



Snap4City *Tools for
rapid implementation of
- Sustainable Smart Solutions
- Decision Support Systems
as a no-coding, low-coding*

Paolo Nesi *snap4city@disit.org, <https://www.Snap4city.org>*

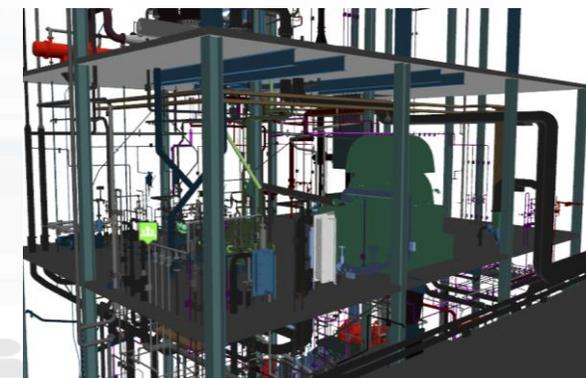
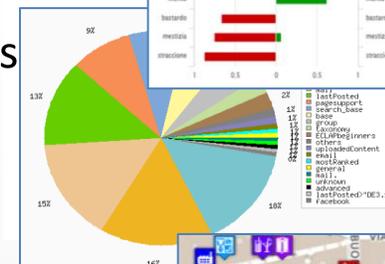
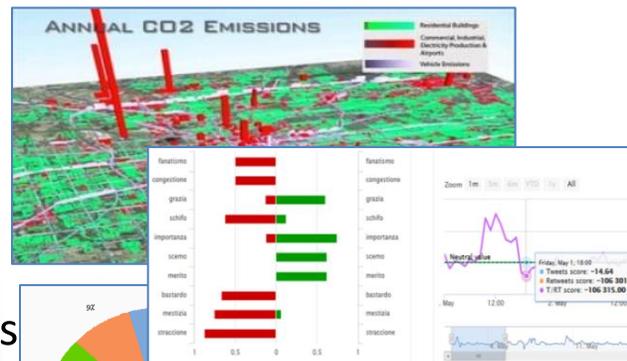
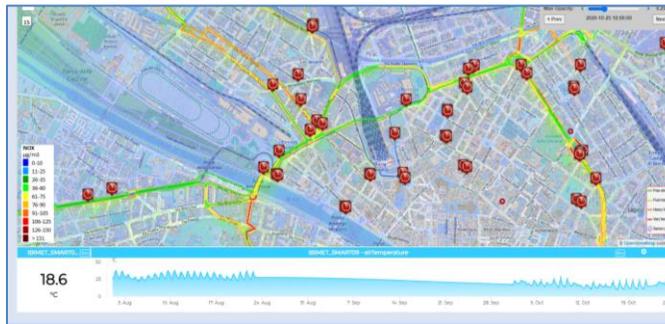
Digital Twin

- **Digital Twin**

- **Connected** with real systems
- **Modelling** aspects: structural, visual, informative, real time data sensors (context), POI, functional, resources, etc.
- **Integration:** AI/XAI techniques, simulations, users' needs, etc.

- **Utility to**

- Experiment via simulations and analysis by case
 - Reduction of costs to experiments new solutions
 - Share the possibilities with city users
- Virtual Representation
 - Easier to understand the context, review from multiple points of view
- Who
 - Discussion with city users, decision makers
 - Support: decision makers, proposers of solutions





SMART SOLUTIONS AND DECISION SUPPORT SYSTEMS

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



Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

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 ...

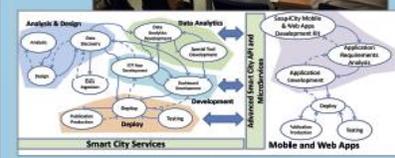
ANY: DATA, BROKER, NETWORK AND VERTICAL

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

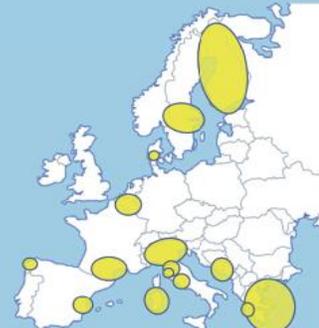
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE EXPLAINABLE AI, MACHINE LEARNING OPERATIVE RESEARCH, STATISTICS

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



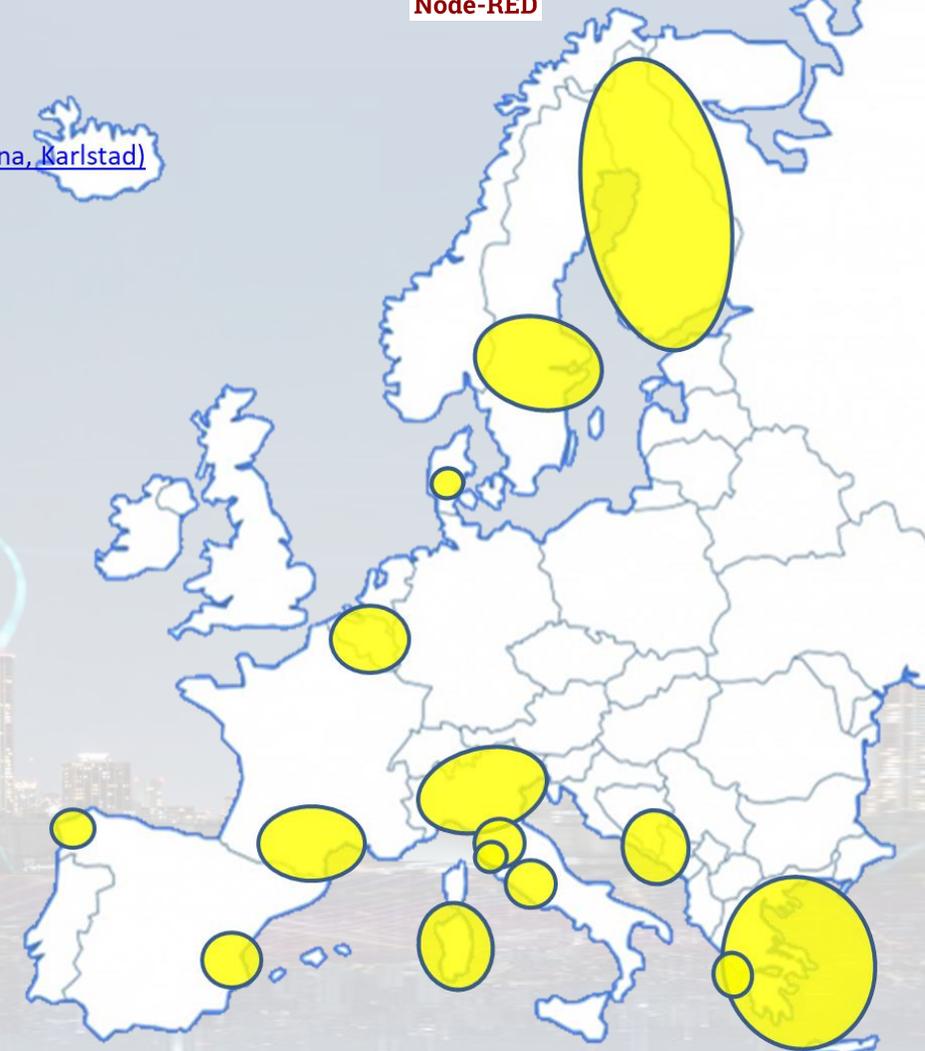


- 11 running installations in Europe
 - Snap4.city.org, Greece, Merano, ...
 - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
 - Altair, Italmatic, Sweden, Romania,
- 16 projects, 12 pilots on 10 Countries
 - >40 cities/area
- **Widest MULTI-tenant deploy has**
 - 19 Organizations / tenant
 - > 8000 users on
 - > 1600 Dashboards
 - > 16 mobile Apps
 - > **2.1 Million of structured data per day**
 - > 520 IoT Applications/node-RED
 - > 700 web pages with training
 - > 70 videos, training videos

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 \(Gr\)](#)

- + Israel, Colombia, Brasile, Australia, India, China, etc.



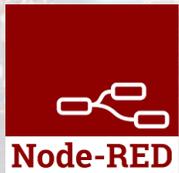
Standards and Interoperability (9/2022)



Compliant with:

- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **General:** HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP,
- **Formats:** JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, Lidar, gITF, GLB, DTM, GDAL, Satellite, D3 JSON, ...
- **Database:** Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, PostGres, MS Azure, ..
- **Industry:** OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility:** DATEX, GTFS, Transmodel, ETSI, ..
- **Social:** Twitter, FaceBook, Telegram, ..
- **Events:** SMS, EMAIL, CAP, RSS Feed, ..
- **OS:** Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.

