

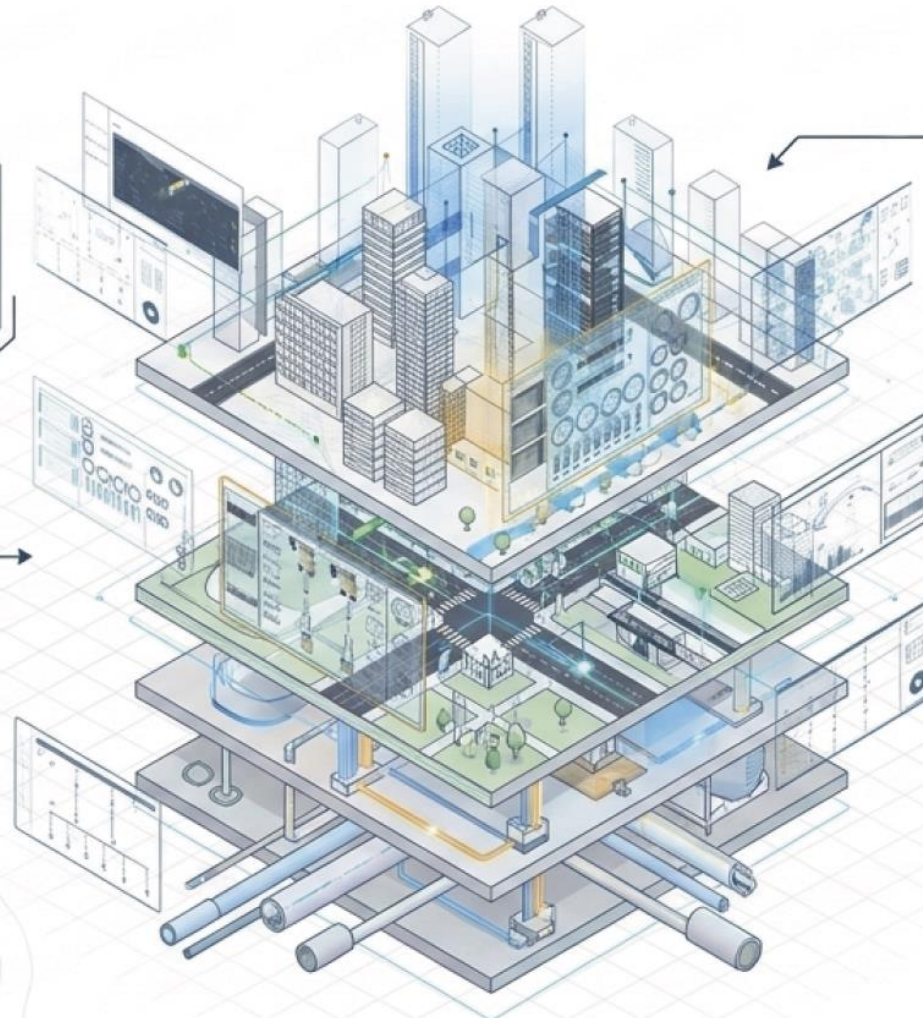
Bingol Smart City Workshop

***Big Data Analytics and IoT-Based
Smart City Platforms: Urban
Mobility and Decision Support
Mechanisms***

Paolo Nesi, Paolo.nesi@unifi.it

Shattering Silos with Global 3D Digital Twins

A multi-domain, multi-tenant platform designed to ingest any data type while respecting its original semantic meaning.



Transitions urban management from reactive, event-driven monitoring to proactive, holistic 3D simulation.

Unifies the fragmented city into a single, highly searchable and actionable Knowledge Base.

End-to-End Intelligence Architecture

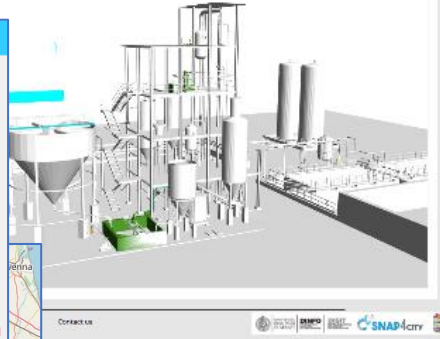
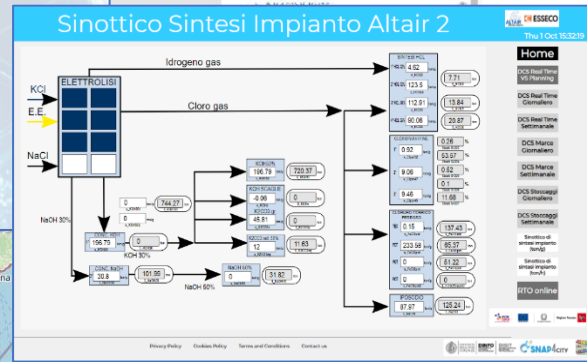
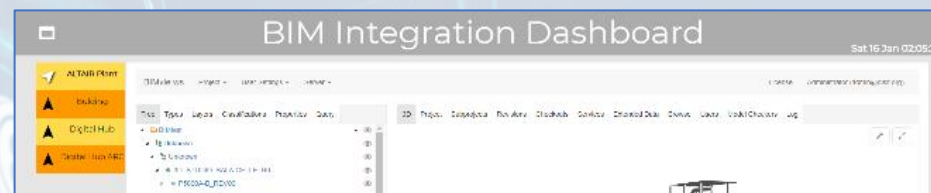


