Industria 4.0)



Punti di interesse e servizi su Prato



Use Case LEADER

Partner coinvolti

Aziende/Enti Coinvolti

Green Impact Capacity (GIC)

- Improve productivity of chemical plant
- Keep GREEN the environmental impact
- Exploiting innovative technologies
- Diversify the production
- Monitoring environmental conditions



Sigma ingegneria





HERIT-DATA

**Sustainable Heritage Management towards
Mass Tourism Impact thanks to a holistic use
of Big and Open Data**

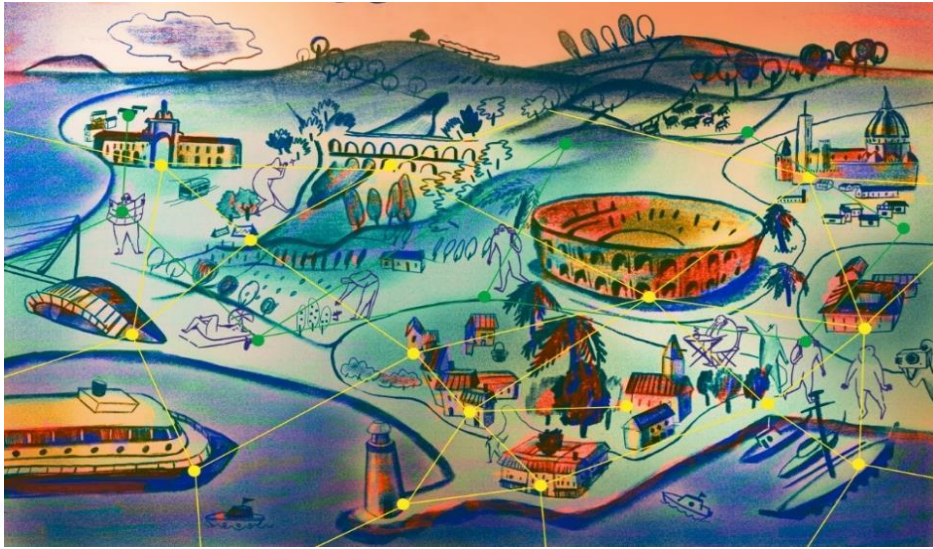
BUDGET: 4.195.515,20 €



Regione Toscana



Fondazione per la ricerca e l'innovazione



Sustainable and responsible Tourism Management

Key aspect: Carrying Capacity

consider European Tourism Indicators ETIS

Respectful of the ICZM recommendations

Cultural heritage

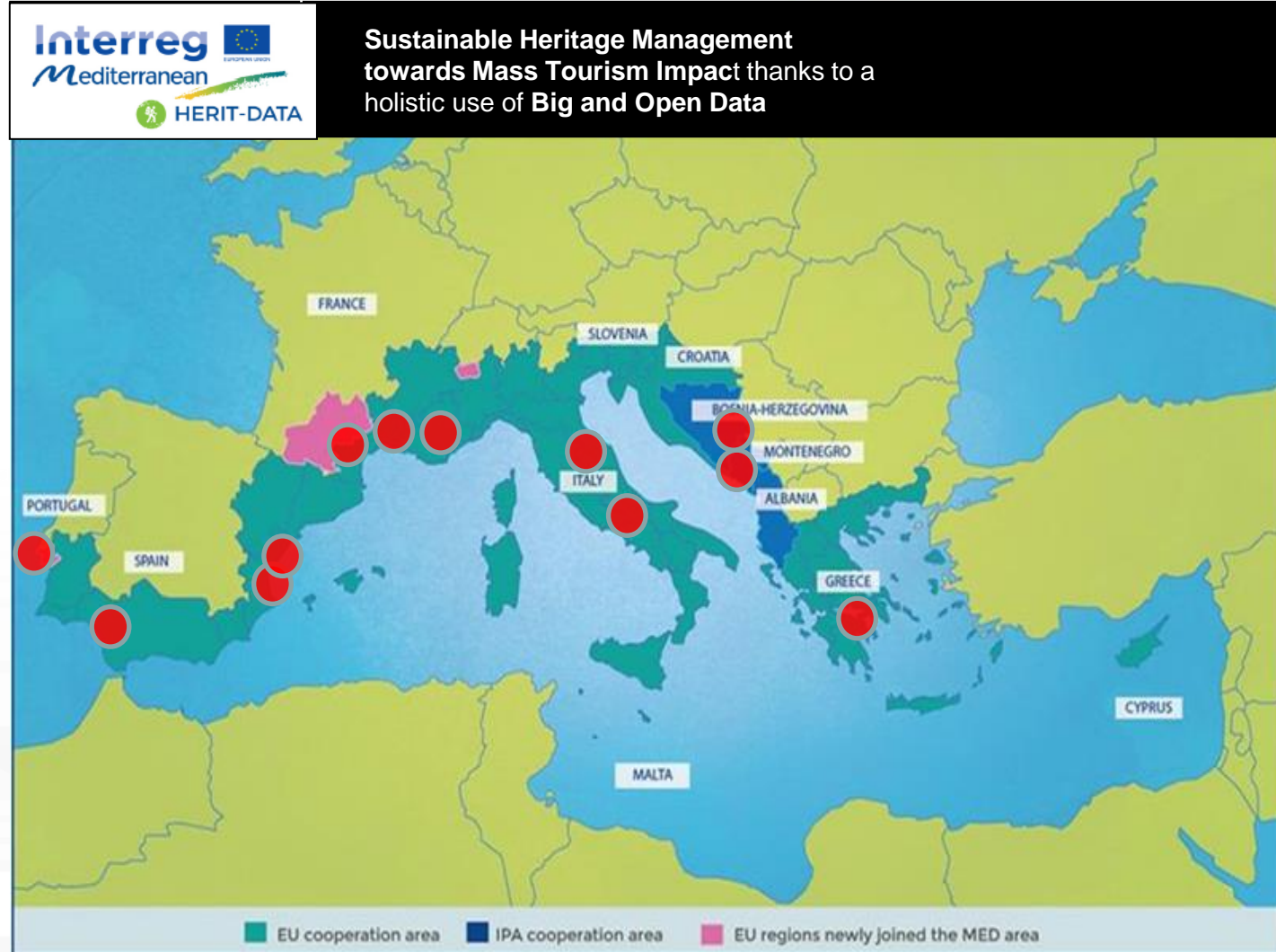
Special interest on UNESCO World Heritage Sites

Evaluation of impact

Big & Open data

At service of Planners, visitors, local stakeholders and dwellers

Sustainable Heritage Management towards Mass Tourism Impact thanks to a holistic use of Big and Open Data



2013 Km4City Ontology 1.1

- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph



(2016-21) H2020 REPLICATE

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

(2016-21) SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.6.4



- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

E015 digital ecosystem

Powered by EXPO MILANO 2015

(2016-19) GHOST SIR

- Sardinia Region Smart City Strategies and plan

2016 FIWARE

GREEN IMPACT CAPACITY

GREEN IMPACT POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

2017

H2020 (2015-18)

- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis

MOSAIC Mobility 4.0 for Smart (II) City

(2018-20)

2018



- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

IOT/IOE Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities

H2020 (2017-19)

- IOT/IOE, IOT App
- Living Lab
- Maker Support
- IOT Edge
- Smart City IOT
- GDPR, Privacy & Security

(2017-20) life weee

- Smart Waste

- Mobility Demand / Offer Analytics and Strategy

5G (2018-21)

5G tech Energy Industry 4.0 Synoptics



TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

LAID Smart Bed

Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0

- Industry 4.0

bee smart city

- Smart Lonato

Reverberi Enetec Gruppo MPES

SELECT 1' place award to SNAP4CITY

2020

Interreg Mediterranean HERIT-DATA

- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform

smartGARDAlake

Interreg MARITTIMO-IT FR-MARITIME MOBI MART

- Smart Mobility
- PISA, PUMS
- Living lab

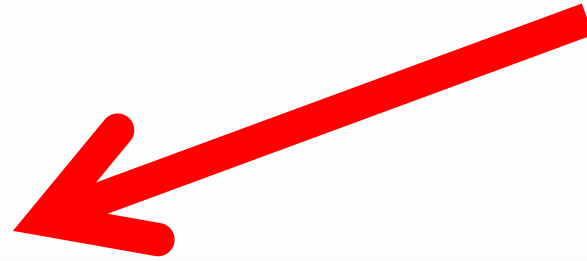
- CAPELON
- Sweden

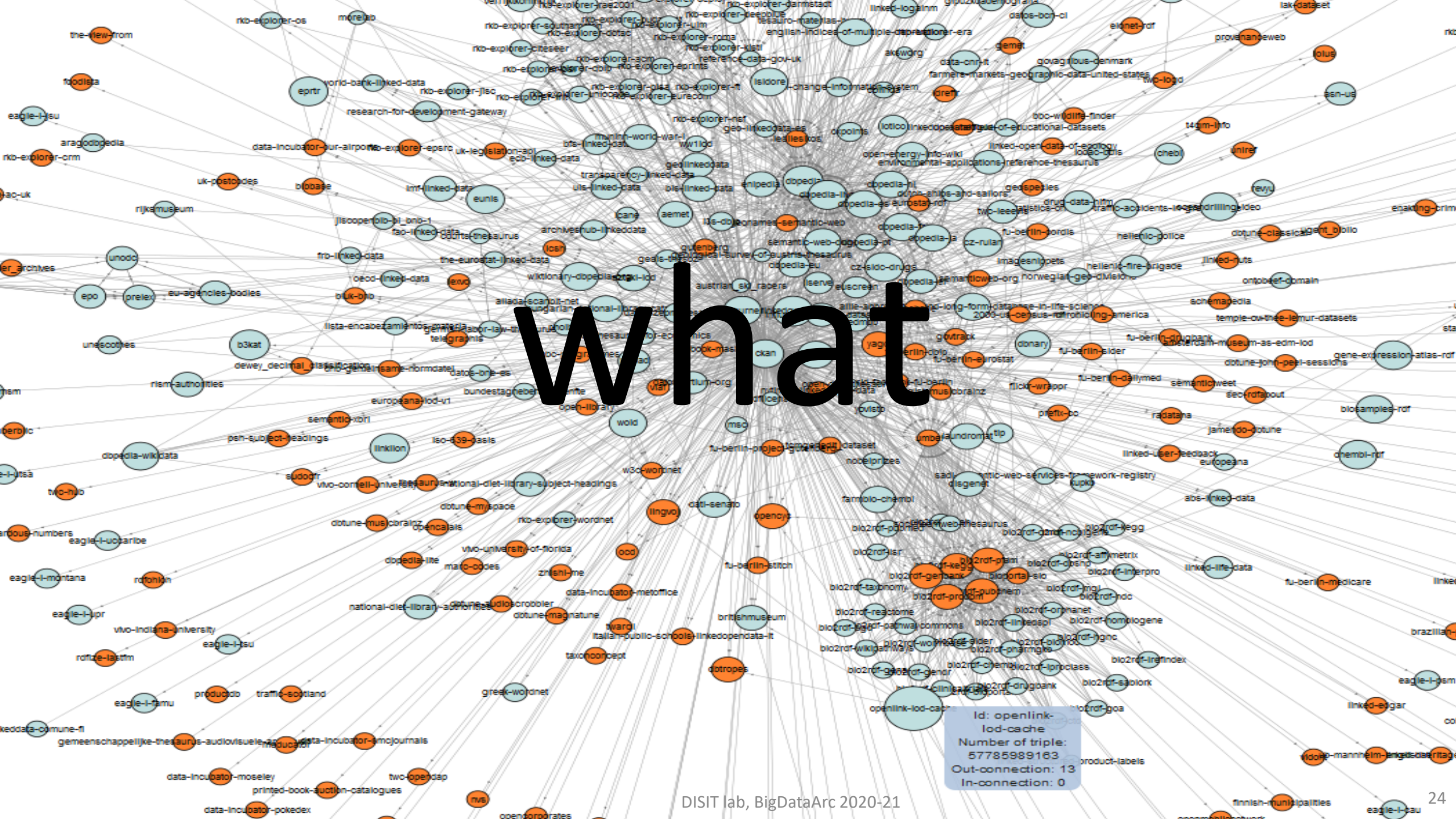
2021

ckan resolutive

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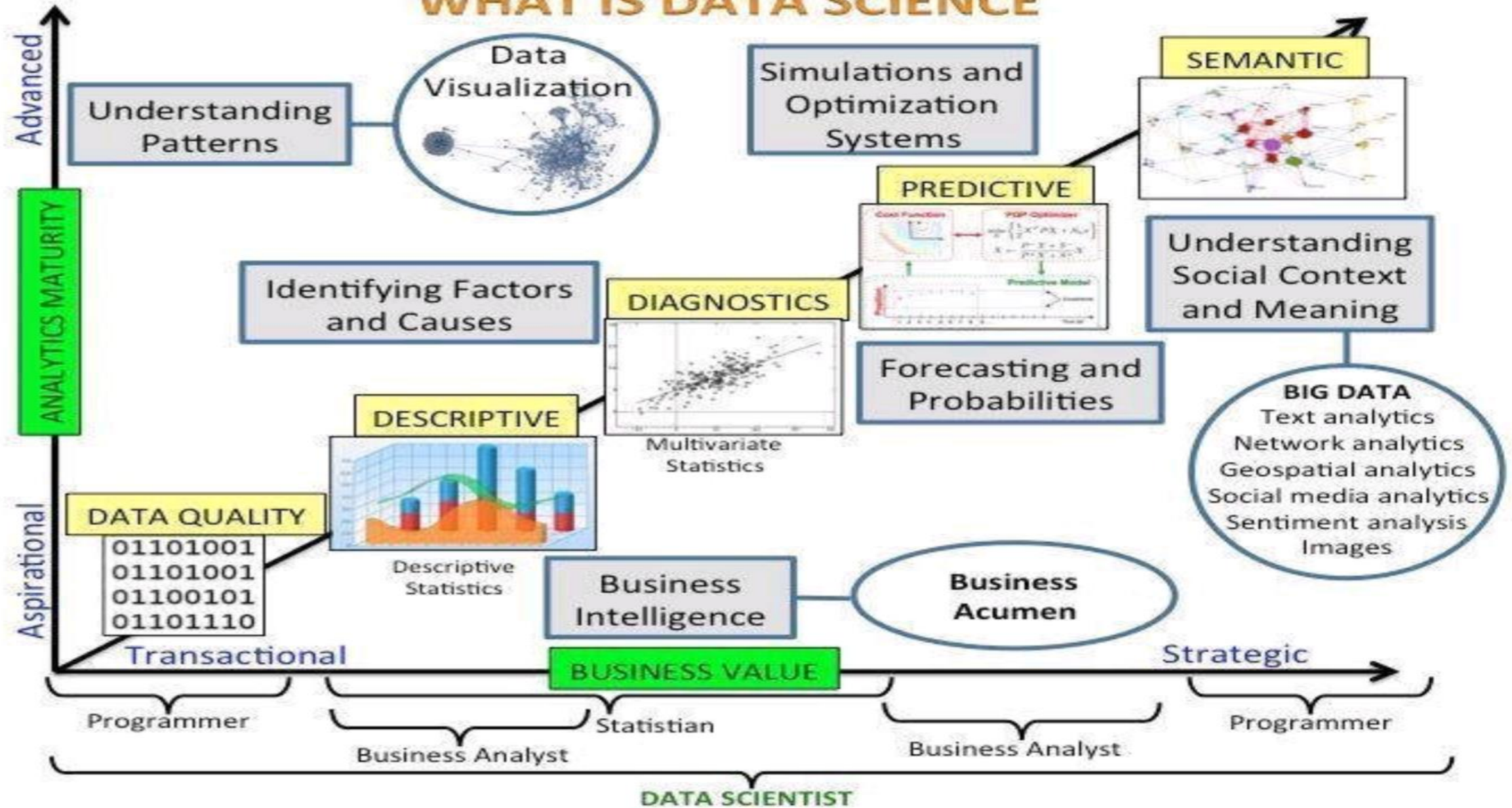




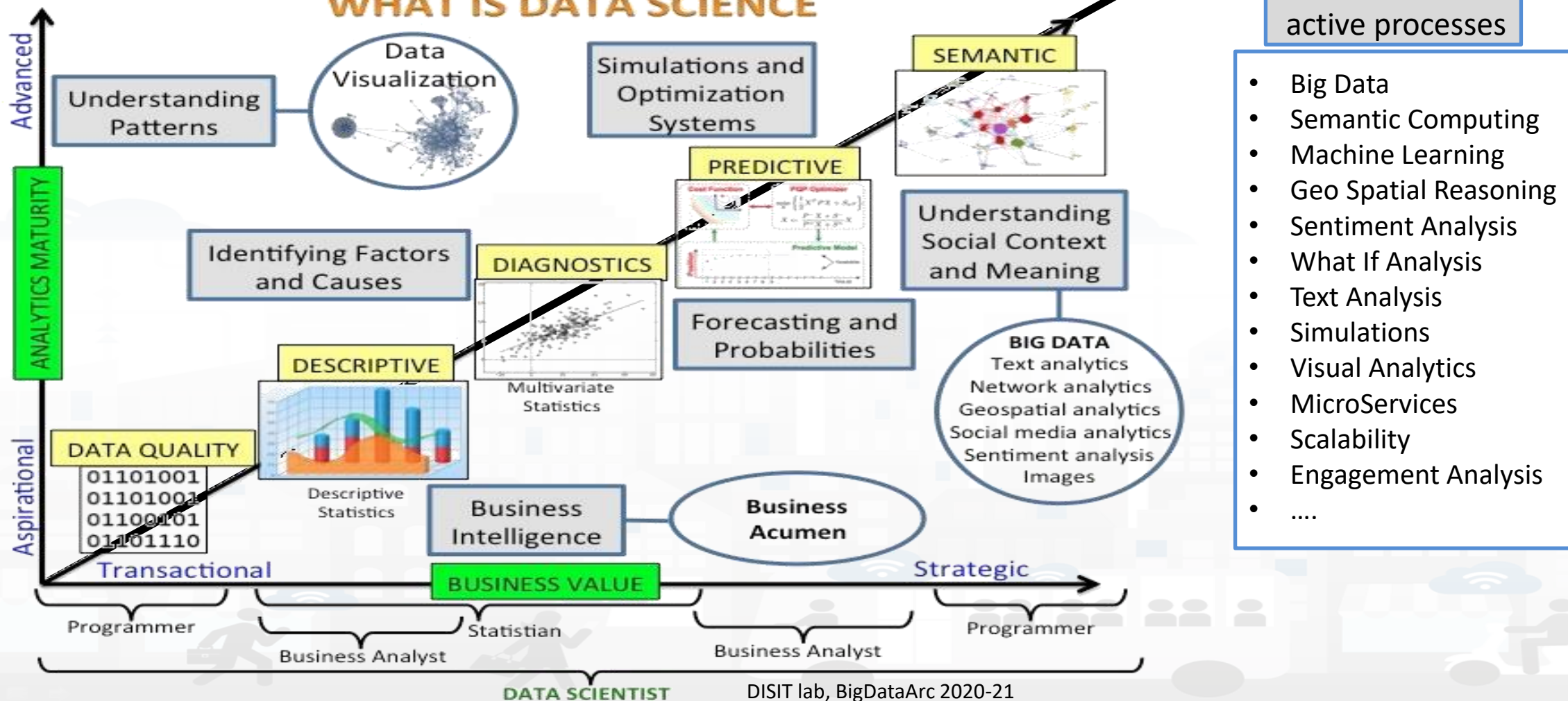
what

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

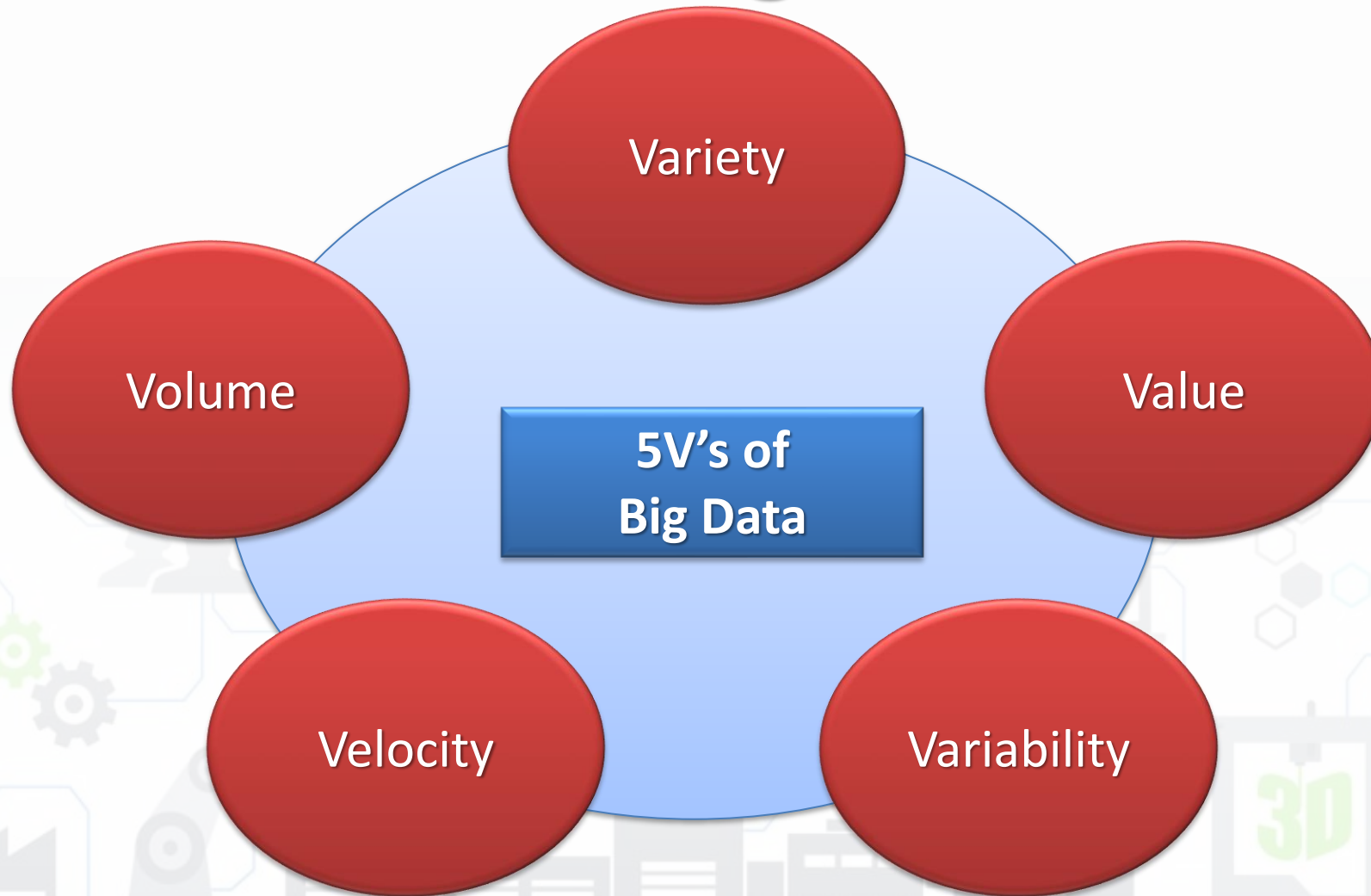
WHAT IS DATA SCIENCE



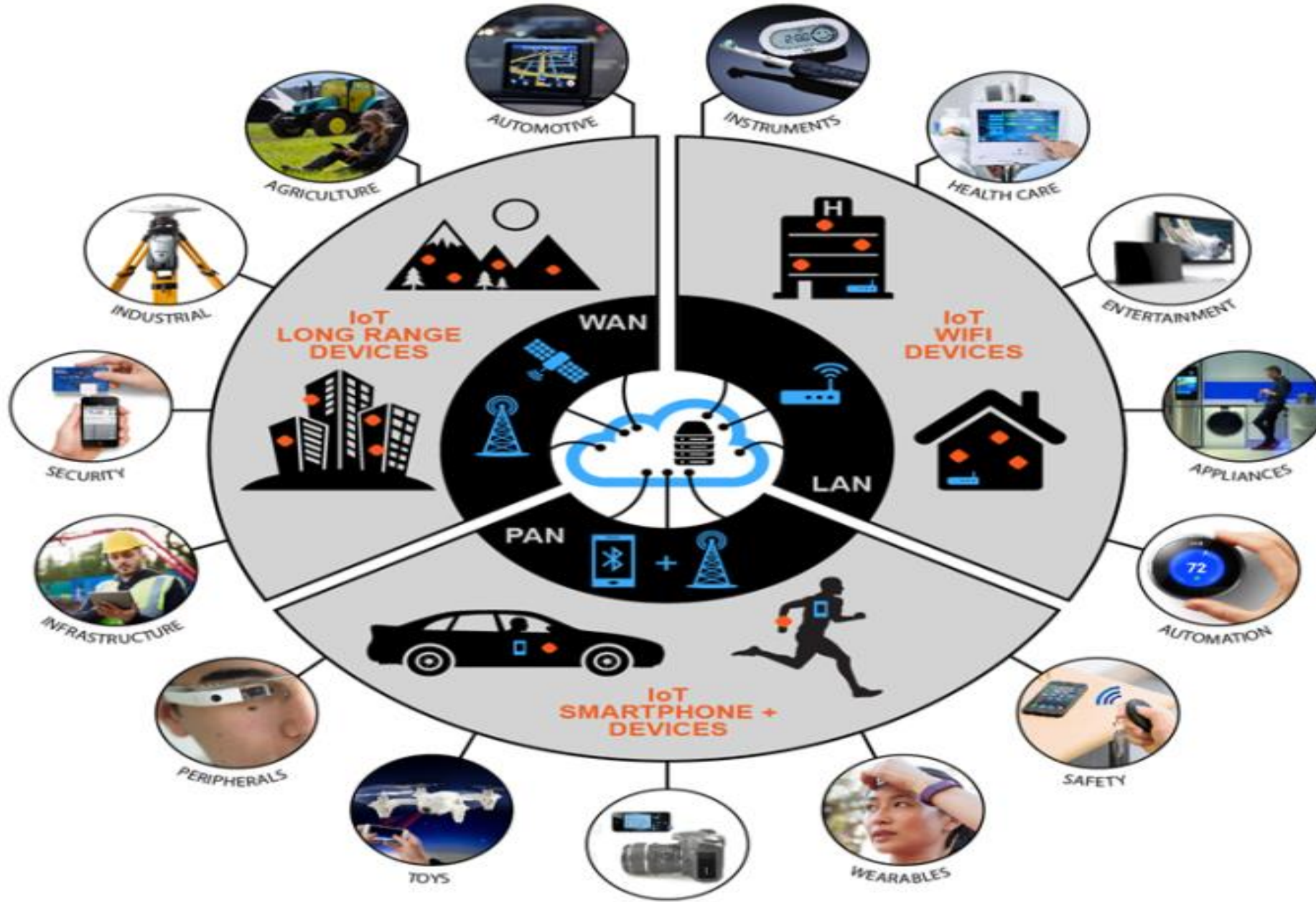
WHAT IS DATA SCIENCE



5V of Big Data



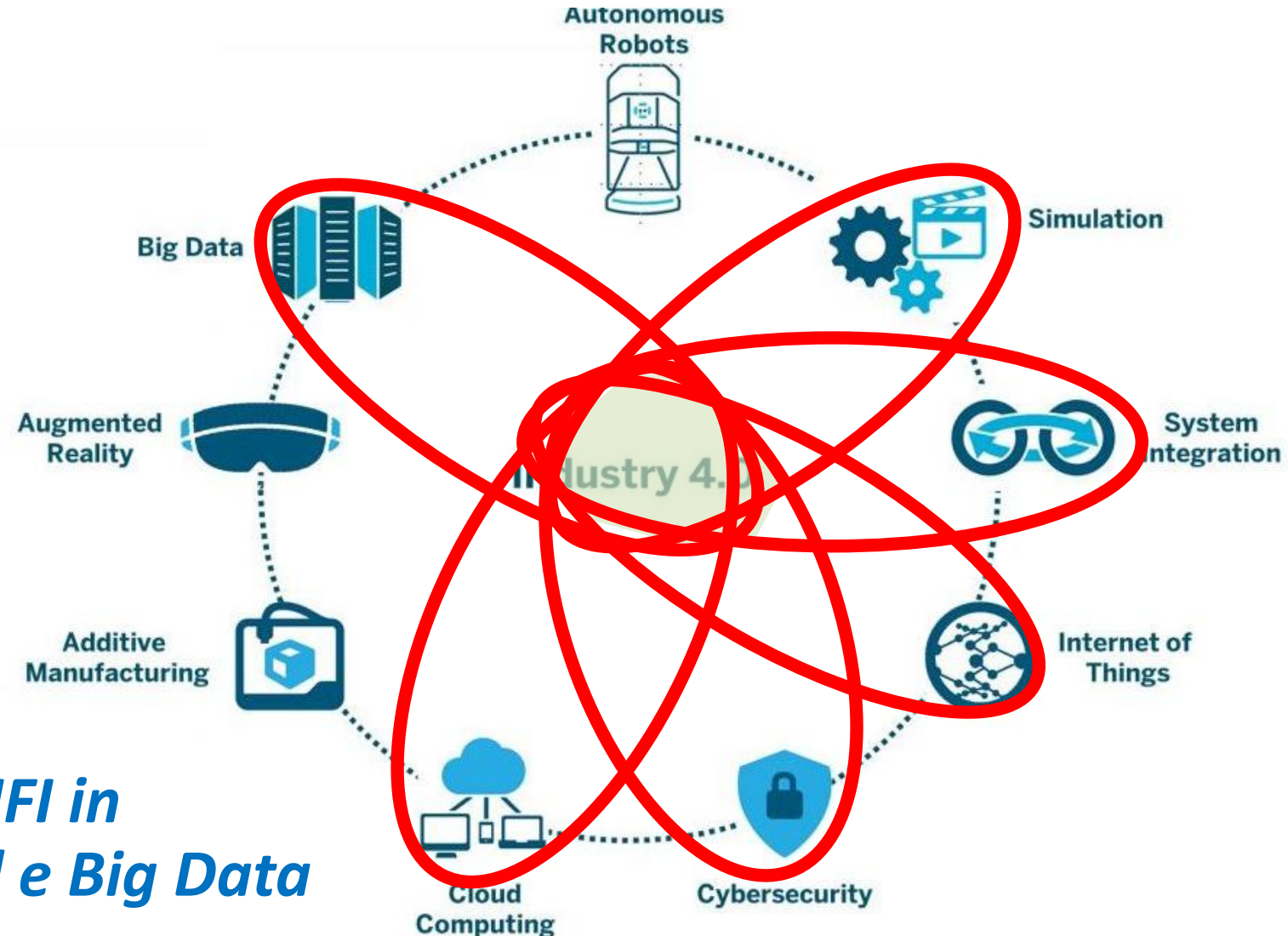
Bia Data & Analytics



Industria 4.0 vs DISIT Lab

- Big Data
- Cloud Computing
- Cybersecurity
- IOT/IOE
- System Integration
- Simulation
- +
- Data Analytics

• *P. Nesi è referente per UNIFI in Regione Toscana per Cloud e Big Data*



- **Technologies:**

- **Big Data Architectures:** architectures for managing big data, processing, ingesting and exploiting them in real time

- **Cloud:** smart cloud, cloud simulation, optimization, containers, ..
- **Storage, parallel architectures, data driven, etc.....**
- **IOT/IOE:** internet of things/everything, brokers, microservices, ..
- **Mobile Computing:** mobile application, user behavior analysis, ..

- **Big Data and Analytics:** data management, user analysis, user engagement, prediction, predictive maintenance, early detection, anomaly detection, data intelligence, what-if analysis, simulation, ...

- **Data Mining:** artificial intelligence, machine learning, natural language processing, semantic computing, semantic reasoner, expert systems, statistic analysis, ..
- **NLP and Sentiment Analysis:** response vigilance, interaction, answering, Personal Assistant, NLP, SA, ..

- **See projects on:** <http://www.disit.org/5501>, <https://www.snap4city.org>

DISIT Application Fields

Increasing investments in Big Data can lead to interesting discoveries in **science**, **medicine**, benefits and gains in the **ICT sector** and in **business** contexts, new services and opportunities for digital **citizens** and **web users**.

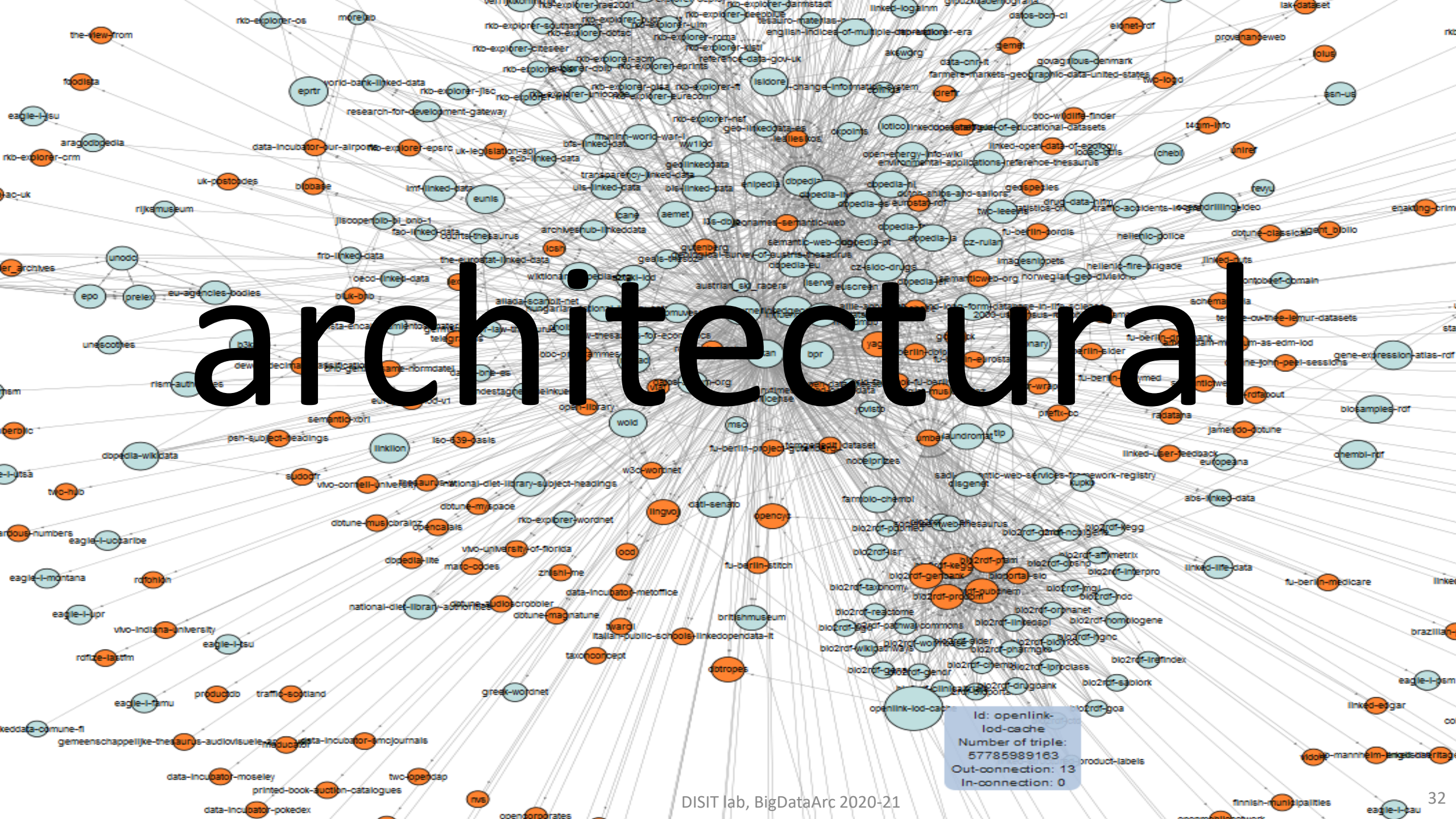
- **Present Domains of DISIT Big Data Analytics and Scientific Research**

- Smart City
- Mobility and transport
- Environment and health
- Industry 4.0, IOT
- Energy and Govern
- Financial/Business
- Security

- **Former**

- Social Network – Internet Service – Web Data
- Educational

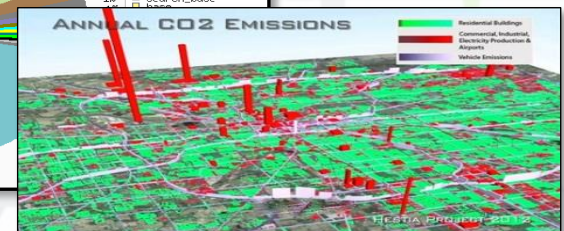
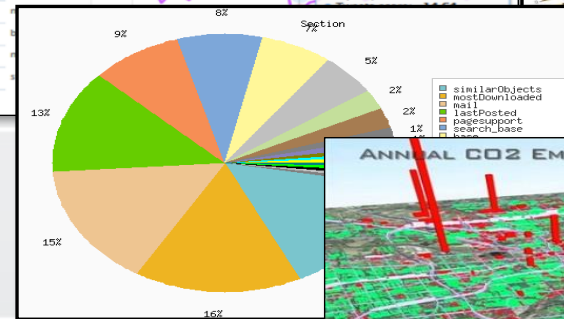
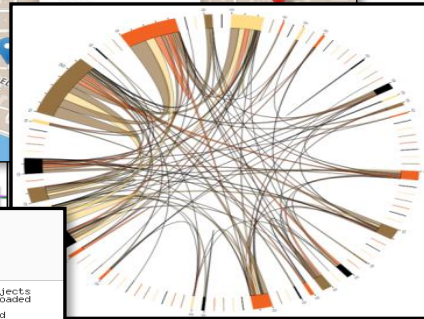
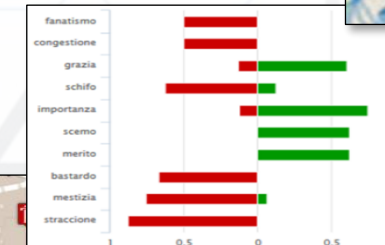
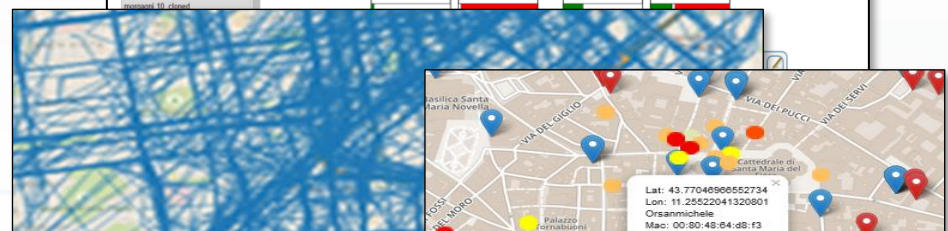
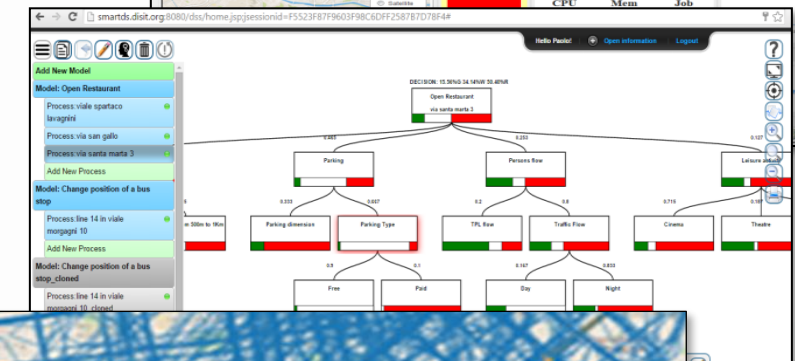
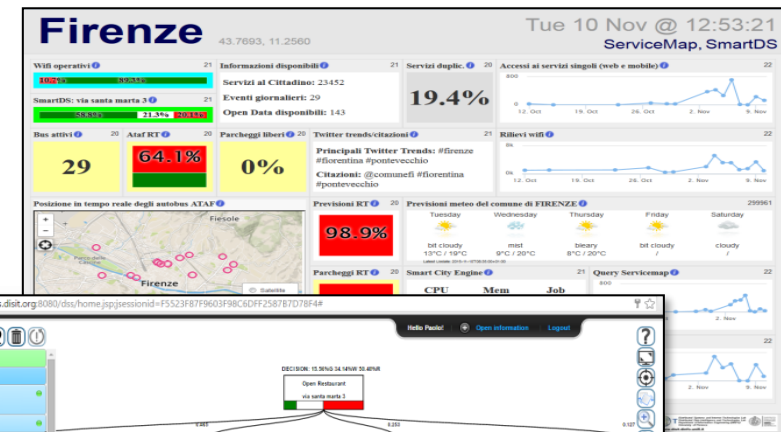
architectural



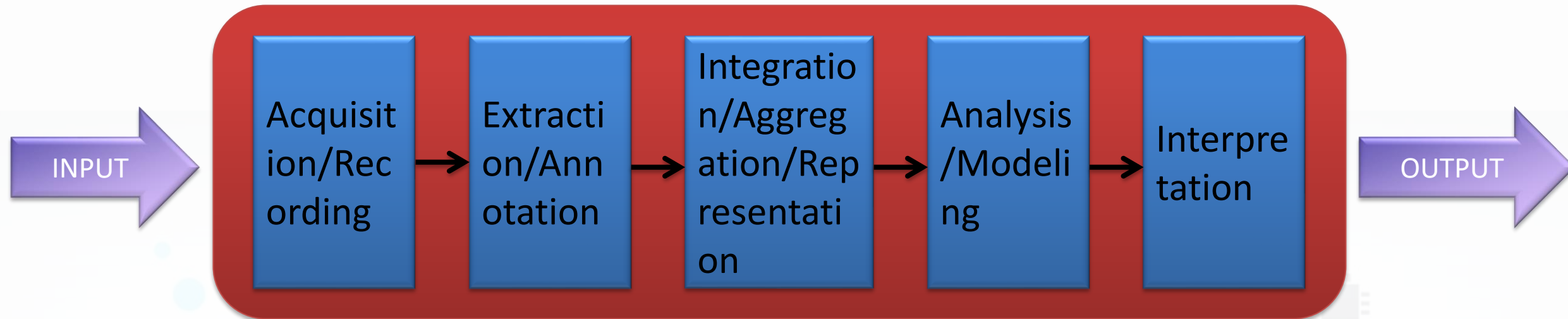


Decisioni supportate dai dati periodiche ed in tempo reale

- **Condivisione e Integrazione Dati multidominio: *semantica e bigdata***
- **Dati → Smart City Engine → Control Room**
- **analisi: monitoraggio, flussi e comportamenti, sondaggi, mining, correlazioni, cause – effetti, etc.**
 - Per il miglioramento di servizi correnti
 - Per reagire ad eventi, incremento della resilienza,
 - Per la creazione servizi innovativi



Pipeline

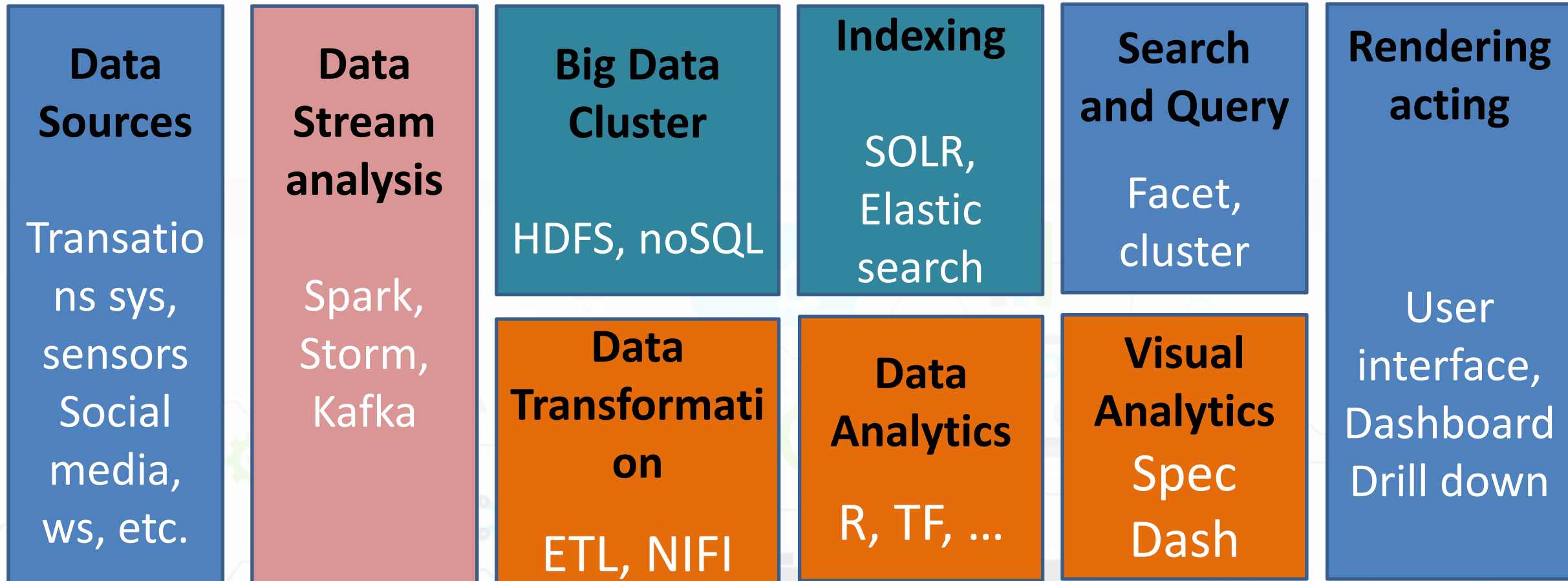


A livello di Sistema

non abbiamo il tempo di pulire i dati o regolarizzarli, il sistema deve lavorare con quello che arriva, ed inoltre deve essere:

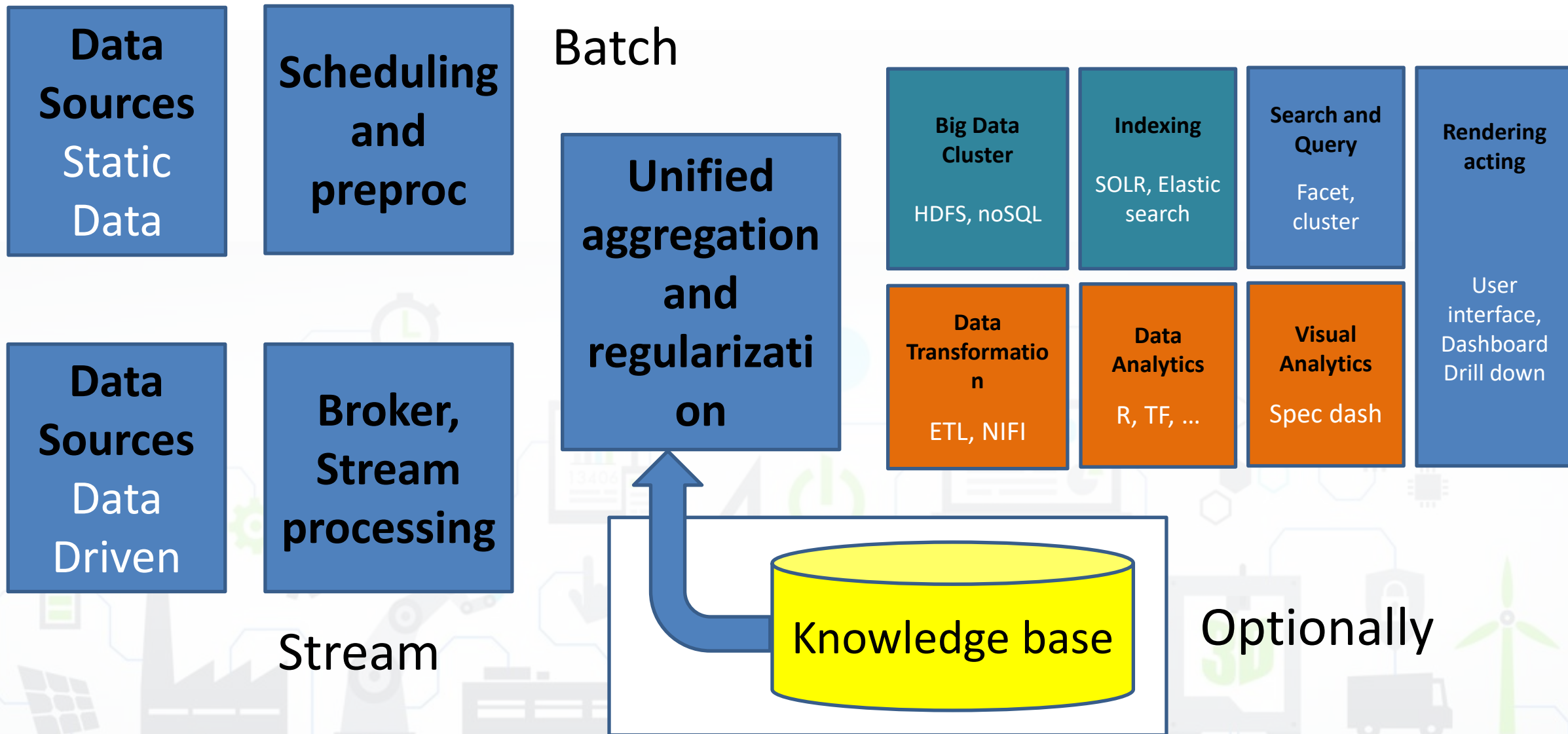
- in grado di operare H24/7, in HA?
- in grado di reggere il carico delle richieste? è scalabile?
- in grado di lavorare alla massima precisione in predizione?
- in grado di rispondere in tempo reale?
- resiliente: recupera stabilità a fronte di eventi inattesi?
- modulare, è flessibile, è replicabile, è open, è
- sicuro?
- In grado di rispettare la Privacy?