<https://www.snap4city.org/65>



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DISTRIBUITI SISTEMI
E INTERNET
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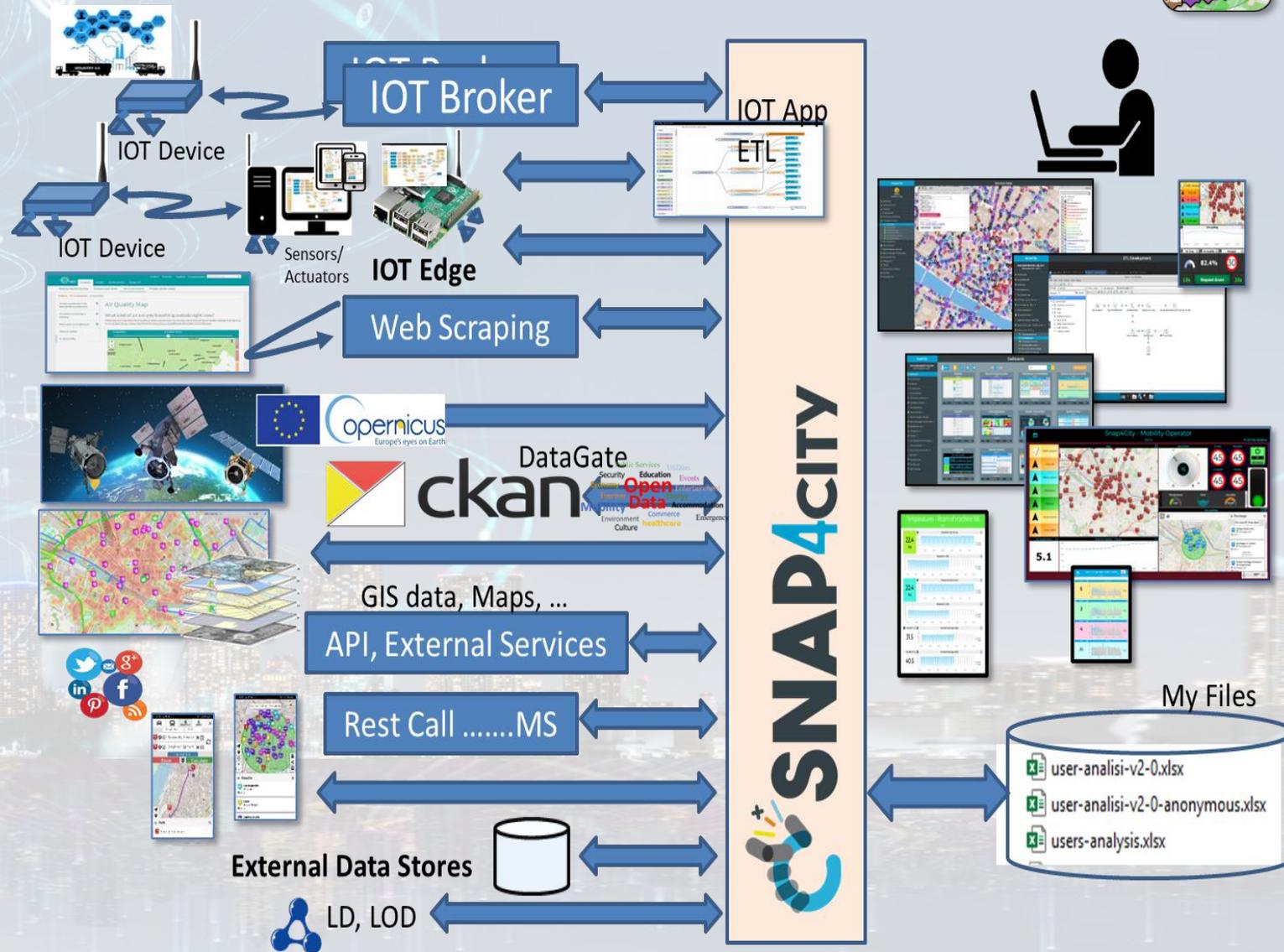
Ingestion, agg. → exploitation

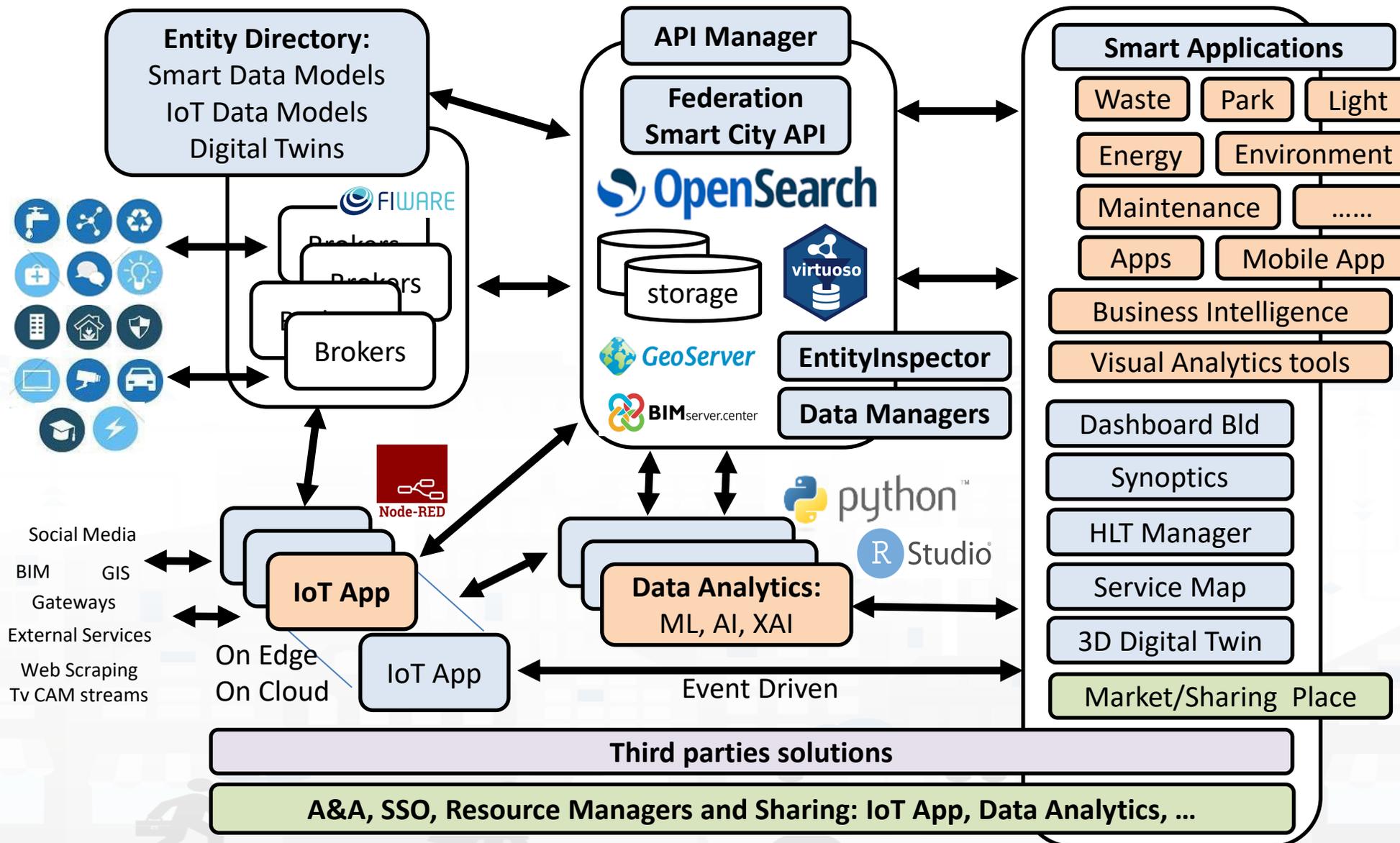


- **Snap4City** efficient tools for

- Bidirectional data channels
- Any format, any channel, any data, any broker, any protocol, ...