The entire pipeline ensures strict GDPR compliance, encompassing robust authentication and authorization at every level.

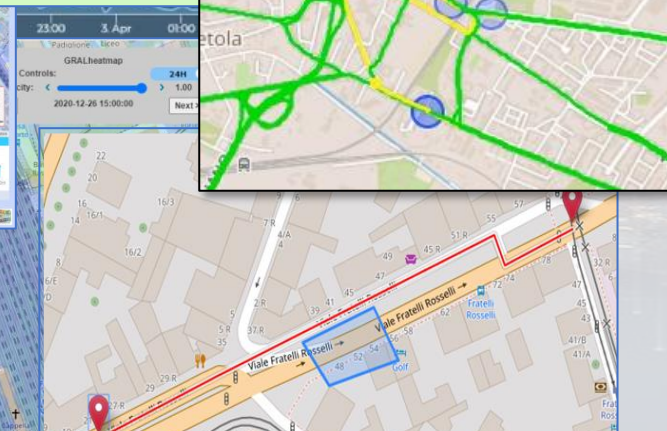
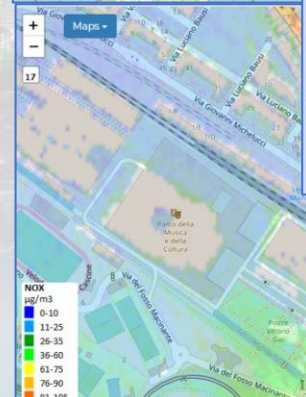
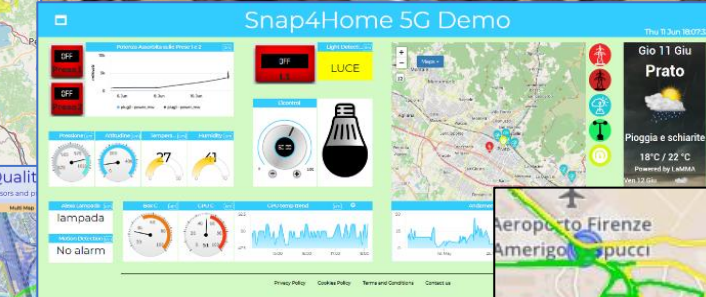
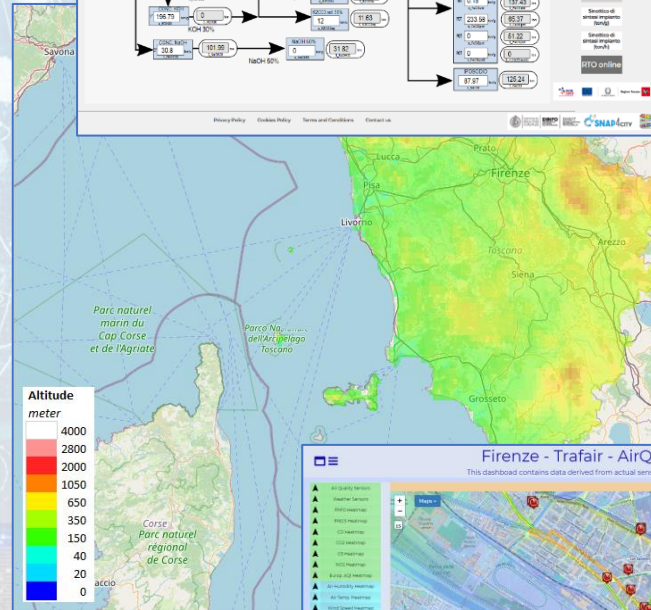
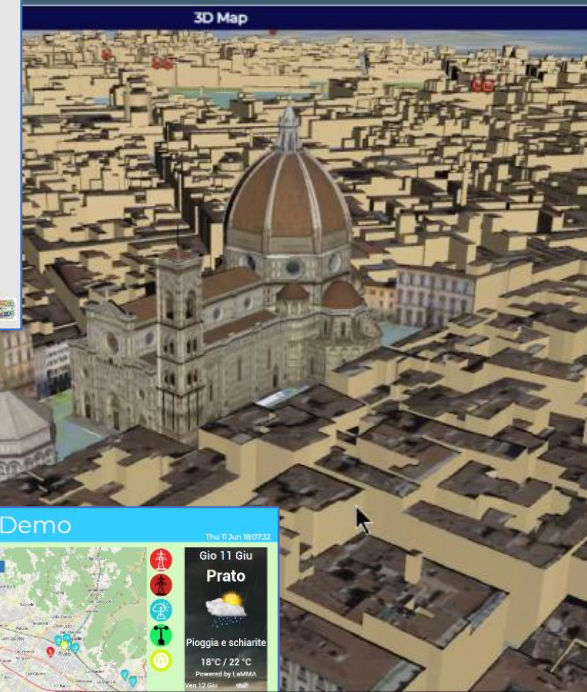
High Level Types

