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 (2023-24)

Agenda

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

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DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

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

Paolo Nesi

Department of Information Engineering

University of Florence

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

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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

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

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

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

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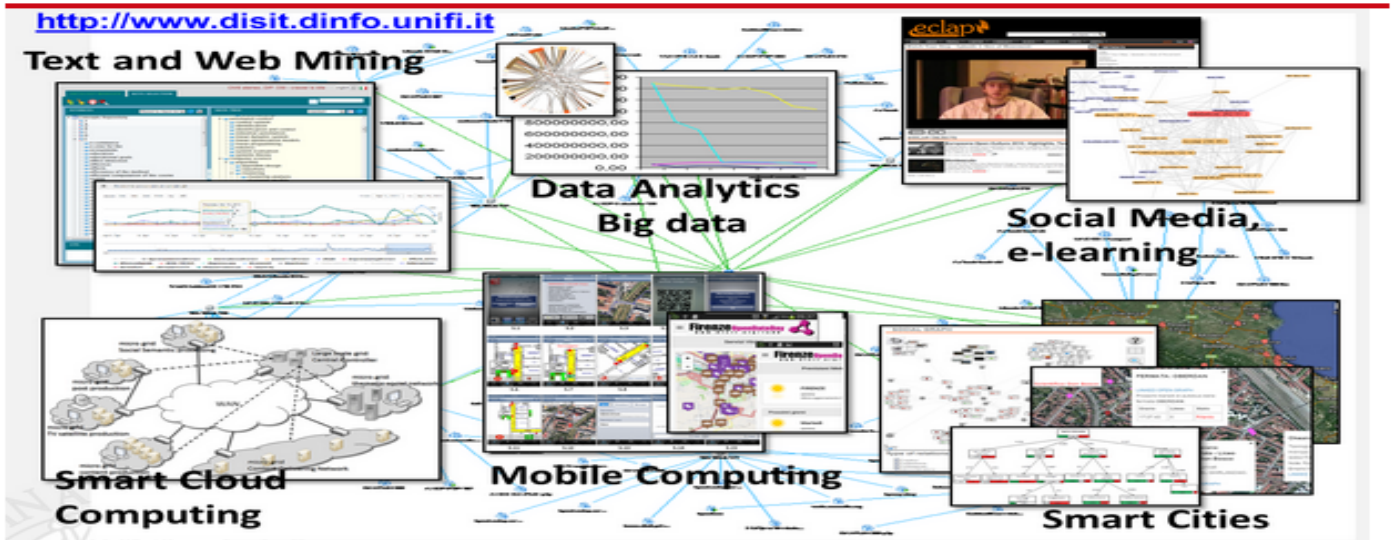
qualsiasi tipo | deep search

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

Mostra | Modifica | Log | Translate | Devel

DISIT LAB OVERVIEW



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 [illegible] and distri[illegible] has covered the role of partner, and also coordinating scientific and tech[illegible] 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

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

https://www.disit.org

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Con chi lavoriamo

swarco First in Traffic Solutions. · VARgroup · THALES · BUSITALIA NORD GRUPPO FERROVIE DELLO STATO ITALIANE · BBC

TIM · LEONARDO · ALTAIR CHIMICA · ECM · COSTRUZIONI NOVICROM · ataf · NORD CTT · BMG · europeana think culture

ALSTOM · eutelsat · liberologico · Società Italiana degli Autori ed Editori · SIAE · Rai

Hewlett Packard Enterprise · COMPUTER GROSS · ENGINEERING · GIUNTI EDITORE

PHILIPS · tiscali: · Effective Knowledge s.r.l.

e-distribuzione · Fondazione per la ricerca e l'innovazione

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS · ENTE CASSA DI RISPARMIO DI FIRENZE · CITTÀ METROPOLITANA DI FIRENZE · COMUNE DI FIRENZE

Fraunhofer · Consiglio Nazionale delle Ricerche · cini · cnit consorzio nazionale interuniversitario per le telecomunicazioni · Camera di Commercio Firenze · ARPAT Agenzia regionale per la protezione ambientale della Toscana · REGIONE TOSCANA

National Technical University of Athens · EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE · UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA · UNIVERSITÀ DEGLI STUDI DI CAGLIARI · APRE TOSCANA AGENZIA PER LA PROMOZIONE DELLA RICERCA EUROPEA · ACCADEMIA NAZIONALE DI SANTA CECILIA · CONSORZIO LaMMA

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

SNAP4CITY

REPLICATE

resolute

Sii-Mobility

TRAFAIR

GREEN IMPACT C.A.P.A.C.I.T.Y.

LAID Smart Bed

GREEN FIELD PEAS Soda4.0

5G

MOSAiC

Coll@bora

TESYS RAIL

feedback

Trace-IT

RAISSS

Smart COMMUNITIES Tech Italian Technology Cluster for Smart Communities

Regione Toscana

MIUR

Horizon 2020 European Union Funding for Research & Innovation

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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

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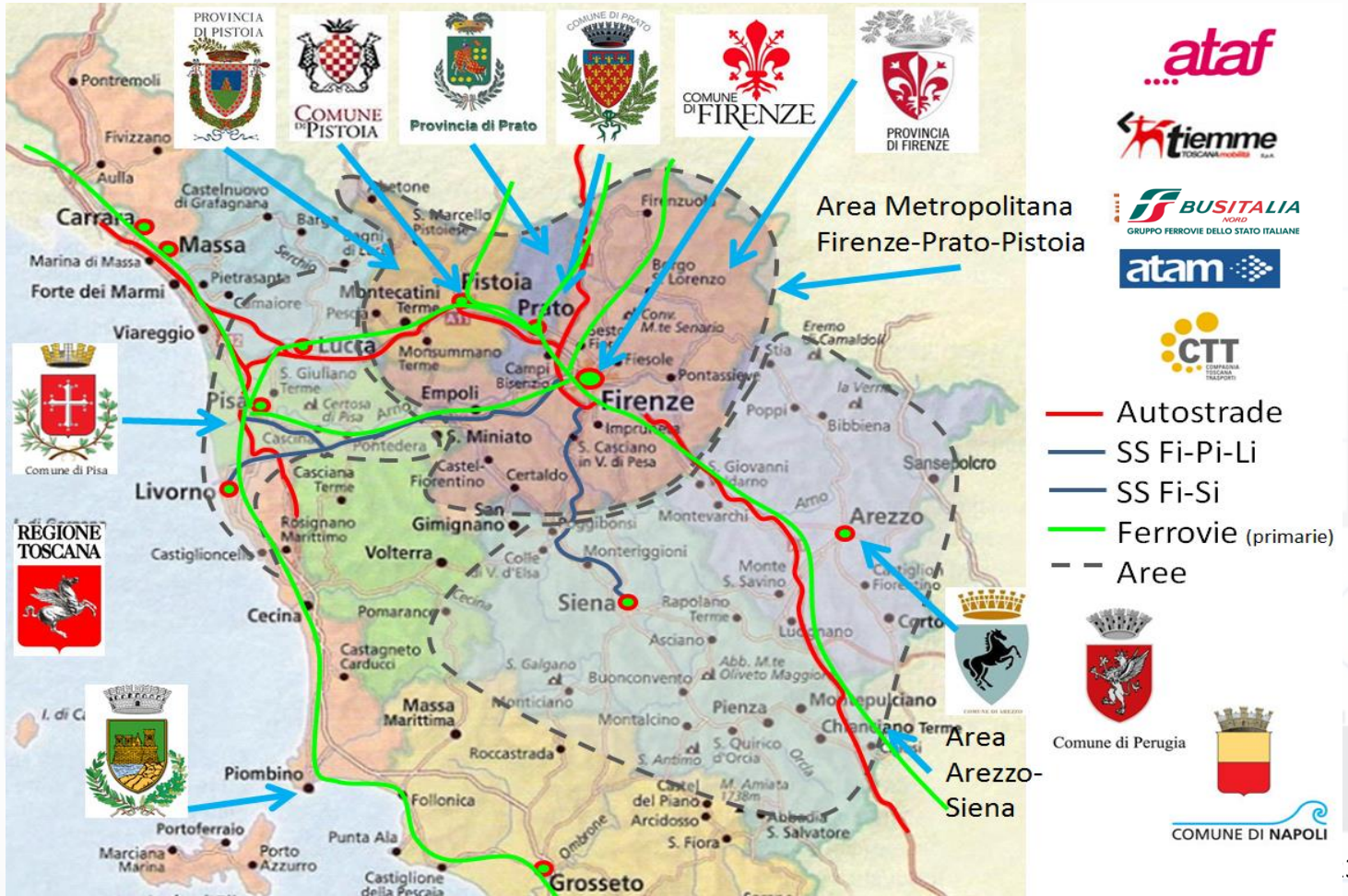
Sii-Mobility

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*



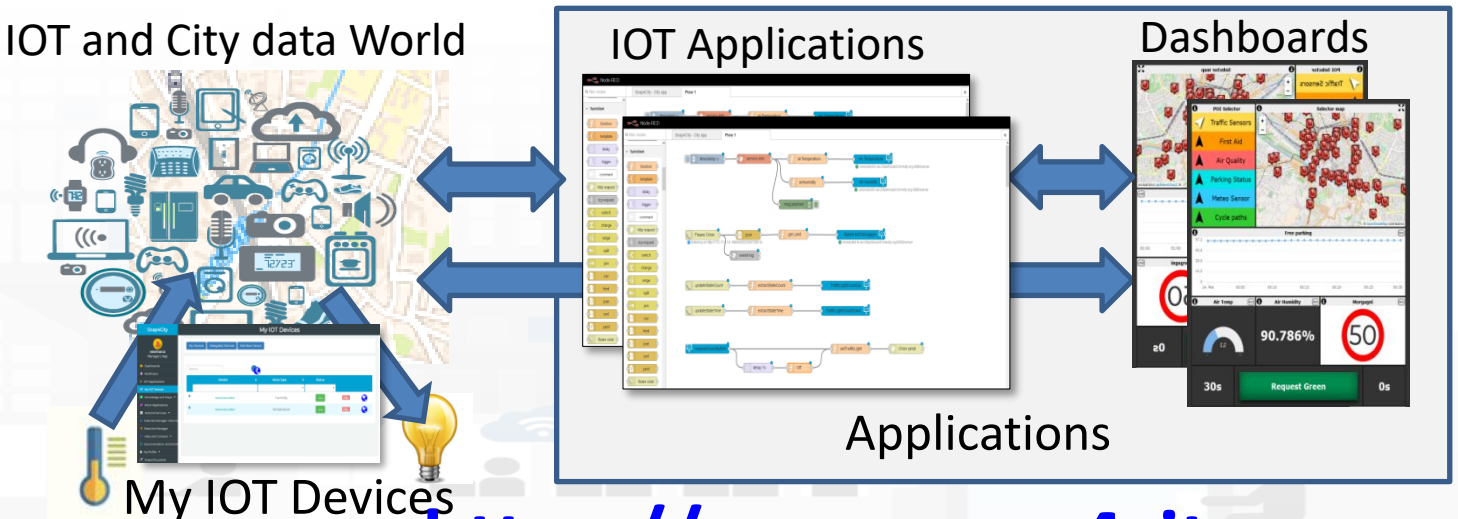
ECM; Swarco Mizar; Inventi In20; Geoin; QuestIT; Softec; T.I.M.E.; LiberoLogico; MIDRA (autostrade, motorola); ATAF; Tiemme; CTT Nord; BUSITALIA; A.T.A.M.; Effective Knowledge; eWings; Argos Engineering; Elfi; Calamai & Agresti; Project; Negentis

General Objectives

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

- 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
- ***smart city solutions in a***



https://www.snap4city.org

REPLICATE

Horizon 2020
European Union Funding
for Research & Innovation

REnaissance of PLaces
with Innovative Citizenship
And TEchnology

http://replicate-project.eu/

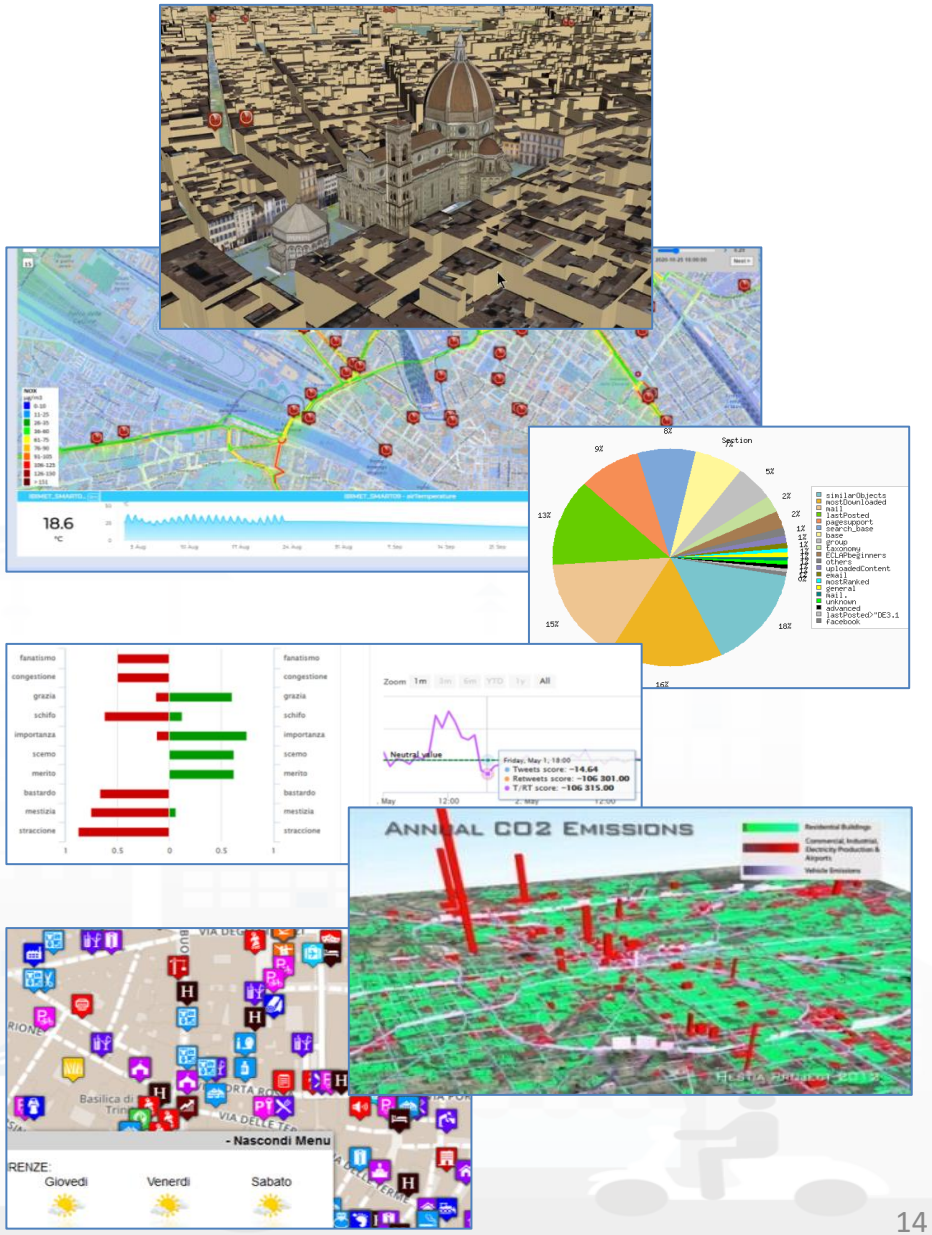
- demonstrate Smart City technologies in energy, transport and ICT in districts in:
  - San Sebastian, Florence and Bristol,
  - follower cities of Essen, Nilufer and Lausanne
- Cities are the customer: considering local specificities
- Solutions must be replicable, interoperable and scalable.
  - Integrated Infrastructure: deployment of ICT architecture, from internet of things to applications
  - Low energy districts
  - Urban mobility: sustainable and smart urban services

DISIT lab,

- ***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*

Digital Twin

- **Digital Twin**
  - **Connected** with real physical systems
  - **Modelling aspects**: structural, visual, informative, real time data sensors (context), POI, functional, resource managements, etc.
  - **Integration of** AI/XAI techniques with simulations and modelling
- **Easier to understand the context, review from multiple points of view**
- **Useful to perform**
  - Discussion with city users
  - Support decision makers
  - By Case Experiments for analysing
    - New solutions, impact of disaster (natural and provoked)
    - Reduction of costs in the analysis, in reduction of mistakes




SNAP4CITY
3D Map Global Digital Twin -Newgui2
Thu 25 May 17:54:20
3D Map
Traffic
FirenzeTrafficRealtime
Traffic Controls:
24H
Max Opacity:
1
< Prev
2023-05-22 08:01:00
Free street
Fluid traffic
Heavy traffic
Very heavy
Sensor position
© OpenStreetMap contributors
Air Quality FI-BASSI - NO2
6m
40
20
0
18:00
20:00
22:00
25. May
02:00
04:00
06:00
08:00
10:00
Weather_sensor_ Open Weather 3176959 - Air Temperature
6m
30
20
10
18:00
21:00
25. May
03:00
06:00
09:00
12:00
15:00
https://youtu.be/JLzT9k3Xbc0

OCULUS

https://www.youtube.com/watch?v=Rcf_B2_GOio


Snap4City
Dashboard Management Syst
Dashboard Management Syst
Nuova scheda
snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQzOA==
Ospite
Firenze Oggi
Mon 16 May 12:59:27
20991
COLONNINE
SITUAZIONE VIABILI
0 INCIDENTI
0 CHIUSURE PER CANTIERI
0 PROGR.
0 NON PROG.
0 LIMITAZIONI PER CANTIERI
0 NON PROG.
0 PROGR.
SMN
42.2
BINA..
54.5
FORT..
23.2
LEOP..
37.3
CALZA..
48
S.AM..
58.6
PART..
55
CARE..
13.8
BECC..
77.6
ANALYSIS
Energy
Environment
Mobility
Social
Resilience
FLUSSI INGRESSO CIT
TOTA..
92207
FLUSSI INGRESSO ZTL
TOTA..
15964
Nati italiani
175
Nati s..
48
Dece..
499
Matri..
72
Unio..
2
Manutenzioni Strad..
19
Verd..
18
Decoro Urba..
3
Reiti..
5
Indicatore Rt per la provincia di
Rt
0.94
Linea..
Linea..
Linea..
Linea..
Linea..
Linea..
The European House
Ambrosetti

Horizon 2020
European Union Funding
for Research & Innovation

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
Consorzio Milano Ricerche	CMR	IT

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http://trafair.eu/

TRAFAIR

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**

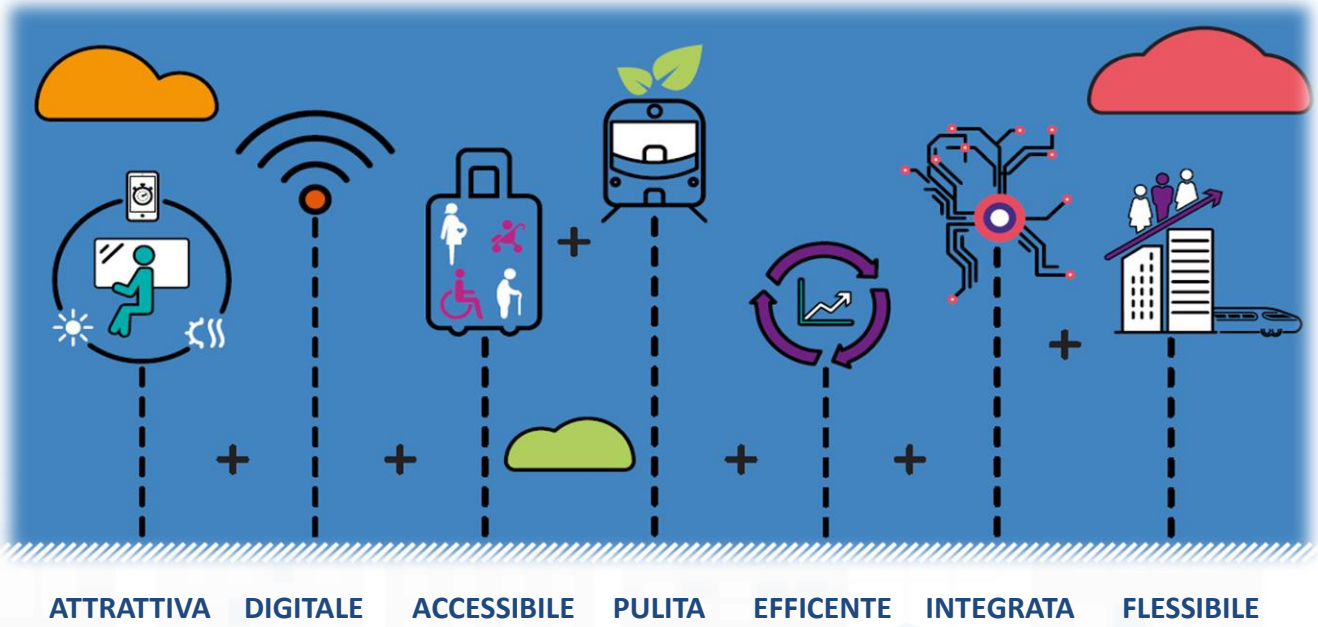
- Università degli studi di Modena e Reggio Emilia (UNIMORE) -- Italy
- **Università degli Studi di Firenze – DISIT DINFO -- Italy**
- Universidade de Santiago de Compostela (USC) - Spain
- Comune di Modena (CMO) - Italy
- Regione Toscana (TR) - Italy
- Concello de Santiago de Compostela (CSC) - Spain
- 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

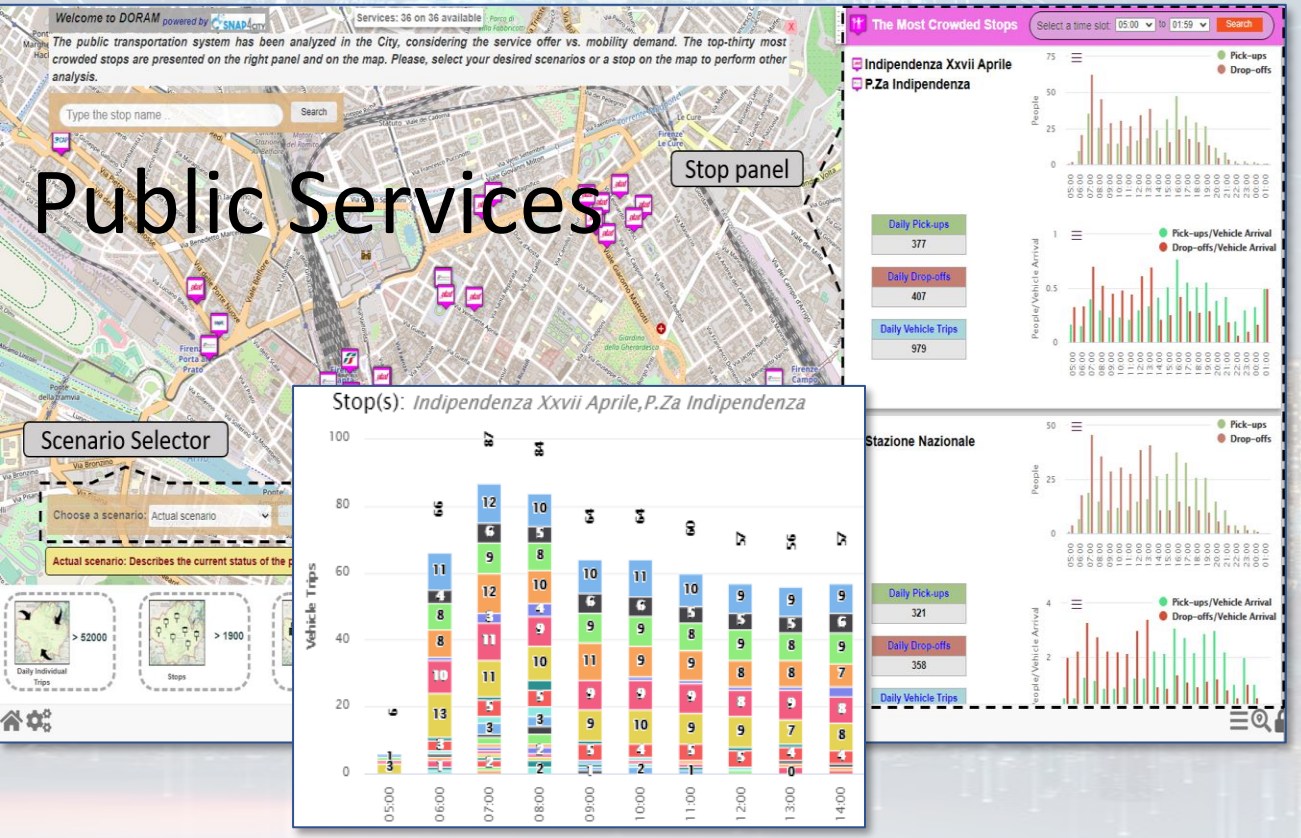
- Demand Analysis
- Prediction on Parking
- Connected Drive
- Offer Analysis
- Simulation of Mobility
- Etc.

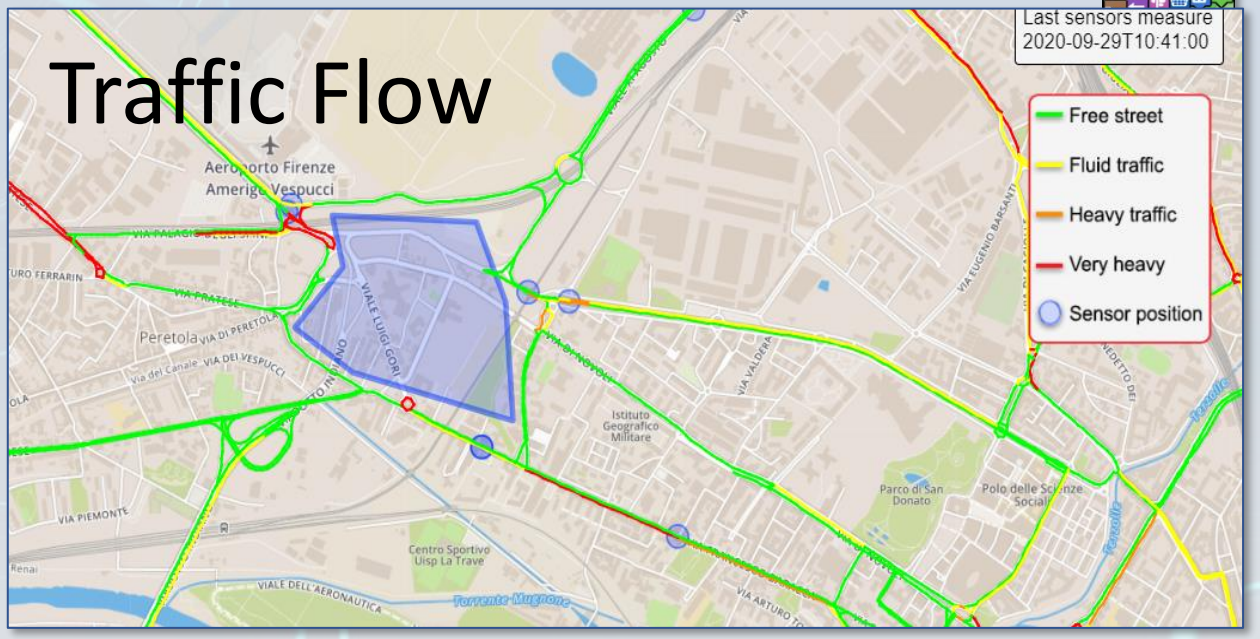
Where: in Tuscany

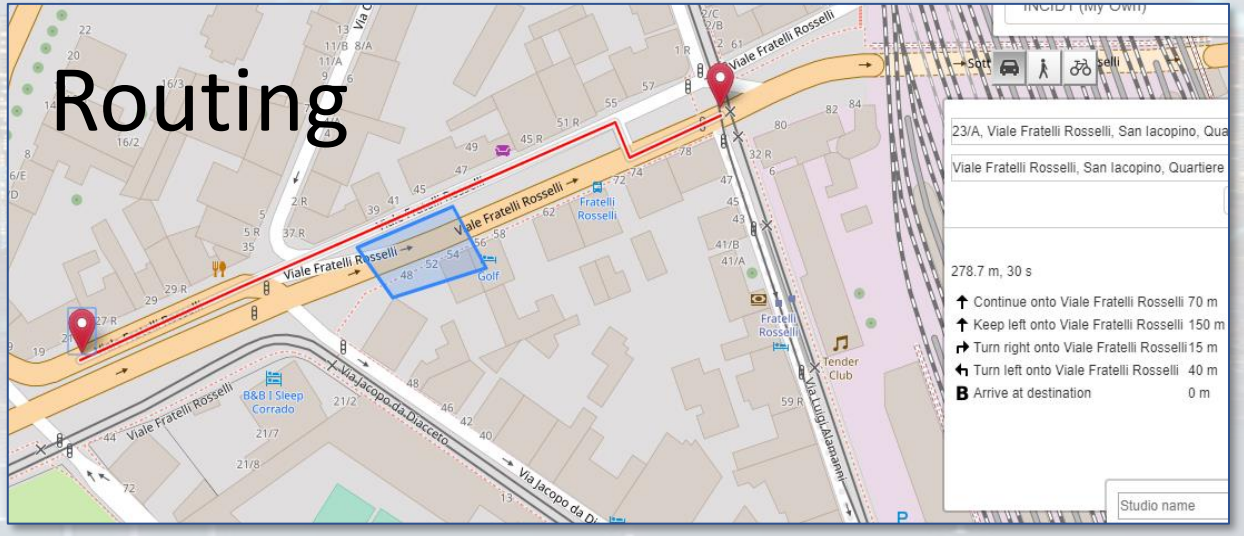


What-if Analysis

- Definition of scenarious impact on
  - Traffic, Pollutant, parking, public transport, private flows, etc.
  - KPI analysis







WEEE: Waste from Electrical and Electronic Equipment

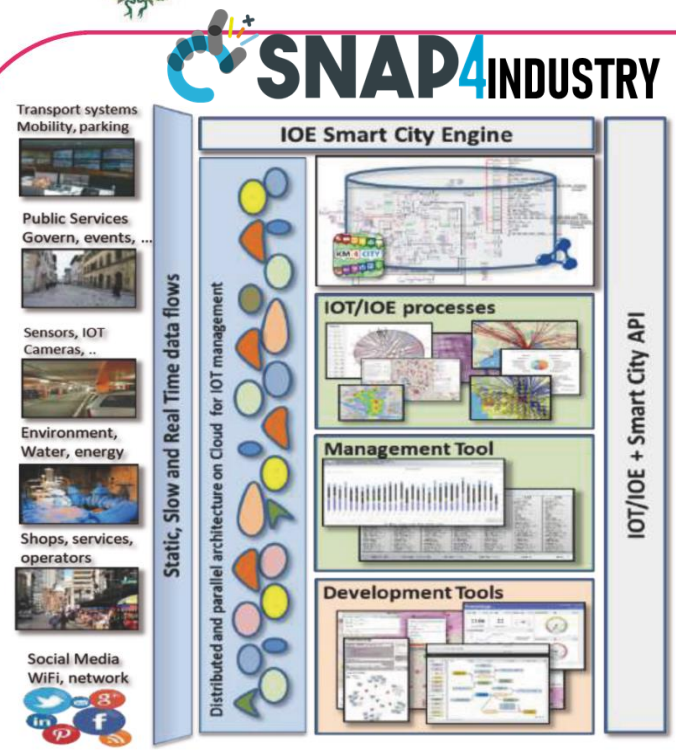
- **maximize the collection of WEEE** in Tuscany through a new governance model based on the involvement of SMEs and awareness raising activities towards citizens and its **replication in Andalucía**.
- Actions:
  - Improve the regional governance
  - Support municipalities in capacity building of public 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.

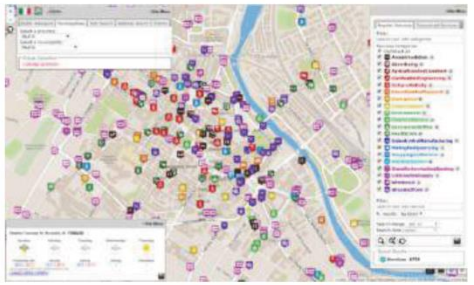
http://www.regione.toscana.it/-/life-weee

SENSORI E IOT - PRATO

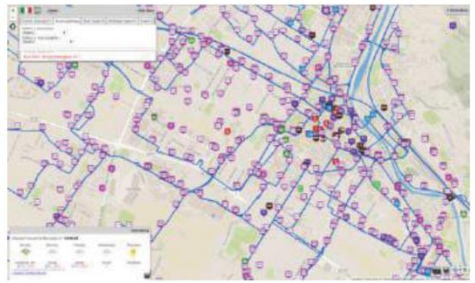
Piattaforma IoT/IoE abilitata dal 5G per applicazioni di:

- 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 estra

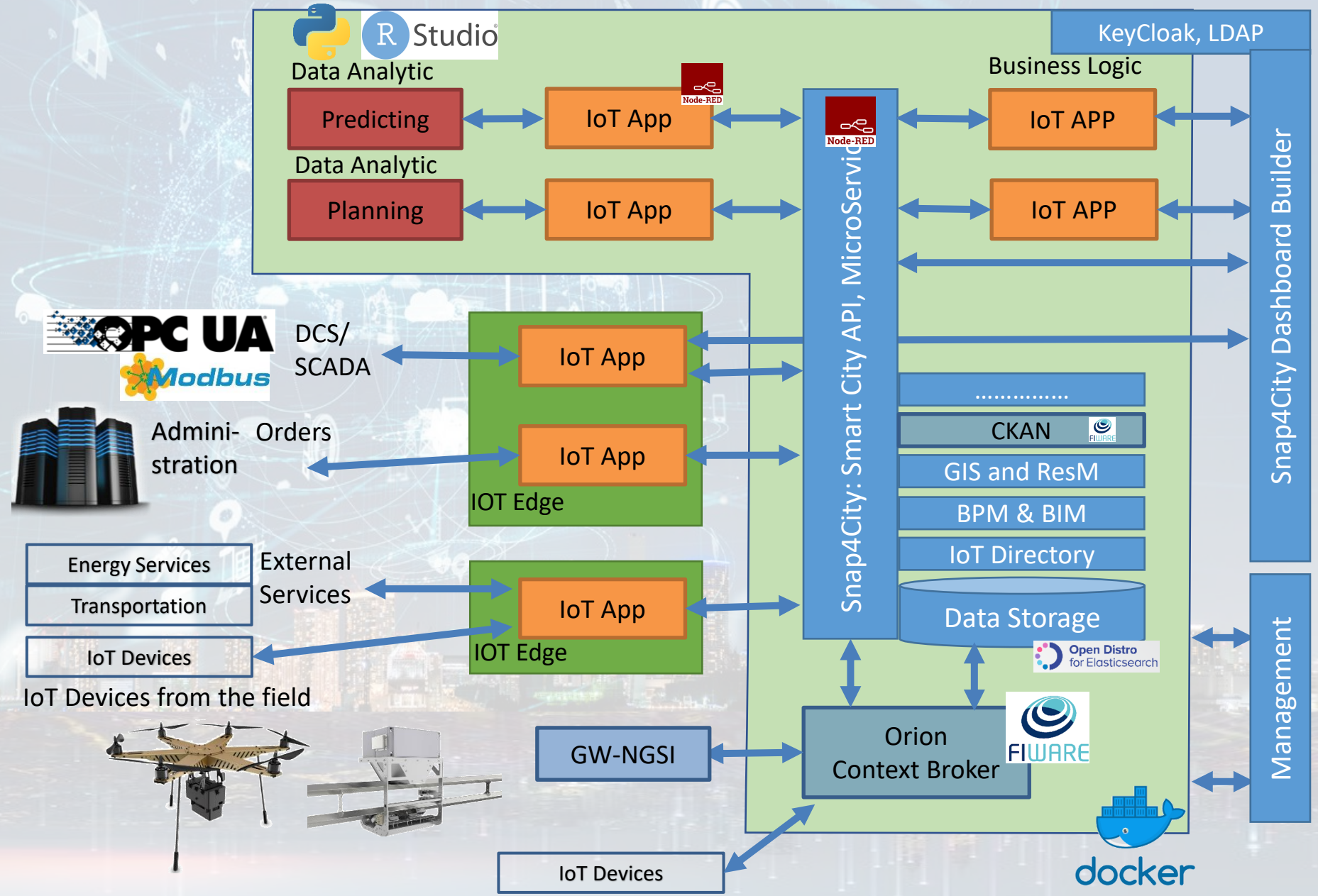
Partner coinvolti open fiber, ZTE Leading 5G Innovations, Università degli Studi Firenze, cellnex driving telecom connectivity, SSE Sirio Sistemi Elettronici, PIN - Polo Universitario Città di Prato

Aziende/Enti Coinvolti Qualcomm, Interporto della Toscana Centrale, Unione Industriale Pratese Confindustria Prato, Publiacqua, GIDA, Programma Ambiente, centria Reti Gas

Green Impact Capacity (GIC)

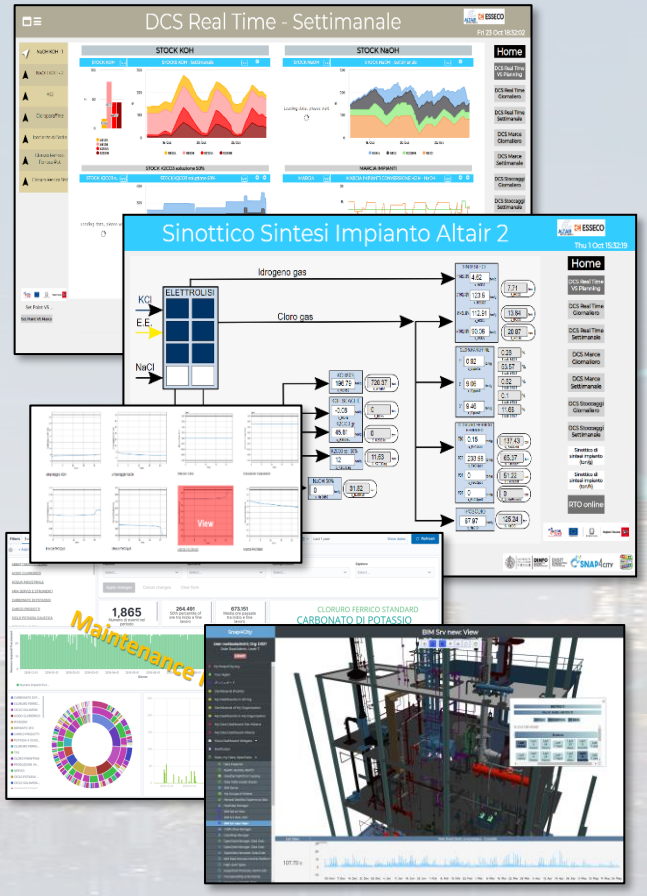
- Improve productivity of chemical plant
- Keep GREEN the environmental impact
- Exploiting innovative technologies
- Diversify the production
- Monitoring environmental conditions

Snap4City/Industry Detailed Architecture



Production Parameters

Dashboards, Visual Analytics, Synoptics, 3D, Maps



Regione Toscana

Fondazione per la ricerca e l'innovazione

Interreg Mediterranean HERIT-DATA

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**

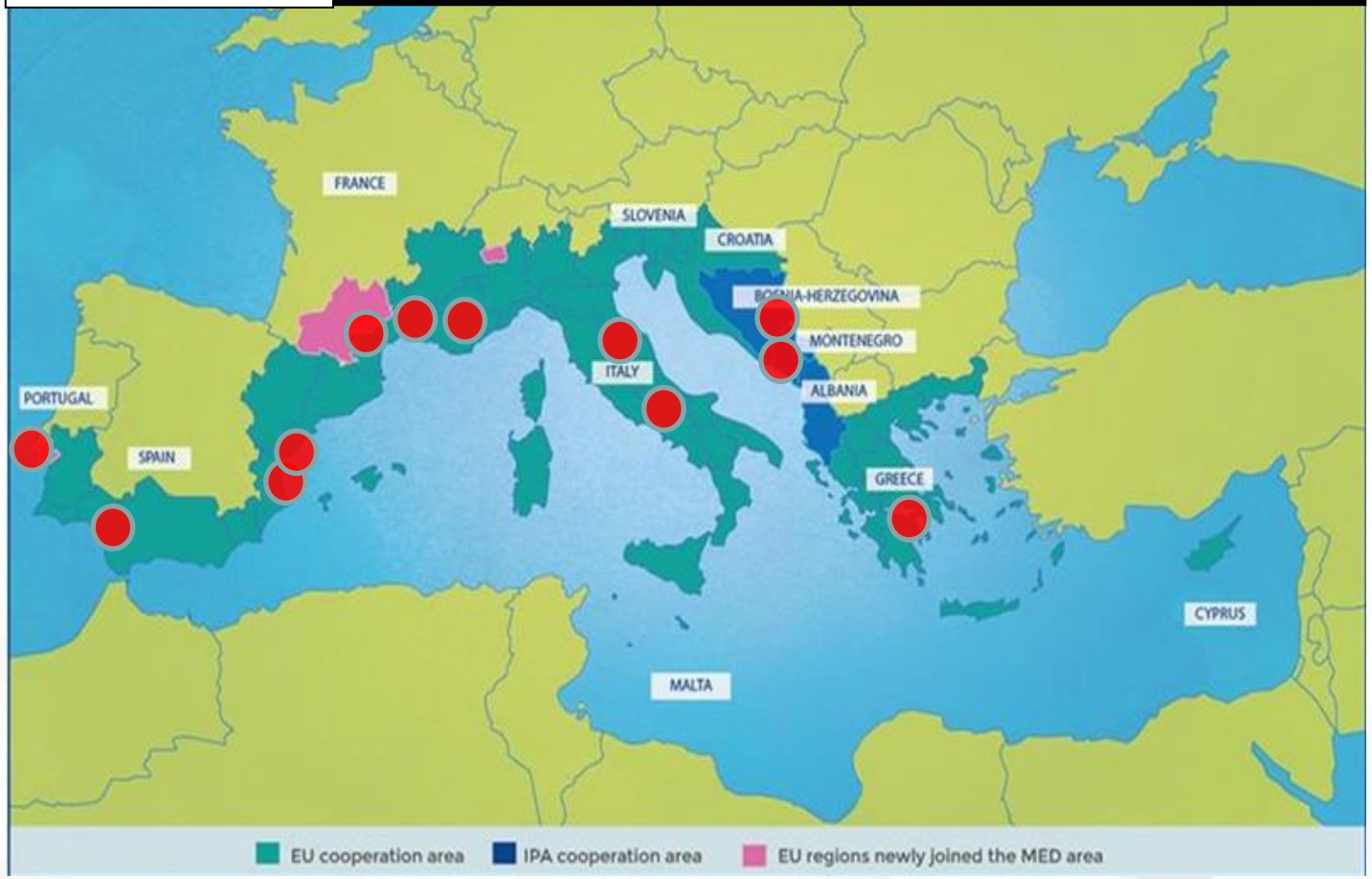
Evaluation of impact

Big & Open data

At service of Planners, visitors, local stakeholders and dwellers

Interreg Mediterranean HERIT-DATA

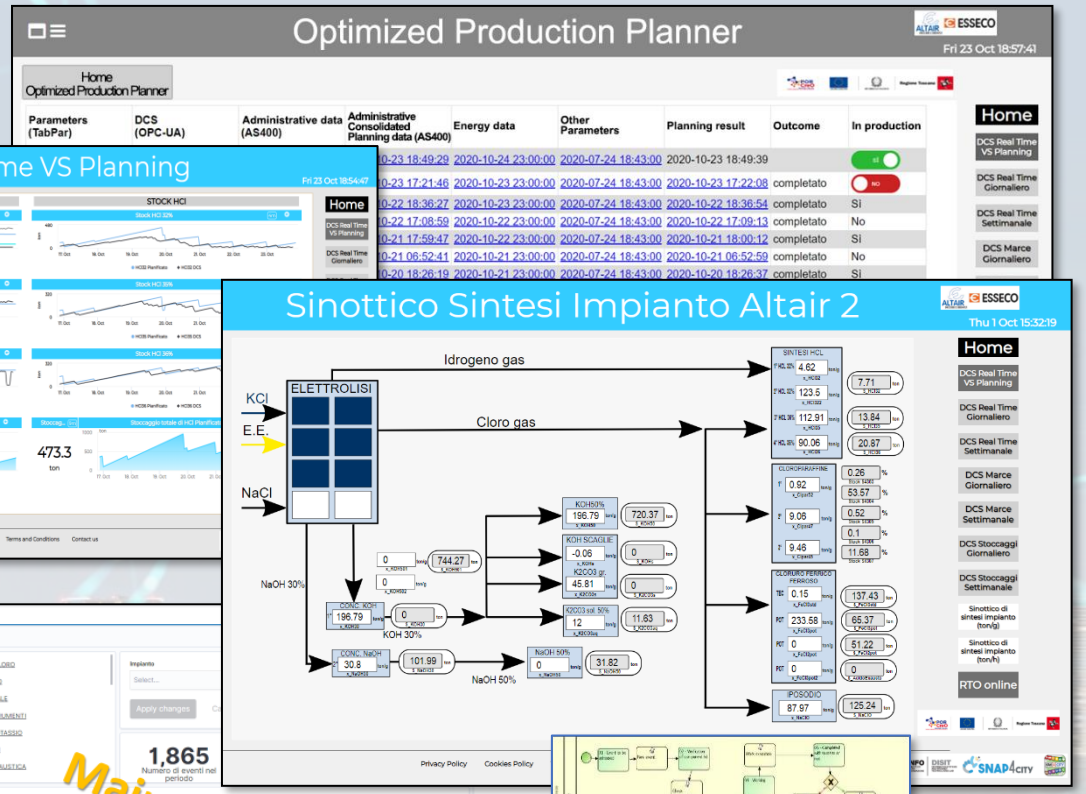
Sustainable Heritage Management towards Mass Tourism Impact thanks to a holistic use of **Big and Open Data**



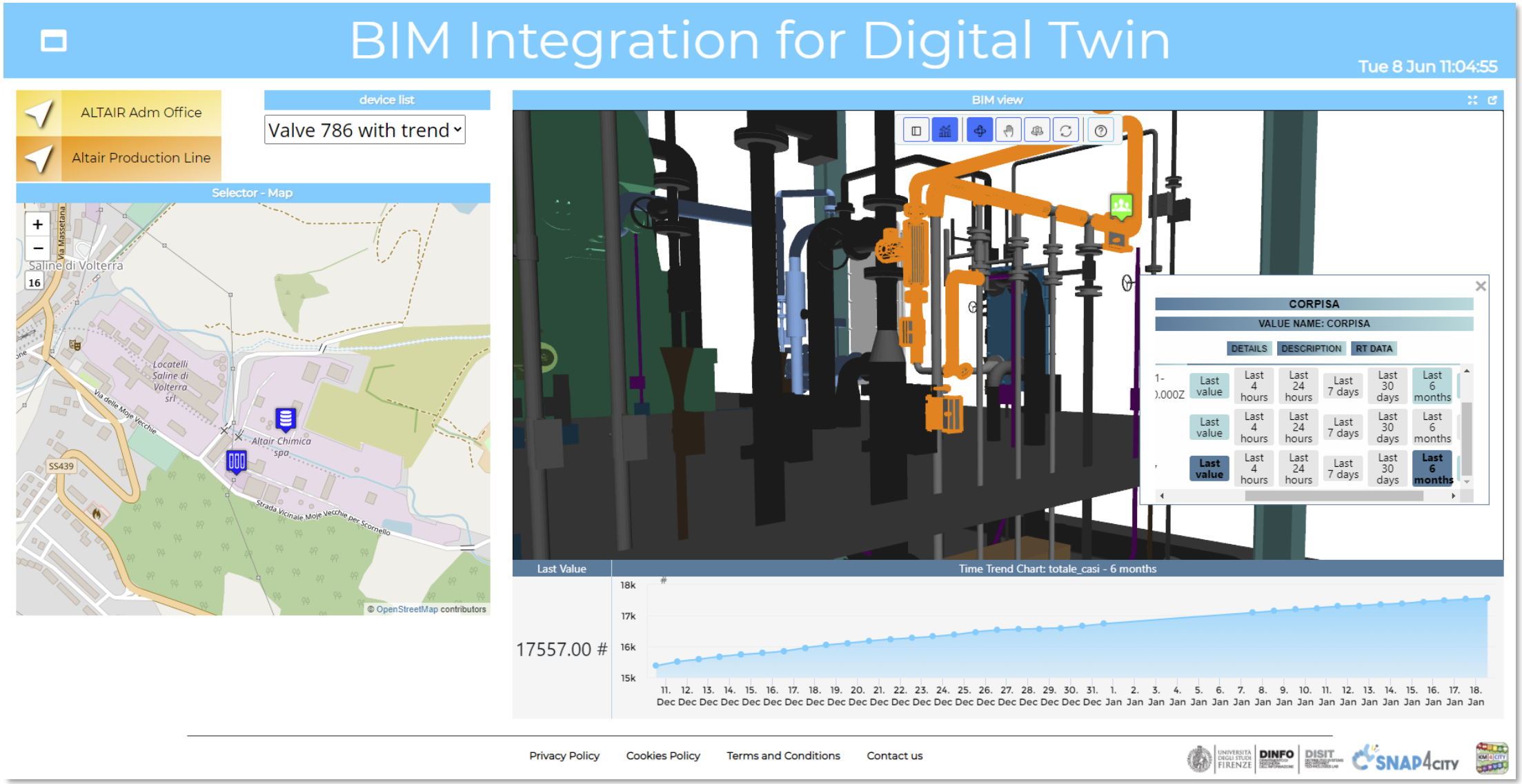
Snap4Altair Decision Support supervision and control, Industry 4.0

reference

- **Multiple Domain Data**
  - Distributed Control System: energy, flows, storage, chemical data, settings, ..
  - Cost of energy, Orders,
  - Production Parameters
  - Maintenance data
- **Multiple Levels & Decision Makers**
  - Optimized planning on chemical model
  - Business Intelligence on Maintenance data
- **Historical and Real Time data**
  - Billions of Data
- **Services Exploited on:**
  - Multiple Levels, Mobile Apps, API
- **Since 2020**



Digital Twin Local, 3D vs Real Time Data



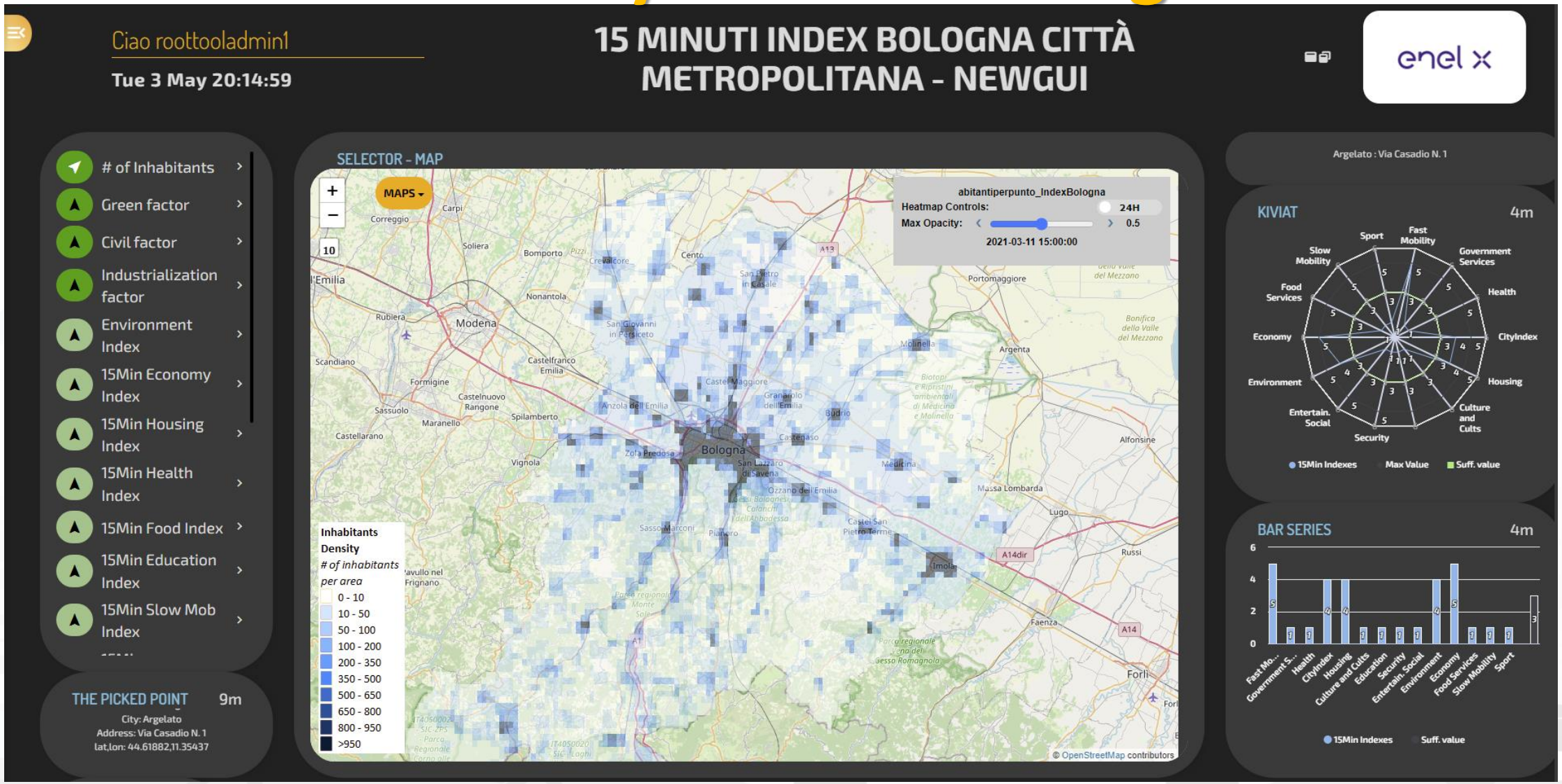
IoT Health Scenarios

- **1) Smart Ambulance:**
  Collecting and managing local data from tools and sensors inside the ambulance, IoT Devices, Tablets, Drones etc.

- **2) Personal Health devices:**
  e.g.: glucometers, etc.