- **Km4City** Knowledge base Ontology reasoning on geo, space, time, relationships

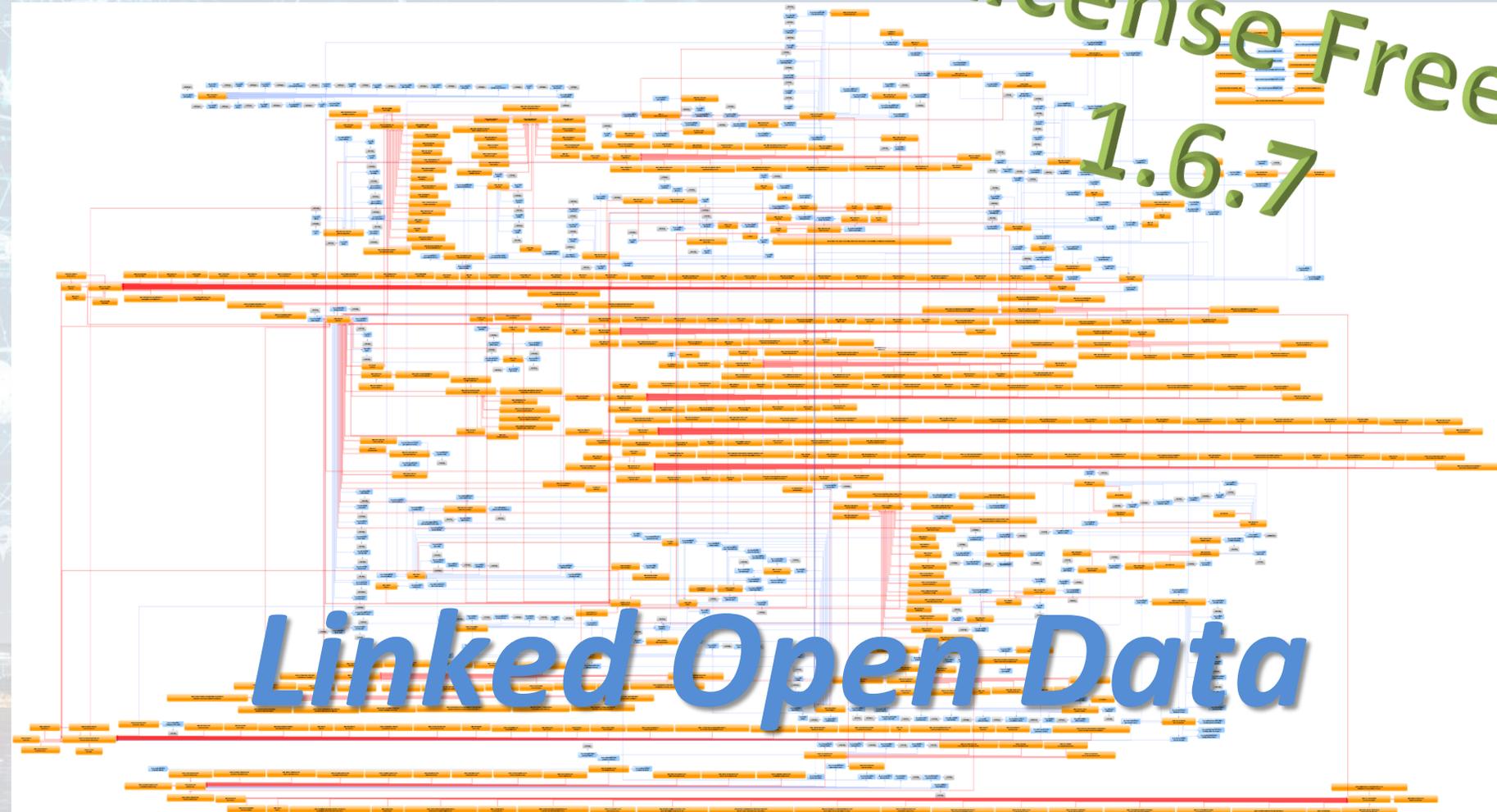




Expert System semantic queries



- **via:**
- **Smart City API**
for
Apps and third
party
- **MicroServices**
data driven
develop via
visual language
Node-RED

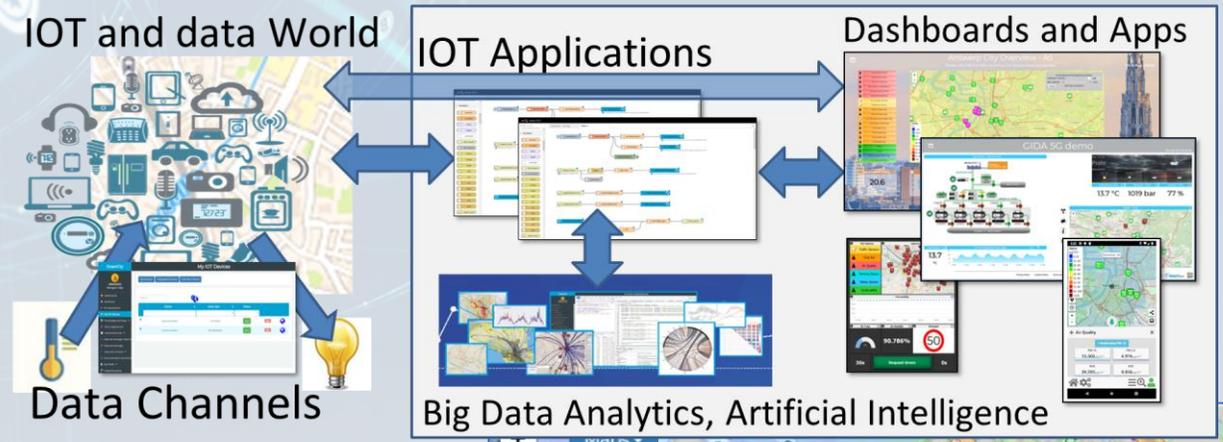


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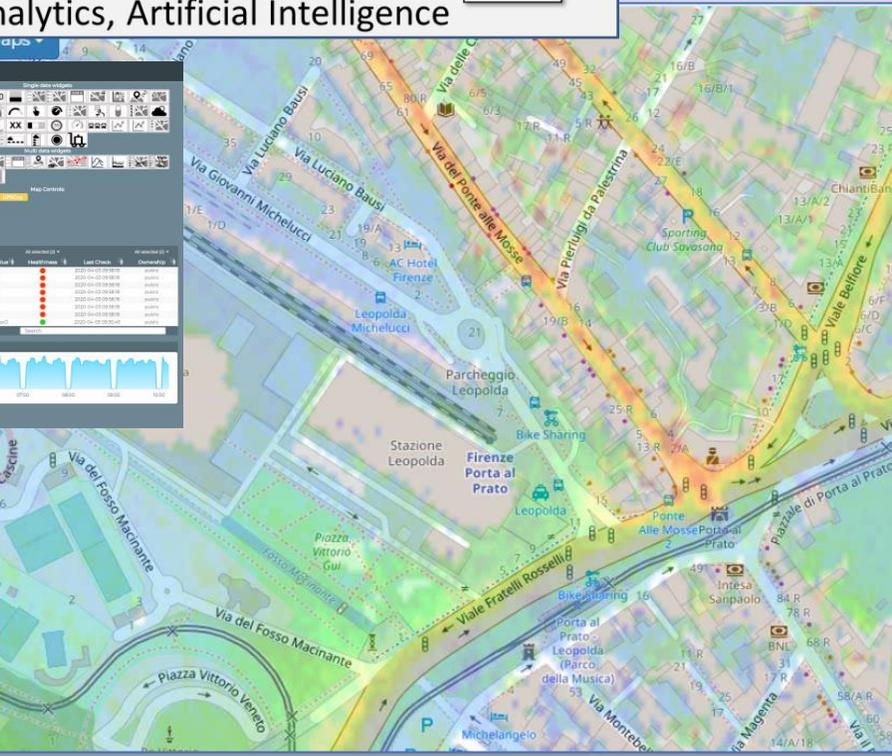
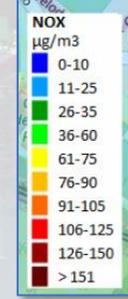
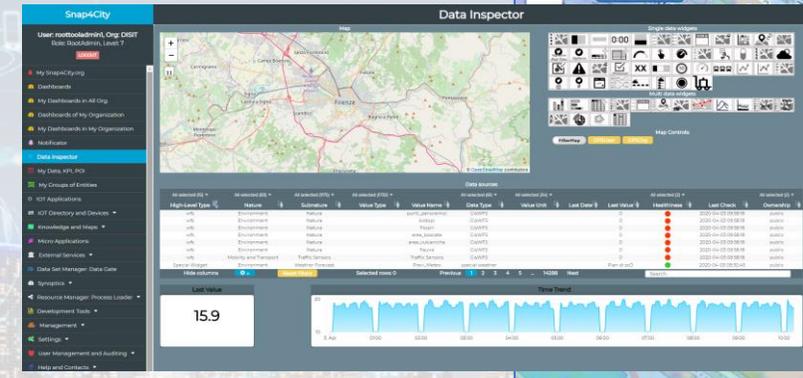


Fast to realize reliable & secure Solutions

- Via Snap4City tools
 - Dashboard Wizard
 - Dashboard Builder
 - Data/Visual Analytic