Architettura di base Big Data, IOT, Industry 4.0



Data Management: security, privacy, licensing, etc.

Lambda Architecture



Transport systems
Mobility, parking



Public Services
Govern, events, ...



Sensors, IOT
Cameras, ...



Environment,
Water, energy



Shops, services,
operators

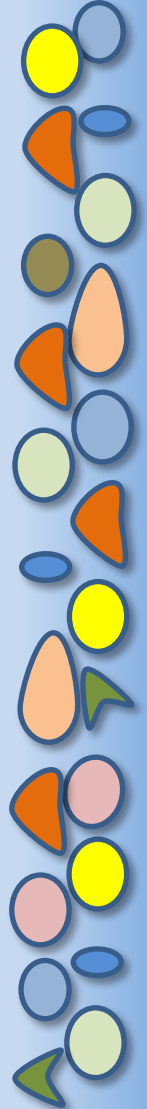


Social Media
WiFi, network

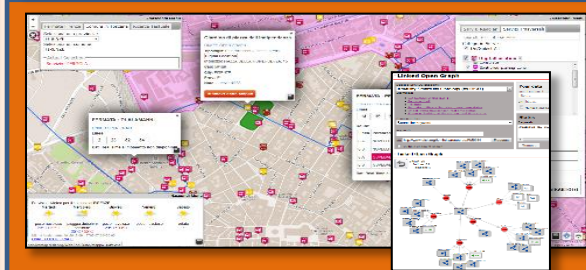
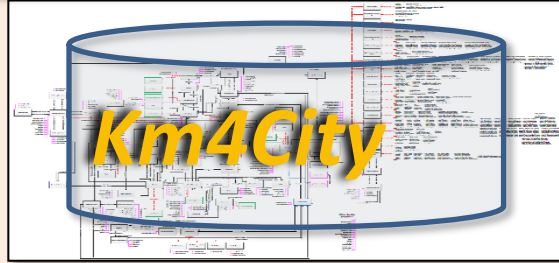


Static, Slow and Real Time data flows

DISCES -- Distributed and parallel architecture on Cloud

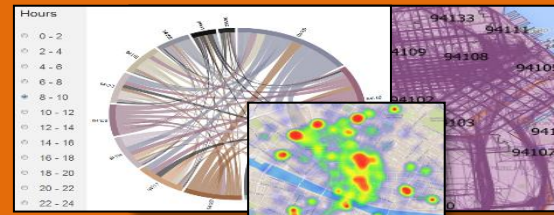


Km4City Smart City Engine



User Profiling and Suggestions on Demand

Flow and Origin Destination Matrix
<http://www.disit.org/odsf>



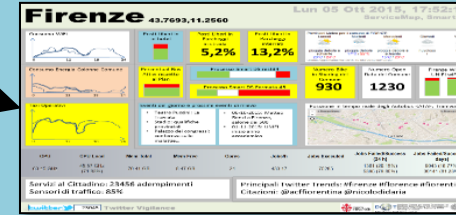
Km4City Tools for Developers

Km4City Smart City API

Tools for City Operators and Decision Makers

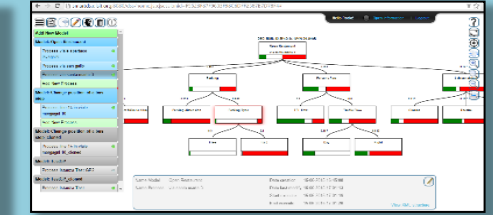
Smart City Dashboard

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



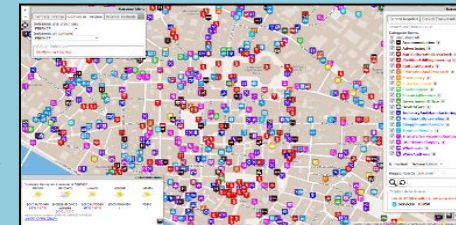
Smart Decision Support

<http://Smartds.disit.org>



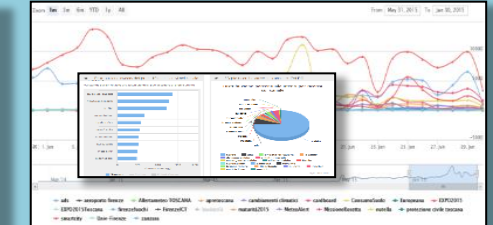
Service map browser

<http://servicemap.disit.org>



Twitter Vigilance

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



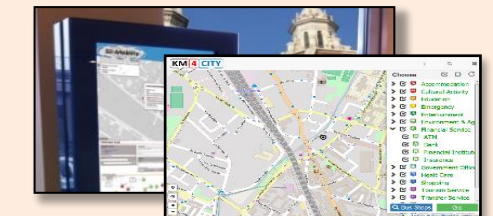
Collective User behavior Analyzer

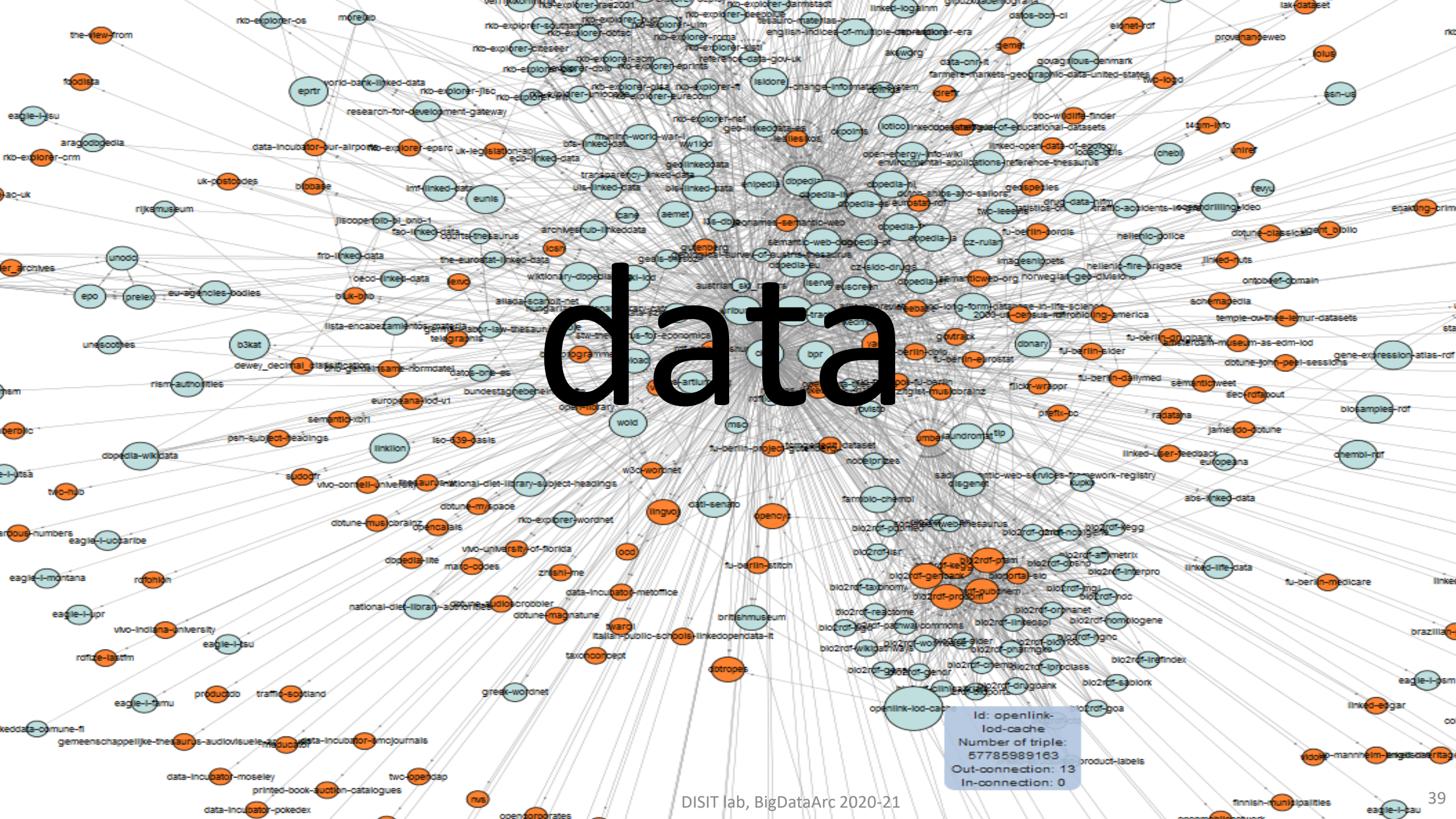


Tools for Final Users

Mobile e Web Apps

<http://www.km4city.org>





data

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

Privati Statici

- Codice fiscale
- Foto non condivise
- Aspetti legali
- Cartella clinica
- ..

- Movimenti personali non pubblicati
- Relazioni personali non pubblicate

- comportamenti social media
- contributi
- consumi

Privati Tempo reale

- Traffico personale
- Posizione mezzi,
- Parcheggi
- Posizione taxi
- Posizione CarSharing ...

Publici statici (open data)

statistiche: incidenti, censimenti, votazioni

- Statistiche accessi alla ZTL
- Strutture pubbliche UNIFI

posizione dei punti di interesse

- Musei
- Strutture della città
- Servizi attivi

- Info traffico
- video camere
- Info Meteo
- Info Ambiente
- Code ai musei pubblici
- Terremoti
- Parcheggi

- Stato accessi alla ZTL
- Stato dei servizi

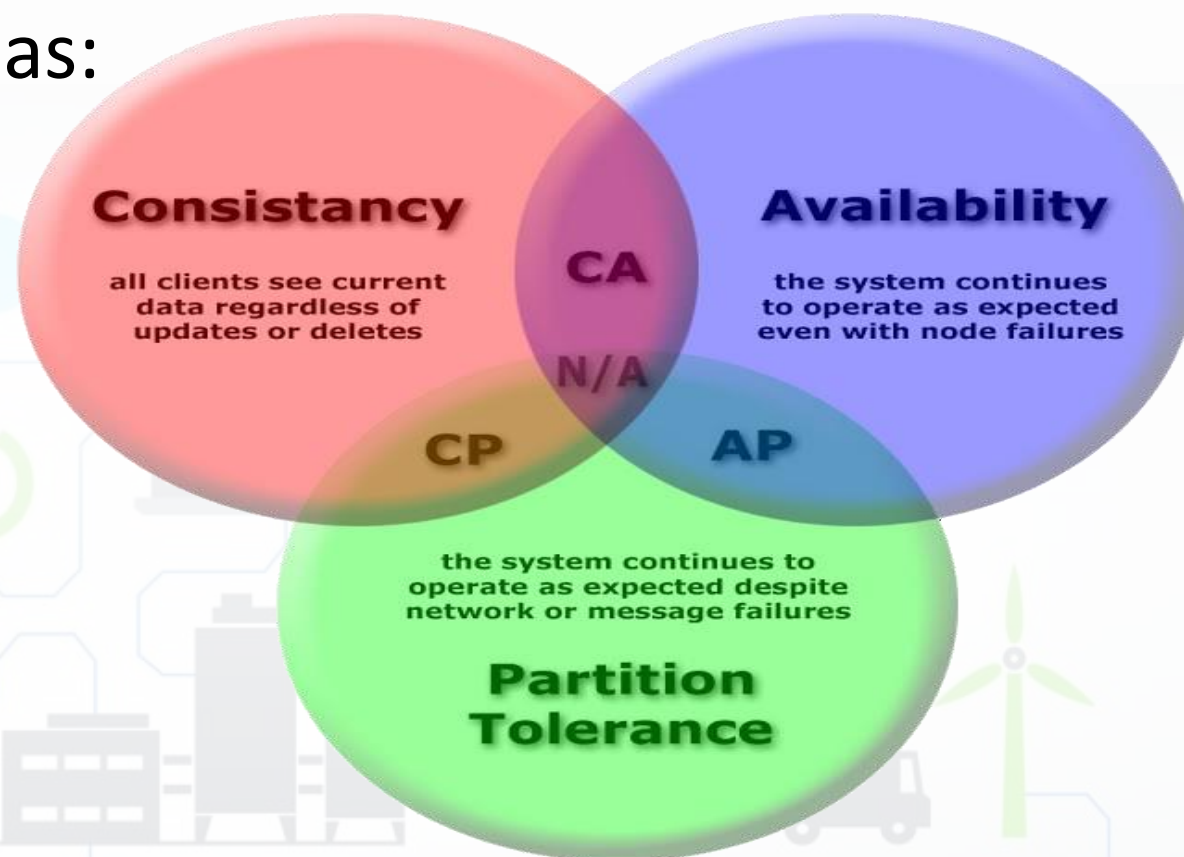
Publici Tempo reale (open data)

Complessità del Dato

- **Formati diversi, valori sparsi e discontinui** anche in stream
 - Data healthiness, integrity, etc.
- Tecniche: Data Lake per la normalizzazione del dato
 - → big data graveyards based on HDFS
- **Formati e dati non riferibili in modo preciso alla stessa semantica** delle entità in gioco: temperatur*e*, coordinat*e*, misure dei sensori in generale, ... → molto dipendenti dal contesto
 - Modelli ontologici → ontologie → knowledge base → expert systems, per ricerche in chiave semantica, Riconciliazione semantica, completamento, contestualizzazione, ...

CAP theorem

- The **CAP theorem** (Consistency - Availability - Partition tolerance) is essential to **understand the behavior of distributed SW systems**, and **how to design the architecture** in order to meet stringent requirements, such as:
 - High **performance**.
 - Continued **availability**.
 - **Geographically distributed** systems.
- Working on billions and trillions of day, **scalability** became a key concept.



Modeling Data store

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

Types of NoSQL Database

- Key-Value DB
- Col- Family/Big Table DB
- Document DB
- XML DB
- Object DB
- Multivalued DB
- ACID NoSQL
- Graph DB

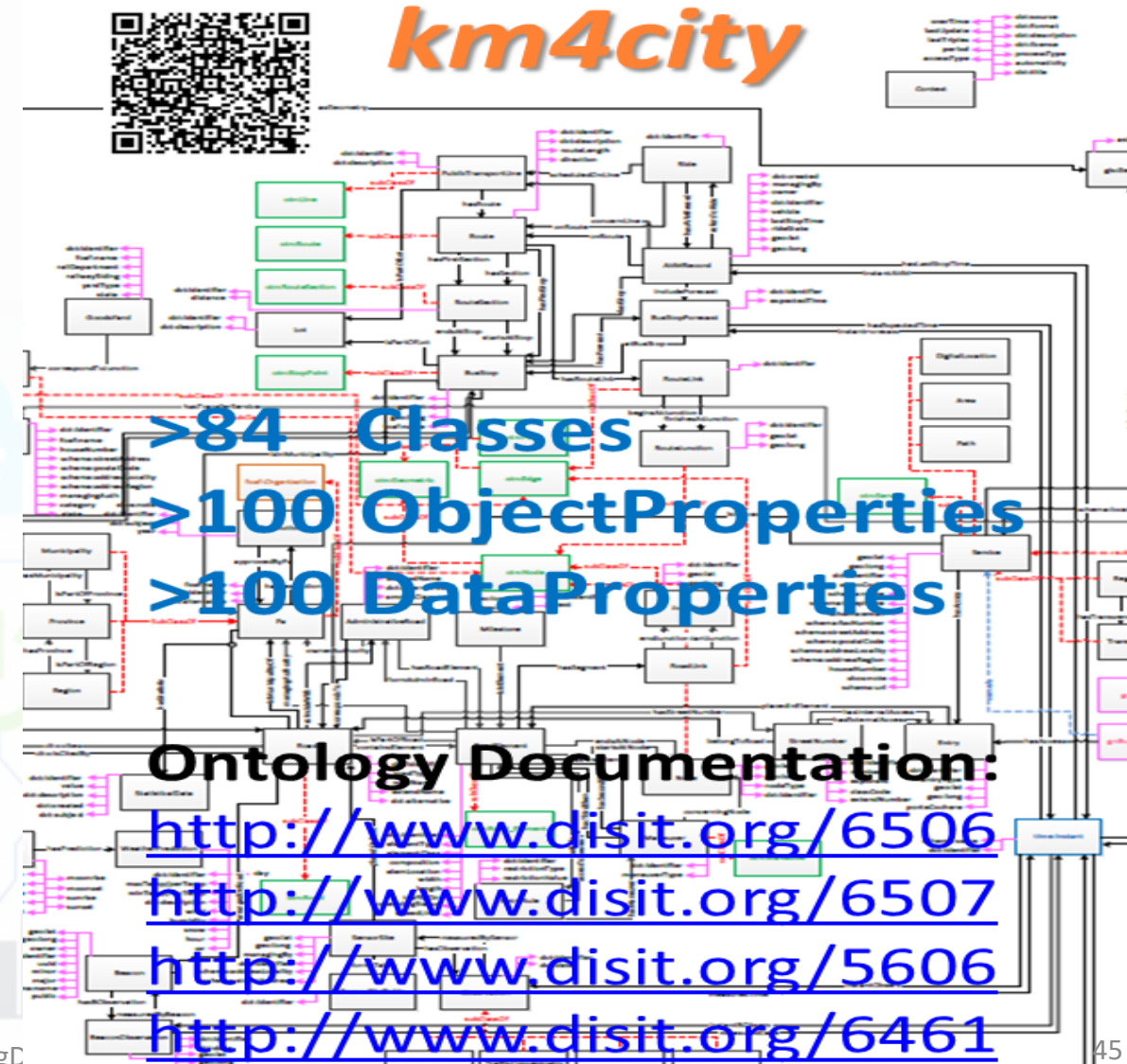


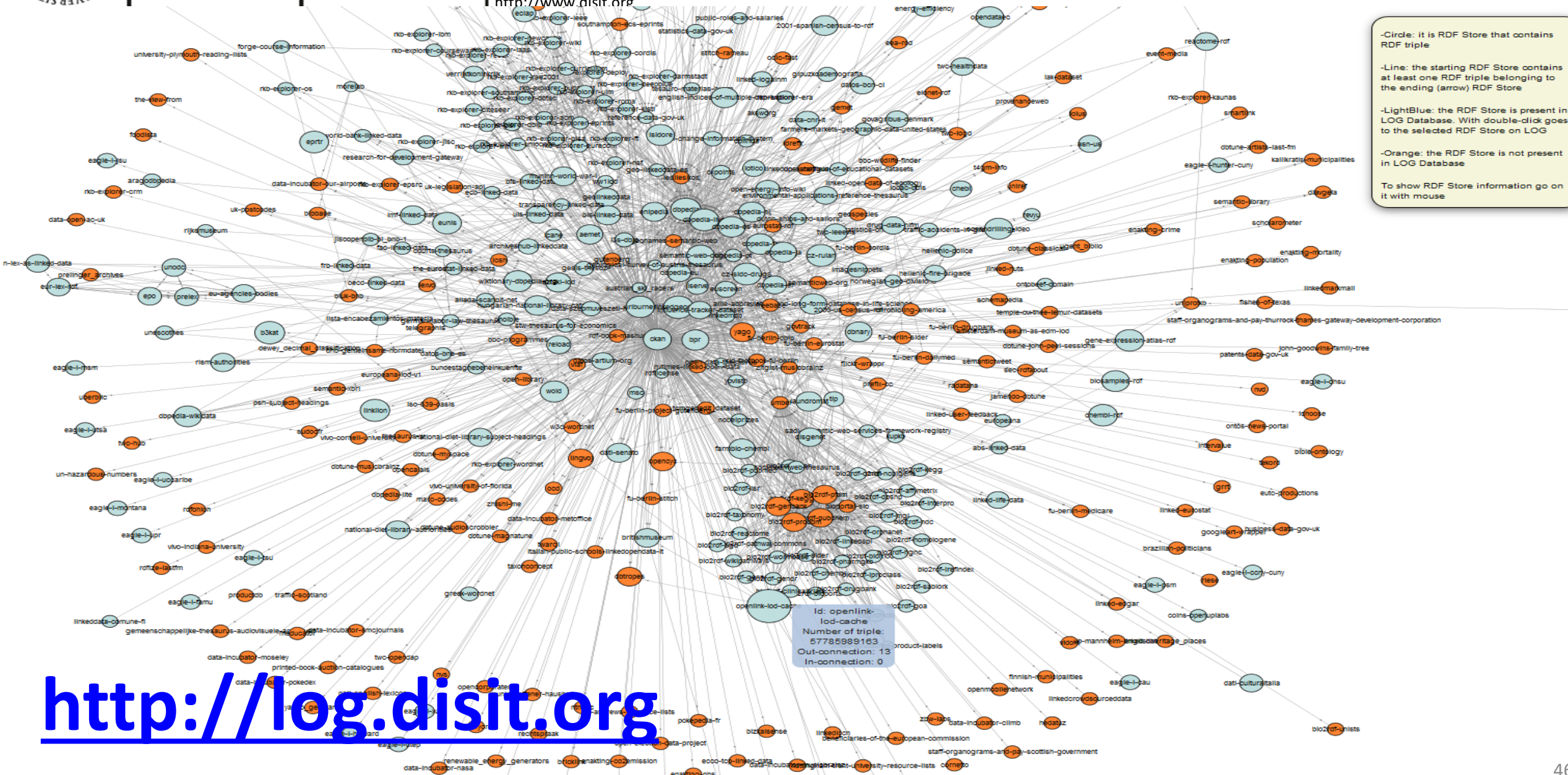
I Dati

- **Collezionamento dati** statici, quasi statici e real time, stream
 - **Dati open:** geo localizzati, servizi, statistiche, censimenti, etc.
 - **Dati privati degli operatori:** con licenze limitate per non permettere di fare profitto ad altri operatori sulla base dei loro dati
 - **Dati personali delle persone:** profili, comportamenti tramite APP, IOT, sensori, web, etc.
- **Integrazione dati** per renderli *semanticamente interoperabili*, ed operare deduzioni (time, space...)
 - I tradizionali **collettori di open data** danno visioni statistiche ma **non sono adatti a produrre servizi integrati**
 - **Integrazione con modelli semantici unificanti come Km4City**

Smart-city Ontology

km4city





-Circle: it is RDF Store that contains RDF triple

-Line: the starting RDF Store contains at least one RDF triple belonging to the ending (arrow) RDF Store

-LightBlue: the RDF Store is present in LOG Database. With double-click goes to the selected RDF Store on LOG

-Orange: the RDF Store is not present in LOG Database

To show RDF Store information go on it with mouse

<http://log.disit.org>

Linked Open Graph

SiiMobility (by DISIT)

Examples:

- VIA GIACOMO MATTEOTTI
- Bagno a ripoli
- Florence

Choose a class:

Search for keyword

keyword:

uri: Request

Your data

sparql endpoint: (optional)

uri: Request

Status

Requests:

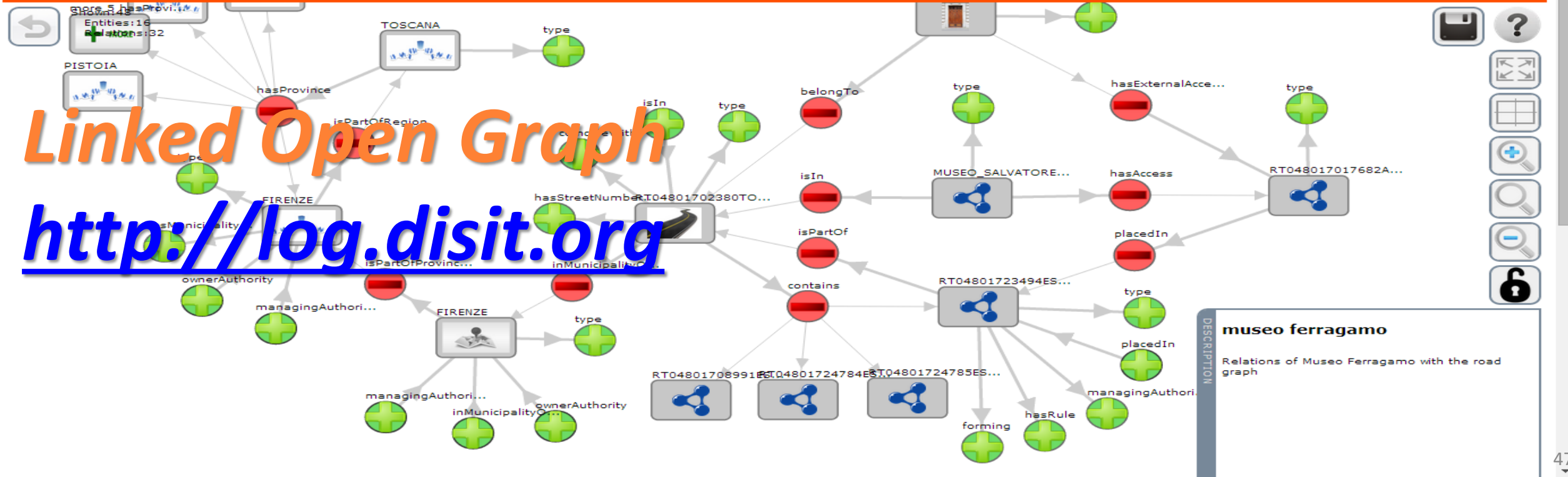
Remove Clear

Type of relations

Select all Deselect all Invert Hide all inverse

<input checked="" type="checkbox"/> belongTo	<input checked="" type="checkbox"/> coincideWith
<input checked="" type="checkbox"/> contains	<input type="checkbox"/> depiction
<input type="checkbox"/> ends	<input checked="" type="checkbox"/> forming
<input type="checkbox"/> has	<input checked="" type="checkbox"/> hasAccess
<input checked="" type="checkbox"/> hasExternalAccess	<input checked="" type="checkbox"/> hasMunicipality
<input checked="" type="checkbox"/> hasProvince	<input checked="" type="checkbox"/> hasRule
<input checked="" type="checkbox"/> hasStreetNumber	<input checked="" type="checkbox"/> inMunicipalityOf
<input checked="" type="checkbox"/> isIn	<input checked="" type="checkbox"/> isPartOf
<input checked="" type="checkbox"/> isPartOfProvince	<input checked="" type="checkbox"/> isPartOfRegion
<input checked="" type="checkbox"/> managingAuthority	<input checked="" type="checkbox"/> ownerAuthority
<input checked="" type="checkbox"/> placedIn	<input type="checkbox"/> sameAs
<input checked="" type="checkbox"/> seeAlso	<input type="checkbox"/> starts

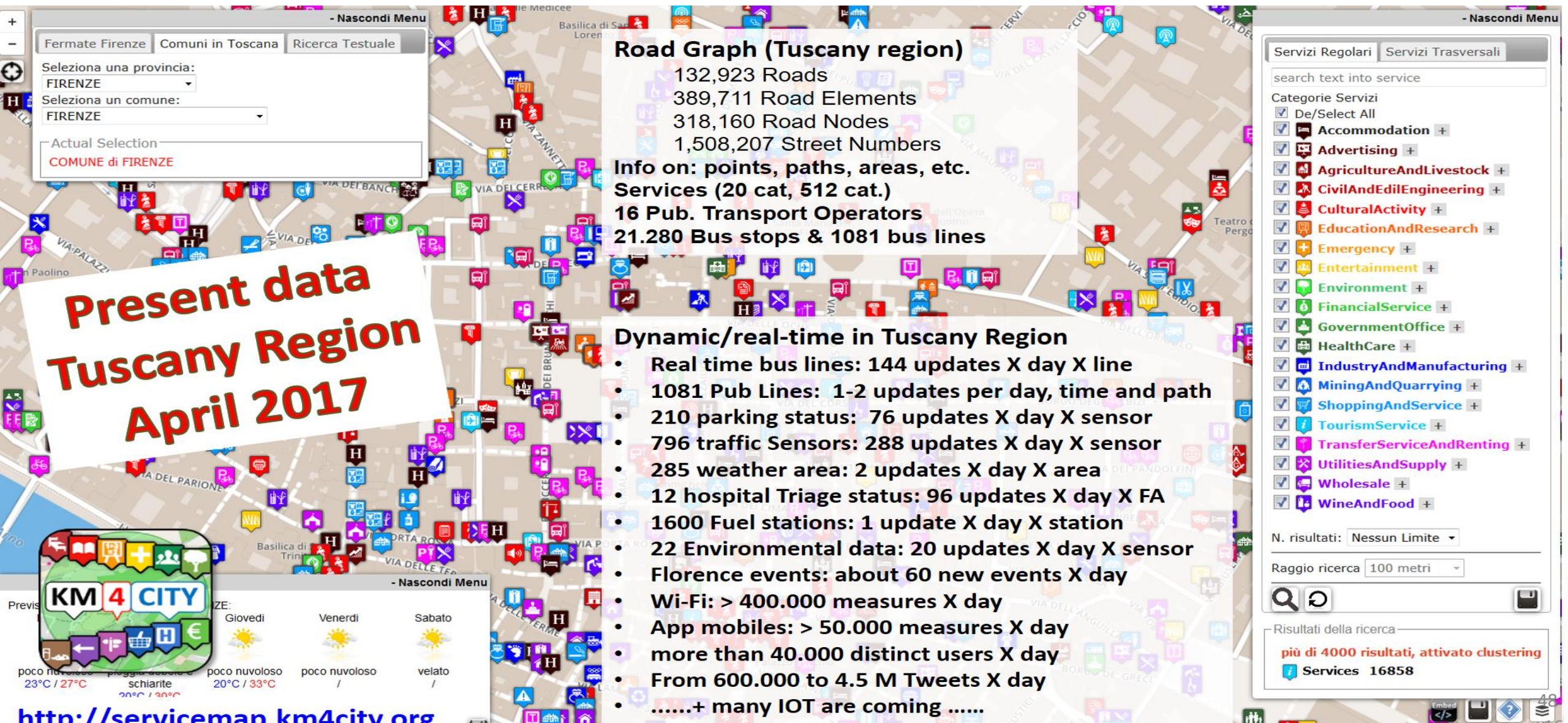
Linked Open Graph





Smart City

<http://www.km4city.org>



**Present data
Tuscany Region
April 2017**

Road Graph (Tuscany region)

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

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

Dynamic/real-time in Tuscany Region

- Real time bus lines: 144 updates X day X line
- 1081 Pub Lines: 1-2 updates per day, time and path
- 210 parking status: 76 updates X day X sensor
- 796 traffic Sensors: 288 updates X day X sensor
- 285 weather area: 2 updates X day X area
- 12 hospital Triage status: 96 updates X day X FA
- 1600 Fuel stations: 1 update X day X station
- 22 Environmental data: 20 updates X day X sensor
- Florence events: about 60 new events X day
- Wi-Fi: > 400.000 measures X day
- App mobiles: > 50.000 measures X day
- more than 40.000 distinct users X day
- From 600.000 to 4.5 M Tweets X day
-+ many IOT are coming

Servizi Regolari Servizi Trasversali

- search text into service
- Categorie Servizi
- De/Select All
 - Accommodation +
 - Advertising +
 - AgricultureAndLivestock +
 - CivilAndEdilEngineering +
 - CulturalActivity +
 - EducationAndResearch +
 - Emergency +
 - Entertainment +
 - Environment +
 - FinancialService +
 - GovernmentOffice +
 - HealthCare +
 - IndustryAndManufacturing +
 - MiningAndQuarrying +
 - ShoppingAndService +
 - TourismService +
 - TransferServiceAndRenting +
 - UtilitiesAndSupply +
 - Wholesale +
 - WineAndFood +

N. risultati: Nessun Limite

Raggio ricerca 100 metri

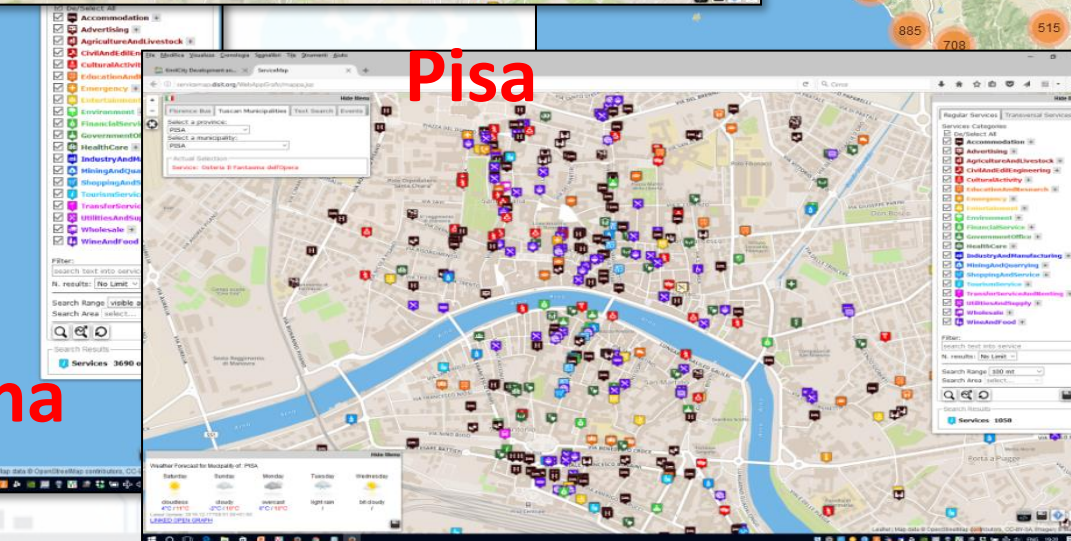
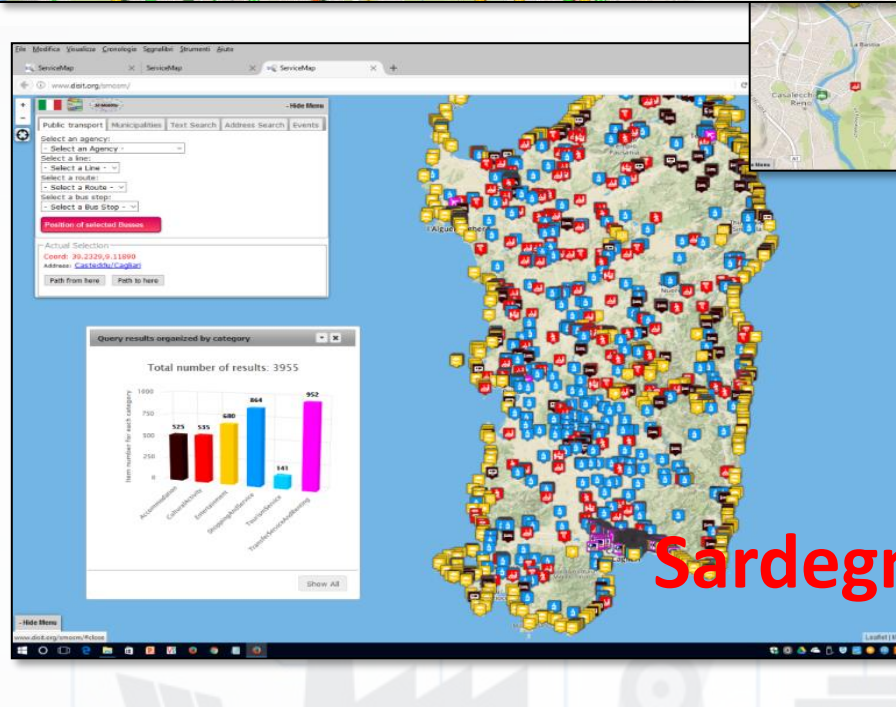
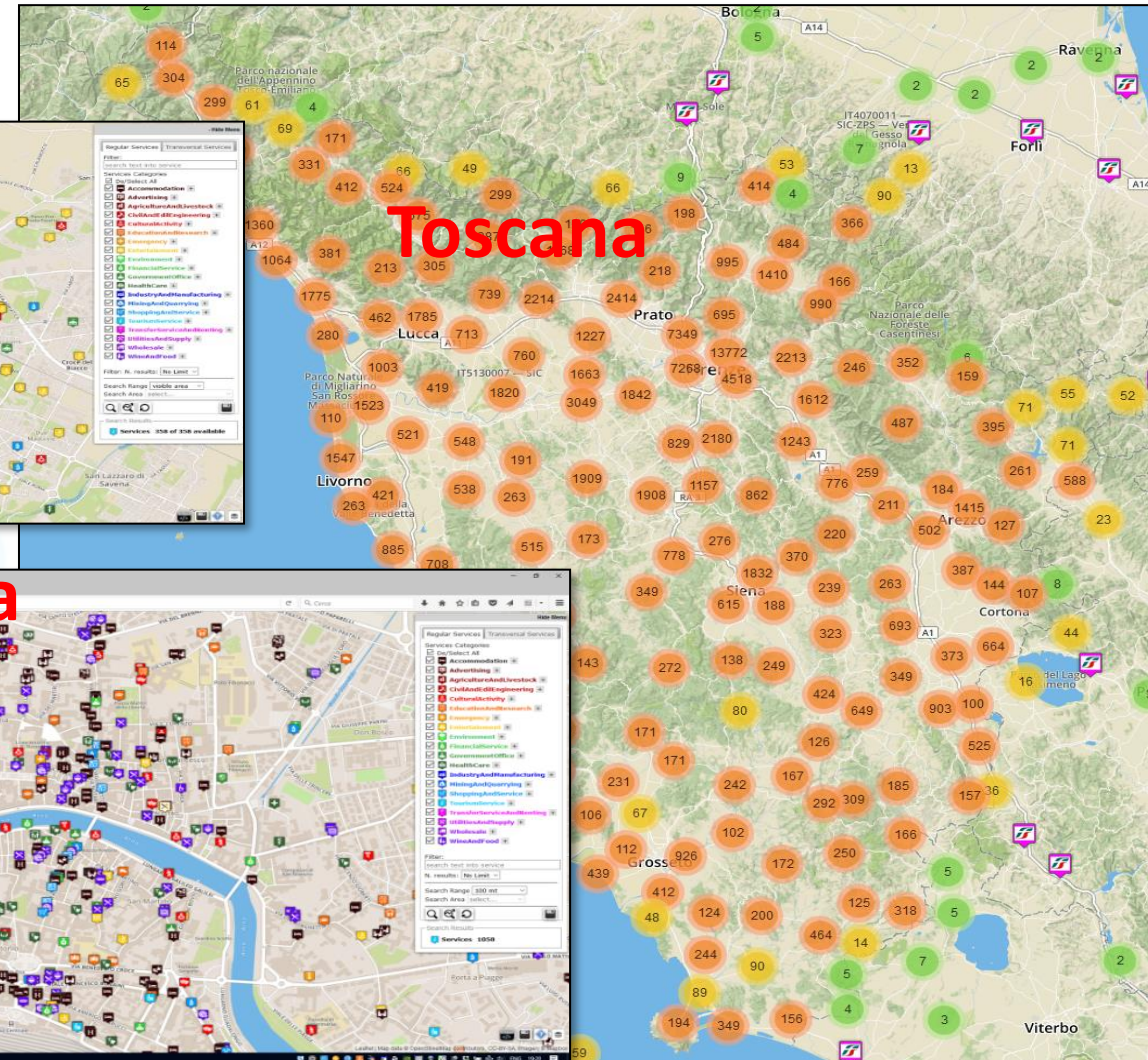
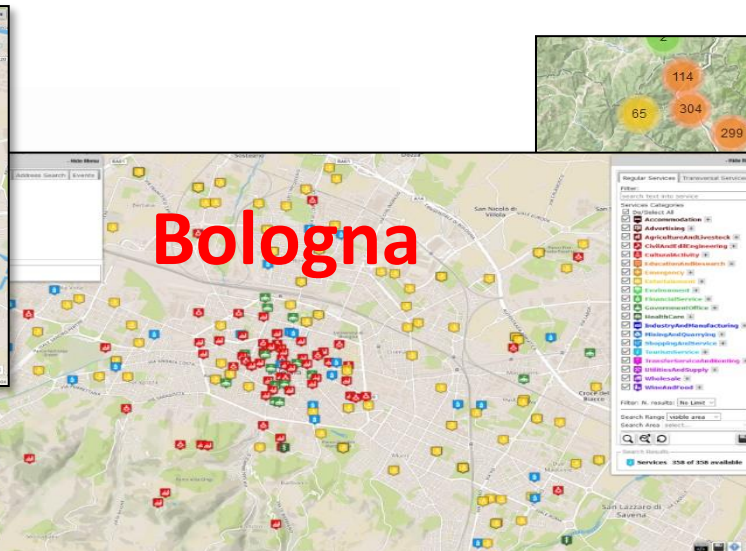
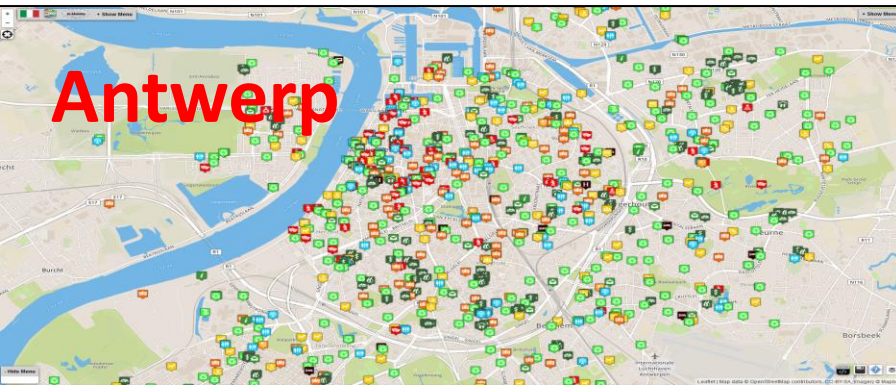


Risultati della ricerca

più di 4000 risultati, attivato clustering
Services 16858



Coverage: examples



• Search all services in the area

- Nascondi Menu

Fermate Firenze Comuni in Toscana Ricerca Testuale

Seleziona una provincia:
FIRENZE

Seleziona un comune:
FIRENZE

Actual Selection
COMUNE di FIRENZE

KM4CITY

Giovedì 23°C / 25°C
Venerdì 20°C / 33°C
Sabato 20°C / 30°C

- Nascondi Menu

What is enabling and providing smart services

- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart search for POI and public transport srv.
- Public Transportation in Tuscany
- Routing in Tuscany, simple and multimodal
- Social Media Monitoring and acting
- Traffic events and Resilience in Florence
- Bike Sharing in Pisa and Siena
- Recharge stations for e-vehicles
- Entertainment Events in Florence
- Traffic Sensors in Tuscany
- IOT/IOE sensors and actuators
- Weather forecast/condition in Tuscany
- Pollution and Pollination in Tuscany
- People Monitoring, in Tuscany via App
- ..People Monitoring Assessment in the City, in Florence via Wi-Fi

All Point of Interests, cultural activities, IOT, ...
Over than 1.2 Million of complex events per day!