- **3) Smart Bed:**
  Collecting and managing data from smart bed sensors, monitoring parameters in real-time

15MinCityIndex on Bologna

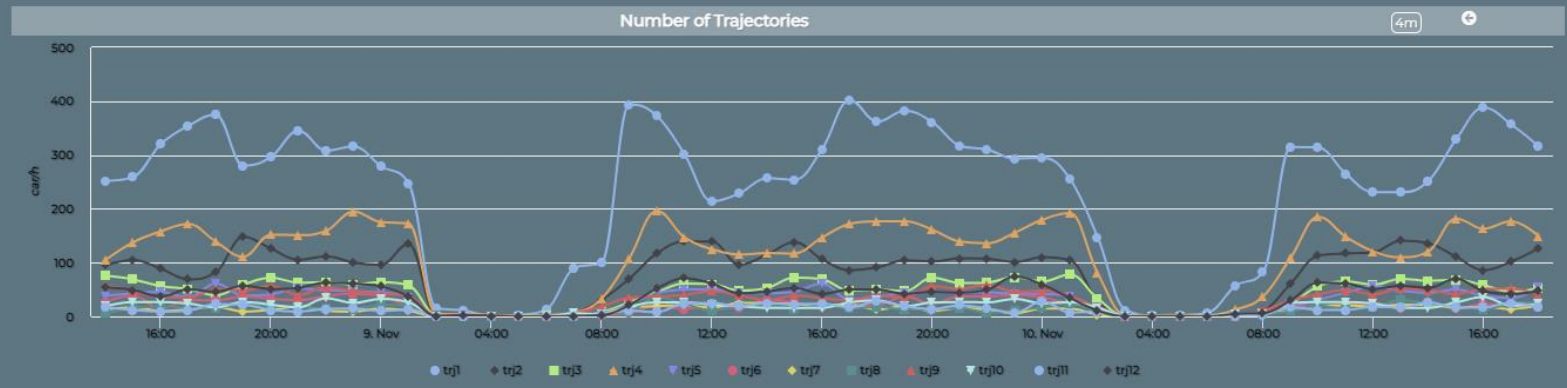


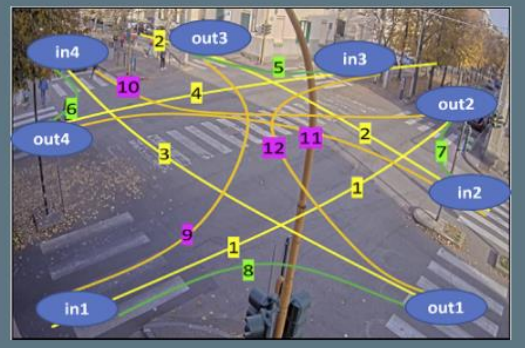
https://www.snap4city.org/dashboardSmartCity/view/Baloon-Dark.php?iddasboard=MzQxMg==

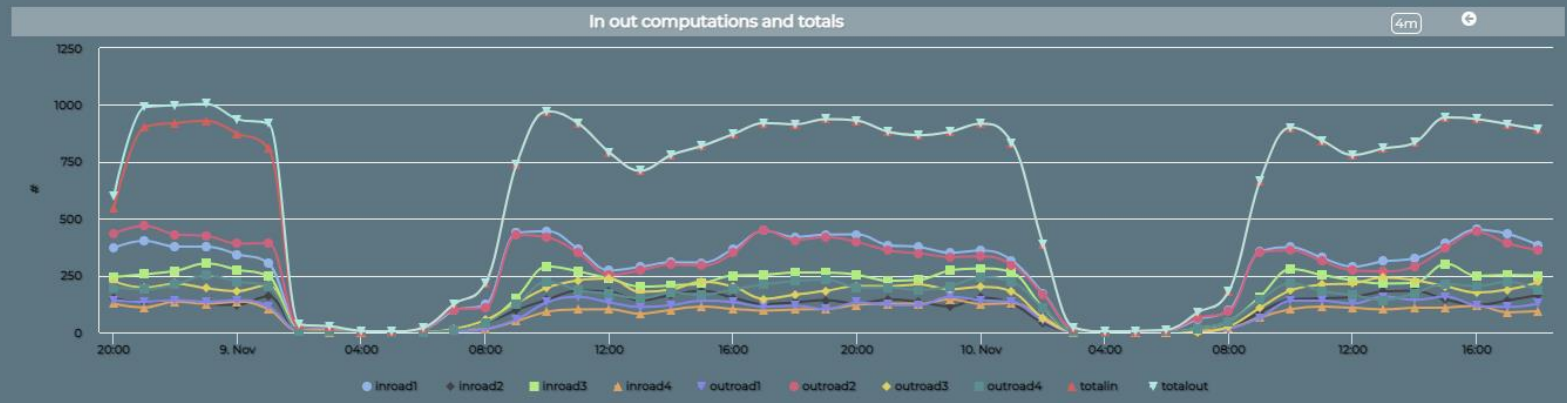
Venaria Reale

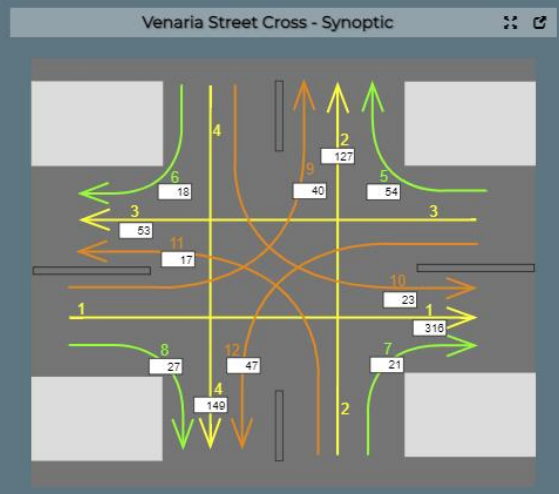
Monitoring Cross Road Venaria - (AXIS Camera)

Wed 10 Nov 18:50:53









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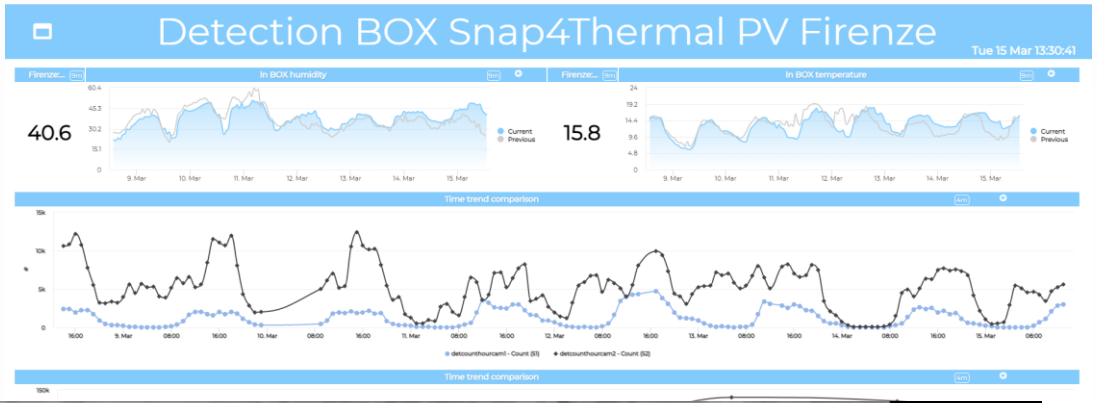
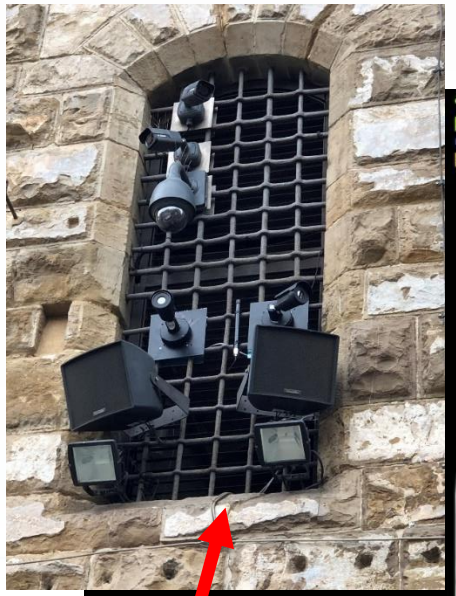
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI5Ng==

A view and data from the Thermal Camera





Sinottico Impianto

Sinottico Impianto Presse - Autoclave

italmatic

Mon 4 Oct 15:34:59

Stato Presse

OFF 1	OFF 2	OFF 3	OFF 4	OFF 5	ON 6
OFF 7	OFF 8	OFF 9	OFF 10	ON 11	OFF 12
OFF 13	ON 14	OFF 15	OFF 16	OFF 17	OFF 18
OFF 19	OFF 20	OFF 21	OFF 22	OFF 23	

Select Pressa

PRESSA 6

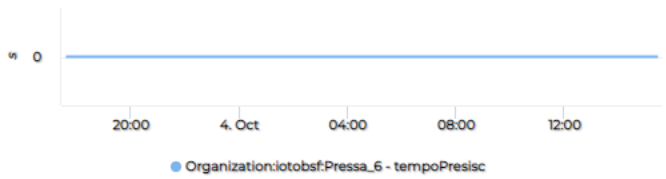
Press to update the list

Status 9m

NO STATUS

Tempo Vulcanizzione Pressa 4m

Tempo Preriscaldo Pressa 4m

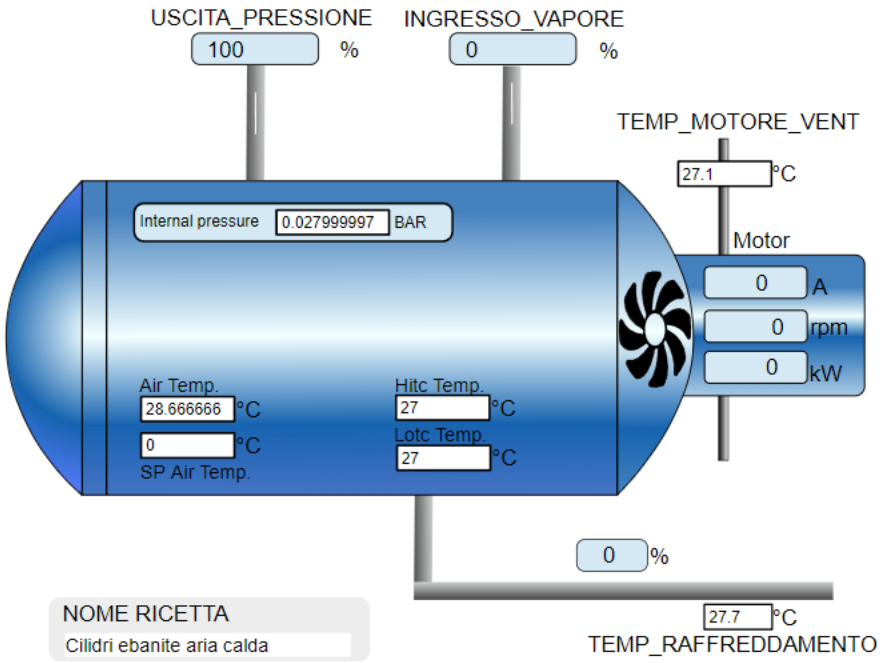


Temperatura Settore Pressa 4m

Pressione Pressa 4m

Temperatura Piani Pressa 4m

Stato autoclave



NOME RICETTA
Cilidri ebanite aria calda

- Main Dashbaord
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues Trend Comparison

http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MTk=

SNAP4

DISIT lab roadmap vs model and tools' usage

2013
Km4City Ontology 1.1

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

2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015
Km4City 1.5

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

ckan, resolute, H2020 (2015-18)

2016
(2016-21) H2020 REPLICATE

Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

Sii-Mobility (2016-21) MIUR

SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

FIWARE

Km4City 1.5

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

2017
Sii-Mobility

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

E0I5 digital ecosystem (Powered by EXPO MILANO 2015)

(2016-19) MIUR GHOST SIR

- Sardinia Region Smart City Strategies and plan

GREEN IMPACT C.A.P.A.C.I.T.Y.

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

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

life weee (2017-20)

- Smart Waste

2018
MOSAiC Mobility 4.0 for SmArt (i) City (2018-20)

- Mobility Demand / Offer Analytics and Strategy

Sii-Mobility

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

IOT/IOE

Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities H2020 (2017-19)

2019
5G (2018-21)

- 5G tech
- Energy
- Industry 4.0
- Synoptics

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

EUROPEAN OPEN SCIENCE CLOUD

SIRIUS

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

SNAP4CITY

Winner of Select4Cities PCP

SNAP4CITY roadmap

SODA

2020

JRC EUROPEAN COMMISSION

Interreg Mediterranean HERIT-DATA

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

Interreg MARITTIMO-IT FR-MARITIME MOBI MART

- Smart Mobility
- PISA, PUMS
- Living lab

smartGARDAlake

Km4City 1.6.7

Smart Ambulance (2021-22)

Enterprise (2021-22) Industry 4.0

enel x Contract

JRC EUROPEAN COMMISSION

2021

PC4City (2020-21) Monitoring Terrain

Winner of Open Data Challenge of enel x

CAPELON

- Smart Light
- Sweden

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22) Industry 4.0

SYN-RG-AI SmartCity

GRUPPO PRETTO

Industry 4.0

uni.systems

SmartCity, 2021-23

AXIS COMMUNICATIONS

AXIS collab SmartCity

2022

ASYMMETRICA URBAN TECHNOLOGY

Asymmetrica Smart City, 2022-23

JRC EUROPEAN COMMISSION

Contract, 2022-23

2023

ART-ER ATTRATTIVITÀ RICERCA TERRITORIO

Contract, 2022-23

Filippi

2022-2023

enel x Contract

IMPETUS

Security and Risk

Smartea

ITALFERR GRUPPO FERROVIE DELLO STATO ITALIANE

Italferr, Smart City

CN MOST, 2022-26

EI THE, 2022-26

G. Agile, 2021-23

TUSCANY XD EDIH

2023-26

Merano, smart light

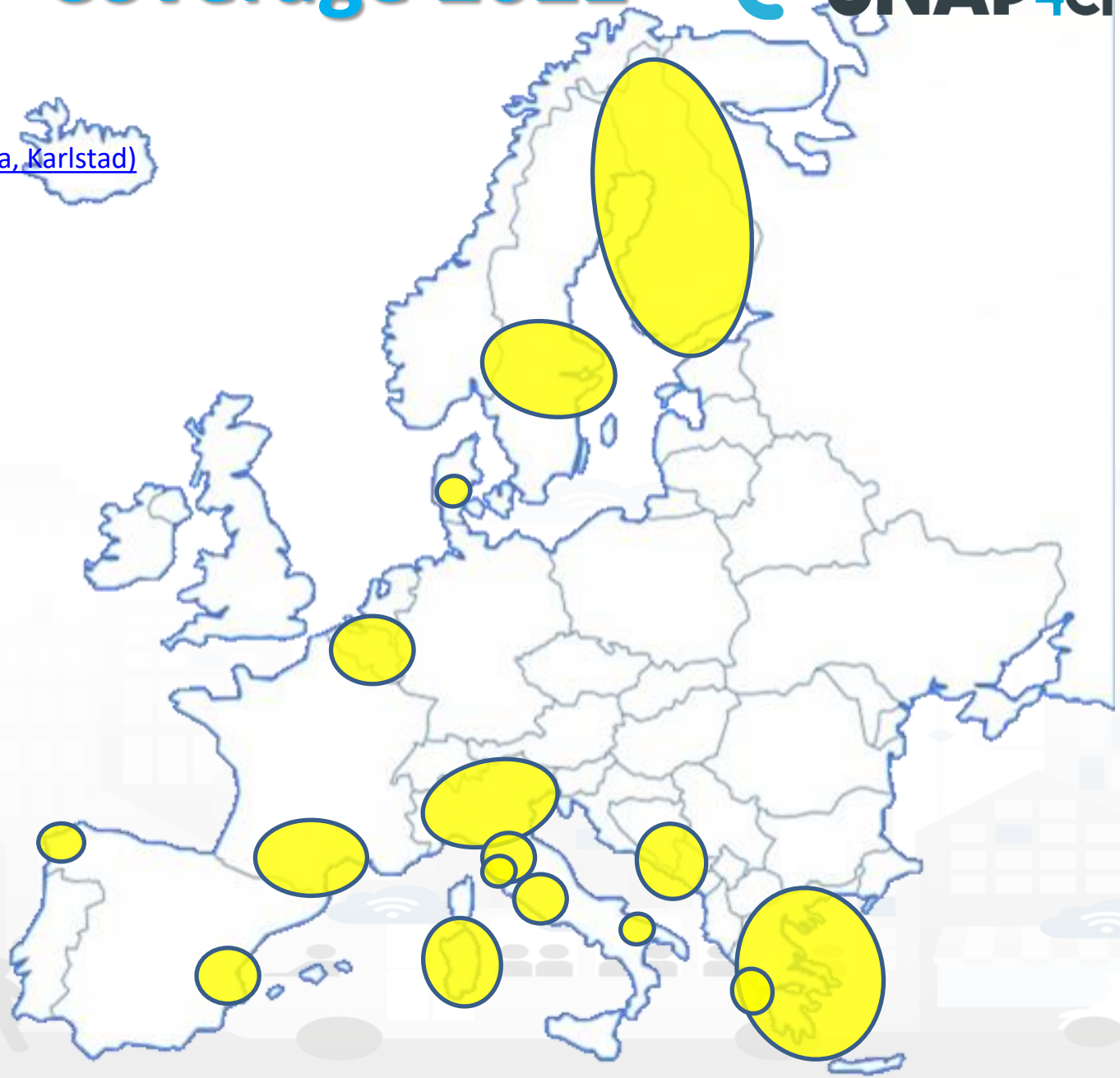
OceanRace, Genova, AWS

Cuneo, smart city

Coverage 2022

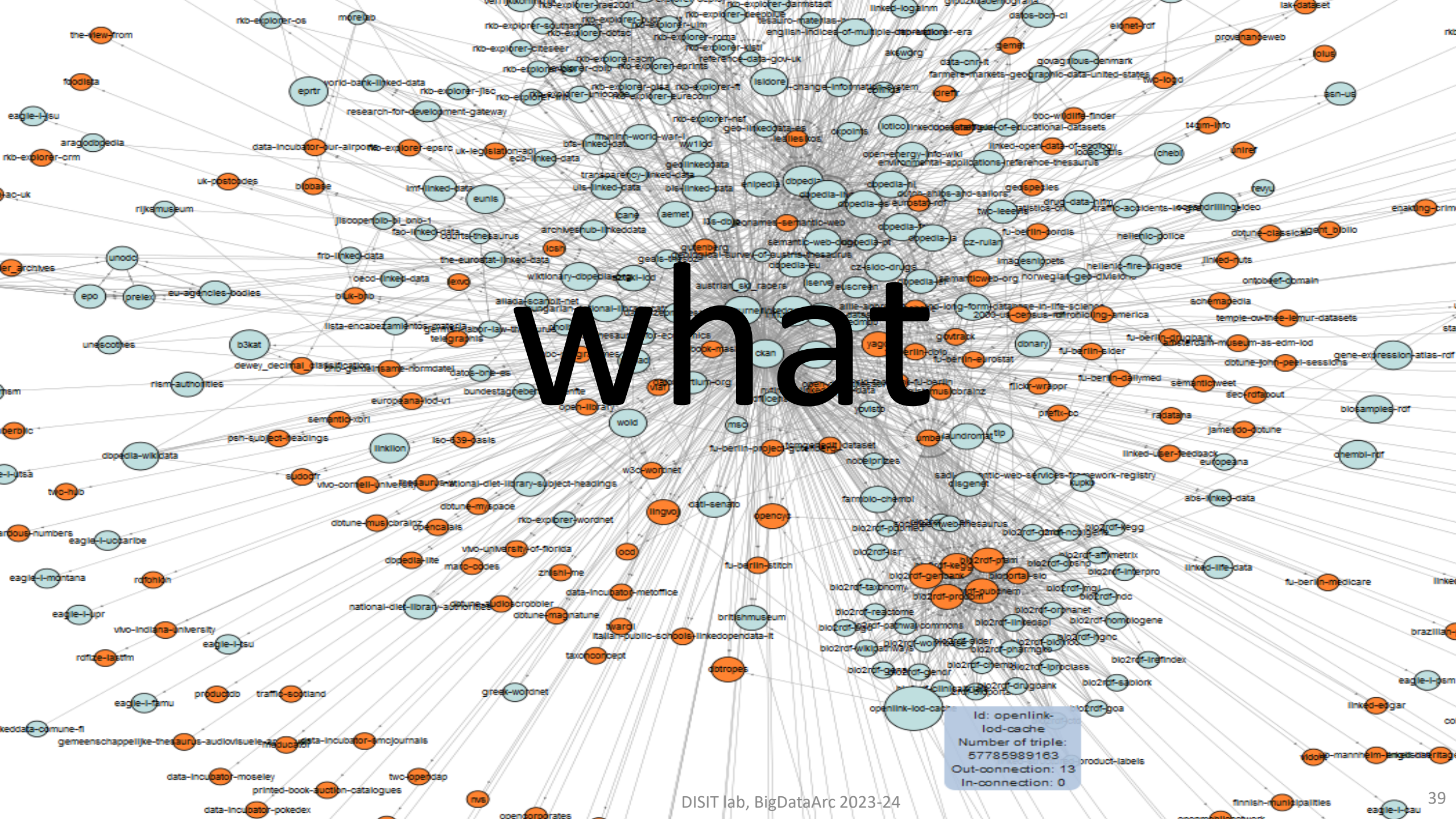
Main Organizations/areas

- Antwerp area (Be)
- Bologna (I)
- Capelon (Sweden: Västerås, Eskilstuna, Karlstad)
- DISIT demo (multiple)
- Dubrovnik, Croatia
- Firenze area (I)
- Garda Lake area (I)
- Greece (Gr)
- Helsinki area (Fin)
- Livorno area (I)
- Lonato del Garda (I)
- Modena (I)
- Mostar, Bosnia-Herzegovina
- Oslo & Padova (Impetus)
- Pisa area (I)
- Pistoia (I)
- Pont du Gard, Occitanie (Fr)
- Prato (I)
- Roma (I)
- Santiago de Compostela (S)
- Sardegna Region (I)
- Siena (I)
- SmartBed (multiple)
- Toscana Region (I), SM
- Valencia (S)
- Venezia area (I)
- WestGreece area (Gr)



Agenda

- Laboratorio DISIT
- Tematiche del corso
- Struttura del corso
- Infrastruttura del DISIT Lab
- Modalità dell'esame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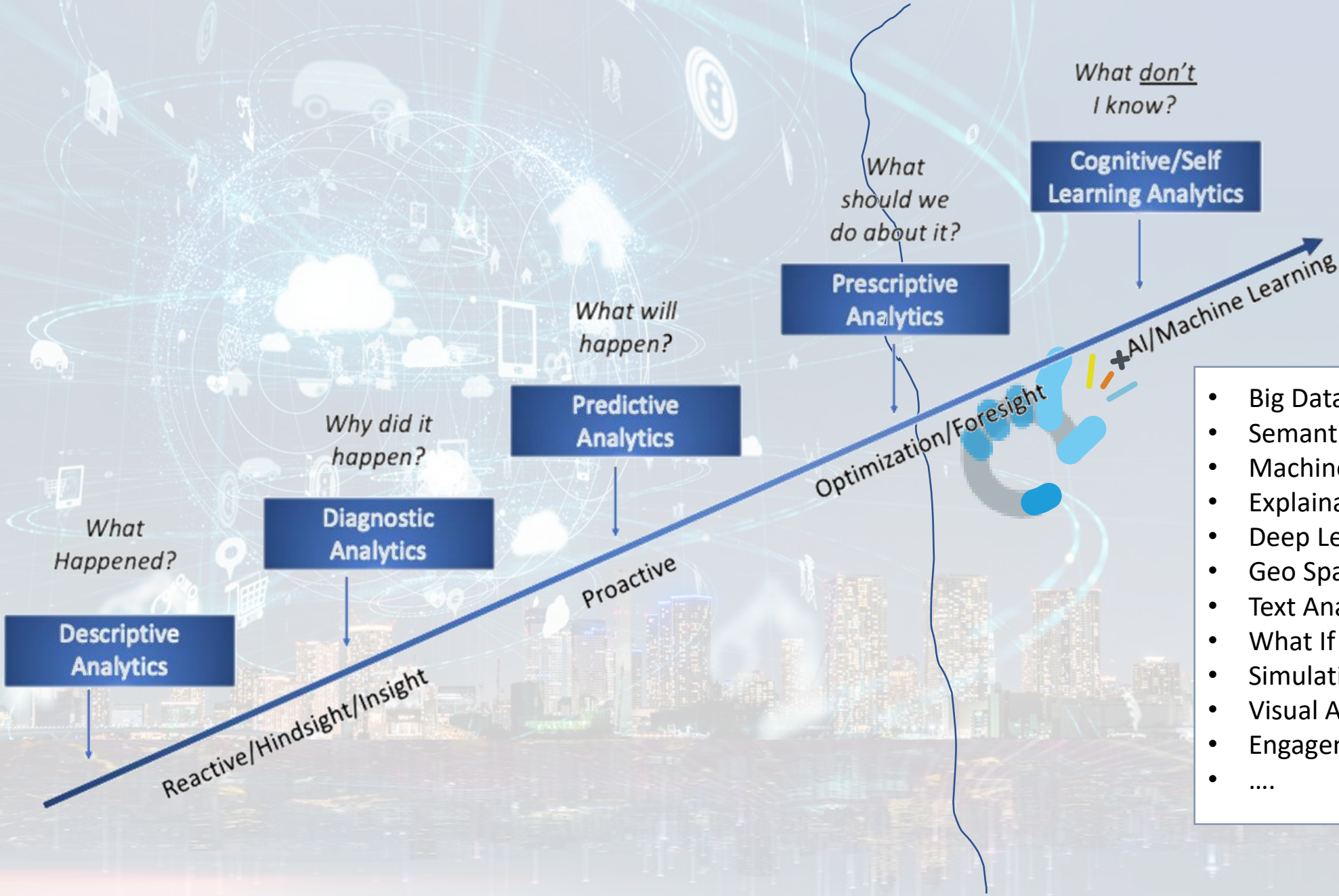
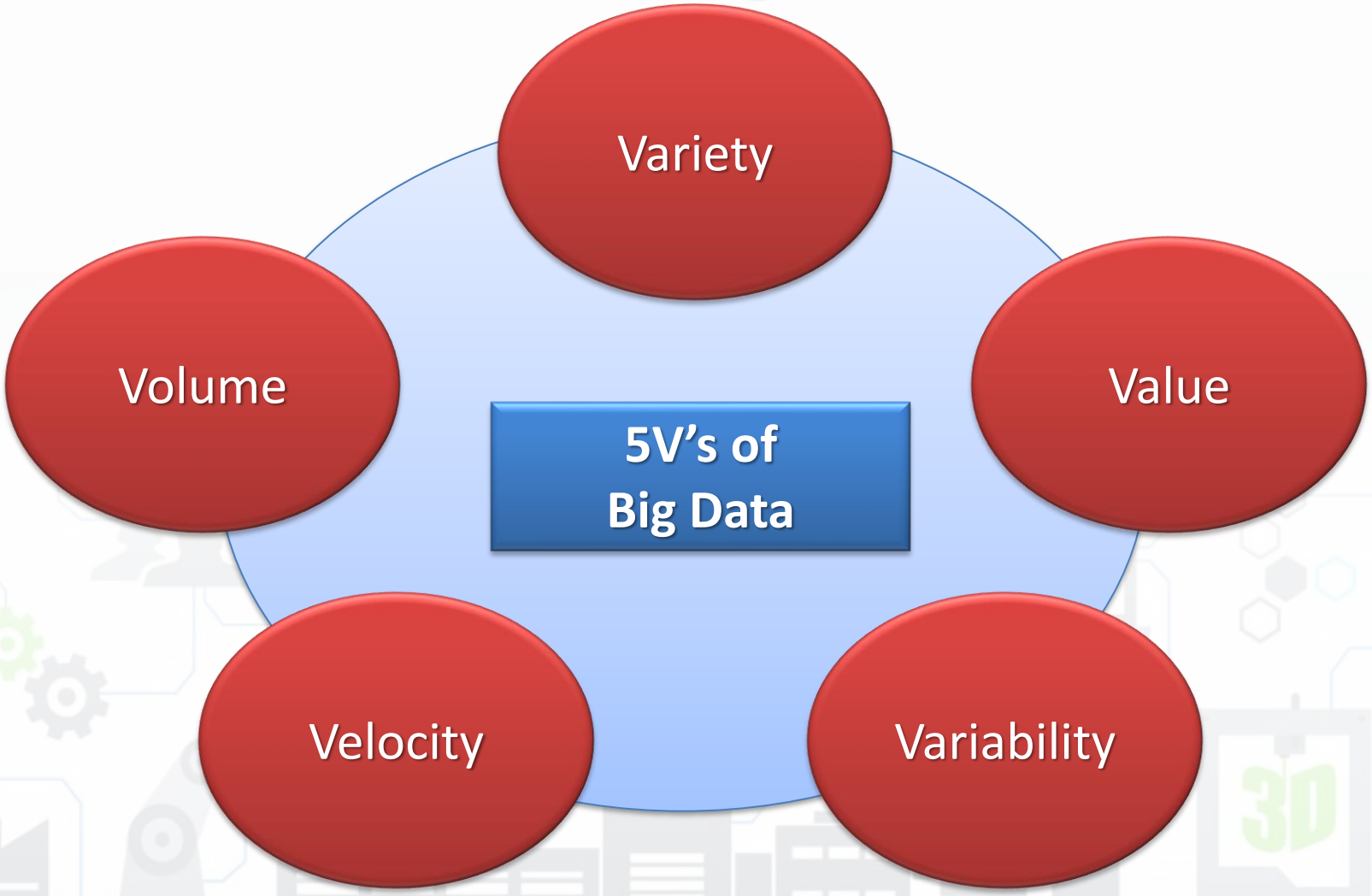
In-connection: 0



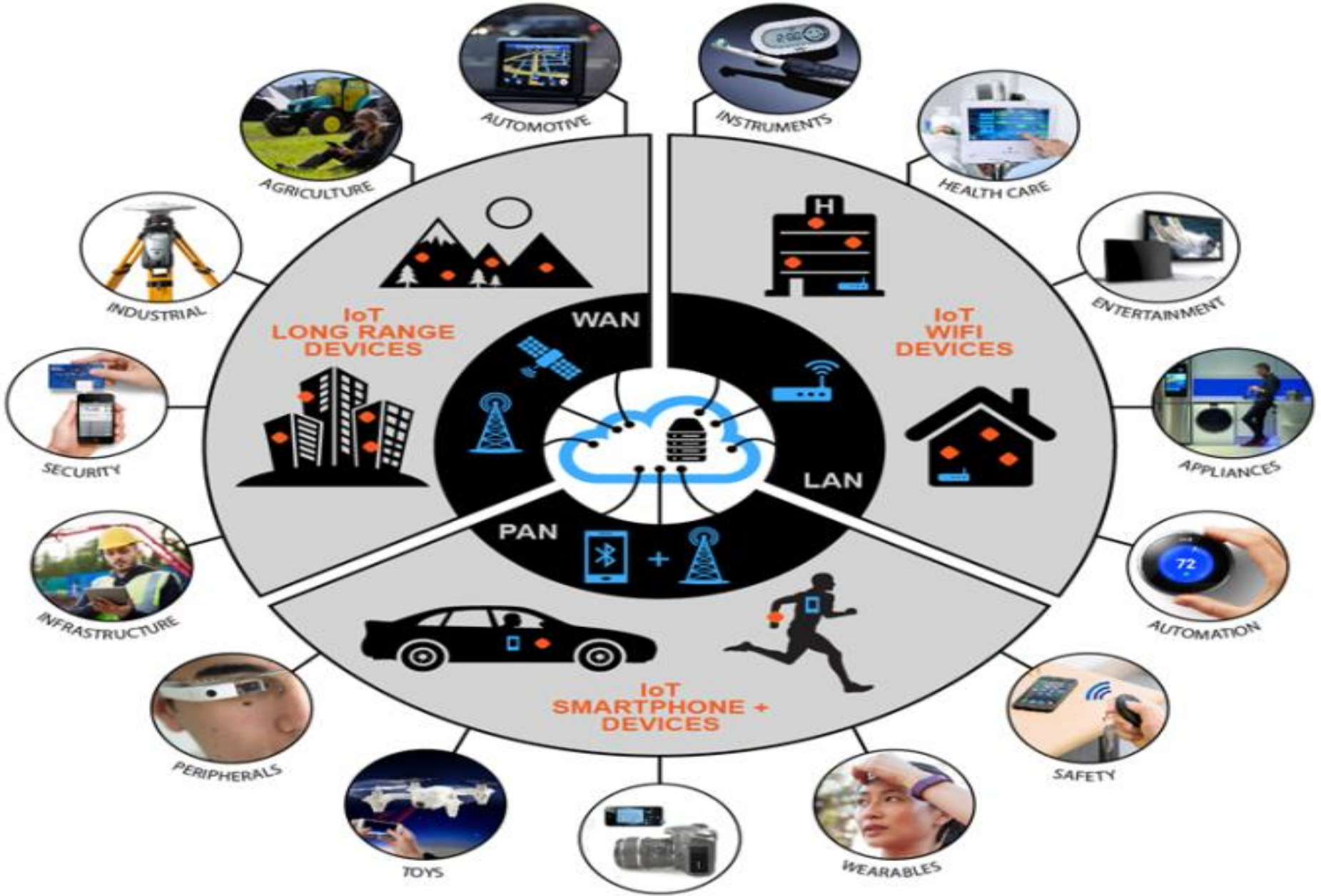
Sentient and active processes

- Big Data Analytics
- Semantic Computing
- Machine Learning
- Explainable Artificial Intelligence
- Deep Learning
- Geo Spatial Reasoning
- Text Analysis, Sentiment Analysis
- What If Analysis
- Simulations
- Visual Analytics
- Engagement Analysis
- ….

5V of Big Data

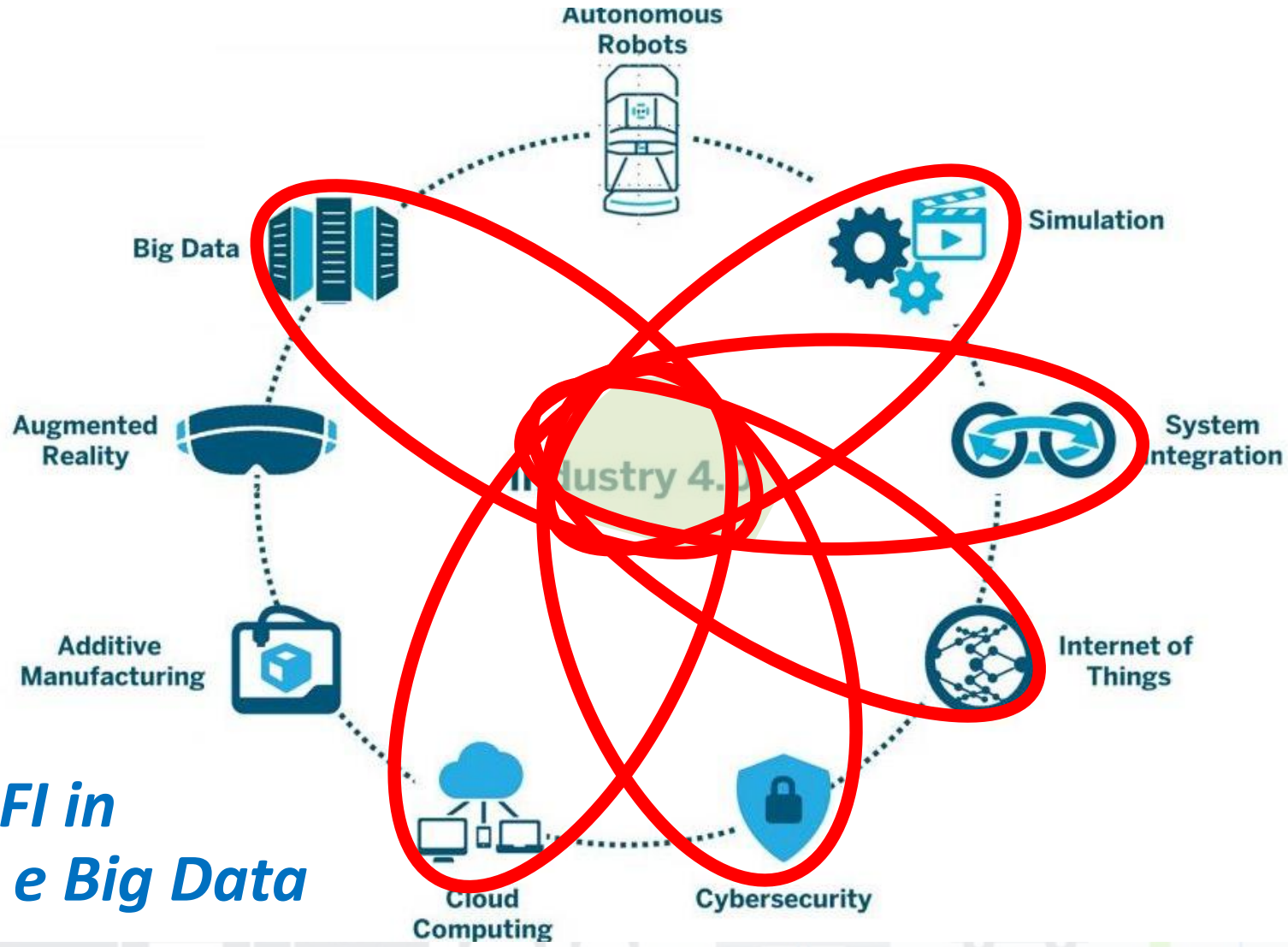


Bia Data & Analytics



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 RegioneToscana per Cloud e Big Data***



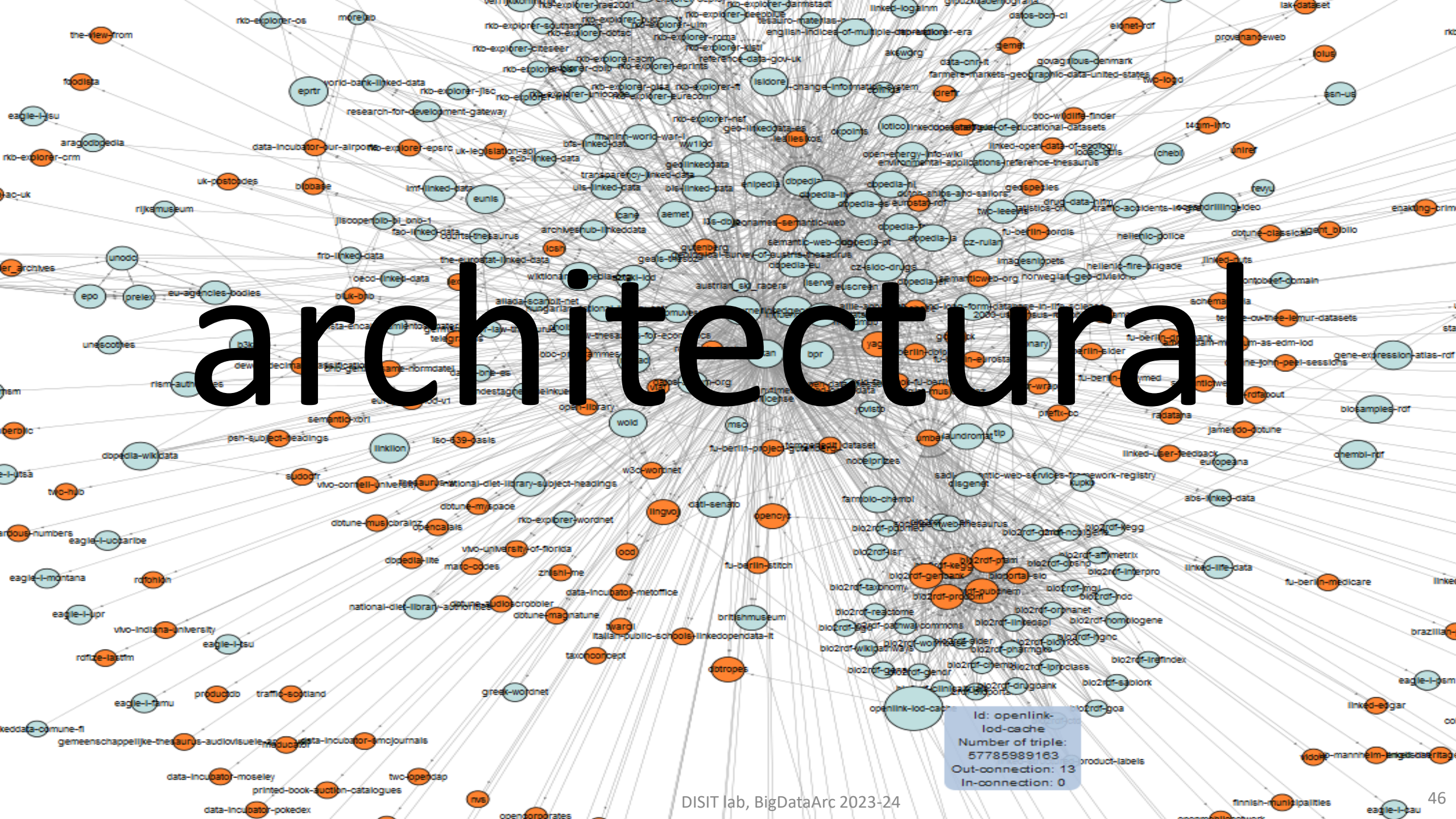
DISIT: Competences

- **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 Analytics:** data management, 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:** https://www.snap4city.org/download/video/course/da/Snap4City-4th-slot-Data-Analytic-v7-2.pdf

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**
  - Mobility and transport
  - Environment and health
  - Energy and Govern
  - Industry 4.0, IOT
  - Financial/Business
  - Security
- **Former**
  - Social Network – Internet Service – Web Data
  - Educational


architectural
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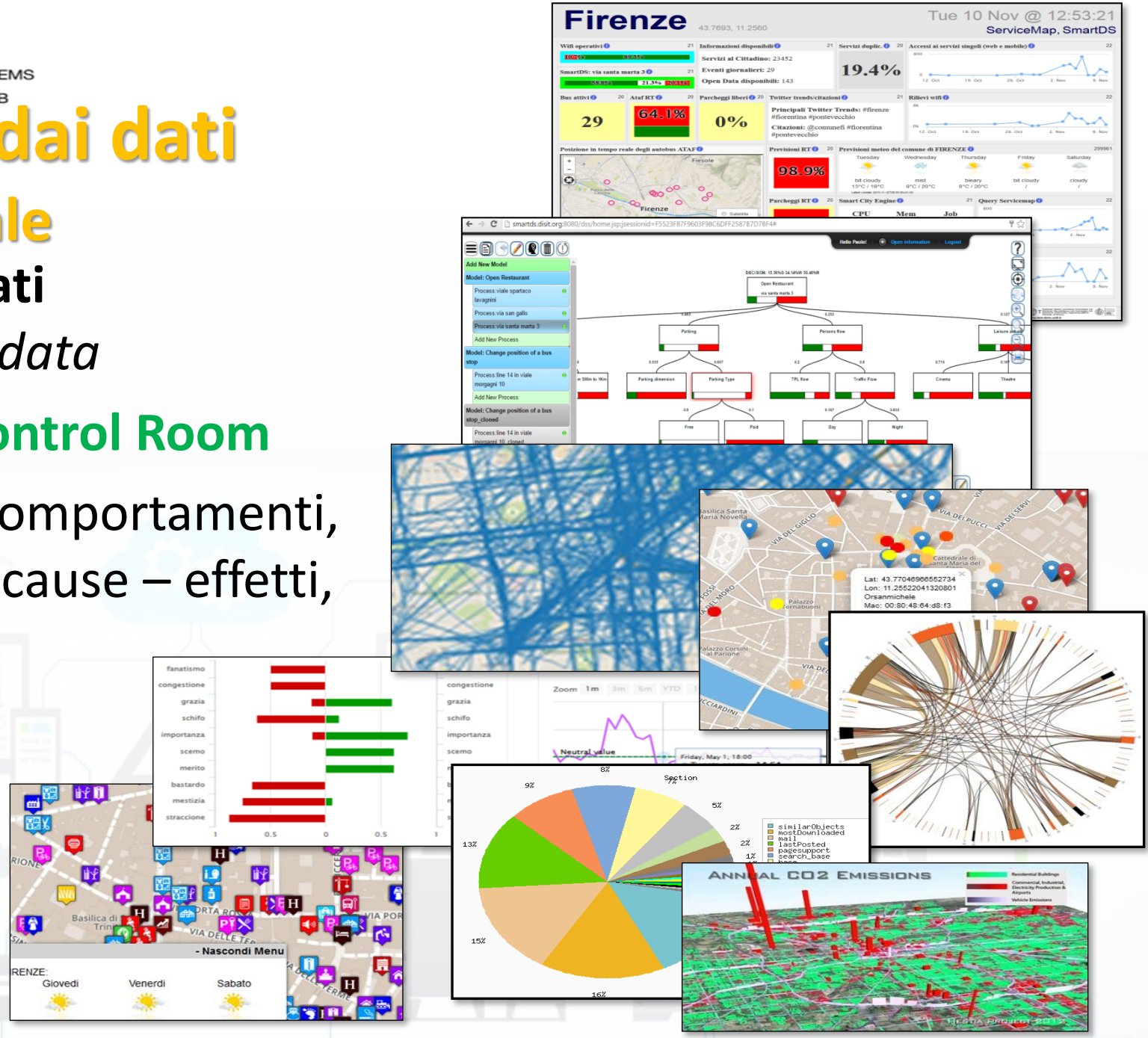
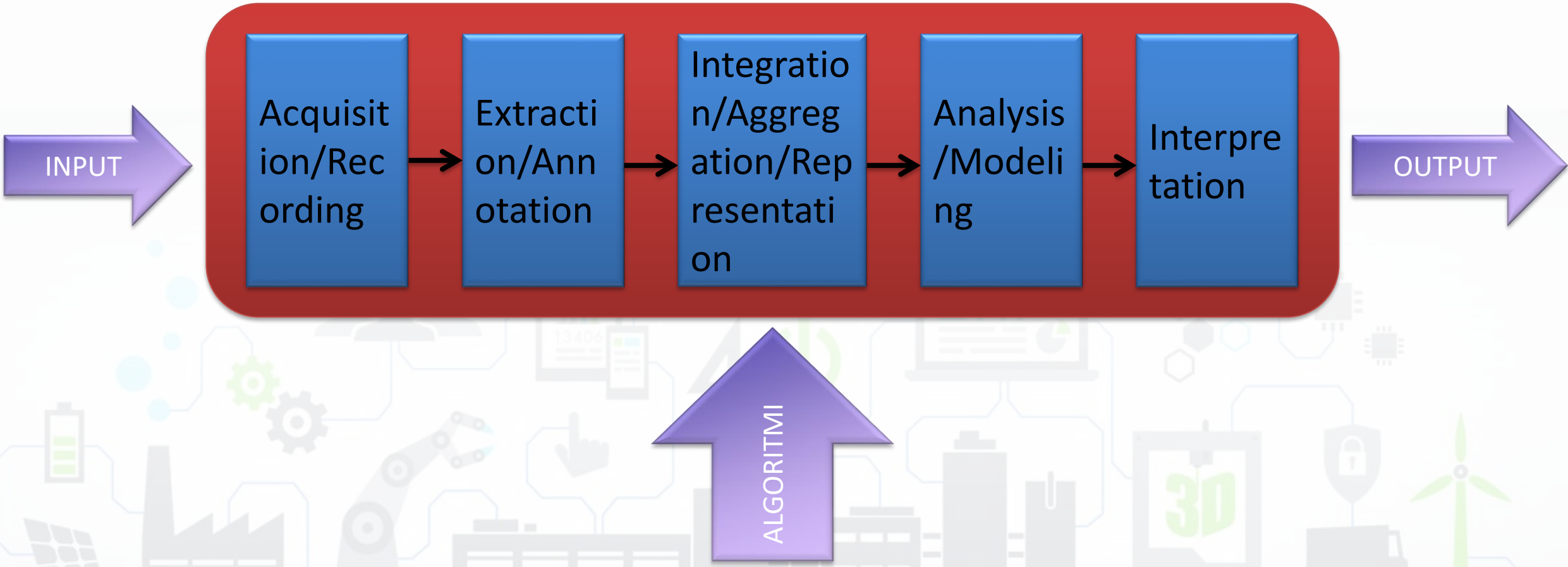
Decisioni supportate dai dati periodiche ed in tempo reale

- **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


INPUT
Acquisition/Recording
Extraction/Annotation
Integration/Aggregation/Representation
Analysis/Modeling
Interpretation
OUTPUT
ALGORITMI

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 Sources

Transatio ns sys, sensors Social media, ws, etc.

Data Stream analysis

Spark, Storm, Kafka

Big Data Cluster

HDFS, noSQL

Indexing

SOLR, Elastic search

Search and Query

Facet, cluster

Rendering acting

User interface, Dashboard Drill down

Data Transformation

ETL, NIFI

Data Analytics

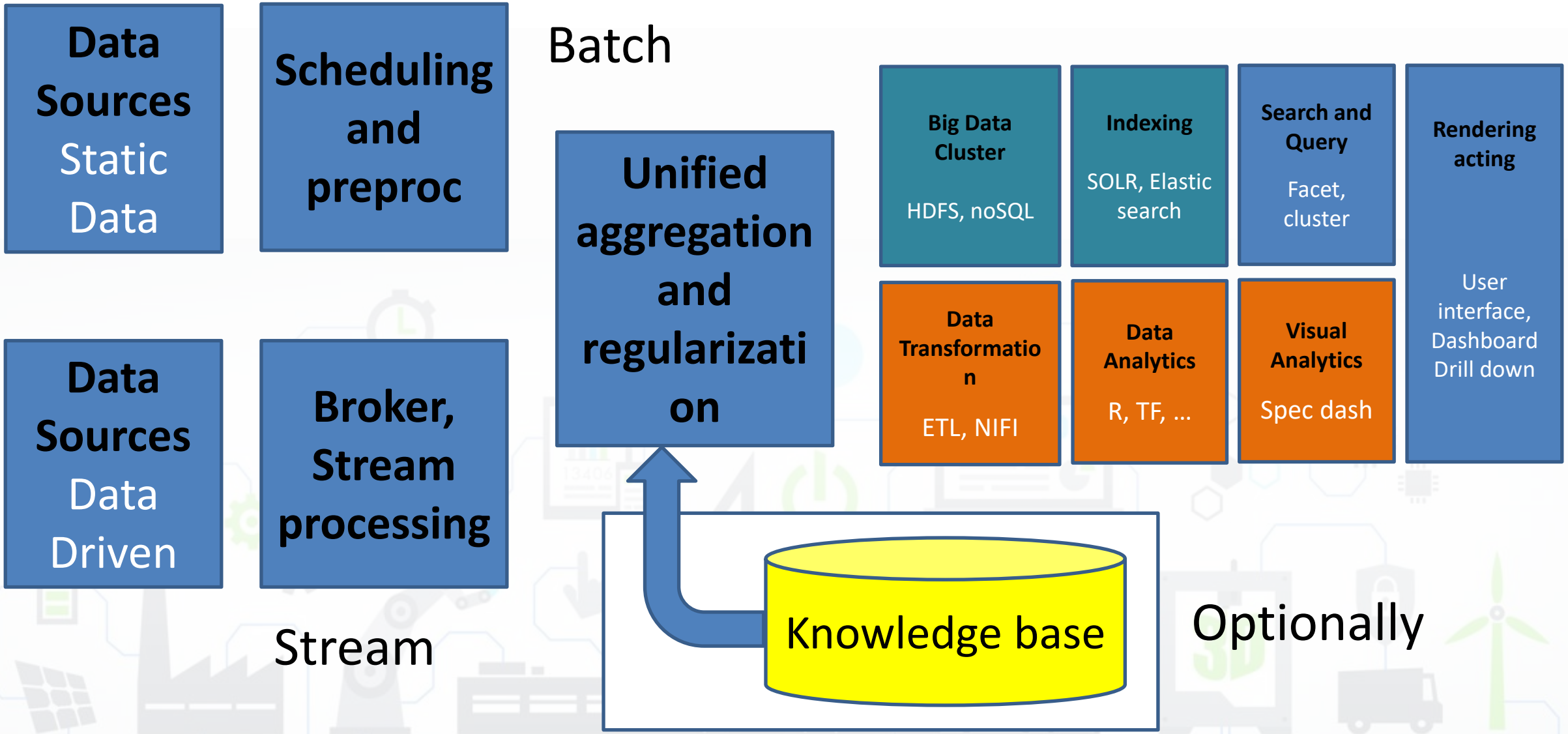
R, TF, …

Visual Analytics

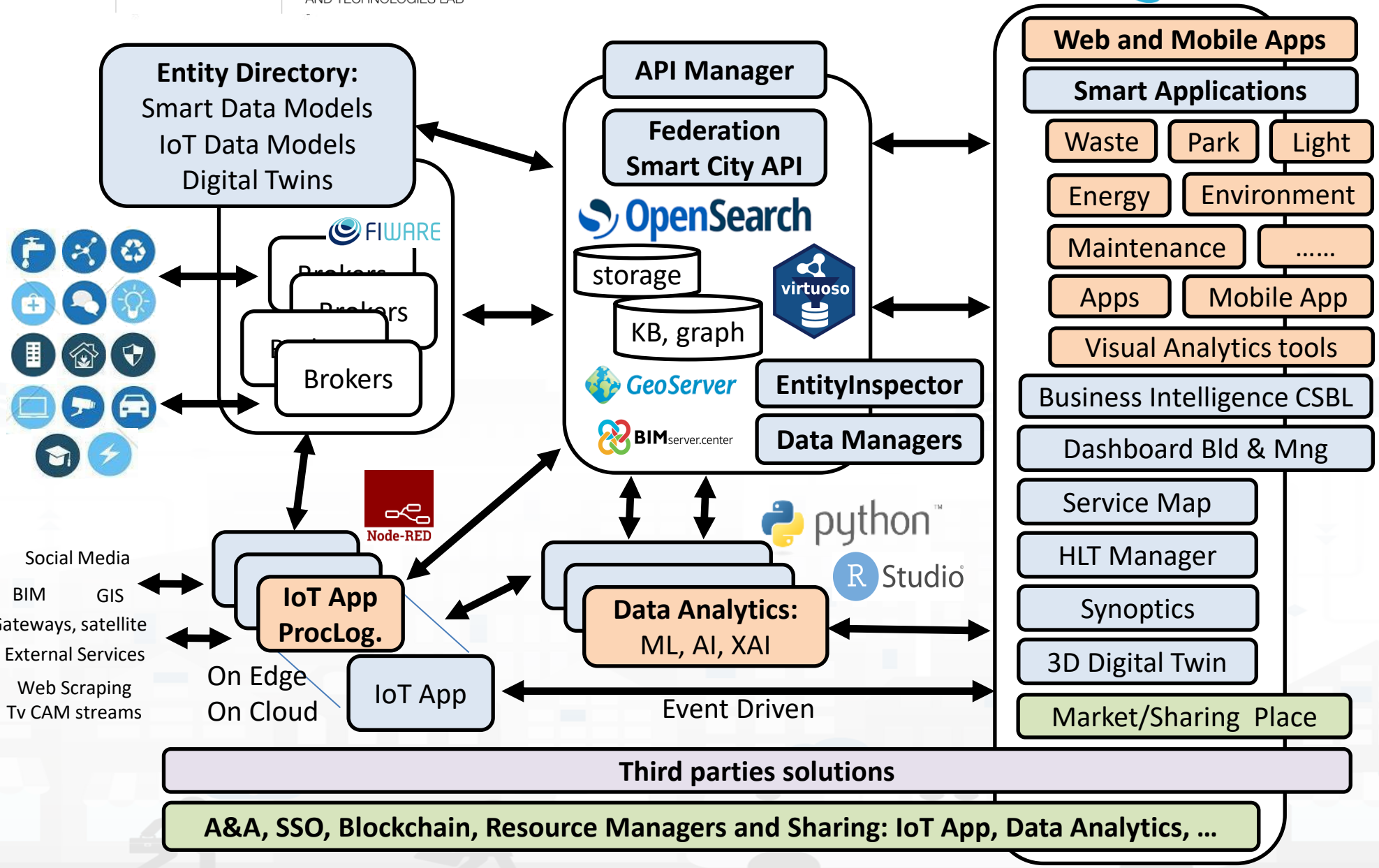
Spec Dash

Data Management: security, privacy, licensing, etc.