- Smart Solutions results to be
 - Real time data drive
 - Secure end-to-end
 - GDPR compliant
 - Reliable, interoperable
 - Auditable, marketable



High Level Types

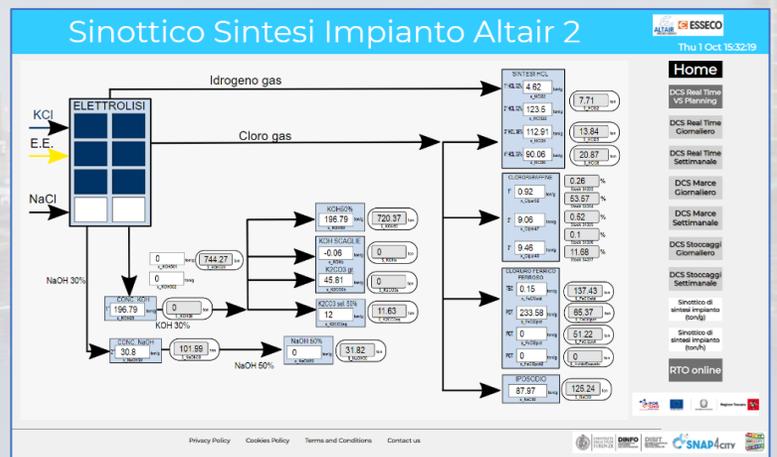
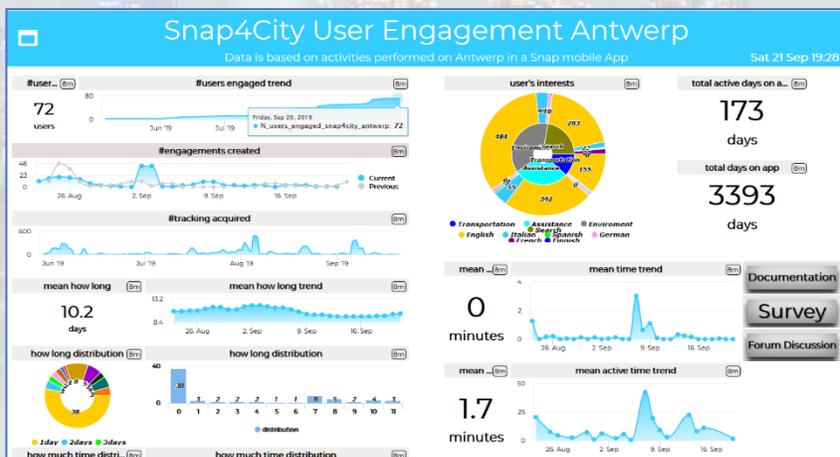
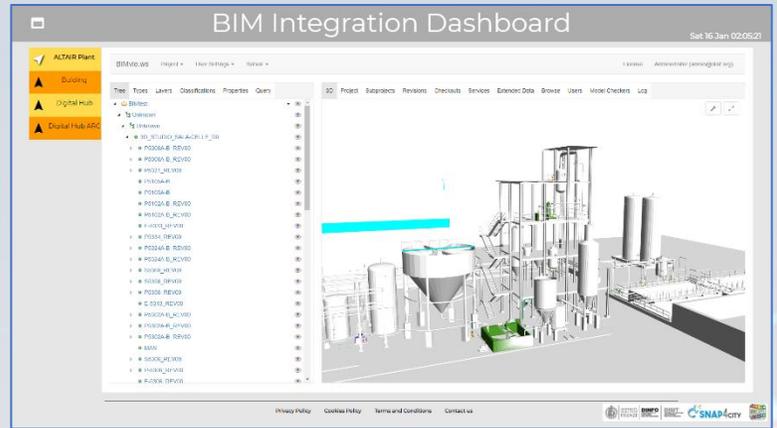
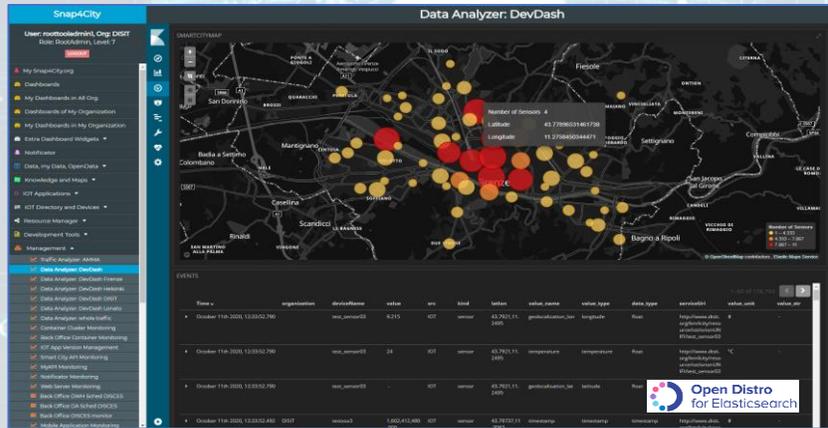
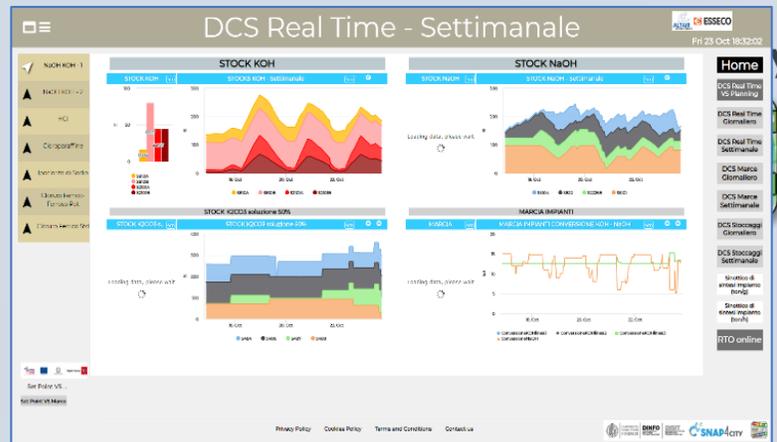
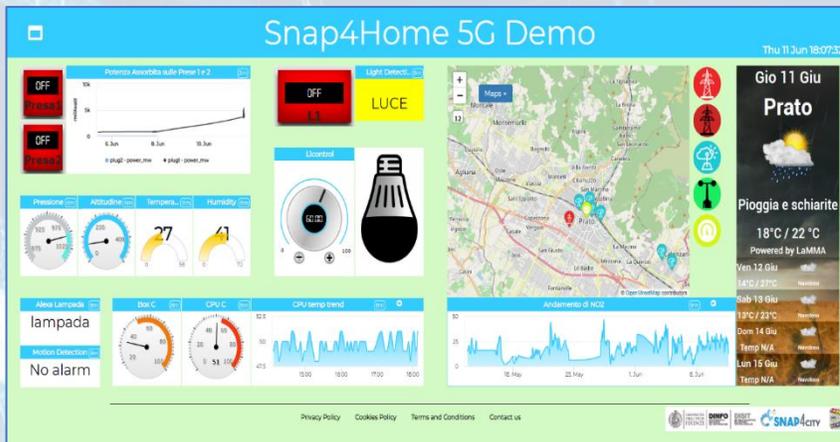
- POI, IOT Devices, shapes,...
- FIWARE Smart Data Models,
- IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of several kinds,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