© Snap4City, May 2026, DISIT lab

- POI, IOT Devices, shapes,..
 - FIWARE Smart Data Models,
 - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, any kind..
- traffic flow, typical trends, ..
- Vector fields + heatmaps, ..
- 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, ..
- scenarios,
- etc.



SNAP4CITY
- Digital Twin Global - Fire
demonstrator



UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

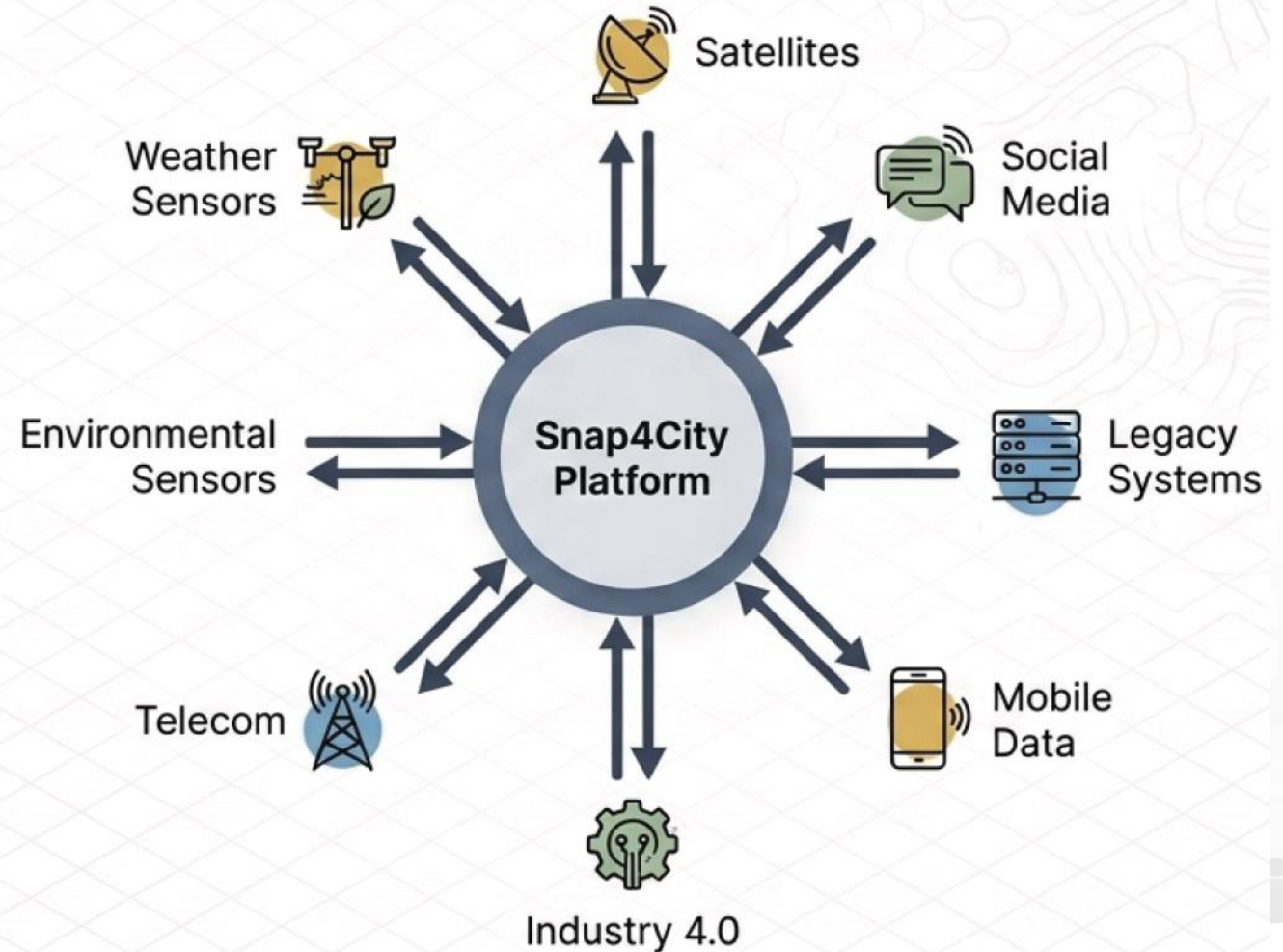
Universal, Bidirectional Data Ingestion

Protocol Agnostic

Seamlessly adapts to existing IoT networks, legacy databases, proprietary vendor solutions, and Open Data portals.