- Nascondi Menu

Servizi Regolari Servizi Trasversali

search text into service

Categorie Servizi

- De/Select All
- Accommodation +
- Advertising +
- AgricultureAndLivestock +
- CivilAndEdilEngineering +
- CulturalActivity +
- EducationAndResearch +
- Emergency +
- Entertainment +
- Environment +
- FinancialService +
- GovernmentOffice +
- HealthCare +
- IndustryAndManufacturing +
- MiningAndQuarrying +
- ShoppingAndService +
- TourismService +
- TransferServiceAndRenting +
- UtilitiesAndSupply +
- Wholesale +
- WineAndFood +

N. risultati: Nessun Limite

Raggio ricerca 100 metri

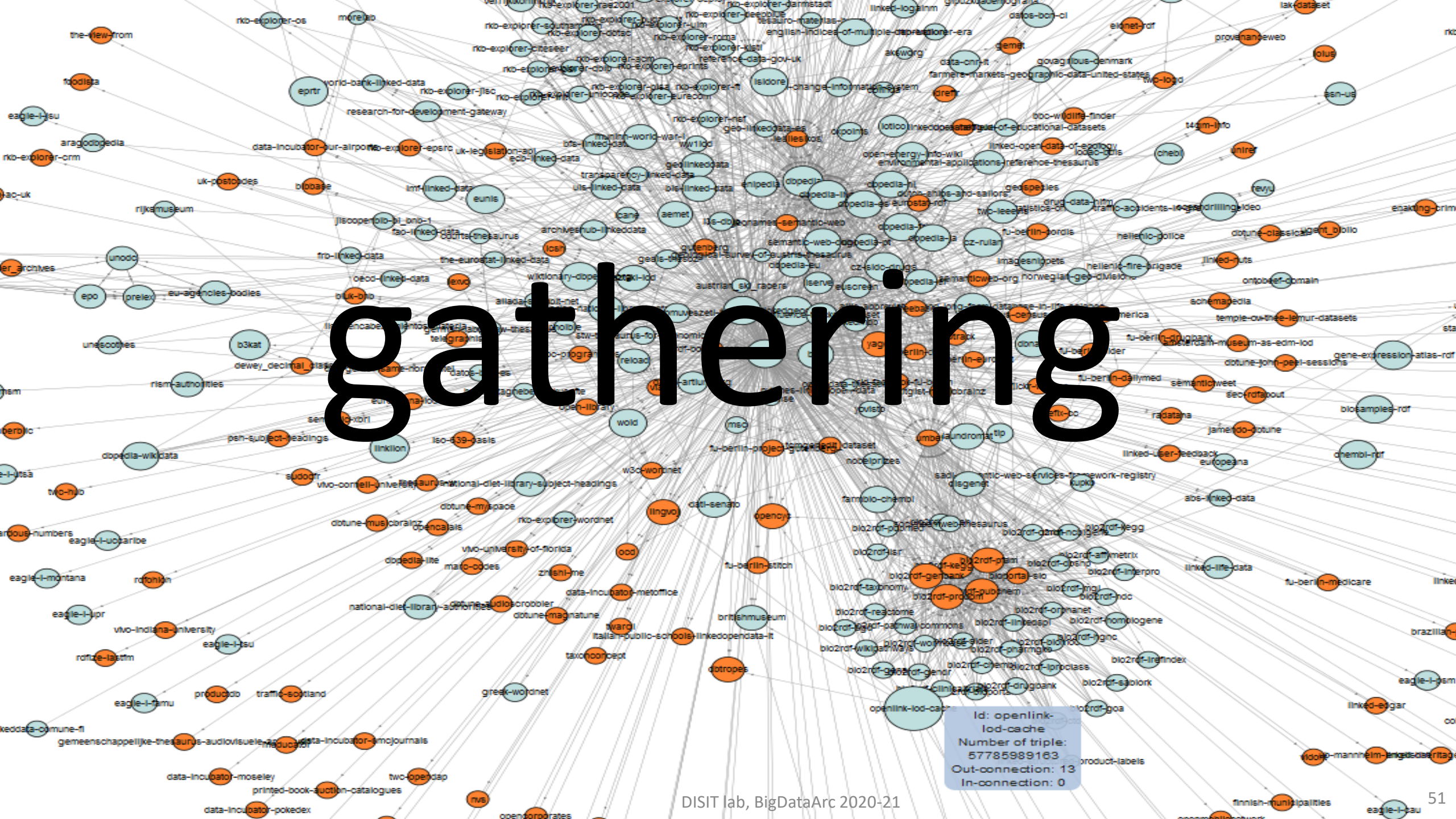
Risultati della ricerca

più di 4000 risultati, attivato clustering

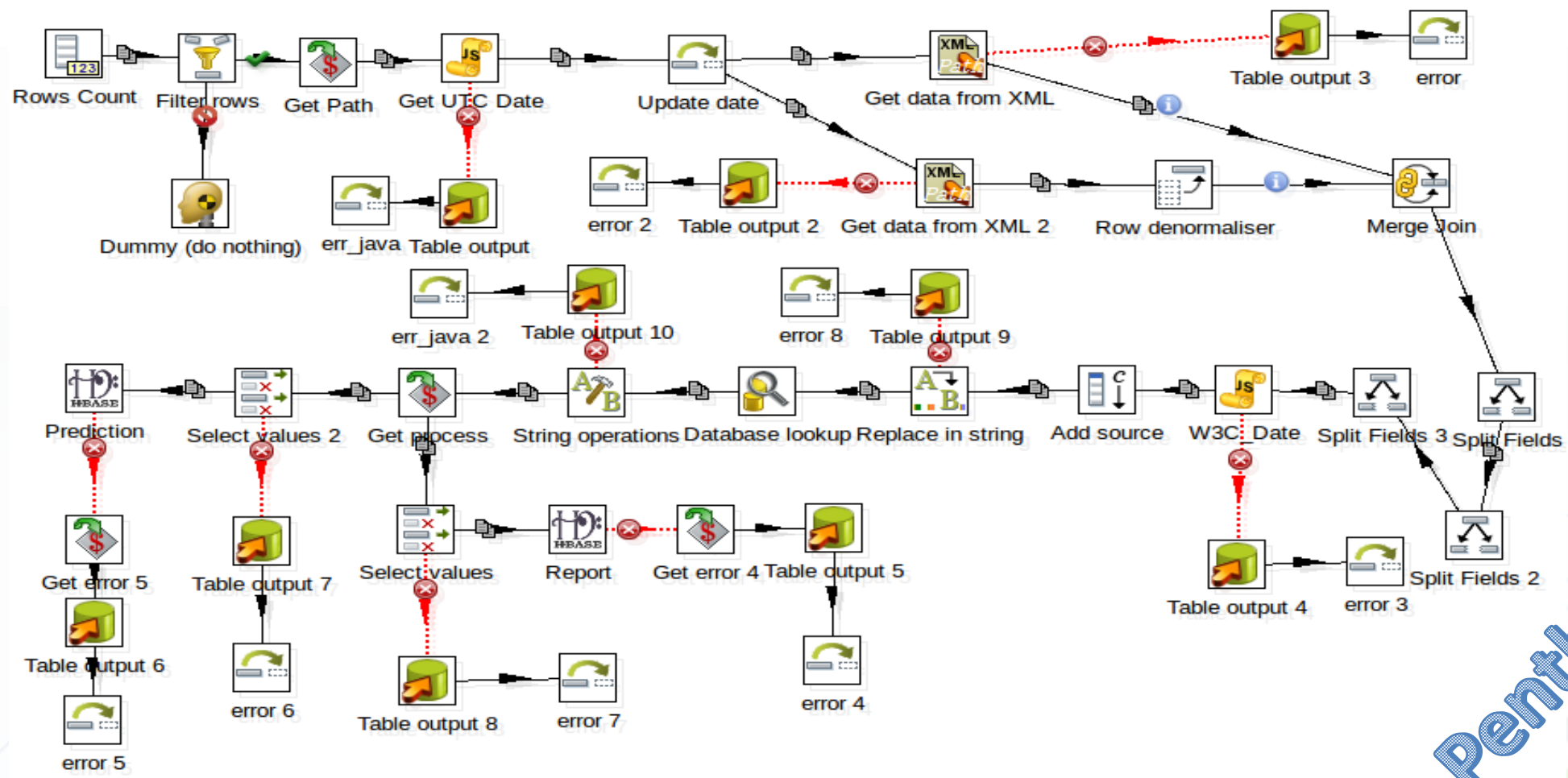
Services 16858

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

gathering



Example of ETL



Batch Processing

ETL Pentaho Kettle





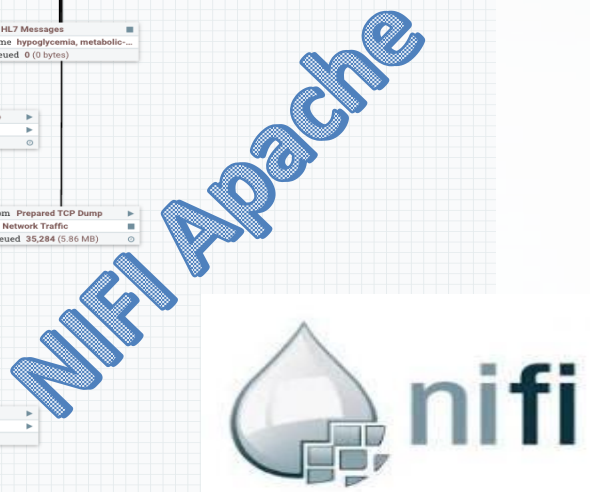
Example of NIFI

The screenshot displays the Apache NiFi web interface with a process group named "Deliver Source Data to Analytics". The interface includes a top navigation bar with user information (nifguy@apache.org), a search bar, and various status indicators. On the left, there are panels for "Navigate" and "Operate". The main workspace shows a complex data flow with several processors and connectors. Each processor has a detailed status window showing metrics like "Queued", "In", "Read/Write", "Out", and "Tasks/Time".

Key components in the flow include:

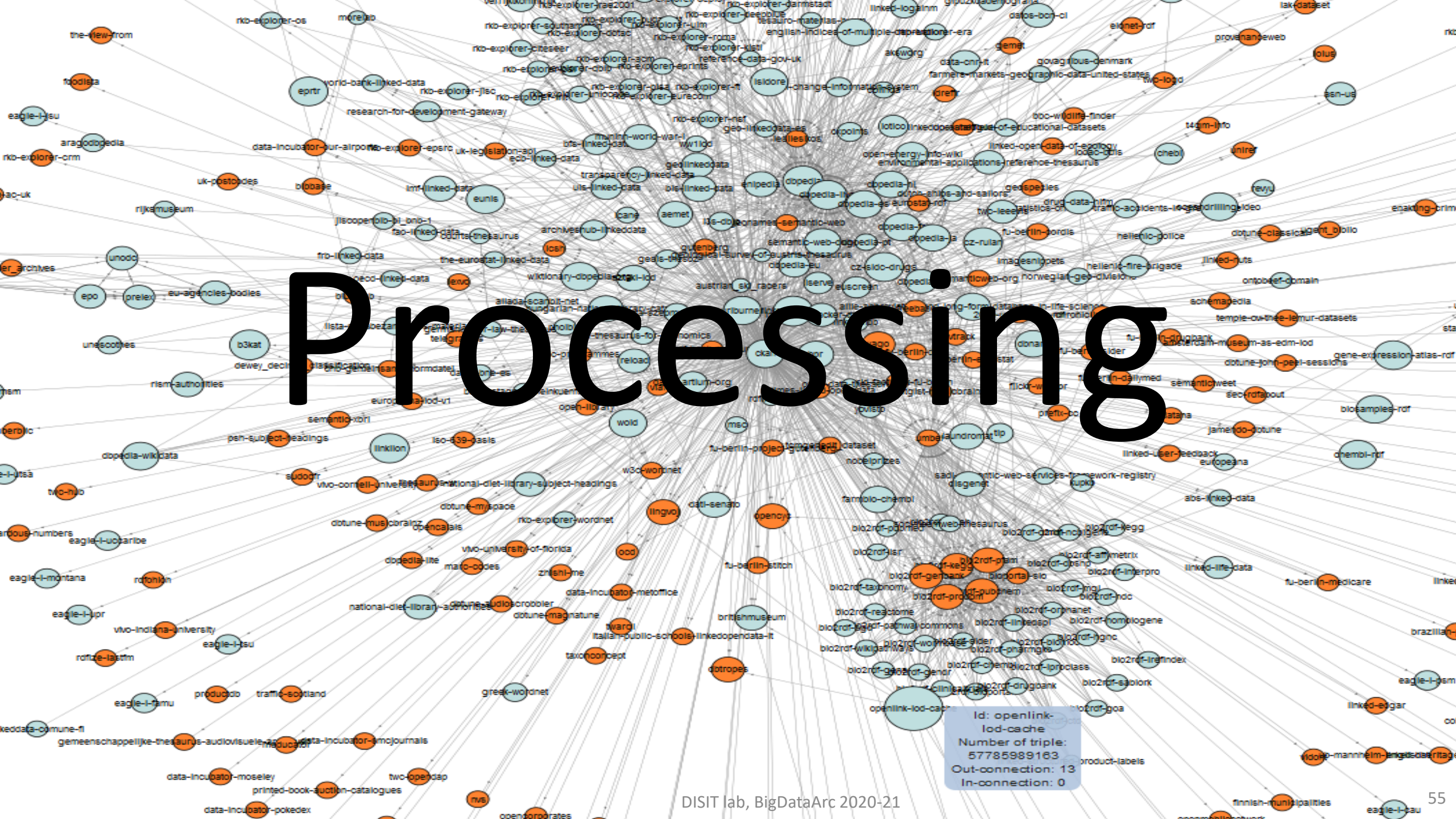
- Receive Configuration Resources**: Queued 0 (0 bytes), In 0 (0 bytes) → 0, Read/Write 0 bytes / 0 bytes, Out 0 → 0 (0 bytes).
- Translate Language**: Queued 0 (0 bytes), In 6,106 (25.97 MB) → 1, Read/Write 0 bytes / 0 bytes, Out 1 → 47,967 (207.2 MB).
- Unwrap HL7 Data**: Queued 0 (0 bytes), In 0 (0 bytes) → 1, Read/Write 0 bytes / 0 bytes, Out 1 → 0 (0 bytes).
- Find interesting tweets**: In 53,020 (229.54 MB), Read/Write 0 bytes / 0 bytes, Out 106,040 (459.08 MB), Tasks/Time 53,023 / 00:00:10.268.
- RouteHL7**: In 0 (0 bytes), Read/Write 0 bytes / 0 bytes, Out 0 (0 bytes), Tasks/Time 0 / 00:00:00.000.
- Geo Enrich Non-Local Traffic**: Queued 2,864 (487.27 KB), In 331,243 (55.58 MB) → 1, Read/Write 55.59 MB / 0 bytes, Out 1 → 659,098 (221.54 MB).
- Split Lines**: In 95 (52.37 MB), Read/Write 52.37 MB / 0 bytes, Out 310,885 (52.07 MB), Tasks/Time 95 / 00:00:20.476.
- Batch Analytics**: Queued 216,822 (506.84 MB), In 53,564 (229.62 MB) → 6, Read/Write 0 bytes / 0 bytes, Out 0 → 0 (0 bytes).
- Streaming Analytics**: Queued 55,184 (236.96 MB), In 0 (0 bytes) → 4, Read/Write 0 bytes / 0 bytes, Out 0 → 0 (0 bytes).

Connectors and other processors include "To Raw Tweets", "To Wrapped HL7", "To Network Traffic", "To Network Activity", "To Tweets", "To HL7", "To HL7 Messages", "To Photos", "To TCP Dump Entries", "To Network Traffic", "From Prepared TCP Dump", "From Unwrapped Photos", "From Prepared TCP Dump", "To Network Traffic", "From Prepared TCP Dump", "To Network Traffic", "From Prepared TCP Dump", "To Network Traffic".



Batch Processing

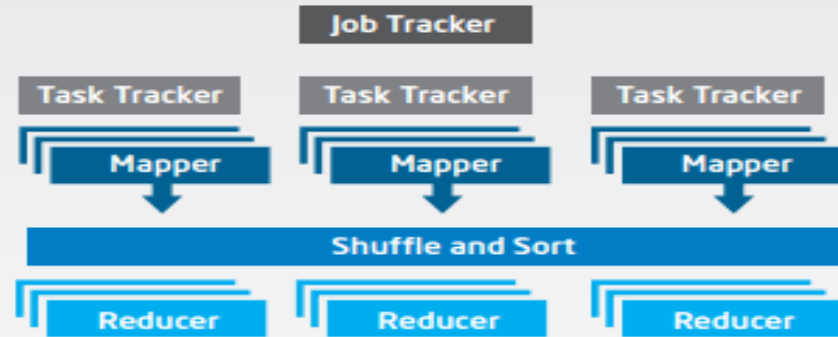
Processing



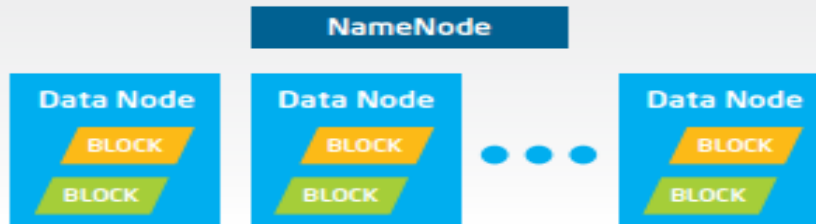
Hadoop and MapReduce

LOGICAL ARCHITECTURE

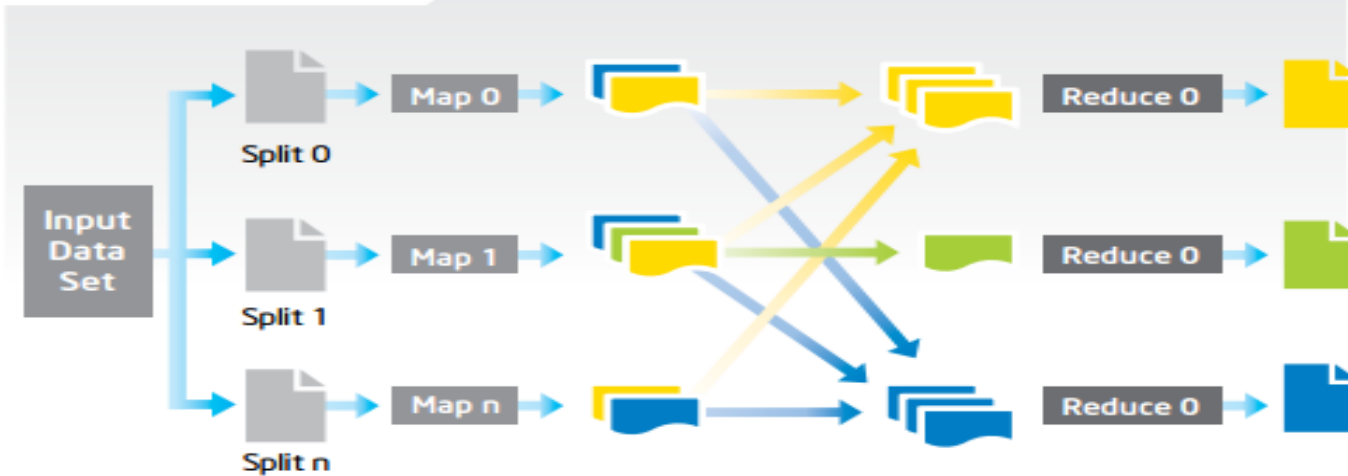
Processing: MapReduce



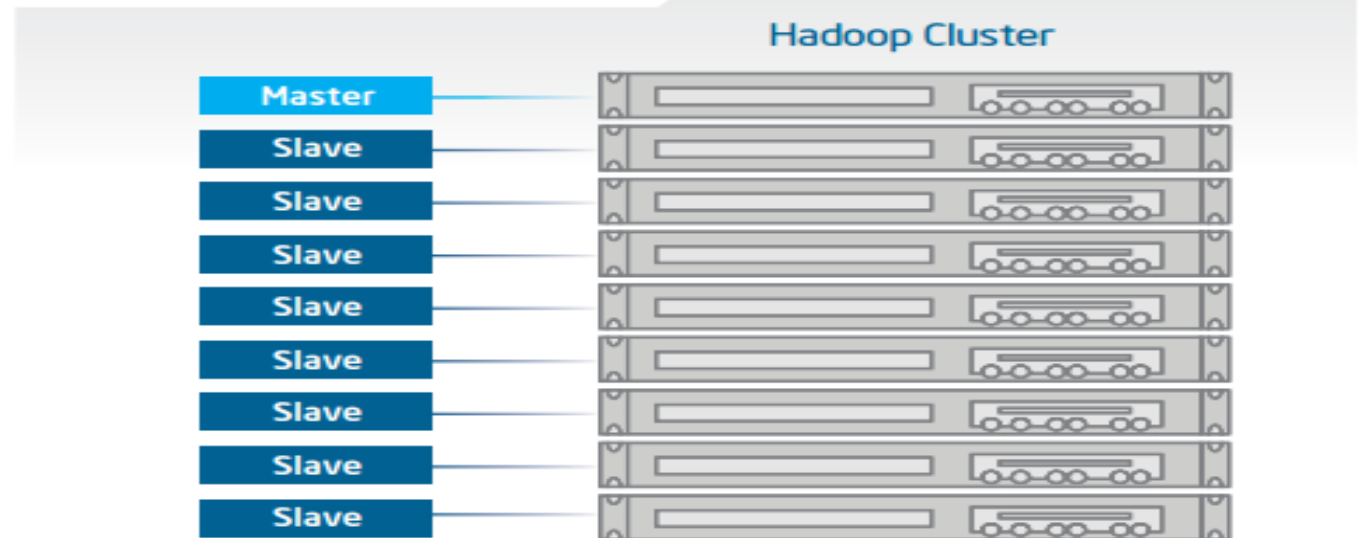
Storage: HDFS



PROCESS FLOW



PHYSICAL ARCHITECTURE





Developer in R Studio, Python + Tensor Flow

Snap4City

- dashboards
- Notificator
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal

R Studio Development

```

110 anomaliesMat[, "timestamp"] <- as.character(dataFinal[res$anoms$index, "alignDate"])
111 anomaliesMat[, "anoms"] <- as.numeric(res$anoms[, "anoms"])
112
113 #table with anomalies
114
115 setwd(outdir)
116 options(digits = 1)
117 t$table <- tableGrob(anomaliesMat, rows = NULL, cols = c("Date and Time", "Anomaly"), theme=ttheme_default(base_size=
118 grid.draw(t$table)
119 h <- convertHeight(sum(t$table$heights), "in", TRUE)
120 w <- convertWidth(sum(t$table$widths), "in", TRUE)
121
122 plot <- res$plot
123
124 plotMix <- grid.arrange(plot, t$table,
125                       ncol = 2,
126                       heights=c(5,1),
127                       as.table=TRUE)
128
129 setwd(outDir)
130 ggsave(paste(columnsName[i], "Anomalies.png", sep=""), plotMix, width=22, height=h*5)
131
132 }, finally = {
133
134 }
135
136 statisticsResult[[indfolder]]$resultFiles[indResult]$sensor=NULL
137 statisticsResult[[indfolder]]$resultFiles[indResult]$sensor=unbox(as.character(columnsName[i]))
138 statisticsResult[[indfolder]]$resultFiles[indResult]$png=unbox(paste(outDir, paste(columnsName[i], "Anomalies.png", se
139 indResult = indResult + 1
140
141 }else{
142 print(paste("NO ANOMALIES ON THE SENSOR ", "-", columnsName[i], "-", sep=""))
143 }
144
145
146 setwd("~/Snap4City")
147 write(jsonlite::toJSON(statisticsResult[[1]]), "JsonStatisticsResult.json")
148 return(statisticsResult[[1]])
149
150
151

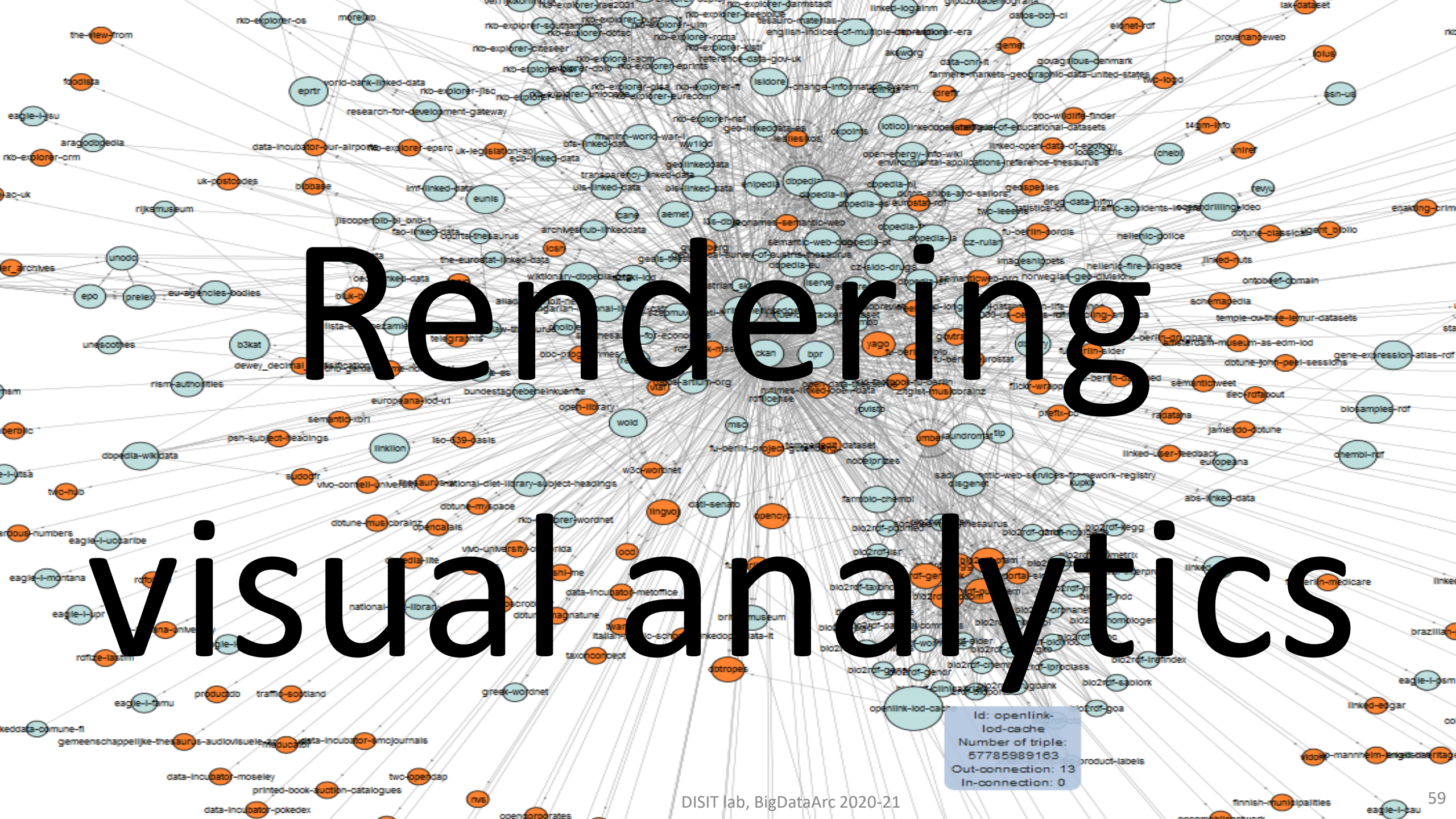
```

Environment

Object	Attributes
dataFinal	2794 obs. of 18 variables
dataset	35539 obs. of 12 variables
dataTest	97 obs. of 15 variables
dataTestFinal	97 obs. of 3 variables
dataTrain	2793 obs. of 15 variables
meltDataTest	97 obs. of 4 variables
p3	Large ttable (784 elements, 9.2 Mb)
plt	List of 9
statisticsResult	List of 1

Click on each .png file to visualize the statistics: a new tab will be opened

- AverageSpeedDailyTrend.png
- CarParksDailyTrend.png
- CorrelationMatrix.png
- PredictedFreeParking.png
- SensorsMeanPerDayMoment.png
- StatisticsBySensors.png
- StatisticsBySensorsAndDayMoment.png
- VehicleFlowDailyTrend.png



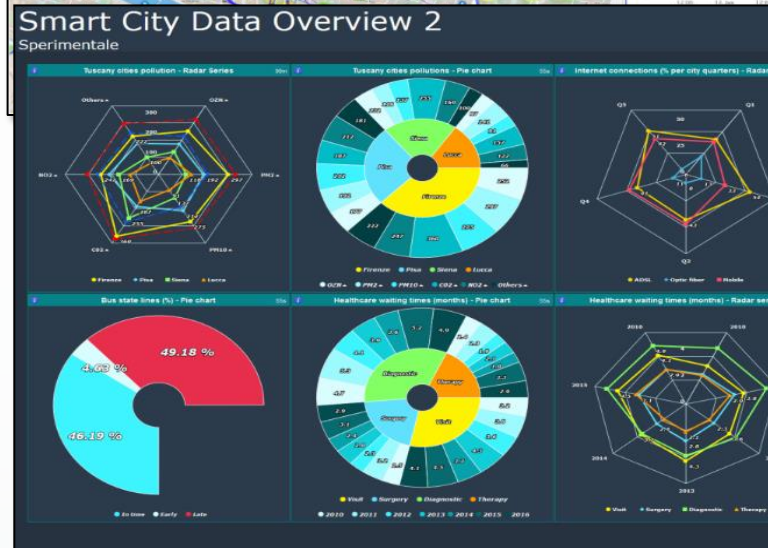
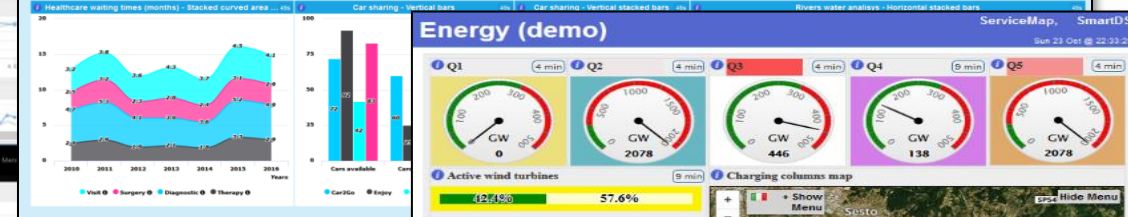
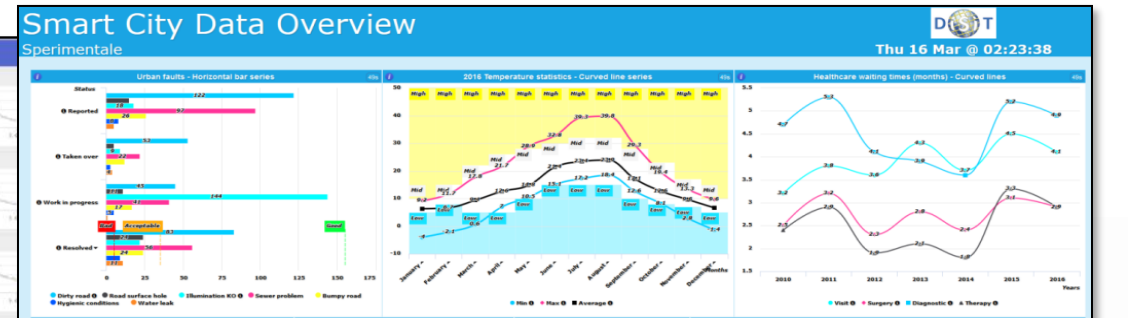
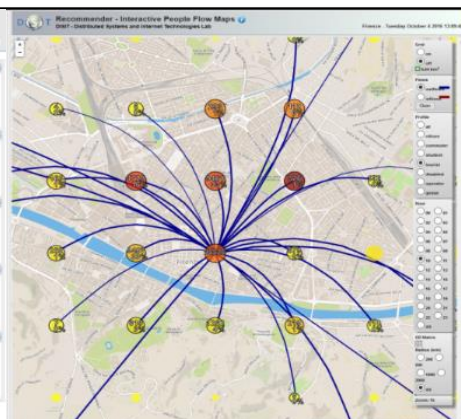
Rendering

visual analytics

Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0



Dashboard vs Business Intelligence



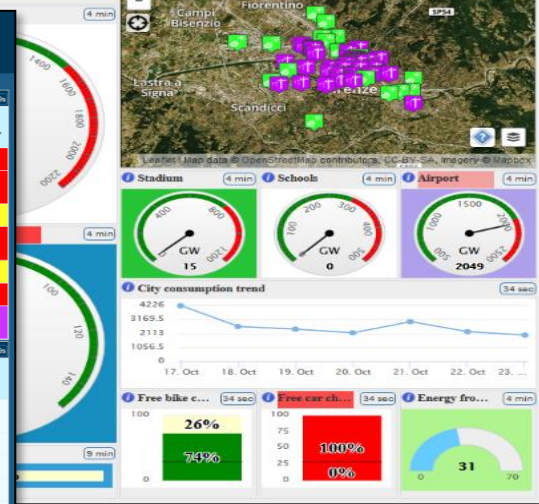
Florence data overview

A table based overview over city main data

Wed 18 Jan @ 19:19:10

Air Quality Index					Weather stations				Citizens satisfaction index								
Substance / Quarters	OZn	PM2.5	PM10	CO2	NO2	Data / Station	Wind speed (km/h)	Direction	Temperature (°C)	Humidity (%)	Rain today (mm)	Pressure (mbar)	Criteria / Services	Quality (%)	Cost (%)	Availability time (%)	Emergency handling (%)
01	120	41	165	36	4	Sesto Fiorentino	50	N	12	72	0	922	Water	92	67	95	42
02	33	25	66	123	45	Livorno	65	NE	10	17	0	876	Public transportation	36	29	27	31
03	225	153	342	193	217	Grosseto	78	E	4	22	0	1022	Public safety	77	64	58	62
04	174	221	87	122	93	Vado	42	S	6	0	34	895	Roads management	28	42	27	25
05	79	87	23	27	65	Follonica	102	N	7.2	23	0	913	Healthcare	72	64	23	56
						Ciglio	97	O	3	19	0	957	Wellfare	43	51	38	36
													Public administration	58	16	18	22

Tourists flow				Florence events 2017 overview						
Categories / Vehicle	Total arrivals	Overnights	Day trippers	Fields / Categories	Free	Paid	Winter	Spring	Summer	Autumn
Airplane	56	36	20	Classical music, opera, ballet	7	23	6	10	4	10
Train	122	81	41	Exhibitions	4	16	3	7	6	4
Car	215	133	82	Guided tours	60	140	15	100	50	35
Bus	157	110	47	Film festival	0	0	0	0	0	0
Cruise	0	0	0	Markets, fairs	7	7	2	6	2	4
Boat	0	0	0	Readings, conferences	35	15	10	22	9	9
				Contemporary music	30	42	8	25	30	9
				Sport	20	192	55	104	27	26



Energy Dash

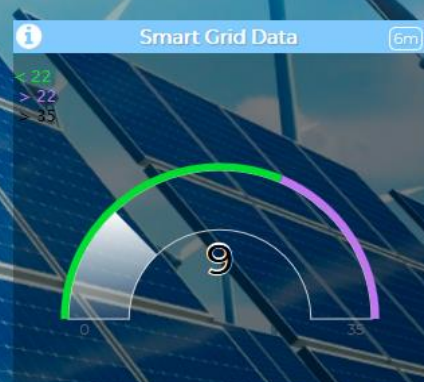
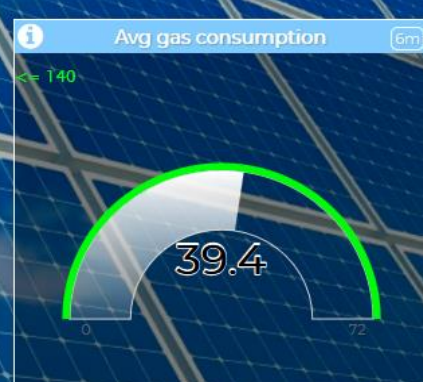
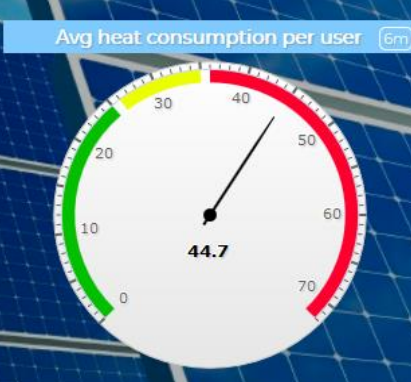
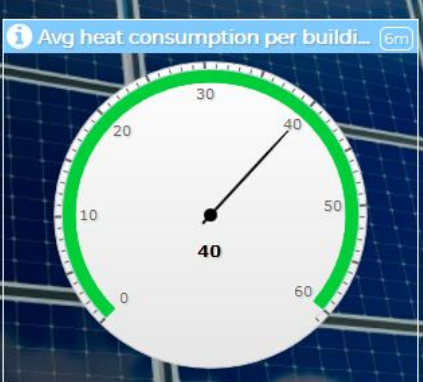
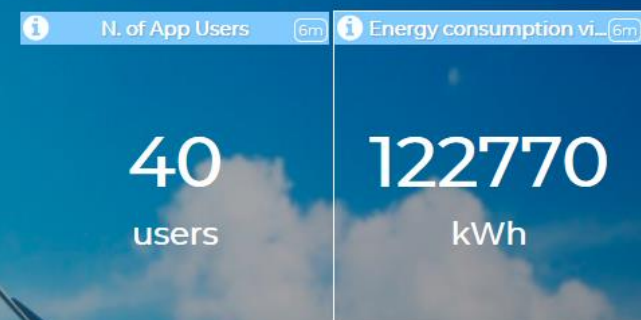
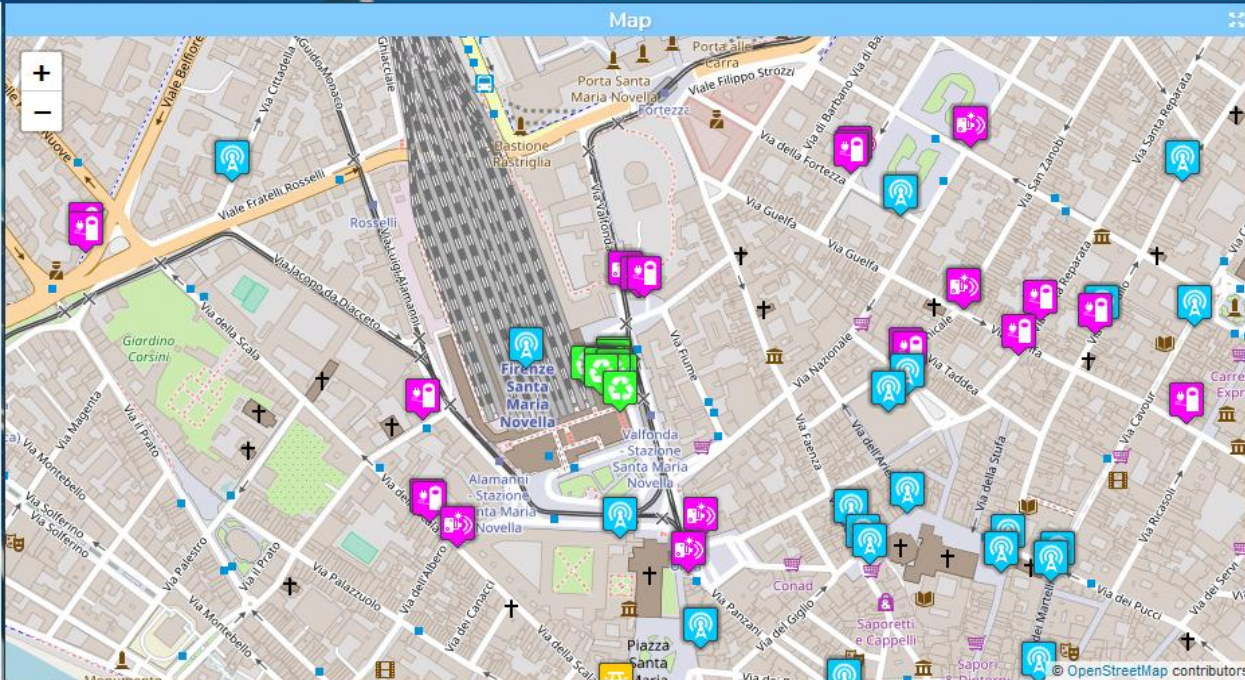
Pilot dashboard