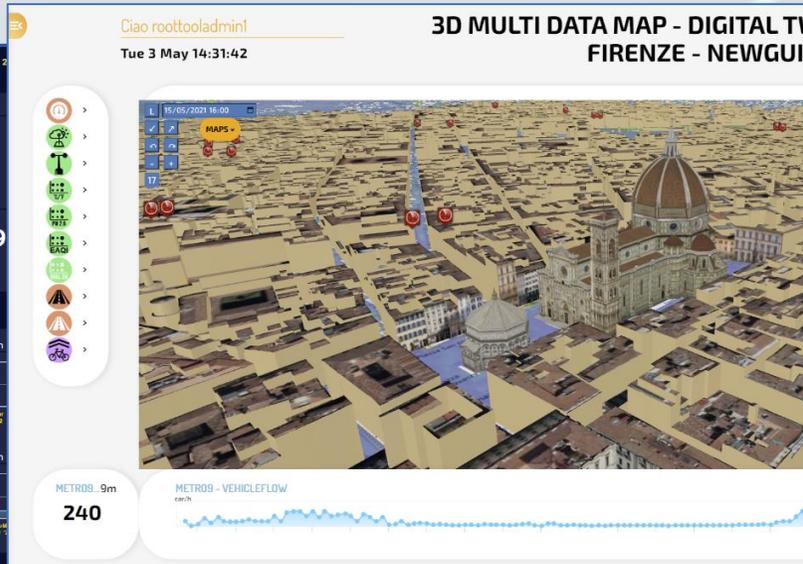
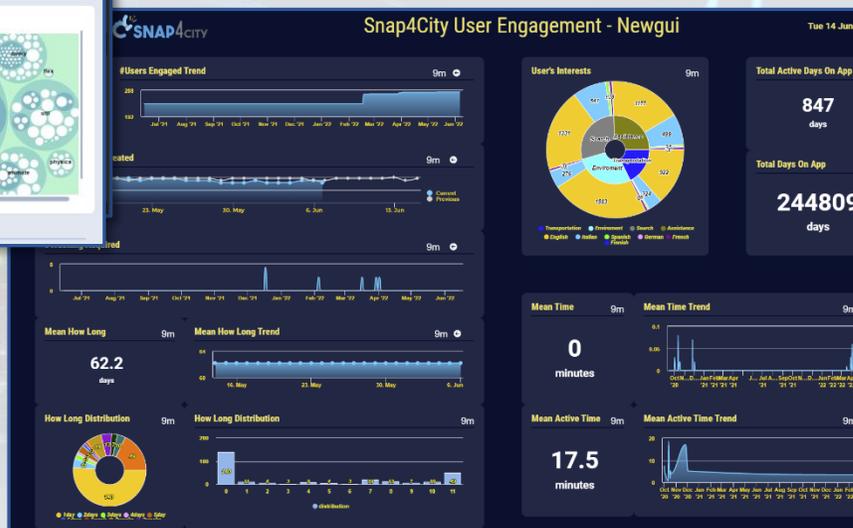
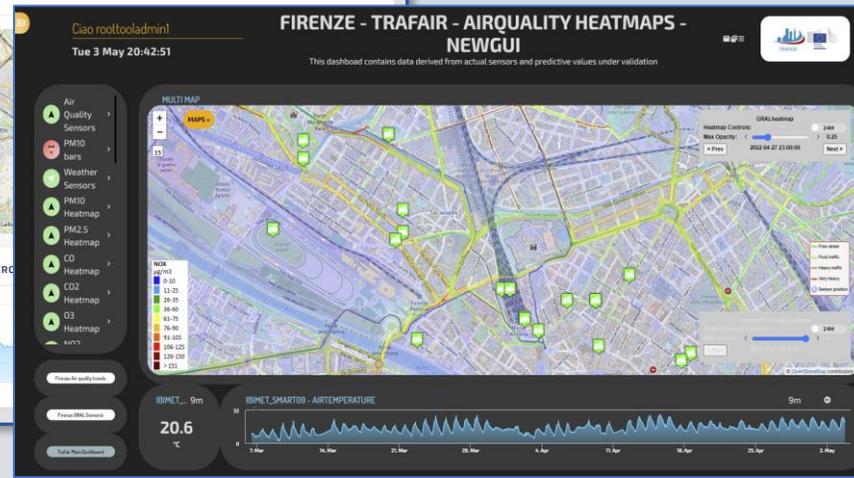
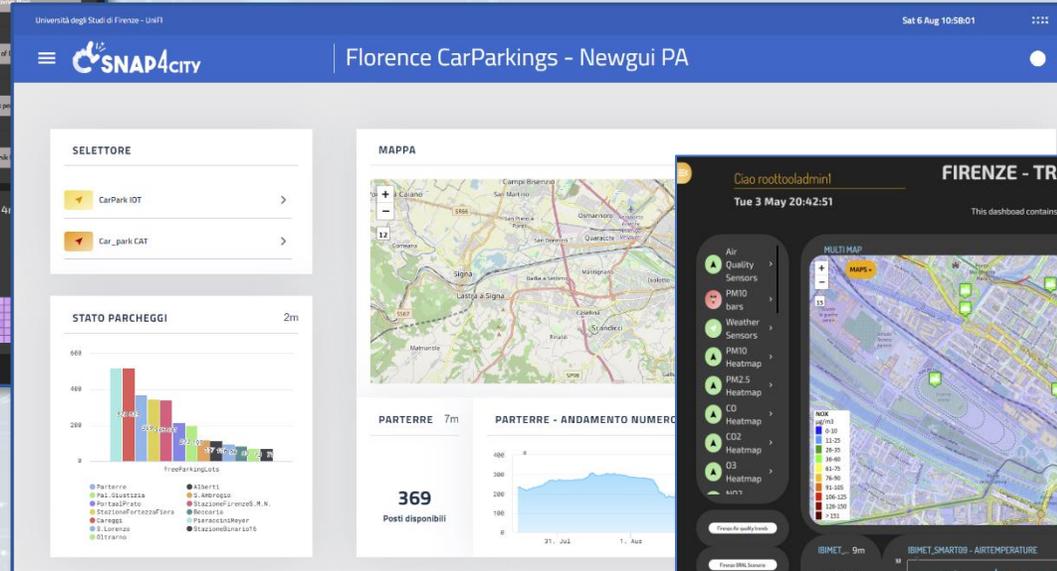
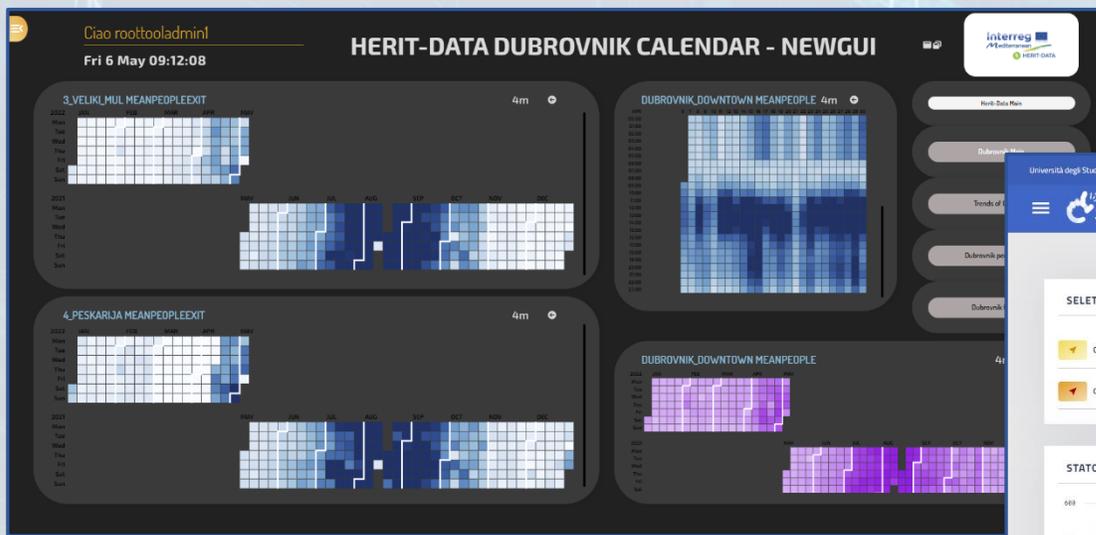
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Different Themes



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

<https://www.snap4city.org/793>

Ciao roottooladmin!

Tue 3 May 14:37:14

DIDA DATA 2 - NEWGUI

to see BIM log as user: info@disiit.org, passwd: guest

BIM SANTA VERDIANA

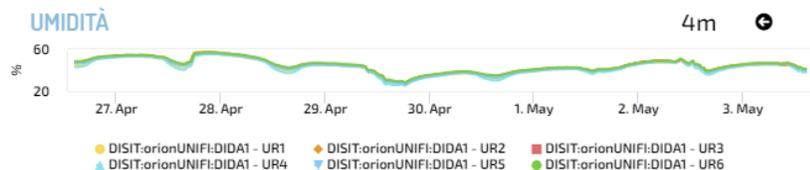
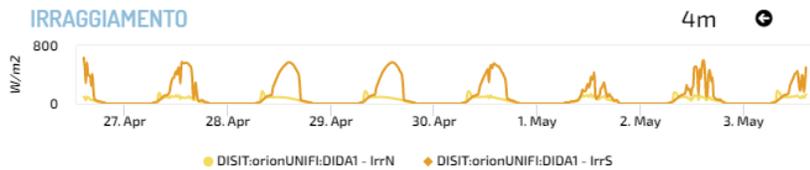


Last Value

Time Trend Chart: Glob - Day



No data



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzI4OA==>



• **15 Minute City Index:**

- 13 subindexes: energy, slow mobility, fast mobility, housing, economy education, culture and cults, health, entertainment, gov, food, security...