Lambda Architecture



Tech Arch


Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Brokers
Brokers
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

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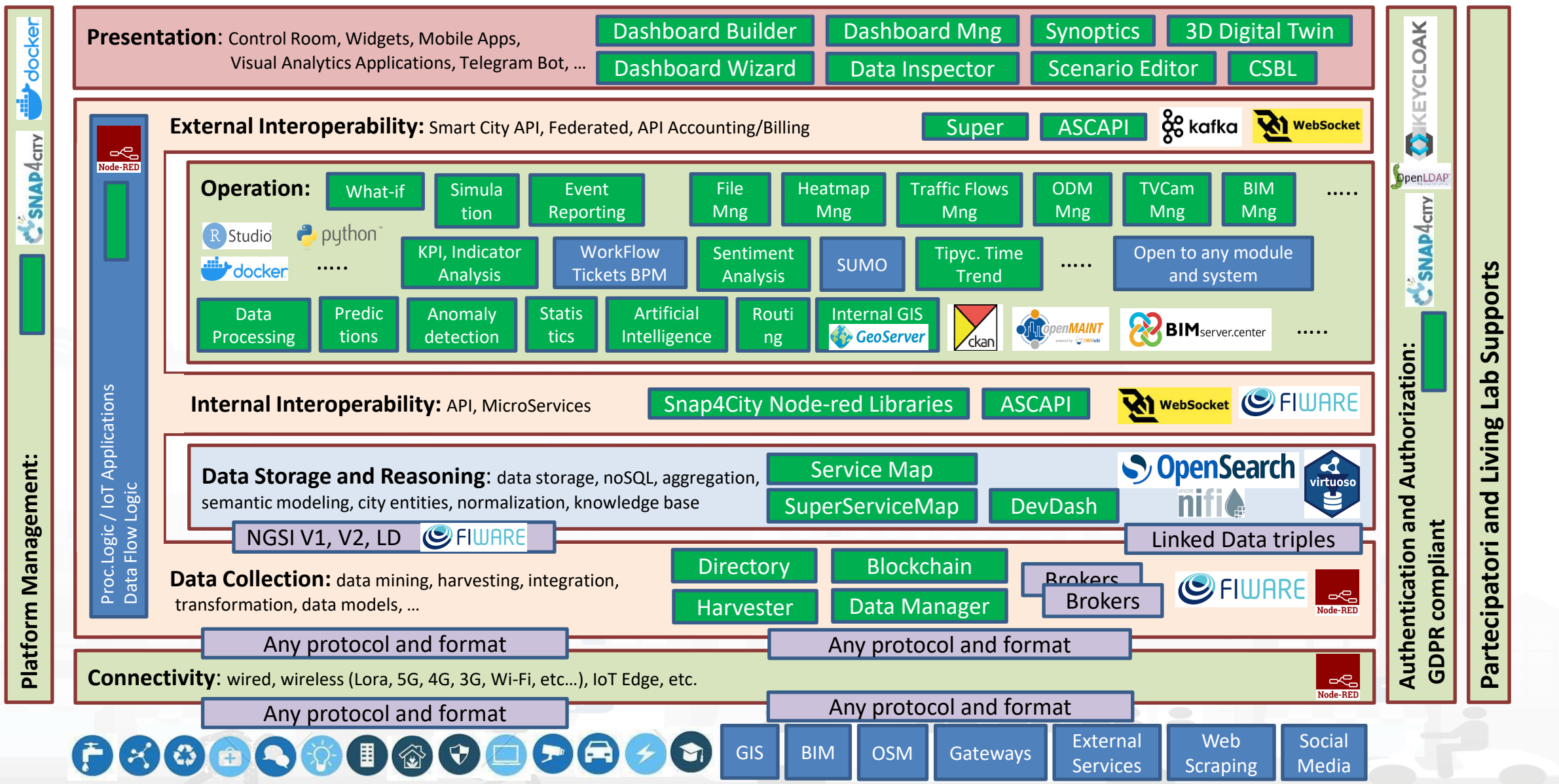
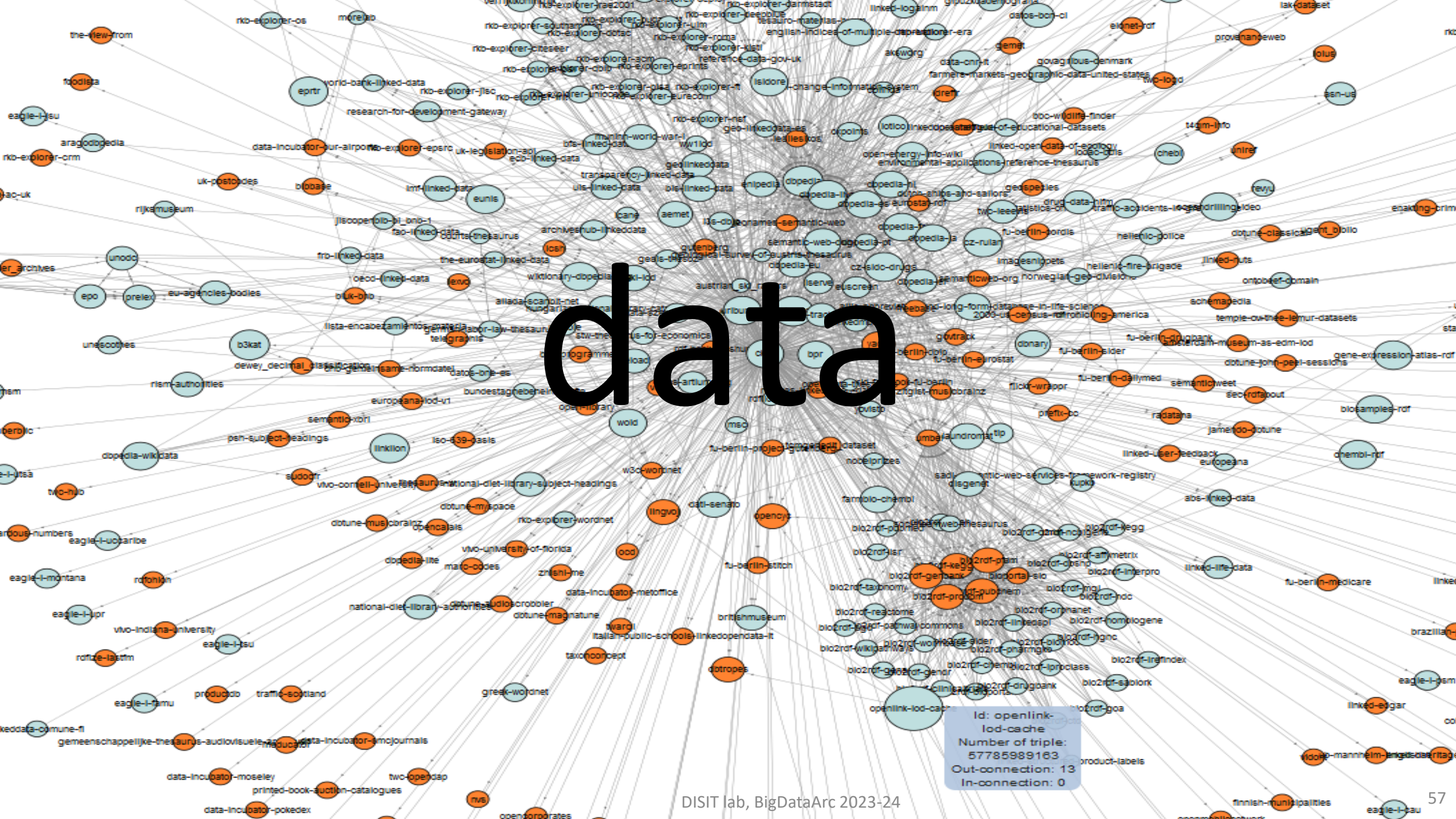
legenda

SNAP4CITY | KM 4 CITY

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In-connection: 0

Privati Statici

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

- Movimenti personali non pubblicati
- Relazioni personali non pubblicate

Pubblici 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

- comportamenti
- social media
- contributi
- consumi

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

Privati Tempo reale

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

- Stato accessi alla ZTL
- Stato dei servizi

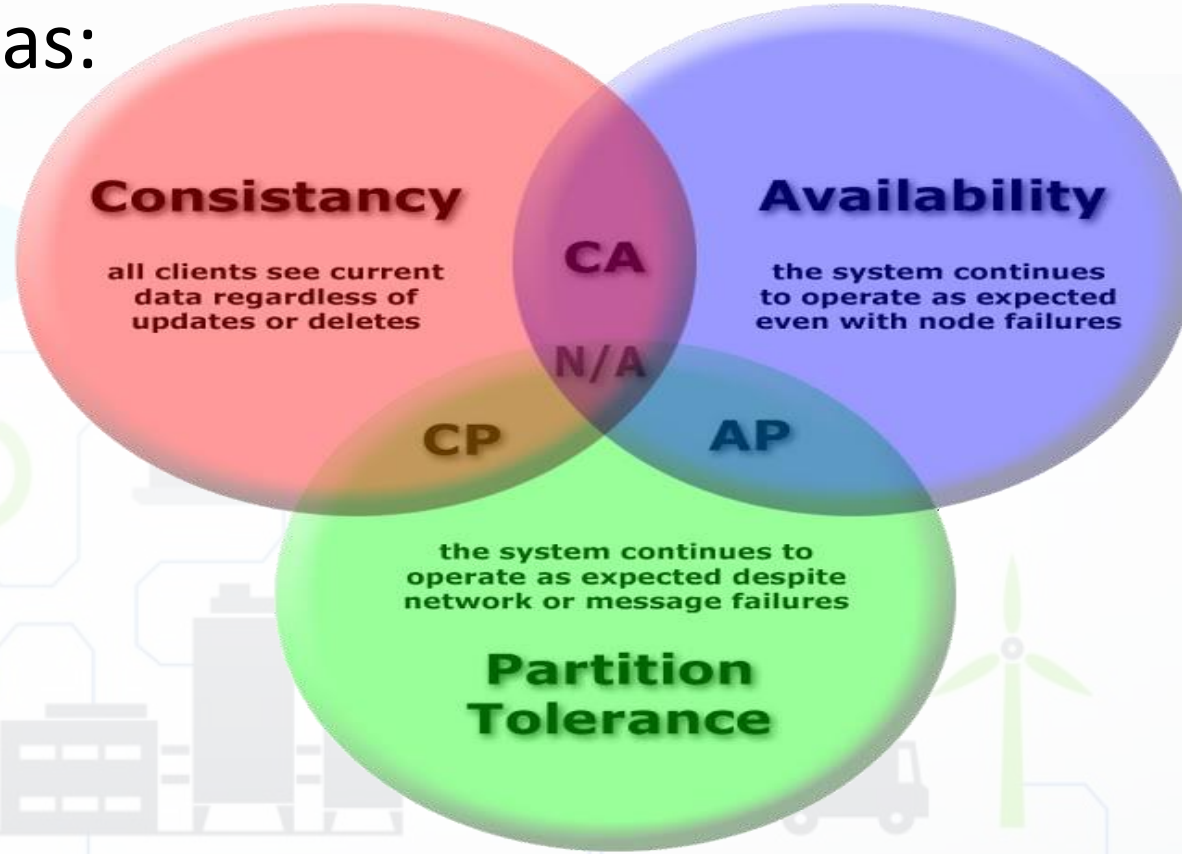
Pubblici Tempo reale (open data)

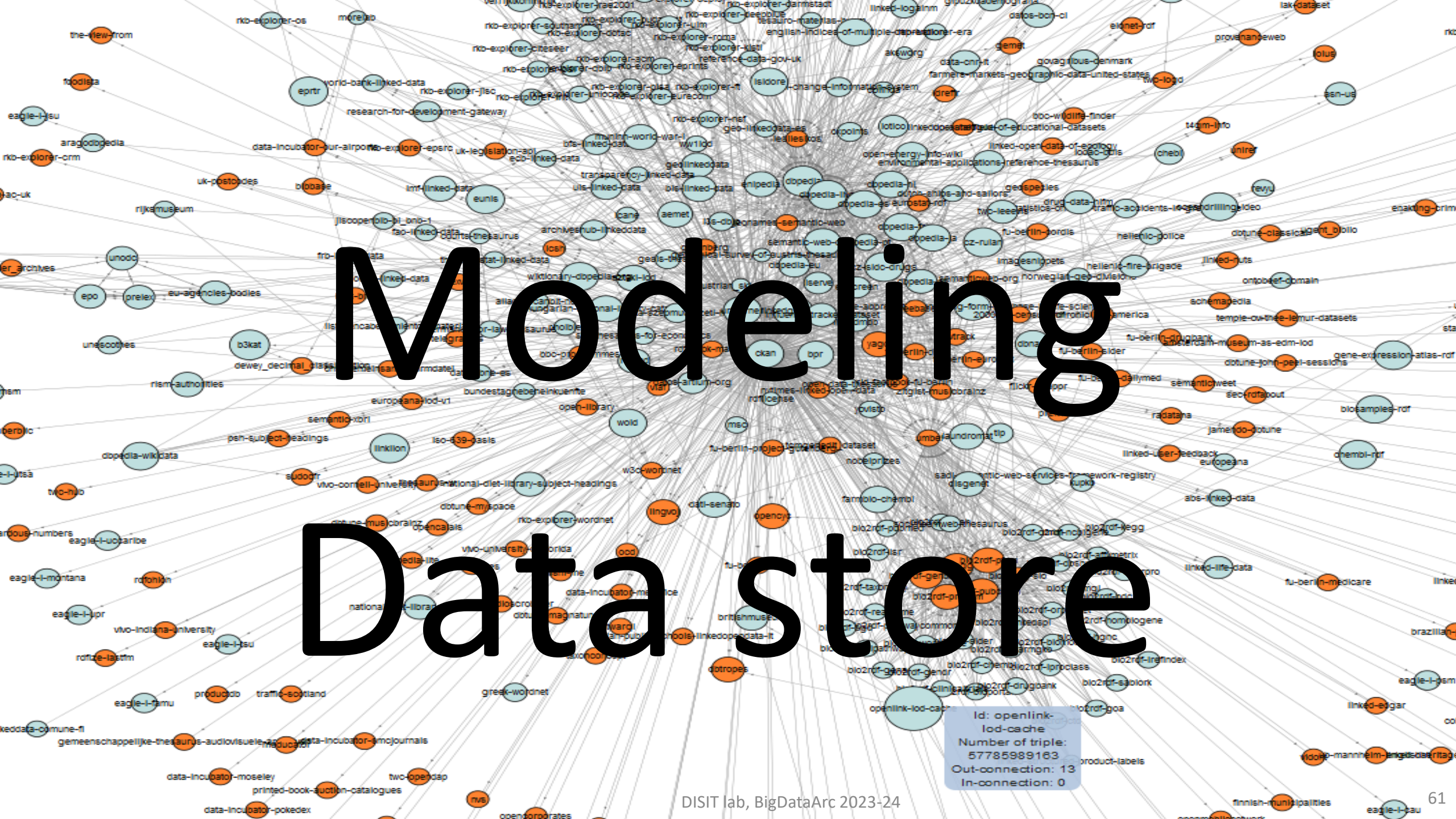
Complessità del Dato

- **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
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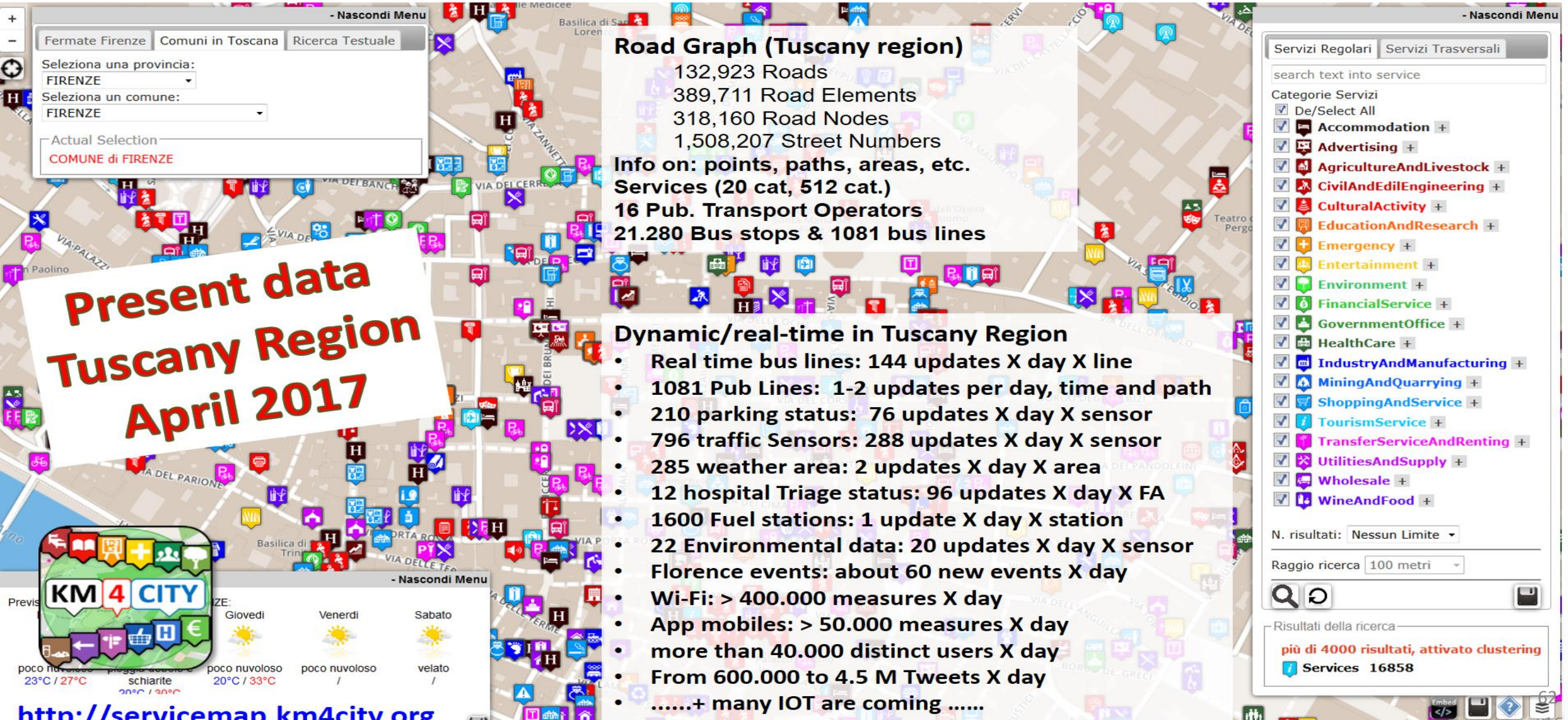
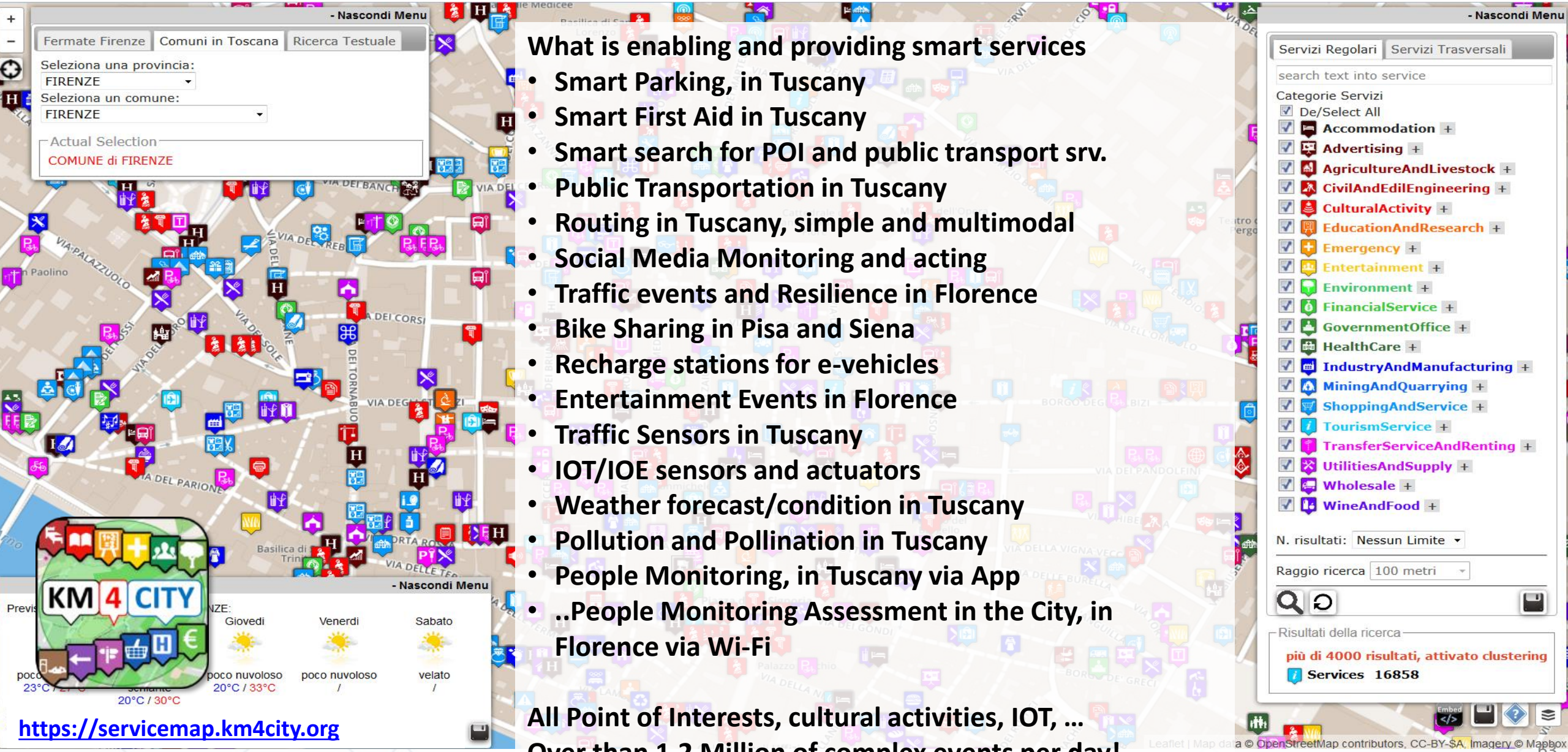
http://www.disit.org

Smart City

http://www.km4city.org





https://servicemap.km4city.org

What is enabling and providing smart services

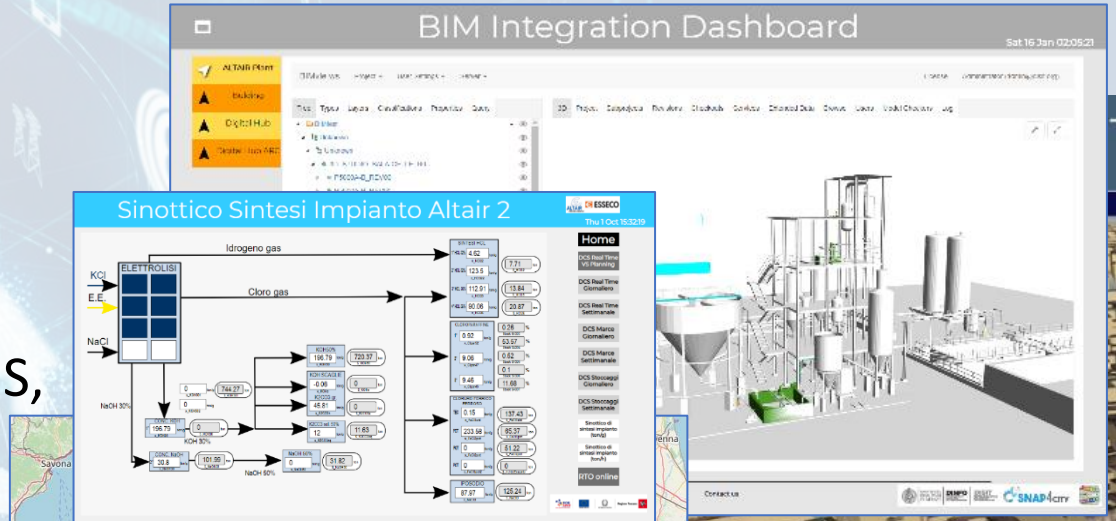
- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart search for POI and public transport srv.
- Public Transportation in Tuscany
- Routing in Tuscany, simple and multimodal
- Social Media Monitoring and acting
- Traffic events and Resilience in Florence
- Bike Sharing in Pisa and Siena
- 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

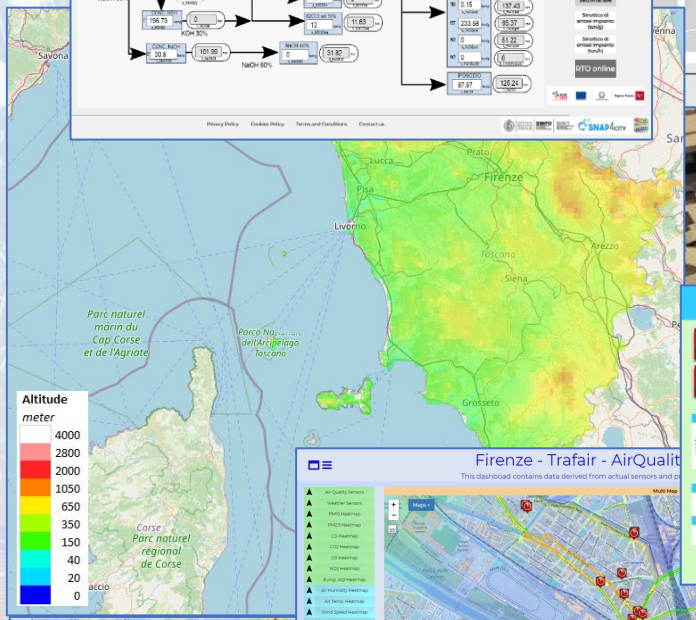
All Point of Interests, cultural activities, IOT, …
Over than 1.2 Million of complex events per day!

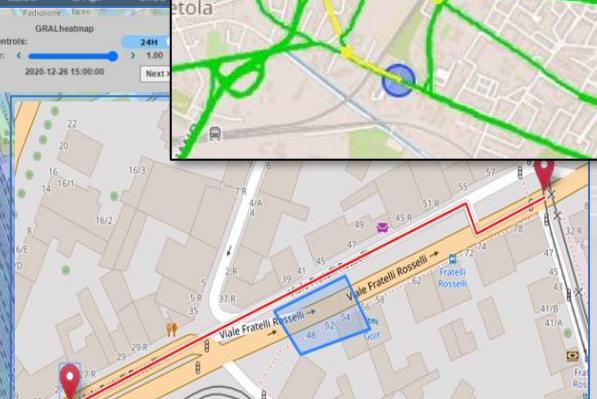
High Level Types

DISIT lab, BigDataArc 2023-24

- POI, IOT Devices, shapes,..
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of several kinds, ..
- Dynamic icons/pins, ..
- Synoptics, animations, ..
- KPI, personal KPI,..
- social media data, TV Stream,
- routing, multimodal, constraints, ..
- decision scenarios, ….
- etc.







Types of NoSQL Database

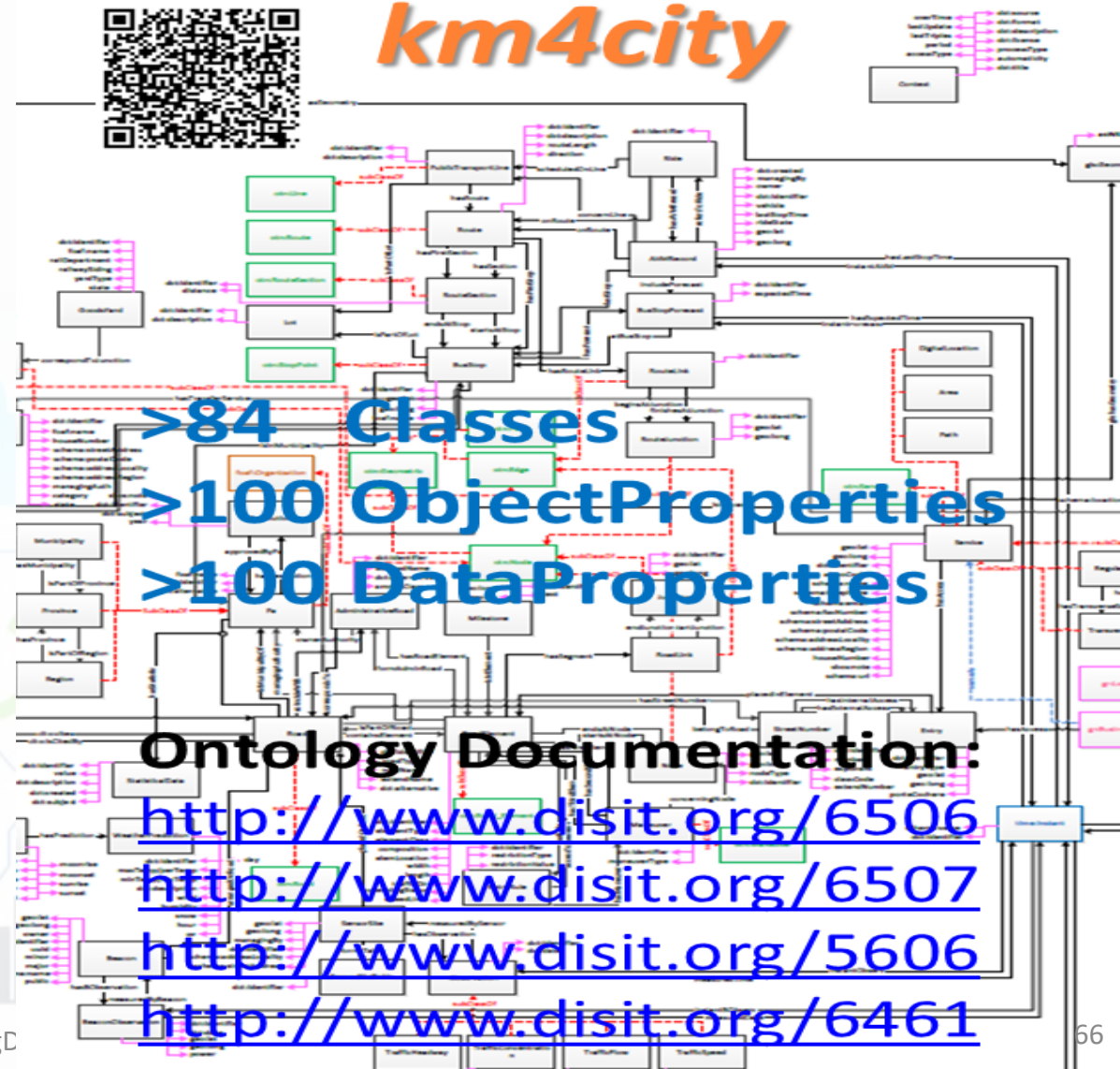
- Key-Value DB
- Col- Family/Big Table DB
- Document DB
- XML DB
- Object DB
- Multivalue DB
- ACID NoSQL
- Graph DB

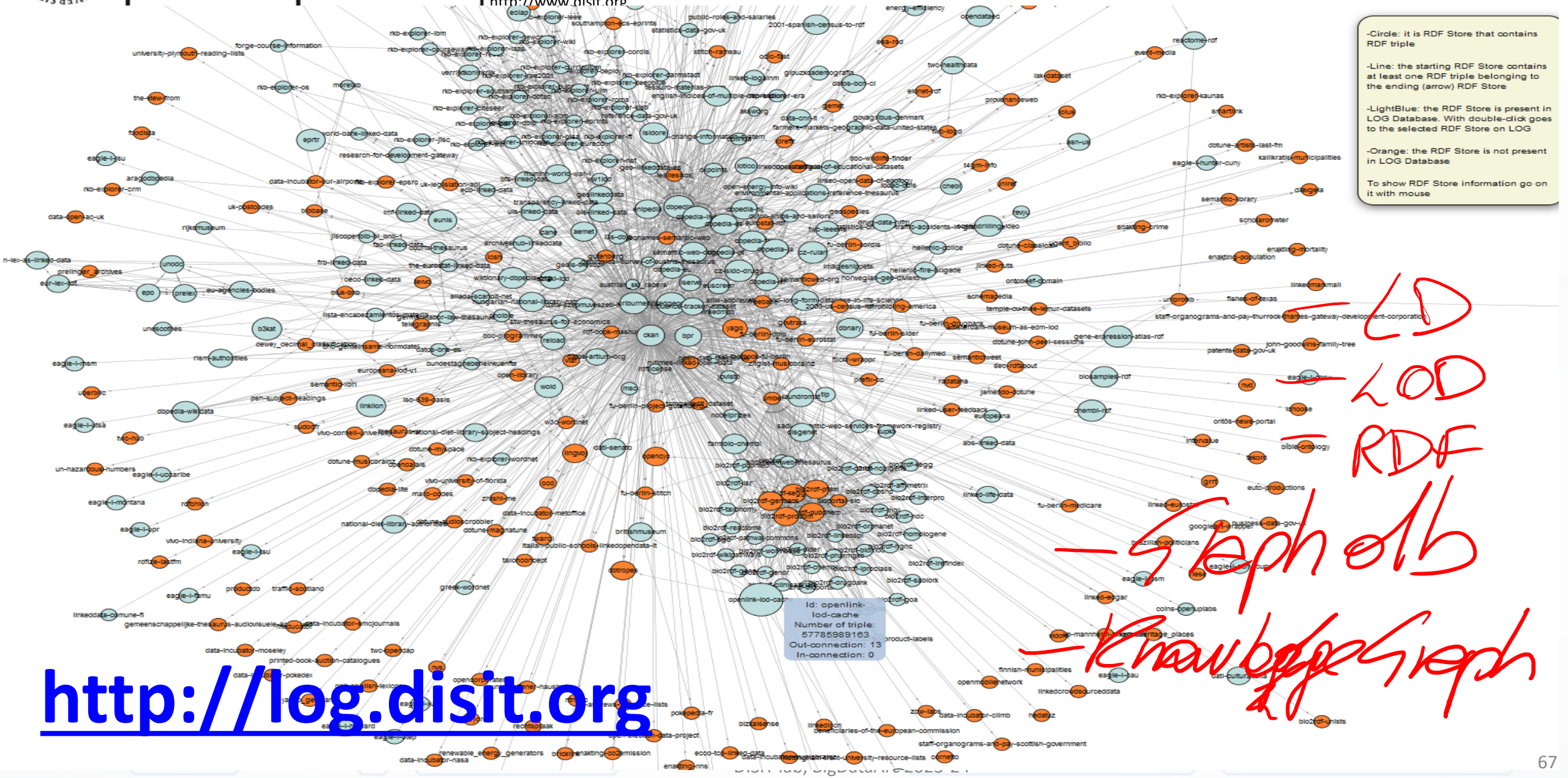
I Dati

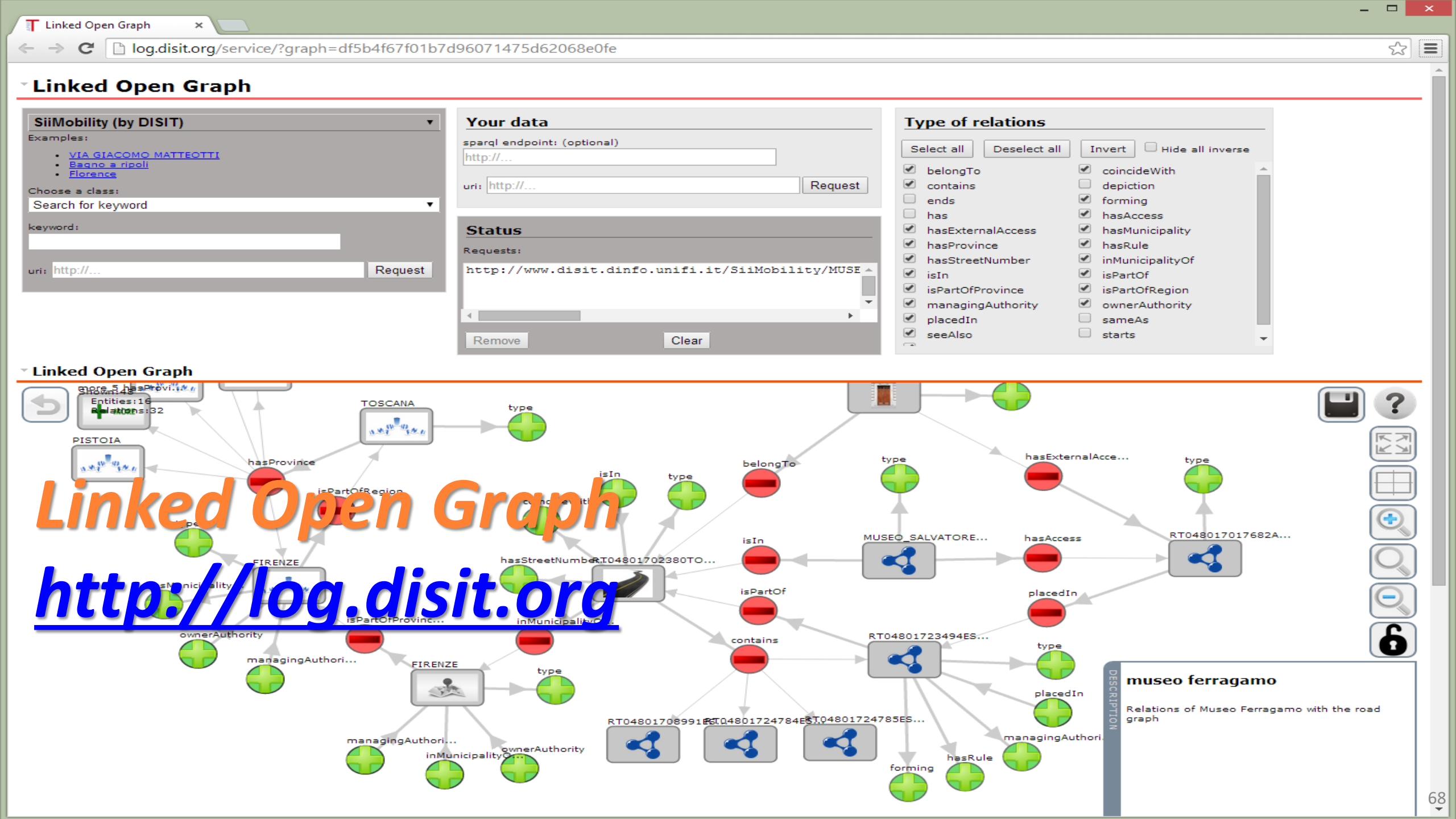
- **Collezionamento dati** statici, quasi statici e real time, stream
  - **Dati open**: geo localizzati, servizi, statistiche, censimenti, etc.
  - **Dati privati degli operatori**: con licenze limitate per non permettere di fare profitto ad altri operatori sulla base dei loro dati
  - **Dati personali 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***

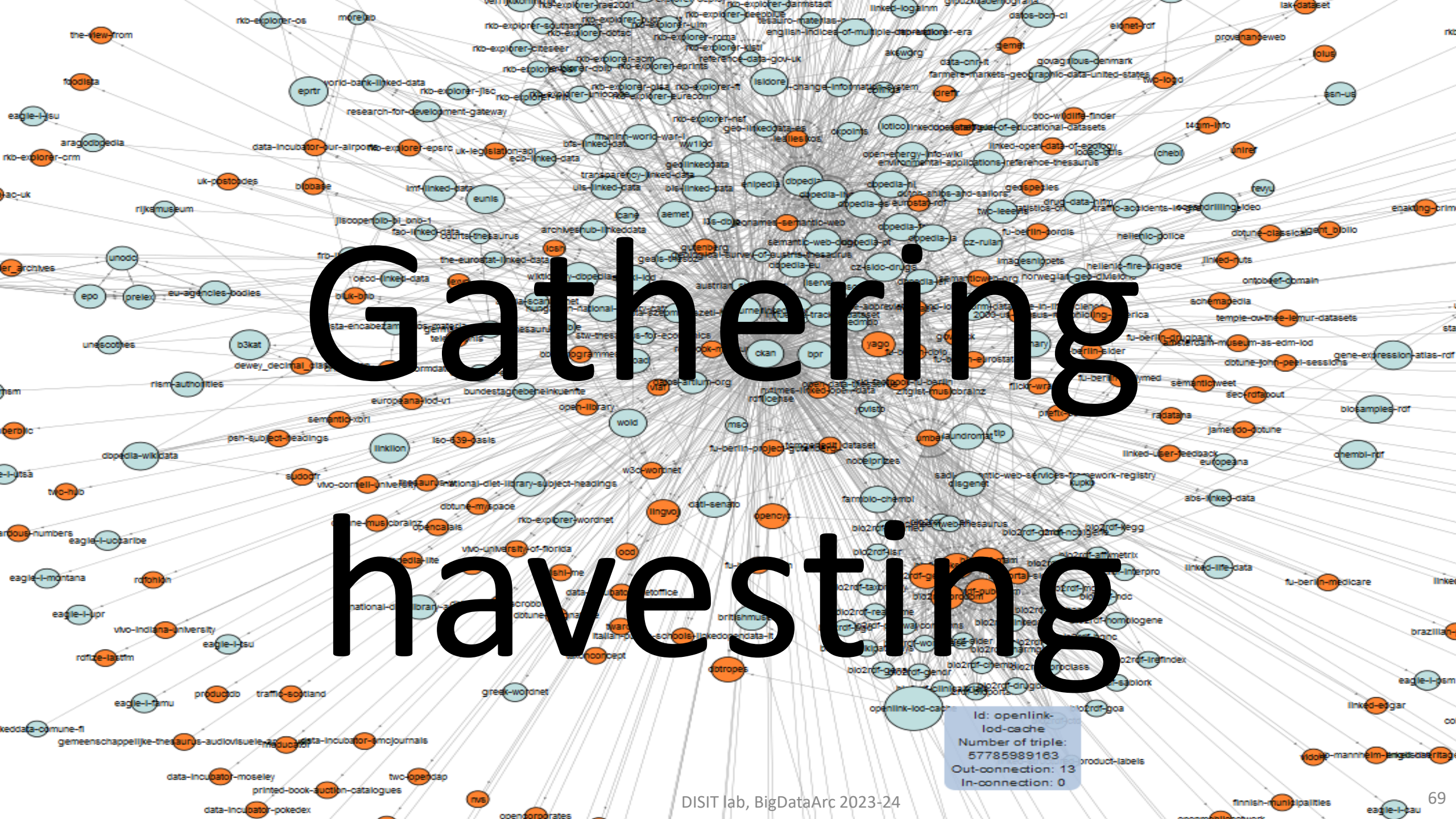
S-P-O

Smart-city Ontology km4city

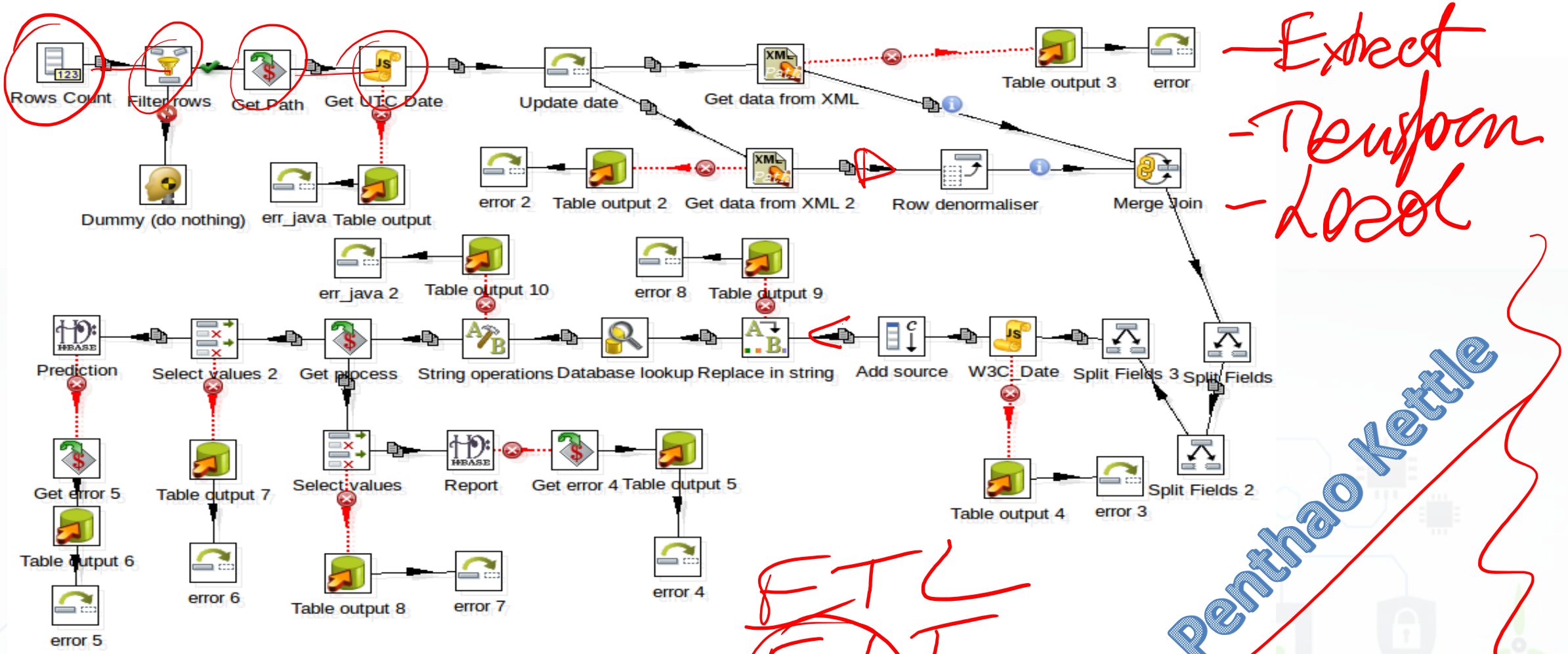



-Circle: it is RDF Store that contains RDF triple
-Line: the starting RDF Store contains at least one RDF triple belonging to the ending (arrow) RDF Store
-LightBlue: the RDF Store is present in LOG Database. With double-click goes to the selected RDF Store on LOG
-Orange: the RDF Store is not present in LOG Database
To show RDF Store information go on it with mouse
Id: openlink-lod-cache
Number of triple: 5778589163
Out-connection: 13
In-connection: 0
LD
LOD
RDF
Graph
Graph
http://log.disit.org


Linked Open Graph
log.disit.org/service/?graph=df5b4f67f01b7d96071475d62068e0fe
Linked Open Graph
SiiMobility (by DISIT)
Examples:
VIA GIACOMO MATTEOTTI
Bagno a ripoli
Florence
Choose a class:
Search for keyword
keyword:
uri: http://...
Request
Your data
sparql endpoint: (optional)
http://...
uri: http://...
Request
Status
Requests:
http://www.disit.dinfo.unifi.it/SiiMobility/MUSE
Remove
Clear
Type of relations
Select all
Deselect all
Invert
Hide all inverse
belongTo
contains
ends
has
hasExternalAccess
hasProvince
hasStreetNumber
isIn
isPartOfProvince
managingAuthority
placedIn
seeAlso
coincideWith
depiction
forming
hasAccess
hasMunicipality
hasRule
inMunicipalityOf
isPartOf
isPartOfRegion
ownerAuthority
sameAs
starts
Linked Open Graph
Shown:48
Entities:16
Relations:32
TOSCANA
type
PISTOIA
hasProvince
isPartOfRegion
FIRENZE
ownerAuthority
managingAuthori...
isPartOfProvinc...
inMunicipalityO...
FIRENZE
type
managingAuthori...
inMunicipalityO...
ownerAuthority
isIn
type
hasStreetNumber
RT048017023800TO...
belongTo
isIn
isPartOf
contains
type
MUSEO_SALVATORE...
hasExternalAcce...
hasAccess
type
RT048017017682A...
placedIn
RT04801723494ES...
type
placedIn
managingAuthori...
hasRule
forming
RT048017089918
RT04801724784ES...
RT04801724785ES...
museo ferragamo
Relations of Museo Ferragamo with the road graph
DESCRIPTION
Linked Open Graph
http://log.disit.org


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

Example of ETL

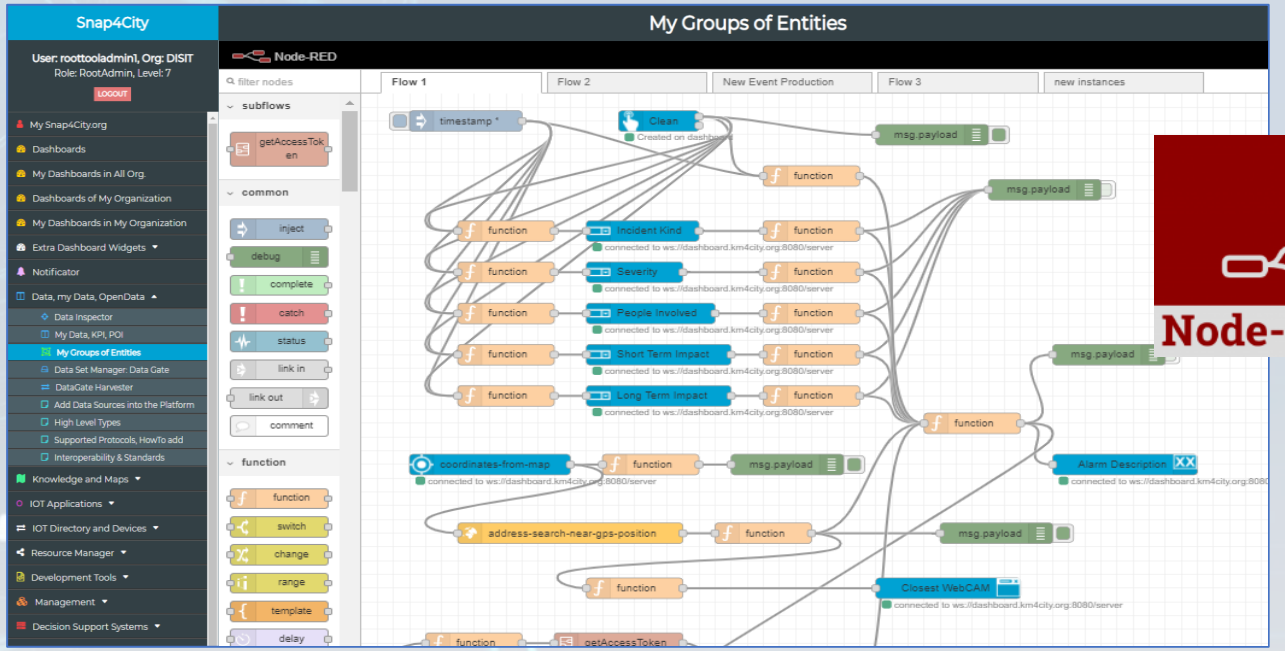


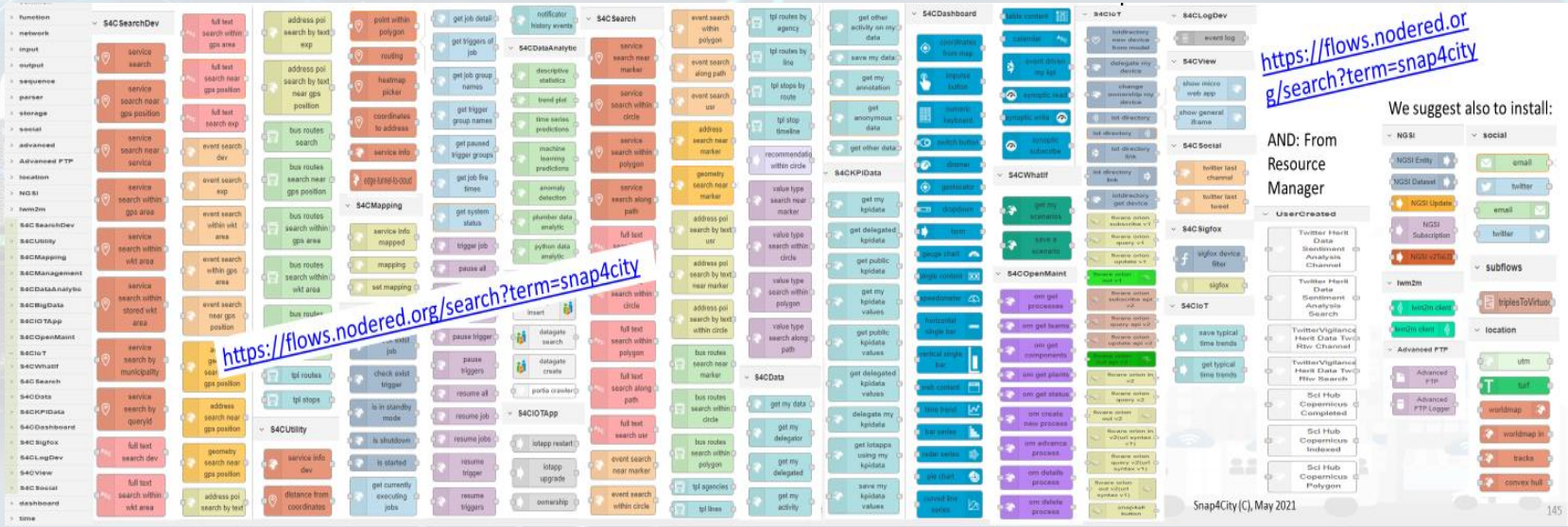
Batch Processing

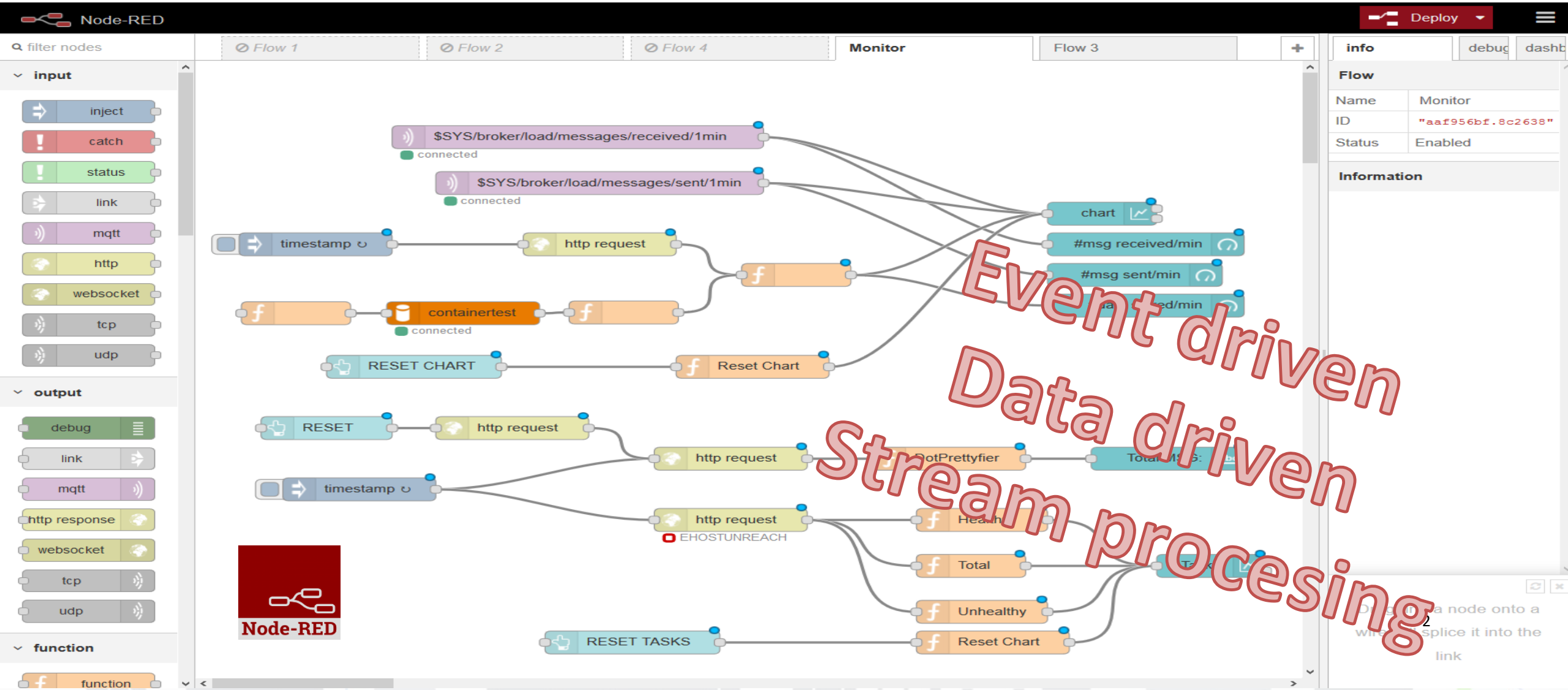
ETL Penthao Kettle

Ingestion, aggreg. → exploitation

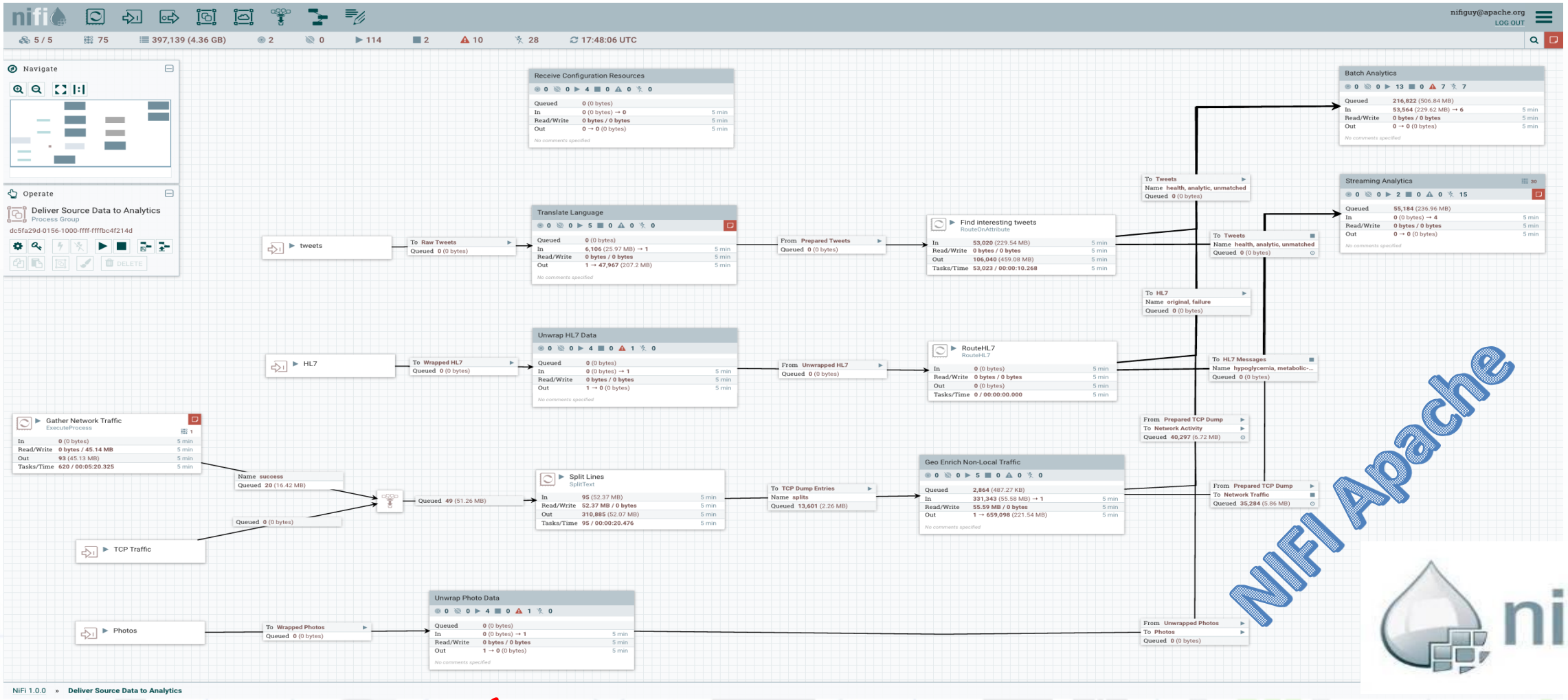
- **IoT App Visual Programming, no coding**
  - **Data transformation**
  - **Integration, Interoperab.**
  - **Scripting Data Analytics**
  - **Data ingestion**
  - **Business logic**
- **Edge and Cloud**
- **MicroServices** data driven develop via visual language Node-RED






Node-RED
Deploy
filter nodes
Flow 1
Flow 2
Flow 4
Monitor
Flow 3
info
debug
dashb
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
output
debug
link
mqtt
http response
websocket
tcp
udp
function
function
$SYS/broker/load/messages/received/1min
connected
$SYS/broker/load/messages/sent/1min
connected
timestamp
http request
containertest
connected
RESET CHART
Reset Chart
RESET
http request
timestamp
http request
http request
EHOSTUNREACH
RESET TASKS
Reset Chart
chart
#msg received/min
#msg sent/min
Total
Unhealthy
Flow
Name
Monitor
ID
"aaf956bf.8c2638"
Status
Enabled
Information
Event driven
Data driven
Stream procesing