Bidirectional Capability

Snap4City does not merely read data; it actively produces and pushes entities, prescriptions, and warnings back through any channel or protocol.



Ciao

Fri 13 Oct 18:29:18

FLORENCE SCDT

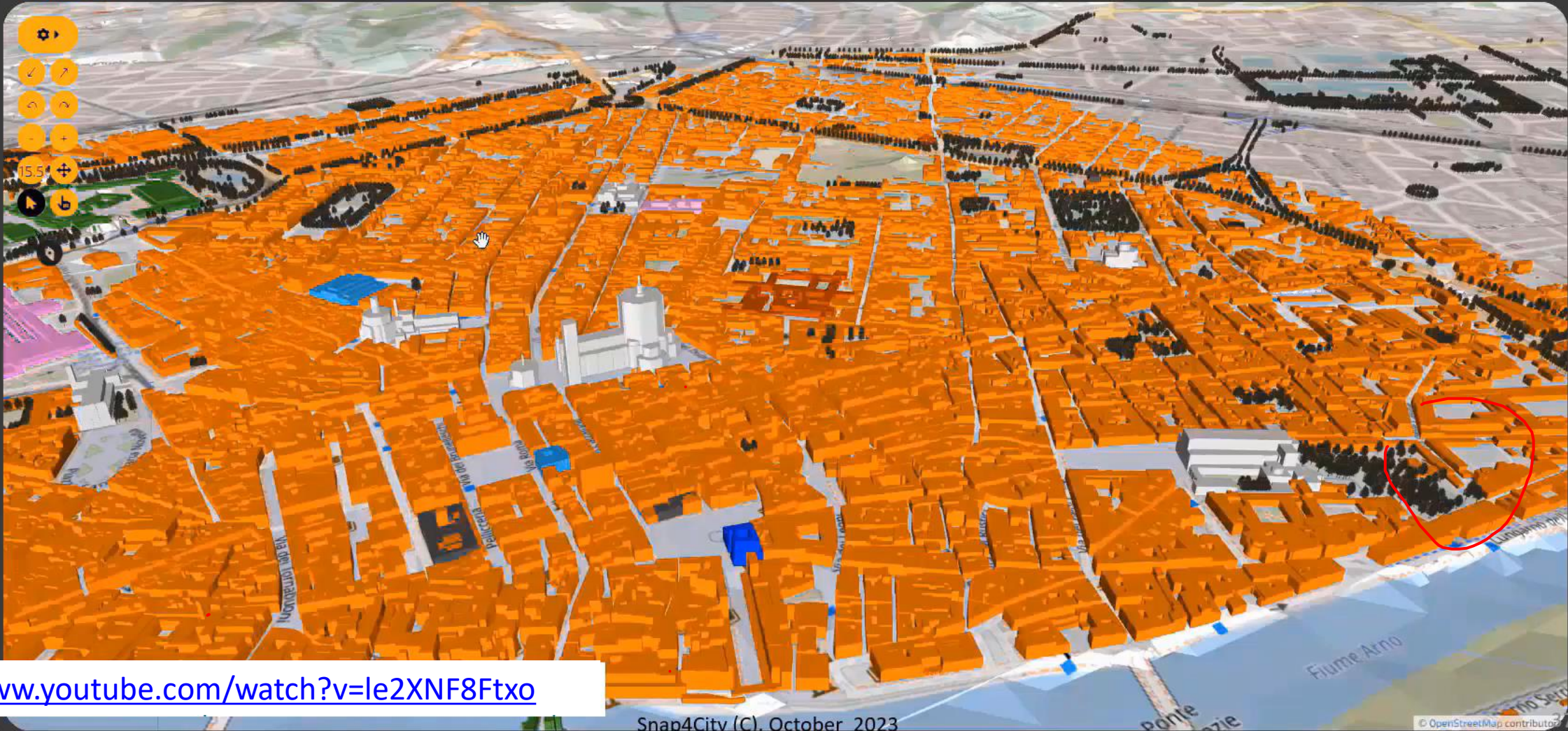


SELECT...