10/22



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



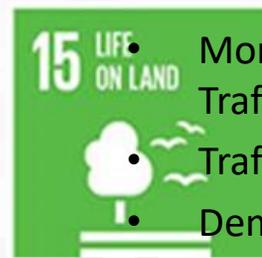
- Industry 4.0 integrated solutions
- Decisions Support Systems
- Process optimization, control
- Predictive maintenance



- Smart City infrastructure: monitoring and resilience, long terms predictions
- Effective and Low cost smart solutions
- What-if analysis, Simulations
- Origin Destination matrices computation



- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Optimization of Waste Collection



- Monitoring and Predicting: NO2, NOX, CO2, Traffic flow, pollutant, landslide, waste, etc.
- Traffic flow reconstruction
- Demand vs Offer of Mobility analysis



- Shortening justice time
- Anonymization and indexing legal docs.
- Prediction of mediation proneness
- Ethical Explainable Artificial Intelligence



Big Data Analytics + Artificial Intelligence

- **Short and Long terms predictive models on:**
 - traffic, parking, people flow, maintenance, land sliding, NO2
- **3D Flow prediction:** Pollutant (NOX, NO2, ...)
- **Early warning, City Indexes, etc.**
- **AI & XAI:**
 - RF, XGBoost, BRNN, RNN, SVR, DNN, LSTM, CNN-LSTM, Autoencoders, ...
 - Clustering: K-means, K-Medoid, ...
 - XAI: Shap, variations, ..
- **Modeling, simulation, routing**
 - Traffic Flow reconstruction
 - Constrained Routing
- **What-IF analysis** (simulation + AI + data)
- **Based on several computational models:**
 - trajectories, OD matrices, Typical Time Trends, etc.

to cope with

- *any data, format*
- *any channel, protocol*
- *any AI/ML*
- *any place*
- *online development*
- *multi-tenant*
- *Secure, PENTest*
- *GDPR, privacy*
- **→ low costs**
- **→ easy to evolve**

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

Available Data Analytics

- **Mobility and Transport**
- **Users Behaviour analysis**
- **Environment and Weather analysis**
- **Management and strategies**
 - **Early Warning, What-If analysis**
 - **Resilience and Risks Analysis**
 - **Semantic Reasoning**

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



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

Smart City Control Room

Florence Metropolitan City



reference



• Multiple Domain Data

- Thousands of Open/Private data, POI, IOT, etc.
- **mobility and transport**: accidents, public transport, parking, traffic flow, Traffic Reconstruction, KPI, ...
- **AND**: environment, civil protection, gov KPI, covid-19, social & social media, people flow, tourism, energy, culture, ...

• Multiple dash/tool Levels & Decision Makers

- Real Time monitoring, Alerting, quality assess.
- Predictions, KPI, DSS, what-if analysis

• Historical and Real Time data

- Billions of Data

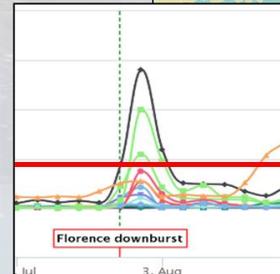
• Services Exploited on:

- Multiple Levels, Mobile Apps, API

• Since 2017



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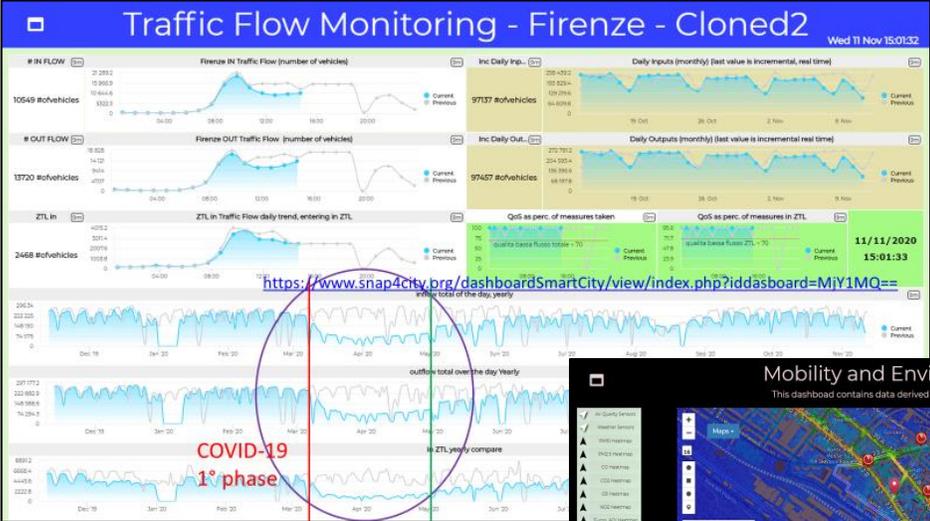


Mobility and Transport Traffic Flow Analysis

Cities: Firenze, Pisa, Livorno, Modena, Santiago di Compostela



- **Multiple Domain Data**
 - Traffic Flow sensors, city structure, weather
- **Decision Makers Multiple Locations**
 - Real time Monitoring, predictions
 - Traffic Flow Predictions,
 - Traffic Reconstructions, routing
 - Dashboards, What-IF analysis
 - Mobile App, people flows
- **Historical and Real Time data**
- **Services Exploited on:**
 - Dashboards, Mobile App
- **Since 2017, 2019**

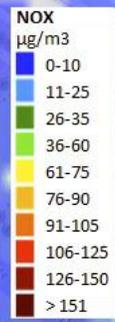
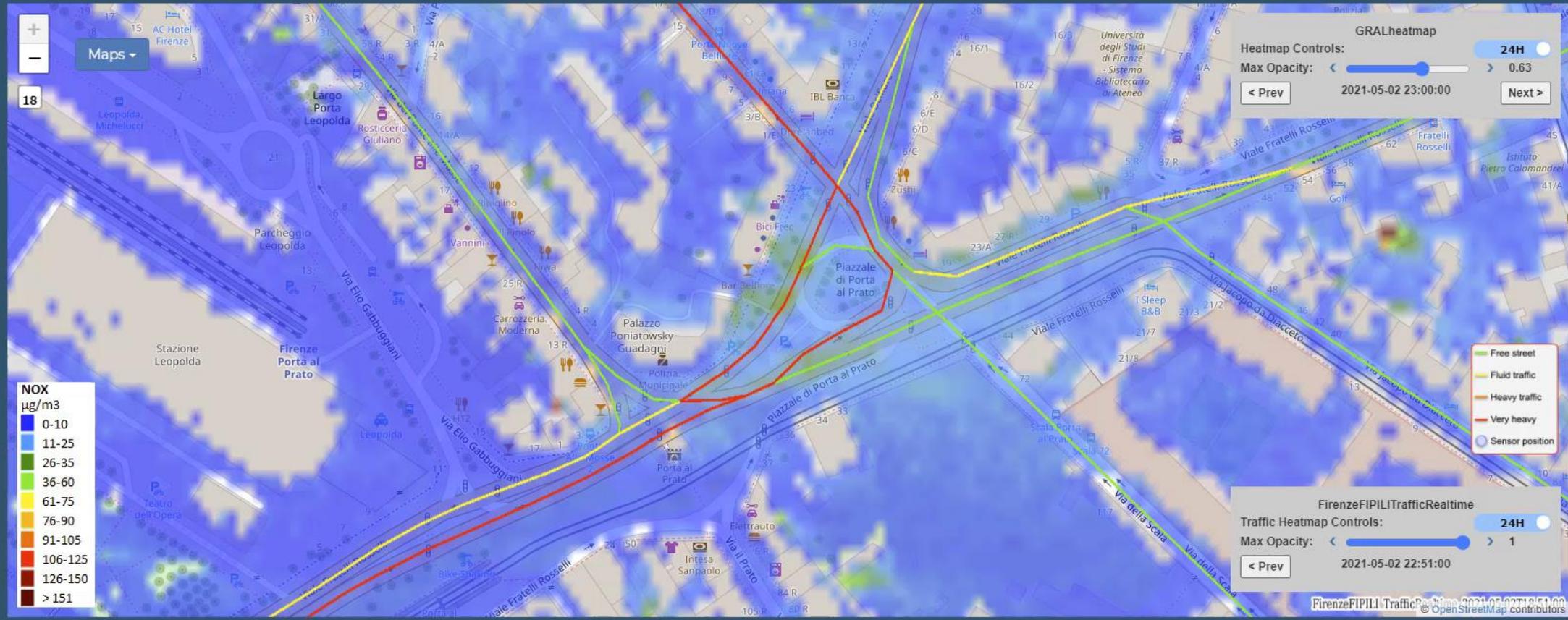