Example of NIFI

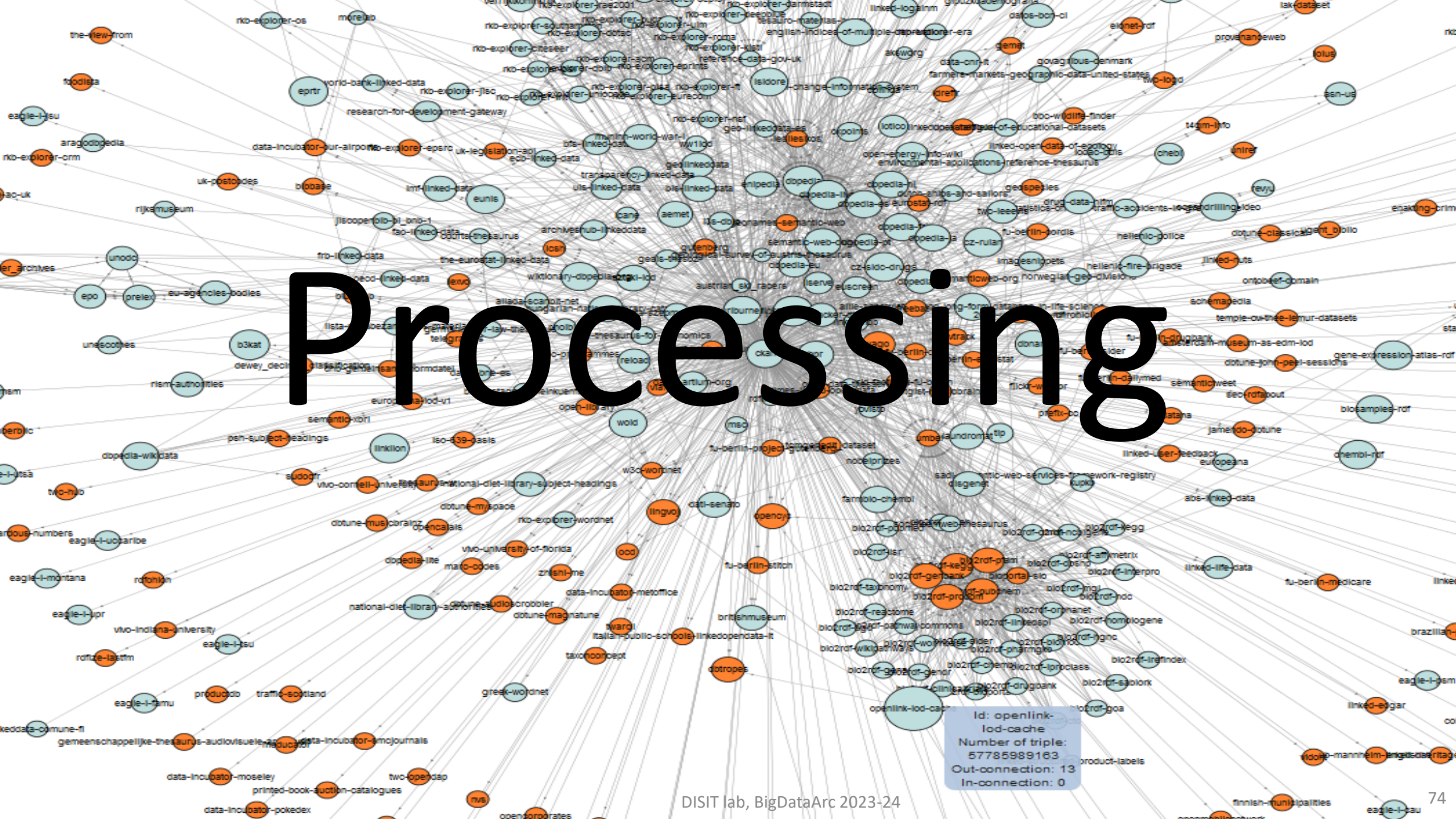


NIFI Apache

nifi

Batch Processing

Ernesto Mocenni


Processing
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
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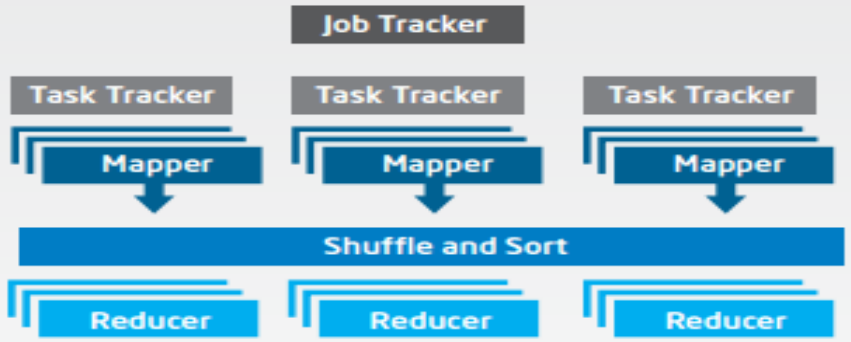
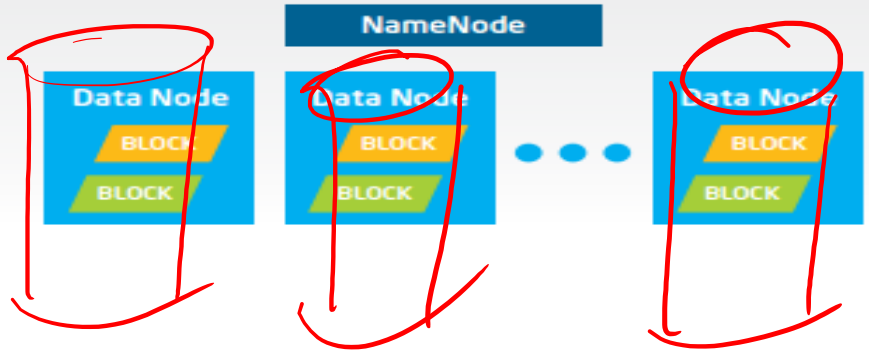
Hadoop and MapReduce

LOGICAL ARCHITECTURE

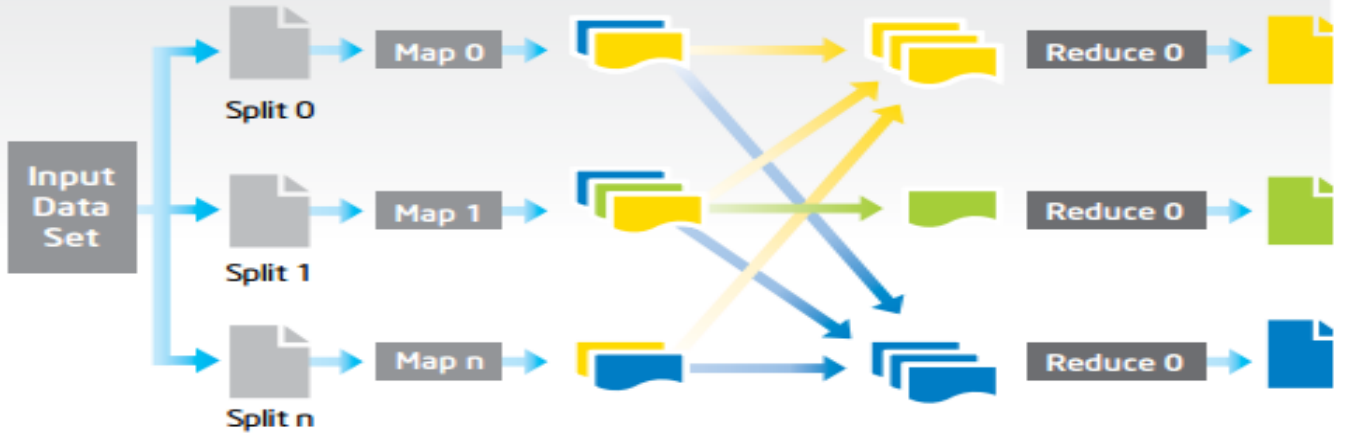
Processing: MapReduce



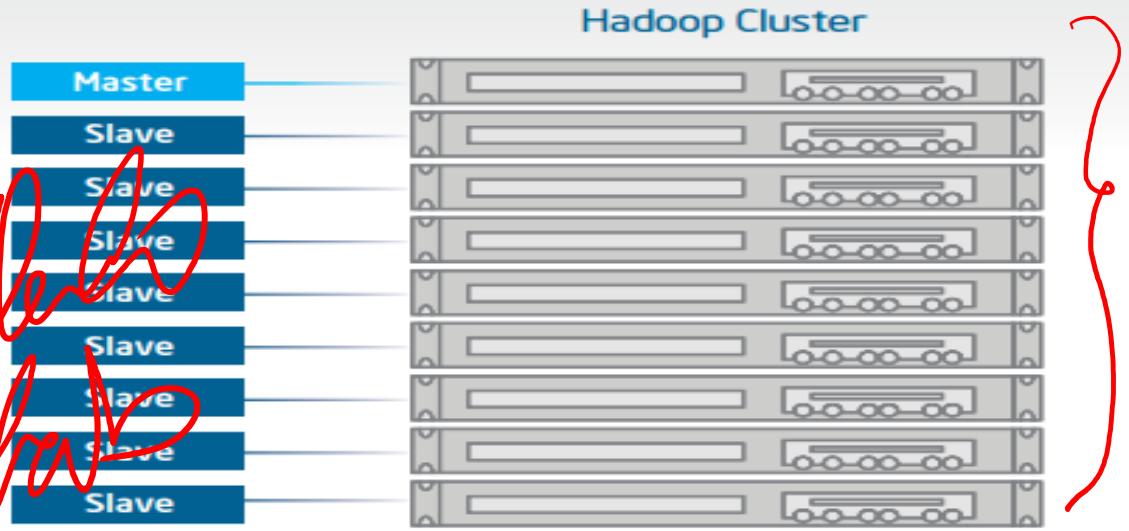
Storage: HDFS



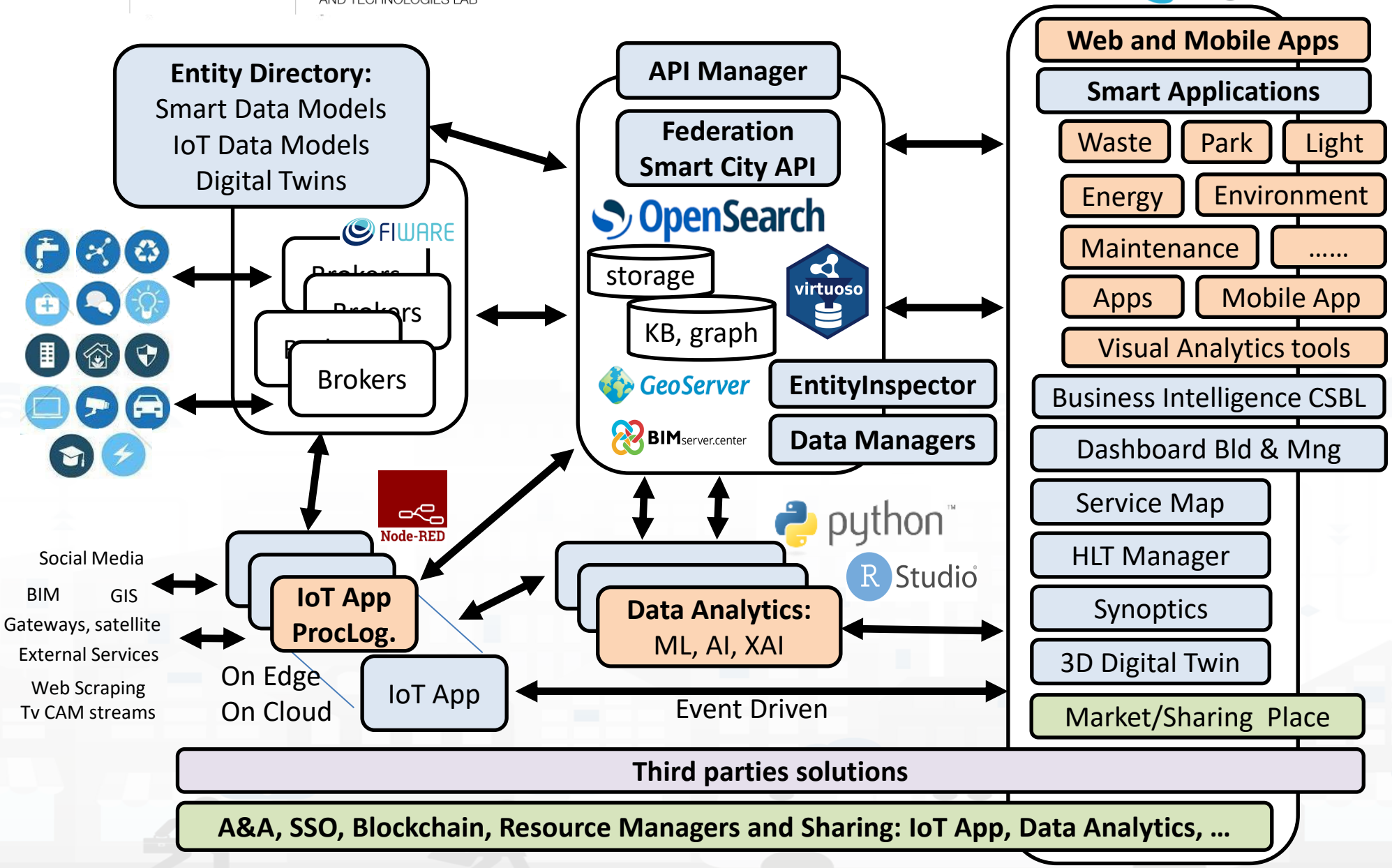
PROCESS FLOW



PHYSICAL ARCHITECTURE



Tech Arch


Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Brokers
Brokers
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

Ingestion, aggreg. → exploitation

- **IoT App Visual Programming, no coding**
  - **Data transformation**
  - **Integration, Interoperab.**
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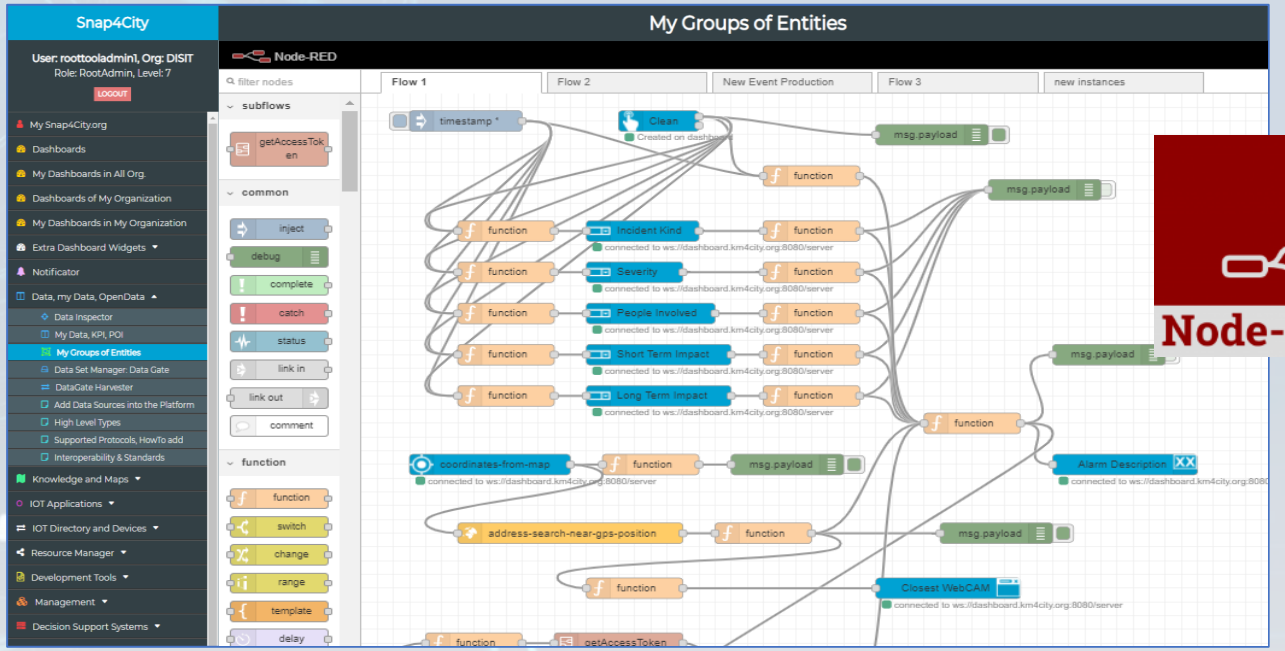
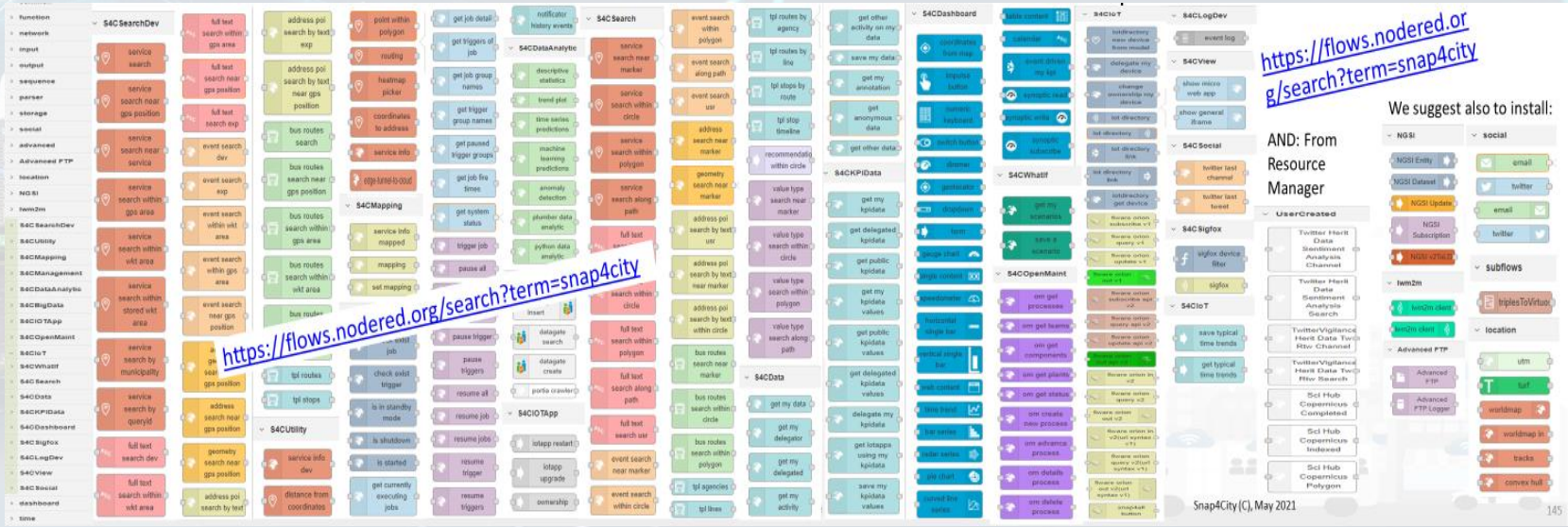
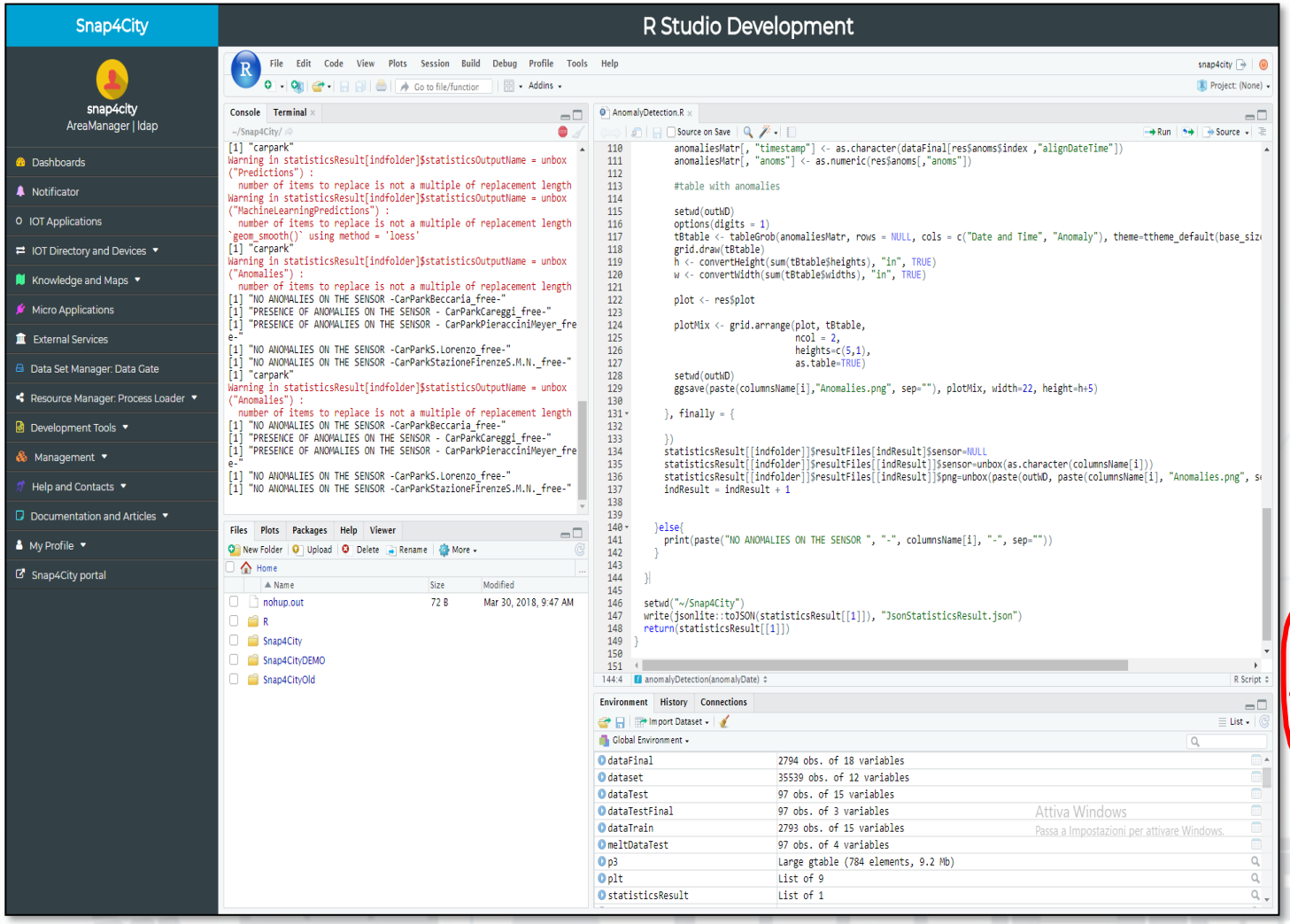
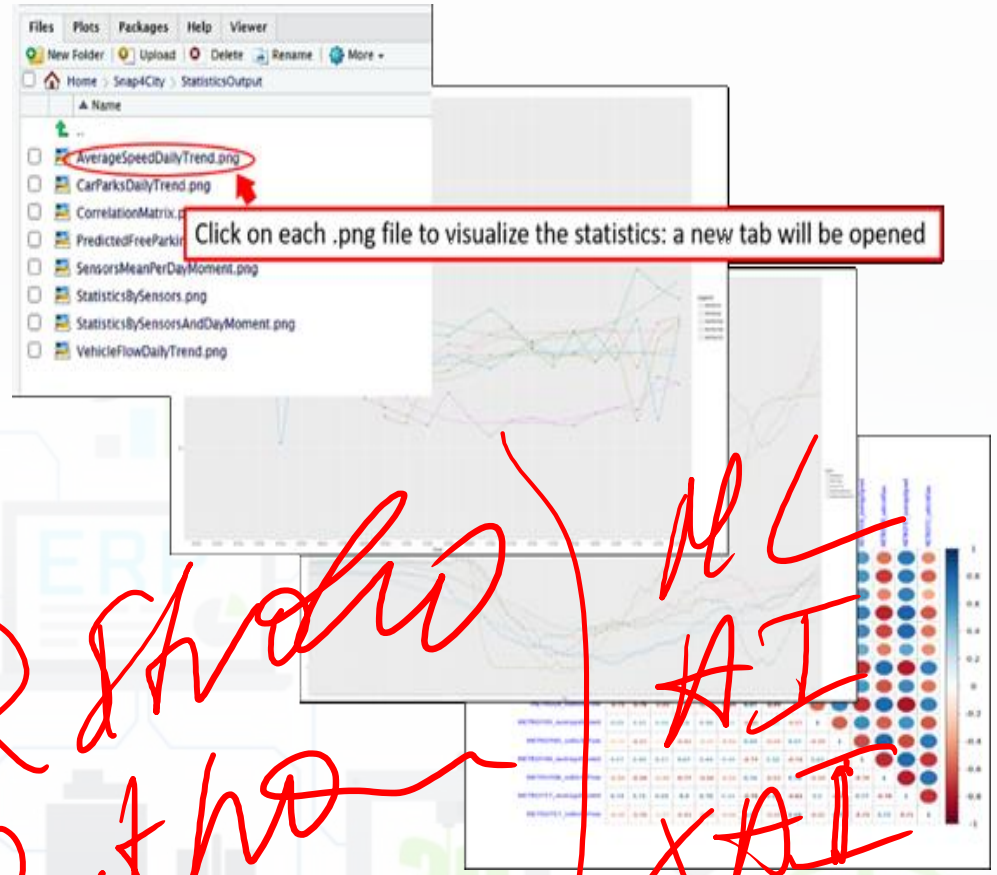


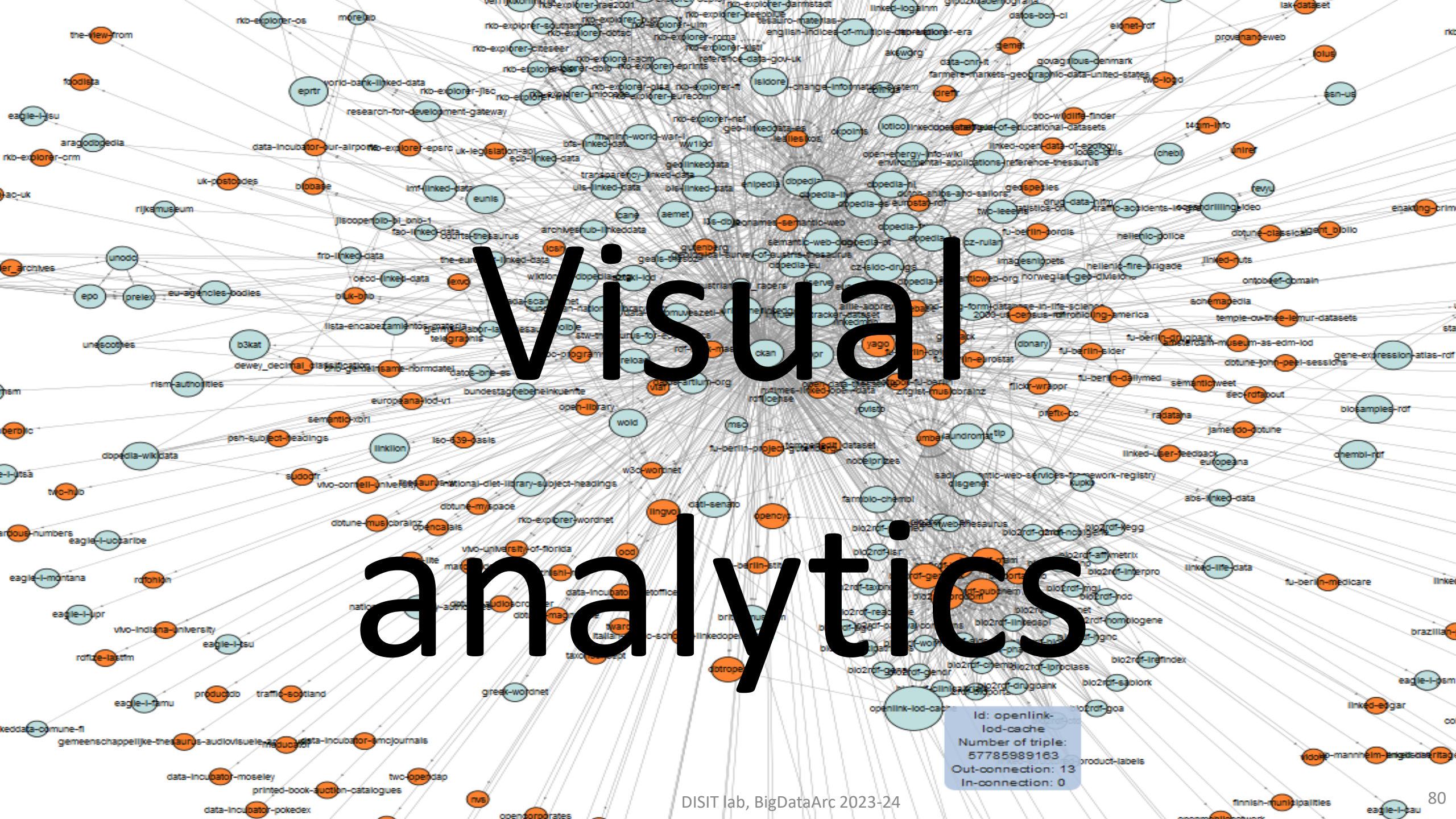


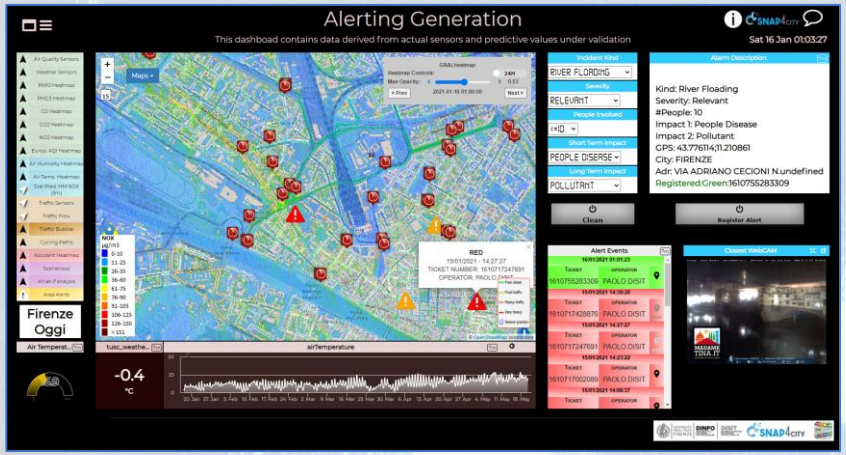
Developer in R Studio, Python + Tensor Flow — NVIDIA

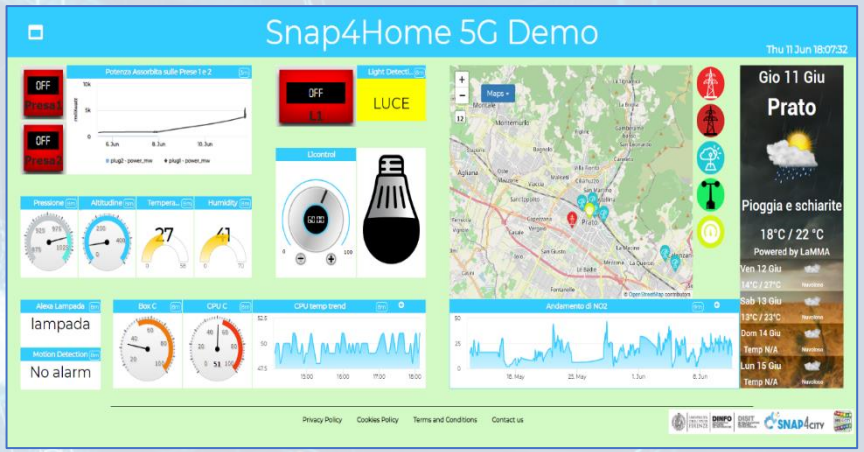


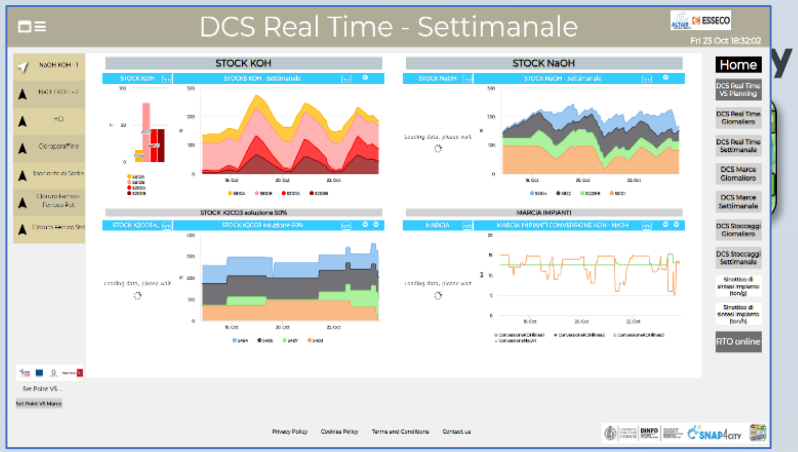


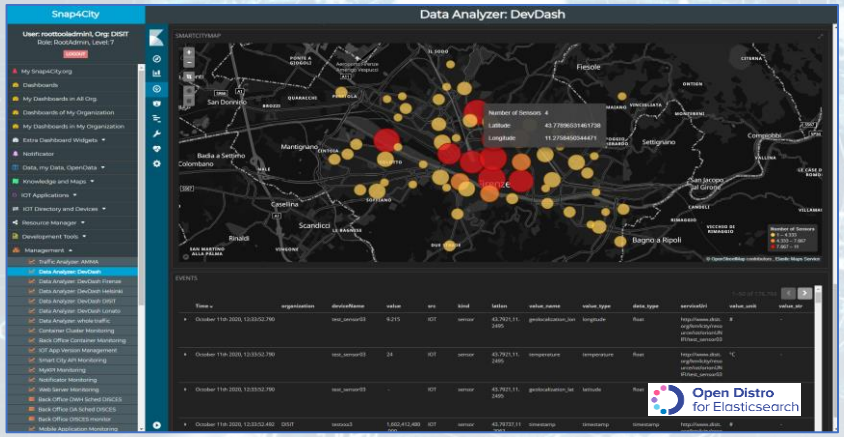
R studio
Python
ML
AI
XAI

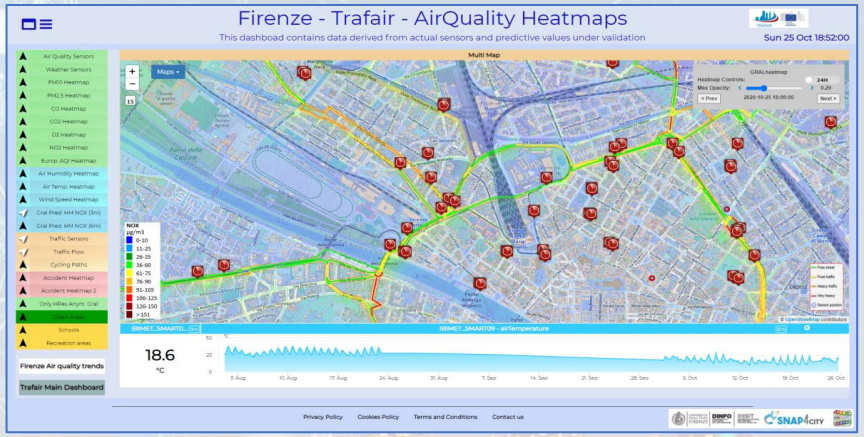

Visual
analytics
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

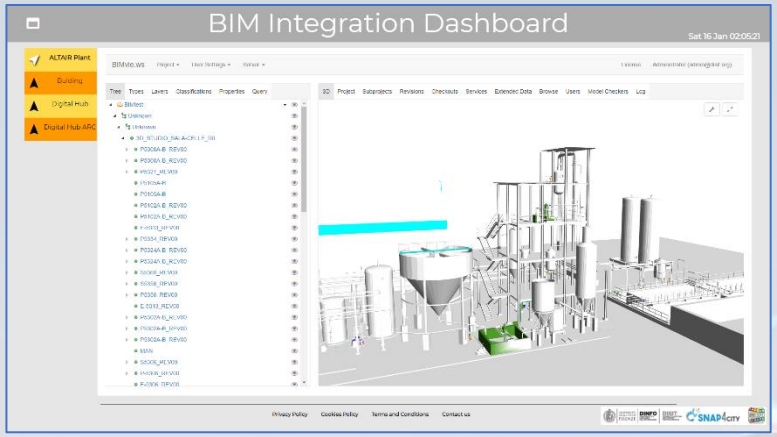

Alerting Generation
This dashboad contains data derived from actual sensors and predictive values under validation
Firenze Oggi
-0.4

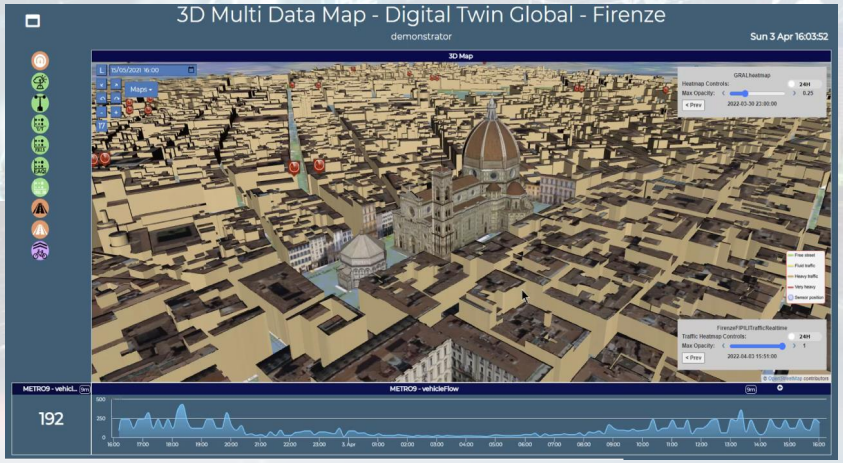

Snap4Home 5G Demo
Thu 11 Jun 18:07:32
LUCE
lampada
No alarm
Gio 11 Giu
Prato
Pioggia e schiarite
18°C / 22 °C
Powered by LaMMA

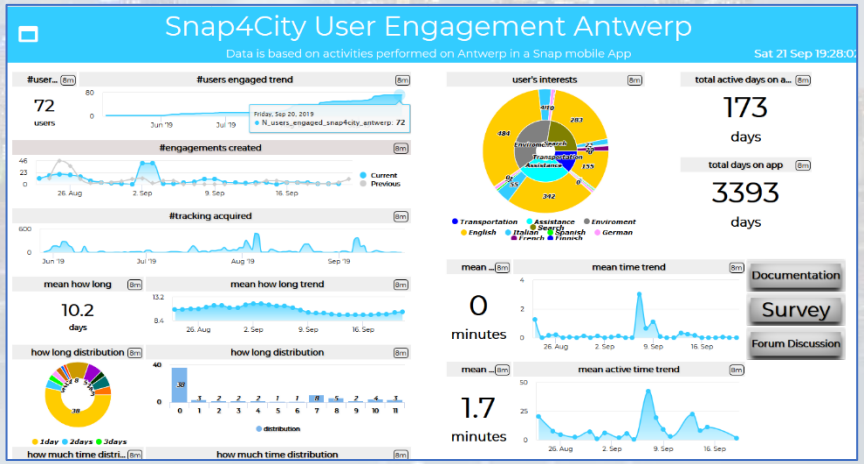

DCS Real Time - Settimanale
STOCK KOH
STOCK NaOH
Home

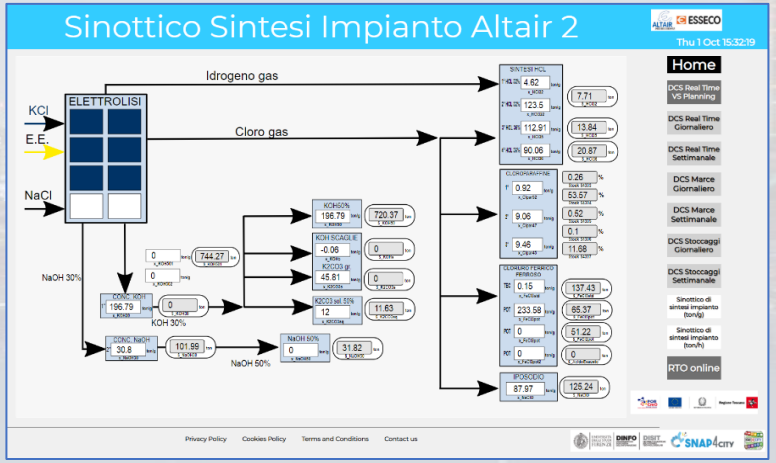

Data Analyzer: DevDash
Open Distro for Elasticsearch


Firenze - Trafair - AirQuality Heatmaps
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 25 Oct 18:52:00
18.6

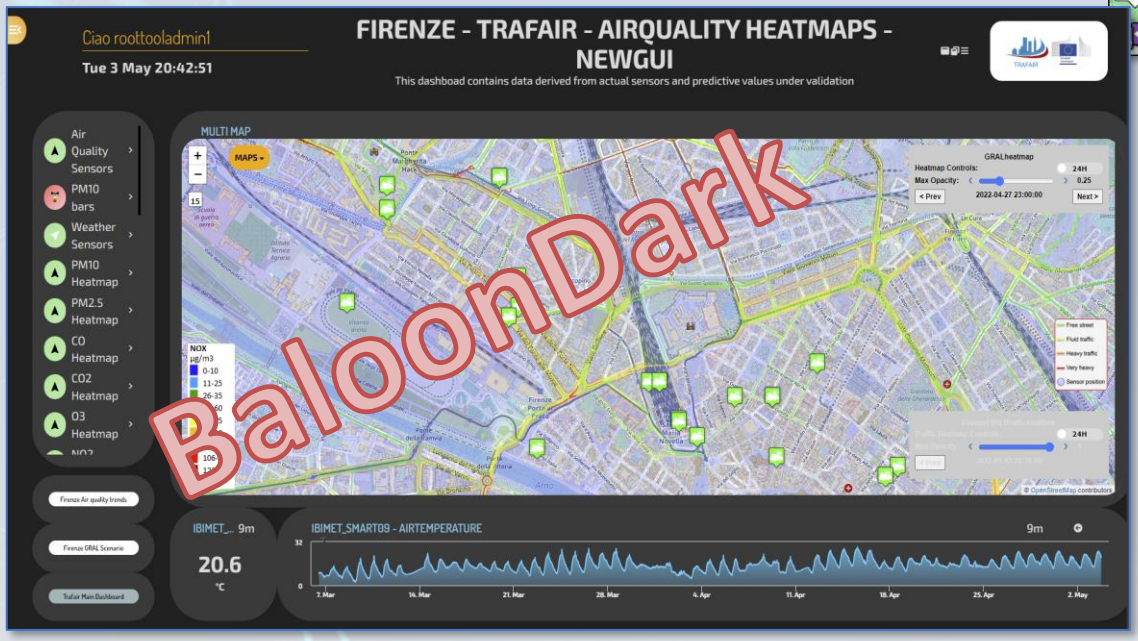

BIM Integration Dashboard

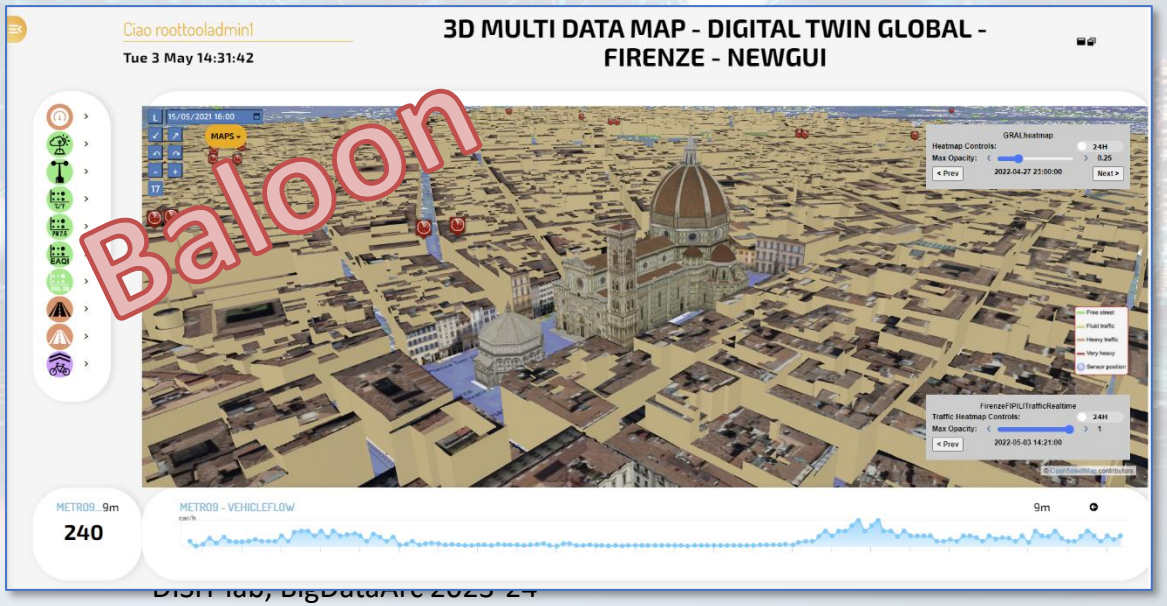

3D Multi Data Map - Digital Twin Global - Firenze
demonstrator
Sun 3 Apr 16:03:52
192

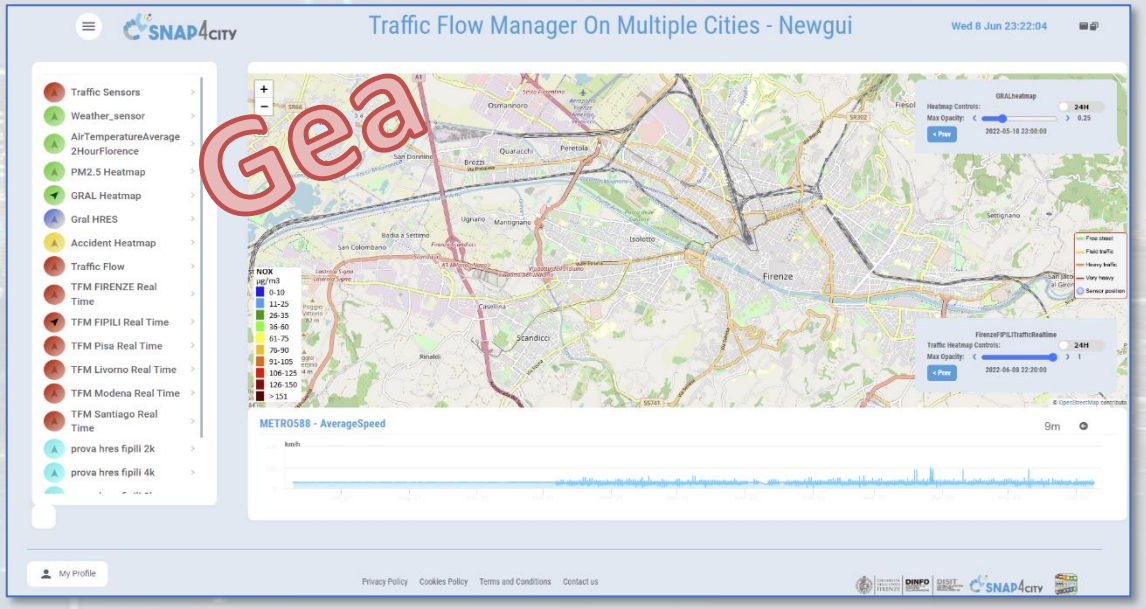

Snap4City User Engagement Antwerp
Data is based on activities performed on Antwerp in a Snap mobile App
72
173
days
3393
days
10.2
days
0
minutes
1.7
minutes
Documentation
Survey
Forum Discussion

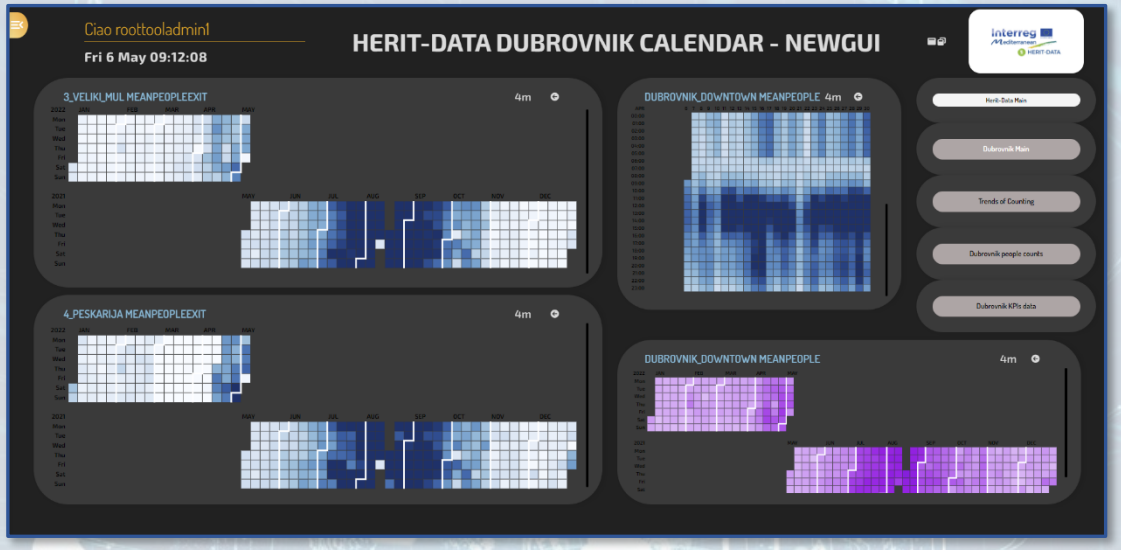

Sinottico Sintesi Impianto Altair 2
Idrogeno gas
Cloro gas
ELETTROLISI
KCl
E.E.
NaCl
NaOH 30%
KOH 30%
NaOH 50%
Home