- GRAL HD
- NO 2
- Mobile
- Bar chart
- Highway
- Highway
- Bus
- WHAT-IF
- Car
- Person
- Bicycle

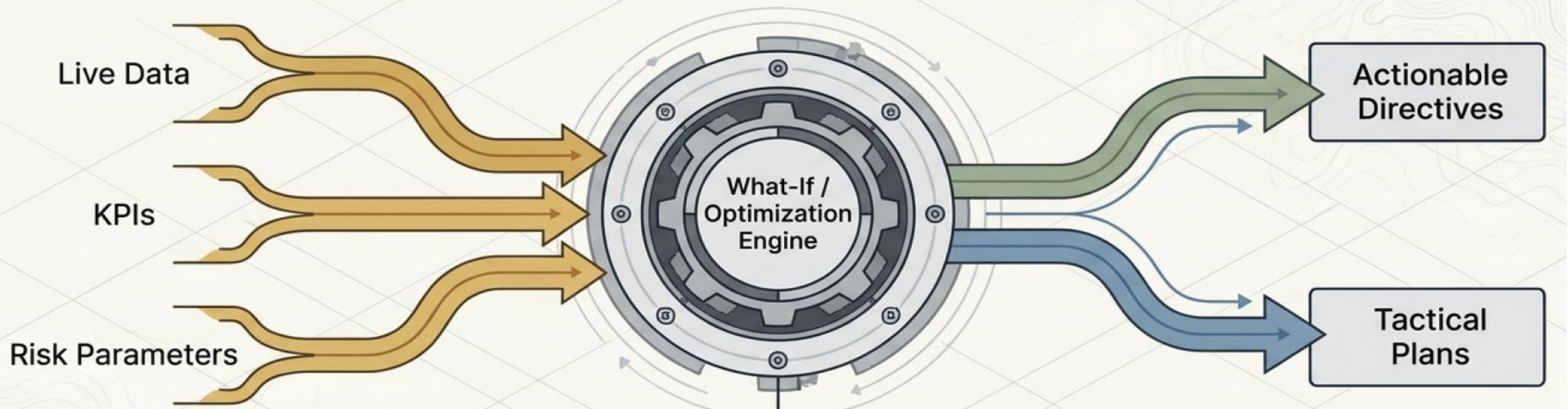
DOUBLE MAP

- Settings
- Layers
- Navigation
- Zoom
- 15.5
- Play
- Home



<https://www.youtube.com/watch?v=le2XNF8Ftxo>

Decision Support Systems



What-If Analysis:

Grounded on robust predictive algorithms and simulations.

Scenario-Based Optimization:

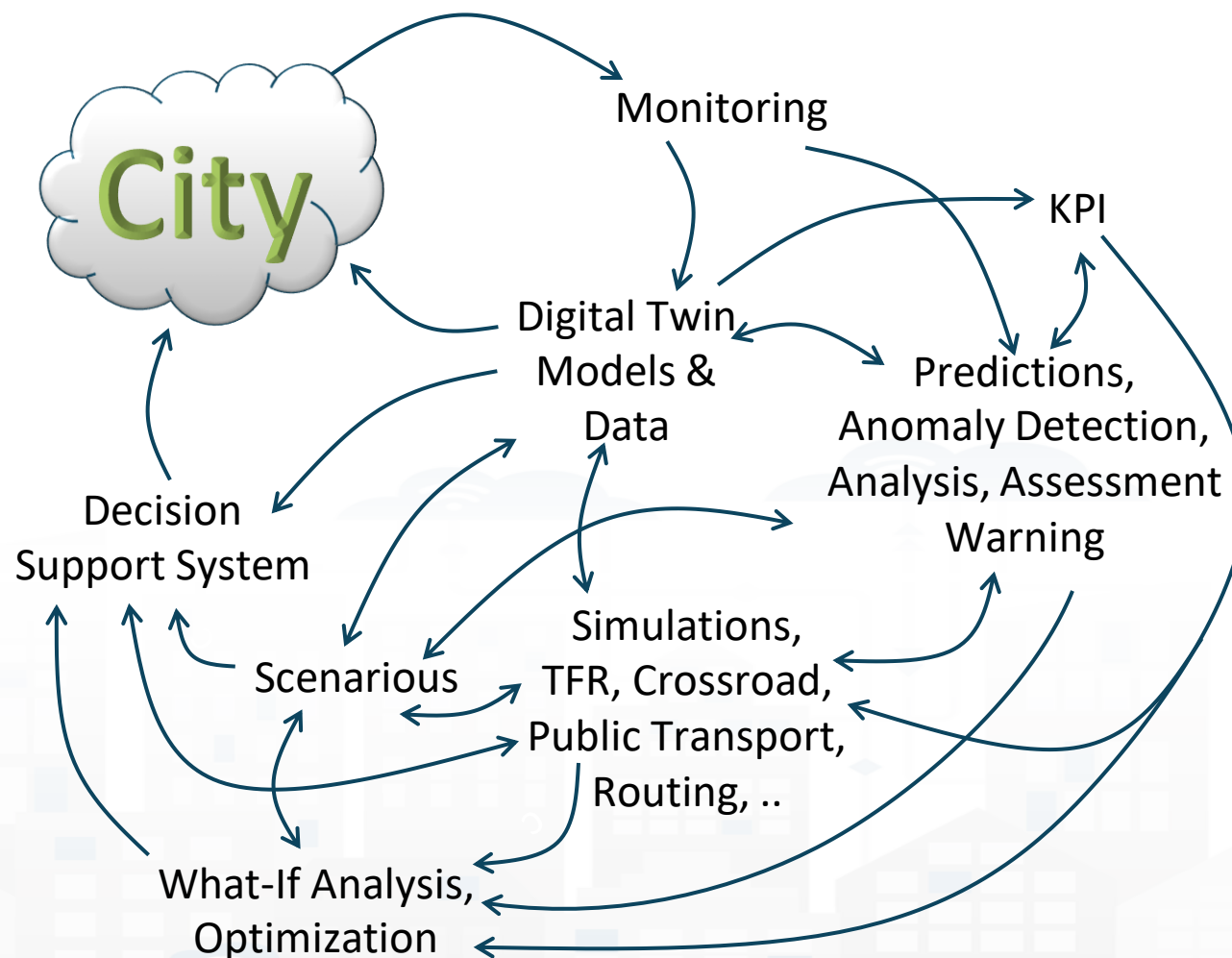
Test traffic light plan optimizations digitally. Evaluate major traffic infrastructure changes. Assess tactical risks and generate prescriptions before spending public funds.