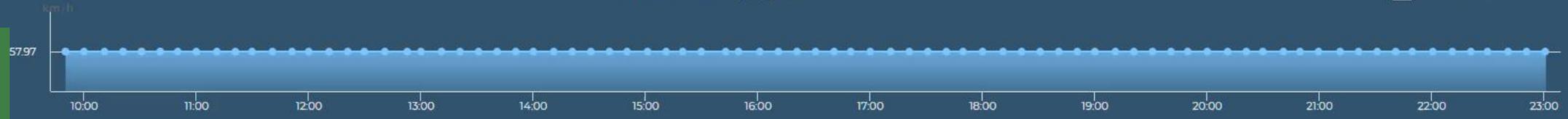
Traffic Flow Manager on multiple cities

Sun 2 May 23:16:31

- Traffic Sensors
- Weather_sensor
- AirTemperatureAverage2HourFlorence
- PM2.5 Heatmap
- GRAL Heatmap
- Gral HRES
- Accident Heatmap
- Traffic Flow
- TFM FIRENZE Real Time
- TFM FIPILI Real Time
- TFM Pisa Real Time
- TFM Livorno Real Time
- TFM Modena Real Time
- TFM Santiago Real Time
- prova hres fipili 2k
- prova hres fipili 4k
- prova hres fipili 8k
- Scenario
- What-if



METROS88 - averageSpeed



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

A view and data from the Thermal Camera

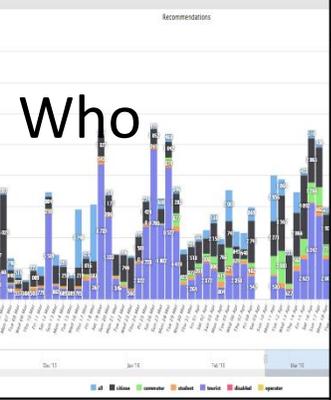


Detection BOX Snap4Thermal PV Firenze Tue 15 Mar 13:30:41

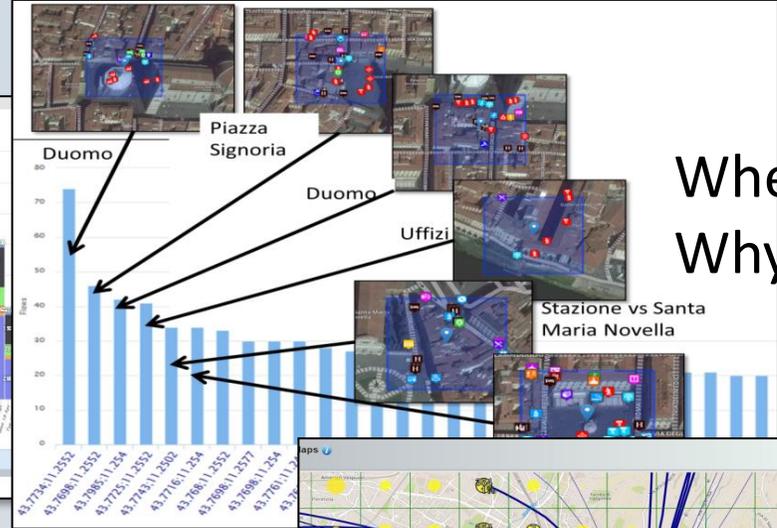




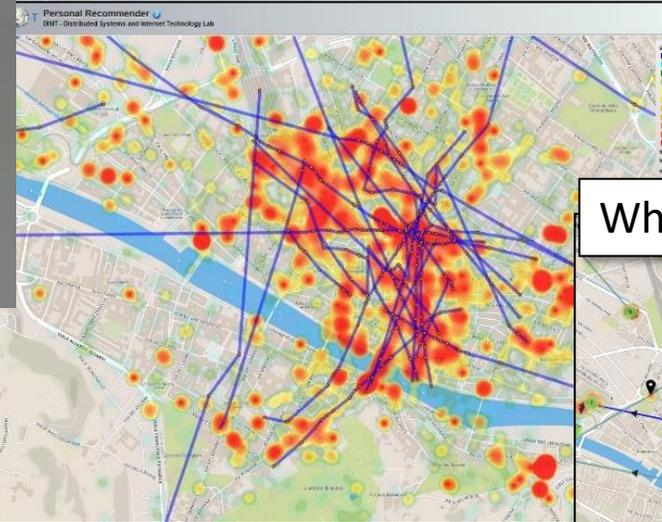
User Behavior Analysis



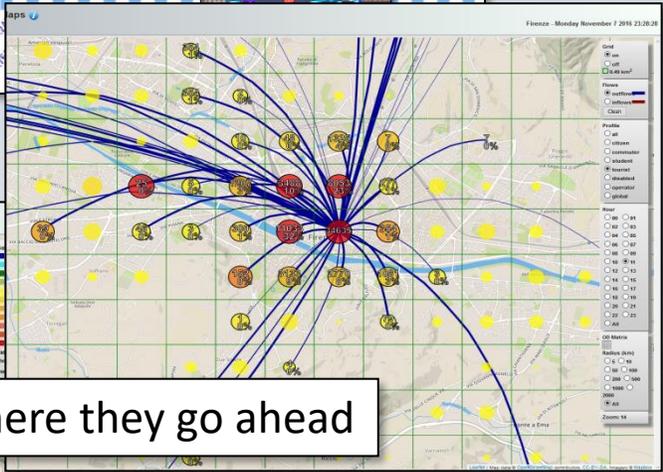
Who



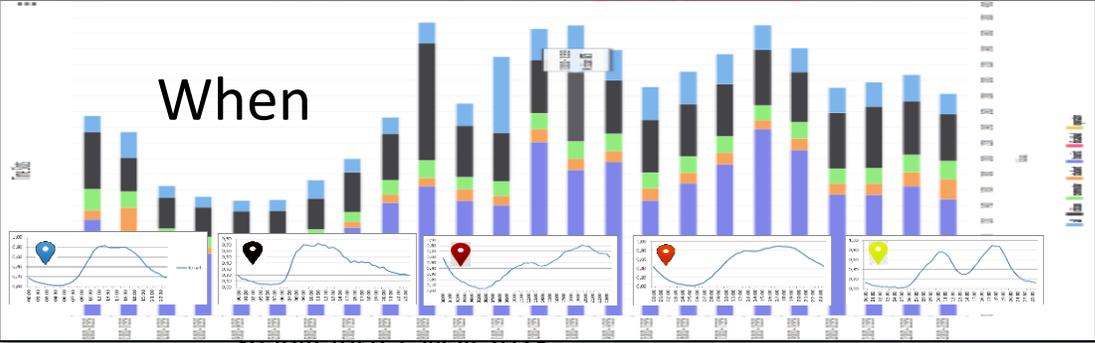
Where?
Why?



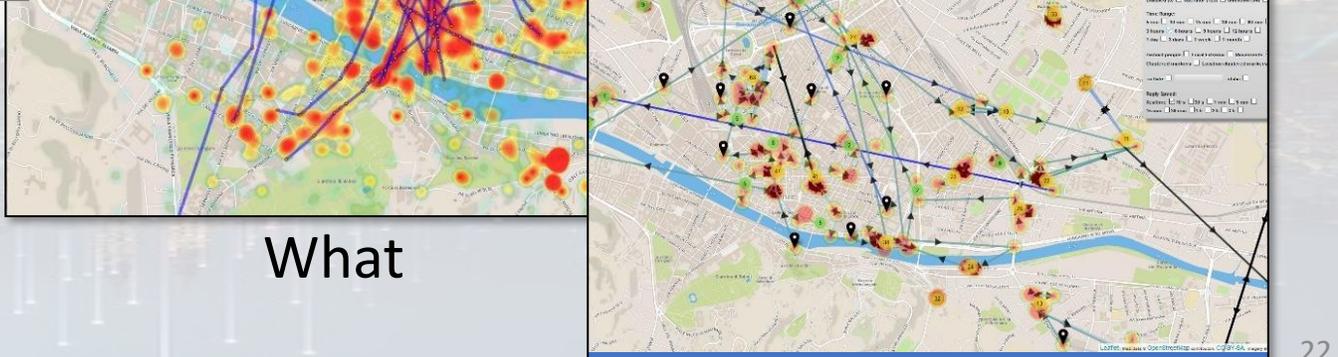
How move



Where they go ahead



When



What



3D Map



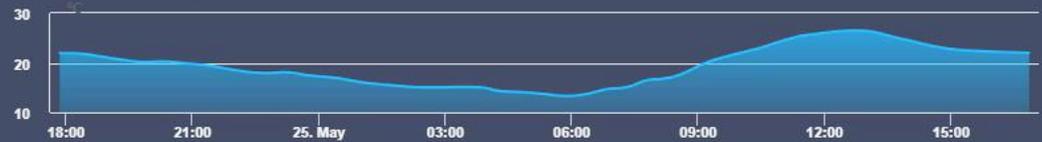
Air Quality FI-BASSI - NO2

6m



Weather_sensor_Open Weather 3176959 - Air Temperature

6m





Switch To New Layout (Beta)