Sun 8 Jul 11:59:06

Selector - Click the icon

- Fast recharging stations
- Florence WiFi POI
- Normal recharging stations
- Smart Benches
- Smart waste
- ZTL gate



Web site status

SNAP4CITY

✓

TOKEN FOUND

2018-07-08 11:51:37

Data Kinds vs Widgets: Special Widgets

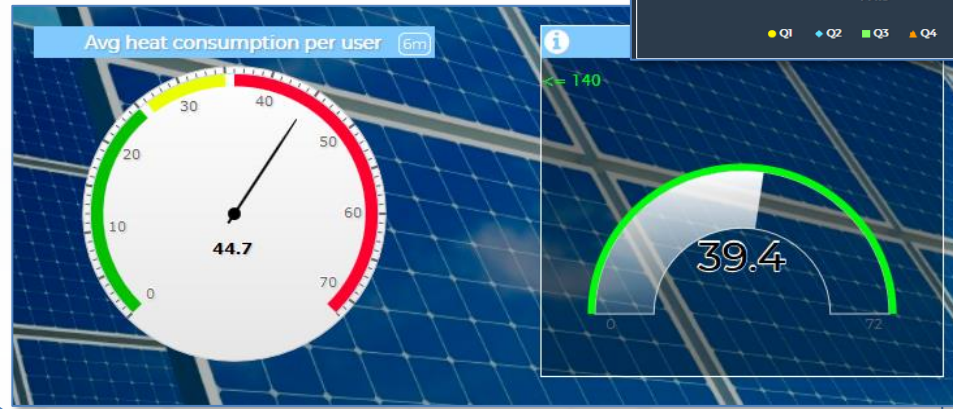
- Complex Event
- External Service
- MicroApplication
- **Special Widget**
- POI, Point of Interest
- KPI, Key Performance Indicator
- Sensor
- Sensor-Actuator
- My Personal Data
- Dashboard-IOT App



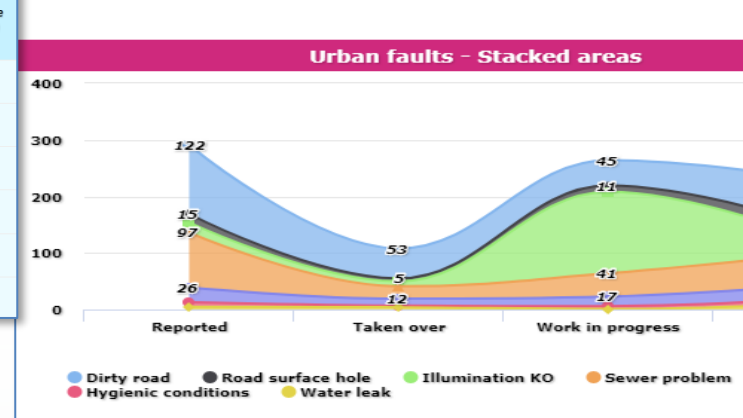
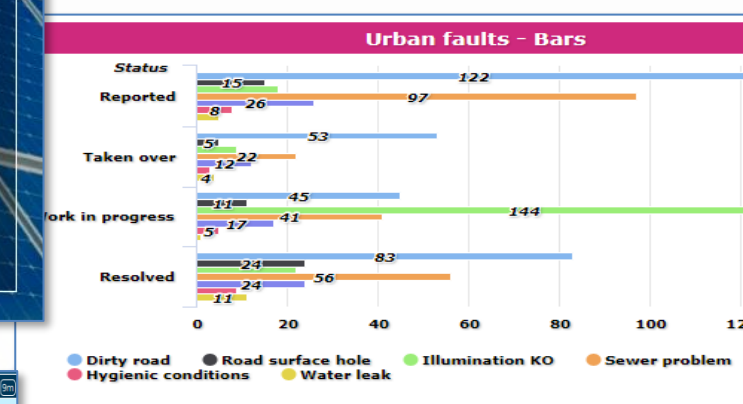
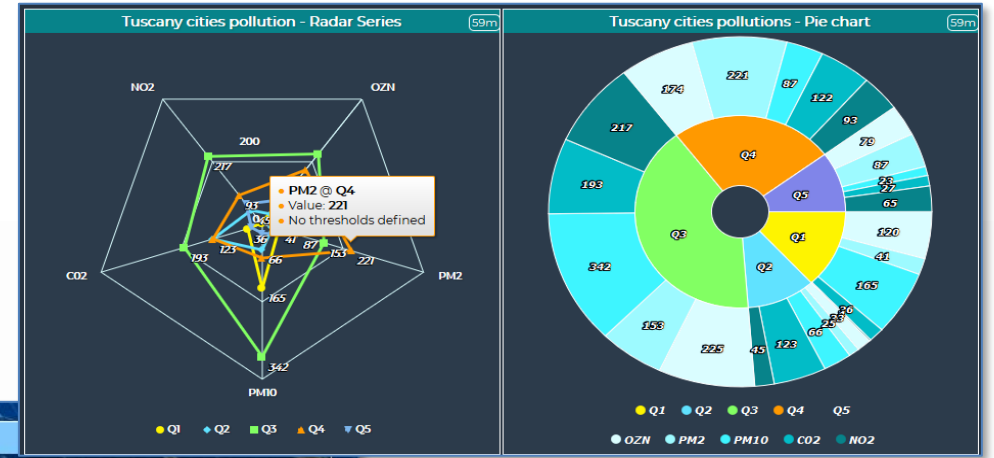
Florence main first aids status					
Priority/ Hospitals	Red code	Yellow code	Green code	Blue code	White code
PS AO CAREGGI	7	9	43	25	0
PS SAN GIOVANNI DI DIO TORREGALLI	1	6	20	6	0
PS SANTA MARIA ANNUNZIATA	0	8	10	8	1
PS SANTA MARIA NUOVA	1	6	17	5	0

Data Kinds vs Widgets: KPI

- Complex Event
- External Service
- MicroApplication
- Special Widget
- POI, Point of Interest
- **KPI, Key Performance Indicator**
- Sensor
- Sensor-Actuator
- My Personal Data
- Dashboard-IOT App



Data / Station	Wind speed (km/h)+	Direction	Temperature (°C)+	Humidity (%)+	Rain today (mm)+	Pressure (mbar)
Sesto Fiorentino	50	N	7	32	0	922
Livorno	65	NE	5.5	37	0	876
Grosseto	78	E	4	22	0	1022
Vado	42	S	6	0	34	895
Follonica	102	N	7.2	23	0	913
Ciglio	97	O	3	19	0	957



Real Time
Event Driven
Historical Data





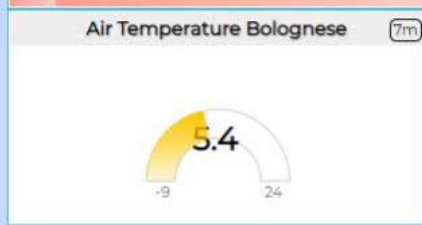
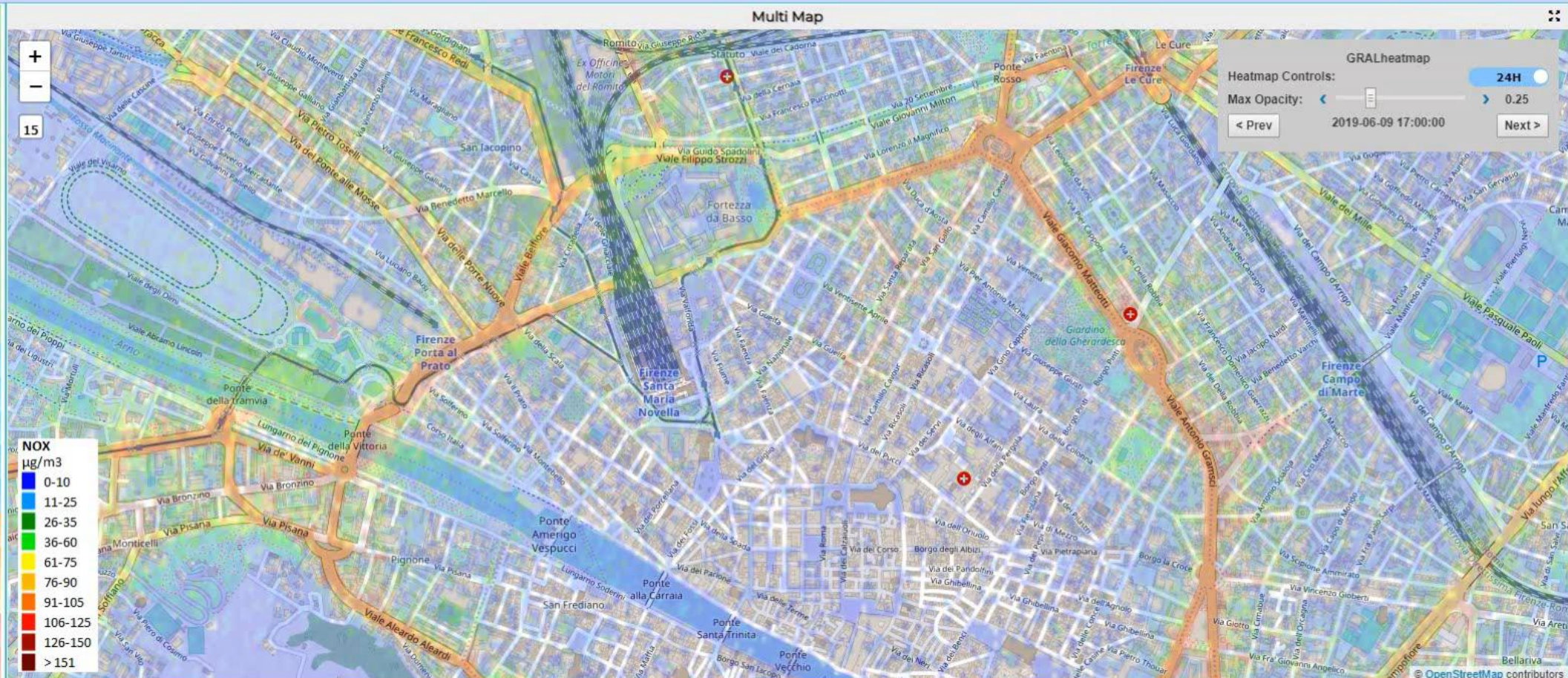
Firenze - Trafair - AirQuality Heatmaps



This dashboard contains data derived from actual sensors and predictive values under validation

Sun 9 Jun 17:41:58

- ▲ Air Quality Sensors
- ▲ PM10 Heatmap
- ▲ PM2.5 Heatmap
- ▲ CO Heatmap
- ▲ CO2 Heatmap
- ▲ SO2 Heatmap
- ▲ O3 Heatmap
- ▲ NO2 Heatmap
- ▲ Benzene Heatmap
- ▲ H2S Heatmap
- ▲ Air Humidity Heatmap
- ▲ Air Temp. Heatmap
- ▲ Wind Speed Heatmap
- ▲ Gral Pred. HM NOX (3m)
- ▲ Gral Pred. HM NOX (6m)
- ▲ Traffic Sensors
- ▲ Traffic Flow
- ▲ Cycling Paths
- ▲ Accident Heatmap
- ▲ Accident Heatmap 2



analytics

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0



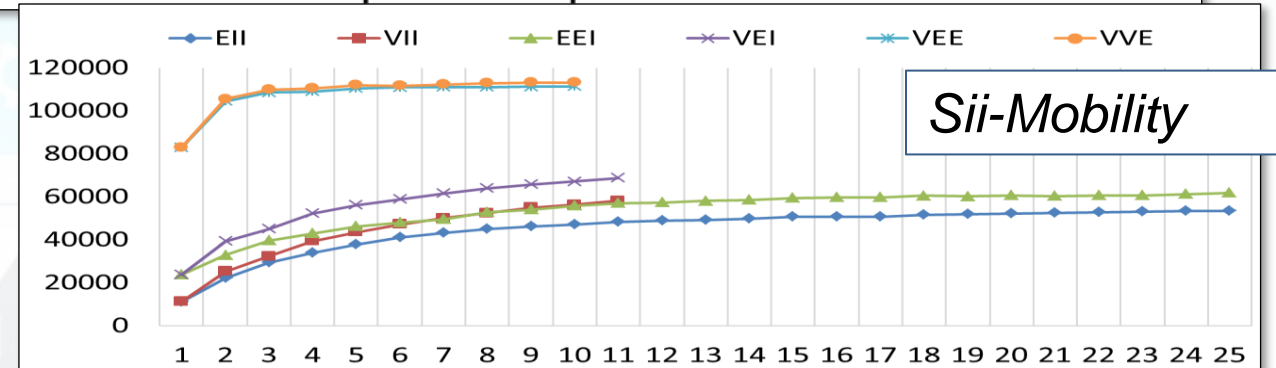
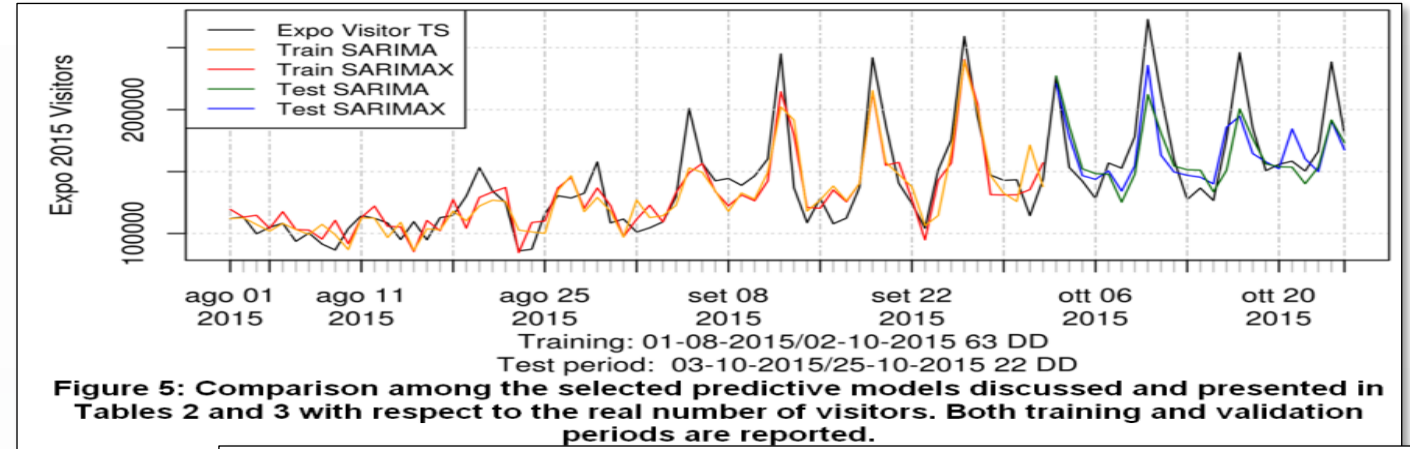
Big Data analytics Aree

Applicative DISIT Lab

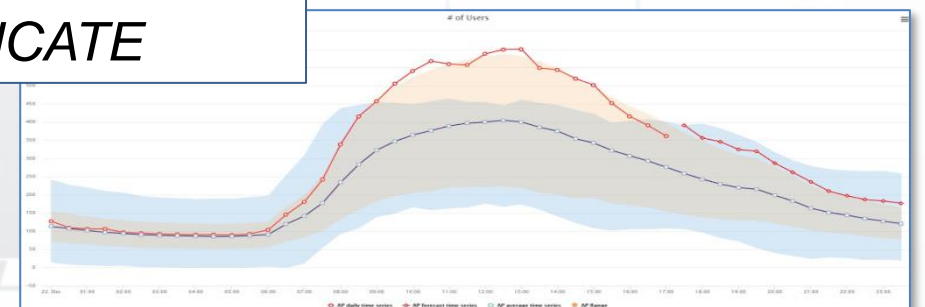
- Smart manufacturing
- Personal assistants
- Autonomous engines, semantic reasoners
- Experts systems, decision support systems
- Smart Cloud, elastic computing
- Services and microservices integration
- Industrie farmaceutiche
- Mobilità e Trasporti
- Turismo e Cultura
- Smart City, Innovation Lab, Living Lab
- Servizi alla persona

- **Solutions for**
 - Predicting models
 - Early detection
 - Anomaly detection
- **Data Analytics**
 - Data mining, Clustering
 - Semantic computing
 - Machine learning
 - Natural Language Processing, Sentiment Analysis
- **Architetture parallele**
 - Hadoop, Spark, Kafka, map reduce
 - Hdfs, Hbase, Mongo, Virtuoso, RDF stores
 - Distributed Scheduling
 - GPU

- **IOT/IOE**
 - Protocols
 - Devices
 - Data aggregation



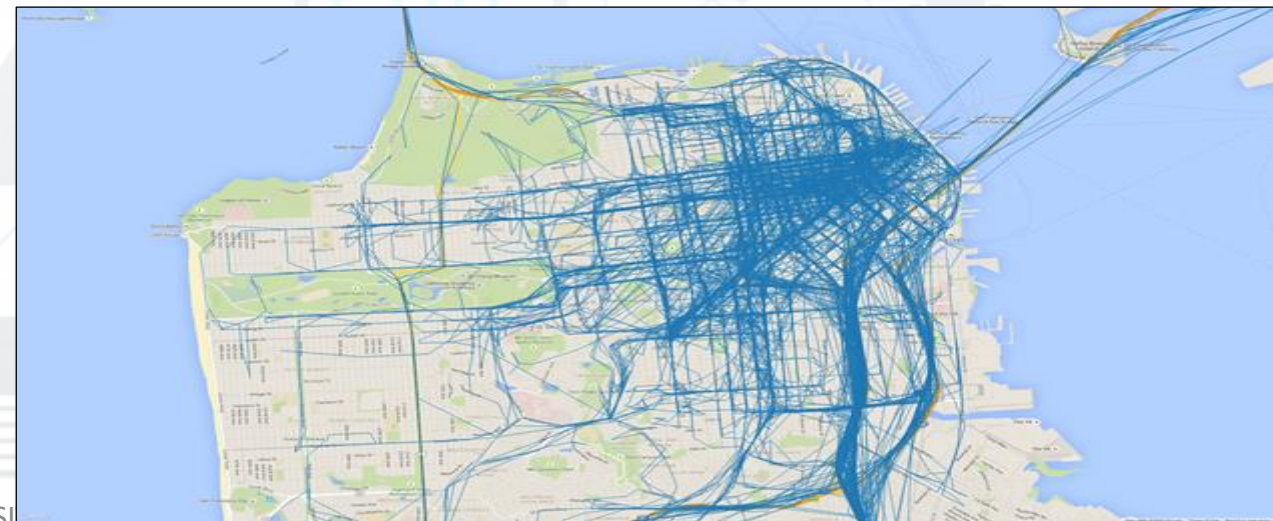
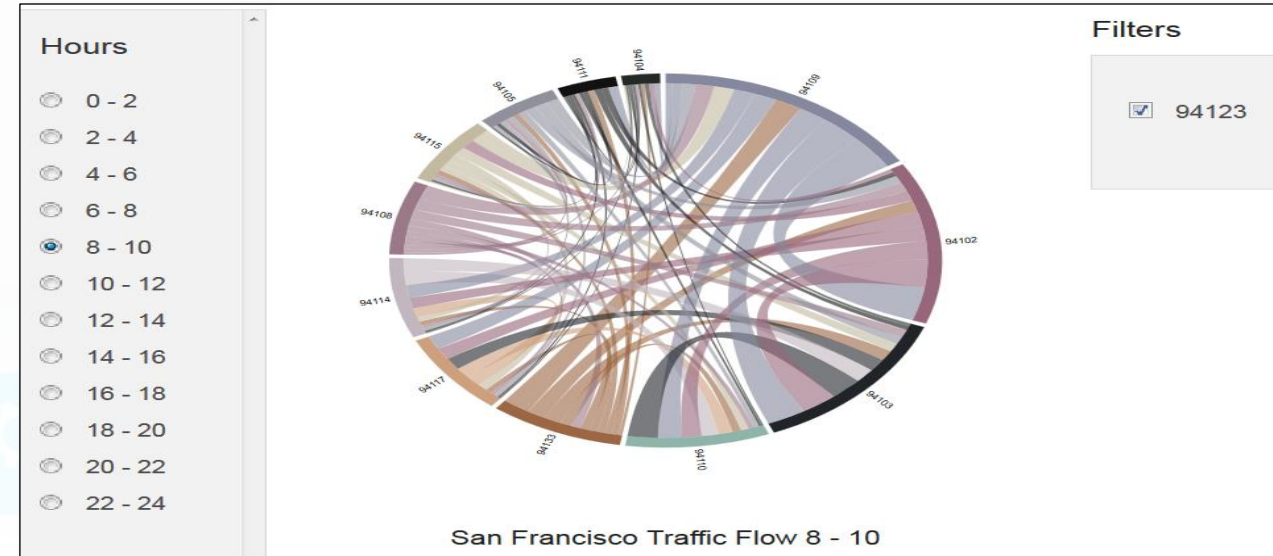
REPLICATE

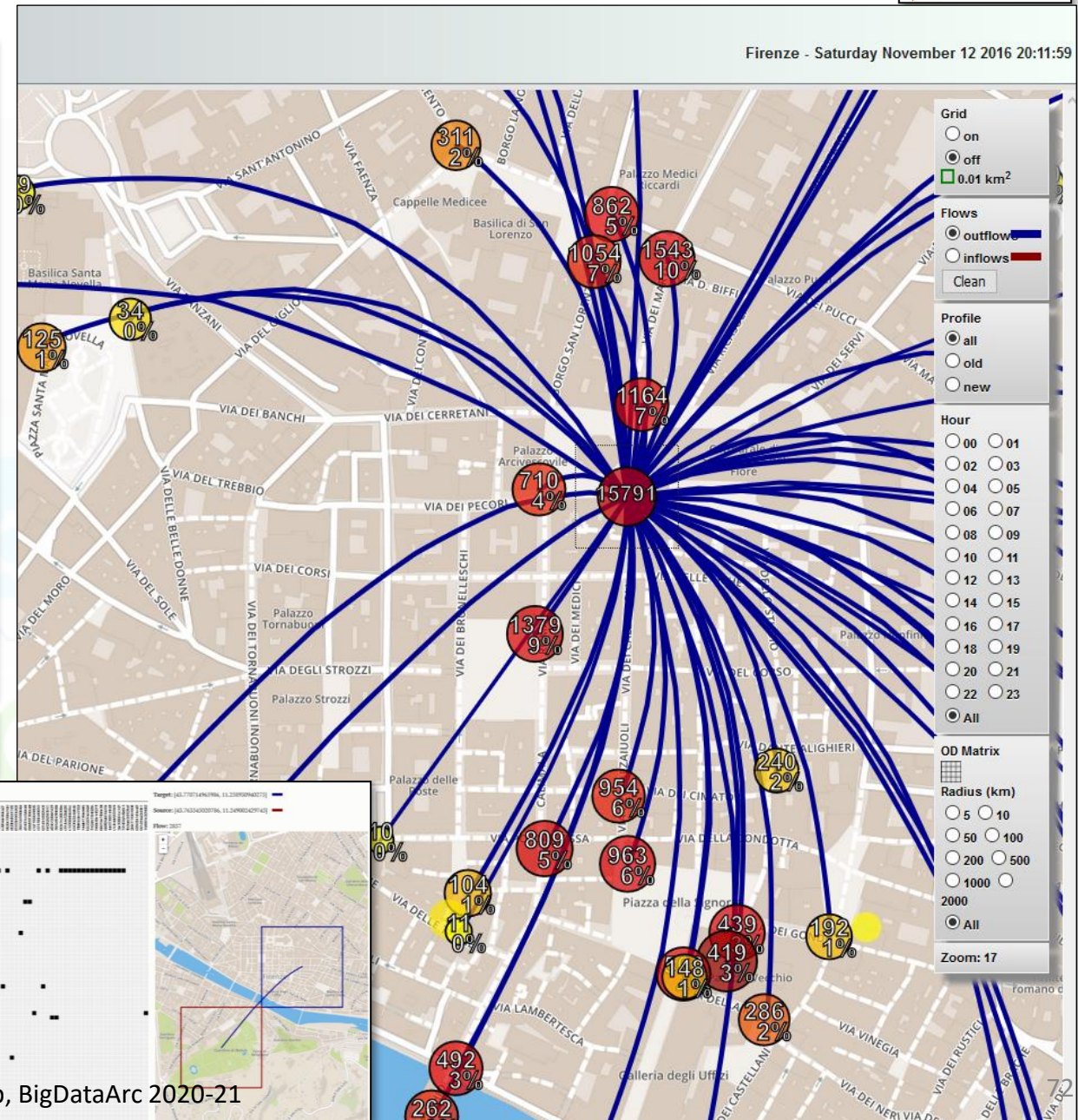
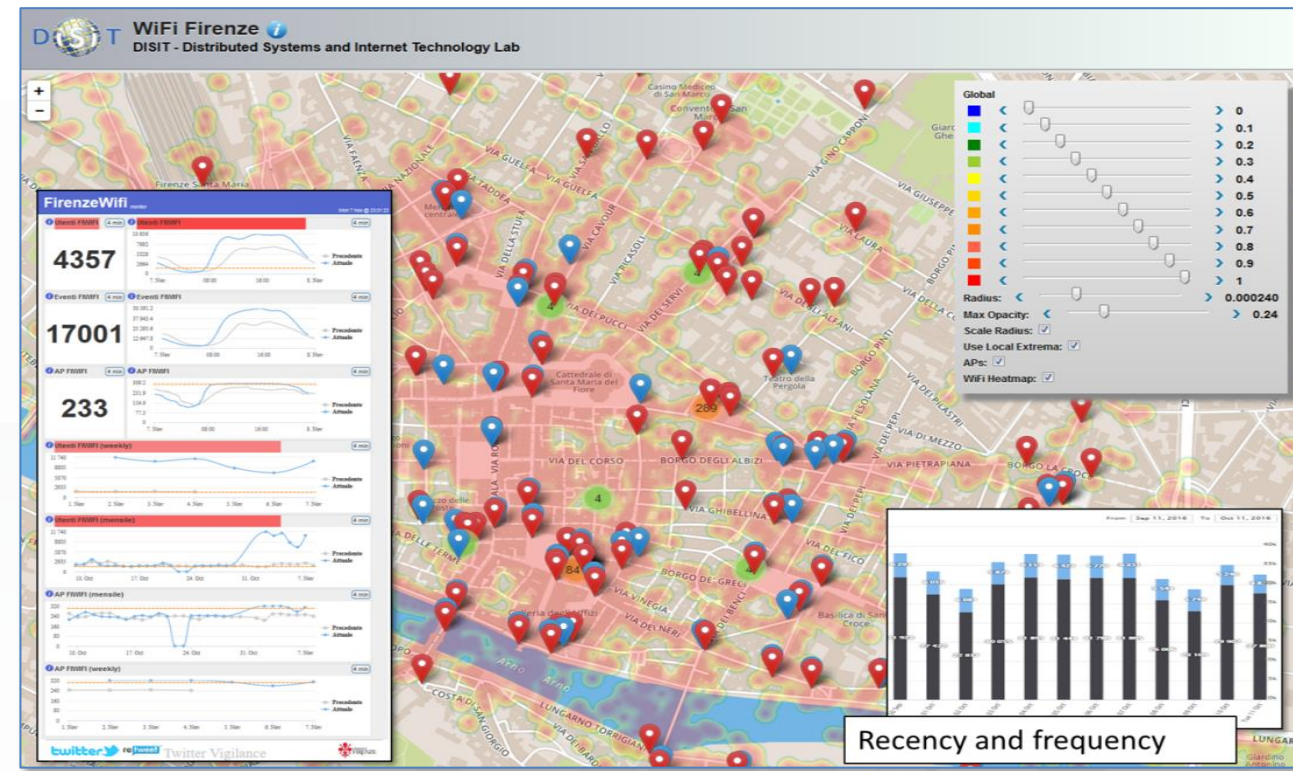


Traffic and People Flow Assessment

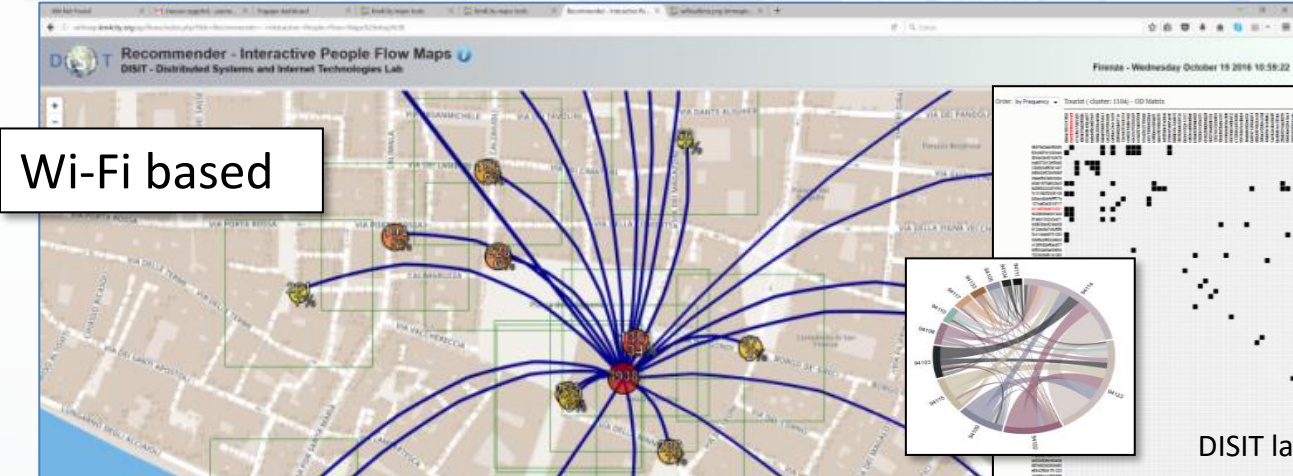
<http://www.disit.org/6694>

- **Origin Destination Matrix**
 - Specific Sensors, vehicle Kits, mobile App, Wi-Fi Access Points, etc.
- **Assess people and traffic flows to**
 - improve services
 - predict critical conditions on Crit. Infra.
 - take real time decisions and sending messages in push to population
 - Increase city resilience
 - optimize traffic flow
 - take decision of routing

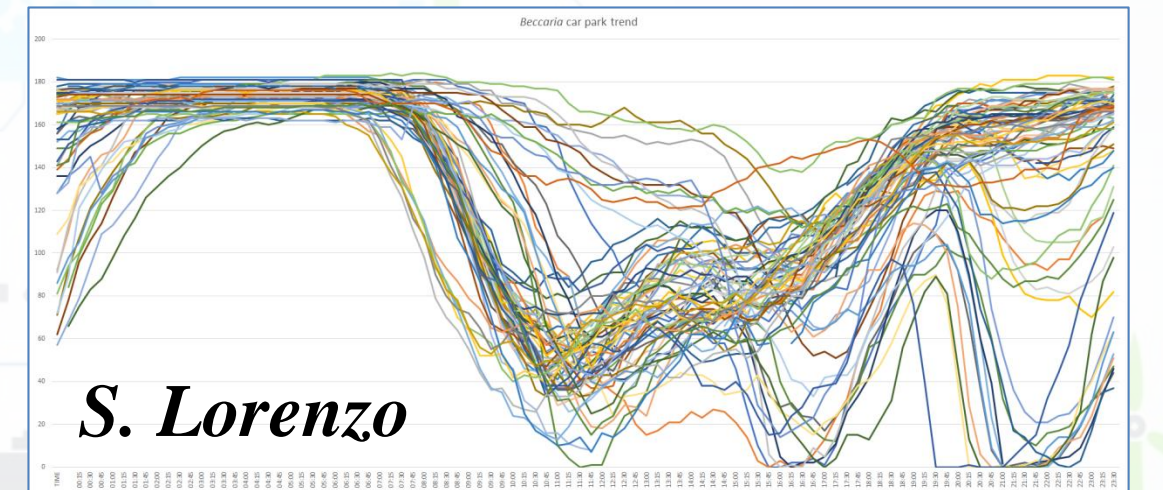
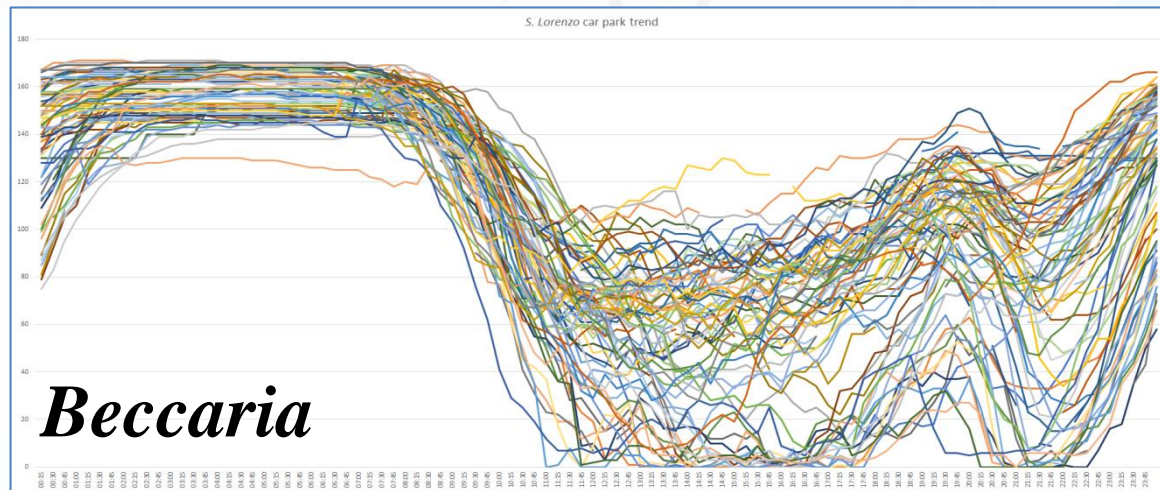
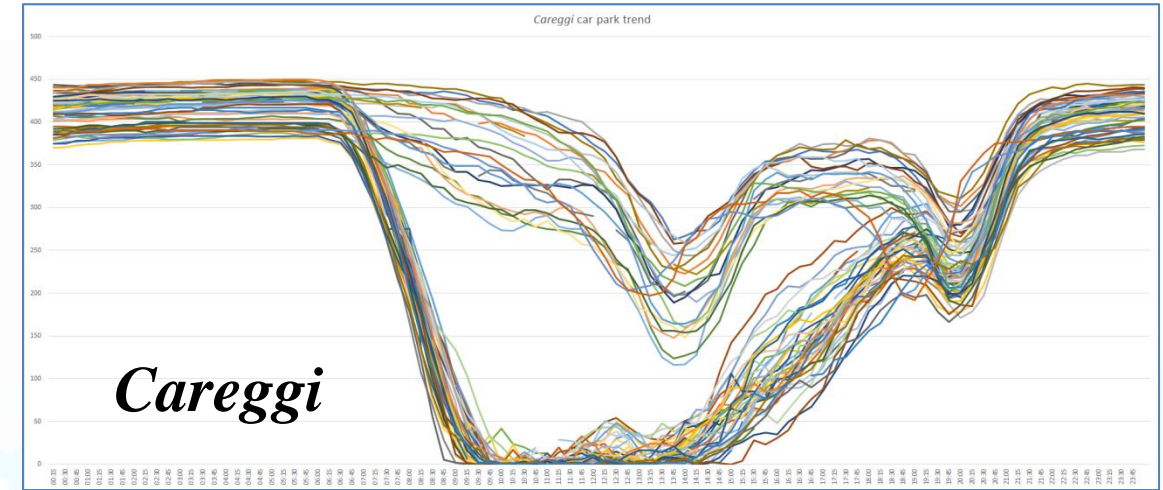
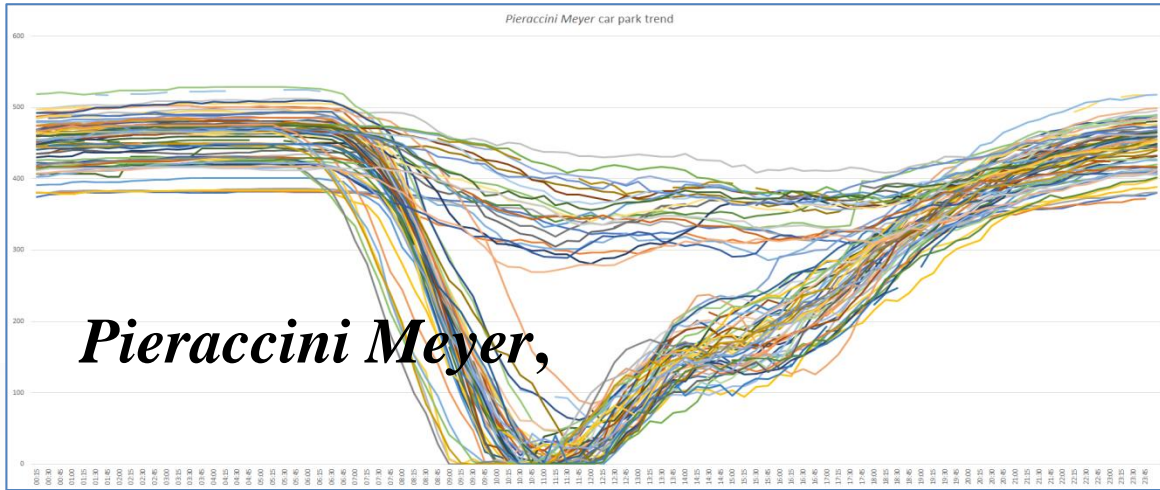




Wi-Fi based



Free Parking space trends





<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

Free Parking PREDICTIONS

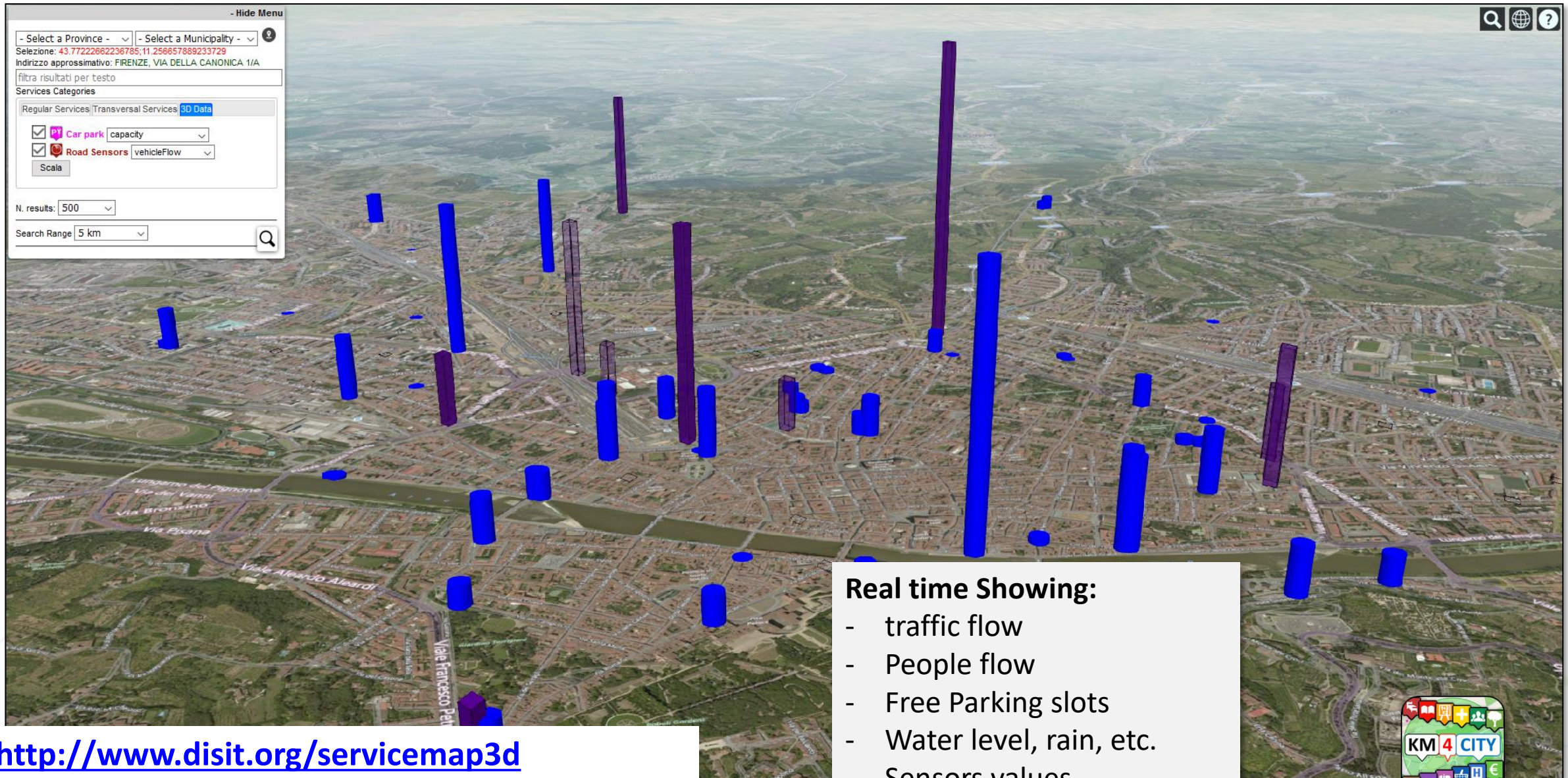
Careggi car park

Model features	BRNN model results		
	R-squared	RMSE	MASE
Baseline	0.974	24	1.87
Baseline + Weather	0.975	24	1.75
Baseline + Traffic sensors	0.975	24	2.04
Baseline + Weather + Traffic sensors	0.975	24	1.87

- Active on Apps
 - «Firenze dove cosa»
 - «Toscana dove cosa»



RealTime Values 3D

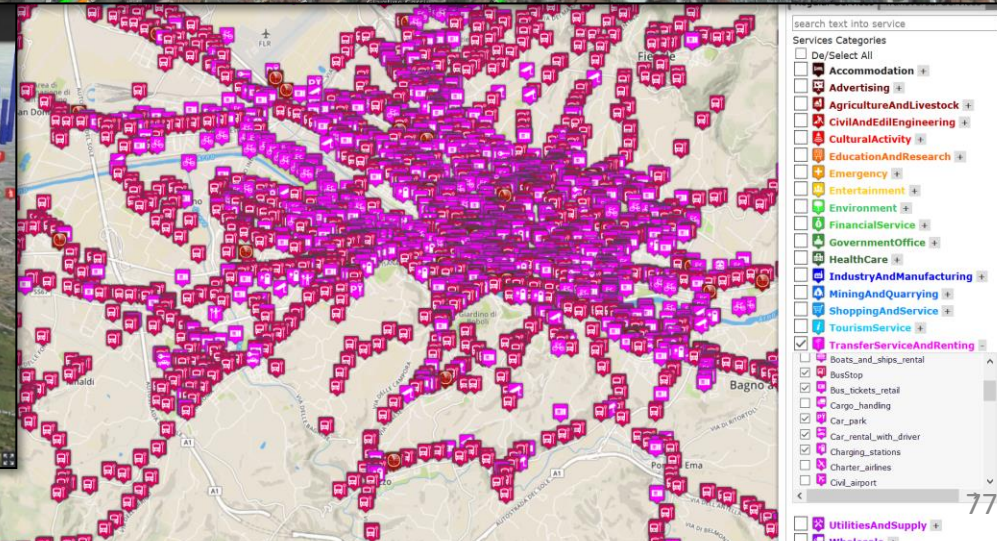
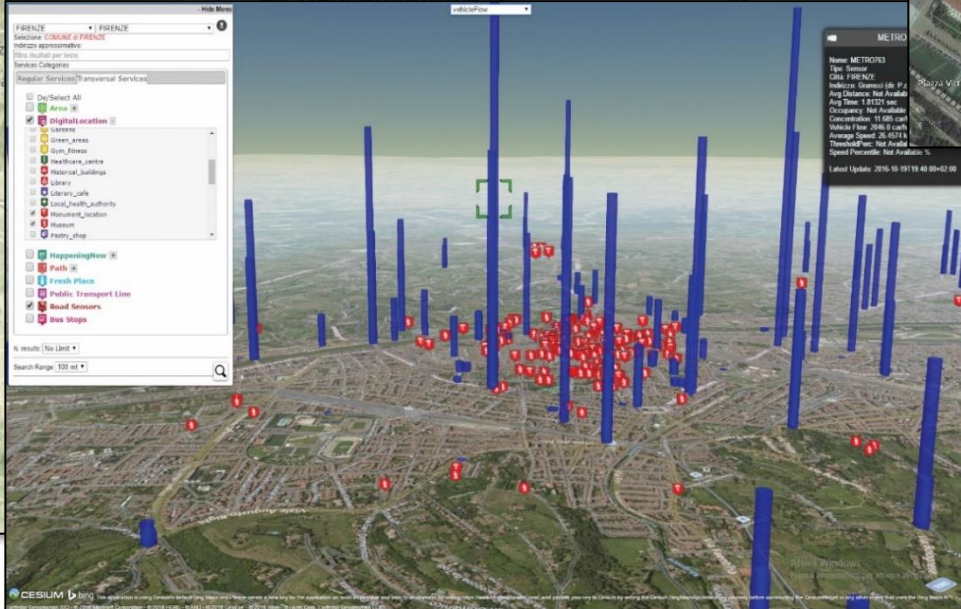
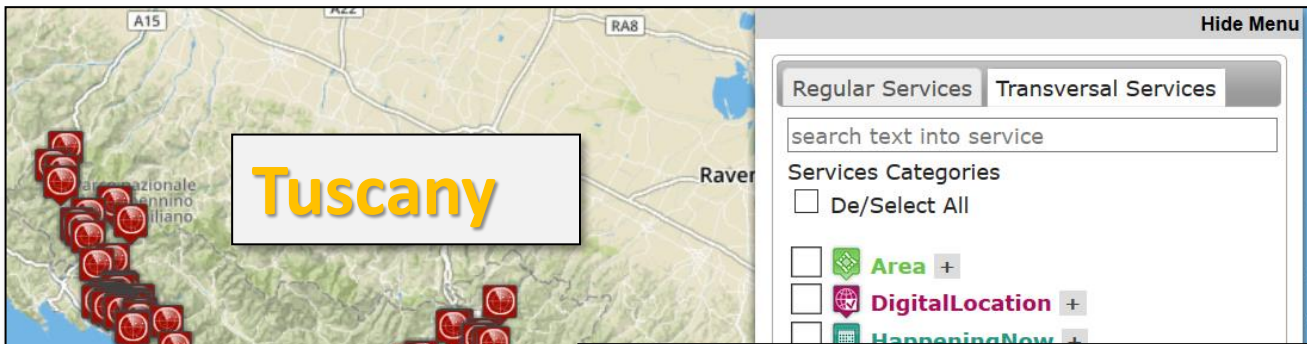


<http://www.disit.org/servicemap3d>

- Real time Showing:**
- traffic flow
 - People flow
 - Free Parking slots
 - Water level, rain, etc.
 - Sensors values....