- **Controlling Status: management, and operational**

- Monitoring via KPI
- Predictions vs KPI
- Anomaly detection
- Neuro-Symbolic analysis
- Risk assessment
- Early warning on critical conditions
- Fast What-if analysis

- **Making plan: tactic and strategic, medium and long range, micro/macro**

- Simulation & optimization
- Generative AI Prescriptions, scenarios
- Resilience to Unexpected unknowns
- What-if analysis wrt scenarios
- Collaboration with stakeholders



Key Performance Indicators, KPI



- **United Nations Sustainable Development Goals, SDGs** (for which cities can do more to achieve some of the 17 SDGs, <https://sdgs.un.org/goals>);
- **15 minutes cities** (where primary services must be accessible within 15 minutes on foot);
- **objectives of the European Commission** in terms of pollutant emissions for: NO2, PM10, PM2.5 (https://environment.ec.europa.eu/topics/air_en);
- **SUMI: mobility and transport vs env**
 - <https://www.snap4city.org/951>
- **SUMP/PUMS: mobility and transport vs env.**
- **ISO indicators:** city smartness, digitization, tech level.
- **Low Level/Real Time:** global traffic, quality of service, betweenness, centrality, queue, time to travel, etc.

Global
&
Local

Periodic
&
Realtime

Air Quality Directive				WHO guidelines	
Pollutant	Averaging period	Objective and legal nature and concentration	Comments	Concentration	Comments
PM _{2.5}	One day			25 µg/m ³ (*)	99 th percentile (3 days/year)
PM _{2.5}	Calendar year	Target value, 25 µg/m ³	The target value has become a limit value since 1 January 2015	10 µg/m ³	
PM ₁₀	One day	Limit value, 50 µg/m ³	Not to be exceeded on more than 35 days per year.	50 µg/m ³ (*)	99 th percentile (3 days/year)
PM ₁₀	Calendar year	Limit value, 40 µg/m ³ (*)		20 µg/m ³	
O ₃	Maximum daily 8-hour mean	Target value, 120 µg/m ³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m ³	
NO ₂	One hour	Limit value, 200 µg/m ³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m ³ (*)	
NO ₂	Calendar year	Limit value, 40 µg/m ³		40 µg/m ³	



• **15 Minute City Index:**

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

7 AFFORDABLE AND CLEAN ENERGY

- Optimization of car sharing/pooling
- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.
- Sizing energy plants, Community of energy

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

- Predictive maintenance
- Decisions Support Systems
- Process optimization, control
- Industry 4.0 integrated solutions
- AI assistant for commercial activities

11 SUSTAINABLE CITIES AND COMMUNITIES

- Reduction of emissions, reduction of congestions
- Smart City infrastructure: monitoring and resilience, long terms predictions, optim. operation and plan
- Effective and Low cost smart solutions
- What-if analysis, Simulations, optimization
- Origin Destination matrices computation

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

- Optimization of Waste Collection
- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Advisor for documentation, generative AI

13 CLIMATE ACTION

15 LIFE ON LAND

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

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

- Shortening justice time
- Prediction of mediation proneness
- Assisting institution is taking legal decisions
- Anonymization and indexing legal docs.
- Ethical Explainable Artificial Intelligence
- Advisor for legal documentation, generative AI

15MinCityIndex on Bologna



Ciao roottooladmin!