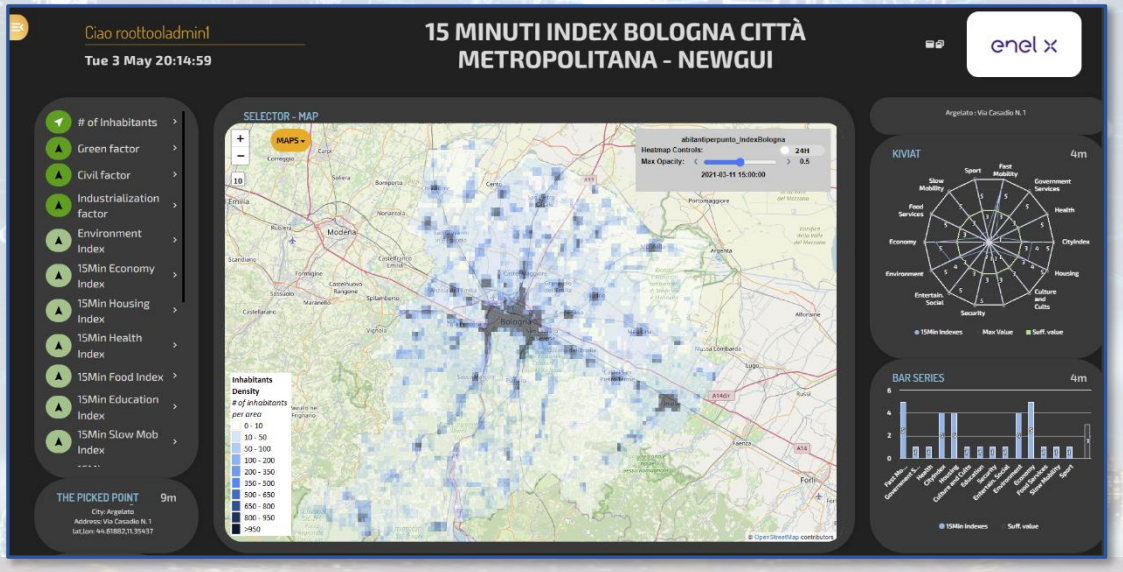
Different Themes

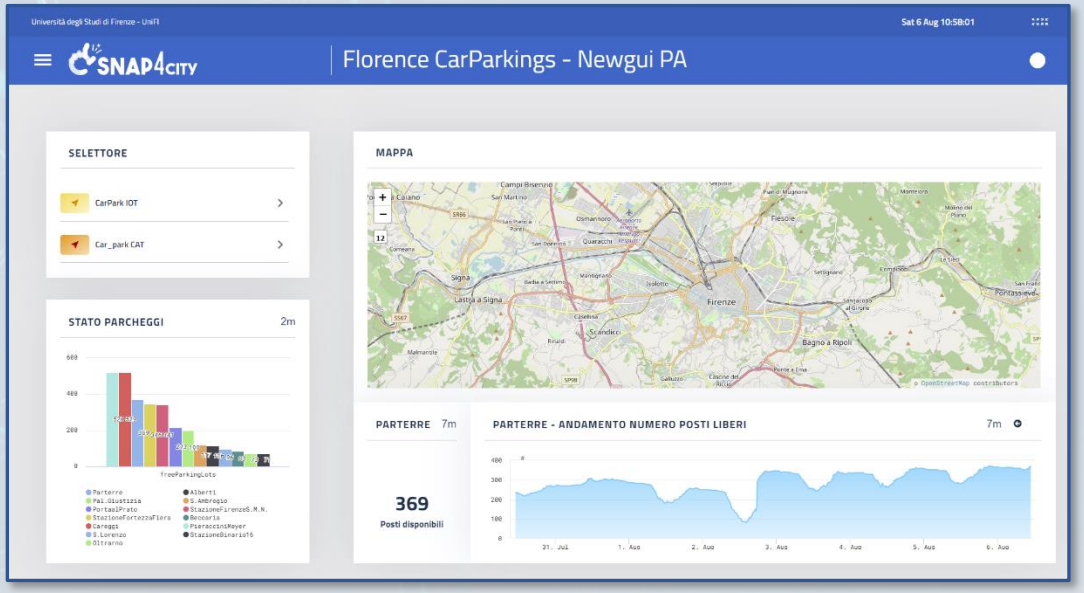


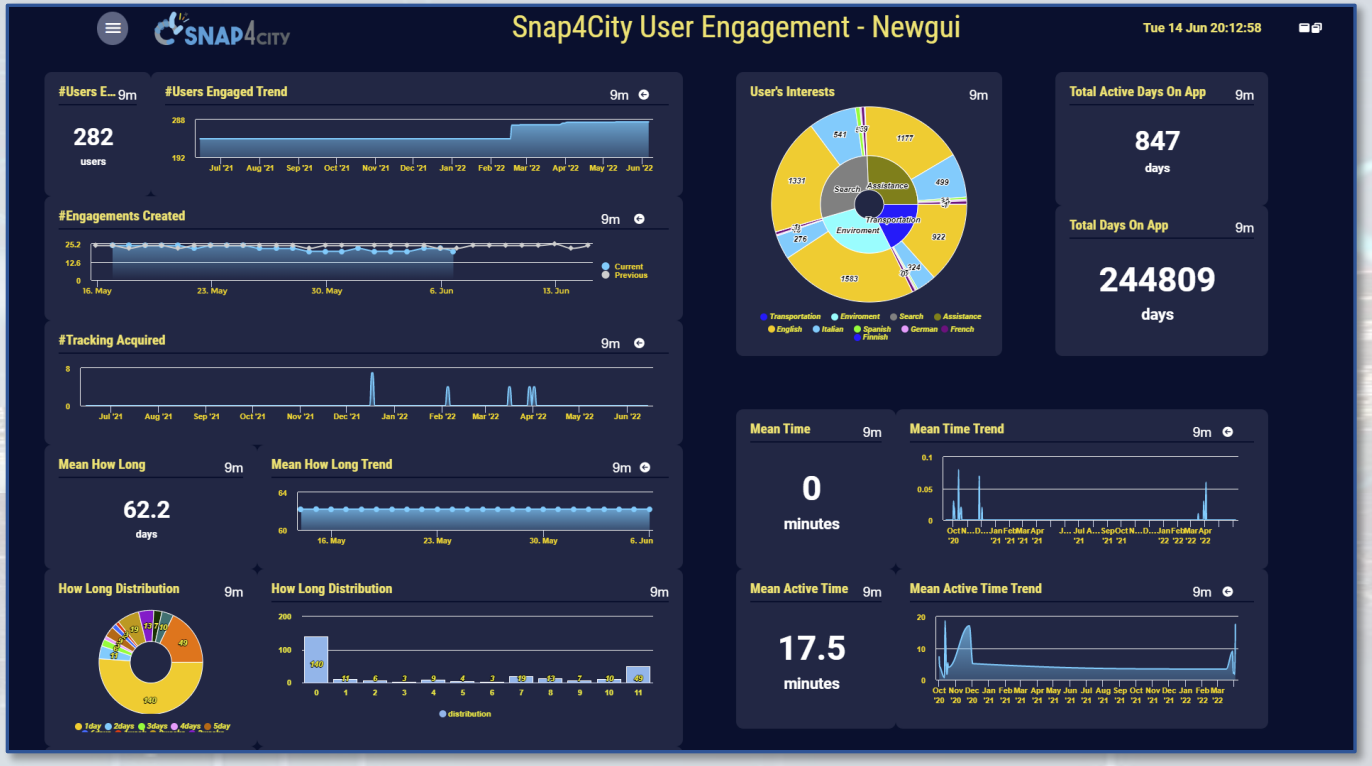








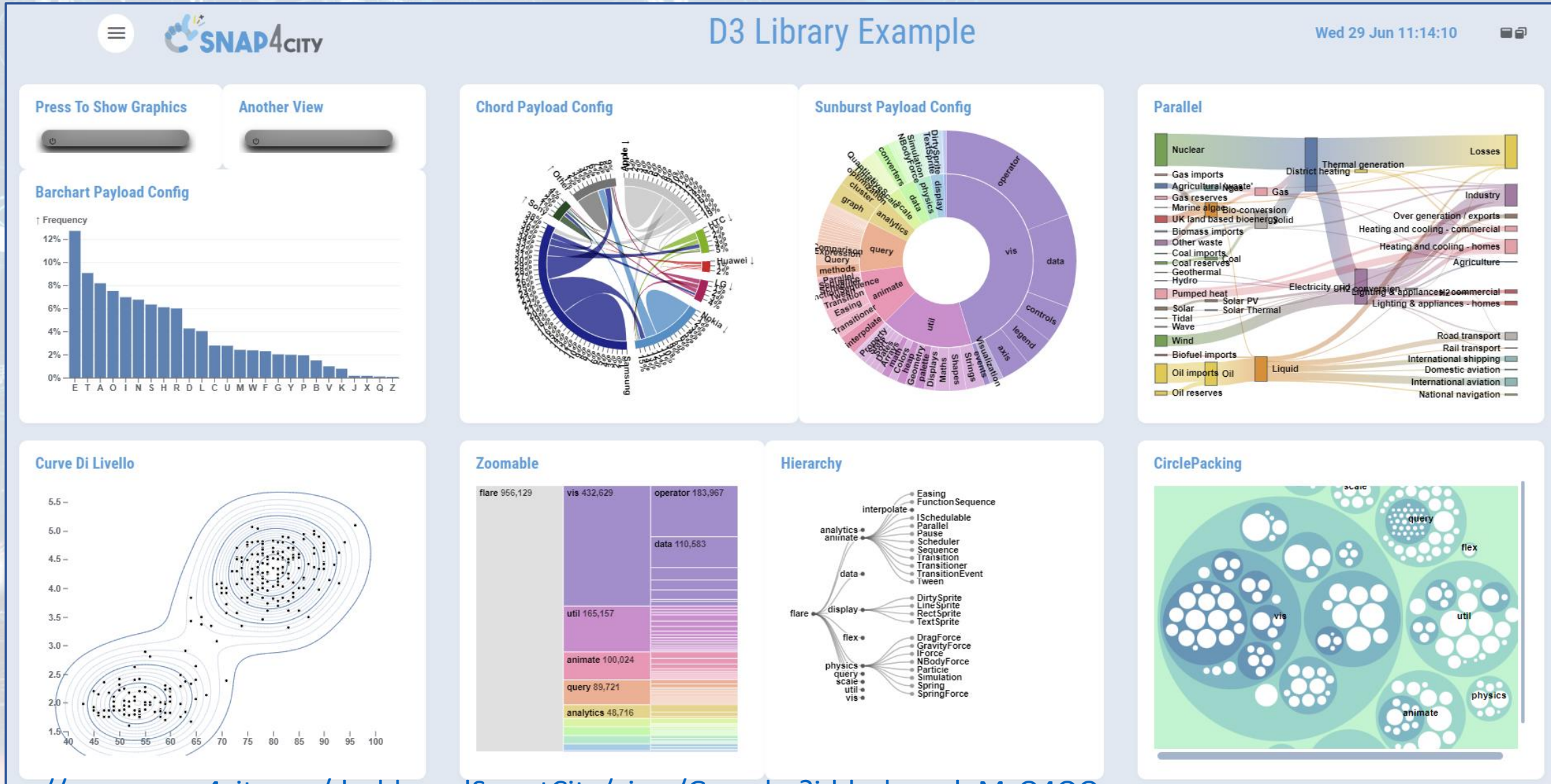




New styles/themes can be developed by specializing a few files from open source

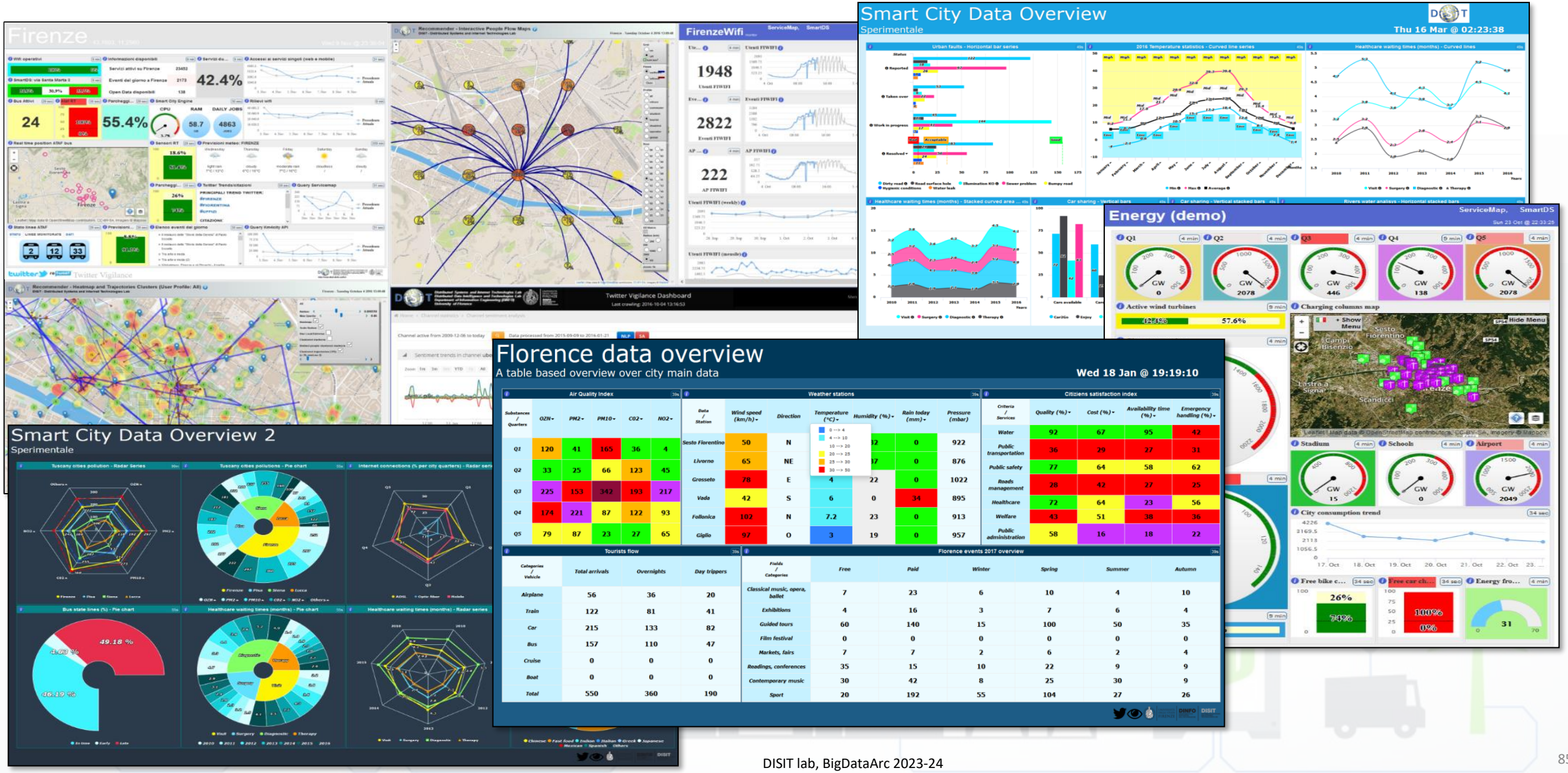
https://www.snap4city.org/793

D3 Graph library capability



https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzQ4OQ==

Dashboard vs Business Intelligence

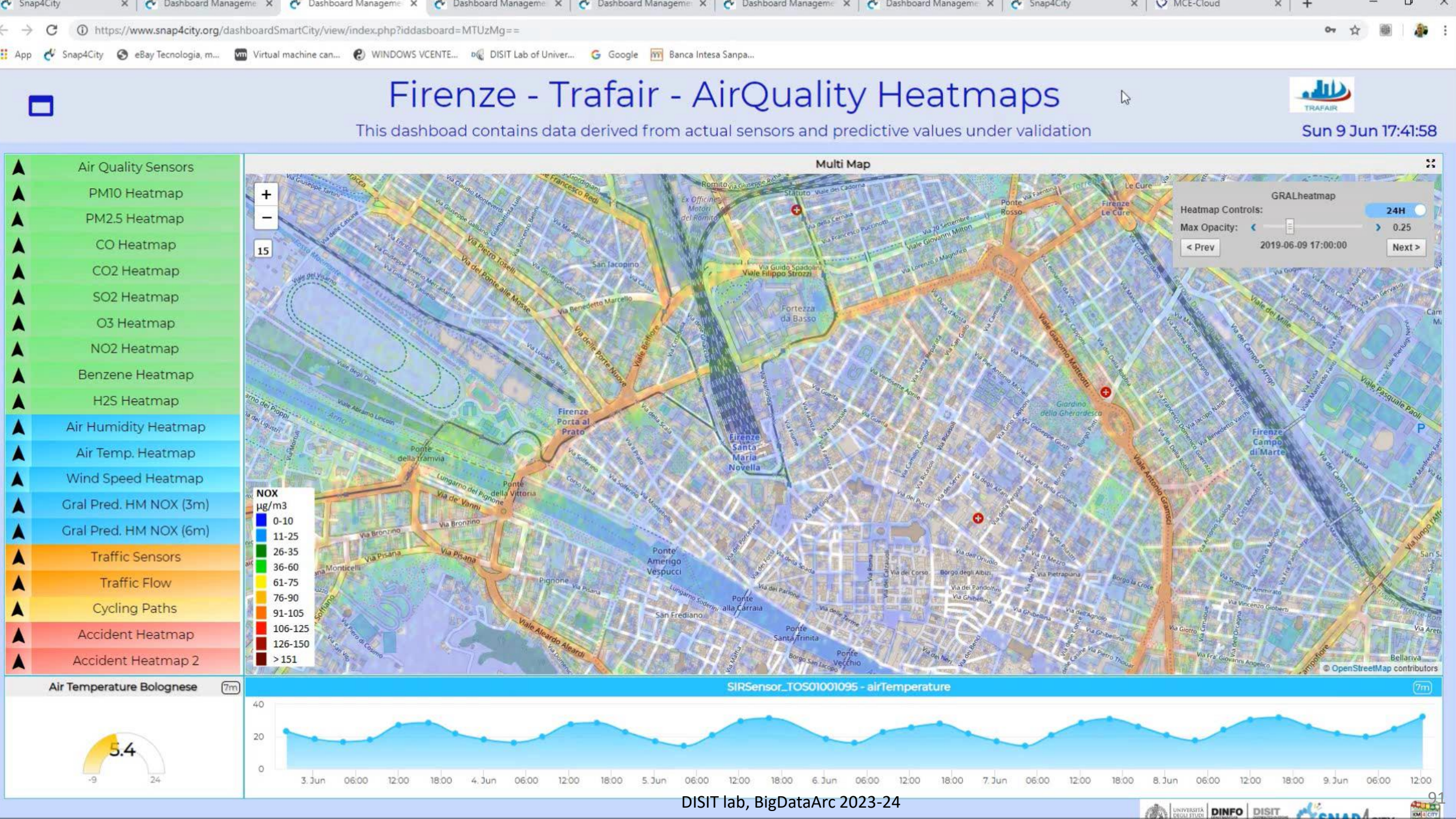


http://www.darionardella.it/il-sindaco-dario-nardella-in-missione-a-madrid-e-barcellona/

REPLICATE

We expect you at Stand 120, Hall P2 , Level 0, Street A
Smart City Expo World Congress 2018
13-15 Novembre 2018, Barcelona, Gran Via Venue

SMARTCITY EXPO WORLD CONGRESS


Firenze - Trafair - AirQuality Heatmaps
This dashboad 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
Multi Map
GRALheatmap
Heatmap Controls:
24H
Max Opacity:
0.25
< Prev
2019-06-09 17:00:00
Next >
NOX
µg/m3
0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
>151
© OpenStreetMap contributors
Air Temperature Bolognese
7m
5.4
-9
24
SIRSensor_TOS01001095 - airTemperature
7m
40
20
0
3. Jun
06:00
12:00
18:00
4. Jun
06:00
12:00
18:00
5. Jun
06:00
12:00
18:00
6. Jun
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18:00
7. Jun
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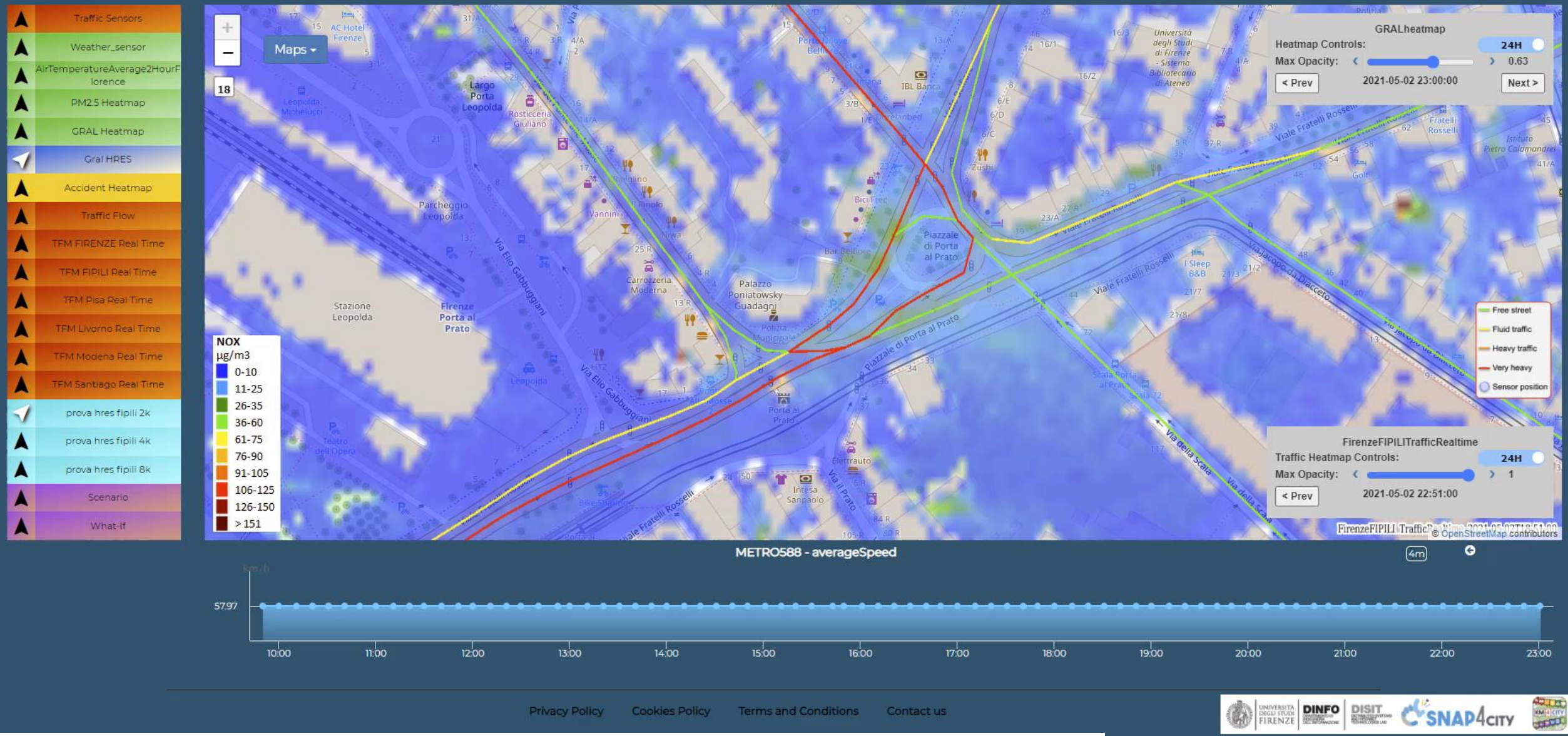
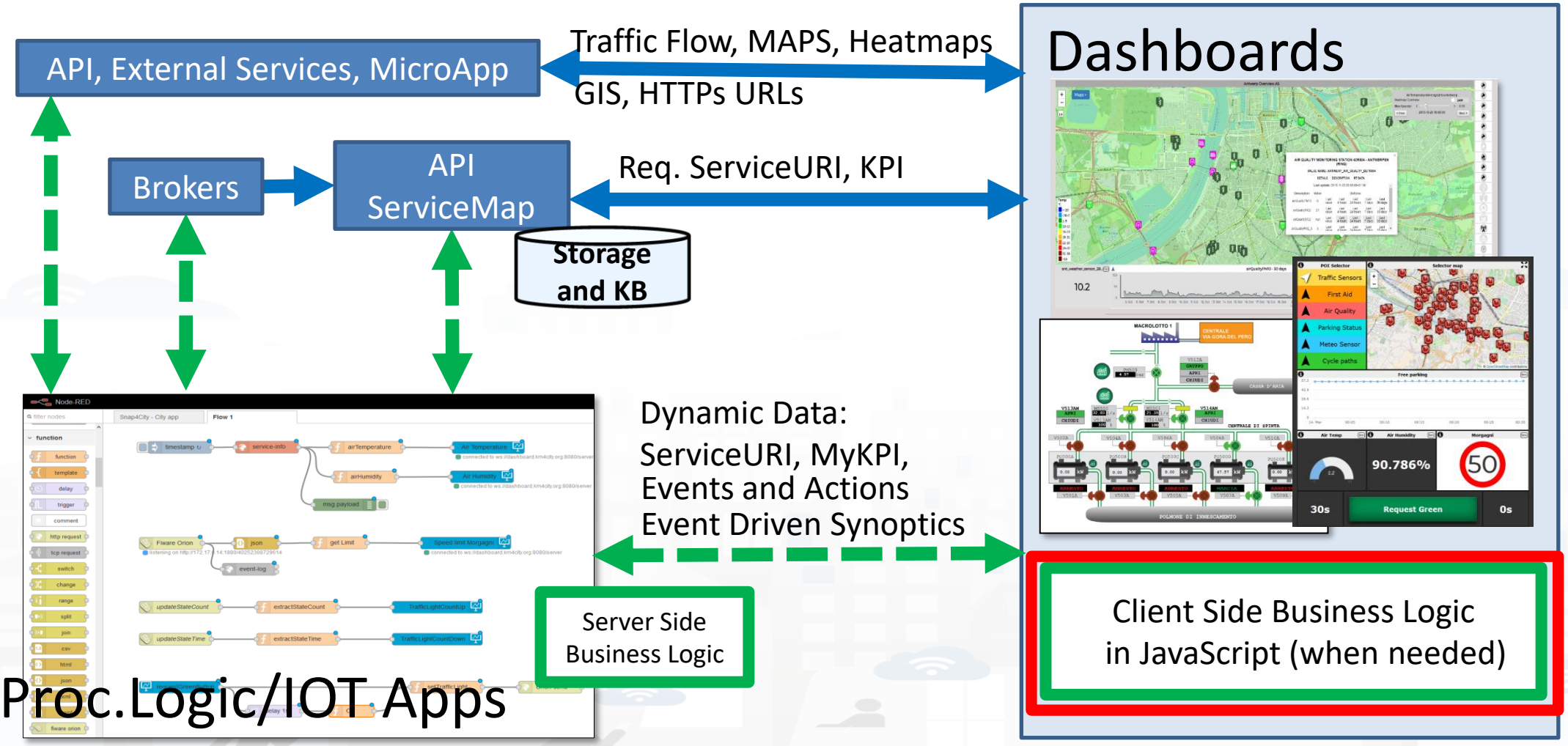
9. Jun
06:00
12:00

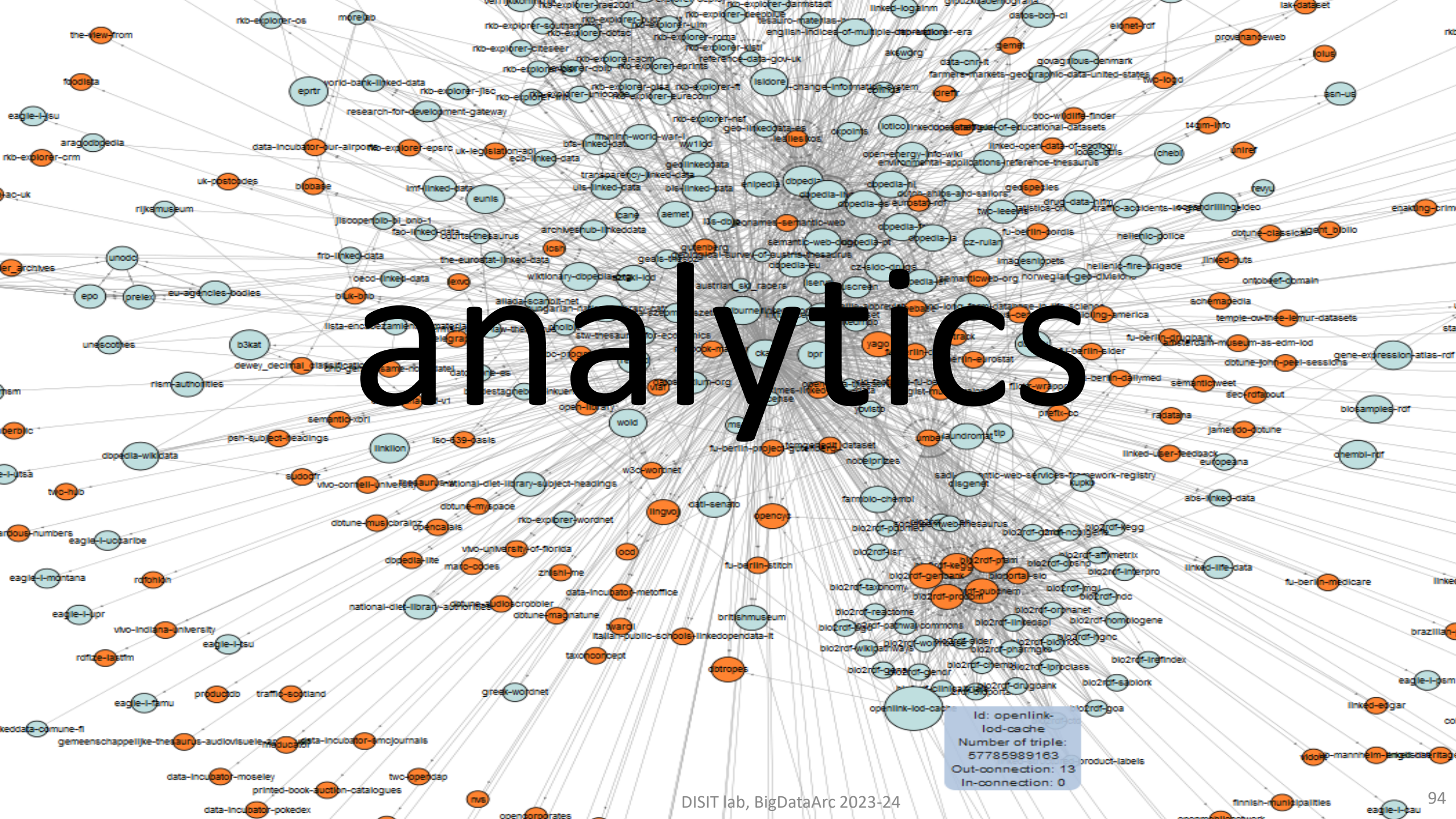
Traffic Flow Manager on multiple cities



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==

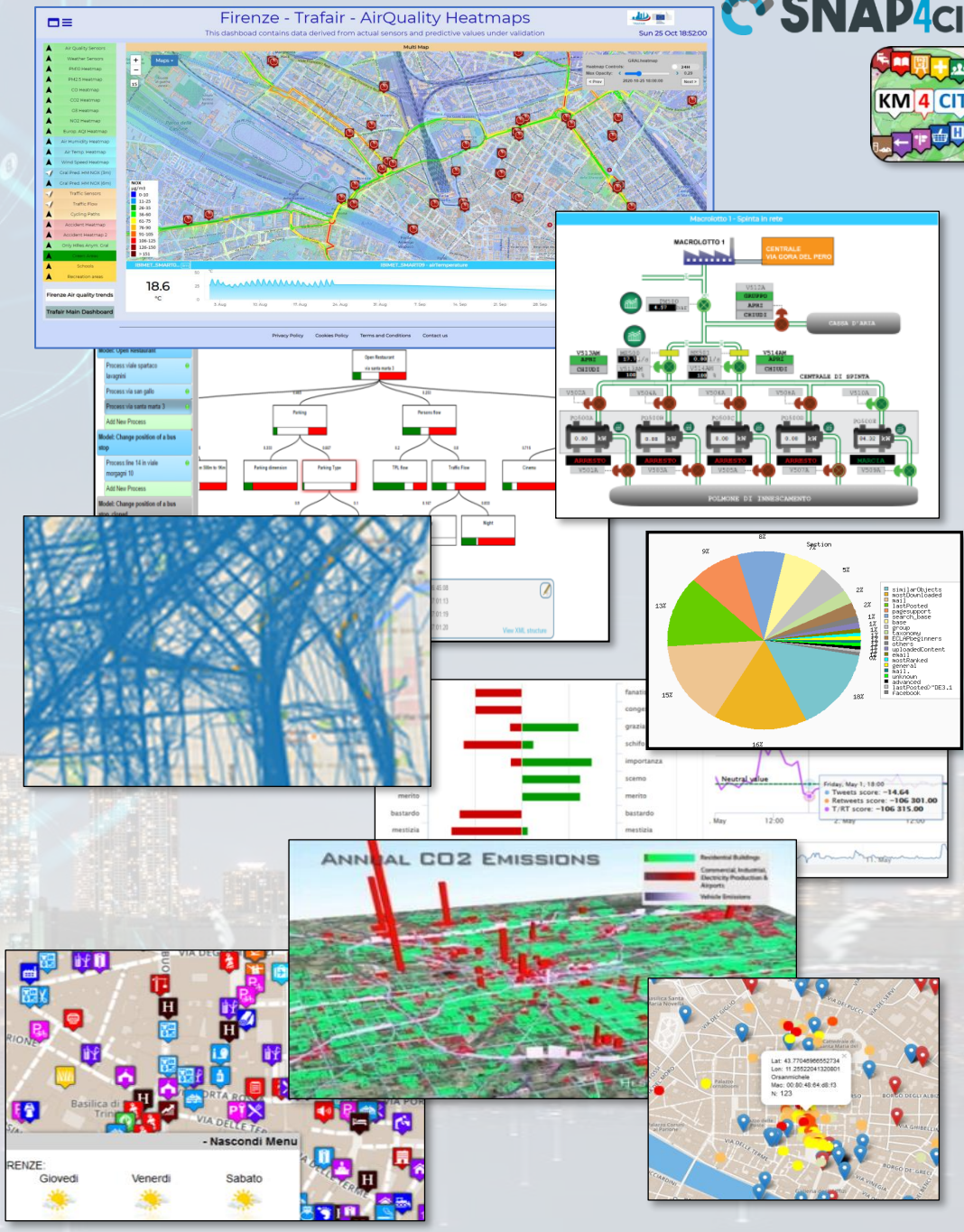
How the Dashboards exchange data




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

Data Driven Decision Support

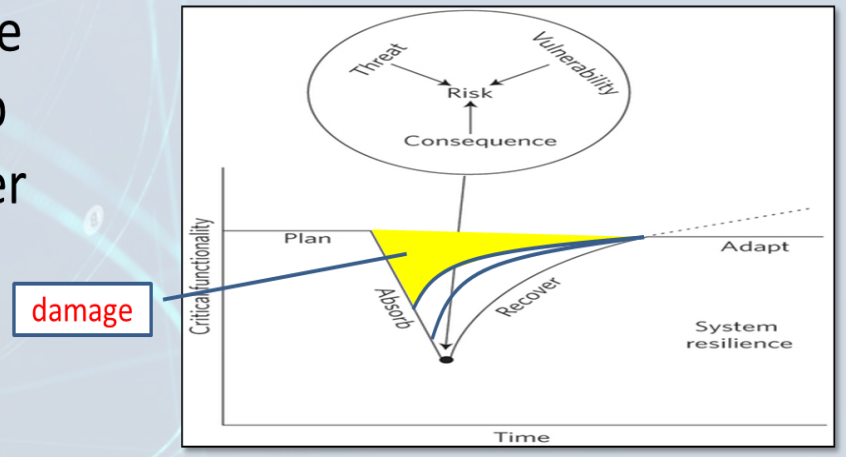
- Decision Support system
- Assessment / Strategies
- Data Rendering, visual analytics
- Data Processing
- Data aggregation, Storage, indexing
- Data Ingestion



Snap4City Analytics

- Decision support systems
- Improvement of life quality
- Sustainable Solutions
- Reduction of costs
- Risk Assessment
- Resilience

Prepare
Absorb
Recover
Adapt



Data Analytics

System Modeling and Simulation

Knowledge Models

Scenarious

Short Term **Predictions**

Long Term **Predictions**, Typical trends

Recommendations & Prescriptions

What-if Analysis

Anomaly Detection
Early Warning

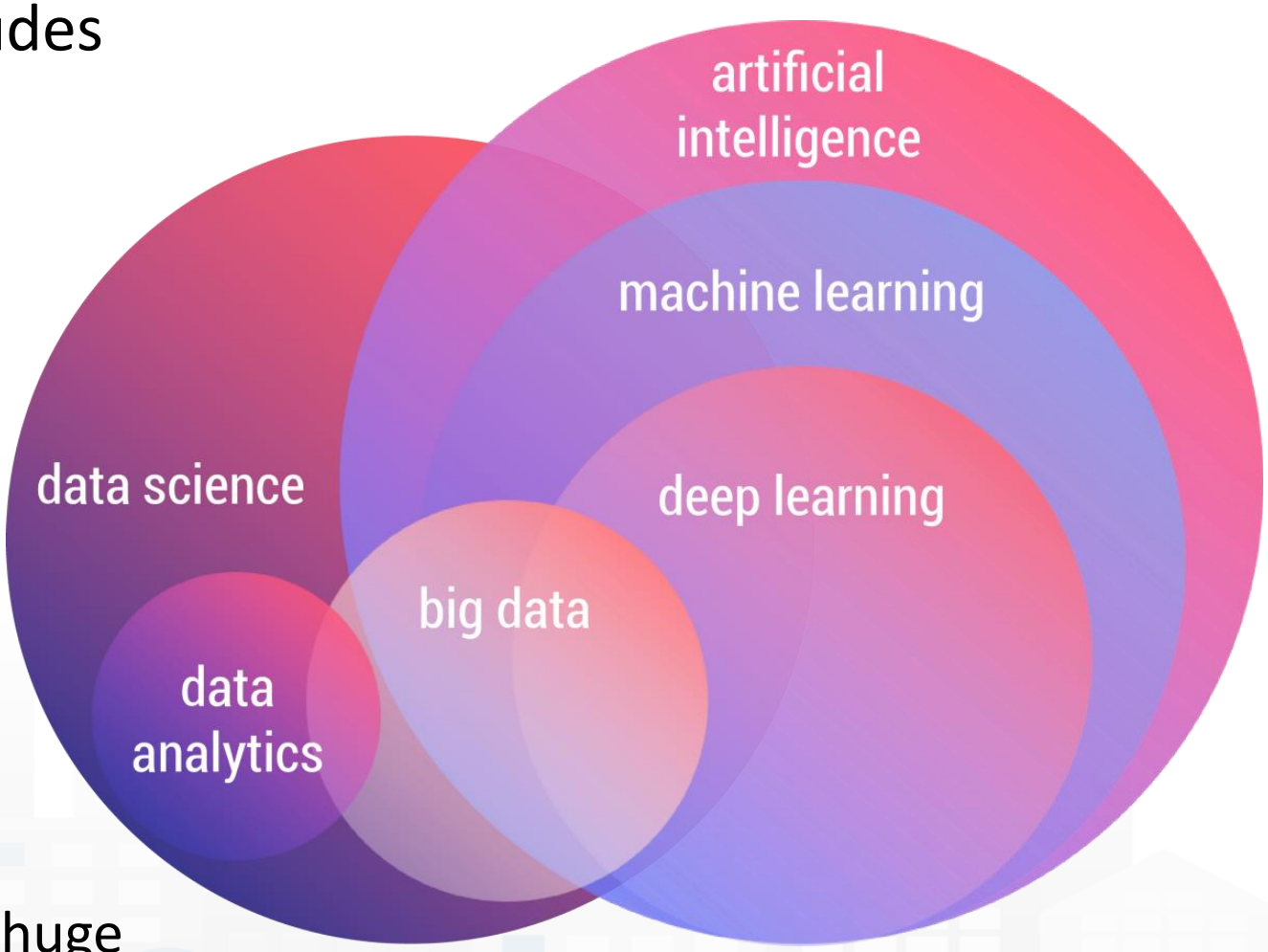
Disaster Recovery

Strategies and Plans

Partial graph

Decision Support System
targeting Indicators: Quality of Life, PUMS, SUMI, KPI, SDG, 15MinIndex,…

- **Artificial Intelligence** usually also includes
  - Code, learn and reasoning
  - Semantic computing, Knowledge Bases
  - Neuro-symbolic reasoning
  - Decision Support Systems
  - Problem solving
- **Machine Learning** usually includes
  - Learn without coding
  - Predictions, decisions (classifications)
  - Supervised or not
  - NLP, vision, pattern recognition
- **Deep Learning** usually includes
  - Capability to learn complex patterns on huge amount of data
  - Specialized ML solutions



Available DA / AI Solutions on Snap4City

- Mobility and Transport
- Environment, Weather, Waste, Water
- City Users Behaviour and Social analysis
- Energy and Control, Security, …..
- High Level Decision Support Solutions
  - Management Strategies
  - Resilience and Risks Analysis
- Low level Techniques

https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

https://www.snap4city.org/download/video/course/da/

- ***15 Minute City Index:***
  - 13 differente subindexes

- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.

- Industry 4.0 integrated solutions
- Decisions Support Systems
- Process optimization
- Predictive maintenance

- Smart City infrastructure: monitoring and resilience
- Effective and Low cost smart solutions
- What-if analysis, Simulations

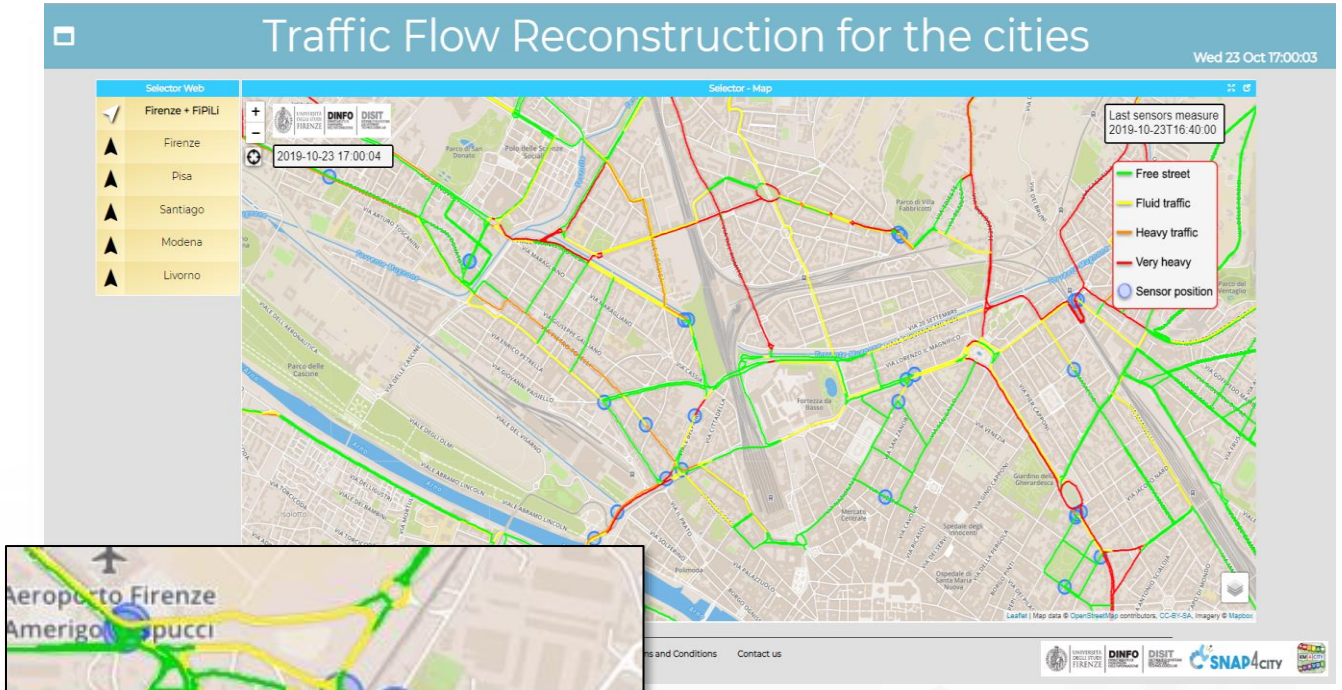
- Monitoring resource consuption,
- business intelligence tools for decision makers,
- Reduction production costs

- Monitoring and Predictions for
  - NO2, NOX, CO2, Traffic flow, pollutant, landslide, etc.
  - Traffic flow reconstruction

- Shortening justice time
- Predictiction of mediation proneness
- Ethical Explainable Artificial Intelligence

Why Dense Traffic Flow Reconstruction ?

- Making decision on mobility and transport solutions → what if analysis
- Controlling pollution
- Dynamic Routing for Firebrigade, Ambulances, general public
- Planning Public Transportation routing



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

Big Data & Analytics

- **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

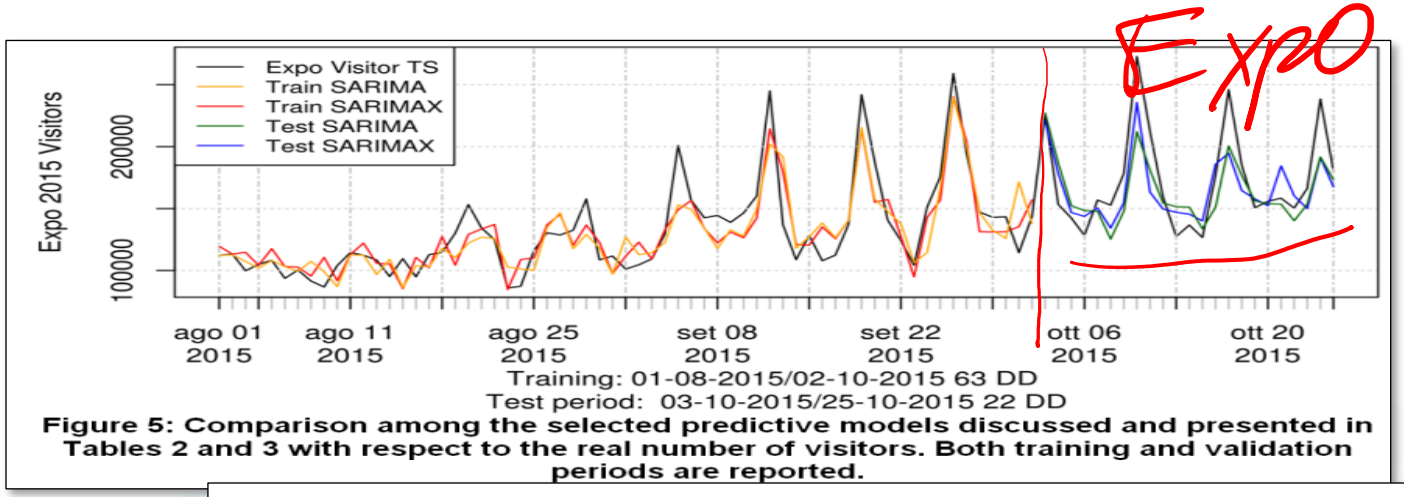
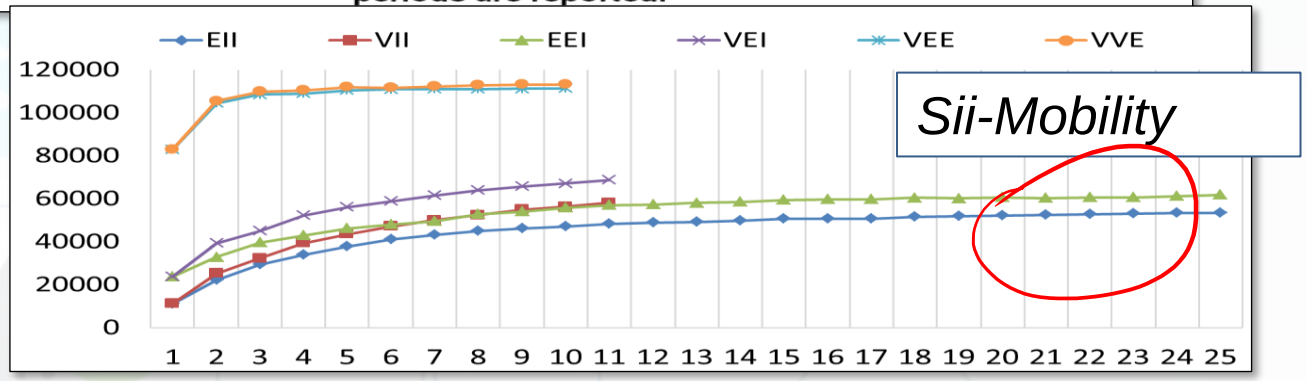
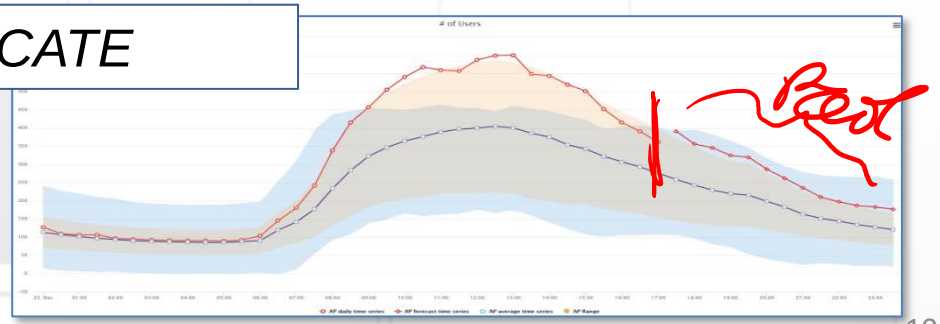


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.



Sii-Mobility

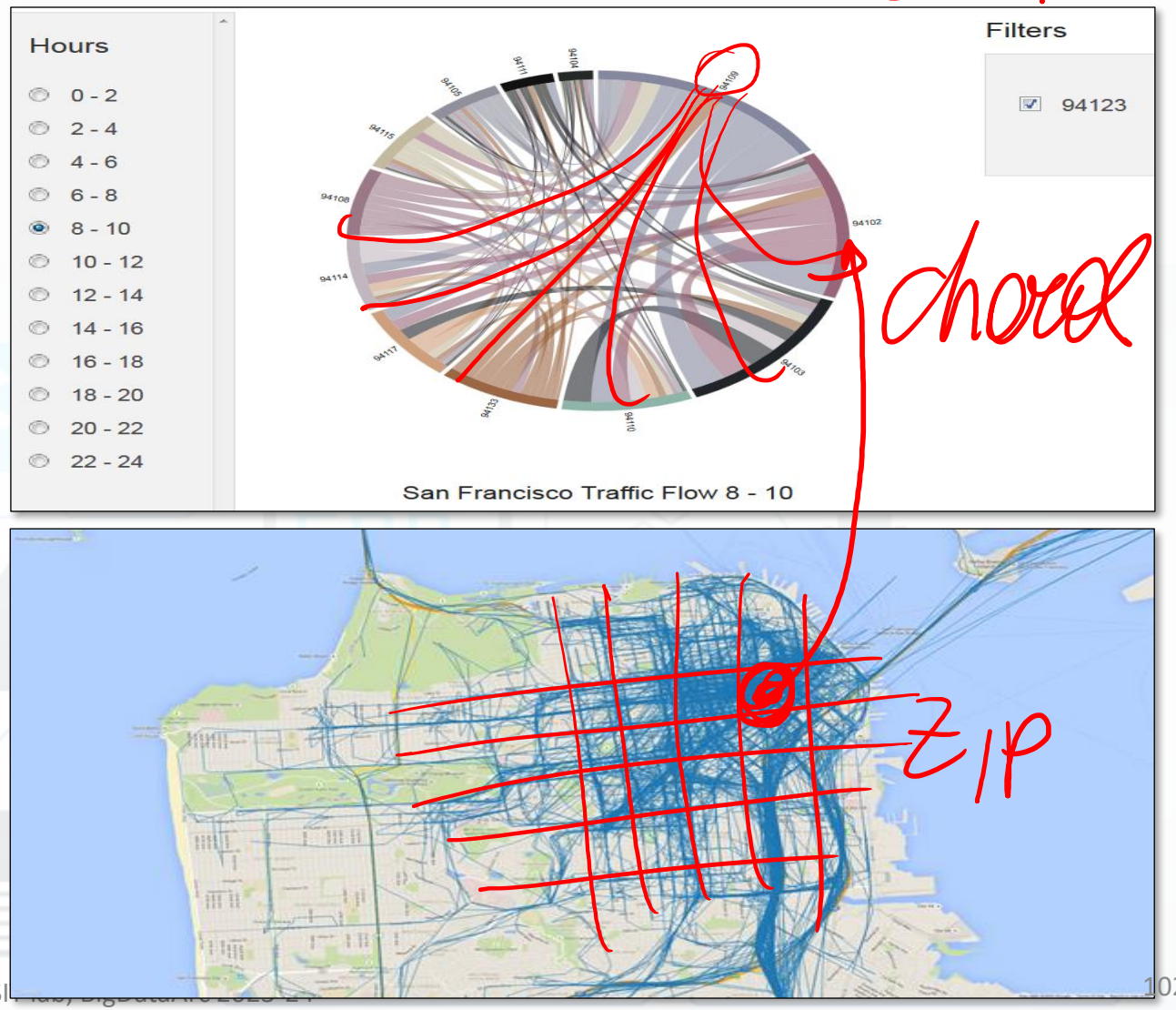
REPLICATE



Traffic and People Flow Assessment

http://www.disit.org/6694

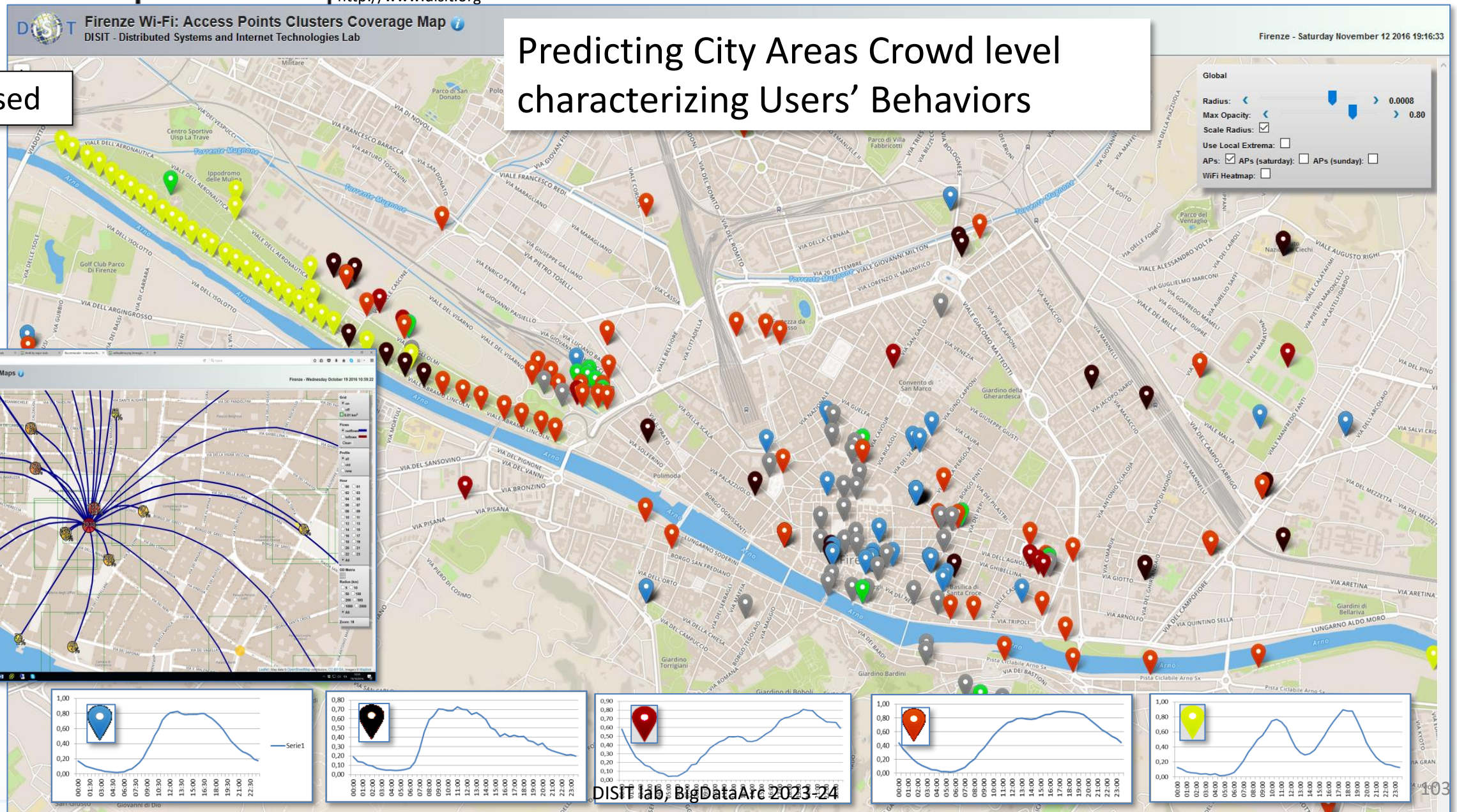
- **Origin Destination Matrix**
  - Specific Sensors, vehicle Kits, mobile App, Wi-Fi Access Points, etc.
- **Assess people and traffic flows to**
  - improve services
  - predict critical conditions on Crit. Infra.
  - take real time decisions and sending messages in push to population
  - Increase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



Characterizing City Areas

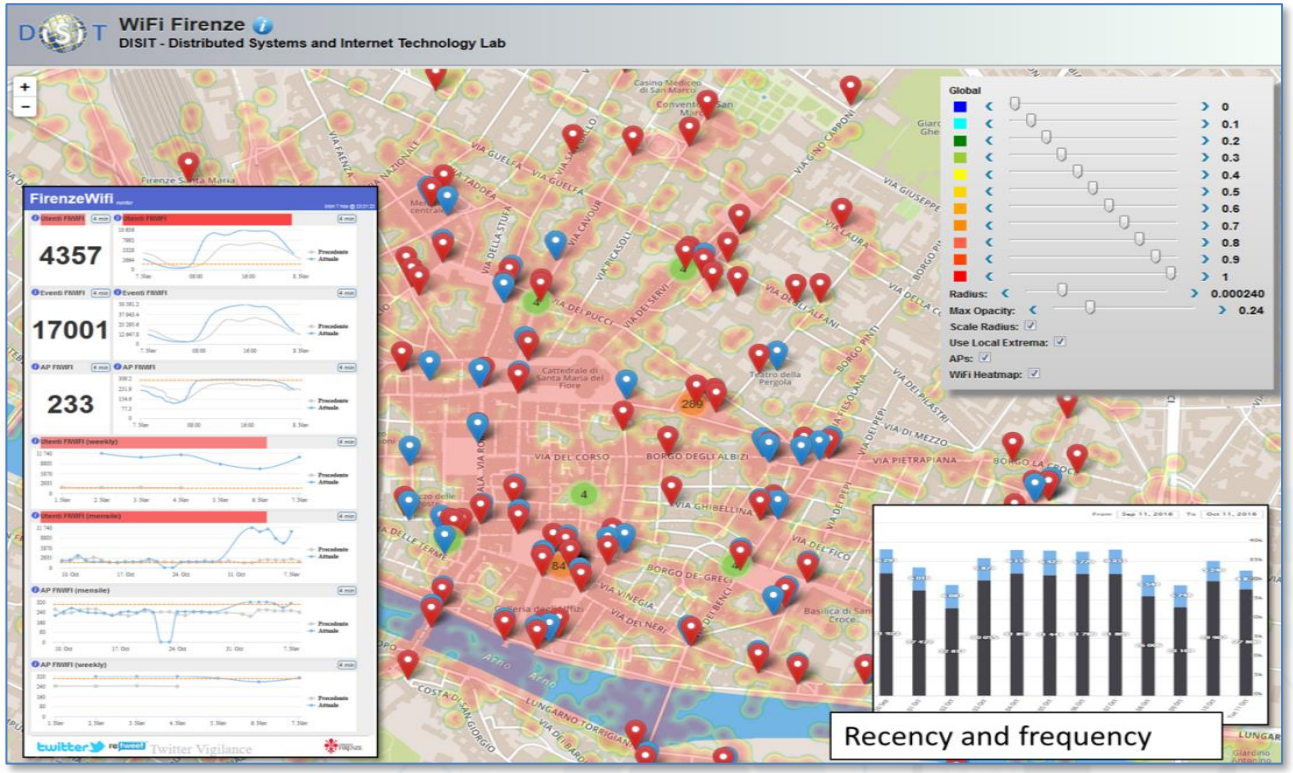
Wi-Fi based

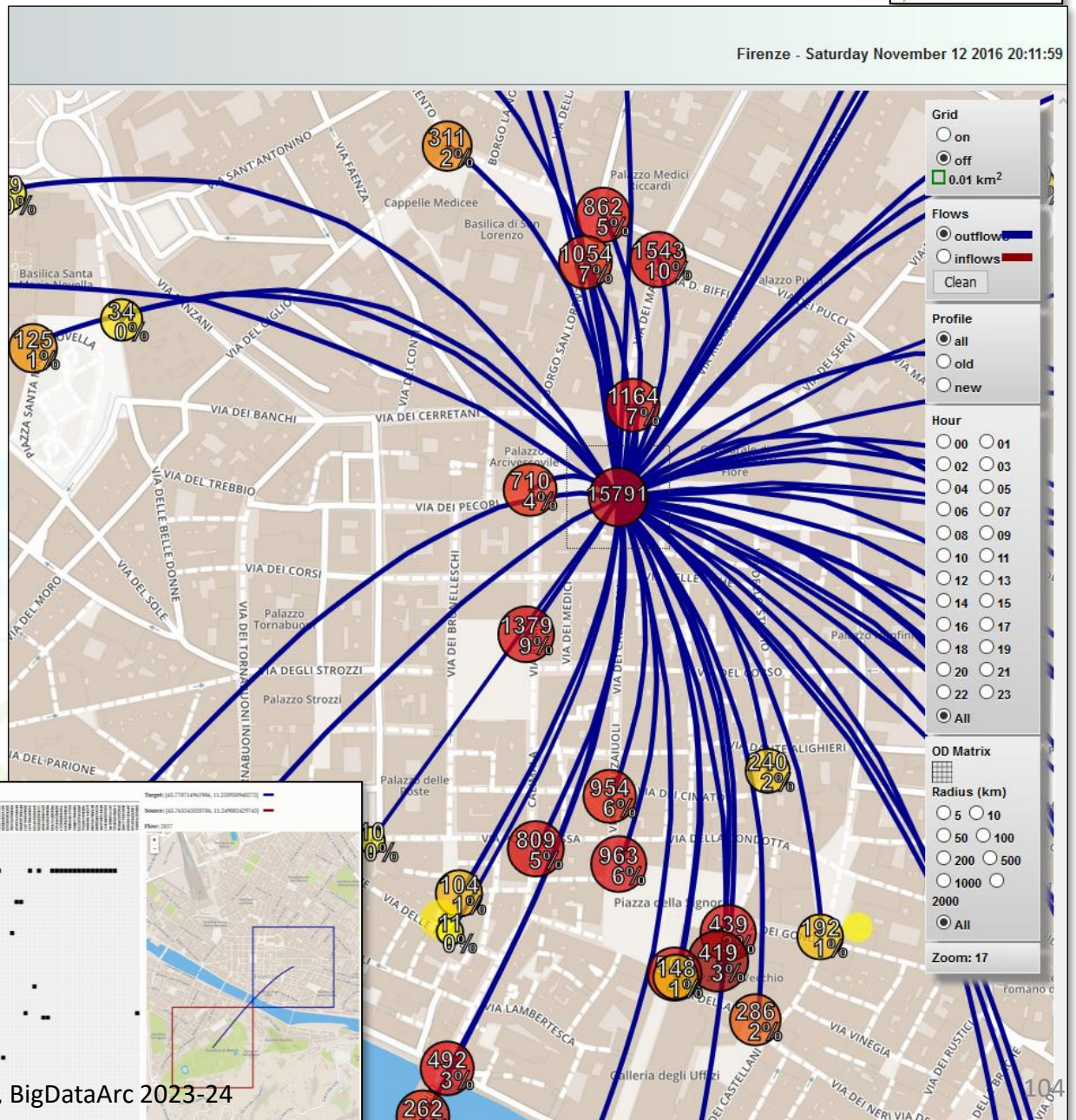
Predicting City Areas Crowd level characterizing Users' Behaviors

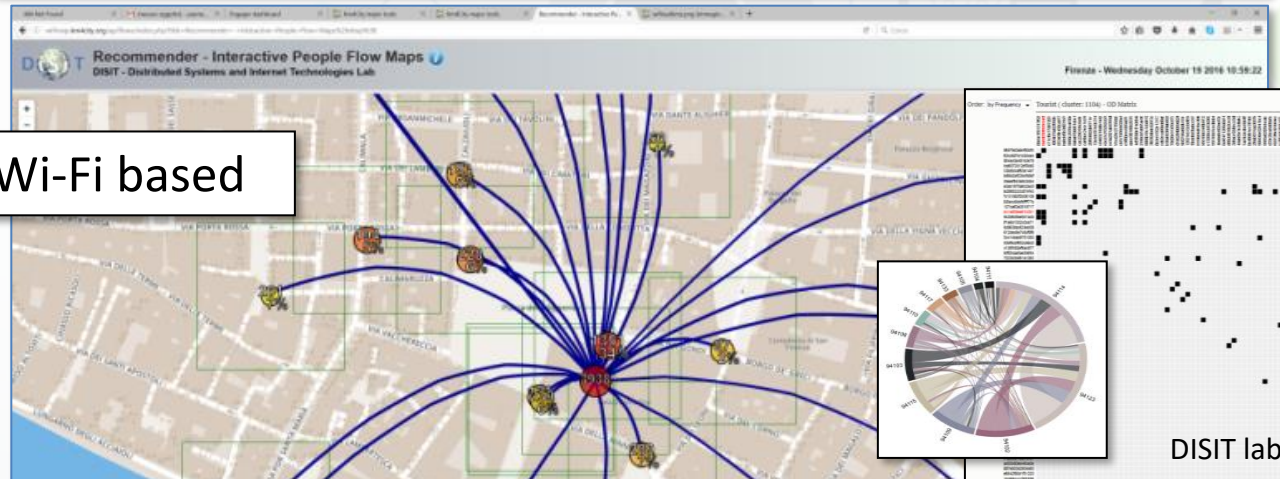


Origin Destination Matrix Estimation

http://www.disit.org

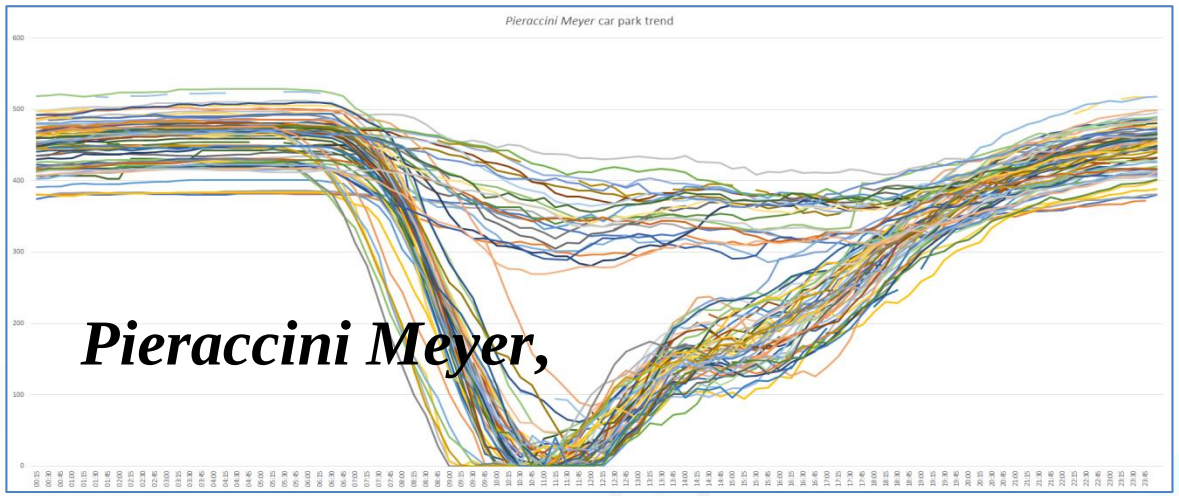


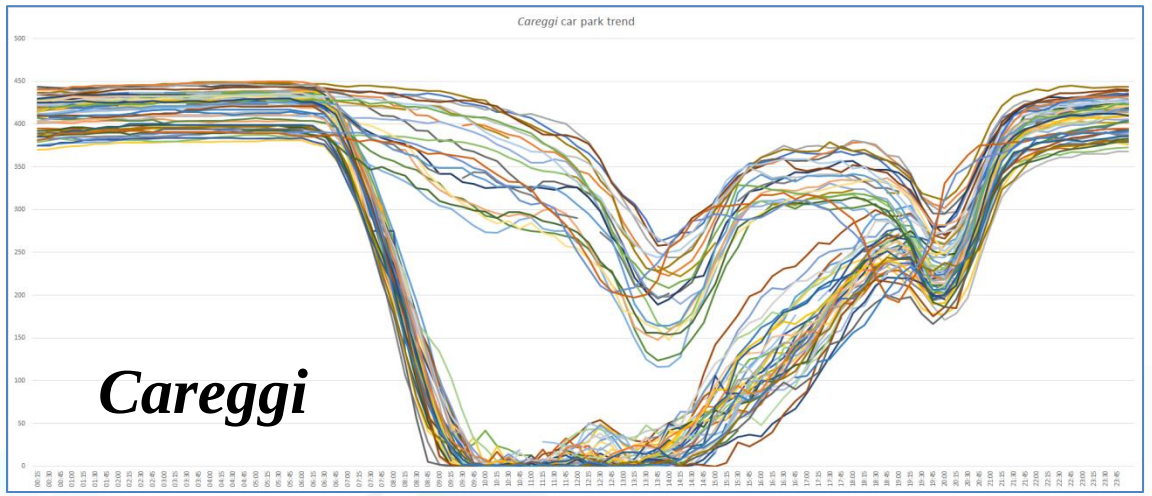


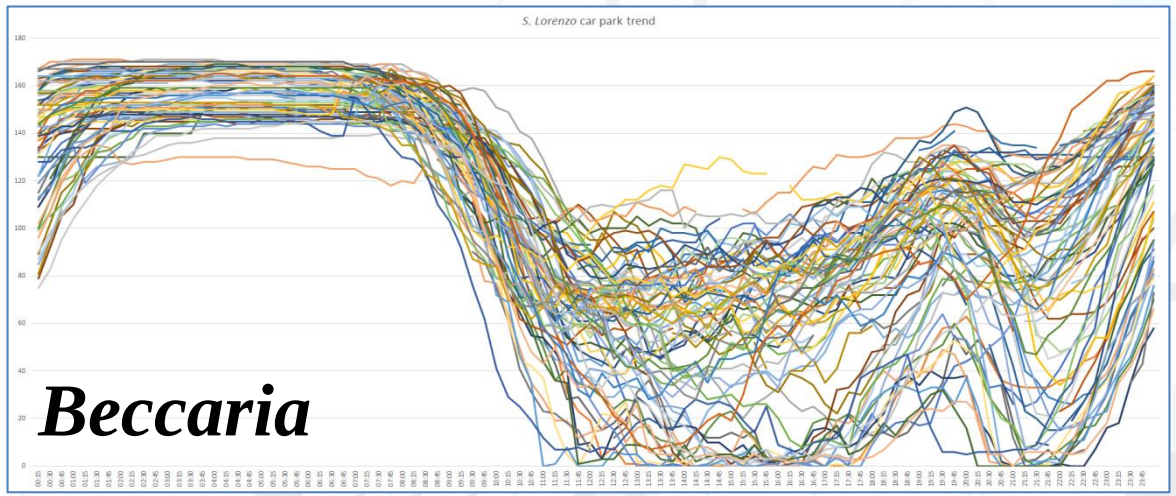


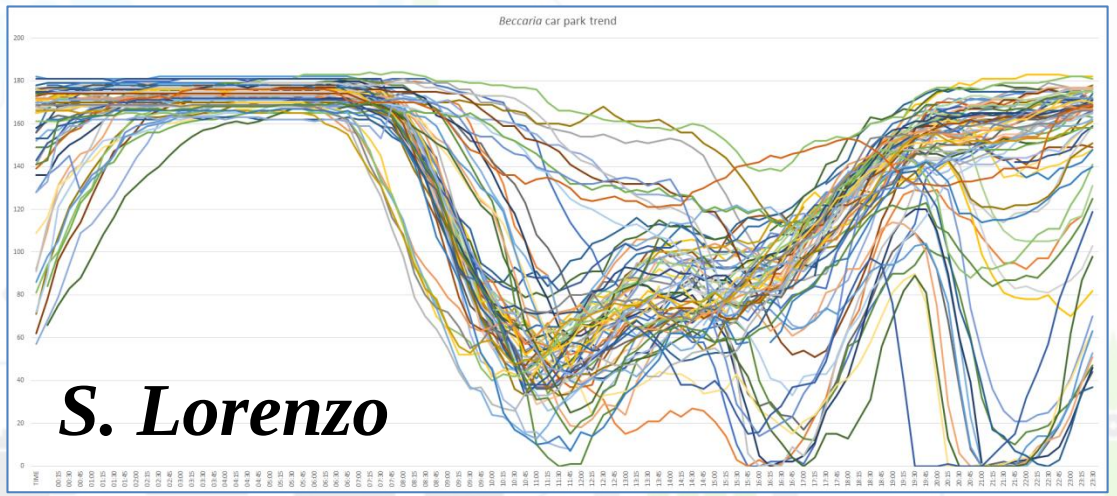
Wi-Fi based

Free Parking space trends



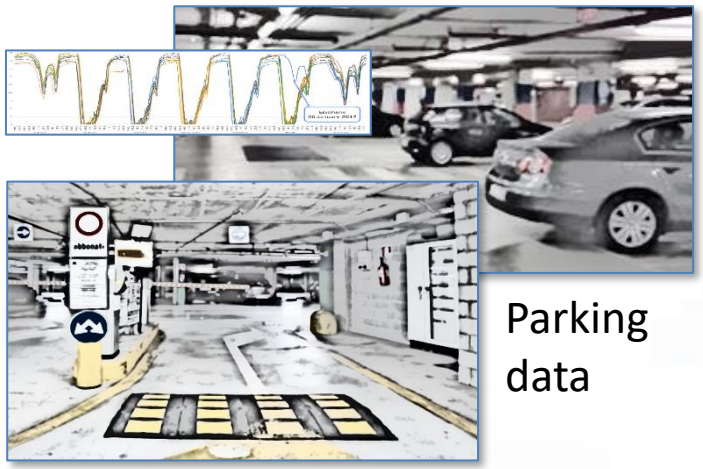




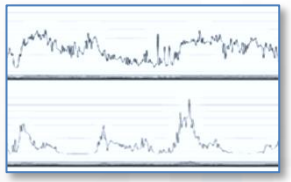


12 parking areas in Florence

Deep Learning AI to surely Park!