Traffic Flow Tools

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



2018-02-01T00:10:00

Last sensors measure
2018-02-01T00:10:00

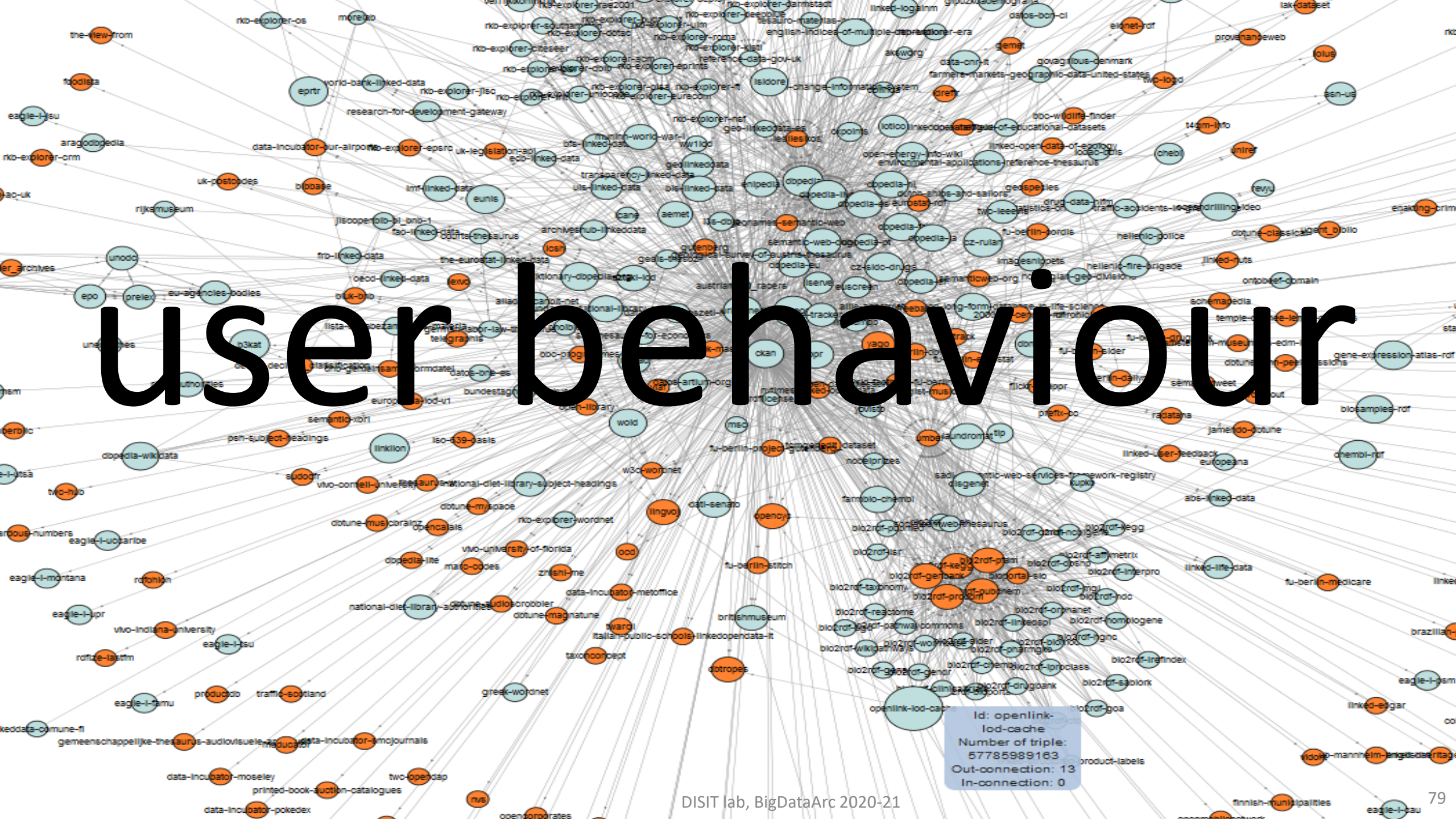
- Free street
- Fluid traffic
- Heavy traffic
- Very heavy
- Sensor position



<http://firenzetraffic.km4city.org>

Traffic Flow reconstruction, real time

user behaviour



Personal Assistant

Operators

Strategy Editor and feedback

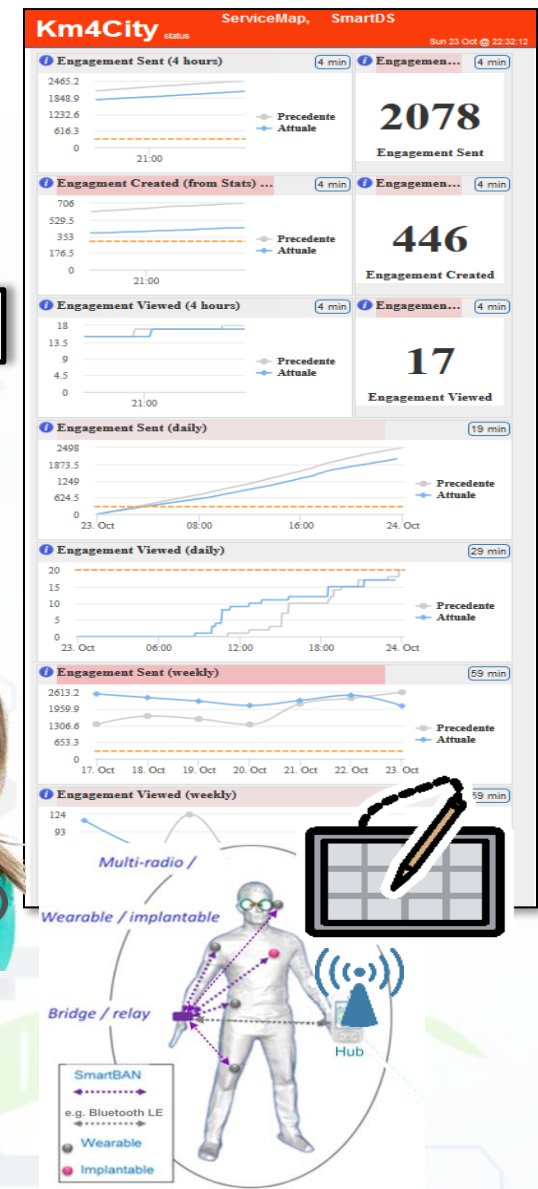


Rule name	Type	#sent	#viewed	#viewed on #sent	Description
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%	Suggest (in german) an event currently on in Florence
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%	Suggest (in english) an event currently on in Florence
- commuter		5 (0.29%)	0 (0%)	0 (0%)	
- student		14 (0.81%)	0 (0%)	0 (0%)	
- tourist		1462 (85%)	25 (35.71%)	25 (1.71%)	
- citizen		113 (6.57%)	39 (55.71%)	39 (34.51%)	
- operator		0 (0%)	0 (0%)	0 (0%)	
- disabled		0 (0%)	0 (0%)	0 (0%)	
- all		119 (6.92%)	6 (8.57%)	6 (5.04%)	
daily_event_es	ENGAGEMENT	6 (0.01%)	4 (0.41%)	66.67%	Suggest (in spanish) an event currently on in Florence
daily_event_fr	ENGAGEMENT	6 (0.01%)	0 (0%)	0%	Suggest (in french) an event currently on in Florence
daily_event_it	ENGAGEMENT	5459 (6.73%)	296 (30.02%)	5.42%	Suggest (in italian) an event currently on in Florence
parking_en	ASSISTANCE	141 (0.17%)	128 (12.98%)	90.78%	Alert (in english) if the user parked in a residential parking zone
parking_it	ASSISTANCE	141 (0.17%)	128 (12.98%)	90.78%	Alert (in italian) if the user parked in a residential parking zone
shoot					Alert for a nearby point-of-interest

- Inform
- Engage
- Stimulate / recommend
- Anomalies Detection
- Provide Bonus, incentives



IOT/IOE





UNIVERSITÀ
DI FIRENZE
DIPARTIMENTO DI STUDI
INGEGNERIA
DELL'INFORMAZIONE

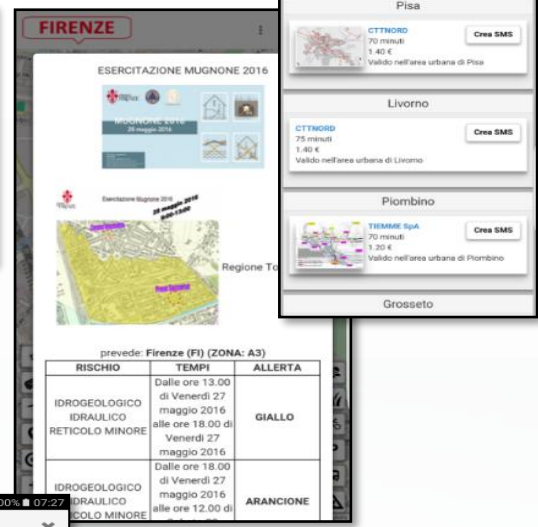
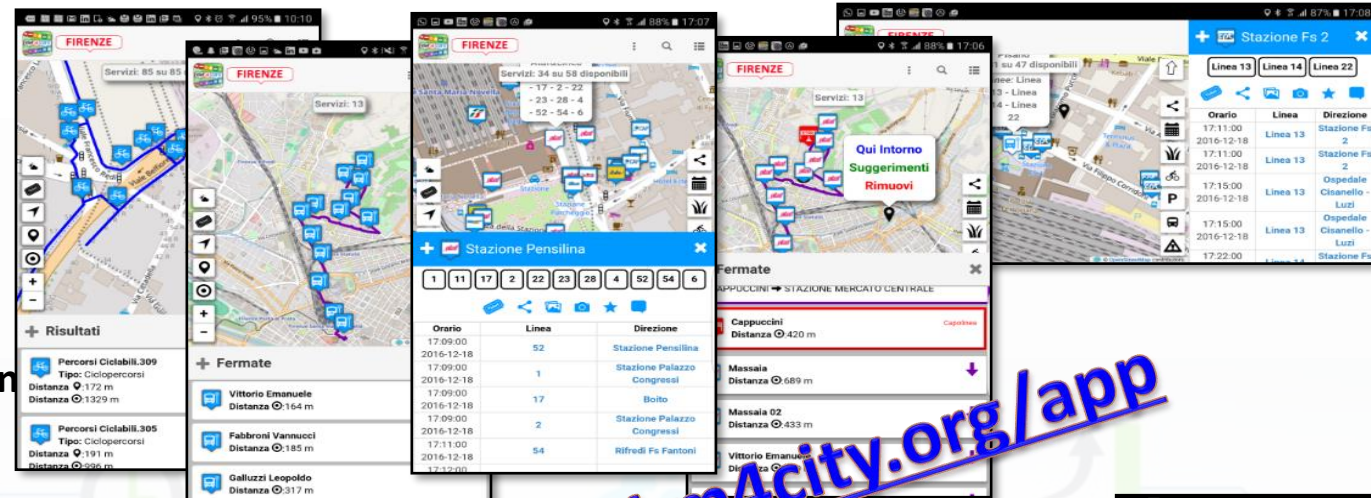
DISEGNIATI
DIPARTIMENTO DI STUDI
INGEGNERIA
DELL'INFORMAZIONE

Toscana dove cosa,

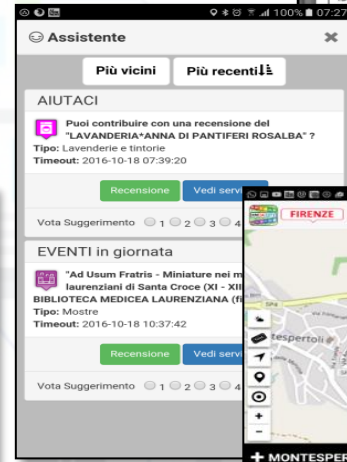
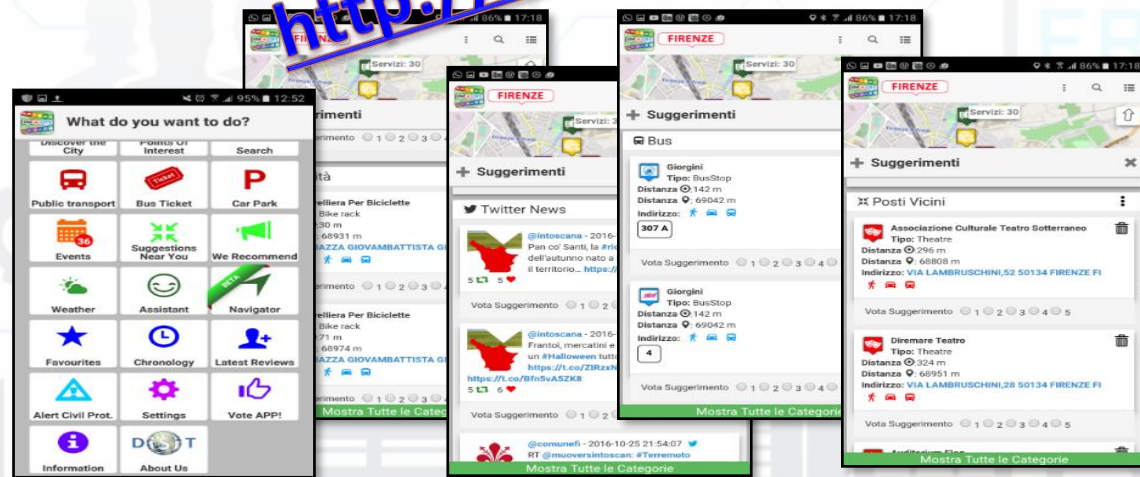
<http://www.disit.org>



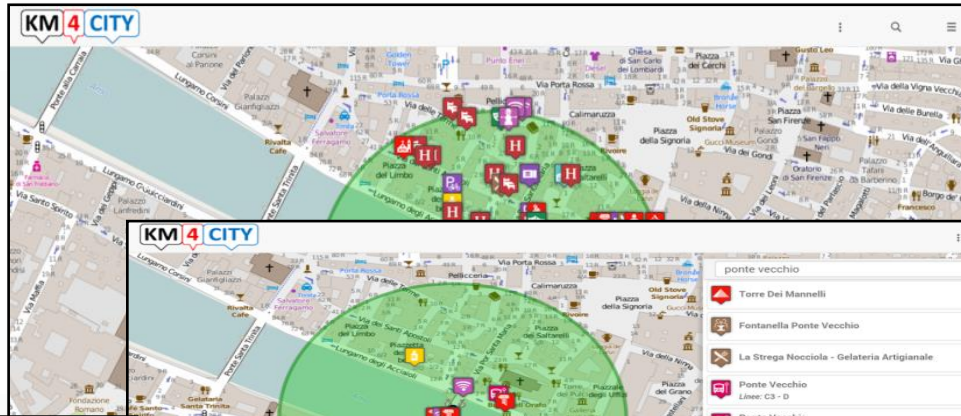
- Tutta la Toscana
- Personalizzabile
- Profilata per tipo di utente
- Trasporto pubblico
- Traffico, percorsi, navigazione
- Parcheggi liberi
- Costi benzina
- Suggerimenti
- Assistenza
- Protezione civile
- Meteo
- Biglietti bus
- Punti di Interesse
- Contributi degli utenti



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

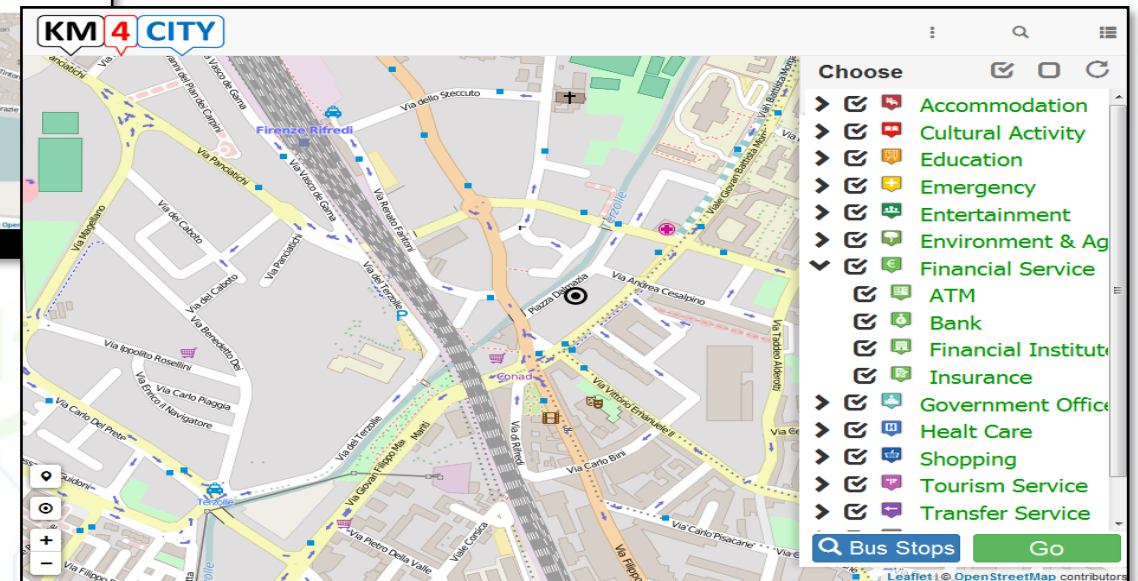
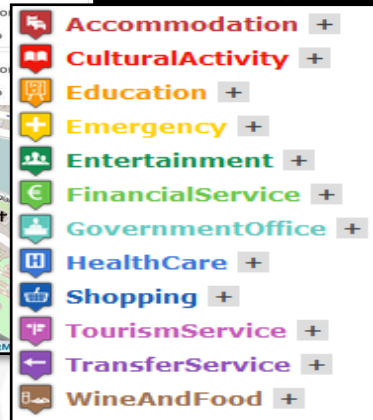
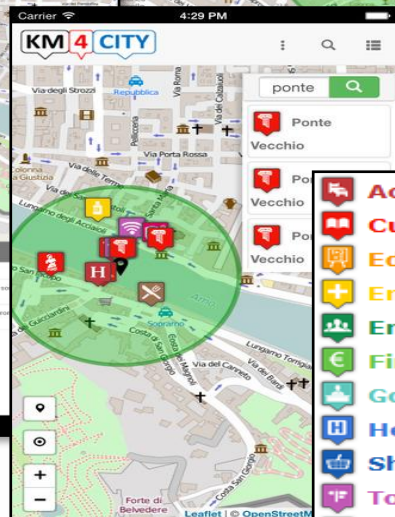
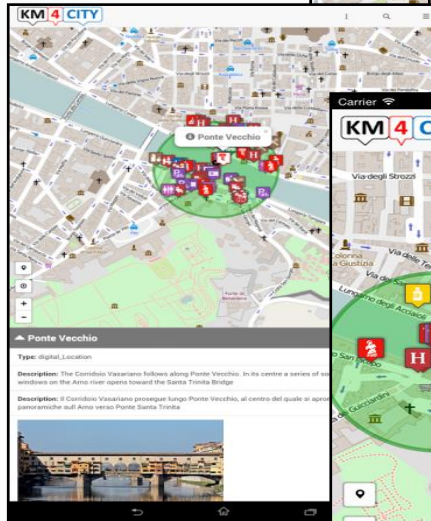


Km4CityMobile App: all stores



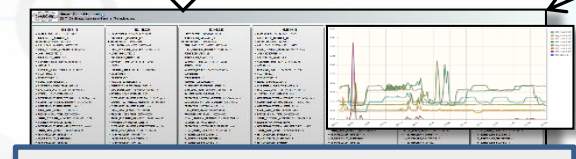
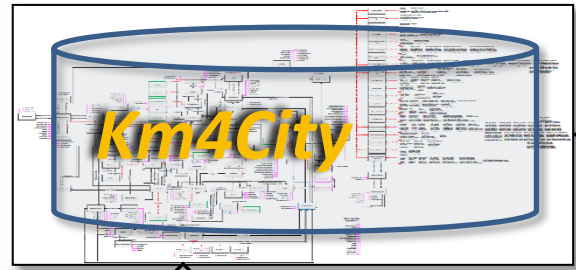
web application

<http://www.km4city.org>



Proximity Suggestion Architecture

- Categorie Servizi
- De/Select All
 - Accommodation** +
 - Advertising** +
 - AgricultureAndLivestock** +
 - CivilAndEdilEngineering** +
 - CulturalActivity** +
 - EducationAndResearch** +
 - Emergency** +
 - Entertainment** +
 - Environment** +
 - FinancialService** +
 - GovernmentOffice** +
 - HealthCare** +
 - IndustryAndManufacturing** +
 - MiningAndQuarrying** +
 - ShoppingAndService** +
 - TourismService** +
 - TransferServiceAndRenting** +
 - UtilitiesAndSupply** +
 - Wholesale** +
 - WineAndFood** +



**Suggestions on Demand,
machine learning**

**User Profiling
Collective Profiling**

Km4City Smart City API

Proximity
search

Suggestion request



Cose da fare 20:30

Tocca per vedere nuovi suggerimenti

Mobilità 20:30

Tocca per vedere nuovi suggerimenti

Suggestions

Weather

FIRENZE

Martedì	Mercoledì	Giovedì	Venerdì	Sabato
20°C 13°C	17°C 14°C	17°C 14°C		

Events

La Casa Delle Eccellenze
Type: Other events
Description: Il meglio della produzione fiorentina in vendita nel cuore di Firenze. Un temporary mall all'interno del bel complesso barocco dell'ex Tribunale di San Firenze, nella Sala della Musica. Partecipano numerose aziende di vari settori (moda, artigianato, enogastronomia, casa, meccanica e innovazione) con una rotazione

Show All Categories

Suggerimenti

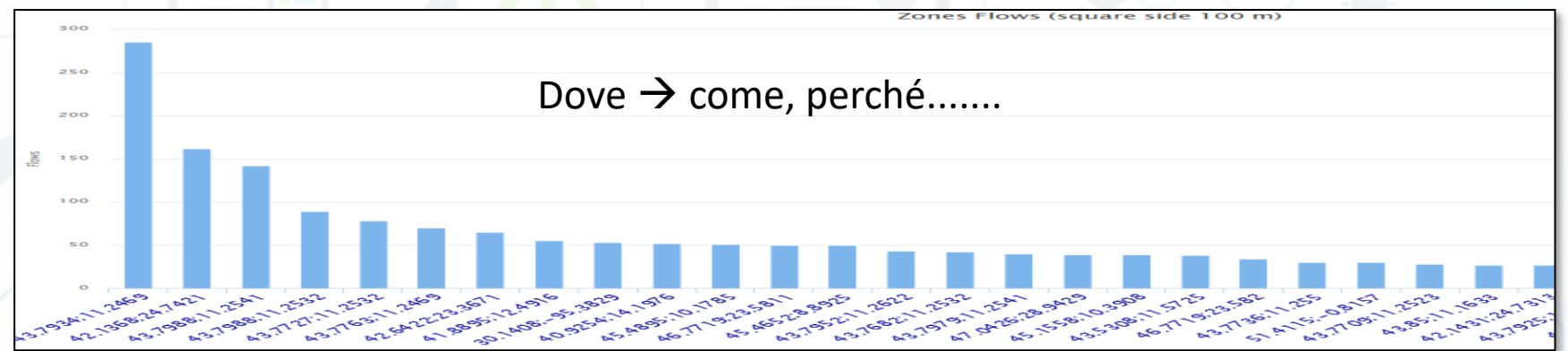
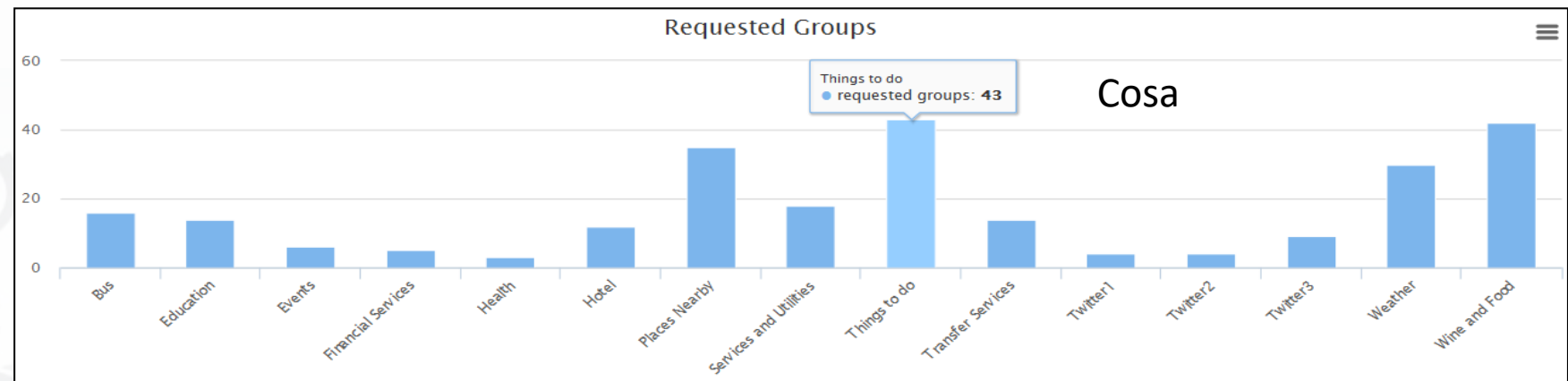
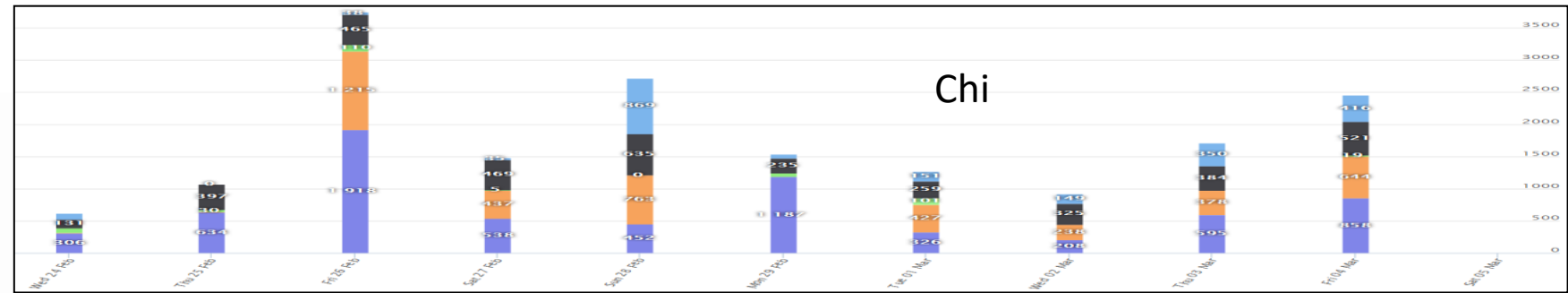
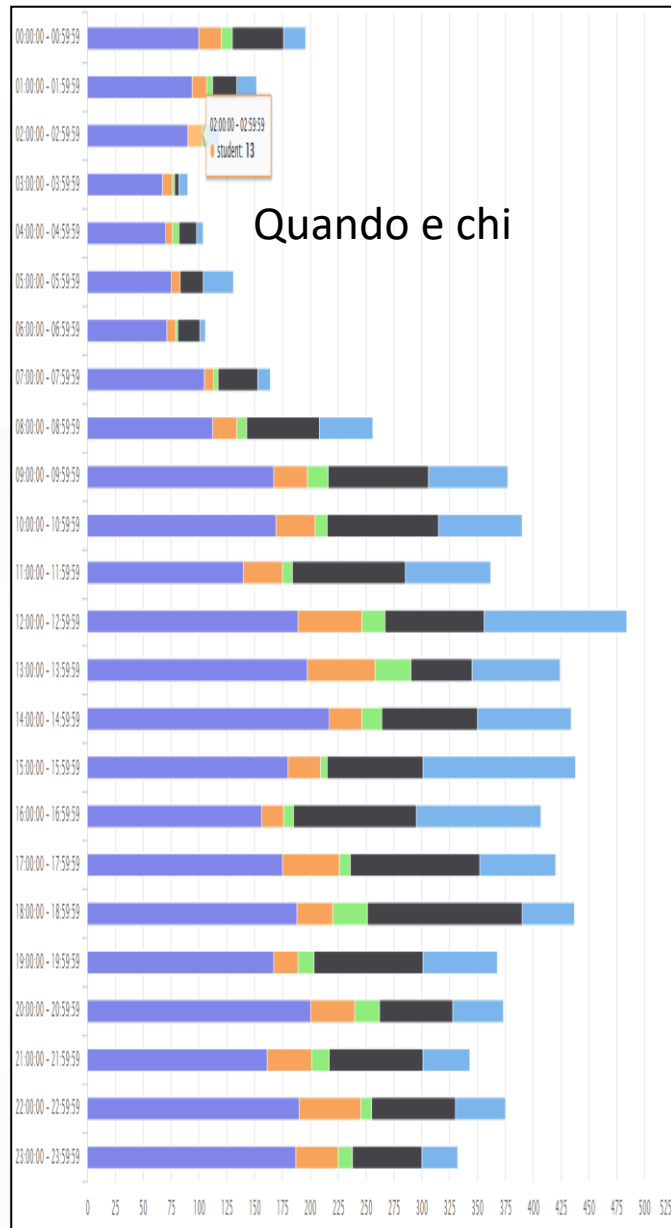
Posti Vicini

Chiostro Dello Scalzo
Tipo: Monument location
Distanza: 1678 m
Indirizzo: VIA CAMILLO BENSO CAVOUR,54-58 50121 FIRENZE FI

Orto Botanico ("Giardino Dei Semplici")
Tipo: Museum
Distanza: 1700 m
Indirizzo: VIA PIER ANTONIO MICHELI,3 50121 FIRENZE FI
Telefono: 0552757402

Mostra Tutte le Categorie

Recommender





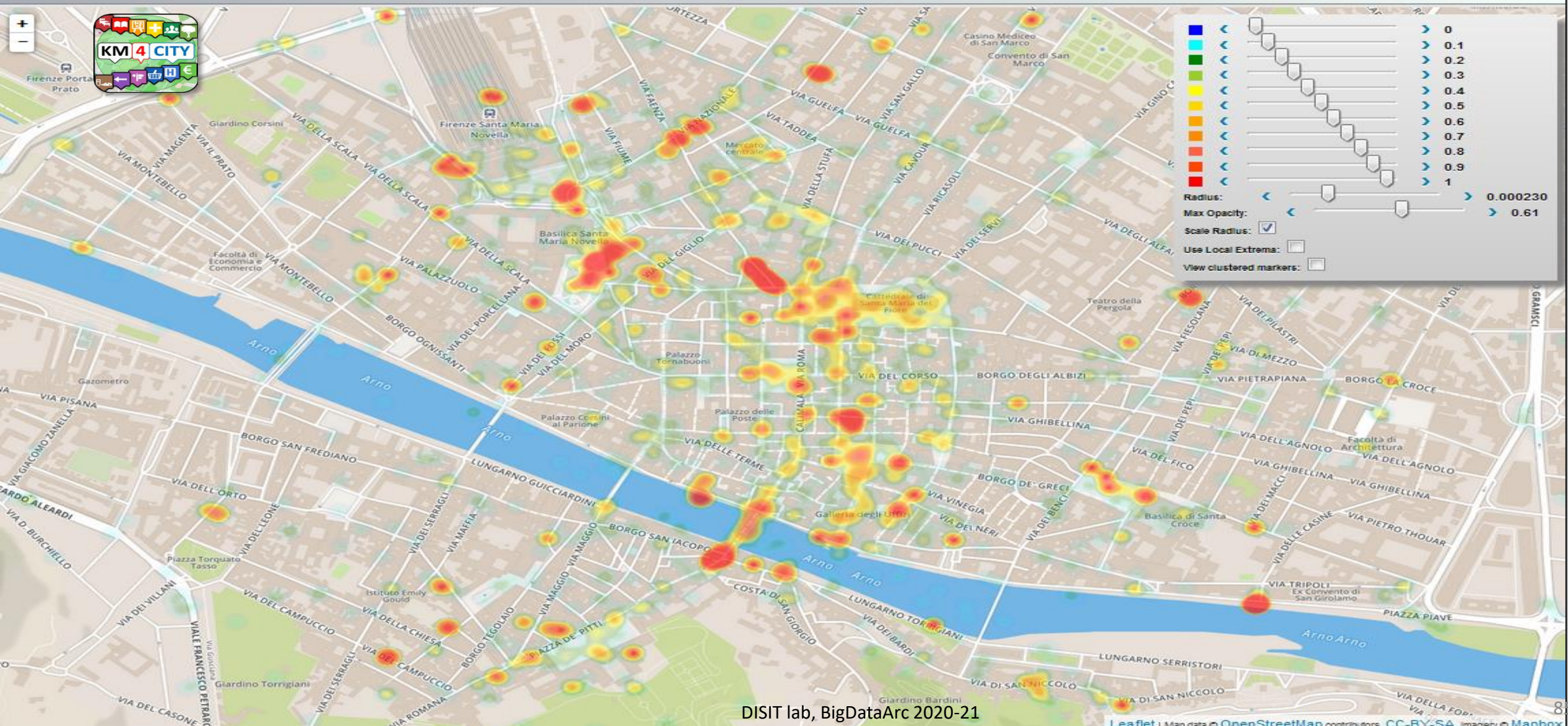
UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

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

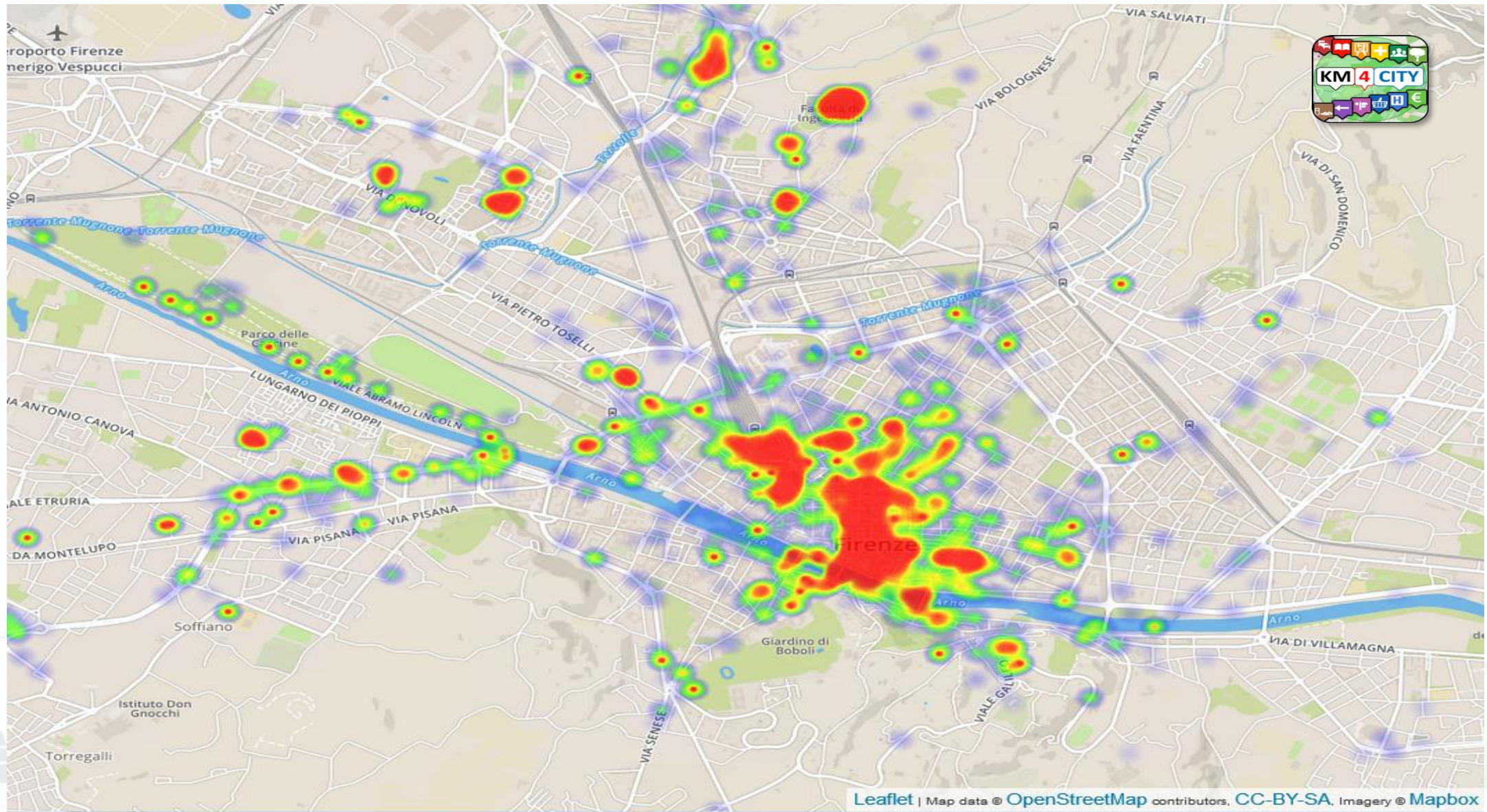
Tourists in Florence

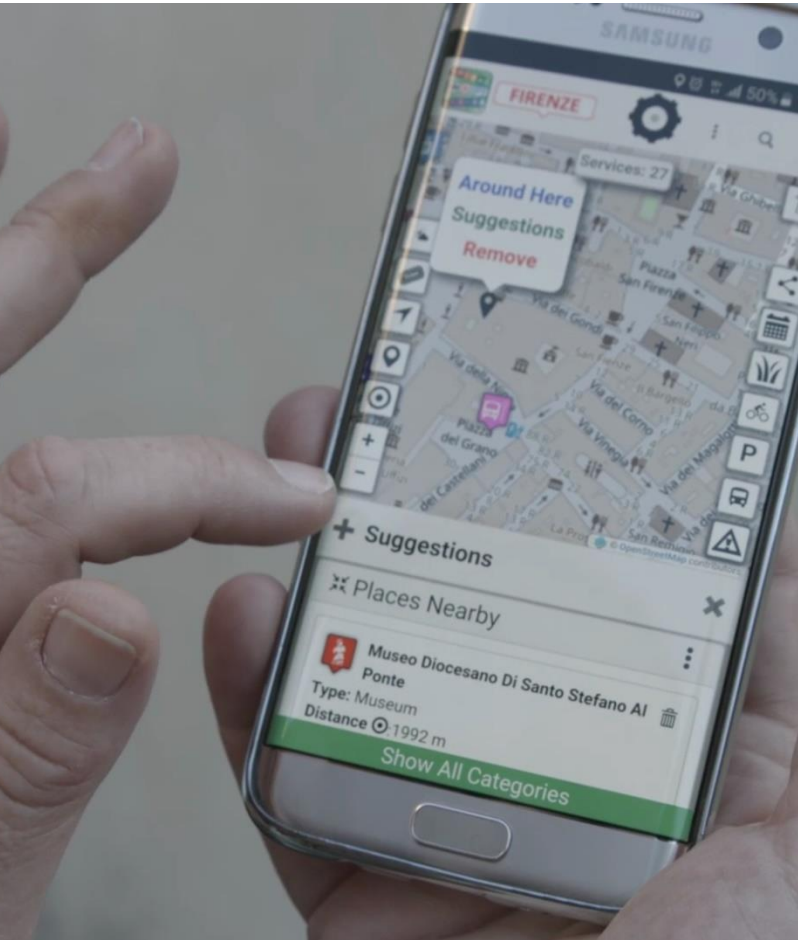
DISIT Personal Recommender
DISIT - Distributed Systems and Internet Technology Lab





Hot WiFi in Florence





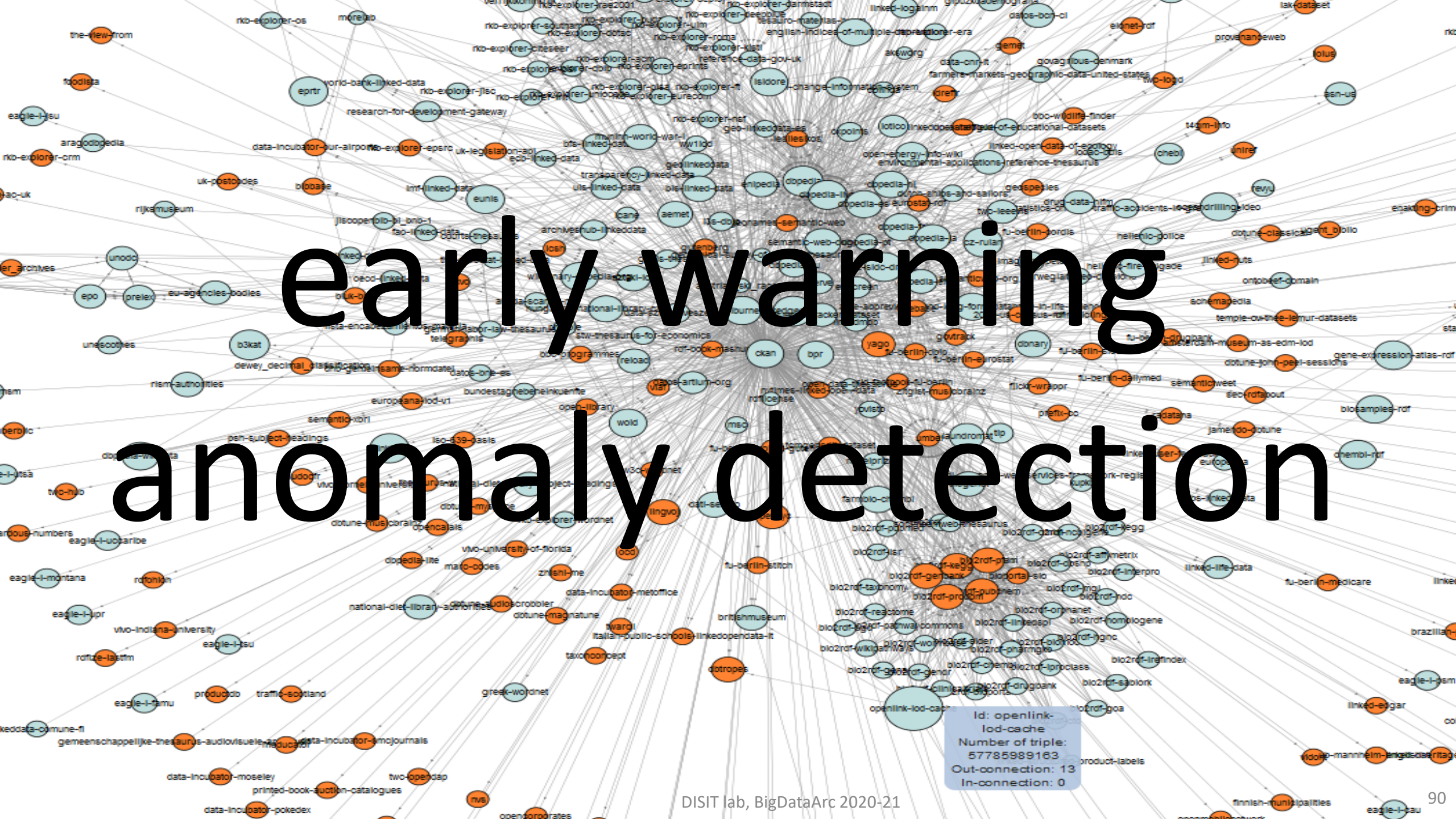
Sii smart. Sii-Mobility!