Tue 3 May 20:14:59

15 MINUTI INDEX BOLOGNA CITTÀ METROPOLITANA - NEWGUI

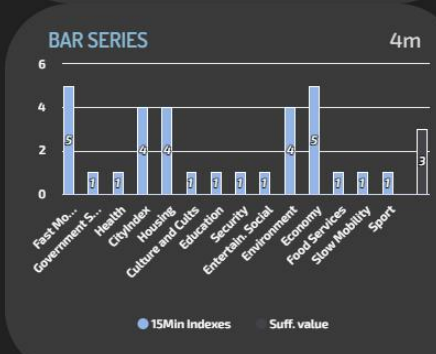
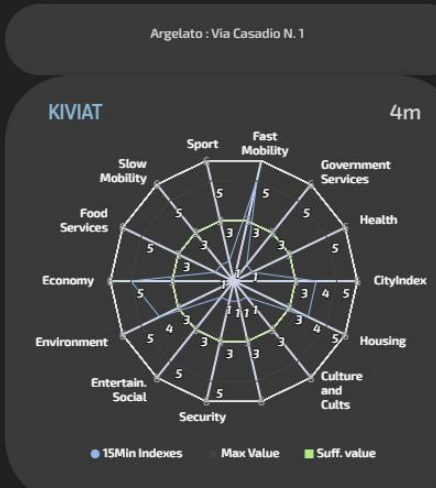
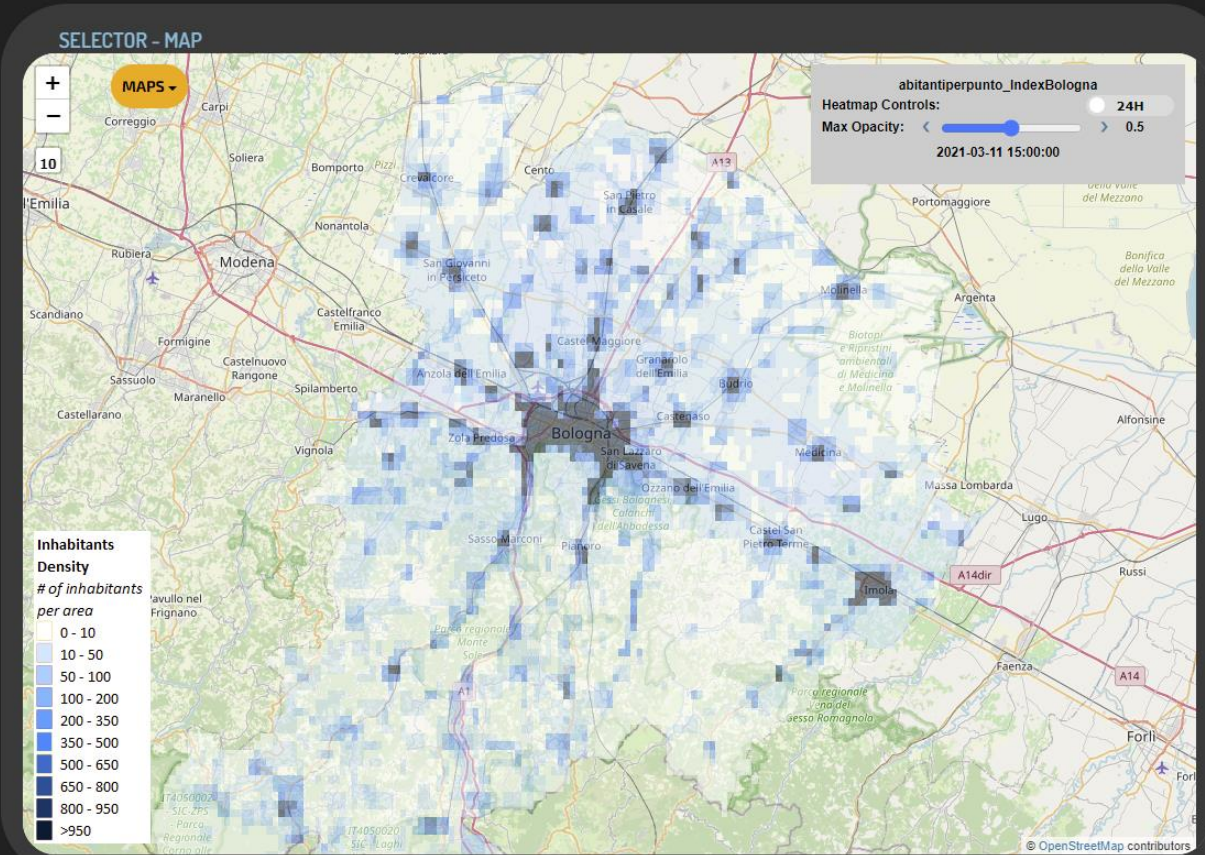