User: nicolaroot, Org: DISIT
Role: RootAdmin, Level: 7

LOGOUT

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- Tour Again
- www.snap4solutions.org
- ダッシュボード
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- My Data Dashboard Kibana
- Extra Dashboard Widgets
- Notificator
- Data Management, HLT
- Knowledge and Maps
- Processing Logics / IOT App
- Entity Directory and Devices
- Resource Manager
- Development Tools
- Management
- Decision Support Systems
- Deploy and Installation



Home / Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

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Username: nicolaroot

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Installations

What People say

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Data Analytics

Dashboards

Living Lab

Smart City API

Training on Tools and Platform

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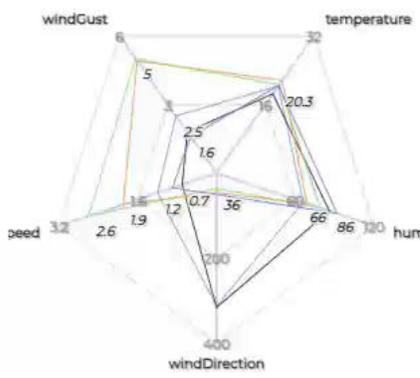
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BIM Airport

Thu 25 May 18:16:22

- Select the view of interest
- Airport Building 1
 - Airport Heatmap dash
 - Terminal Heatmap

Sensor Data 4m



- Sensor_TOS926
- Sensor_TOS1096
- Sensor_TOS1215
- Sensor_TOS811
- Sensor_TOS1205



Last Value	Time Trend Chart
No data	

Digital Twin Local, 3D vs Real Time Data



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Tue 8 Jun 11:04:55

BIM Integration for Digital Twin

ALTAIR Adm Office

Altair Production Line

device list

Valve 786 with trend ▾

Selector - Map

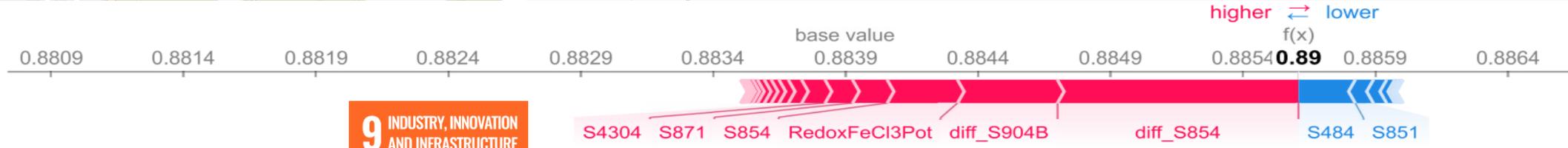
device list

Valve 786 with trend ▾

BIM view

Time Trend Chart: totale_casi - 6 months

CORPISA					
VALUE NAME: CORPISA					
	DETAILS	DESCRIPTION	RT DATA		
1-0,000Z	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days



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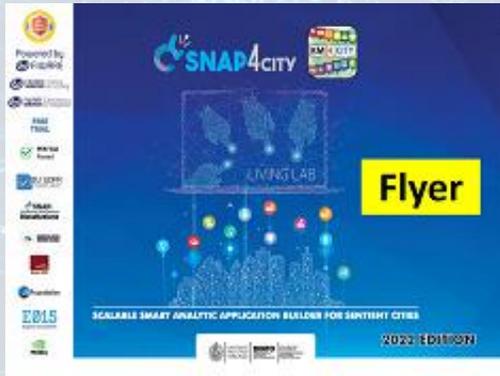
More Info and doc.



2022 booklets

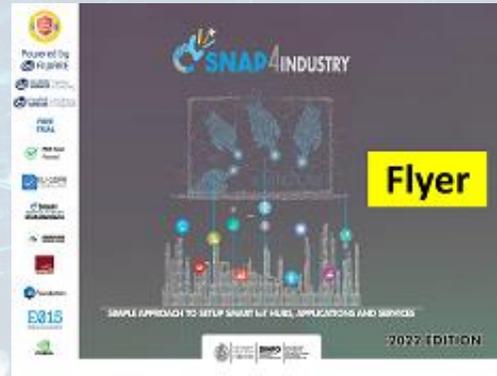


- Snap4City



https://www.snap4city.org/download/video/DPL_SNAP4CITY_2022-v02.pdf

- Snap4Industry



https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY_2022-v03.pdf

- Solutions
- Data Analytics



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

Overview



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Snap4City Platform

Technical Overview

From: DINFO dept of University of Florence, with its
DISIT Lab, <https://www.disit.org> with its Snap4City solution

Snap4City:

- Web page: <https://www.snap4city.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>

Contact Person: Paolo Nesi, Paolo.nesi@unifi.it

- o Phone: +39-335-5668674
- o LinkedIn: <https://www.linkedin.com/in/paolo-nesi-849ba51/>
- o Twitter: <https://twitter.com/paolonesi>
- o Facebook: <https://www.facebook.com/paolo.nesi2>

Access Level: Public.

Date: 05-04-2021

Version: 5.3

1

- <https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf>



Development



Development Life-Cycle

<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle-v1-1.pdf>

From Snap4City:

- We suggest you to read the TECHNICAL OVERVIEW:
 - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg>

Coordinator: Paolo Nesi, Paolo.nesi@unifi.it

DISIT Lab, <https://www.disit.org>
DINFO dept of University of Florence,
Via S. Marta 3, 50139, Firenze, Italy
Phone: +39-335-5668674

Access Level: public

Date: 21-10-2022

Version: 1.4



<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>



Overview



SMART CITIES AND SMART INDUSTRY

Snap4City:
**FIWARE powered smart app
builder for sentient cities**

With the contribution of



- <https://fiware-foundation.medium.com/snap4city-fiware-powered-smart-app-builder-for-sentient-cities-acfe24df49d5>
- https://www.snap4city.org/drupal/sites/default/files/files/FF_ImpactStories_Snap4City.pdf



<https://www.snap4city.org/577>



On Line Training Material (free of charge)

	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
What	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

Video1								
Video2								
Video3								
Video4				none		none	none	none

<https://www.snap4city.org/4>

- [Scenario: SnapBot: Real Time Smart City services via Telegram](#)
- [Scenario: Copernicus Satellite Data](#)
- [Scenario: SmartBed, Materasso Intelligente](#)
- [MicroServices Suite for Smart City Applications](#)
- [Scenario: MODBUS for Snap4Industry Snap4City Applications](#)
- [Scenario: MOBIMART Interreg: MOBilità Intelligente MARE Terra](#)
- [Scenario: City of Roma case, mobility and environmental data](#)
- [Scenario: Herit-Data video and aims](#)
- [Scenario: Control Room vs Video Wall](#)
- [Scenario: Snap4Home the case of: Alexa, Philips, Sonoff, TP-link, etc. \(Italiano\)](#)
- [Scenario: how to manage maintenance and accidents workflows](#)
- [Scenario: Snap4Home, how to exploit Snap4City solution on home automation](#)
- [Scenario: Energy Monitoring](#)
- [Scenario: Multipurpose User Engagement Tools](#)
- [Scenario: 5G Enabled Water Cleaning Control \(smart city, industry 4.0\)](#)
- [Scenario: High Level Control of Industrial Plant \(industry 4.0\)](#)
- [Scenario: Vehicle Monitoring via OBD2](#)
- [Scenario: Events and Museums Monitoring in Antwerp](#)
- [Scenario: High Resolution Prediction of Environmental Data](#)
- [Scenario: Mobility and Transport Analyses in multiple cities](#)
- [Scenario: People Flow Analysis via Wi-Fi](#)
- [Scenario: Antwerp Pilot on Environmental Data](#)
- [Scenario: Helsinki Pilot on Environmental Data](#)
- [Scenario: Firenze Smart City Control Room](#)
- [Scenario: Mobile & Web App: Toscana Where What ... Km4City, Toscana in a Snap](#)
- [Scenario: Helsinki Pilot on User Behaviour](#)
- [Scenario: Antwerp Pilot on User Behaviour](#)



Scenariious

- [Data Analytic: Origin Destination Matrices, Algorithms and tools](#)
- [Data Analytic: Traffic Flow Reconstruction](#)
- [Data Analytic: in general, and the cases of Antwerp and Helsinki](#)
- [Data Analytic: Predicting Air Quality](#)
- [Data Analytic: Analyzing Public Transportation Offer wrt Mobility Demand](#)

TOP



Be smart in a SNAP!

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