Scarica, viaggia, vinci!



Dal 15 aprile al 15 luglio scegliere il trasporto pubblico ti premia! Scarica l'app "Toscana dove, cosa", guadagna punti viaggiando in autobus e vinci tanti fantastici premi. Per maggiori informazioni visita il sito info.sii-mobility.org





early warning

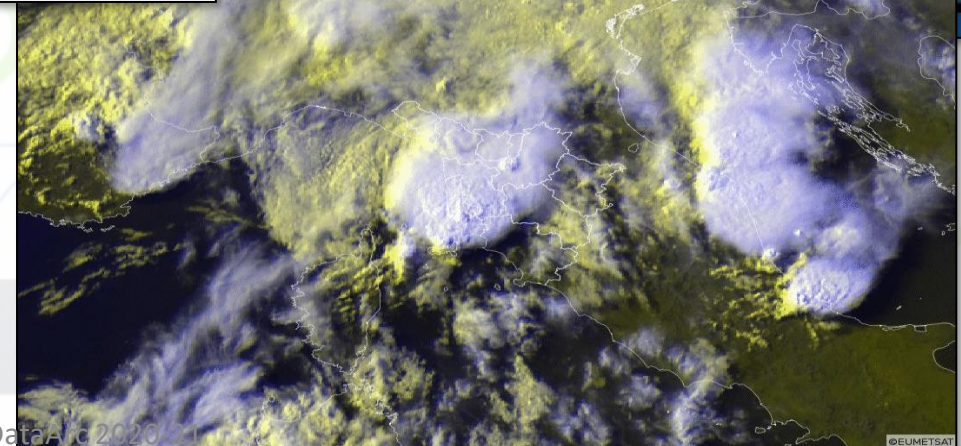
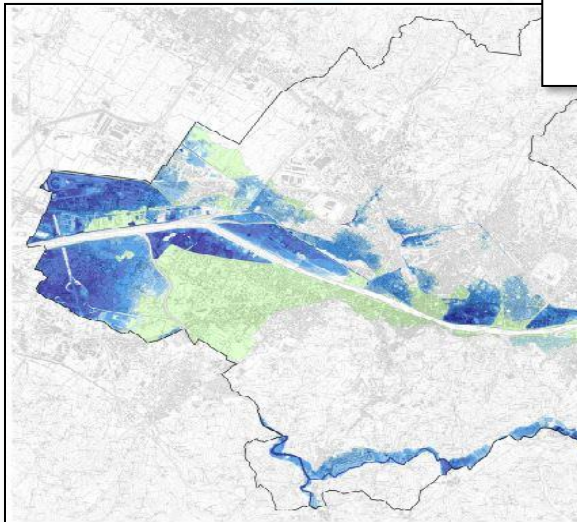
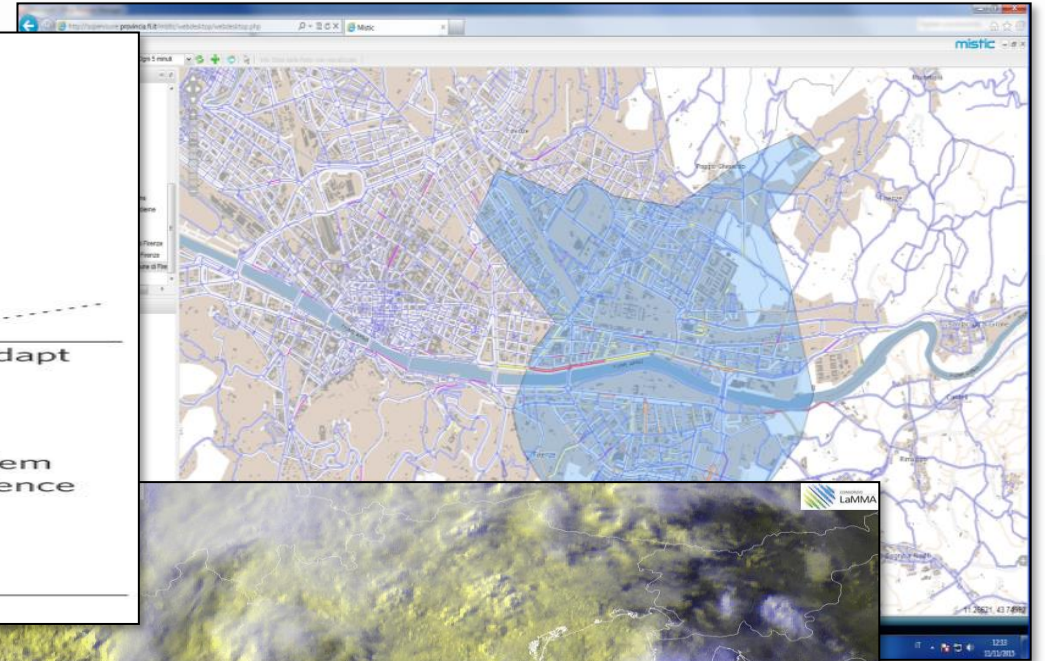
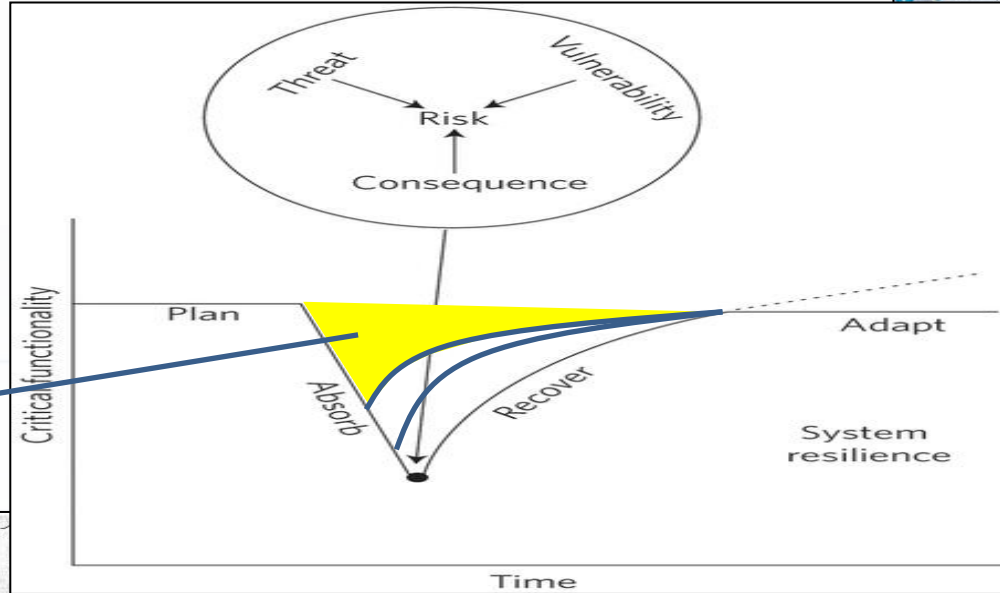
anomaly detection

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

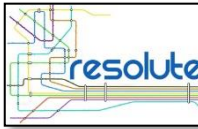
Early warning, detection

Prepare
Absorb
Recover
Adapt

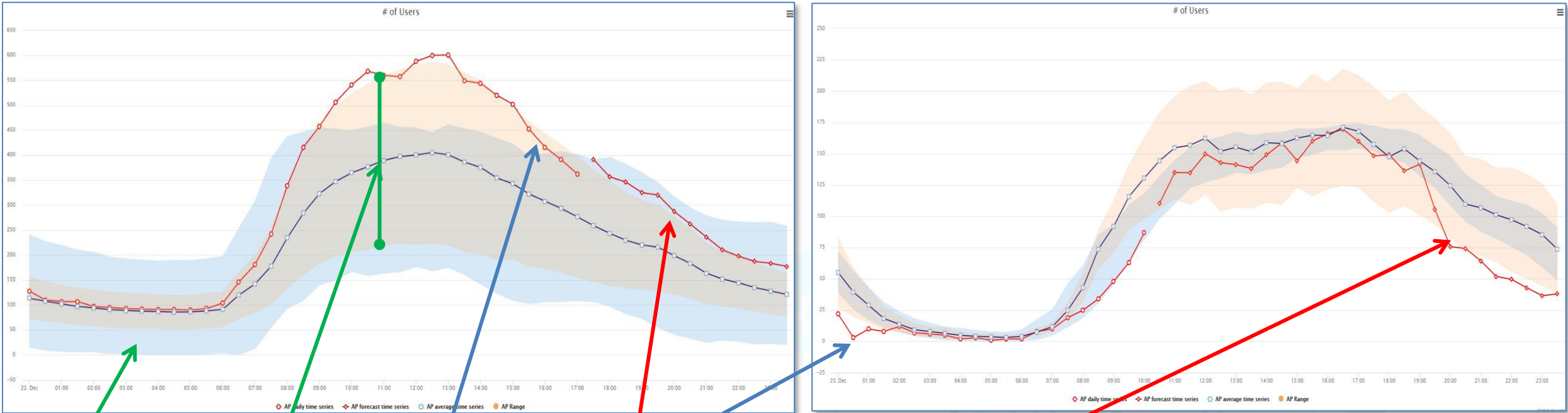
damage



Prediction and identification of anomalies



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



ESB

Alarms

- TEST - ALLUVIONE MUGNONE MAJOR
- ALLUVIONE ARNO COVERCIANO CRITICAL
- ALLUVIONE ARNO VIA PETRIOLO MAJOR
- TEST - SCONTRI ALLO STUDIO CRITICAL

Traffic events

- SEVERE ACCIDENT SERIOUS ACCIDENT(S)
- ROAD WORKS ROADWORKS
- ORD 2017-001302 - SP NA*17 A??ALTO VALDARNOA??1ST
- RESTRICTIONS
- INTERVENTO URGENTE PUBBLICACQUA CLOSED AHEAD

Evacuation plans

- PLAN N.1497263867 IN_PROGRESS
- PLAN N.2000000000 PROPOSED
- PLAN N.1497604404 PROPOSED

Tram position

- TRAM1
- TRAM2

Network Analysis

- FM0495 (NORMALIZED) NODE BETWEENNESS: 1.0000
- FM0496 (NORMALIZED) NODE BETWEENNESS: 0.7825
- FM0701 (NORMALIZED) NODE BETWEENNESS: 0.7825

Environment

PROTEZIONE CIVILE

RISCHIO IDRAULICO

RISCHIO TEMPORALI

RISCHIO IDROGEOLOGICO

RISCHIO NEVE

RISCHIO GHIACCIO

RISCHIO VENTO

RISCHIO MAREGGIATE

Pluv. Flore...

Pluviometer Florence City - Last 24h

Hydromete...

Hydrometer Arno Nave di Rosano - Last 24h

Hydromete...

Hydrometer Arno Florence Uffizi - Last 24h

Hydromete...

Hydrometer Mugnone Ponte alle Mosse - Last 24h

Mobility

Bus Lines Status

ULTIMO AGGIORNAMENTO: 2016-08-04 23:59:03

Underpass Viale Mariti Aperto

Underpass Viale Talenti closed

Underpass Fortezza Aperto

Parterre Pa...

SMN

76.2%

65.7%

23.8%

34.3%

37.2%

65.4%

62.8%

34.6%

Fortezza Fi...

Mercato Ce...

Resources

Planned events

- 1966 - 2016 - LA BELLEZZA SALVATA - PROROGATA FINO AL 2
- 2016-12-01 to 2017-07-02
- VIA CAMILLO CAUVOR 3
- 2017-02-15 to 2017-06-23
- PIAZZA DI SAN LORENZO 9
- 2017-02-15 to 2017-08-29
- PIAZZA DI SAN LORENZO 9

Ambulance...

Ambulance...

Voluntiers

20 num.

33 num.

Florence main first aids status

Priority	Red code	Yellow code	Green code	Blue code	White code
PS SANTA MARIA NUOVA	1	7	14	1	0
PS SAN GIOVANNI DE' DEI TORREGGIALLI	2	10	24	2	0
PS AD CARREGGI	10	27	0	0	0
PS SANTA MARIA ANNUNZIATA	2	0	0	0	0

TV-RT Firenze

Twitter Vigilance Real Time Dashboard

Last crawling: 2017-06-21 12:44:30

Channel active from 2016-06-27 to 2017-06-21 12:35:00

Data processed from 08:10:00 to 2017-06-21 12:35:00

NLP SA

Search related to channel Firenze

Sentiment trends in channel Firenze

Zoom 1h 3h 6h 12h 1d 1w 1m

Most Significant Tweets for Sentiment

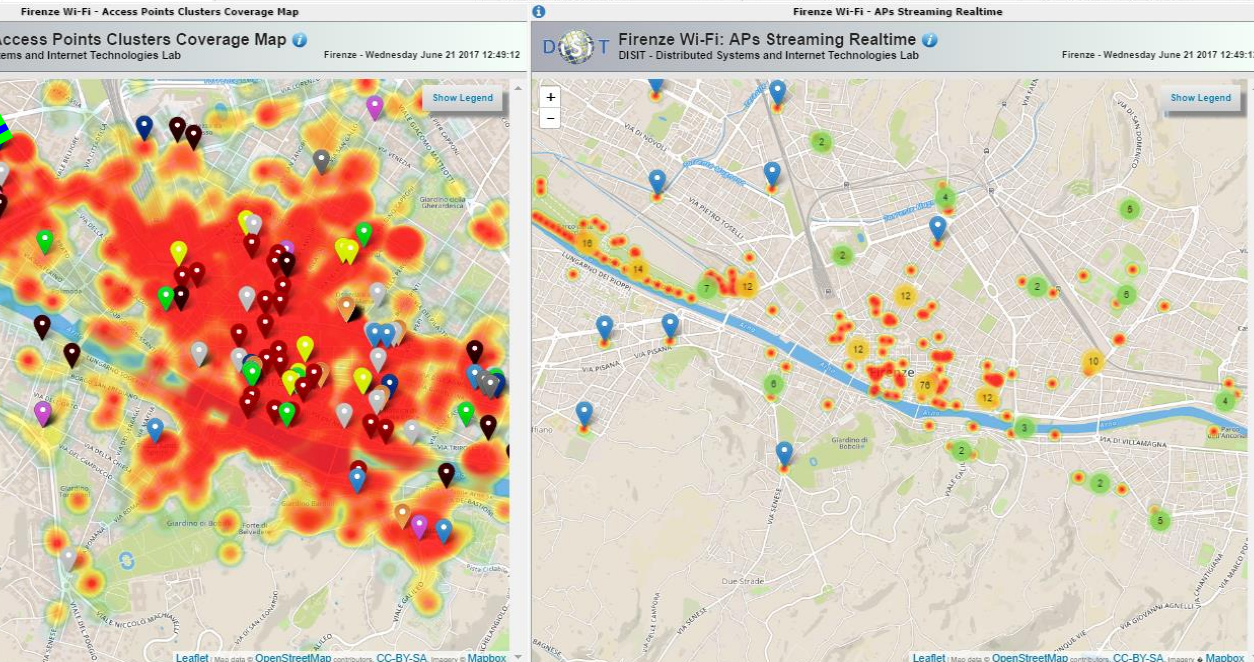
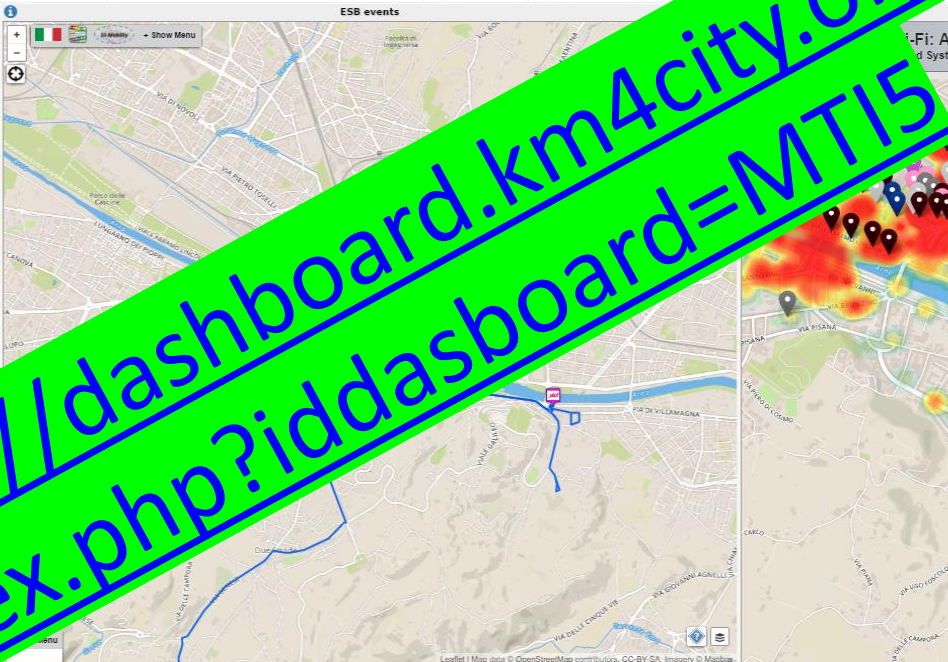
Last tweets per channel Firenze

Firenze Wi-Fi - Access Points Clusters Coverage Map

Firenze - Wednesday June 21 2017 12:49:12

Firenze Wi-Fi - APs Streaming Realtime

Firenze - Wednesday June 21 2017 12:49:12



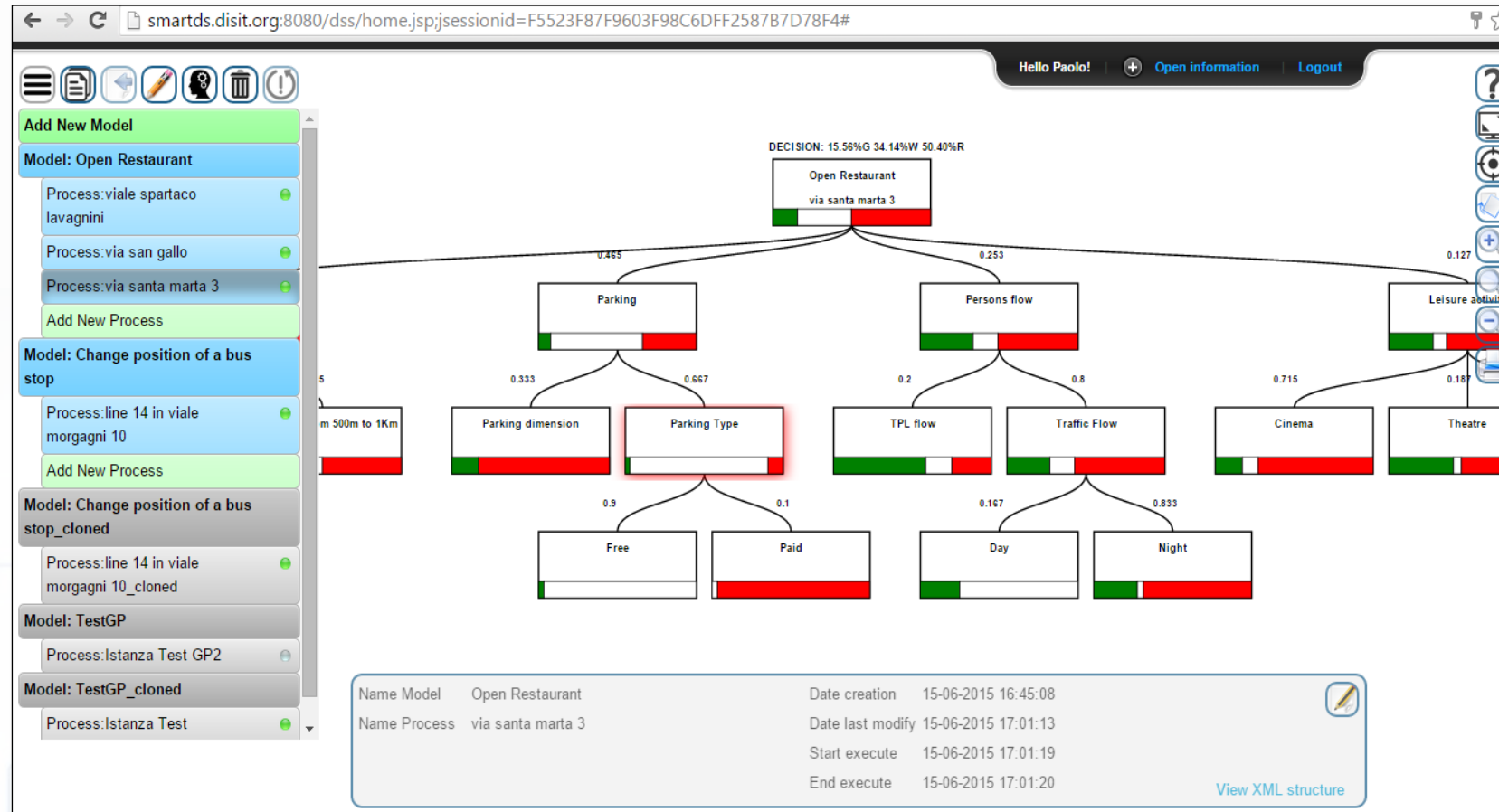
<http://dashboard.km4city.org/dashboard?idashboard=MT15>

Smart City Decision Support

- **Smart Decision Support System based on System Thinking plus**
- Actions to city reaction, resilience, smartness..

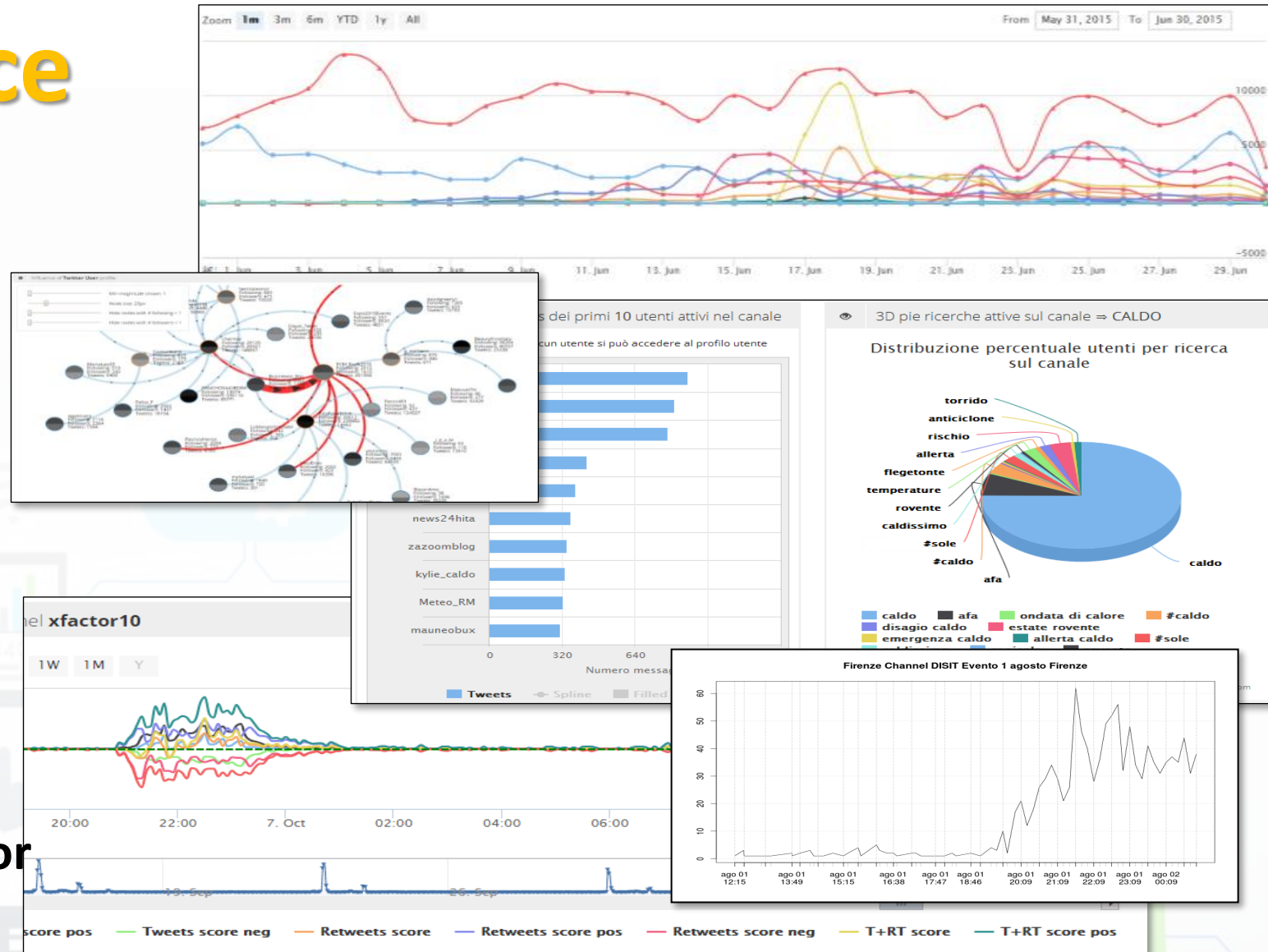
Enforcing

- Mathematical model for propagation of decision confidence..
- Collaborative work....
- Processes connected to city data: DB, RDF Store, Twitter, etc.
- Production of alerts/alarms
- Data analytics process
- Twitter Processes
- reuse, copy past, ...



Twitter Vigilance

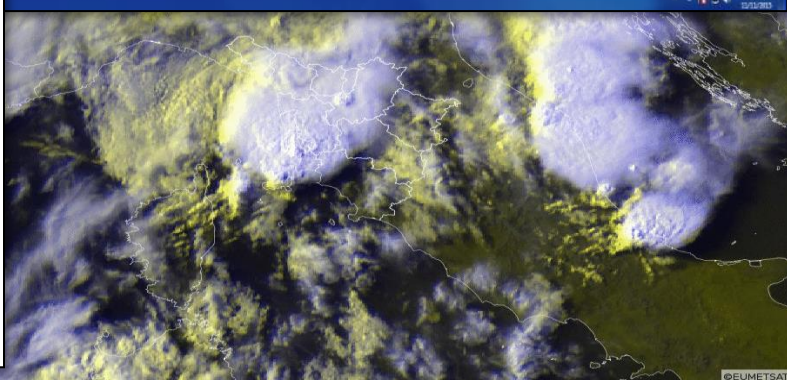
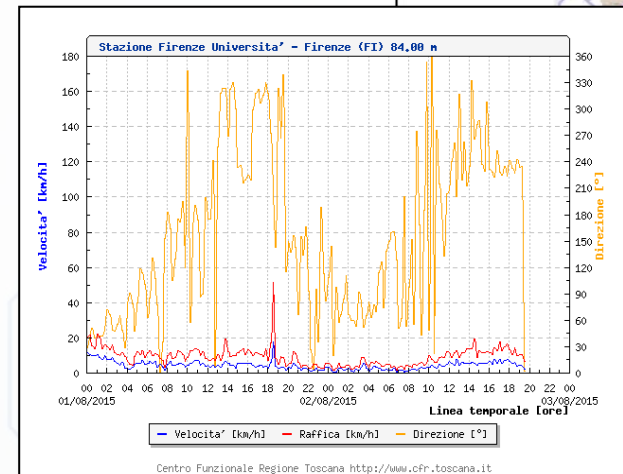
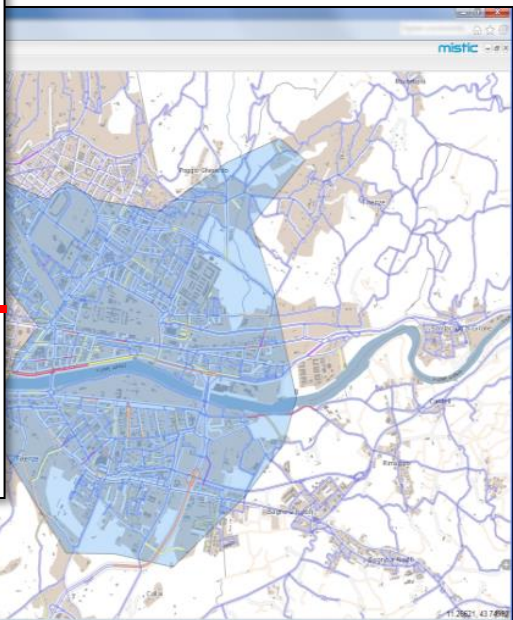
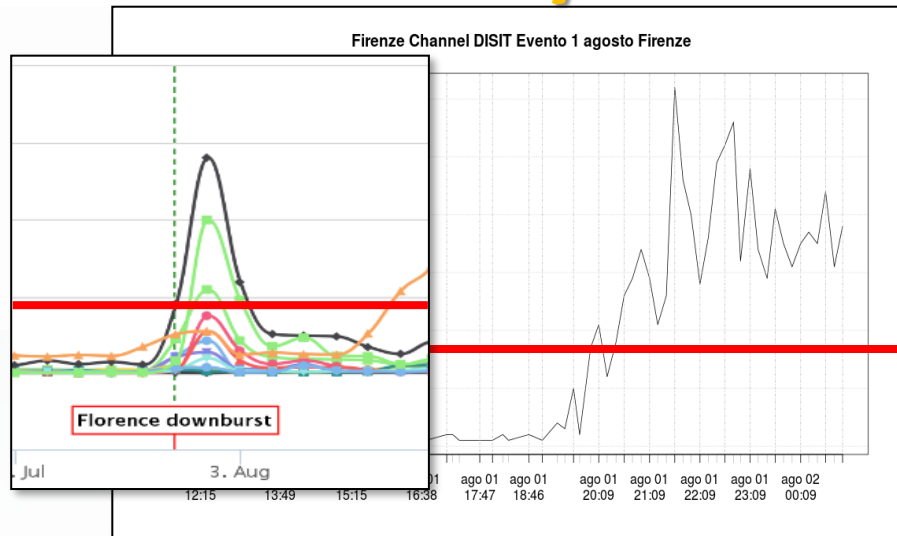
- <http://www.disit.org/tv>
- Citizens as sensors to
 - Assess sentiment on services, events, ...
 - Response of consumers wrt...
 - **Early detection** of critical conditions
 - Information channel
 - Opinion leaders
 - Communities
 - Formation
 - **Predicting volume of visitors for tuning the services**



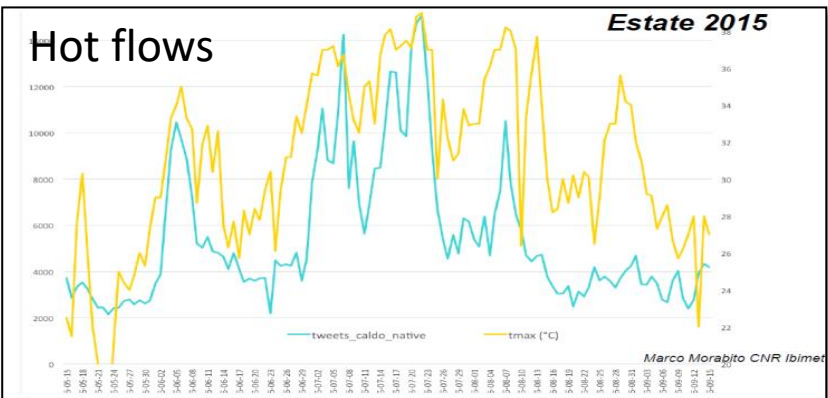


Twitter Vigilance

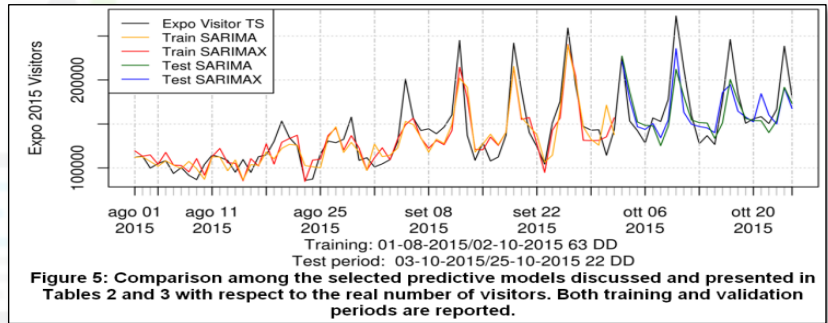
Early Warning



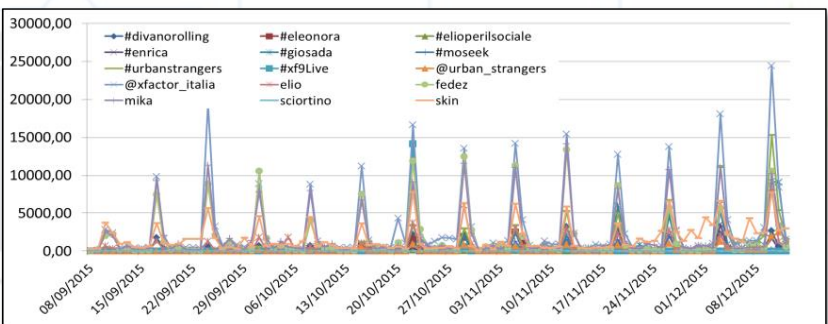
Predictive models



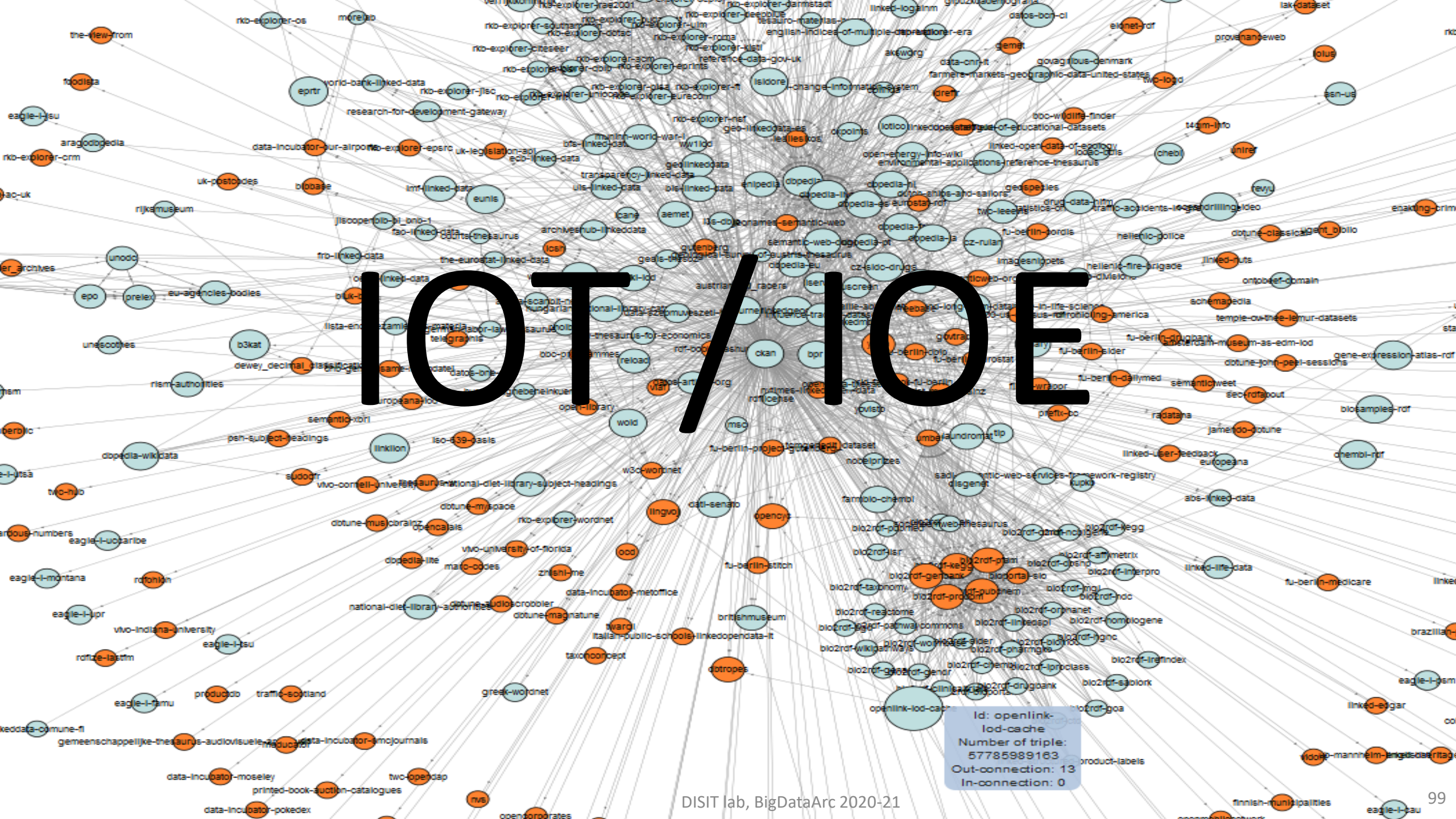
Attendance at long lasting events: EXPO2015



Attendance at recurrent events: TV, football

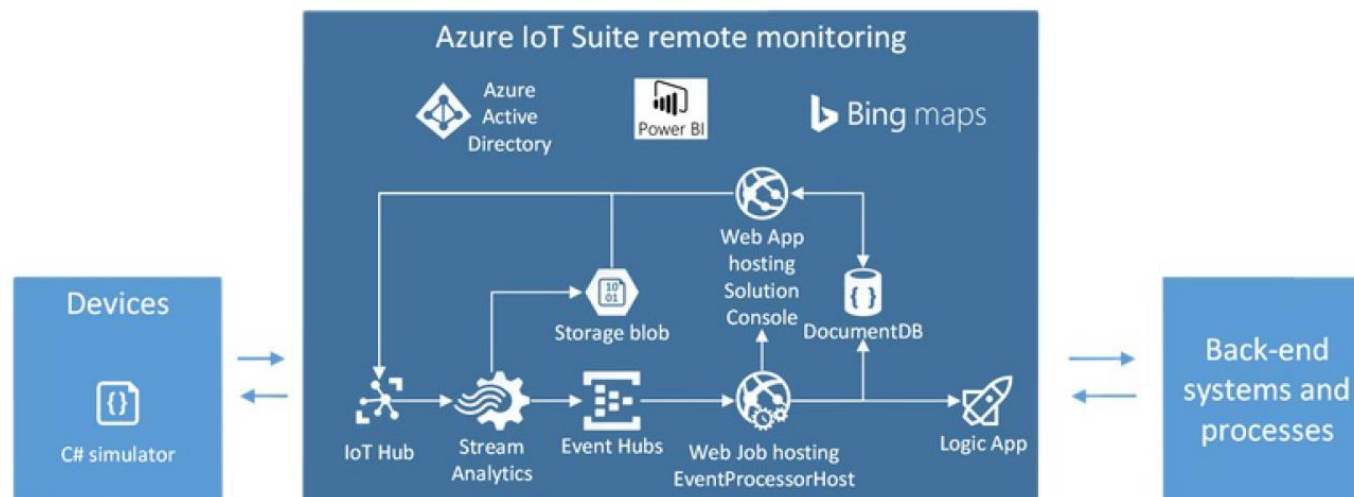
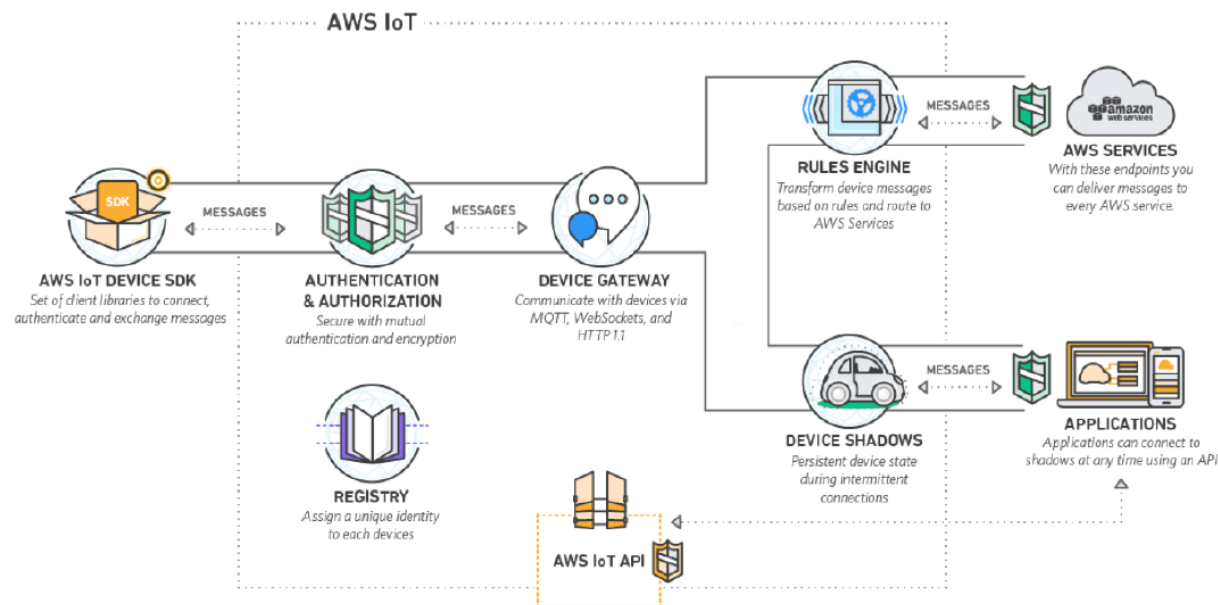


IOT/IOE



Big Data vs IOT/IOE

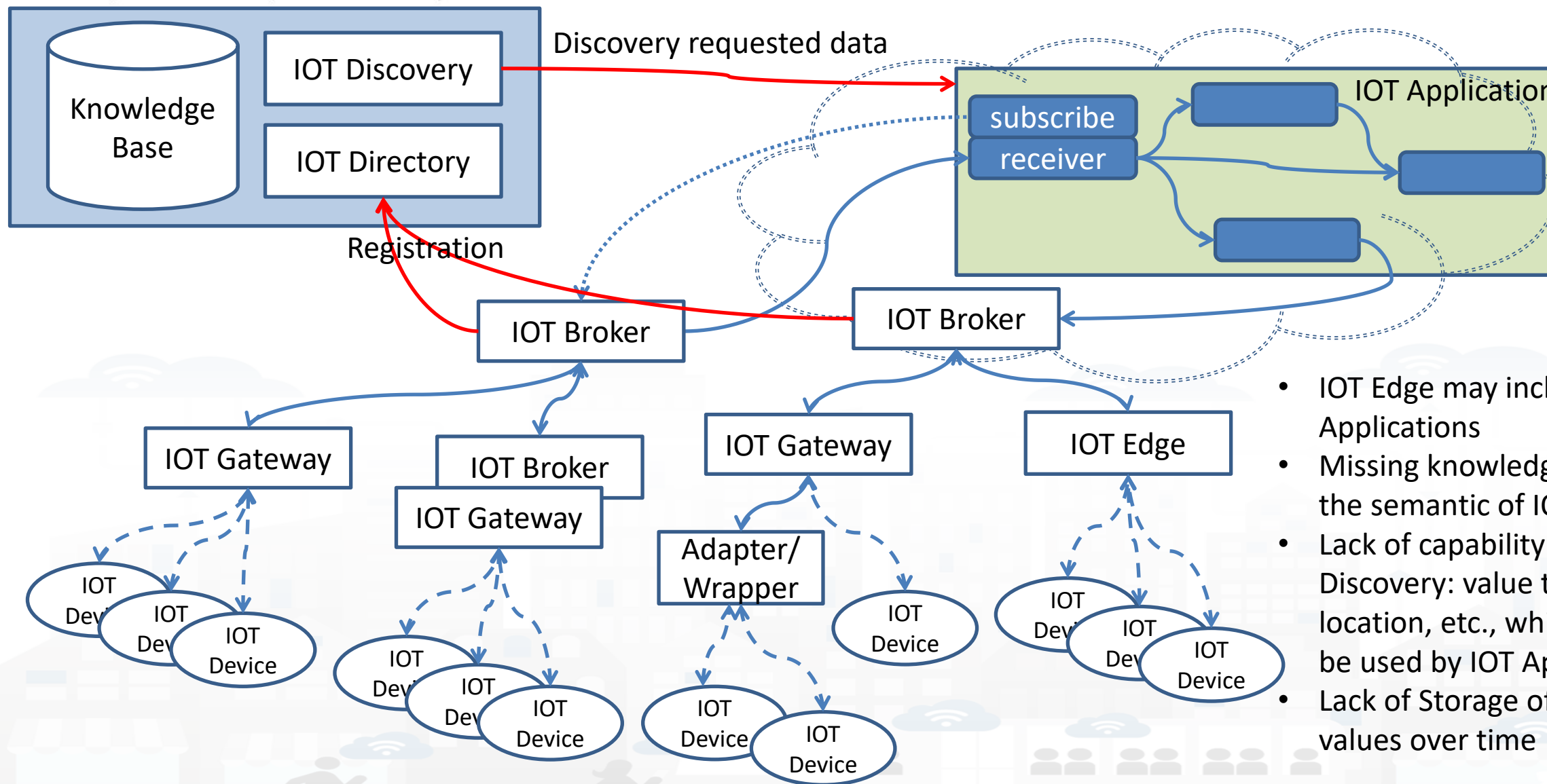
- Store everything
- Shadow (Data Indexing and storage)
- Access to external services ??
- Access to external context of the territory ??
- IOT Applications??
- Data Traffic Monitoring ??
- Privacy vs GDPR ??