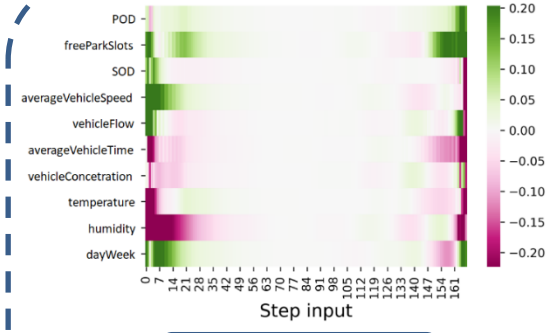


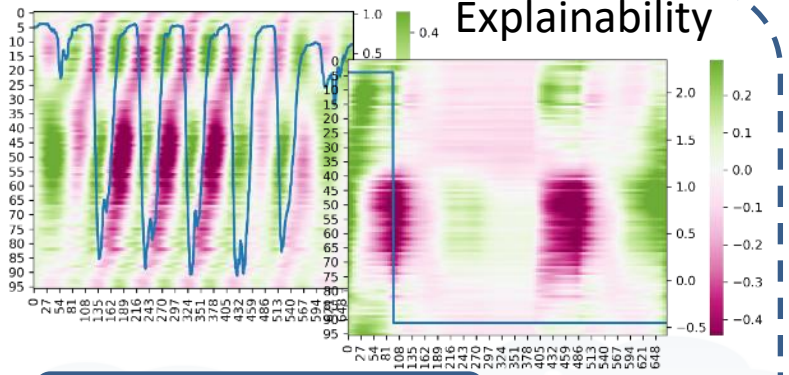
Parking data



Traffic sensors data

Weather Features

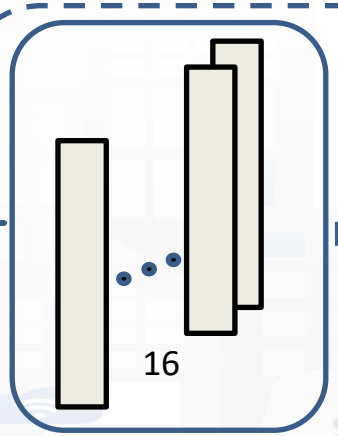


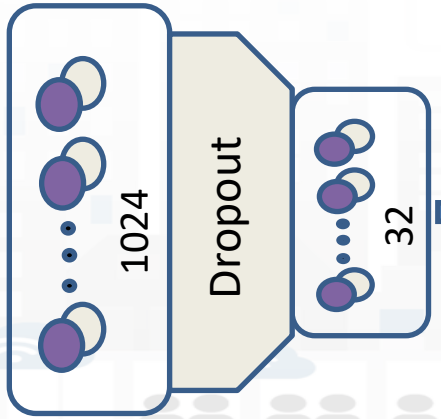


Explainability

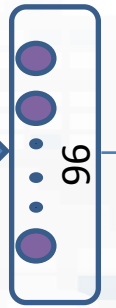
Gradient

Integrated Gradient

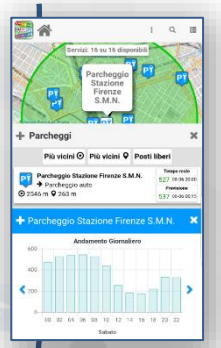




Dropout

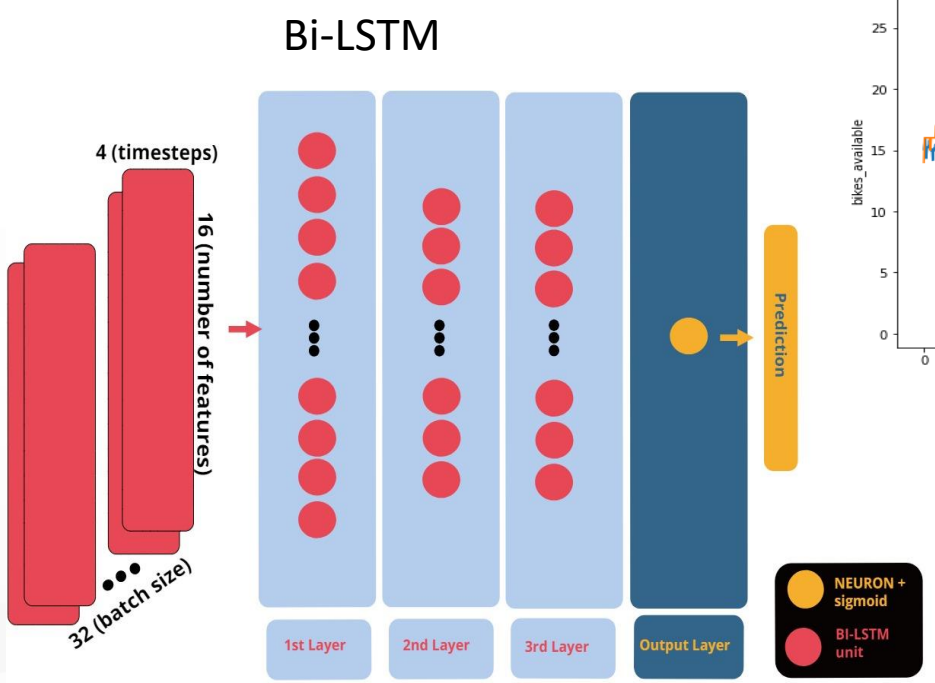


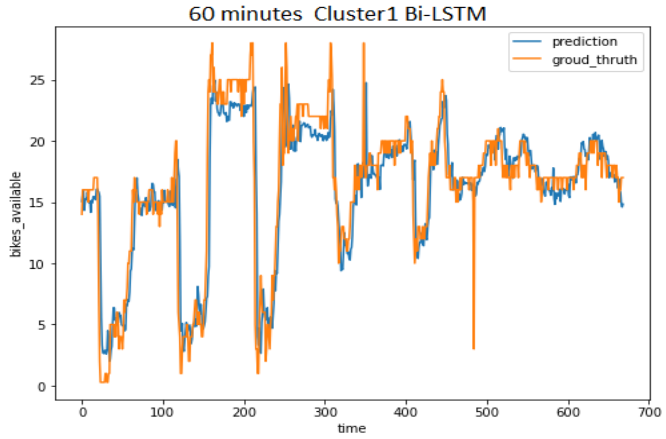
Multi-step Predictions



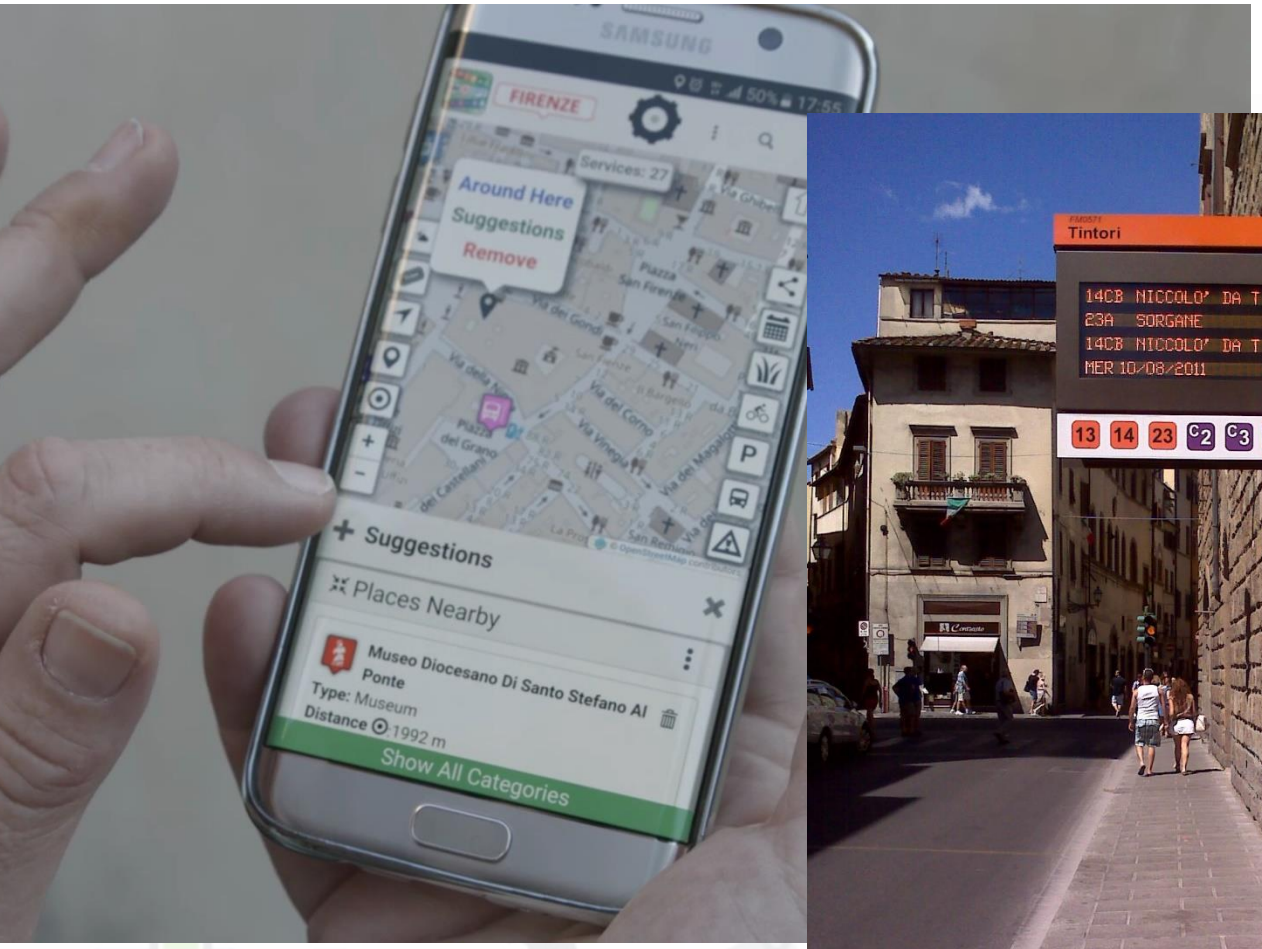
Conv1D+AvPooling1D BI-LSTM BI-LSTM Dense

Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations

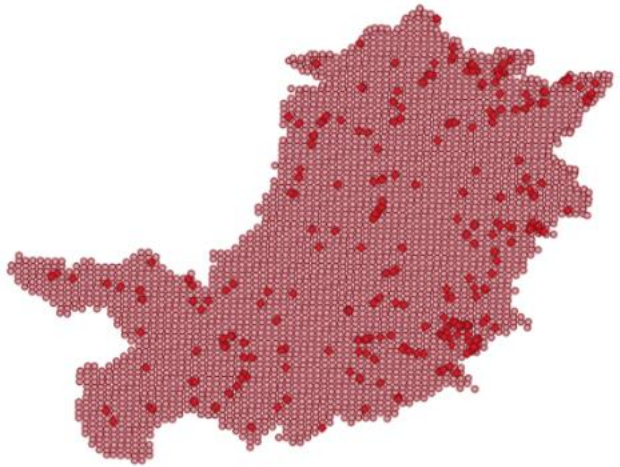


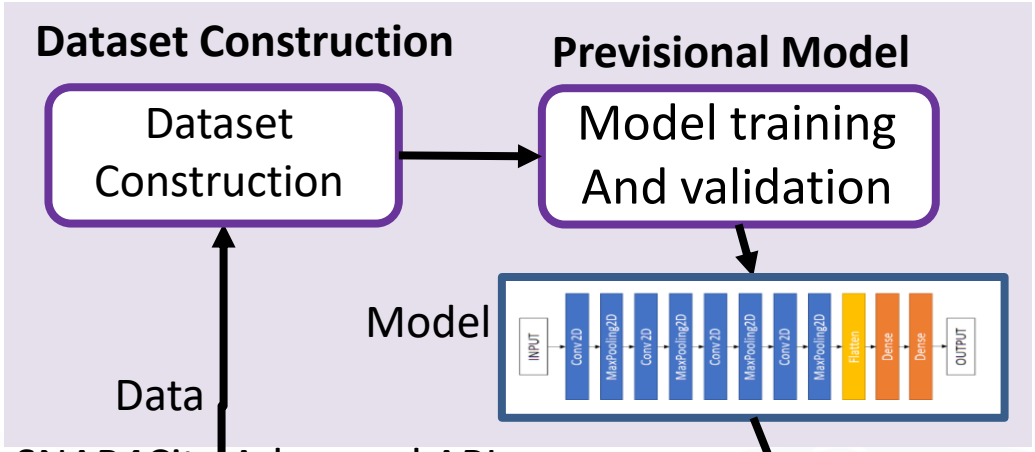


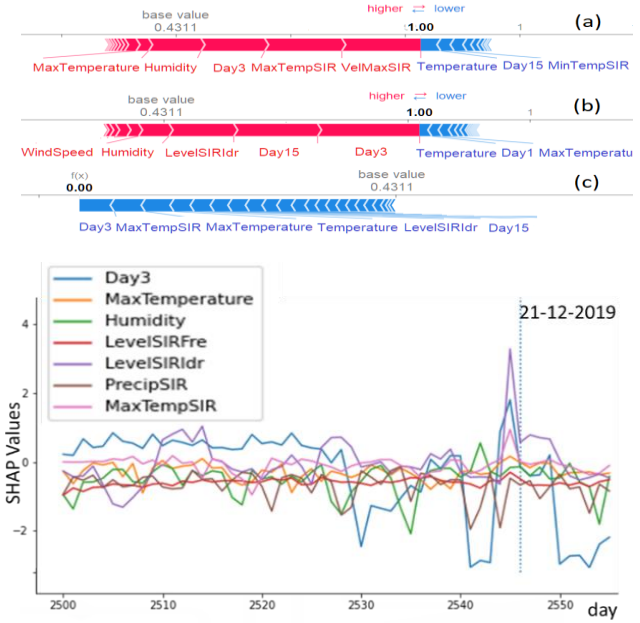
E. Collini, P. Nesi and G. Pantaleo, "Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations," in *IEEE Access*, vol. 9, pp. 124337-124347, 2021, doi: 10.1109/ACCESS.2021.3110794.
https://ieeexplore.ieee.org/abstract/document/9530580

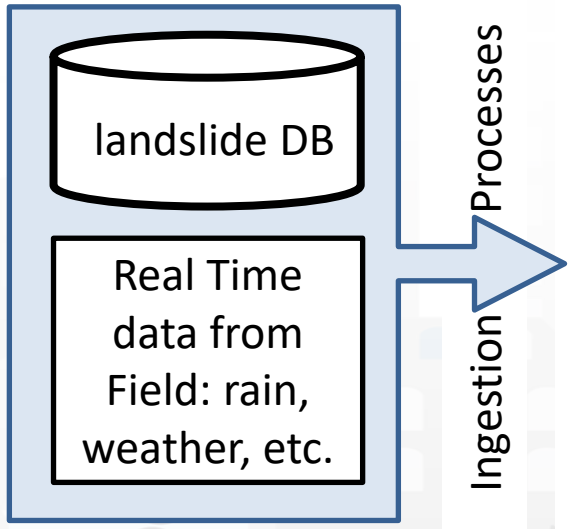


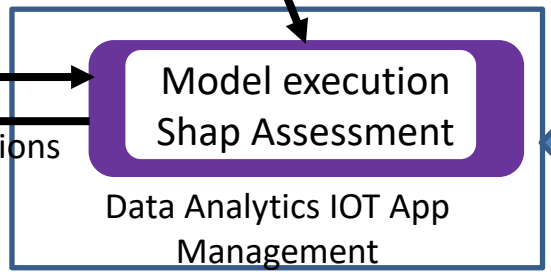
Predicting Land slides

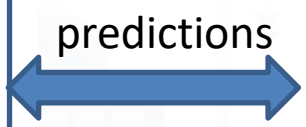










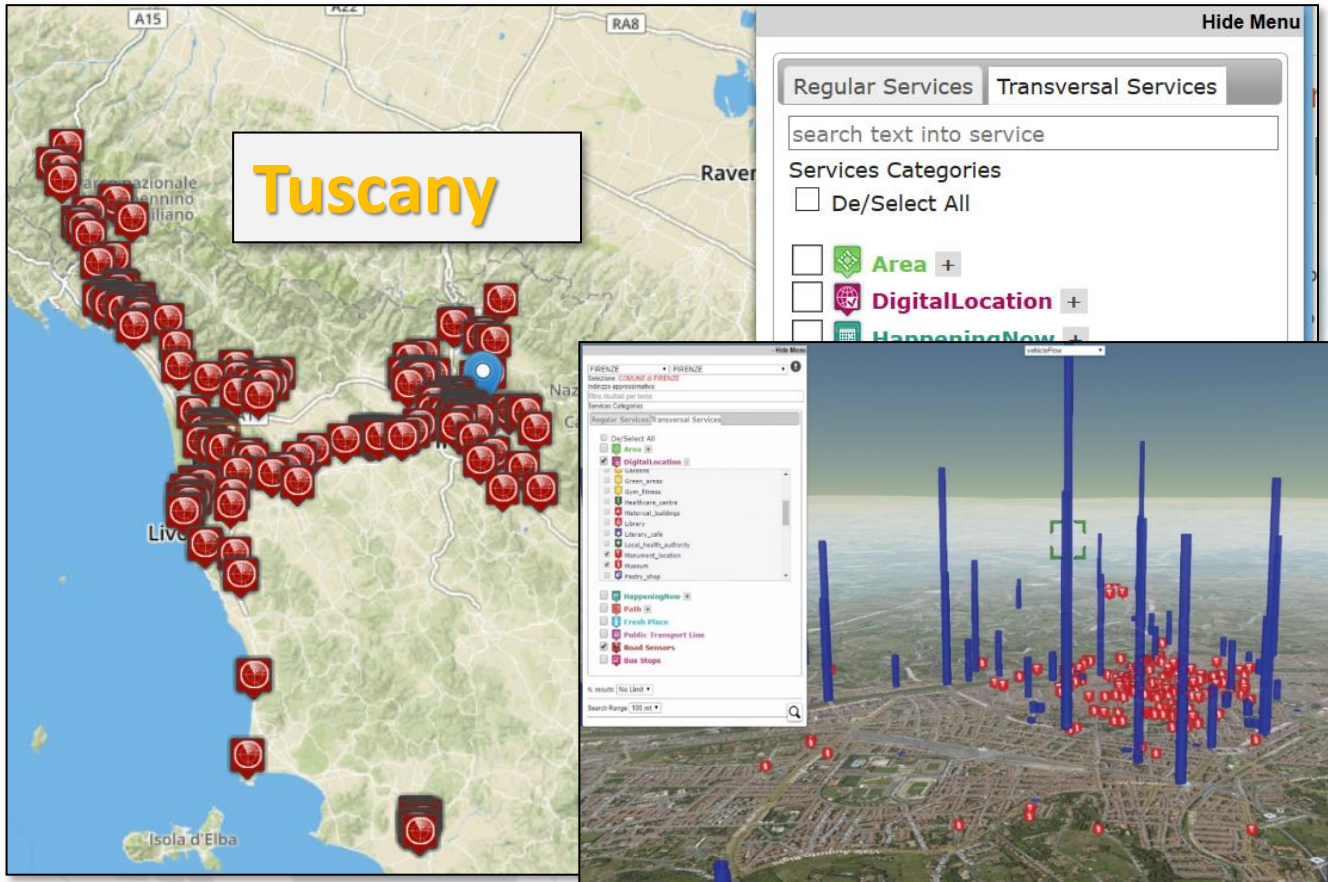


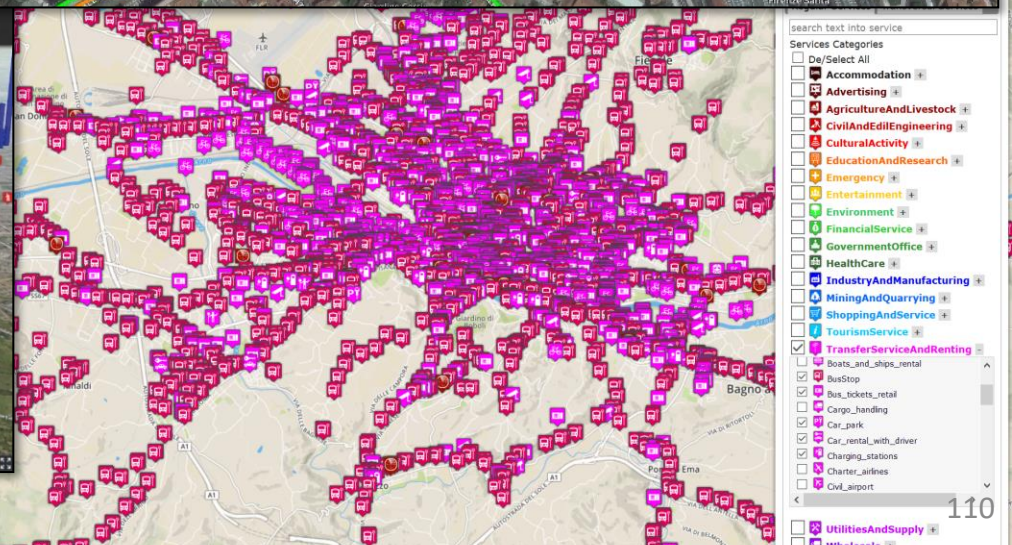
Snap4City Servers and Tools: Dashboard manager, Heatmap manager, GeoServer, Smart City API.

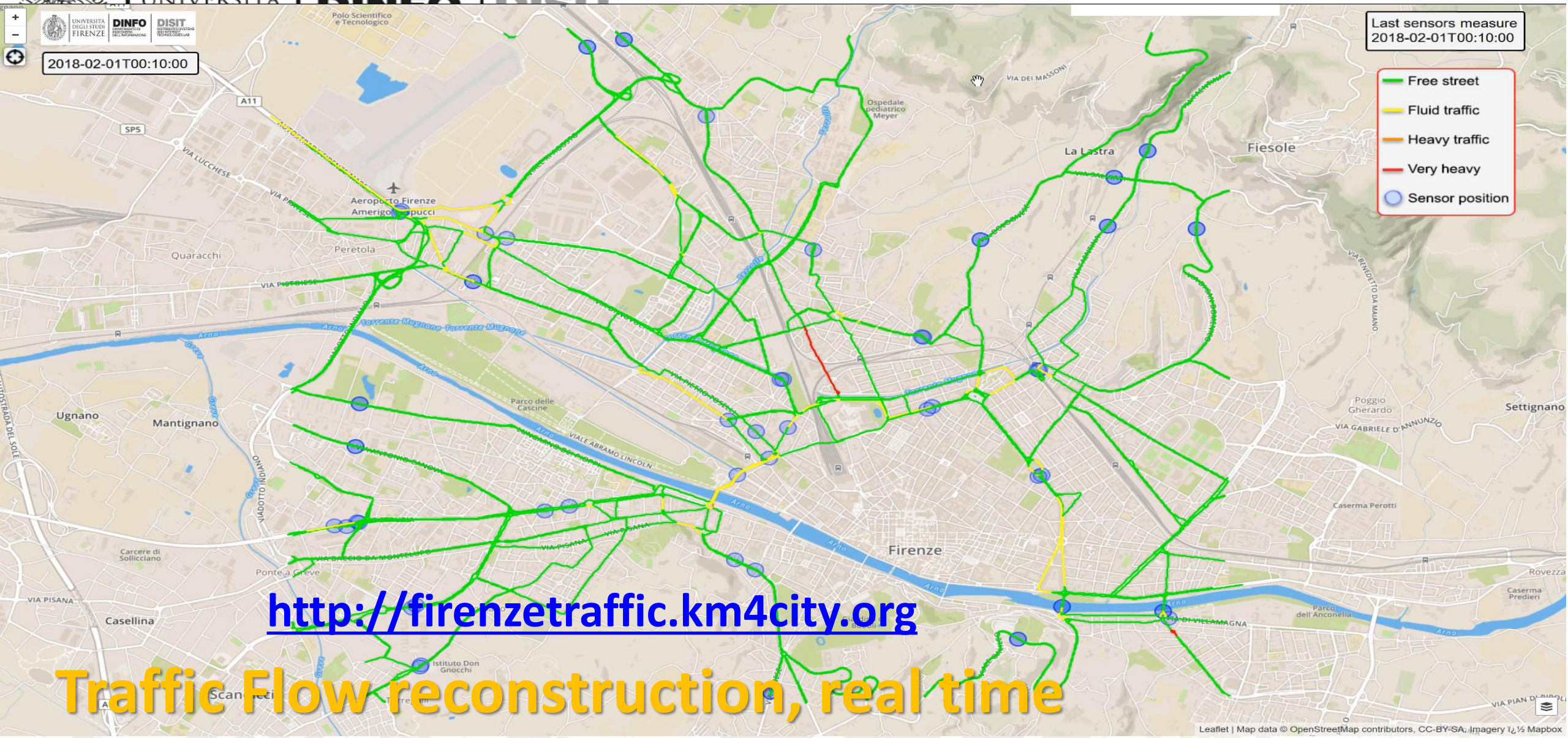
E. Collini, L. A. I. Palesi, P. Nesi, G. Pantaleo, N. Nocentini and A. Rosi, "Predicting and Understanding Landslide Events with Explainable AI," in *IEEE Access*, doi: 10.1109/ACCESS.2022.3158328.
https://ieeexplore.ieee.org/abstract/document/9732490

Traffic Flow Tools

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







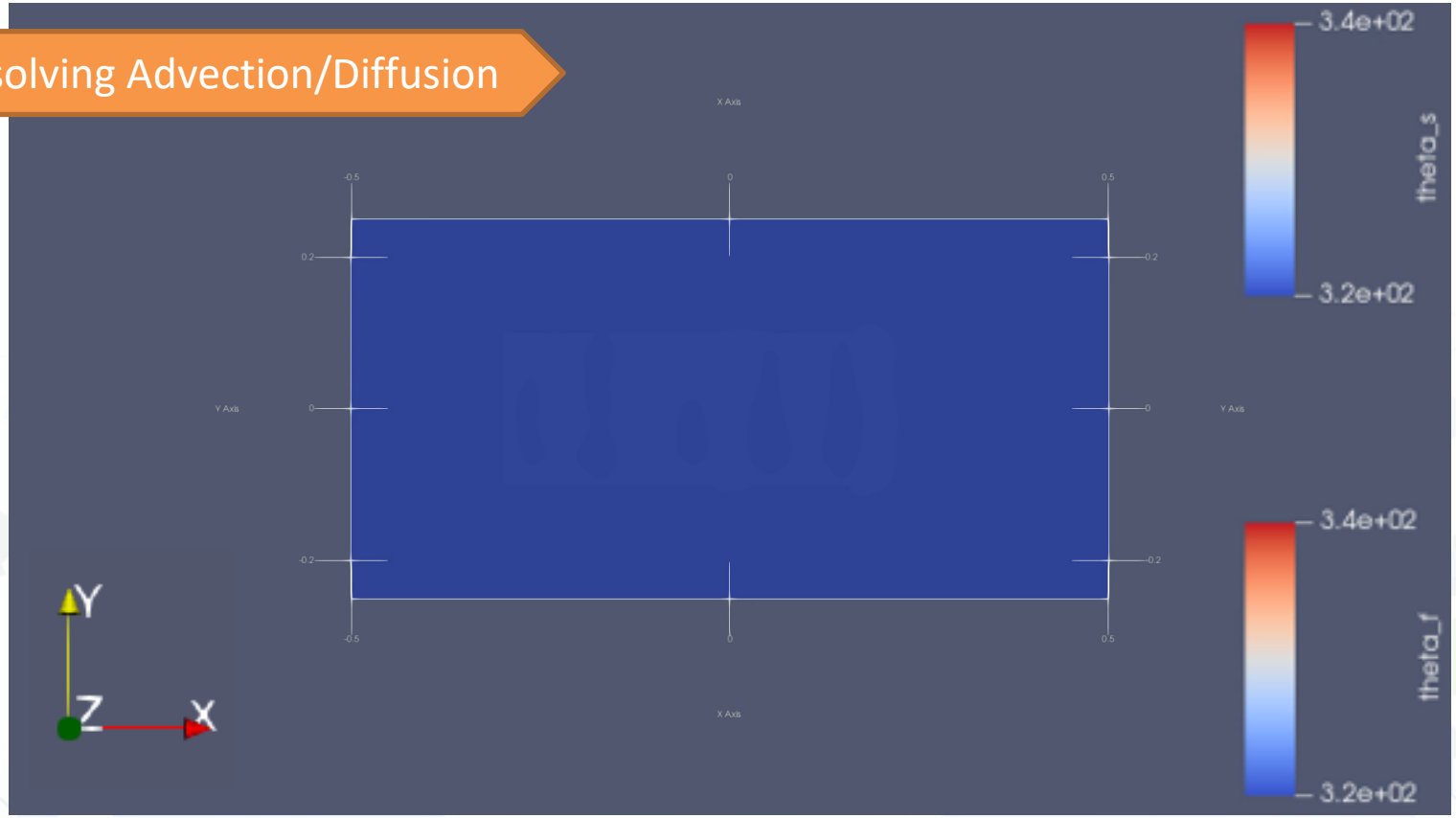
http://firenzetraffic.km4city.org

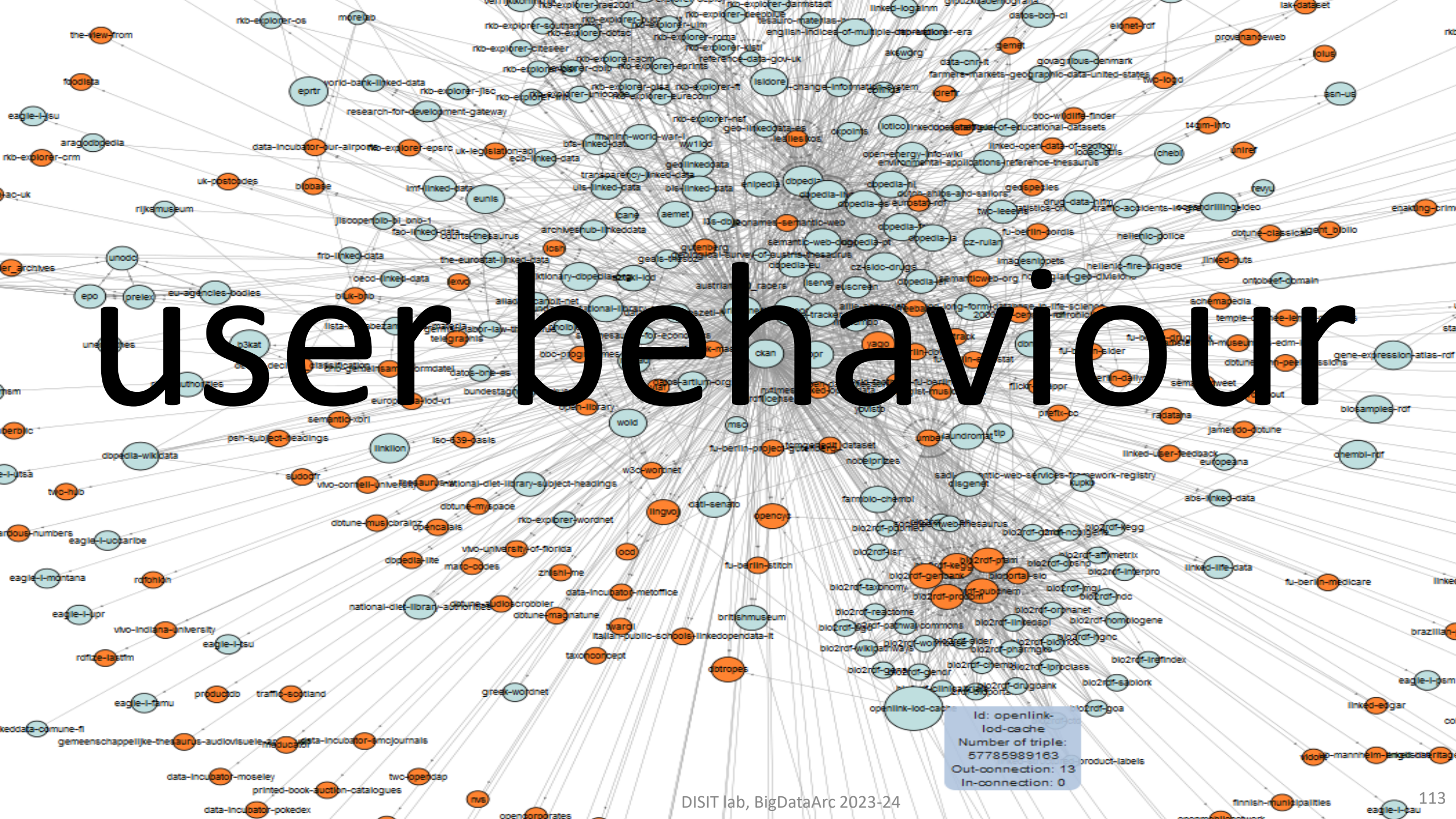
Traffic Flow reconstruction, real time

Physics-informed neural networks (PINN)

Solve complex fluid-dynamic problems based on **partial differential equation (PDE)** using neural networks