Big Data vs IOT

- In una certa misura minor problemi di volume nei casi specifici
- Maggiori problemi di real time, event driven
- Maggiori problemi di non uniformità
 - degli stream data in ingresso
 - Formati e protocolli diversi per devices e pacchetti di comunicazione dati
- Problemi di tracciabilità del dato
- Problemi di licensing del dato
- Problemi diffusi di security nelle soluzioni ICT: comunicazione, storage, accesso e monitoraggio, etc.

Definitions



- IOT Edge may include IOT Applications
- Missing knowledge about the semantic of IOT devices
- Lack of capability for IOT Discovery: value type, location, etc., which could be used by IOT App
- Lack of Storage of data values over time

IOT/IOE Protocols

Communication Patterns



Discovery
*Discover, register
and "thrust" new
devices on the
network*



Telemetry
*Information Flows
From device to
another system for
conveying status
changes in the
device*



Inquiries
*Requests from
devices looking to
gather required
information or asking
to initiate activities*



Commands
*Commands from
other systems to a
device or a group
of devices to
perform specific
activities*



Notifications
*Information flows
from other
systems to a
device or a group
for conveying
status changes in
the world*

- MQTT
- HTTP(s)
- AMQP
- COAP
- NGSI
- OneM2M
- WebSocket
- Etc.
- Etc.





	Open Source end-to-end	Scalability IOT	Execution scalability	Visual Programming end-to-end applications	Advanced Smart City API, MicroServices	Multi Domain Semantic Platform	External services via API	Standard based Modules and IOT, Open Devices	Integrated Community manangement	Resource Sharing	Referral data management	Security end-2-end	Dashboard H24/7	Failible and easy dashboard creation	Multi-protocol on IOT
Snap4City	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
KAAS	Y	Y	Y ¹	N	Y	N	Y	N/Y	Y	N	--	Y	Y	N	Y
AWS	N	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	(Y)	Limited
Azure IOT	N	Y	Y	(Y)	N	N	Y	Y	(Y)	Y	Y	Y	Y	(Y)	Limited
IOT IGNITE	Y	Y ²	N	Y	N	N	Y	N	N	N	--	N	Y	(Y)	MQTT
PTC ThingWorkx	N	Y	(Y)	Y	N	N	Y	Y	N	N	--	Y	Y	(Y)	Y
BEZIRK	Y	N	N	N	N	Y	--	Y	N	N	--	N	N	N	Y
Bosch IoT Suite	N	Y	(Y)	Y	Y	N	Y	Y	N	N	Y	Y	Y	(Y)	Y
FIWARE	Y	(Y)	N	N	Y	N	N	Y	N	N	N	N	Y	N	Y
CISCO Jasper	N	Y	N	N	N	N	Y	N	--	--	Y	--	Y	--	N ³
IBM Watson IoT	(N)	Y	(Y)	Y	Y	Y	Y	Y	N	Y	(Y)	Y	Y	Y	Y
Siemens MindSphere	N	Y	--	Y	N	N	N	Y	N	N	Y	N	Y	N	Y
Carriots	N	Y	--	N	N	N	Y	--	N	N	--	N	Y	Y	MQTT
Thingsboard	Y	Y ⁴	N	N	N	N	N	N	N	N	--	Y	Y	Y	(MQTT, CoAP, http)
IOT eclipse.org	Y	Y	N	N	N	N	Y	Y	N	N	N	N	N	N	Y
Google IOT	N	Y	Y	N	N	N	Y	N	N	N	N	Y	N	N	MQTT, HTTP

Powered by  **FIWARE**

 **SNAP4**
Appliances and Dockers
Installations

FREE TRIAL

 **PEN Test Passed**

 **EU GDPR COMPLIANT**

 **100% OPEN SOURCE**



DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS

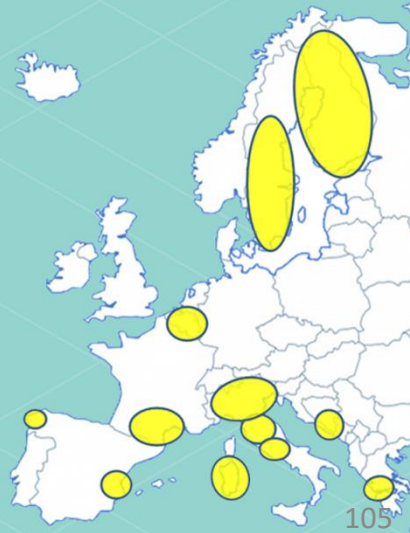
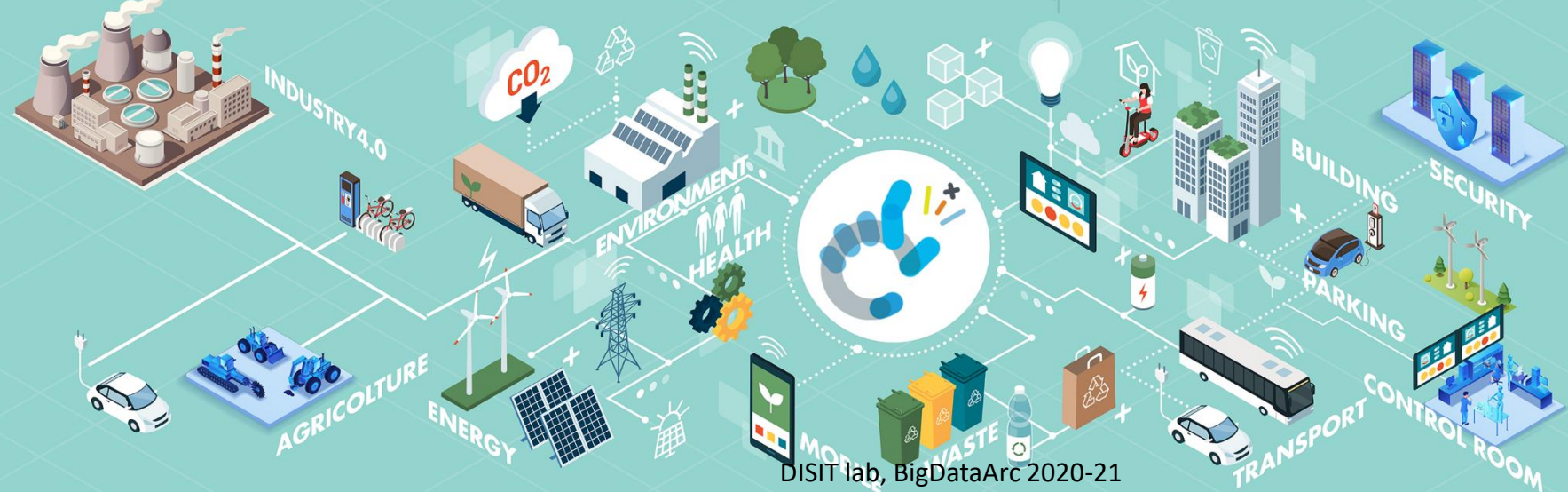


**EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE**

**BIG DATA ANALYTICS
ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING**

**DATA FLOWS, WORKFLOWS
MICROSERVICES
MANAGEMENT**

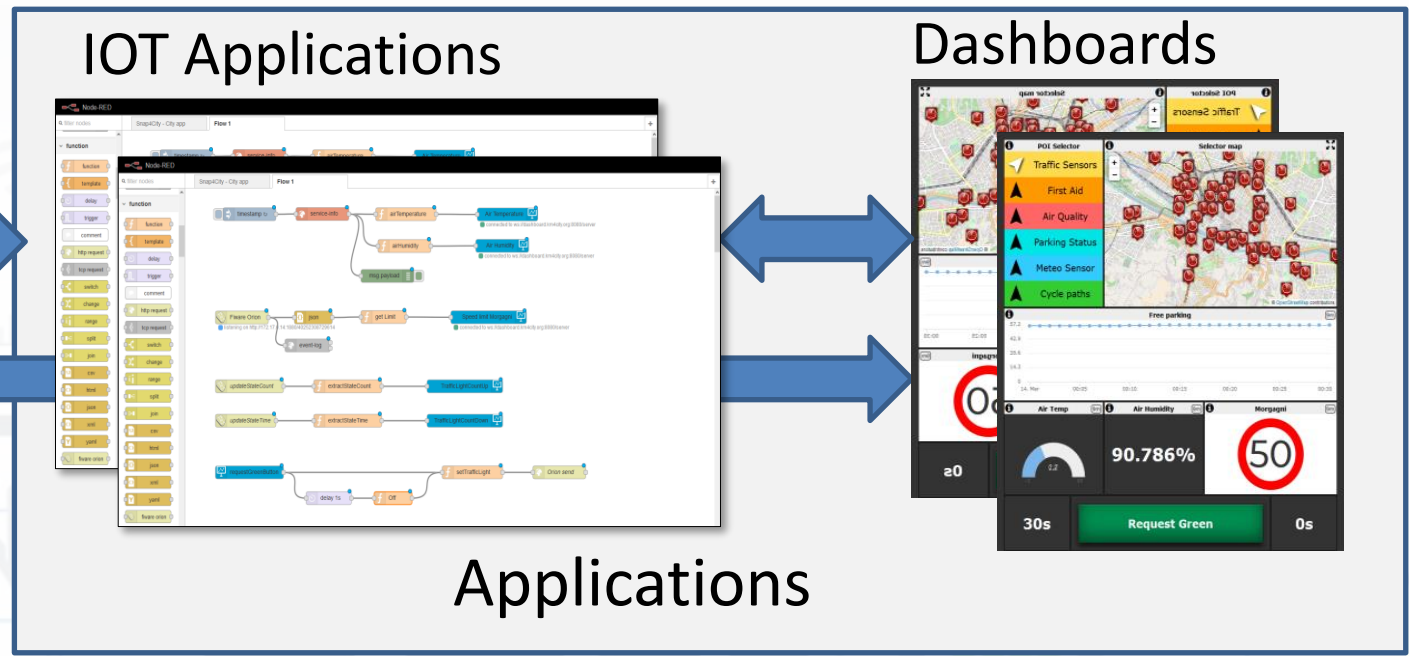
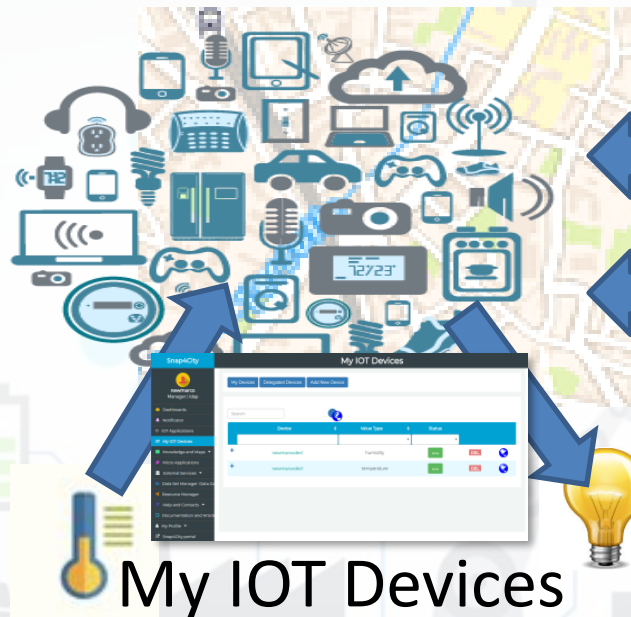
**METHODOLOGIES
COURSES AND COMMUNITY
LIVING LABS
DEVELOPMENT TOOLS**



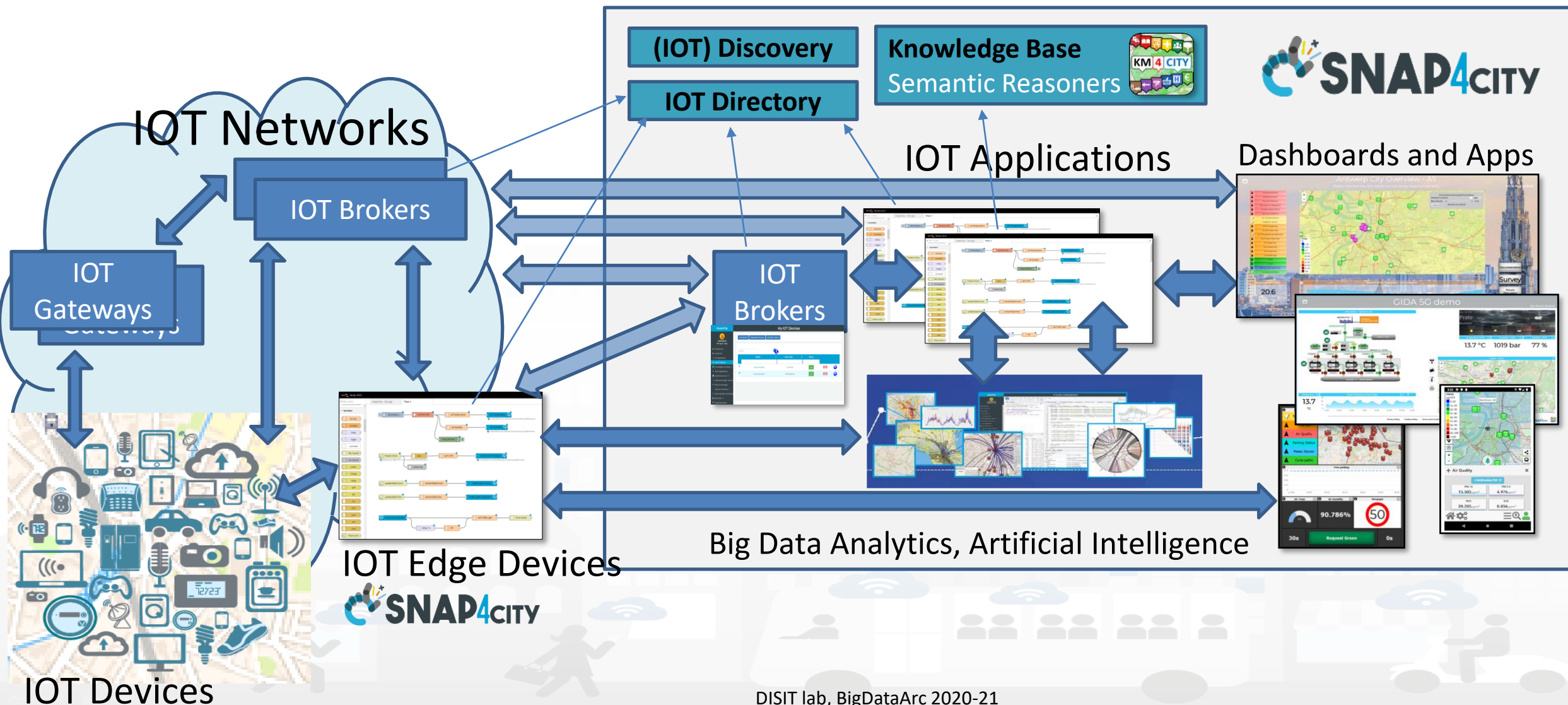
Level 4 users: dashboard with intelligence App

- Dashboards with IOT Applications for enforcing smart and intelligence into them.

IOT and City data World



Snap4City: IOT Directory and data/device Discovery





Node-RED

filter nodes

input

- inject
- catch
- status
- link
- mqtt
- http
- websocket
- tcp
- udp

output

- debug
- link
- mqtt
- http response
- websocket
- tcp
- udp

function

- function

Flow 1 | Flow 2 | Flow 4 | **Monitor** | Flow 3

Deploy

info | debug | dashb

Flow

Name	Monitor
ID	"aaf956bf.8c2638"
Status	Enabled

Information

Node-RED

108

Dragging a node onto a wire will splice it into the link



MicroServices

- > S4CIoT
- > S4CInfo
- > S4CSearch
- > S4CView
- > S4CDataAnalytic
- > S4CDashboard
- > S4CSearchDev
- > S4CInfoDev
- > S4CLogDev
- > S4CManagement
- > S4CSearchExp
- > S4CSearchUsr

ckants

- ckants insert
- ckants search
- ckants create

S4CIoT

- iot directory
- iot directory

S4CInfo

- service info
- tpl agencies
- tpl lines
- tpl routes by agency
- tpl routes by line
- tpl routes by stop name
- tpl routes by line stop name
- tpl stops by route

S4CSearch

- service search by queryid

S4CView

- show general iframe
- show micro web app

S4CDataAnalytic

- descriptive statistics
- trend plot
- time series predictions
- machine learning predictions

S4CDashboard

- city dashboard
- city dashboard
- geolocation

S4CSearchDev

- service search
- full text search dev
- event search dev
- address geometry search near gps position
- address poi search by text
- bus routes search

S4CInfoDev

- tpl routes
- tpl stops

S4CLogDev

- event log

S4CSearchExp

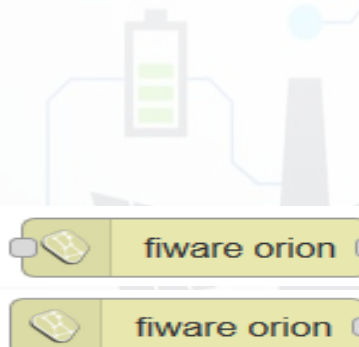
- service search near gps position
- service search near service
- service search within gps area
- service search within wkt area
- service search within stored wkt area
- service search by municipality
- full text search within wkt area
- full text search within gps area
- full text search near gps position
- full text search exp
- event search within wkt area
- event search within gps area
- event search near gps position
- event search exp
- address search near gps position
- geometry search near gps position
- address poi search by text exp

S4CSearchUsr

- address poi search by text near gps position
- bus routes search near gps position
- bus routes search within gps area
- bus routes search within wkt area
- bus routes search within stored wkt area
- service search near marker
- service search within circle
- service search within polygon
- service search along path
- full text search near marker
- full text search within circle
- full text search within polygon
- full text search along path
- full text search usr
- event search near marker
- event search within circle
- event search within polygon
- event search along path
- event search usr

S4CManagement

- address search near marker
- geometry search near marker
- address poi search by text usr
- address poi search by text near marker
- address poi search by text within circle
- bus routes search near marker
- bus routes search within circle
- bus routes search within polygon
- check exist job
- check exist trigger
- get currently executing jobs
- get job detail
- get triggers of job
- get job group names
- get trigger group names
- get paused trigger groups
- trigger job





Developer in R Studio + Tensor Flow

R Studio Development

```

AnomalyDetection.R
110 anomaliesMatr[, "timestamp"] <- as.character(dataFinal[resAnomsIndex, "alignDateTime"])
111 anomaliesMatr[, "anoms"] <- as.numeric(resAnoms[, "anoms"])
112
113 #table with anomalies
114
115
116 setwd(outDir)
117 options(digits = 1)
118 tTable <- tableProb(anomaliesMatr, rows = NULL, cols = c("Date and Time", "Anomaly"), theme=theme_default(base_size=
119 grid.draw(tTable)
120 h <- convertHeight(sum(tTable$heights), "in", TRUE)
121 w <- convertWidth(sum(tTable$widths), "in", TRUE)
122
123 plot <- res$plot
124
125 plotMix <- grid.arrange(plot, tTable,
126                       ncol = 2,
127                       heights=c(5,1),
128                       as.table=TRUE)
129
130 setwd(outDir)
131 ggsave(paste(columnsName[1], "Anomalies.png", sep=""), plotMix, width=22, height=h*5)
132
133 }, finally = {
134
135 })
136 statisticsResult[[indfolder]]$resultFiles[indResult]$sensor=unbox(as.character(columnsName[i]))
137 statisticsResult[[indfolder]]$resultFiles[indResult]$png=unbox(paste(outDir, paste(columnsName[i], "Anomalies.png", s
138 indResult = indResult + 1
139
140 }
141
142 }
143
144 }
145
146 }
147
148 setwd("~/Snap4City")
149 write(jsonlite::toJSON(statisticsResult[[1]]), "JsonStatisticsResult.json")
150 return(statisticsResult[[1]])
151
152 }
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Console

```

[1] "carpark"
Warning in statisticsResult[indfolder]$statisticsOutputName = unbox
("Predictions") :
number of items to replace is not a multiple of replacement length
Warning in statisticsResult[indfolder]$statisticsOutputName = unbox
("MachineLearningPredictions") :
number of items to replace is not a multiple of replacement length
geom_smooth() using method = 'loess'
[1] "carpark"
Warning in statisticsResult[indfolder]$statisticsOutputName = unbox
("Anomalies") :
number of items to replace is not a multiple of replacement length
[1] "NO ANOMALIES ON THE SENSOR -CarParkBeccaria_free-"
[1] "PRESENCE OF ANOMALIES ON THE SENSOR - CarParkCareggi_free-"
[1] "PRESENCE OF ANOMALIES ON THE SENSOR - CarParkPieracciniMeyer_fre
e-"
[1] "NO ANOMALIES ON THE SENSOR -CarParkS.Lorenzo_free-"
[1] "NO ANOMALIES ON THE SENSOR -CarParkStazioneFirenzeS.M.N._free-"
[1] "carpark"
Warning in statisticsResult[indfolder]$statisticsOutputName = unbox
("Anomalies") :
number of items to replace is not a multiple of replacement length
[1] "NO ANOMALIES ON THE SENSOR -CarParkBeccaria_free-"
[1] "PRESENCE OF ANOMALIES ON THE SENSOR - CarParkCareggi_free-"
[1] "PRESENCE OF ANOMALIES ON THE SENSOR - CarParkPieracciniMeyer_fre
e-"
[1] "NO ANOMALIES ON THE SENSOR -CarParkS.Lorenzo_free-"
[1] "NO ANOMALIES ON THE SENSOR -CarParkStazioneFirenzeS.M.N._free-"

```

Files

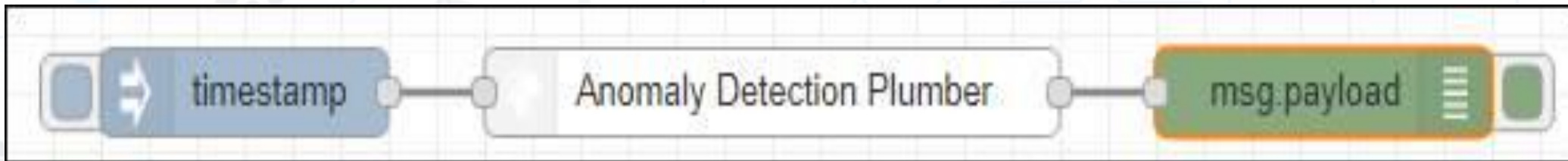
Name	Size	Modified
nohup.out	72 B	Mar 30, 2018, 9:47 AM
R		
Snap4City		
Snap4CityDEMO		
Snap4CityOld		

Environment

Object	Description
dataFinal	2794 obs. of 18 variables
dataset	35539 obs. of 12 variables
dataTest	97 obs. of 15 variables
dataTestFinal	97 obs. of 3 variables
dataTrain	2793 obs. of 15 variables
meltDataTest	97 obs. of 4 variables
p3	Large gtable (784 elements, 9.2 Mb)
plot	List of 9
statisticsResult	List of 1

Click on each .png file to visualize the statistics: a new tab will be opened

Files: AverageSpeedDailyTrend.png, CarParksDailyTrend.png, CorrelationMatrix.png, PredictedFreeParkin..., SensorsMeanPerDayMoment.png, StatisticsBySensors.png, StatisticsBySensorsAndDayMoment.png, VehicleFlowDailyTrend.png





UNIVERSITÀ
DEGLI STUDI
FIRENZE

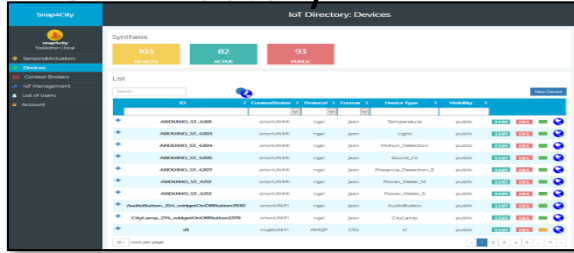
DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

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

Snap4City



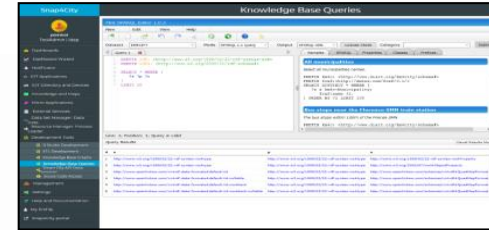
IOT Directory



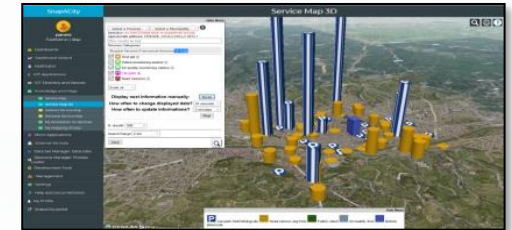
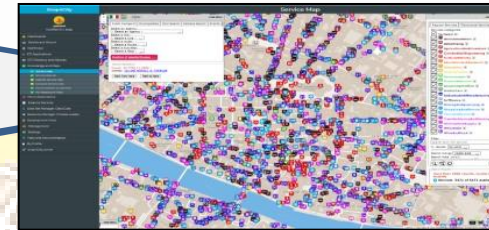
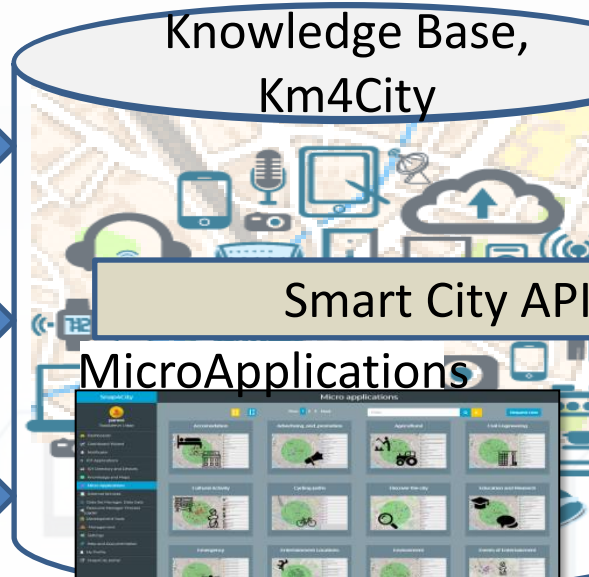
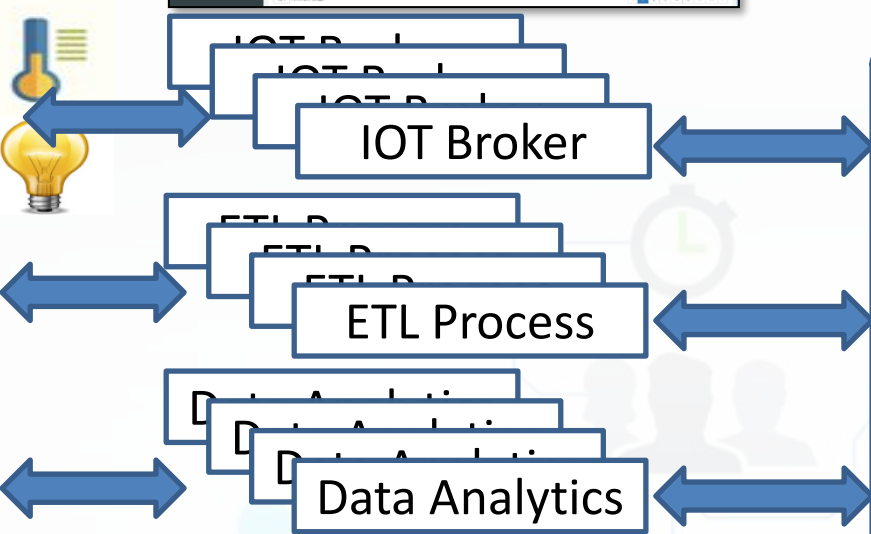
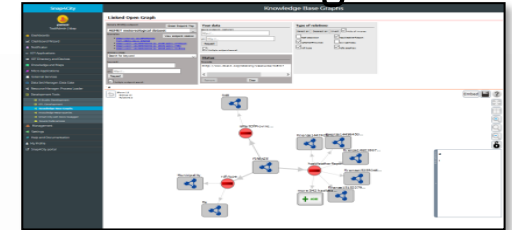
Ontology



SPARQL, FLINT



LOG.disit.org



ServiceMap

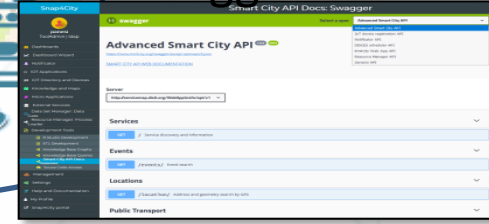
ServiceMap3D

Smart City API from Knowledge Base and other tools

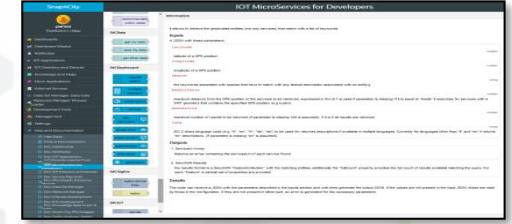
MicroApplications



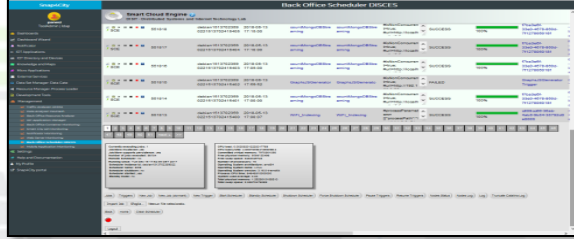
Swagger



MicroServices



Back Office Processes



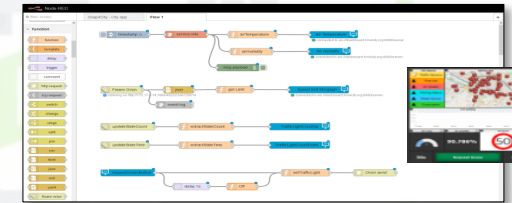
DISCES and back office management tools



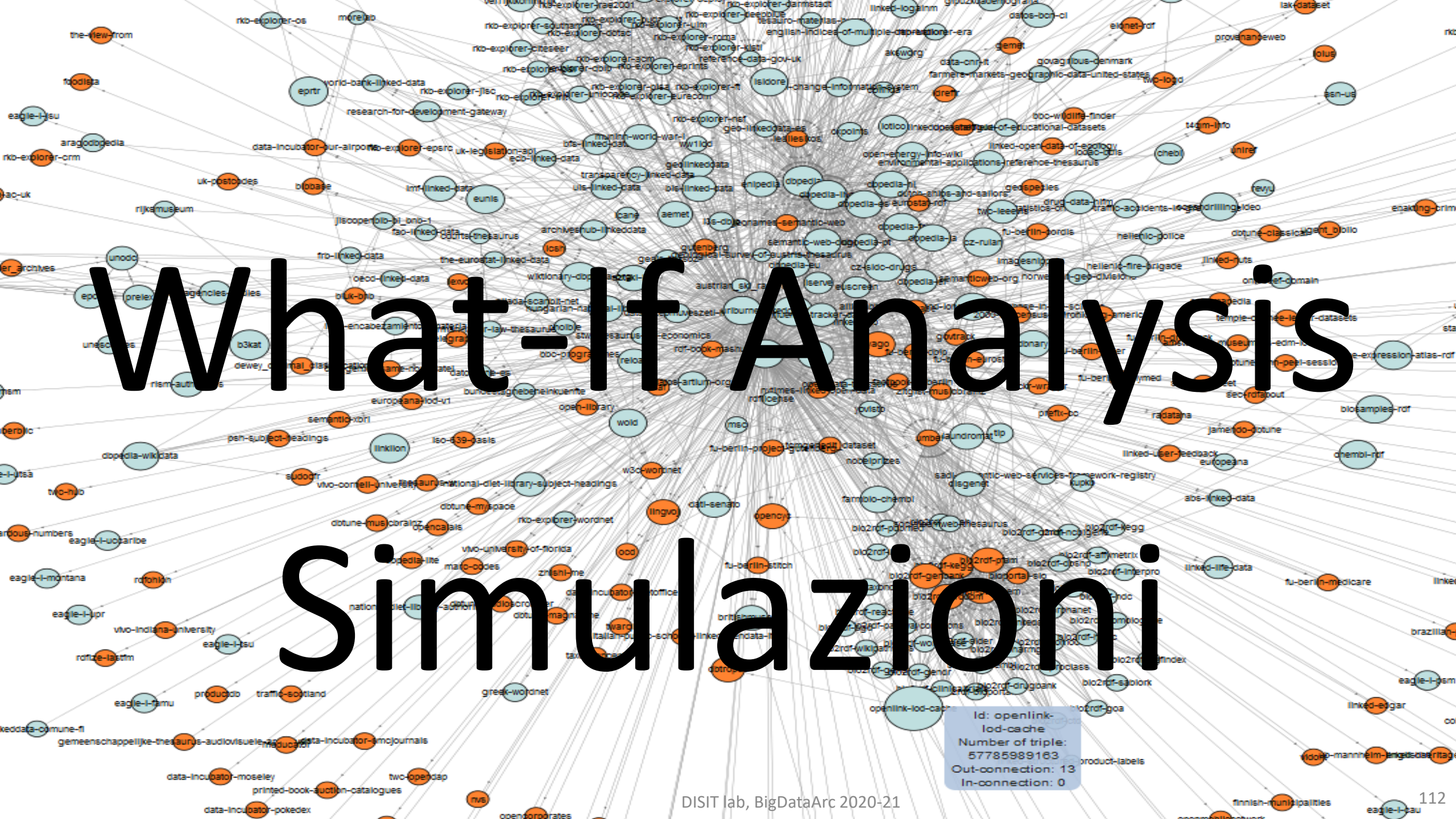
Resource Manager



Web and Mobile



IOT Applications



What-If Analysis

Simulazioni

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

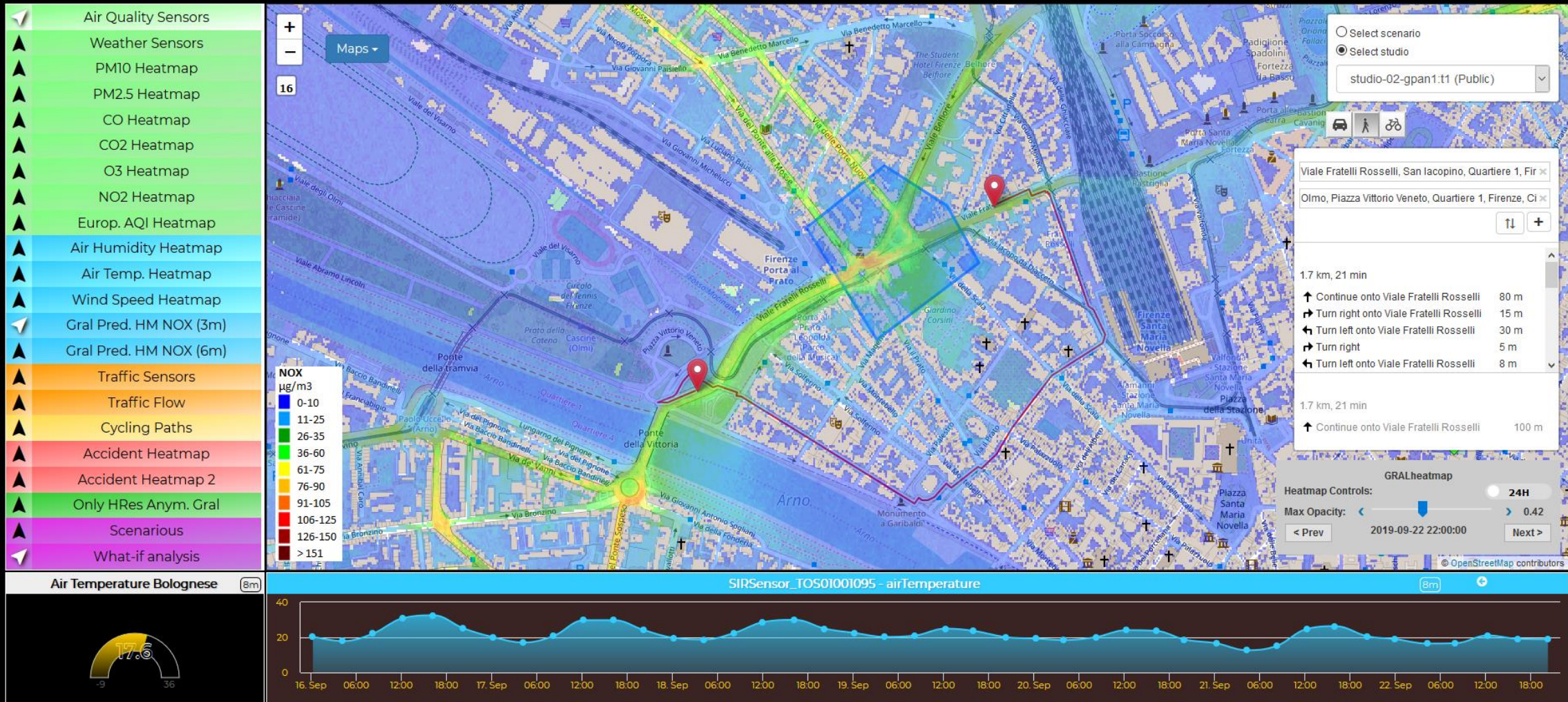
What-If analysis

Firenze & Toscana - Background Orthomaps Test

This dashboard contains data derived from actual sensors and predictive values under validation



Sun 22 Sep 22:59:21





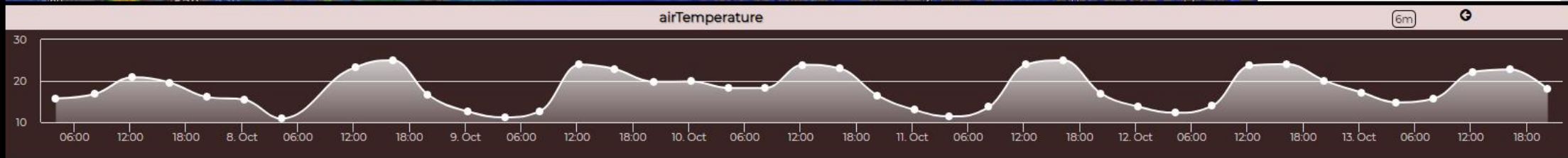
Mobility and Environment What-IF Analysis

This dashboard contains data derived from actual sensors and predictive values under validation

- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM25 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling Paths
- Accident Heatmap
- Only HRes Anym. Gral
- Scenarios
- What-if analysis

Firenze Oggi

Air Temperat... (6m)



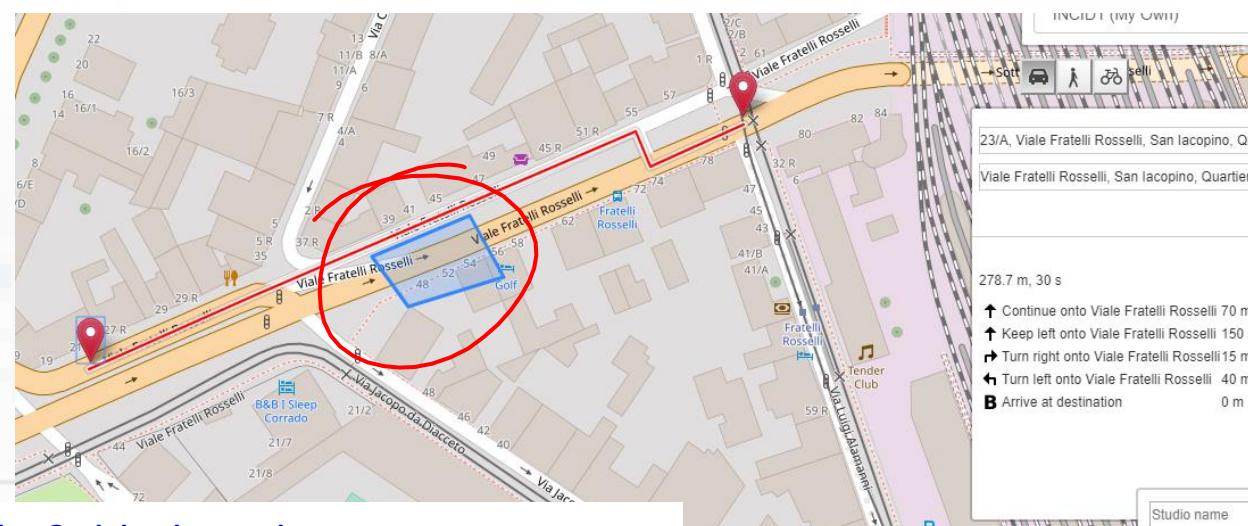
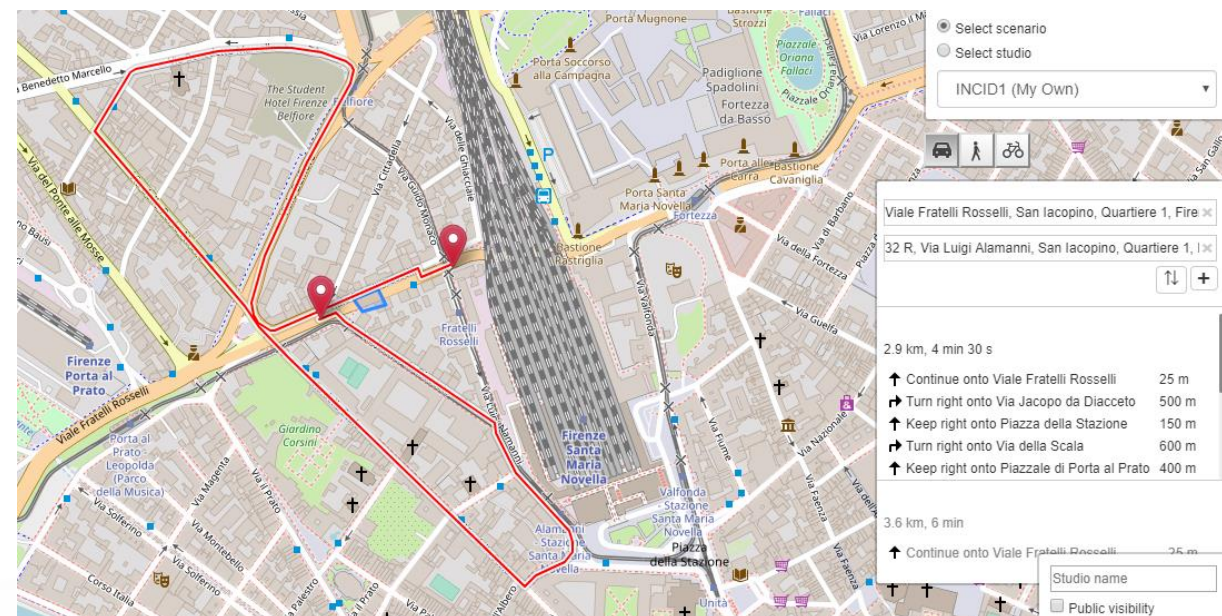
<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjE5MA==>

Accidents and elements blocking Points and Shapes taken into account for:

- Routing
- Traffic Flow reconstruction
- Evacuation paths
- Rescue team paths

Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment



Multi-Widget Map

Thu 13 Sep 13:07:01

SLOW TRAFFIC			
13/09/2018	10:30:42	5	
13-09-2018 10:17 MATERIALI DISPERSI TRA CINESTRA FIORENTINA E CINESTRA A SINISTRA			
SHED LOAD(S)			
13/09/2018	10:17:22	5	
INCIDENTI CON FERITI			
ACCIDENT(S)			
13/09/2018	09:41:48	1	
13-09-2018 09:16 MATERIALI DISPERSI TRA CINESTRA EST E CINESTRA OVEST CINESTRA			
SHED LOAD(S)			
13/09/2018	09:16:05	5	
13-09-2018 09:10 MATERIALI DISPERSI TRA CINESTRA OVEST E CINESTRA EST CINESTRA			
SHED LOAD(S)			
13/09/2018	09:10:49	5	
13-09-2018 09:08 VEICOLO FERMO O AVARIA TRA CINESTRA A SINISTRA E CINESTRA FIORENTINA			
BROKEN DOWN VEHICLE(S)			
13/09/2018	08:32:54	5	
13-09-2018 08:32 VEICOLO FERMO O AVARIA TRA CINESTRA A SINISTRA E CINESTRA FIORENTINA			
BROKEN DOWN VEHICLE(S)			
13/09/2018	08:32:54		
MATERIALE IN CARREGGIATA			
Operator Event			
06/07/2018	18:07:34		
PEOPLE	OPERATOR		
0			
06/07/2018	18:07:14		
PEOPLE	OPERATOR		
0			
26/06/2018	18:38:51		
PEOPLE	OPERATOR		
0			
26/06/2018	18:18:14		



STORIE DI FATICA E DI RABBIA

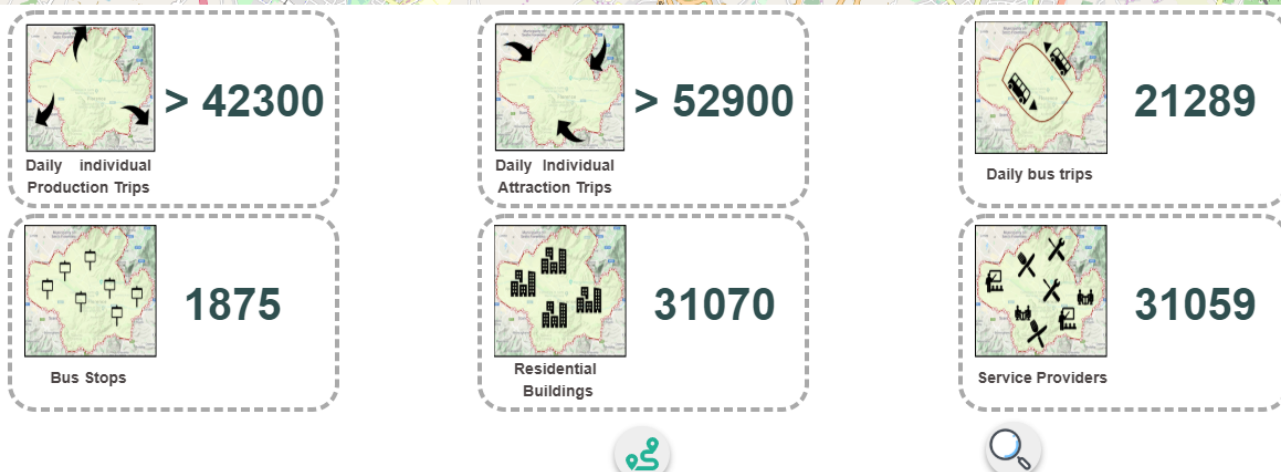
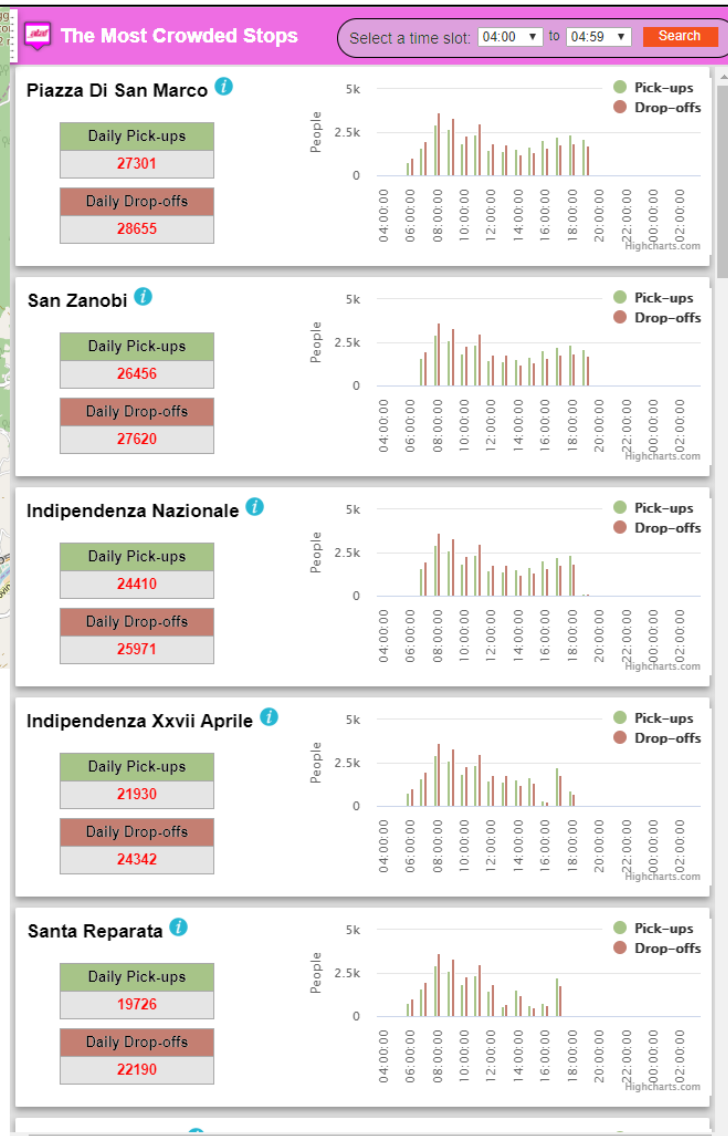
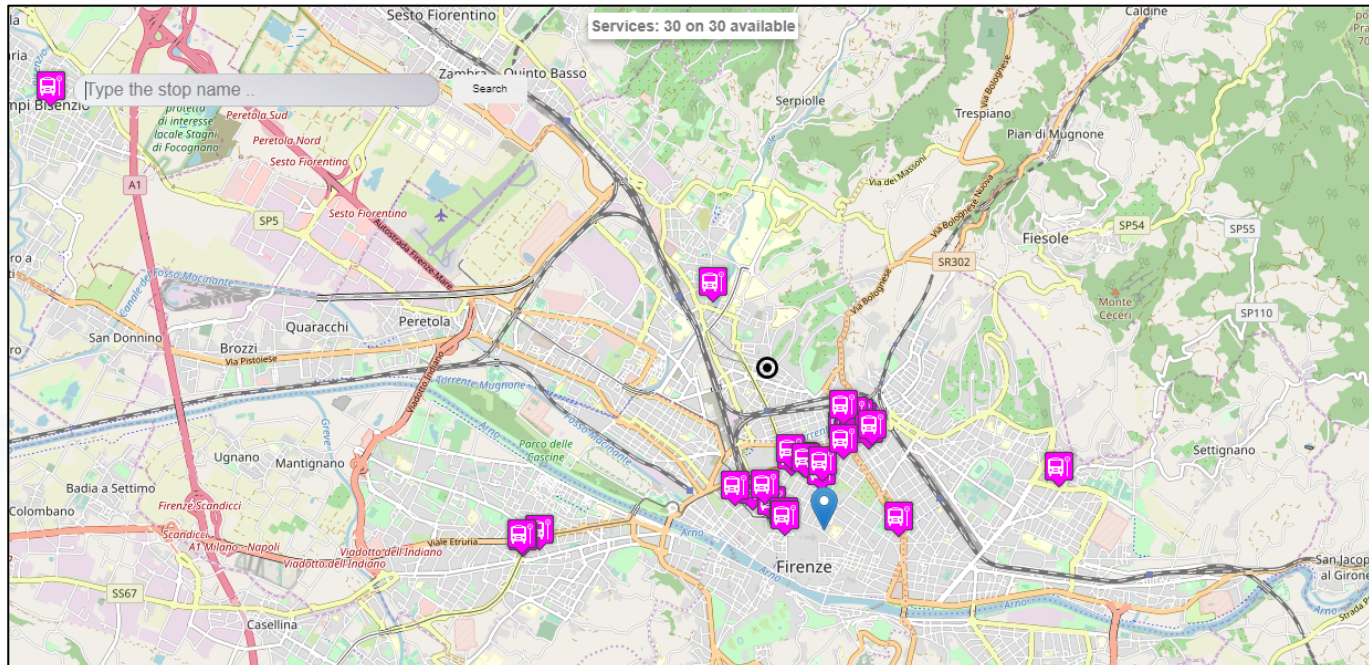
- € ▲
- "TENOR'S NIGHT"
- € ▲
- LA TRAVIATA
- € ▲
- "CELEBRAZIONI 1000 ANNI ABBAZIA DI SAN MINIATO"

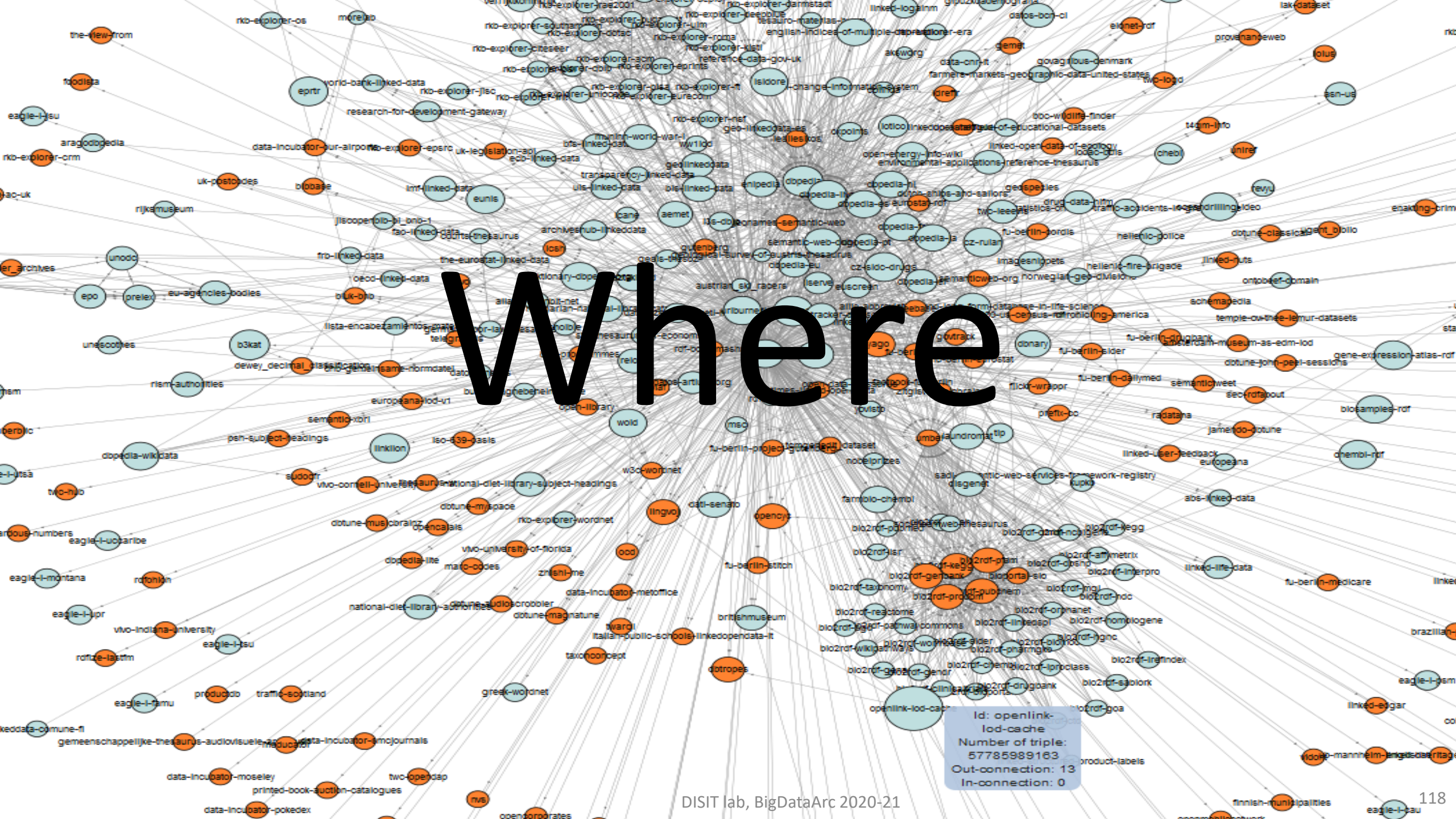
Selector

- Air Quality
- Bus Stops
- Cycle Paths Geometry
- Cycle Paths Pins
- Heatmap
- Meteo Stations
- Recharging Stations - Normal
- Recharging Stations - Fast
- Traffic Flow Density

<https://main.snap4city.org/view/index.php?iddashboard=OTc2>

Bus Stop Analysis: identification of criticalities



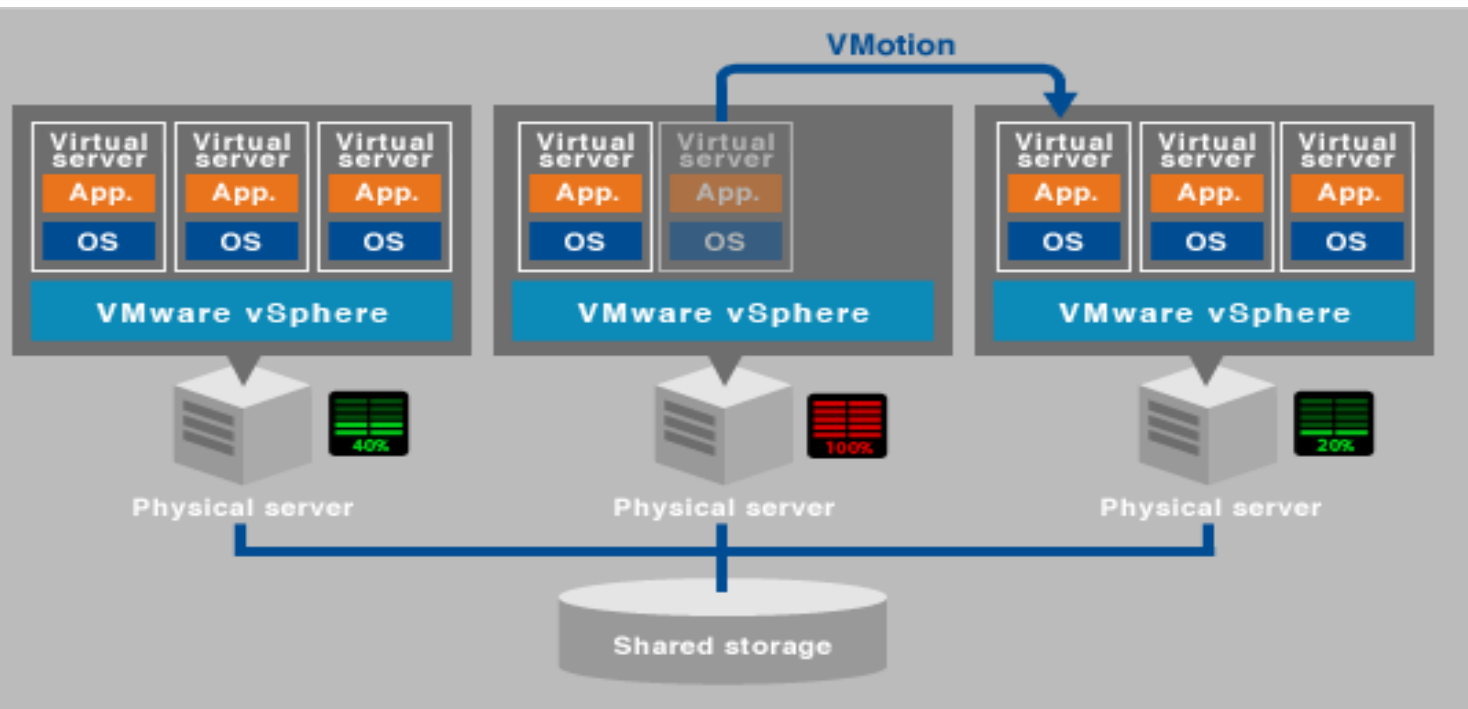


Where

Id: openlink-lod-cache
Number of triple:
57785989163
Out-connection: 13
In-connection: 0

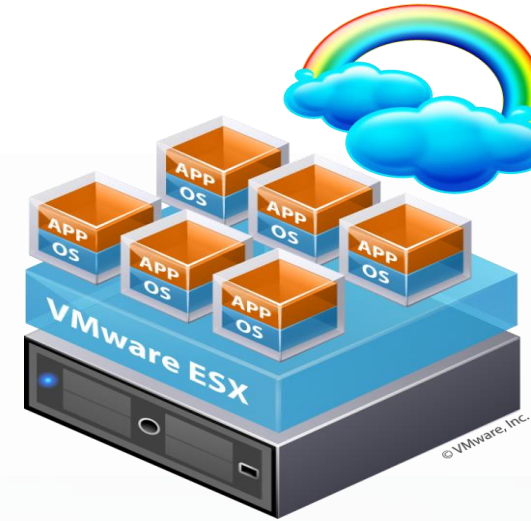


- HA: High Availability,
DRS: Distributed Resource Scheduler



Cloud computing e Virtualizzazione

- **Motivations for Cloud computing and Virtualization**
- **Virtual Machine concepts:** emulation, para-virtualization, snapshots
- **Cloud Computing,** cloud vs grid, goals of cloud computing
- **High Availability,** Workload Balancing
- **vSphere Infrastructure,** Vmotion, Power Management, Resource Scheduling, Fault Tolerance
- **Security on the Cloud**
- **Conversions** among VM and physical machines
 - Conversions: P2V, V2V
- **vCenter, datacenters and cluster management**
 - Performance analysis for the cloud
- **Comparison** among Cloud computing solutions
- **ICARO project**

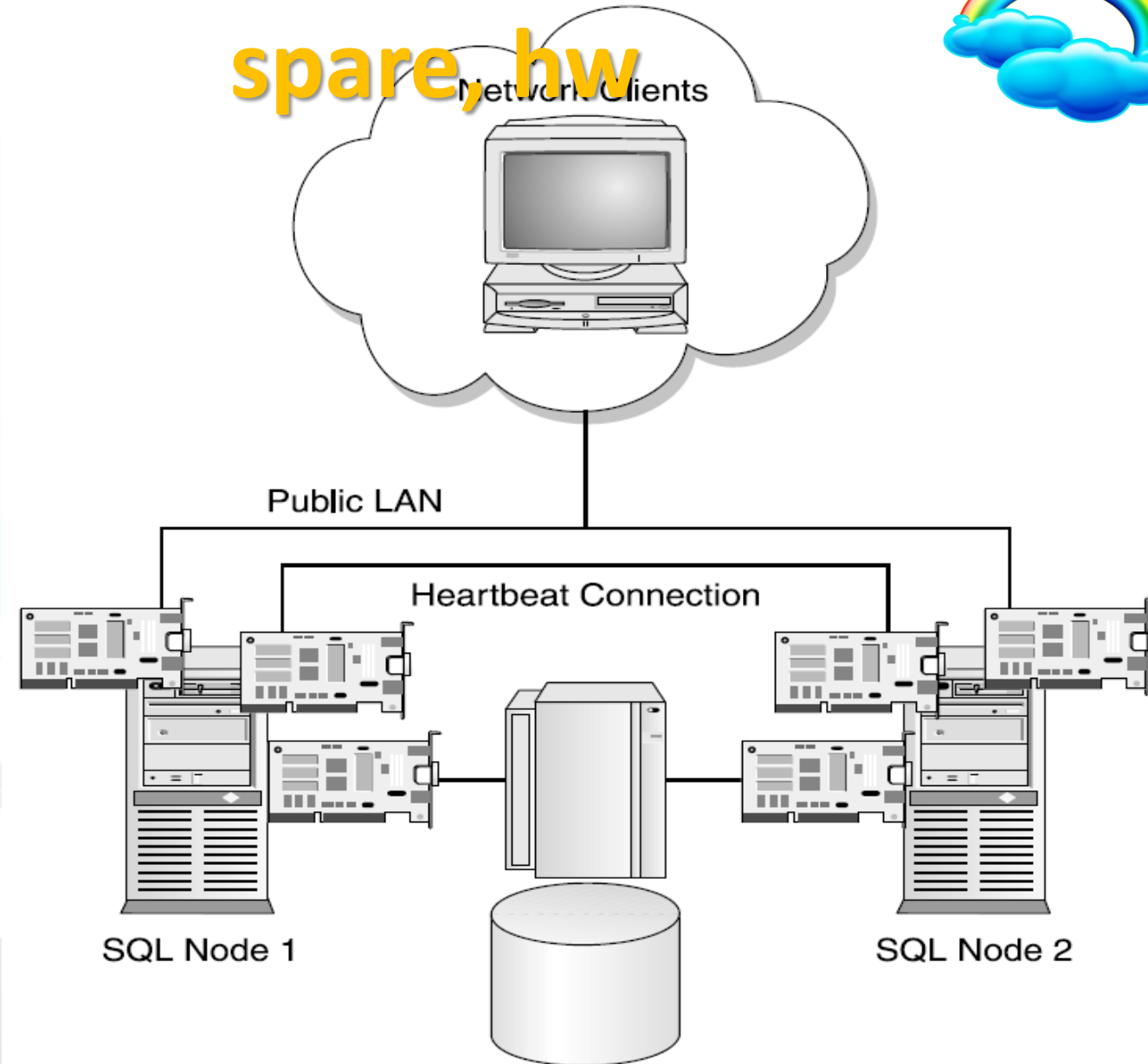


High Availability: Hot

spare, hw



- Three separate networks cards
 - Front end
 - Heartbeat
 - Database NAS/SAN
- UPS/APC solutions with
 - 2 UPS, each of which with network card
- NAS/SAN
 - Raid 5 or 6, 60
 - Fiber connection



Smart Cloud Engine



Cloud Simulator

Cloud Simulator
DISIT - Distributed Systems and Internet Technology Lab

Simulate Data Center TEST-022 Faster 2014-11-18 16:08:41 7 nagios nagios 192.168.0.103 22 /usr/local/pnp4nagios/var/perfdata/ Simulate

Choose Pattern for TEST-022_HM01_VM01

20141118T160656

eclap-bp64net.eclap.eu-running@192.168.0.132 / SNMP WIN CPU AVG

eclap-bp64net.eclap.eu-running@192.168.0.132 / SNMP WIN Net Traffic

eclap-bp64net.eclap.eu-running@192.168.0.132 / SNMP WIN Physical Memory Use

eclap-bp64net.eclap.eu-running@192.168.0.132 / SNMP WIN Volumes

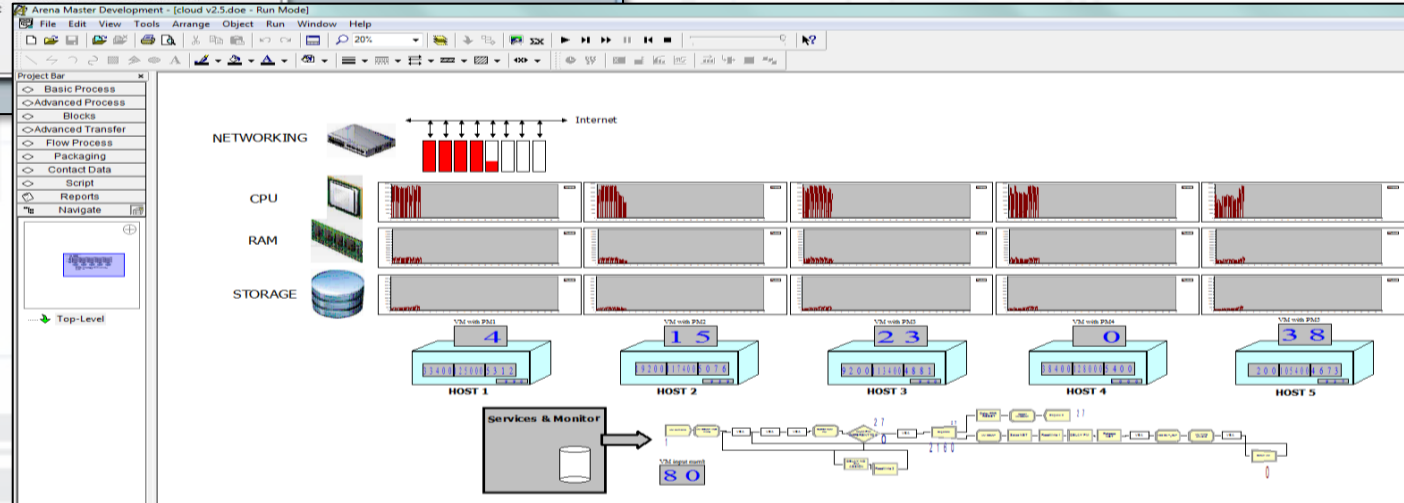
localhost:8080/CloudSimulator/datacenter/dataCenterSimulationFaster.jsf?cid=6#

To simulate complex cloud configurations



<http://www.cloudicaro.it>

Identification of optimal configurations allocations on the basis of effective workload



Agenda

- Laboratorio DISIT
- Tematiche del corso
- Struttura del corso
- Infrastruttura del DISIT Lab
- Modalità dell'esame





- Overview del corso e del Lab (queste slide)
- Cloud: virtualizzazione, HA, DRS, FT, architetture
 - Container: Marathon, Mesos, Docker → kubernetes
- Hadoop, MapReduce, Spark
- Indexing and Search: SOLR, SOLR Sharded, Elastic Search
- Big Data Storage Confronto: Hbase, Mongo
- Visual Analytics: Business intelligence, Dashboard
- Big Data Analytics
- Batch and Data Stream processing: NIFI, Kafka, ETL, ...
 - IOT Architecture: AWS, Azure IOT, Google IOT,
 - Snap4City IOT/IOE
 - IOT Industry 4.0
 - Snap4City architecture for Living Lab
- Tensor Flow for traffic reconstruction, and simulation

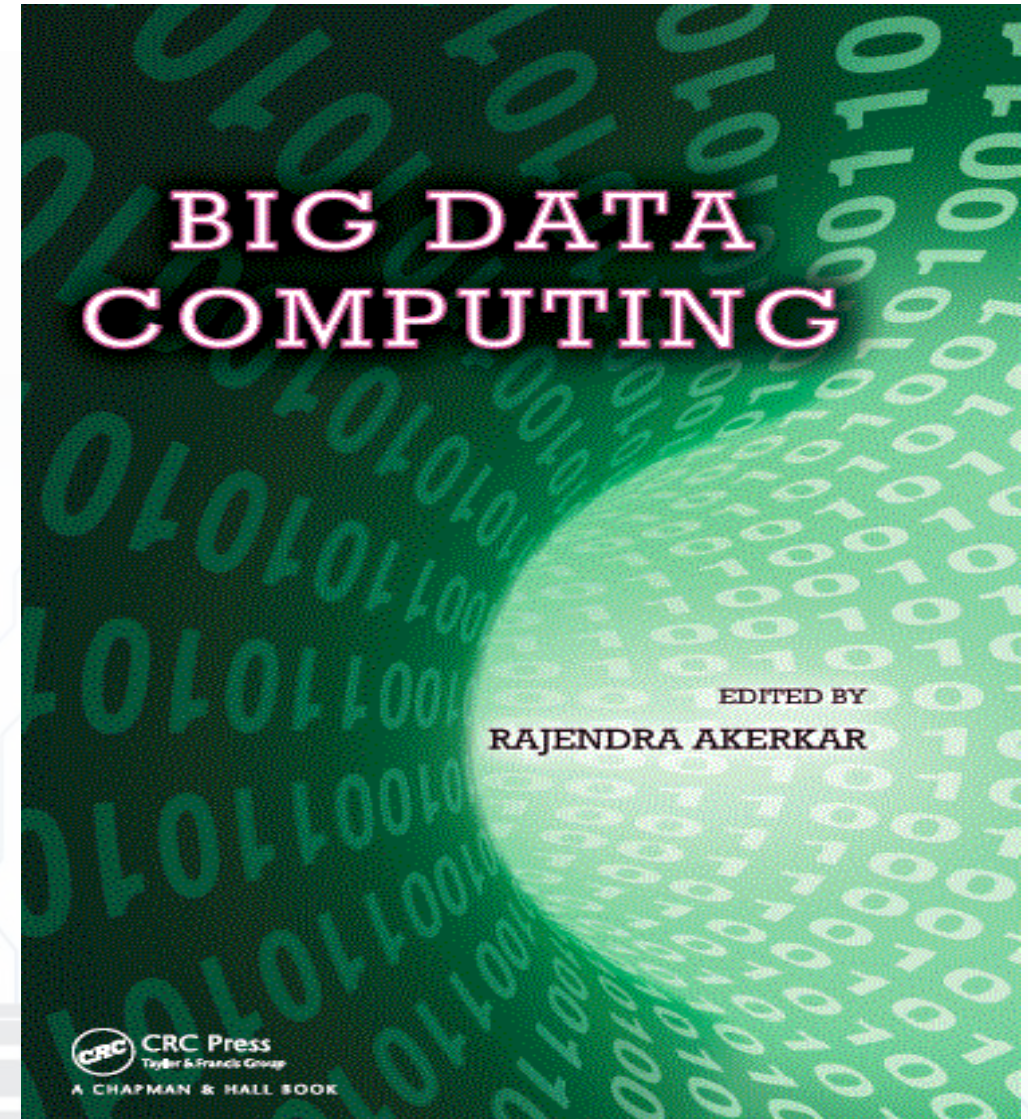
Modello del Corso

- **Tipicamente per ogni argomento sono presentati:**
 - Requisiti e motivazioni dello sviluppo dell'argomento
 - Punto di vista dell'utente e del gestore
 - Stato dell'arte
 - Basi teoriche e tecnologiche, Eventuali standard
 - Prodotti di mercato (leader), pro e contro
 - Recenti Innovazioni e tendenze
 - Confronti fra le varie tecnologie e nuove soluzioni, pro e contro
 - Dettagli progettuali
 - Aspetti prestazionali e di scalabilità
- **Seminari di altri studenti e/o esperti,**

- **Ricevimento per la didattica frontale**
 - Skype, cercatemi come: Paolo.nesi@unifi.it
 - qualsiasi ora, rispondo in chat se necessario fissiamo via skype una call
- **Ricevimento per elaborati**
 - *Come sopra, a qualsiasi ora vi Skype*
- **Modalita' per il superamento dell'esame**
- **Eventuali stage e tesi anche collegati fra loro e con il Lab**

P. Bellini, M. Di Claudio, P. Nesi, N. Rauch, "Tassonomy and Review of Big Data Solutions Navigation", in "Big Data Computing", Ed. Rajendra Akerkar, Western Norway Research Institute, Norway, Chapman and Hall/CRC press, ISBN 978-1-46-657837-1, eBook: 978-1-46-657838-8, **july 2013**, in press.

<http://www.tmrfindia.org/bigdata.html>



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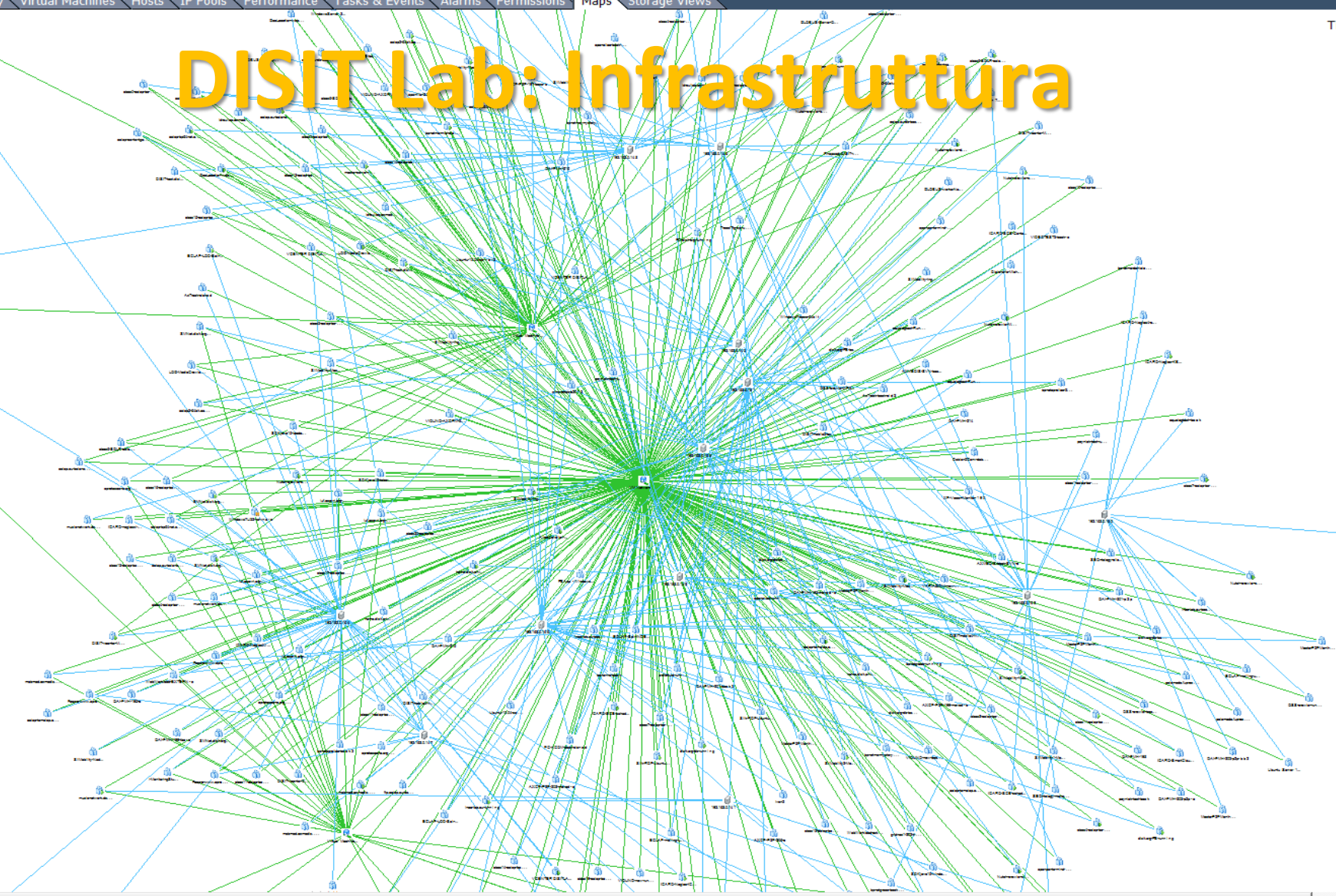


- **Research group since 1994**
- **Cloud and data center with >700 TByte storage in raid 50/60,**
 - >800 CPU cores, >15000 GPU cores, >8 Tbyte RAM
 - Managing several infrastructures
- **Snap4City.org:** development and testing platform
- **IOT center:** reference center
- **Open Data and Linked Open Data center**
 - Integration of more than 800 different Open Data
 - LOD for global linked data <https://LOG.disit.org>
- **Nodo CINI per: Big data, Smart City, Security**

Time since last data update: 02:37 Refresh

- disit-dc
 - 192.168.1.101
 - AxTi
 - ftp.e
 - inea
 - mus
 - SDK
 - 192.168.1.102
 - aqui
 - Dizi
 - ECL
 - horr
 - idra
 - Mas
 - Mas
 - mas
 - OAI
 - OAI
 - OAI
 - OAI
 - OAI
 - pala
 - payr
 - VCE
 - VIO
 - VIO
 - Win
 - 192.168.1.103
 - BLO
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 - oper
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 - 192.168.1.105
 - apre
 - apre
 - Feaj
 - Co

DISIT Lab: Infrastruttura



Overview

Map Relationships:

Custom Map

Host Options

- Host to VM
- Host to Network
- Host to Datastore

VM Options

- Fault Tolerance relationships
- VM to Network
- VM to Datastore
- Show only powered on VMs

Apply Relationships

- **Triennale**

- Sistemi Distribuiti – Prof. Paolo Nesi
- Sistemi Operativi – Pierfrancesco Bellini
- Fondamenti di Informatica per Ingegneria Gestionale – Michela Paolucci
- Fondamenti di Informatica per Infermieristica – Gianni Pantaleo

- **Magistrale**

- Big Data Architectures – Prof. Paolo Nesi (Big Data, Data Analytics, Architecture, Cloud, IoT)
- Security and Knowledge Engineering – Prof. Pierfrancesco Bellini (Knowledge Engineering, Web Security, Natural Language Processing)

- **Altri corsi:**

- Data Intelligence – Corso di Intelligence e Sicurezza Nazionale – Prof. Paolo Nesi
- Master in Big Data-MABIDA: architetture, Big Data, Knowledge engineering, Natural Language Processing, cloud, etc.

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Elaborati

<http://www.disit.org/5492>

- **Gli elaborati (singoli o coppie di studenti) possono essere di tipo**
 - (Tipo A) con sviluppo di software, moduli singoli come descritto in seguito.
 - (Tipo B) con sviluppo algoritmi di Data analytics.
 - (Tipo C) con sviluppo di moduli e processi di data warehouse.

Lo studente può

- chiedere la sostituzione dell'elaborato e/o del tutor di laboratorio tramite email al docente.
- decidere di interrompere l'elaborato in ogni momento chiedendo la valutazione e consegnando la relazione breve di alcune pagine.

A: sw, open source, etc.

- Contributo su strumento visuale per la programmazione di IOT Applications, node.js, node-red
- sviluppo di strumento di simulazione e calcolo della domanda vs offerta di mobilità con diversi tipi di matrici origine destinazione
- studio di simulatori Open Source per lo studio di movimentazioni logistiche di materiali in città anche con uso di Droni, e guida autonoma
- inserimento soluzione per Cut/Past di widget nel Dashboard Builder, con possibilità di export/import in JSON neutro.
- sviluppo di un sistema di serious game per sharing (bike and car), con lock-unlock, booking, tracking, etc.
- mobile app per Node-RED come IOT Edge, IOT Application on mobile
- studio e applicazione di strumenti per la generazione di report in ambito IOT e smart
- Estensione di widget mappa per la ricezione di dati da visualizzare su mappa
- connessione di dashboard a sistemi di supporto alle decisioni come SmartDS.

B) Data analytics

- soluzioni e modelli predittivi per lo studio di eventi di movimenti del terreno potenziali basandosi su dati di pluviometri
- soluzioni e modelli predittivi per la manutenzione di impianti industriali
- soluzioni e modelli predittivi per la manutenzione di flotte di trasporto
- soluzioni per la gestione e la riduzione di consumi energetici in edifici, distretti e città
- valutazione del comportamento di flussi di persone su base PAX Counter.
- Correlazione fra tweets e numero di persone in città
- Etc.

C) Processi IOT App ...

- creazione di una IOT Application che possa simulare il comportamento di un plastico lego o simil lego di una citta' con parcheggi, luci, panchine, cassonetti, camion nettezza, autobus, semafori, flussi, acqua e livelli, etc. in modo da simulare col plastico i problemi di smart parking, smart biking, traffic routing, etc.
 - Simulazione in sinottico completo
- processi IOT per ingestion dati da servizi di raccolta rifiuti o pulizia strade, che tracciano ogni azione del camion in coordinate gps
- valutazione di nodi JS per node-red per l'ambito energia, e altri protocolli per la comunicazione con condizionatori, e centrali elettriche.

Acknowledgements

- Thanks to the European Commission for founding. All slides reporting logo of **Snap4City** <https://www.snap4city.org> of **Select4Cities H2020** are representing tools and research founded by European Commission for the **Select4Cities** project. **Select4Cities** has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 688196)
- **TRAFair** is a CEF project. All slides reporting logo of TRAFair project are representing tools and research founded by the EC on CEF programme <http://trafair.eu/>
- Thanks to the European Commission for founding. All slides reporting logo of **REPLICATE H2020** are representing tools and research founded by European Commission for the REPLICATE project. **REPLICATE** has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 691735).
- Thanks to the European Commission for founding. All slides reporting logo of **RESOLUTE H2020** are representing tools and research founded by European Commission for the RESOLUTE project. **RESOLUTE** has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 653460).
- Thanks to the MIUR for co-founding and to the University of Florence and companies involved. All slides reporting logo of **Sii-Mobility** are representing tools and research founded by MIUR for the Sii-Mobility SCN MIUR project.
- **Km4City** is an open technology and research line of DISIT Lab exploited by a number of projects. Some of the innovative solutions and research issues developed into projects are also compliant and contributing to the Km4City approach and thus are released as open sources and are interoperable, scalable, modular, standard compliant, etc.