Thermal transfer solving Advection/Diffusion




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

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

7 AFFORDABLE AND CLEAN ENERGY

11 SUSTAINABLE CITIES AND COMMUNITIES

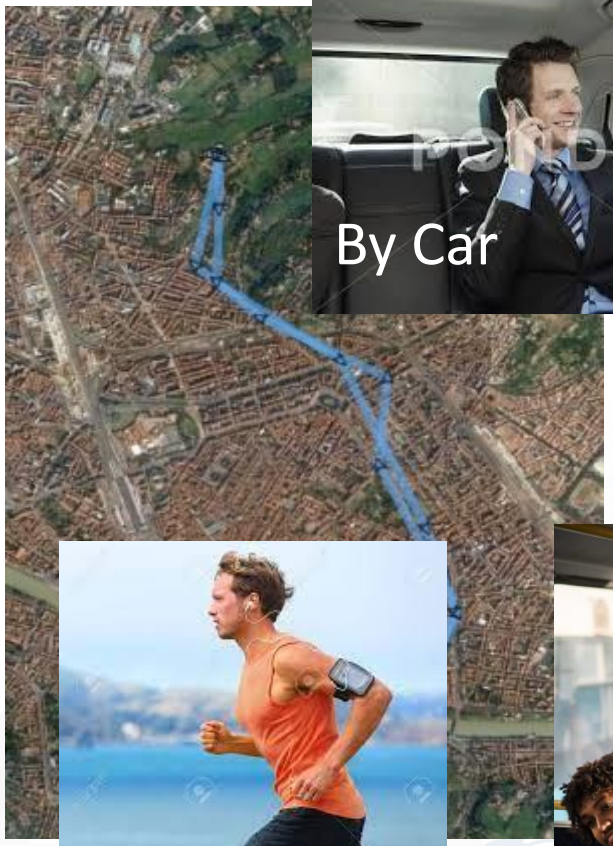
13 CLIMATE ACTION

SNAP4CITY

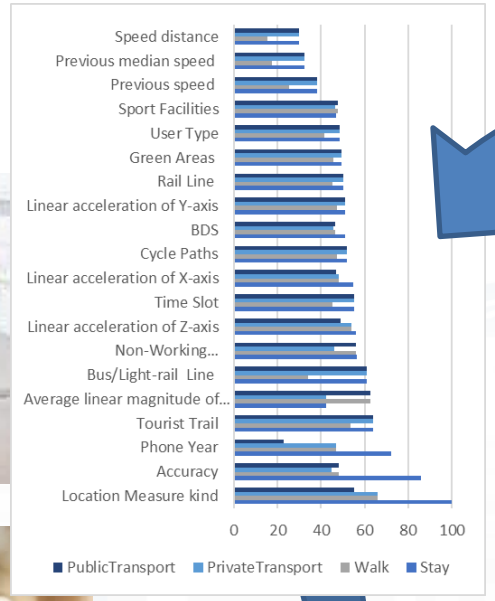
KM4CITY

To propose suggestions and Engage city user

we need to know how they are moving

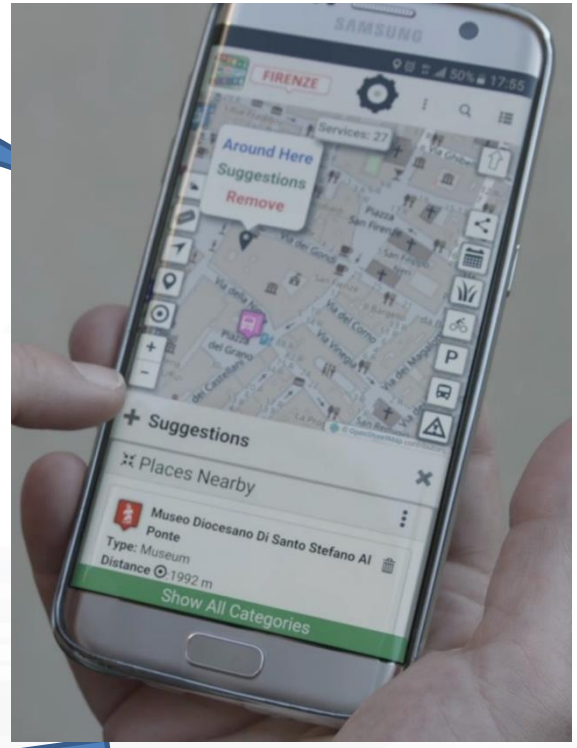


Walk

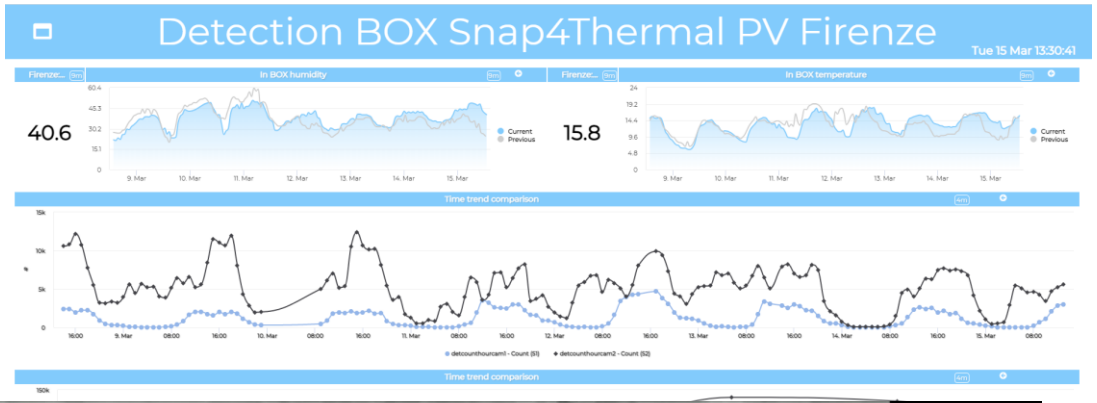


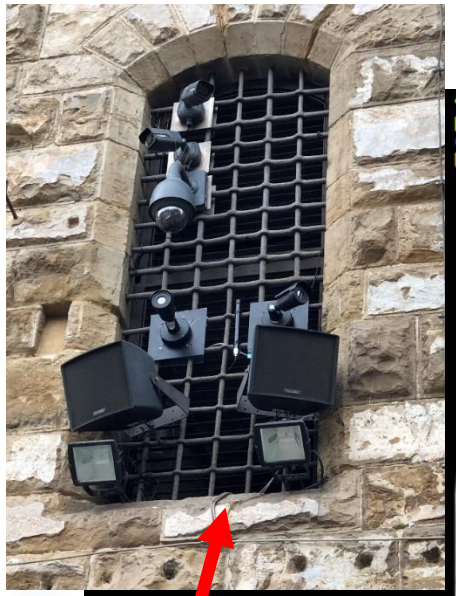
Artificial Intelligence Classification

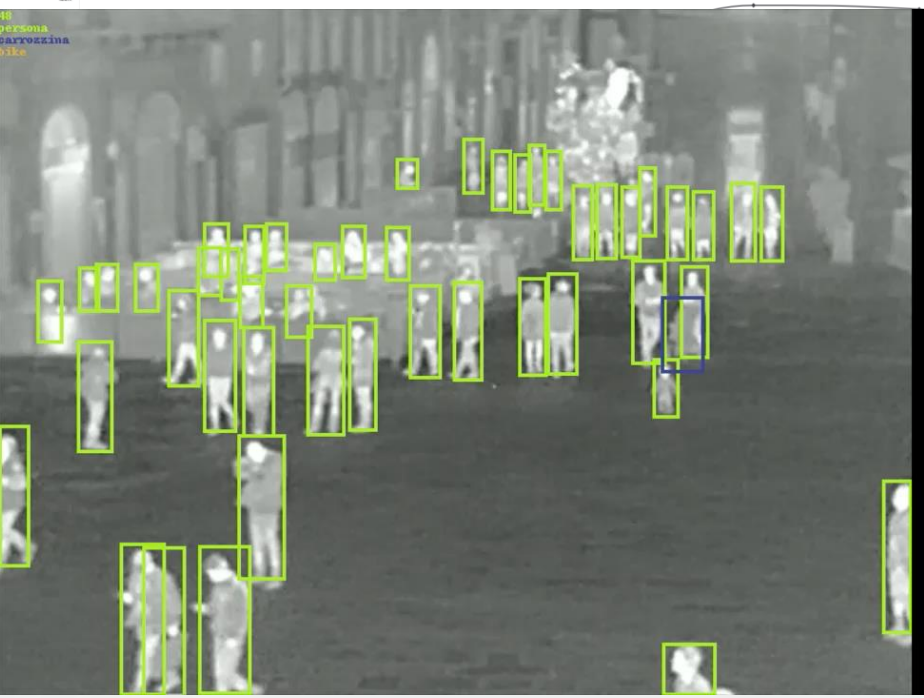
Suggestions

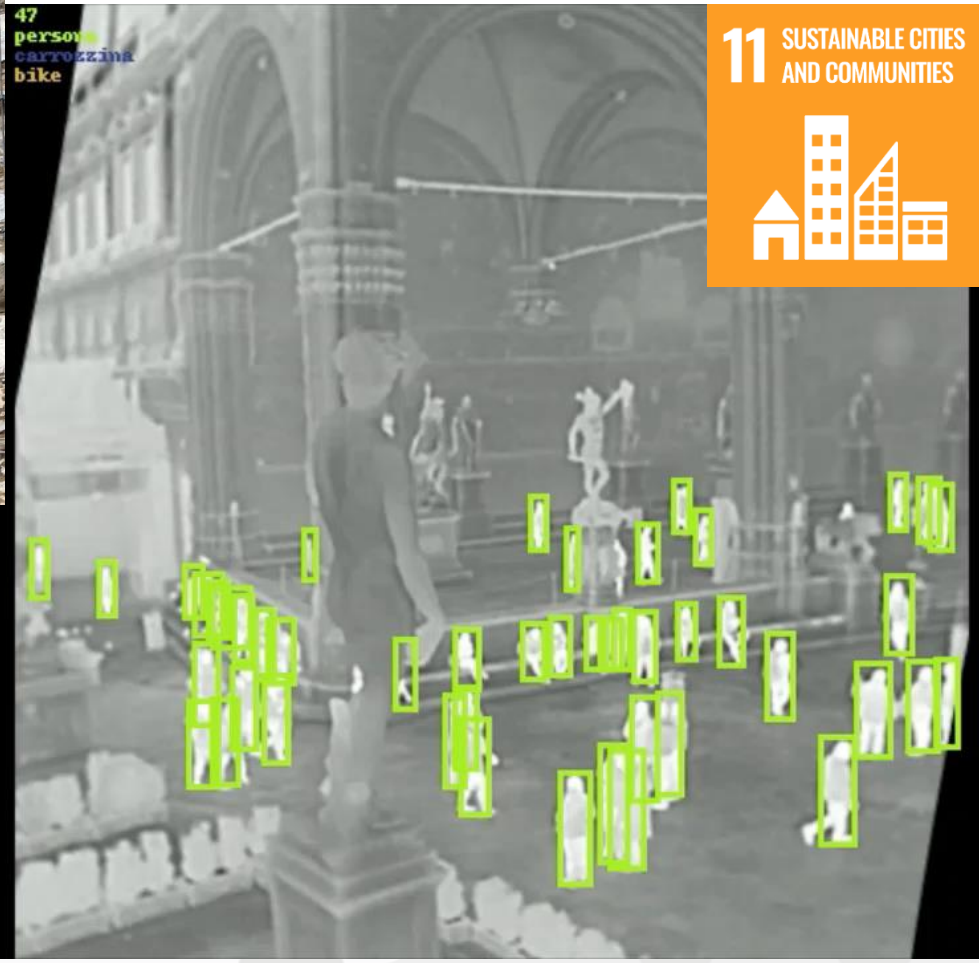


A view and data from the Thermal Camera







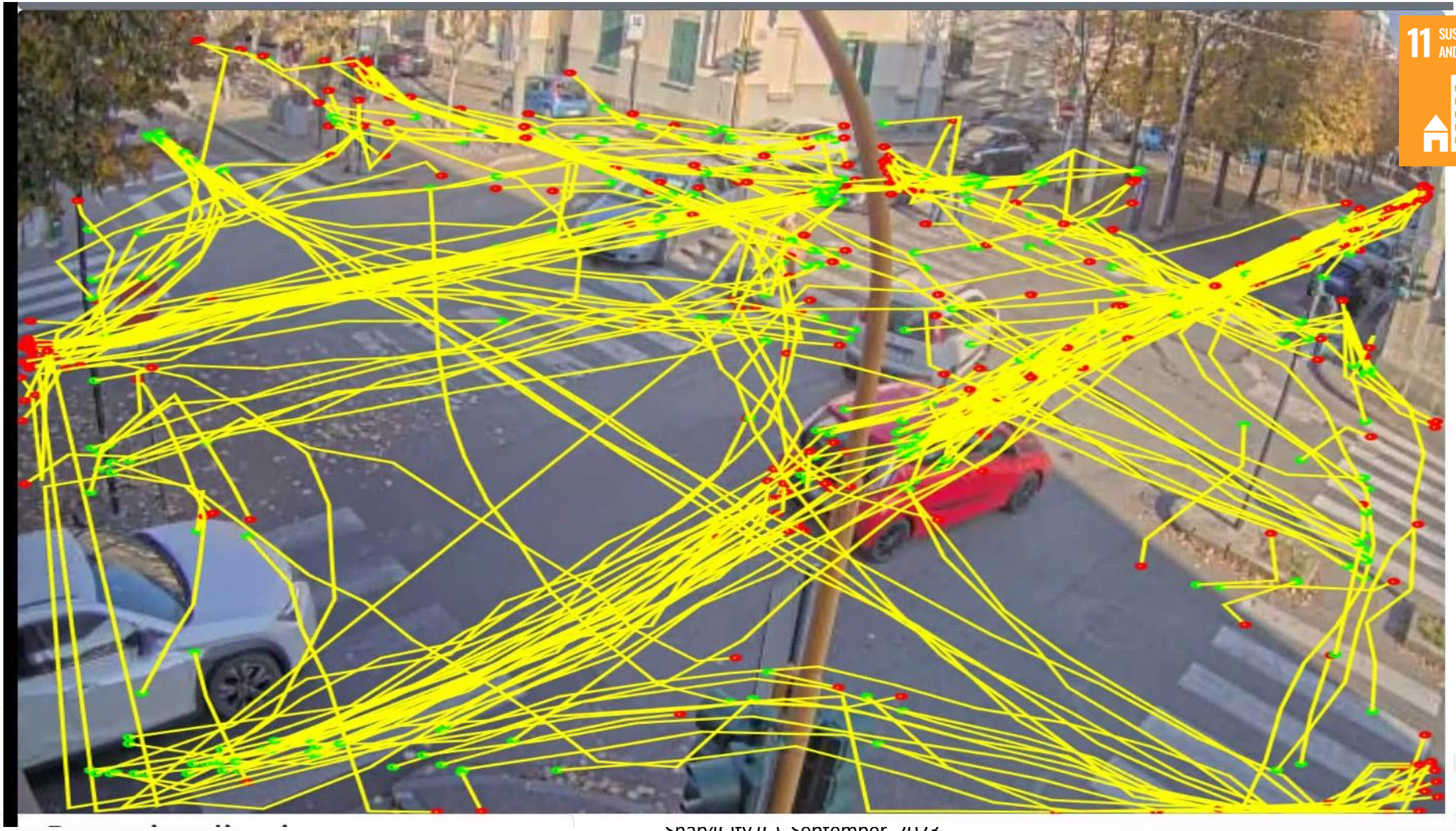


11 SUSTAINABLE CITIES AND COMMUNITIES

Barc 2022

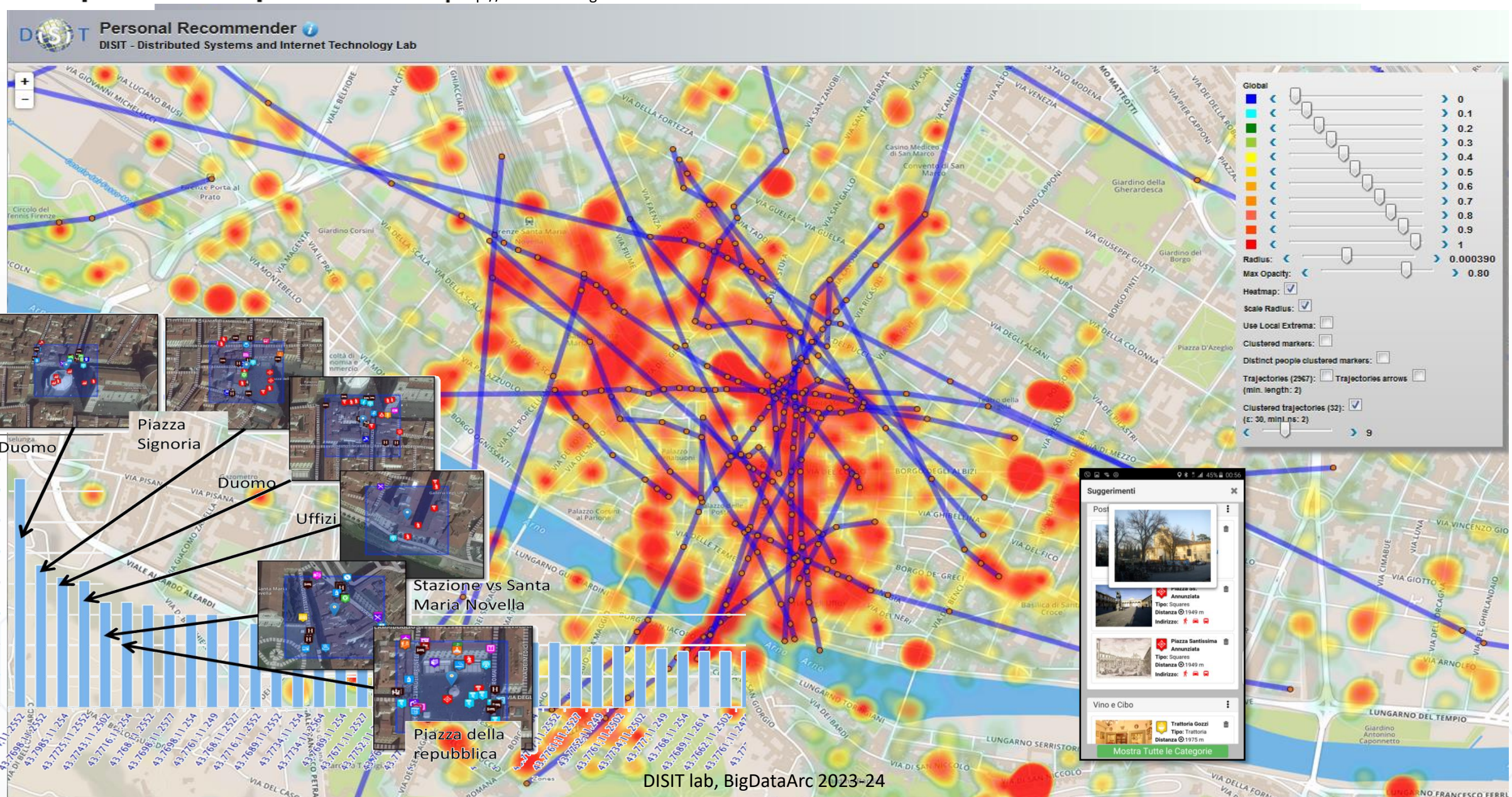

SNAP4CITY
AXIS
COMMUNICATIONS
SPAIN
SPAIN
3D MAP GLOBAL DIGITAL TWIN -NEWGUI


1
2
3
4
5
6
7



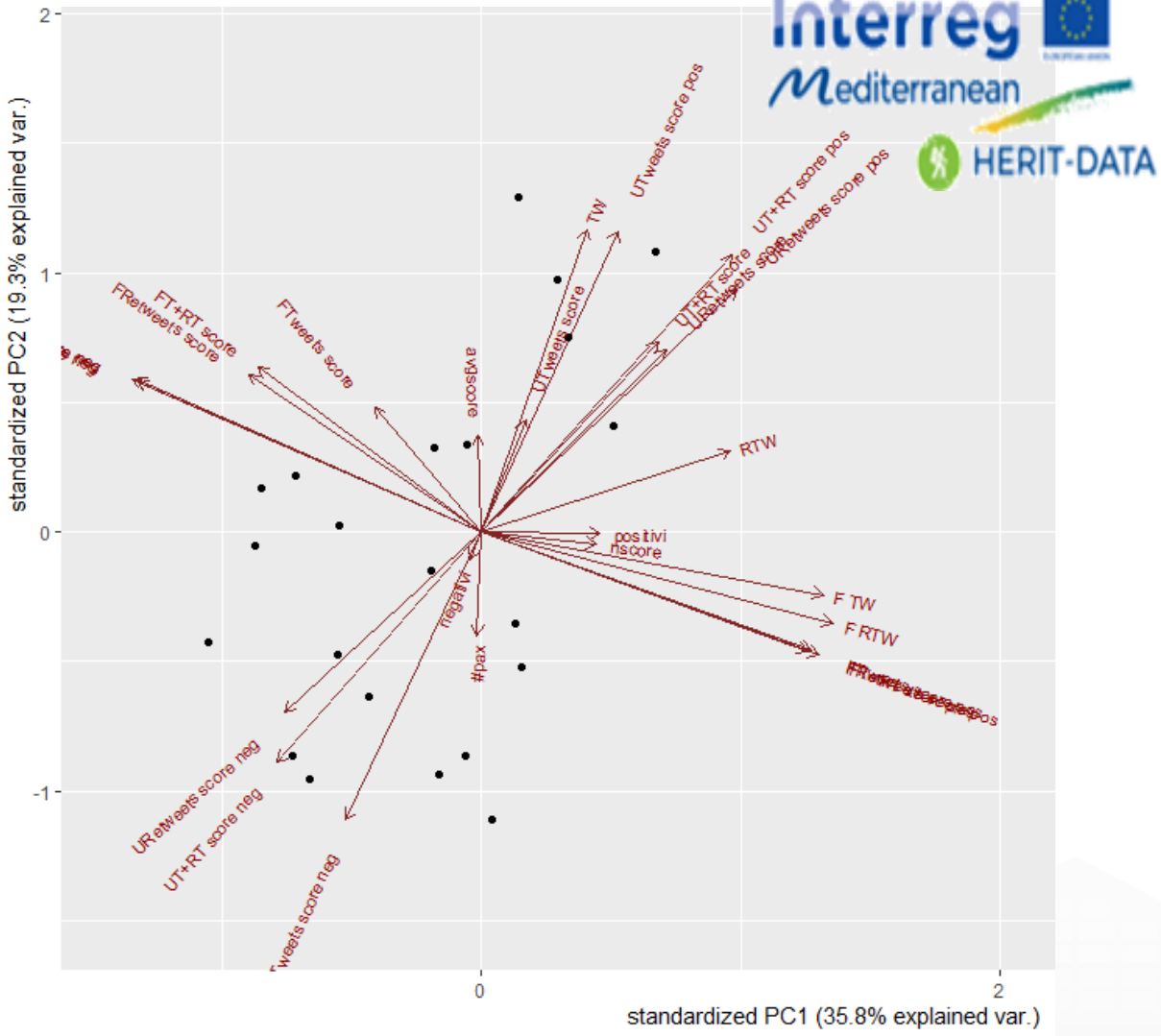
11 SUSTAINABLE CITIES AND COMMUNITIES

User Behavior Analyzer

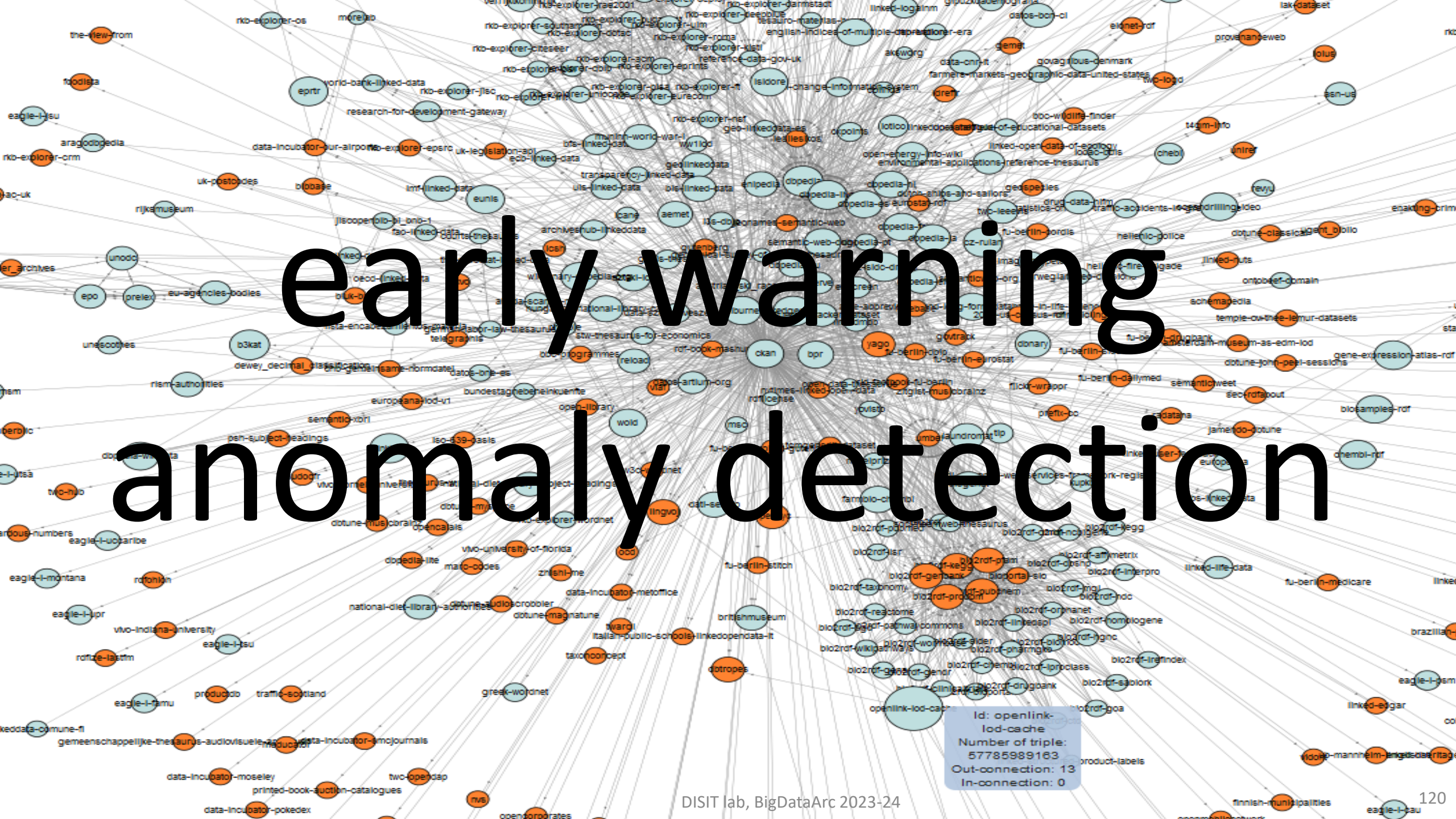


Reputation

- Prediction/estimation of **Average Score of Trip Advisor** as a function of *Twitter Vigilance Metrics + other information*
- Prediction/estimation of **Negative Scores on specific Museum** or service as a function *of Twitter Vigilance Metrics + other information*



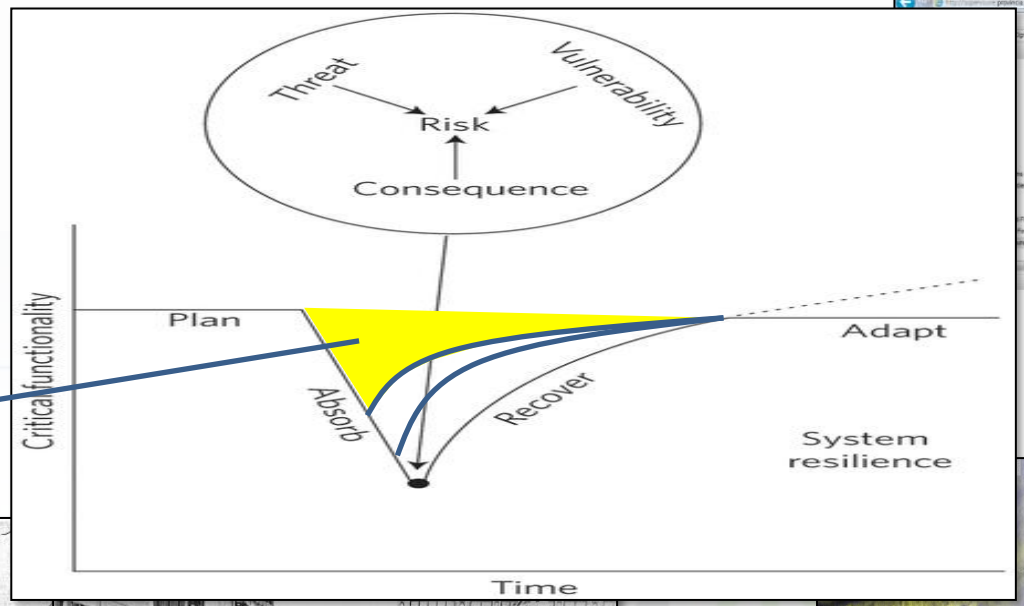
Twitter Vigilance

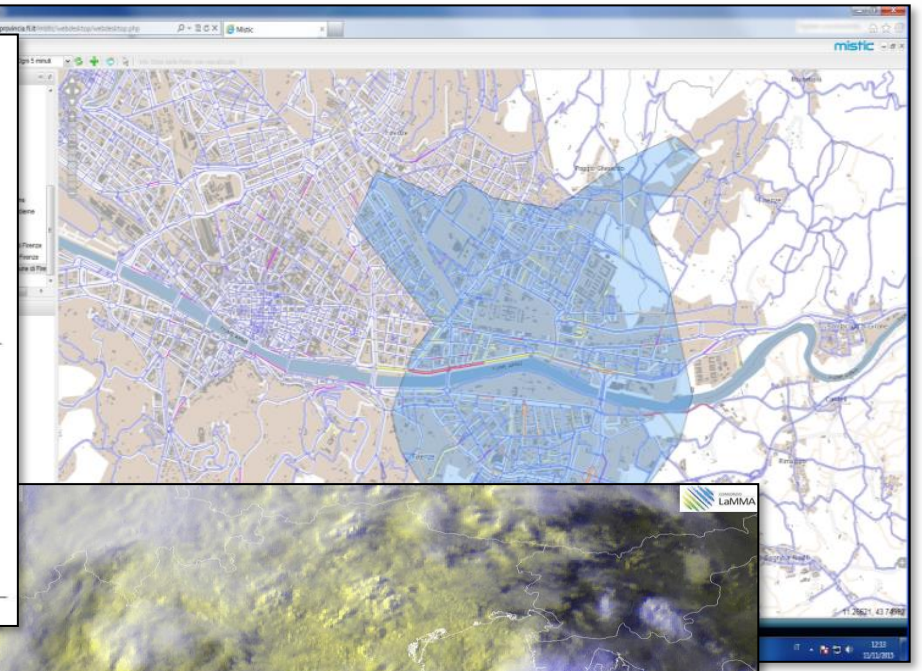

early warning
anomaly detection
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

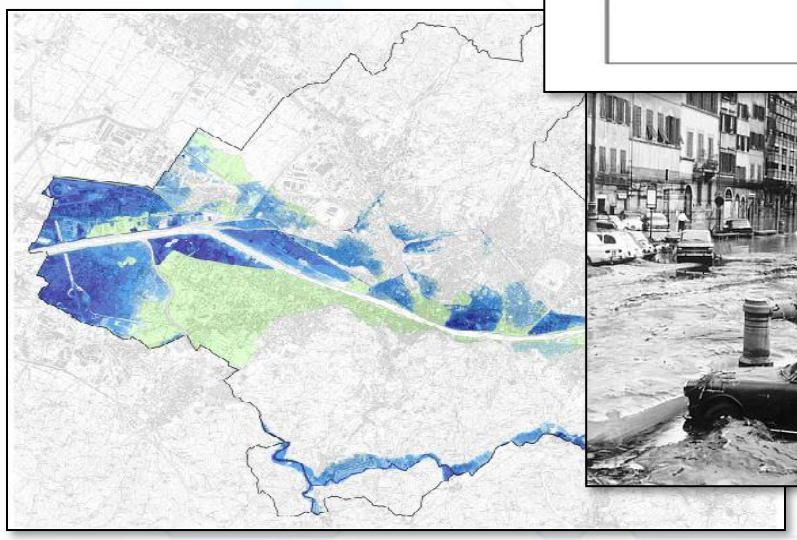
Early warning, detection

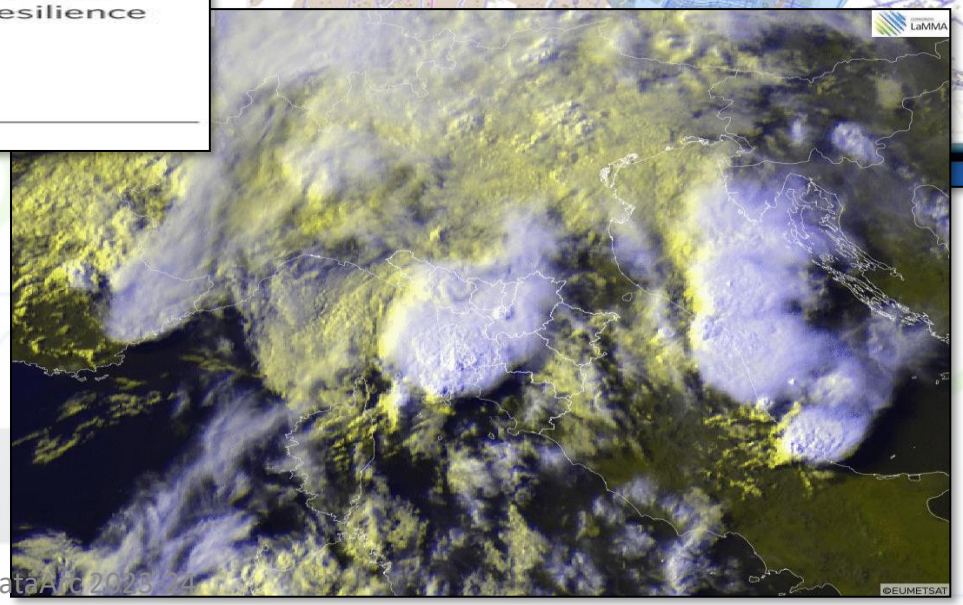
Prepare
Absorb
Recover
Adapt

damage







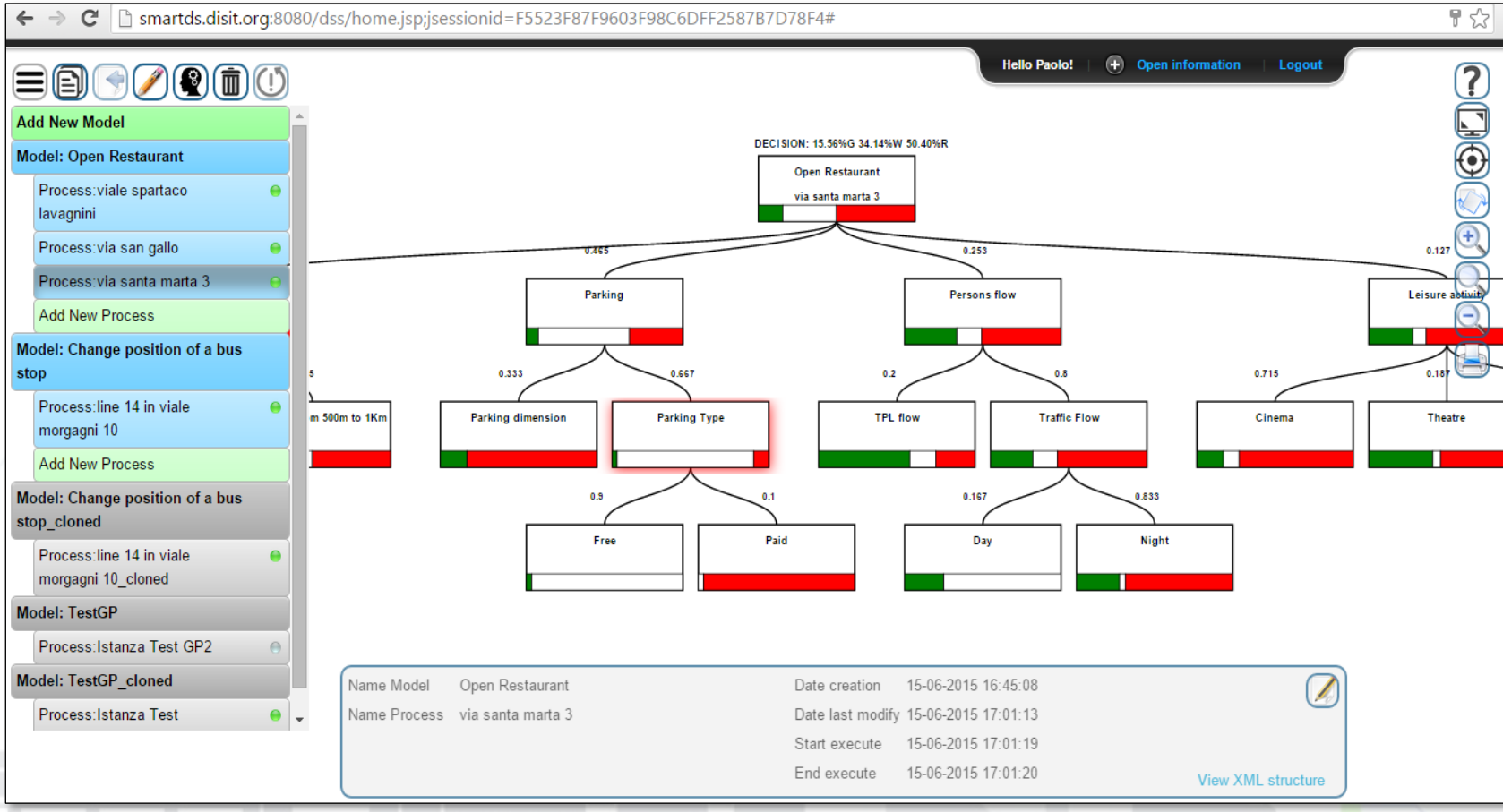


Smart City Decision Support

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

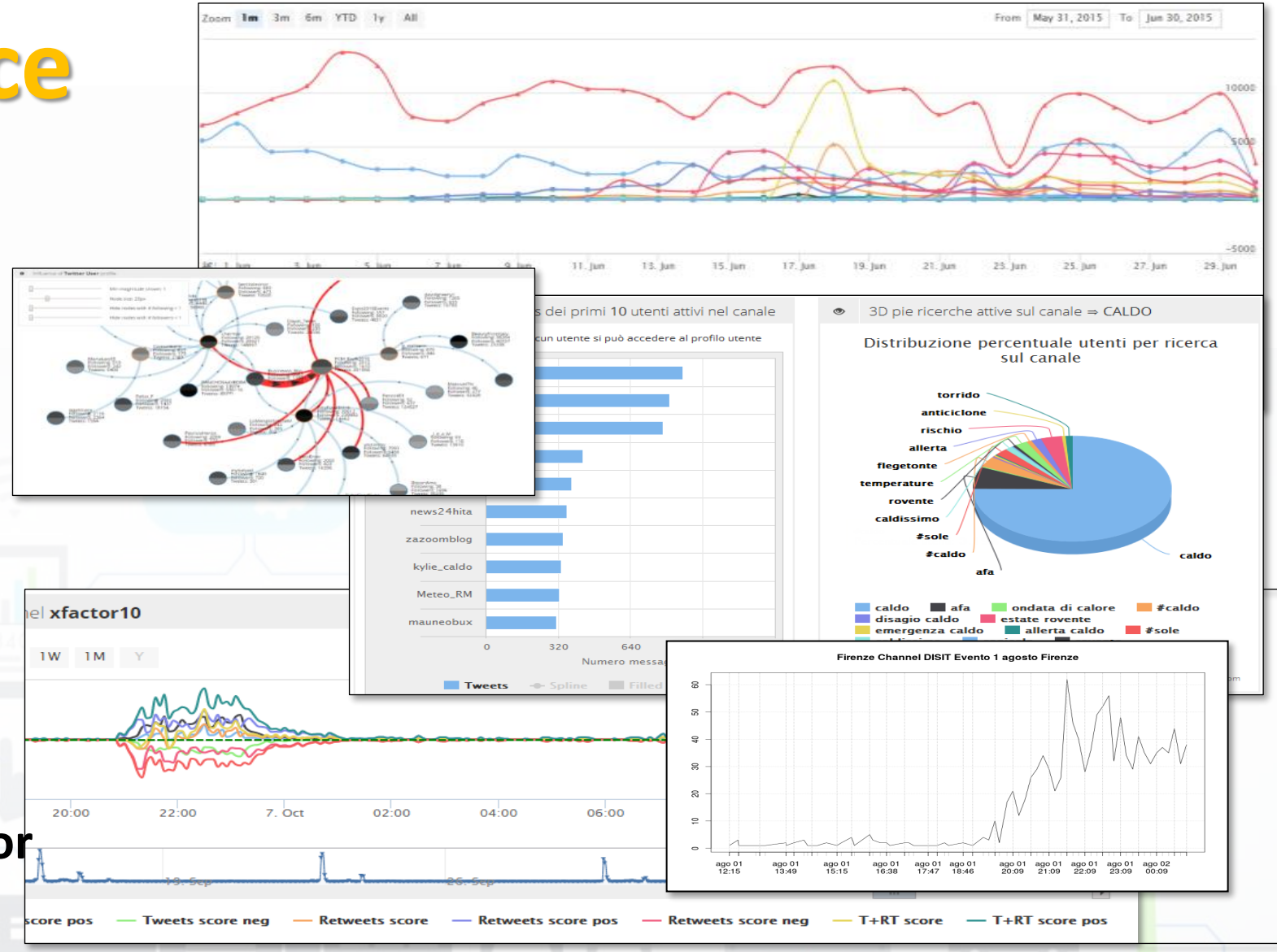
Enforcing

- 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

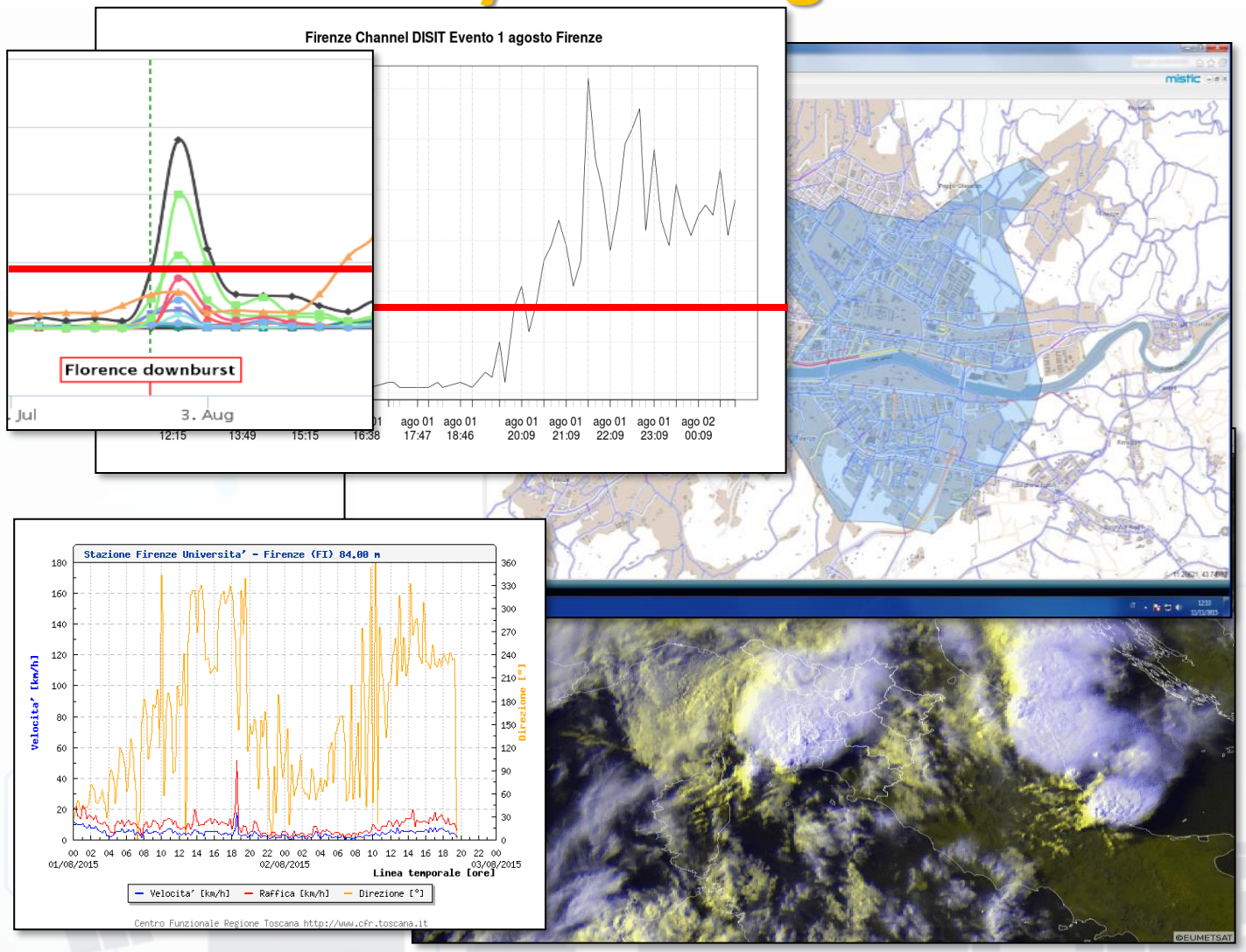
- http://www.disit.org/tv
- Citizens as sensors to
  - Assess sentiment on services, events, …
  - Response of consumers wrt…
  - **Early detection** of critical conditions
  - Information channel
  - Opinion leaders
  - Communities
  - Formation
  - **Predicting volume of visitors for tuning the services**



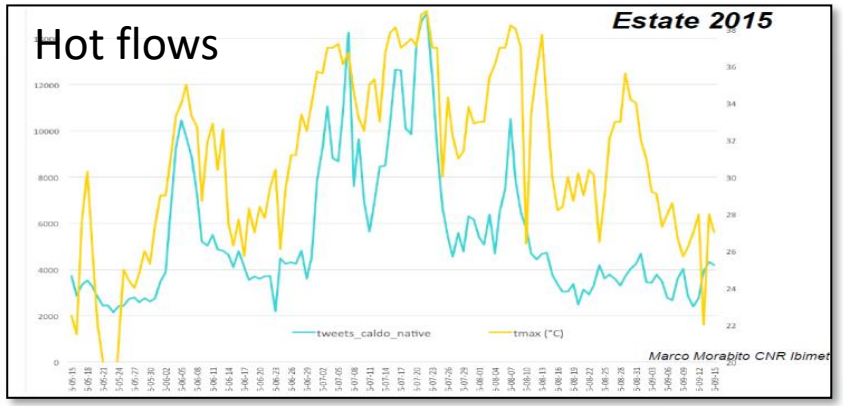
Twitter Vigilance

Twitter Vigilance

Early Warning



Predictive models



Attendance at long lasting events: EXPO2015

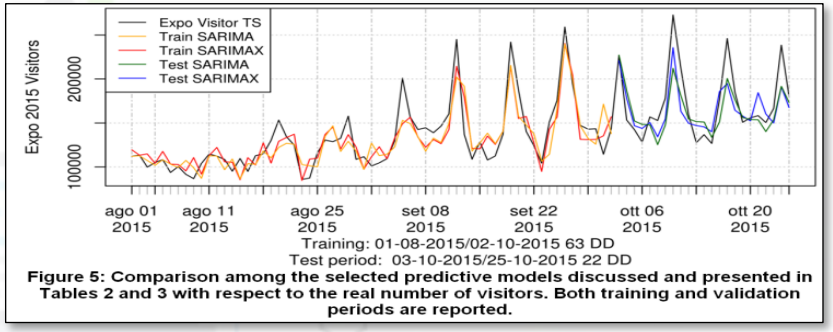
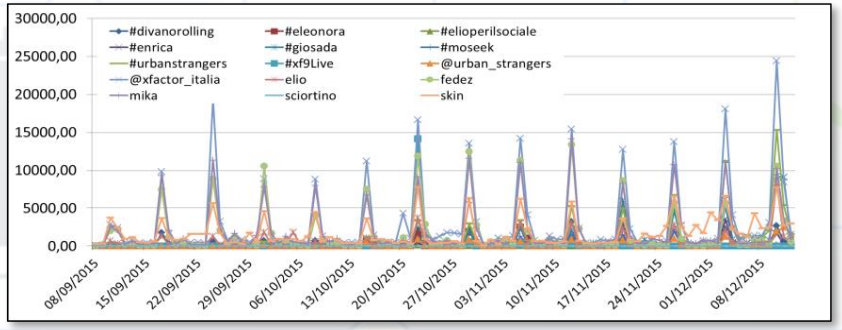
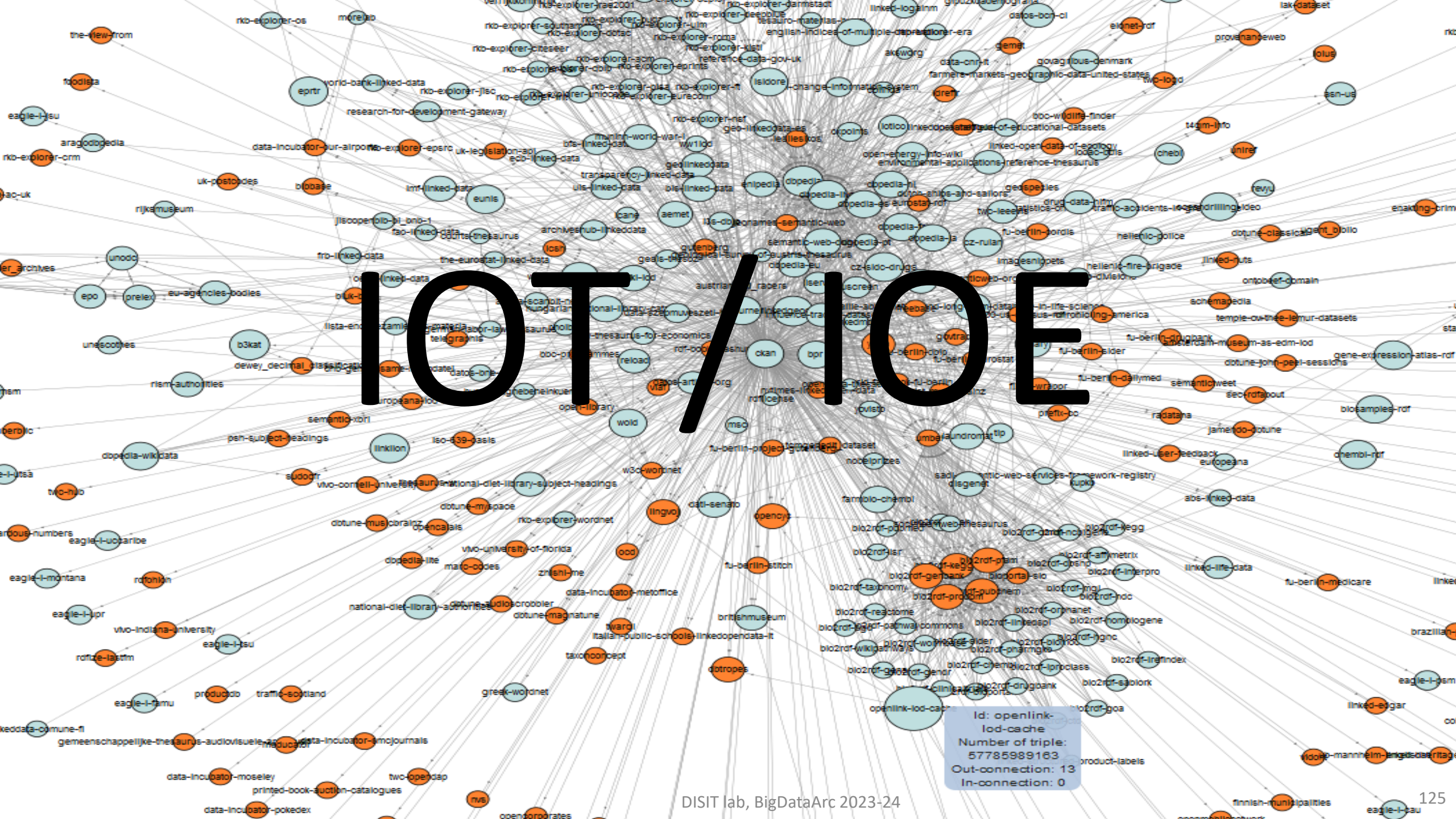


Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

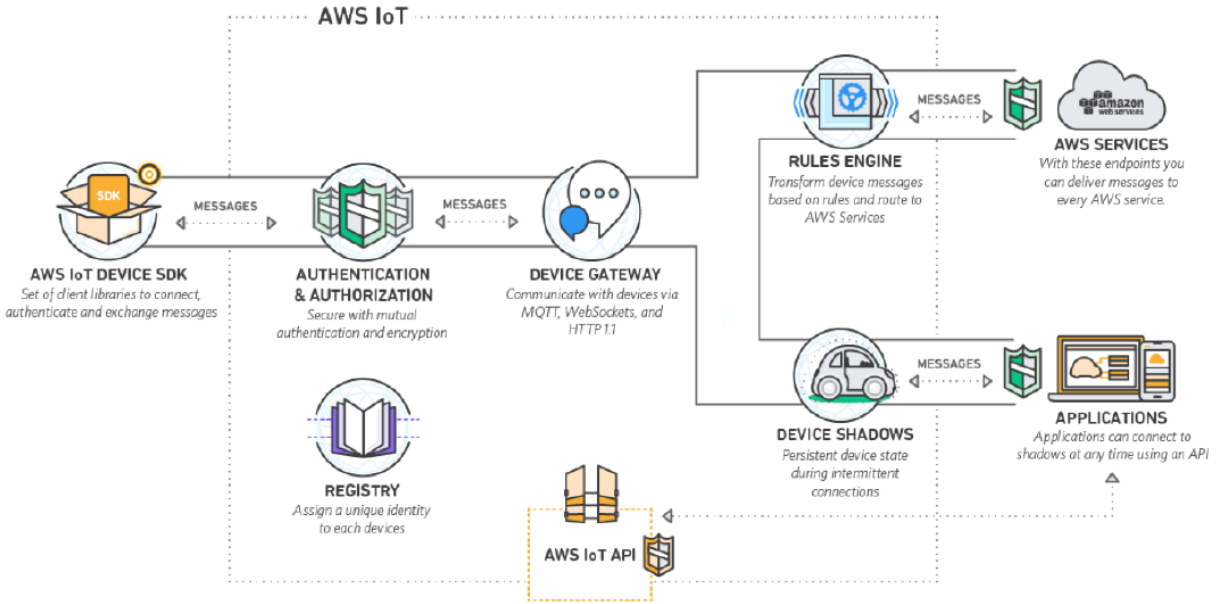
Attendance at recurrent events: TV, footbal

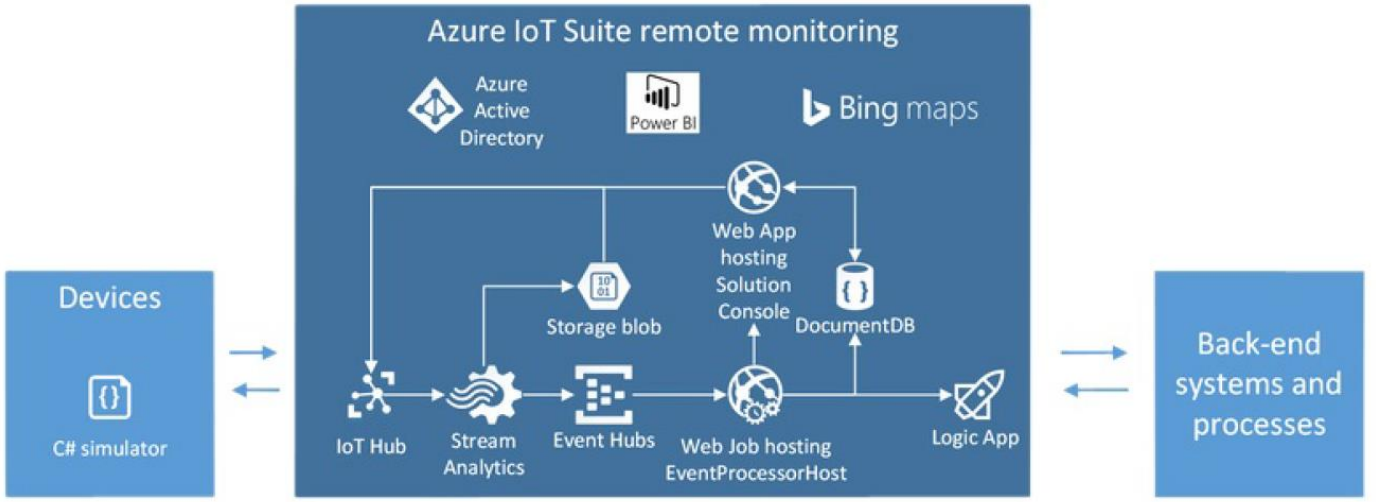



IOT/IOE
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

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 ??

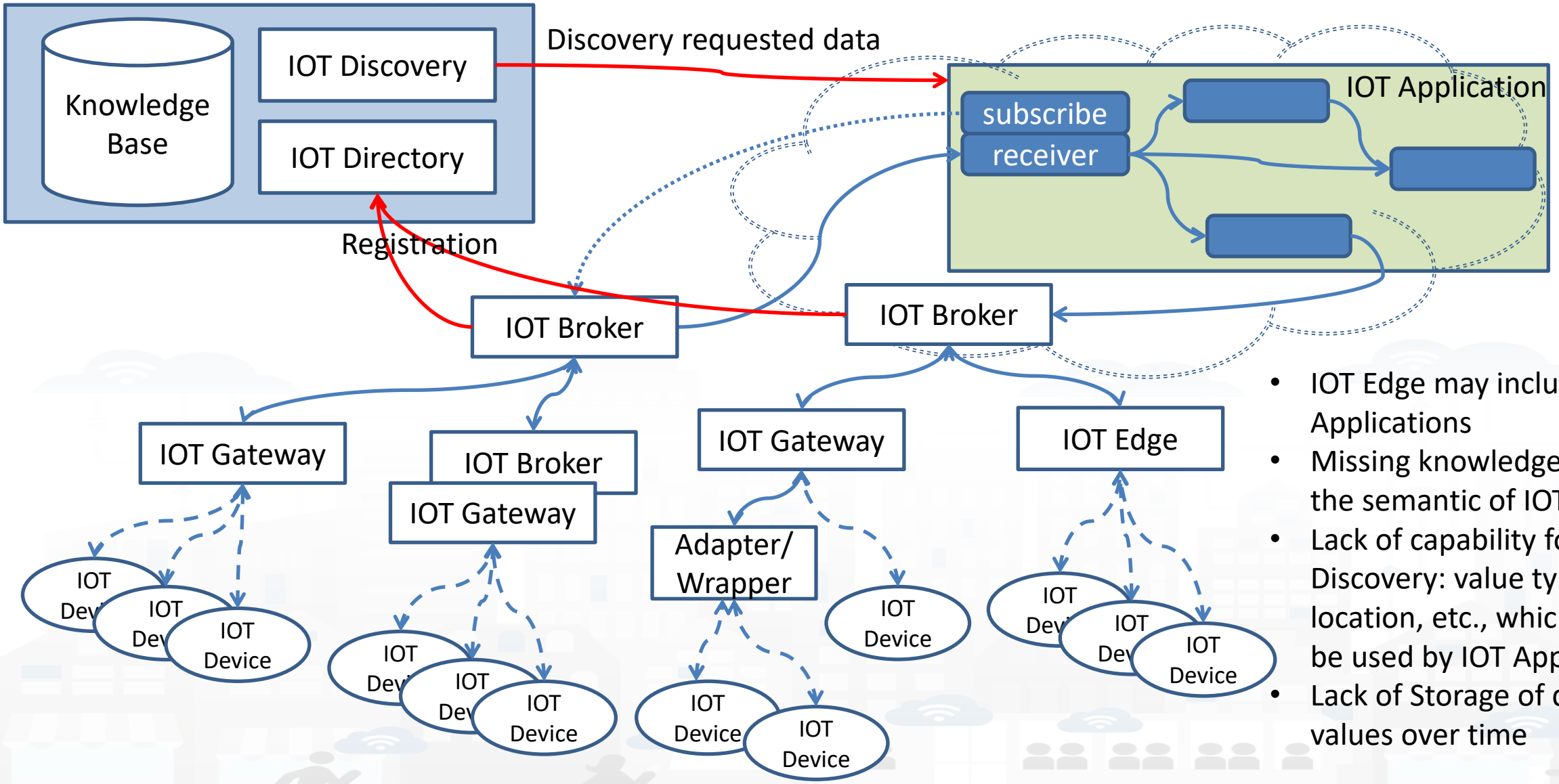




Big Data vs IOT

- 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.

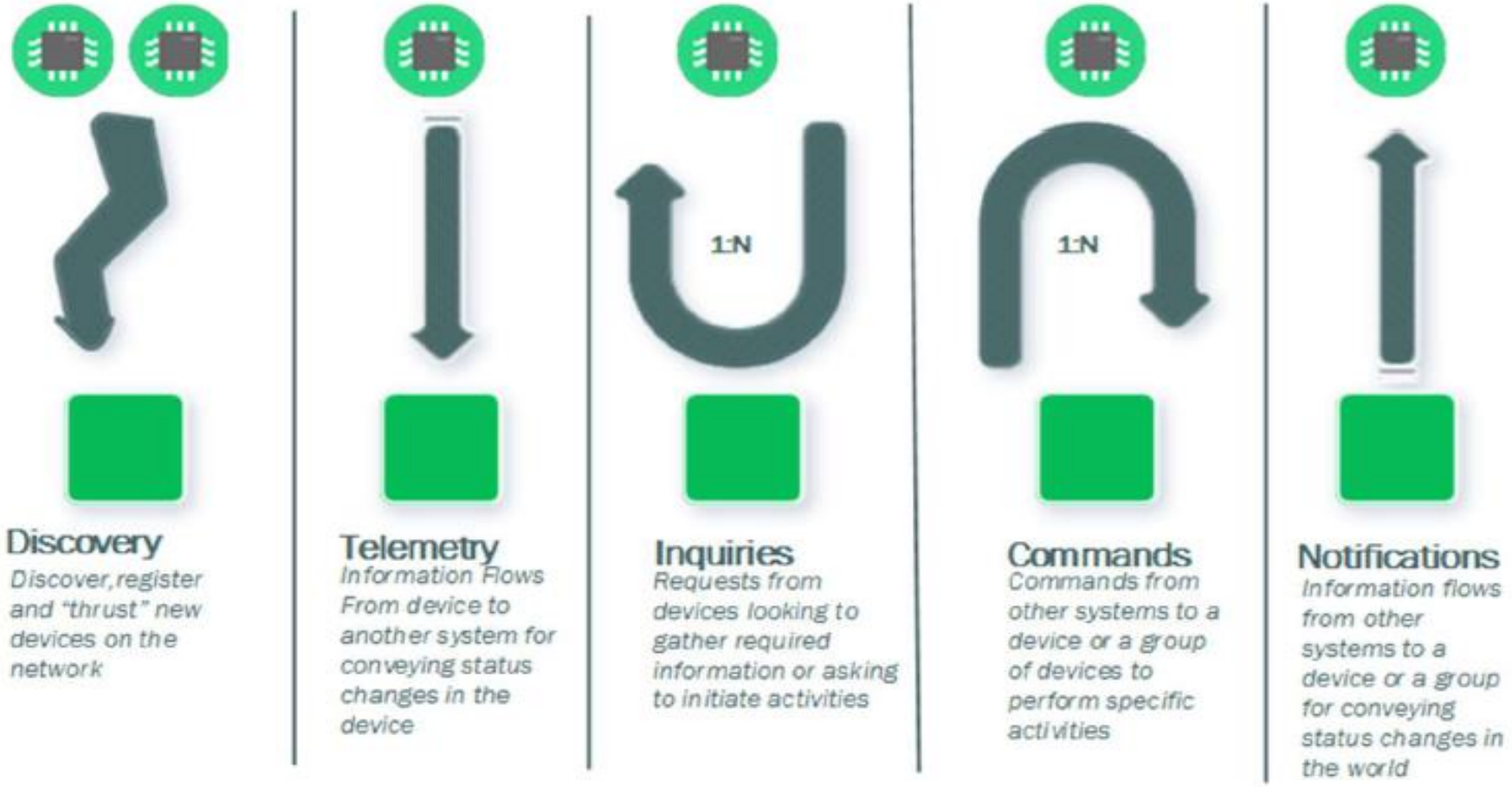
Definitions



- 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



- 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 sevices via API	Standard based Modules and IOT, Open Devices	Integrated Community manmagement	Resoruce Sharing	Referral data management	Security end-2-end	Dashboard H24/7	Faixible and easy dashboard creation	Multi-protocol on IOT
Snap4City	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
KAA	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, HTTTP

100% OPEN SOURCE

Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

EØ15 digital ecosystem

NVIDIA

SNAP4CITY

KM4CITY

SMART SOLUTIONS AND DECISION SUPPORT SYSTEMS

CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - BUSINESS INTELLIGENCE - SIMULATIONS - SMART APPLICATIONS

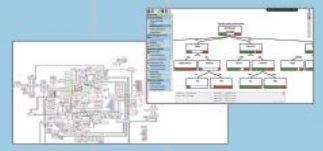
DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING

DASHBOARDS, WIDGETS
TEMPLATES

PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

API - MICROSERVICES - GIS - BPM
VIDEO - REPORTS - MAPS - 3D ...

ANY: DATA, BROKER, NETWORK AND VERTICAL



EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE

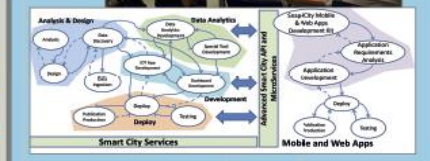
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING
OPERATIVE RESEARCH, STATISTICS

VISUAL PROGRAMMING, ADAPTERS
DATA FLOWS, WORKFLOWS
PARALLEL DISTRIBUTED PROCESSING
DATA DRIVEN

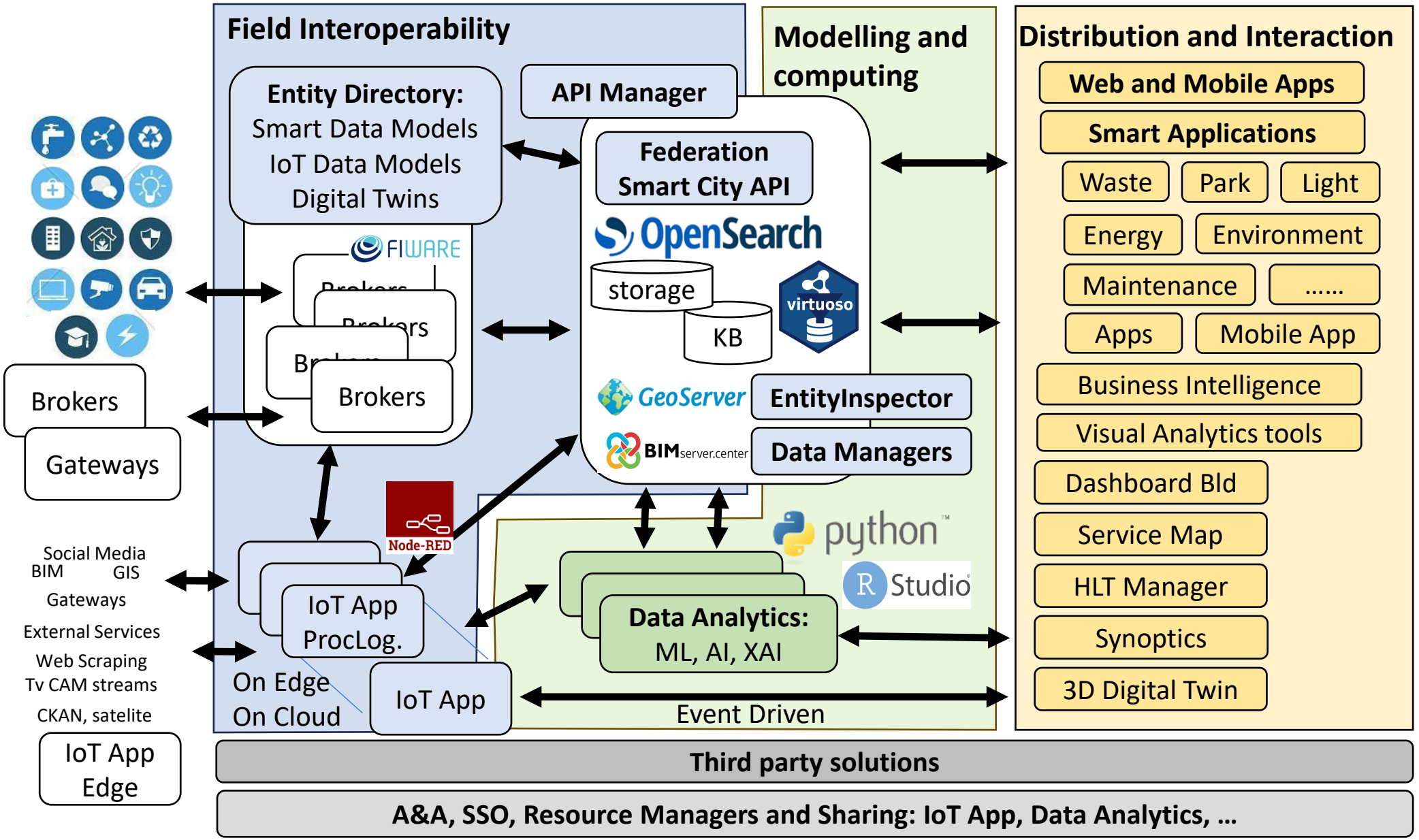
Native and External Applications

- Smart Parking
- Smart Light
- Smart Waste
- Smart Energy
- Social Media Analysis

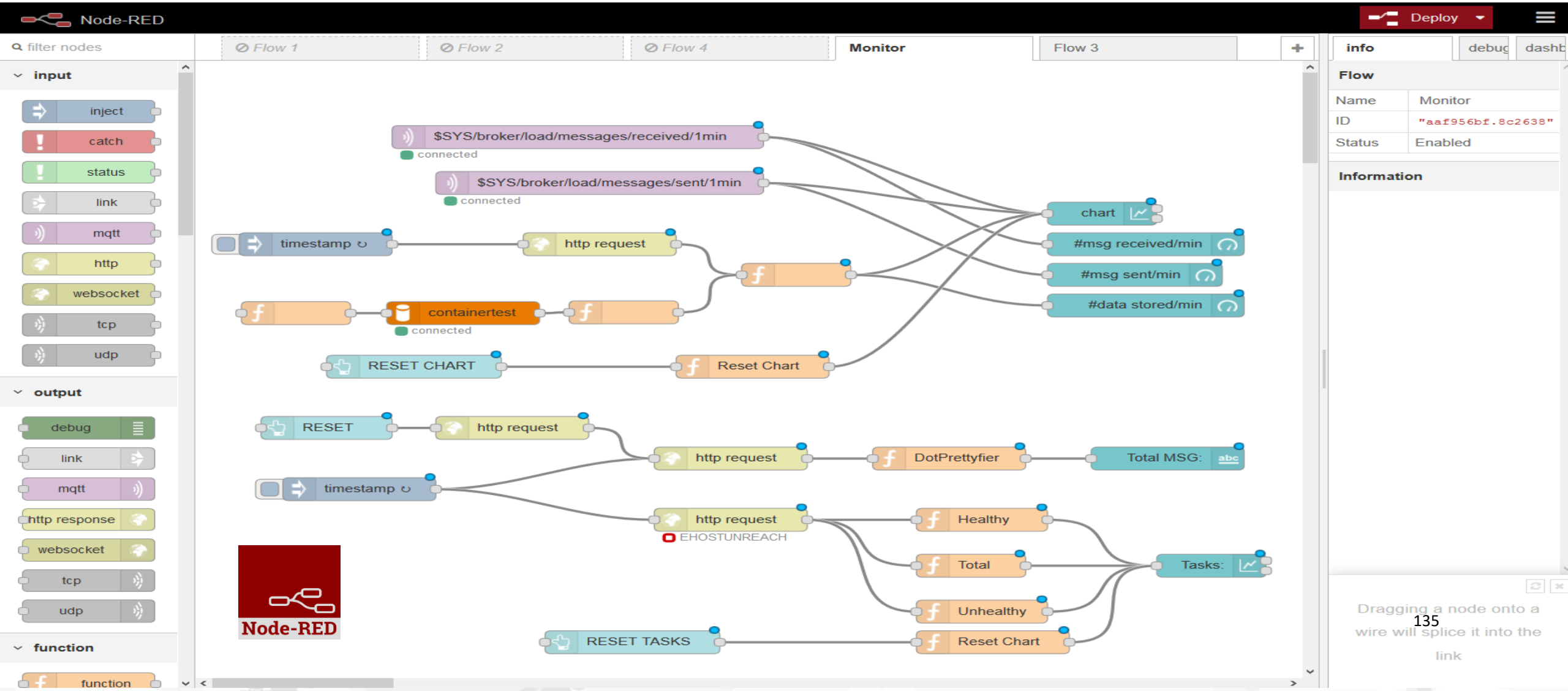
...



METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS


Field Interoperability
Modelling and computing
Distribution and Interaction
Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
API Manager
Federation
Smart City API
OpenSearch
storage
KB
virtuoso
FIWARE
Brokers
Brokers
Brokers
Gateways
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways
External Services
Web Scraping
Tv CAM streams
CKAN, satelite
IoT App
ProcLog.
Data Analytics:
ML, AI, XAI
On Edge
On Cloud
IoT App
Event Driven
IoT App
Edge
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Business Intelligence
Visual Analytics tools
Dashboard Bld
Service Map
HLT Manager
Synoptics
3D Digital Twin
Third party solutions
A&A, SSO, Resource Managers and Sharing: IoT App, Data Analytics, …

IOT Applications



MicroServices

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

fiware orion

fiware orion

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

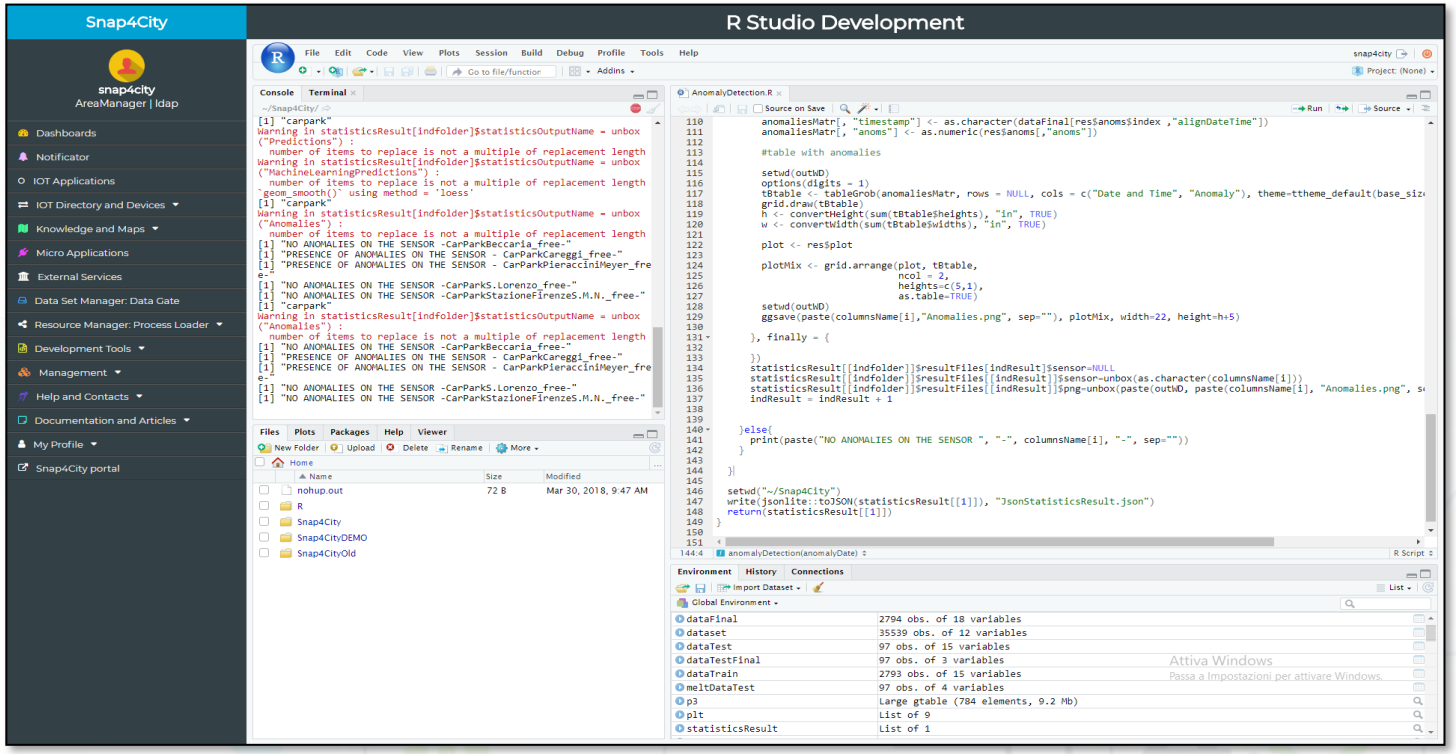
S4CLogDev
- event log

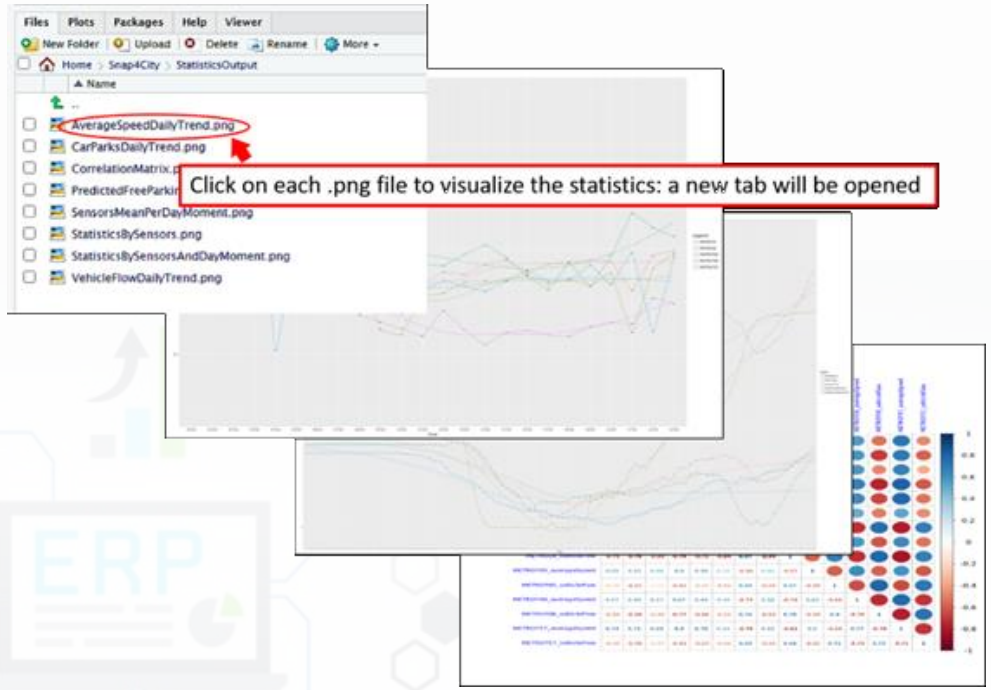
S4CSearchExp
- service search near gps position
- service search near service
- service search within gps area
- service search within wkt area
- service search within stored wkt area
- service search by municipality
- full text search within wkt area
- full text search within gps area
- full text search 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
- 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

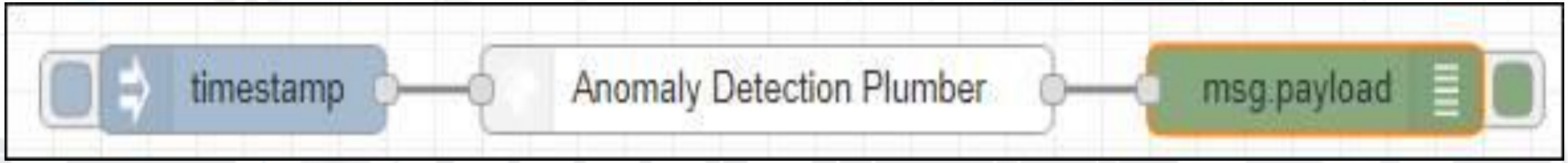
S4CSearchUsr
- service search near marker
- service search within circle
- service search within polygon
- service search along path
- full text search near marker
- full text search within circle
- full text search within polygon
- full text search along path
- full text search usr
- event search near marker
- event search within circle
- event search within polygon
- event search along path
- event search usr
- 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

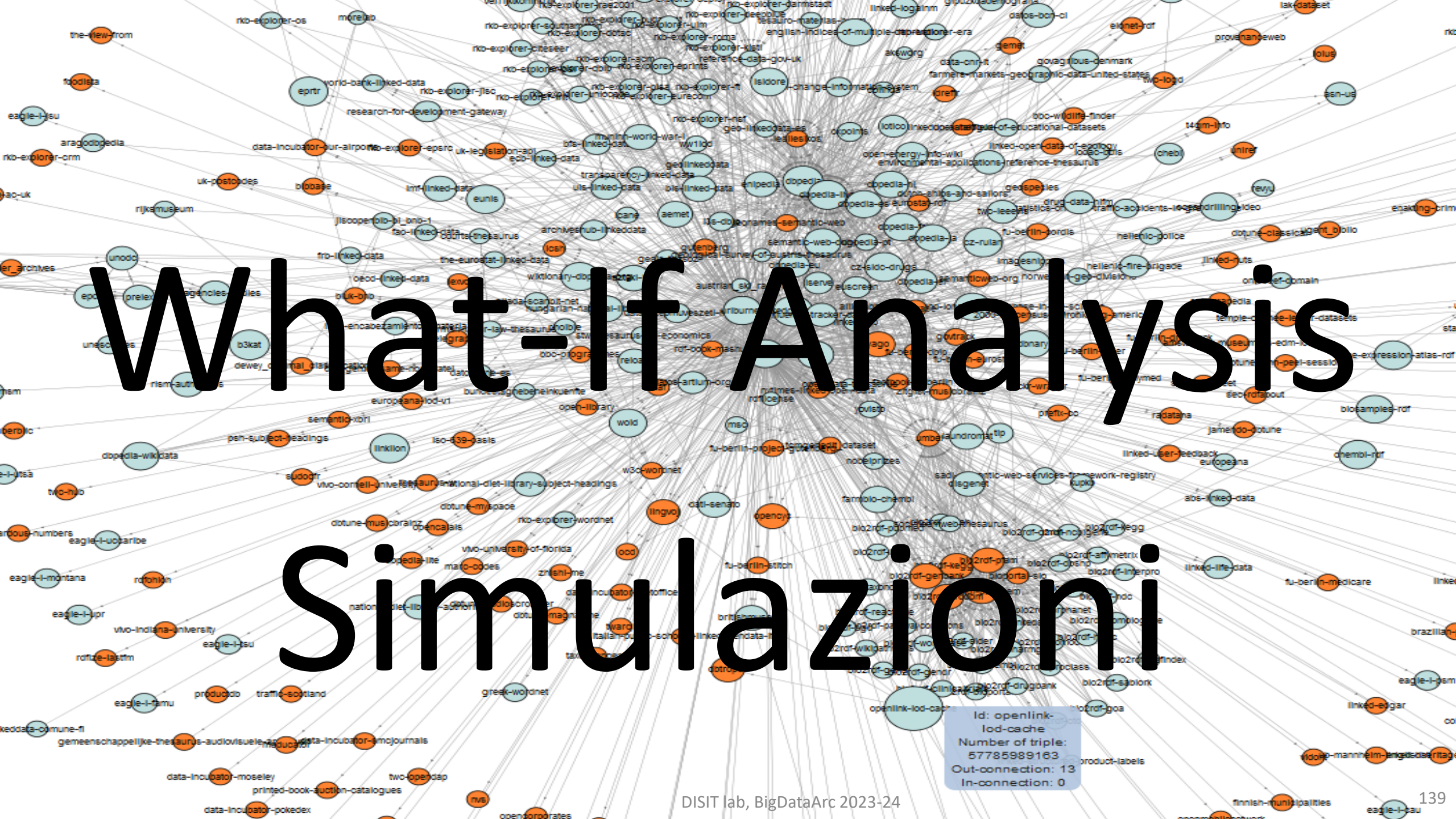
S4CManagement
- check exist job
- check exist trigger
- get currently executing jobs
- get job detail
- get triggers of job
- get job group names
- get trigger group names
- get paused trigger groups
- trigger job

Developer in R Studio + Tensor Flow





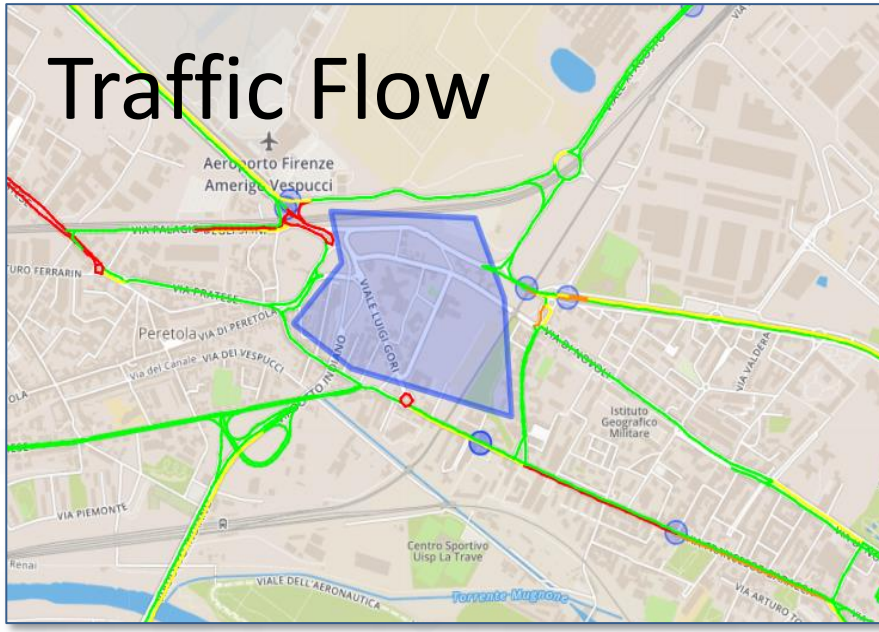


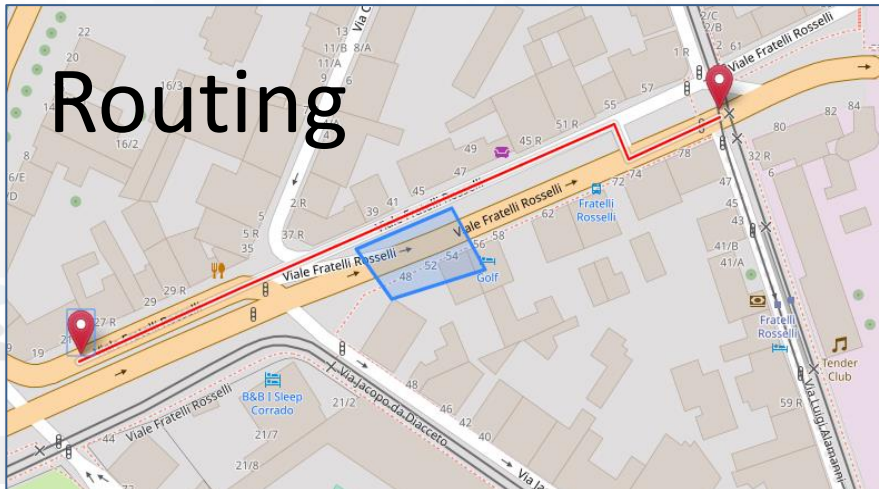

What-If Analysis
Simulazioni
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

What-If analysis

Decision Support Systems, What-if

- **Event planning, via what-if analysis**
  - Change in the graph structure of the city
  - Impact on the flow of people and vehicles
  - Adaptation: public transport, traffic, pedestrian management, etc.
- **Immediate reaction to natural events or not**
  - Everything is ready and updated in real time
  - Each view is contextualized in terms of data: descriptive and prescriptive
- **Digital Twin**
  - More detail in the context integrated data
  - Greater realism in deductions and representations
  - Less fragmentation and non-uniformity in the views to support decisions

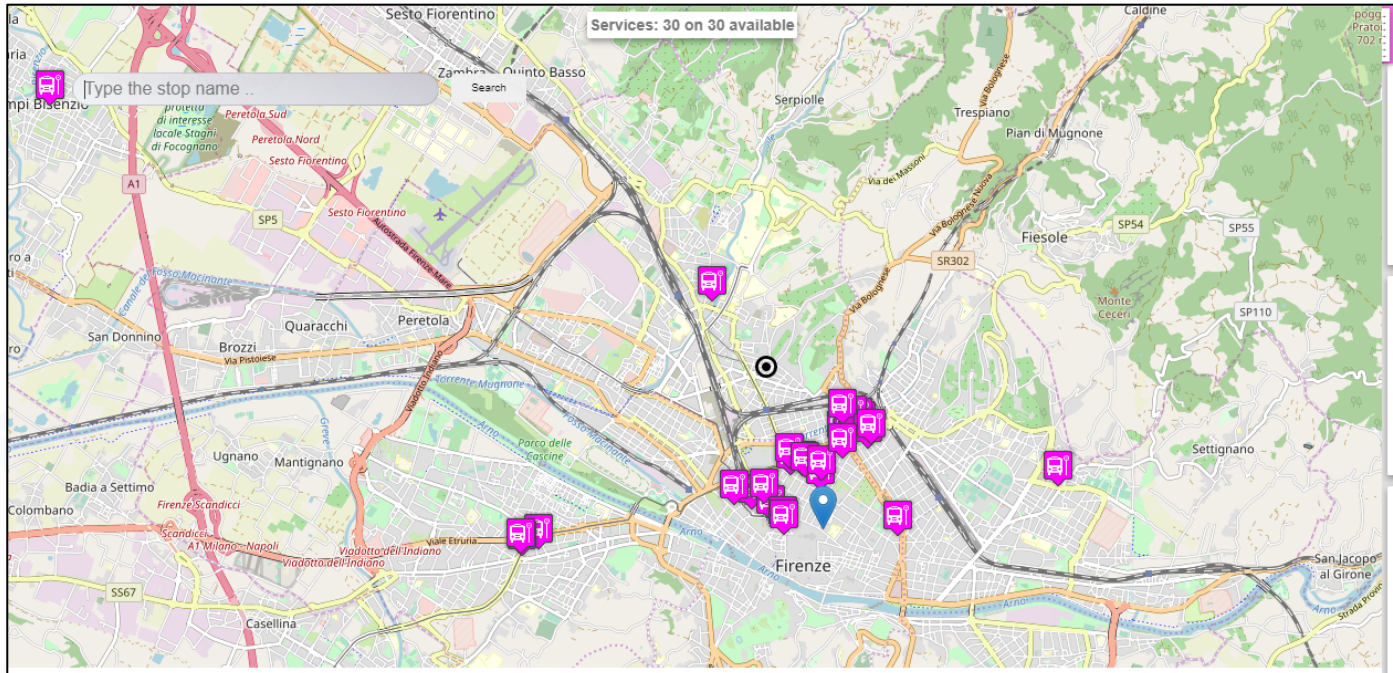


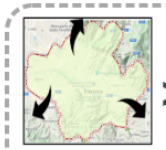


Multi-Widget Map

https://main.snap4city.org/view/index.php?iddasboard=OTc2

Bus Stop Analysis: identification of criticalities





> 42300

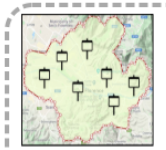
Daily individual Production Trips

> 52900

Daily Individual Attraction Trips

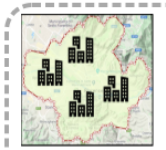
21289

Daily bus trips



1875

Bus Stops

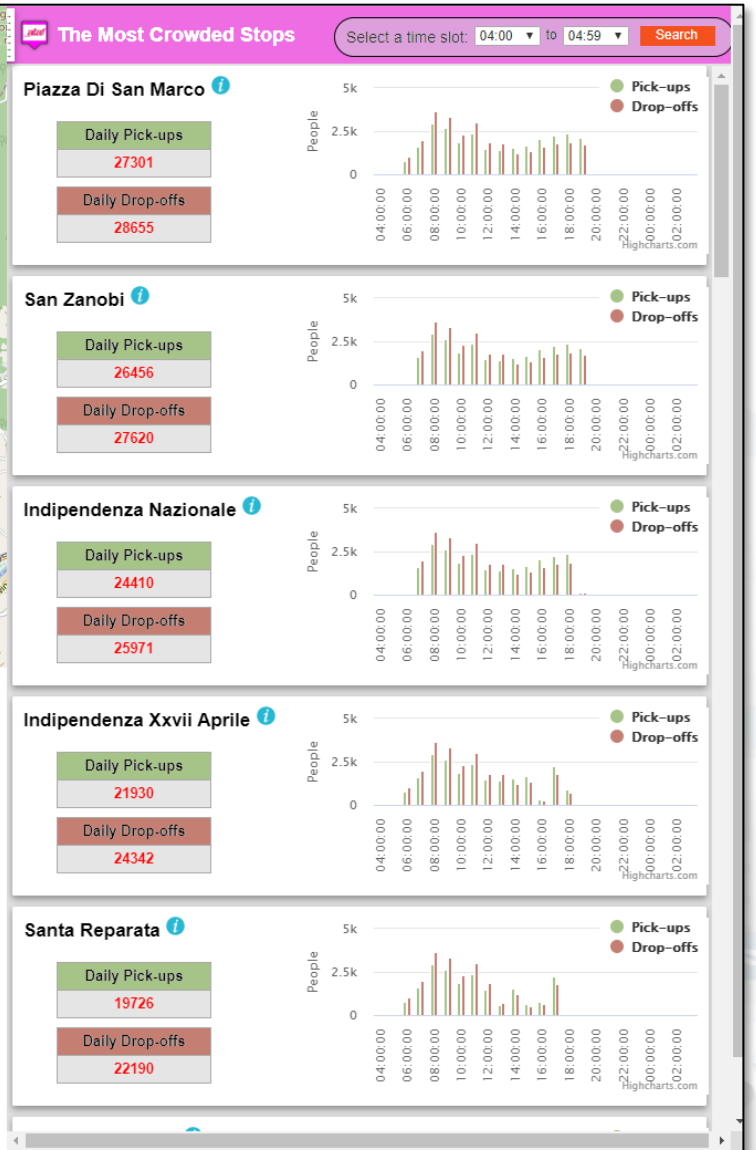


31070

Residential Buildings

31059

Service Providers



https://www.snap4city.org/dashboardSmartCity/view/Baloon.php?iddasboard=MzcxNw==

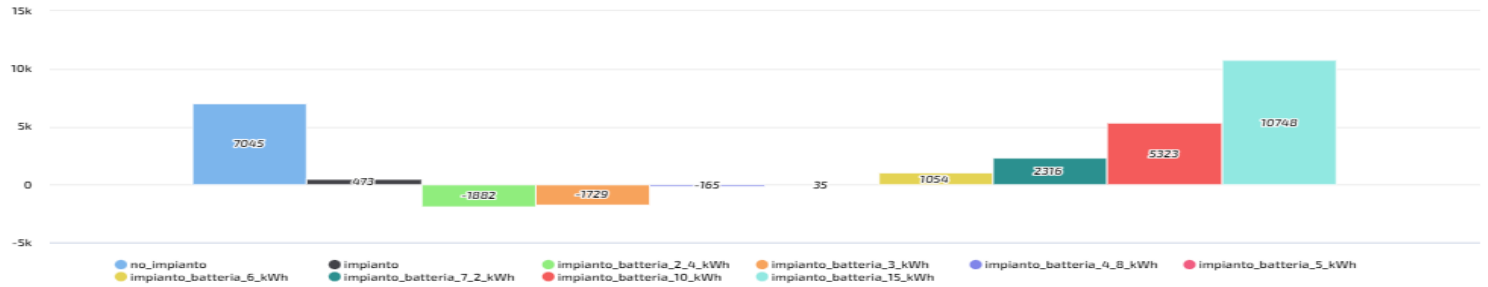
Ciao roottooladmin1

Tue 4 Apr 13:15:34

SIMULATORE IMPIANTO FOTOVOLTAICO

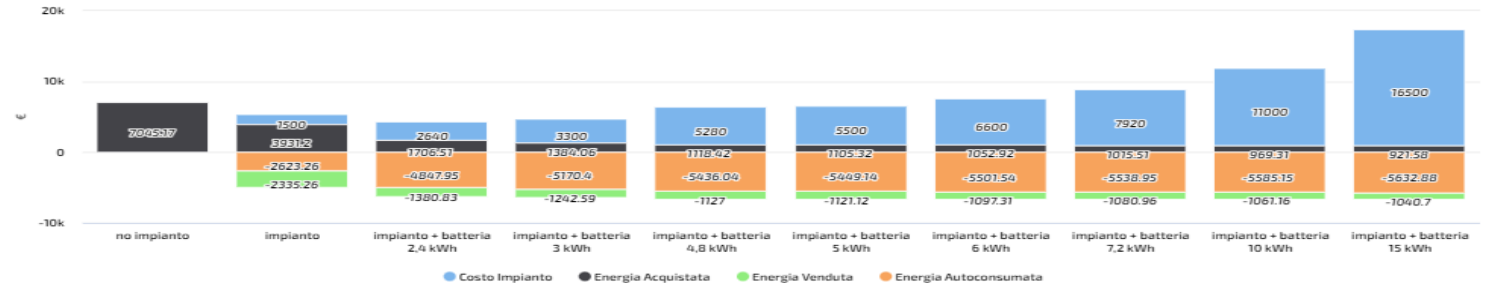
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO

599m



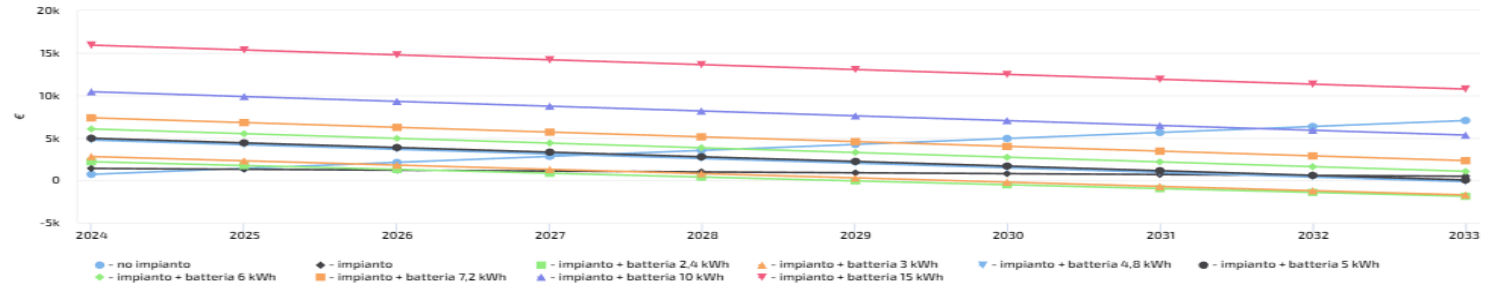
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO PARTIZIONATO

599m



ANDAMENTO PREZZO CUMULATIVO ANNUO

599m



Manuale Utente

English Version

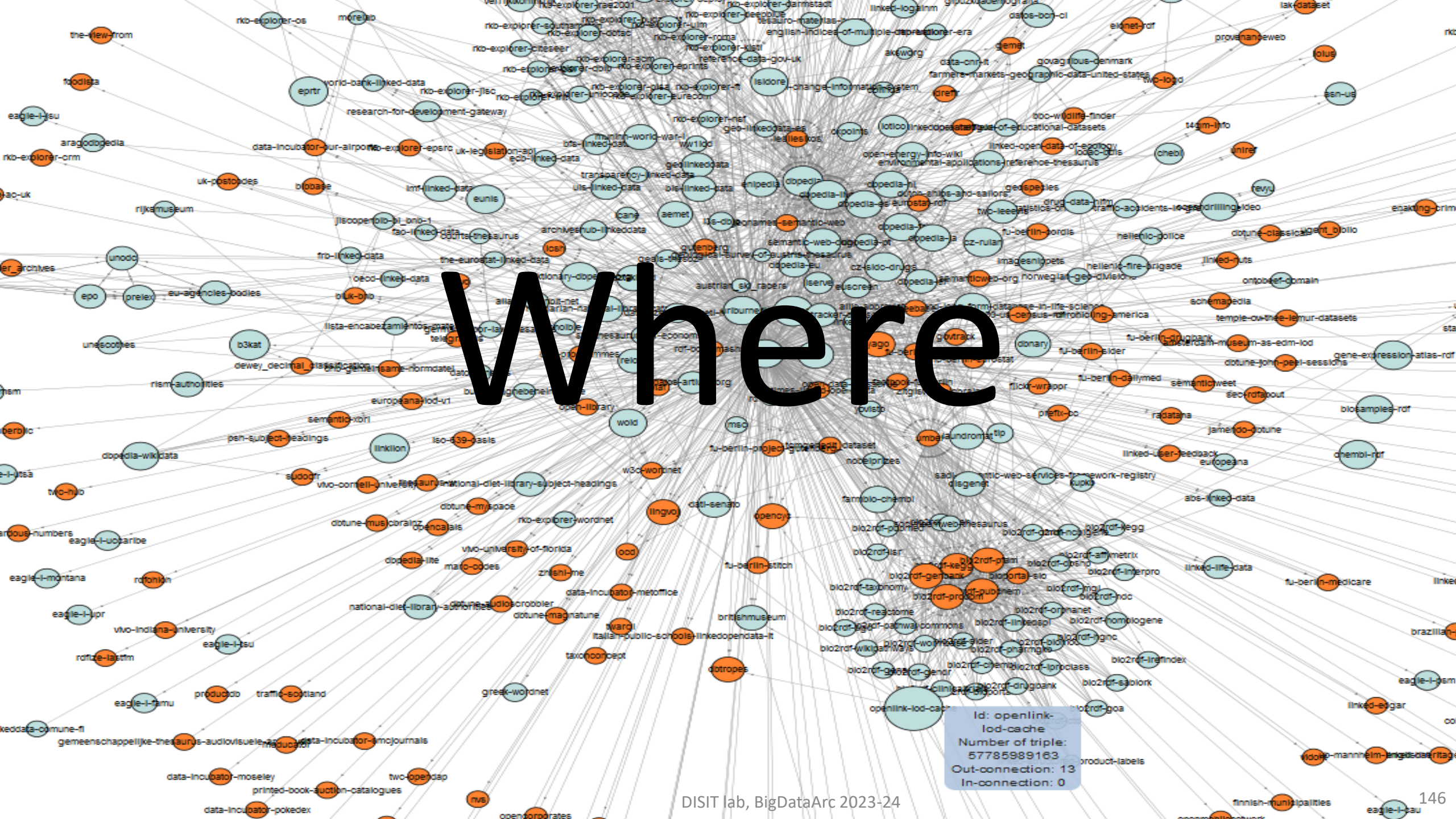
PARAMETRI DELL'IMPIANTO

Ti consigliamo un impianto con batteria da 2,4 kWh

Gruppo di Consumo Annuale	2000 kWh
Prezzo Energia Vendita (€/kWh)	0,15
Prezzo Energia Acquisto (€/kWh)	0,35
Anni di Investimento	10
Mese da simulare	Gennaio

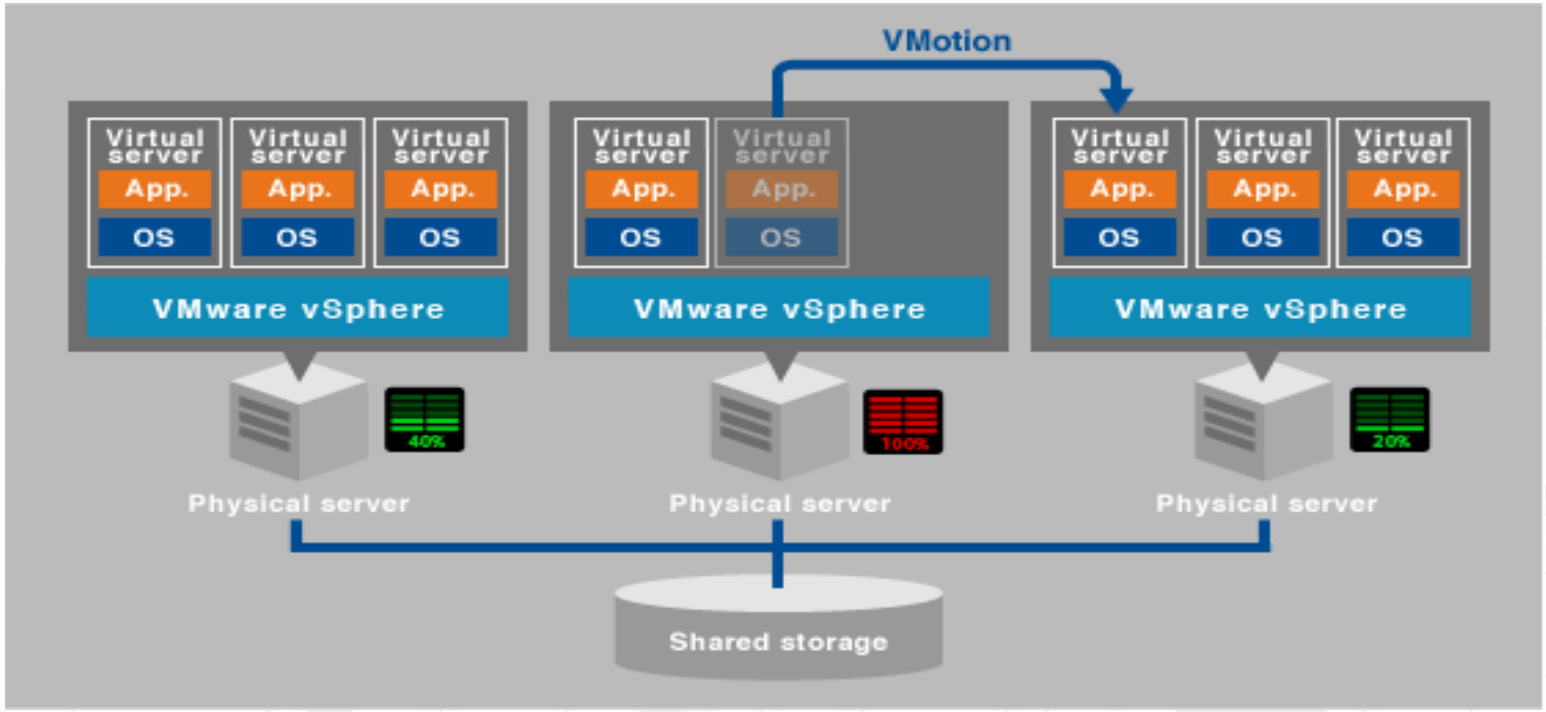
Invia

7 AFFORDABLE AND CLEAN ENERGY

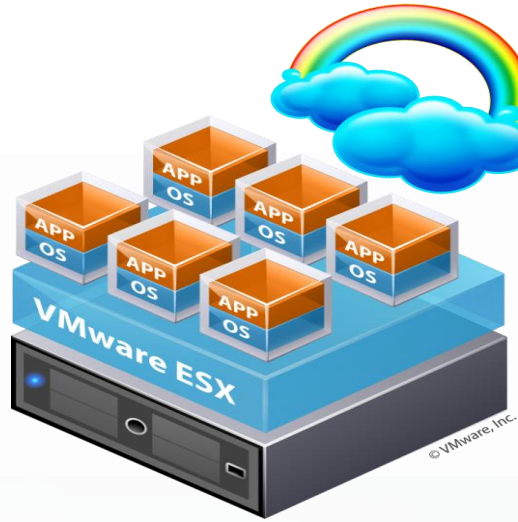

Where
Id: openlink-lod-cache
Number of triple: 57785989163
Out-connection: 13
In-connection: 0

Virtualizzazione e Cloud

- HA: High Availability,
  DRS: Distributed Resource Scheduler



Cloud computing e Virtualizzazione



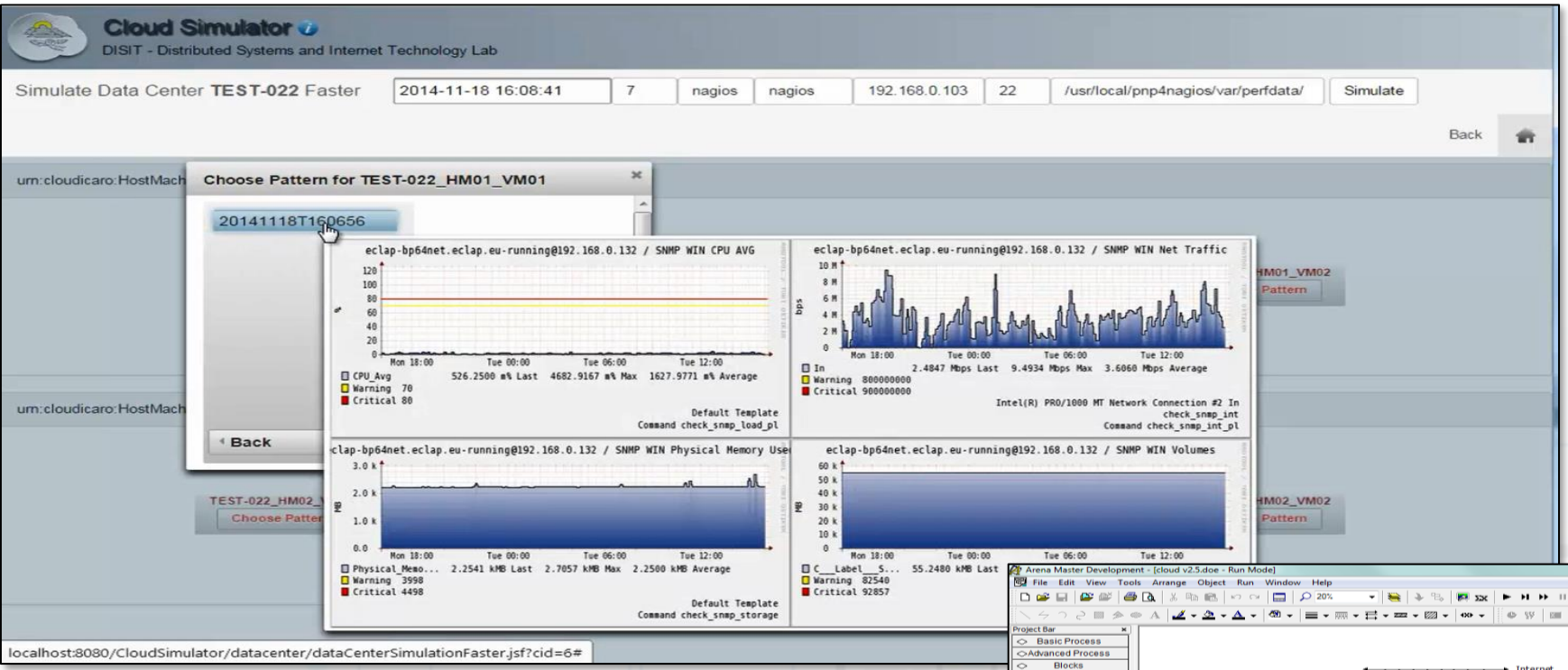
- **Motivations for Cloud computing and Virtualization**
- **Virtual Machine concepts:** emulation, para-virtualization, snapshots
- **Cloud Computing,** cloud vs grid, goals of cloud computing
- **High Availability,** Workload Balancing
- **vSphere Infrastructure,** Vmotion, Power Management, Resource Scheduling, Fault Tolerance
- **Security on the Cloud**
- **Conversions** among VM and physical machines
  - Covnersions: 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

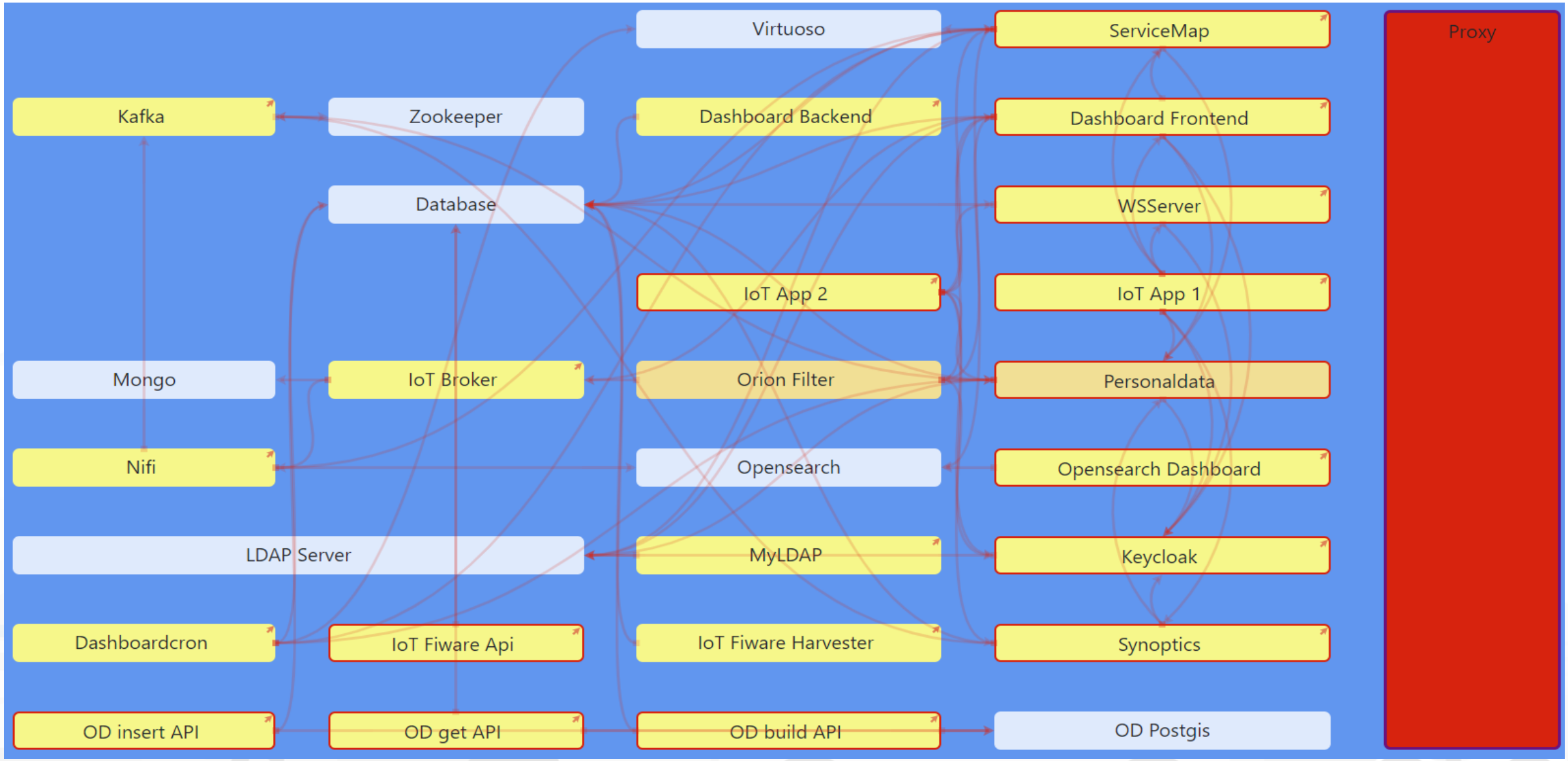
Cloud Simulator



To simulate complex cloud configurations

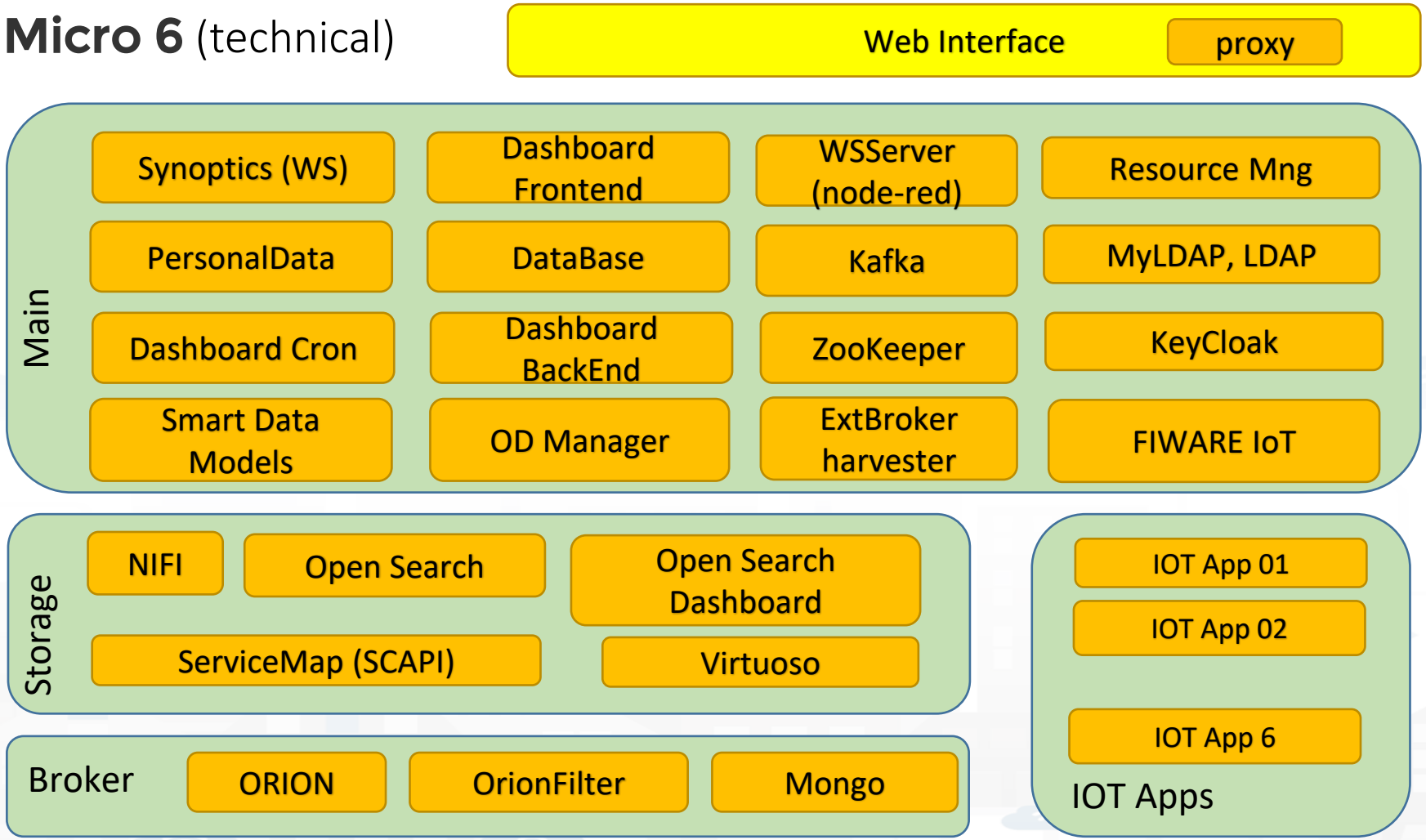
http://www.cloudicaro.it

Identification of optimal configurations allocations on the basis of effective workload


Virtuoso
ServiceMap
Proxy
Kafka
Zookeeper
Dashboard Backend
Dashboard Frontend
Database
WSServer
IoT App 2
IoT App 1
Mongo
IoT Broker
Orion Filter
Personaldata
Nifi
Opensearch
Opensearch Dashboard
LDAP Server
MyLDAP
Keycloak
Dashboardcron
IoT Fiware Api
IoT Fiware Harvester
Synoptics
OD insert API
OD get API
OD build API
OD Postgis

Micro 6 model

Micro 6 (technical)



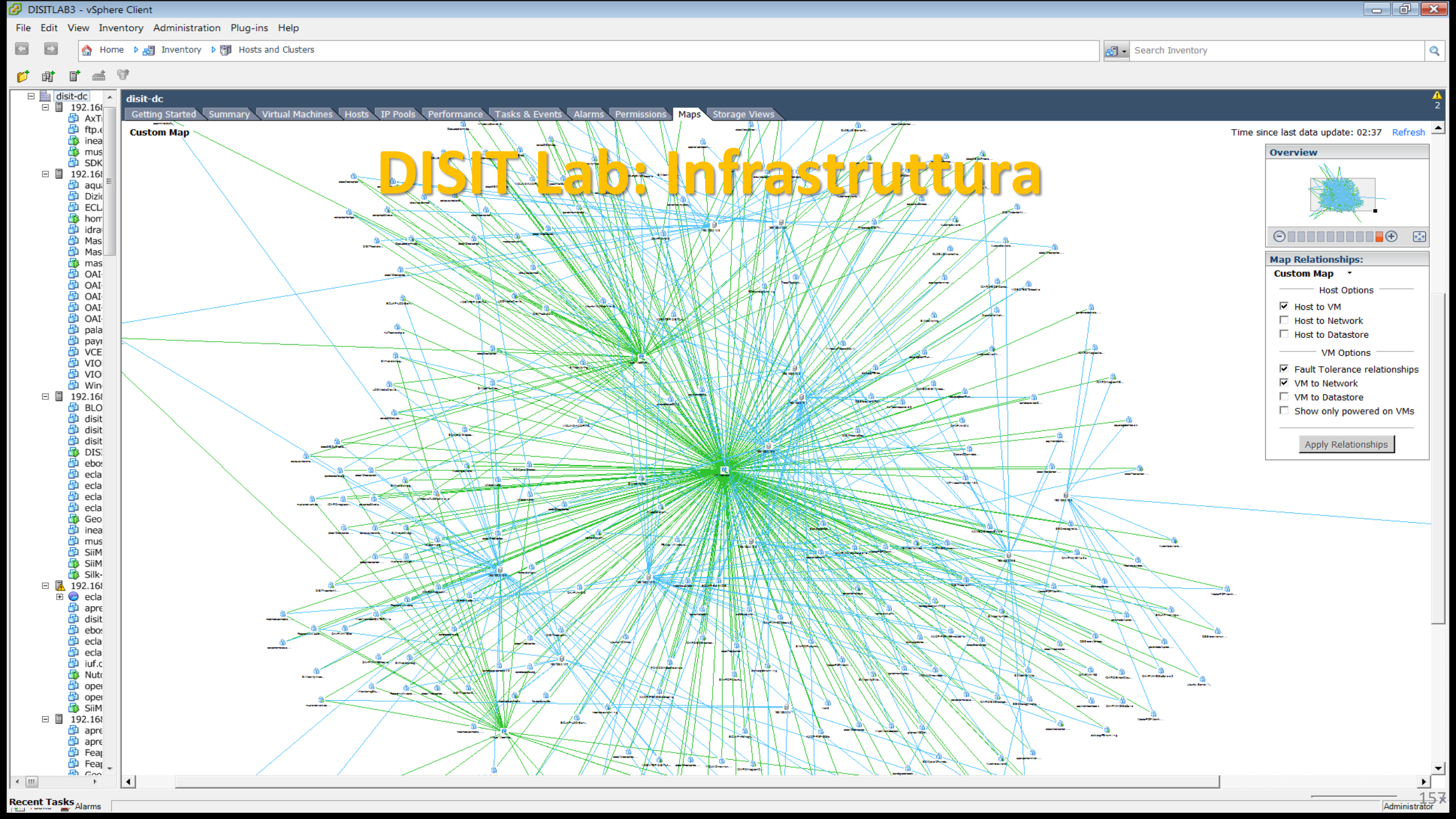
1Hour installation and ready to use

Agenda

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

Infrastructure and support

- **Research group since 1994**
- **Cloud and data center** with >700 TByte storage in raid 50/60,
  - >800 CPU cores, >45000 GPU cores, >8 Tbyte RAM
  - Managing several infrastructures
- **DISIT lab/Snap4City.org :** development and testing r**eference** for:
  - FIWARE Certificates and Experts
  - GAIA-X, EOSC, Node-RED library, etc.
  - Nodo CINI per: Big data, Smart City, Security
- **Open Data and Linked Open Data center**
  - **Integration of more than 800 different Open Data**
  - **LOD** for global linked data https://LOG.disit.org


DISITLAB3 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Hosts and Clusters
Search Inventory
disit-dc
Getting Started Summary Virtual Machines Hosts IP Pools Performance Tasks & Events Alarms Permissions Maps Storage Views
Custom Map
Time since last data update: 02:37 Refresh
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
Recent Tasks
Alarms
Administrator

Corsi di docenti DISIT lab

- **Magistrale in Informatica, Magistrale in Artificial Intelligence**
  - **Big Data Architectures** – Prof. Paolo Nesi (Big Data, Data Analytics, Architecture, Cloud, IoT)
  - **Knowledge Engineering** – Prof. Pierfrancesco Bellini (Knowledge Engineering, Natural Language Processing)
  - **Security and Privacy** – Proff. Nesi and Bellini (Web security, privacy, GDPR, tracking)
- **Dottorati:**
  - PhD-AI, dottorato nazionale in Intelligenza Artificiale: P. Nesi
  - PhD del DINFO, dottorato in Ingegneria Informatica: P. Nesi, P. Bellini
- **Altri corsi:**
  - Master in Big Data-MABIDA: architetture, Big Data, Knowledge engineering, Natural Language Processing, cloud, etc.
  - Master IOT Industria 4.0 di Pisa – Prof. P. Nesi
  - Data Intelligence – Corso di Intelligence e Sicurezza Nazionale – Prof. Paolo Nesi
  - Altri master…..
- **Triennale**
  - Sistemi Distribuiti – Prof. Paolo Nesi
  - Sistemi Operativi – Prof. Pierfrancesco Bellini
  - Fondamenti di Informatica – Prof. Gianni Pantaleo, Stefano Bilotta

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Big Data Architectures, 2022

- **Overview del corso e del Lab (queste slide)**
- **Cloud:**
  - virtualizzazione, HA, DRS, FT, architetture
  - Container: Marathon, Mesos, Docker, Kubernetes
- ***Storage:***
  - *VIDEO: Indexing and Search: SOLR, SOLR Sharded, Elastic Search*
  - *VIDEO: Big Data Storage Confronto: Hbase, Mongo*
- **Architetture**
  - Data Lake vs Data Warehouse
  - Batch and Data Stream processing:
  - IOT Architecture: AWS, Azure IOT, Google IOT,
  - Snap4City IOT/IOE, IOT Industry 4.0
- **Analytics**
  - Mobility and Transport: traffic flow reconstruction, modeling, etc.
  - Big Data Analytics (base): Time Series, predictions,
  - Visual Analytics: Business intelligence, Dashboard (esteso)
  - [Tensor Flow for traffic reconstruction, and simulation]
- **3 CFU per arrivare a 9**
  - **Esercitazioni**
  - **VIDEO: Hadoop, MapReduce, Spark**

Corso a 6 CFU
Corso a 9 CFU

Indicativamente il Corso a 6 CFU finisce a fine Novembre

Modello del Corso

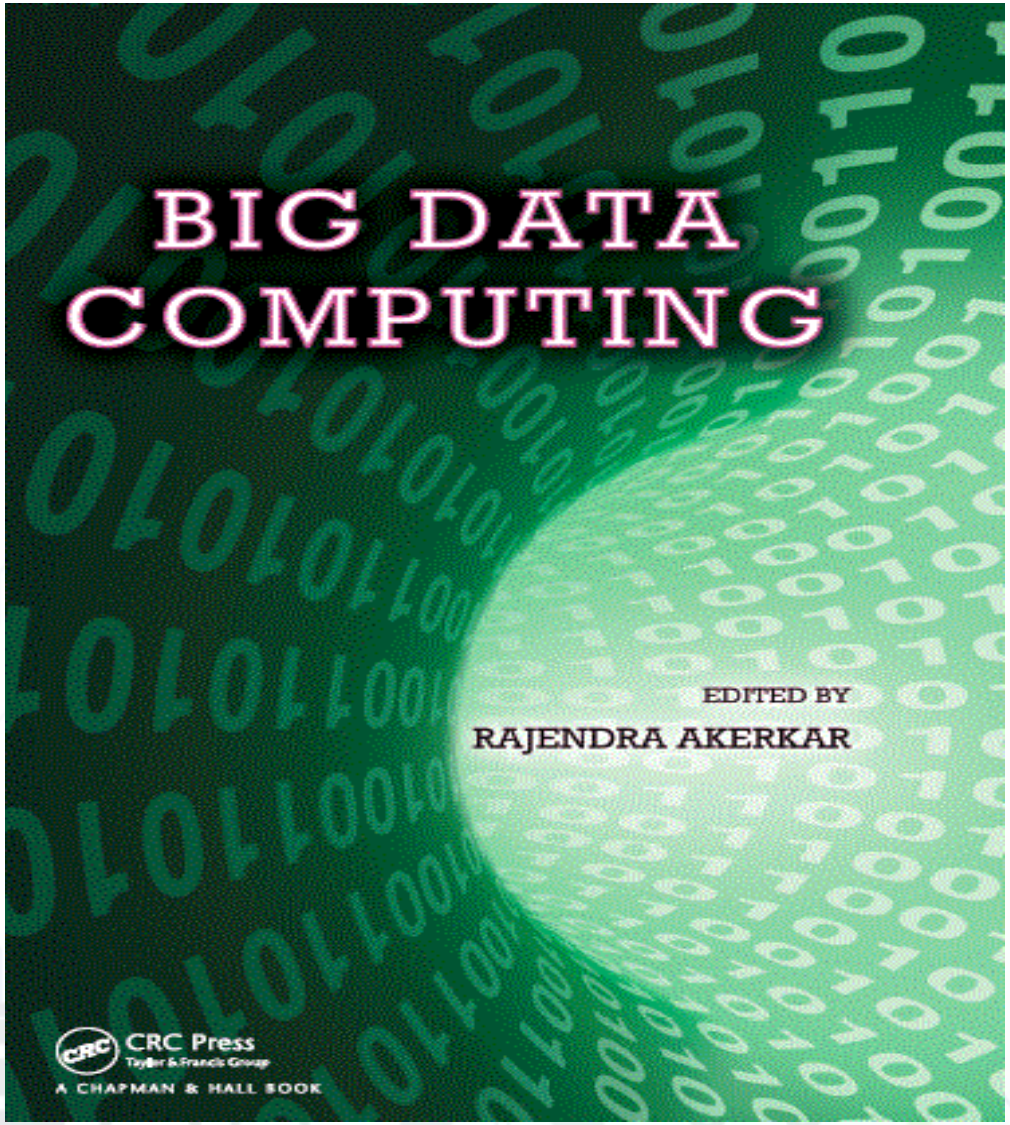
- **Tipicamente per ogni argomento sono presentati:**
  - Requisiti e motivazioni dello sviluppo dell'argomento
    - Punto di vista dell'utente e del gestore
  - Stato dell'arte
    - Basi teoriche e tecnologiche, Eventuali standard
    - Prodotti di mercato (leader), pro e contro
  - Recenti Innovazioni 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

- **Ricevimento per la didattica frontale**
  - Skype, cercatemi come: Paolo.nesi@unifi.it
  - qualsiasi ora,
    - rispondo in chat se necesario fissiamo via skype una call

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



Agenda

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Superamento esame

- **Corso a 6 CFU**
  - **Modalita' per il superamento dell'esame: Orale/scritto**
    - **Chi preferisce puo' fare elaborato**
  - **Eventuale Project Work / Laboratorio per 3 CFU**
    - **Modalità: discussione elaborato**
- **Corso a 9 CFU**
  - **Modalita' per il superamento dell'esame: solo elaborato**
- **Eventuali stage e tesi anche collegati fra loro e con il Lab**

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, installazioni, test, valut. prestazioni.
  - (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.