- # of Inhabitants >
- Green factor >
- Civil factor >
- Industrialization factor >
- Environment Index >
- 15Min Economy Index >
- 15Min Housing Index >
- 15Min Health Index >
- 15Min Food Index >
- 15Min Education Index >
- 15Min Slow Mob Index >

THE PICKED POINT

9m

City: Argelato
Address: Via Casadio N. 1
Lat,lon: 44.61882,11.35437



1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

7 AFFORDABLE AND CLEAN ENERGY

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

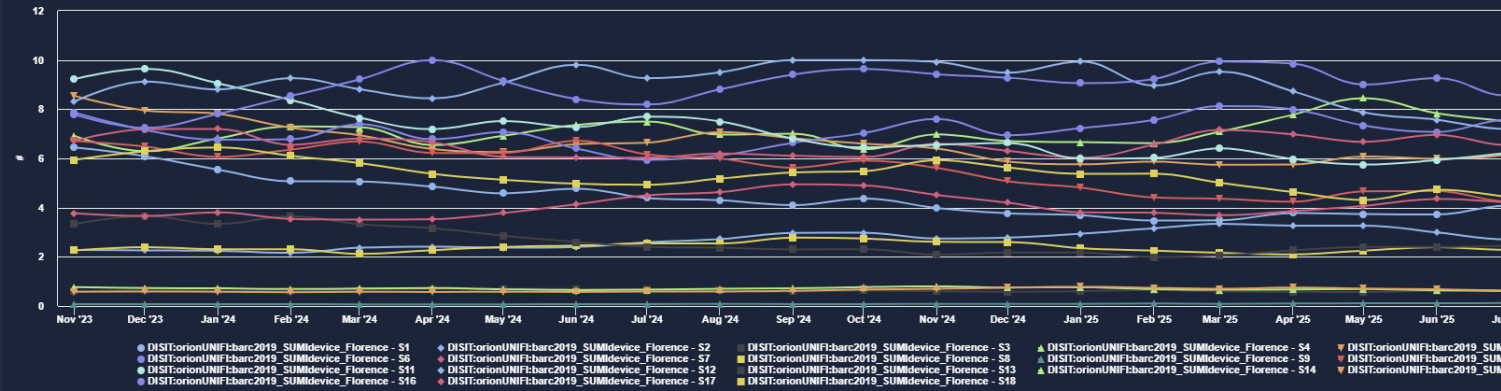
15 LIFE ON LAND

SUMI: Sustainable Urban Mobility Indicators



SUMI Manager Wed 15 Oct 21:45:36

SUMI Viewer
 Select your city: Florence | Time: 2025-10-01T00:00:00.000Z Refresh city list



SUMI Manager Wed 15 Oct 21:47:11

SUMI Data Loading
 Add a new city: Florence Submit

Select Indicator: S11 Mode: Calculate from data Validity start date: gg/mm/aaaa Validity end date: gg/mm/aaaa City select: Select... Refresh citylist

Public transport modes available throughout the area
 Long-distance bus Train Metro LRT/tram Local bus Bike sharing stations Car sharing stations Bike parking Park&Ride Reserved taxi areas Ferry

Mode of transport at the interchange point:
 Long-distance bus Train Metro LRT/tram Local bus Bike sharing stations Car sharing stations Bike parking Park&Ride Reserved taxi areas Ferry Return

Add interchange point

Select city to submit data.

SUMI Manager Wed 15 Oct 21:47:55

SUMI Data Loading
 Add a new city: Florence Submit

Select Indicator: S6 Mode: Calculate from data Validity start date: gg/mm/aaaa Validity end date: gg/mm/aaaa City select: Select... Refresh citylist

Number of people living within 417 meters (5 minutes) of a bus (or tram) stop with more than 10 departures/hour AND within 833 meters (10 minutes) of a train station with more than 10 departures/hour:

Number of people living within 417 meters (5 minutes) of a bus (or tram) stop with more than 10 departures/hour OR within 833 meters (10 minutes) of a train station with more than 10 departures/hour:

Number of people living within 417 meters (5 minutes) of a bus (or tram) stop with between 4 and 10 departures/hour OR within 833 meters (10 minutes) of a train station with between 4 and 10 departures/hour:

Number of people living within 417 meters (5 minutes) of a bus (or tram) stop with fewer than 4 departures/hour OR within 833 meters (10 minutes) of a train station with fewer than 4 departures/hour:

Number of people living more than 417 meters (5 minutes) from a bus (or tram) stop AND more than 833 meters (10 minutes) from a train station:

Select city to submit data.

Mobility and Transport

Goals



Decongestion



Safety



Accessibility



Cost Reduction



Decarbonization

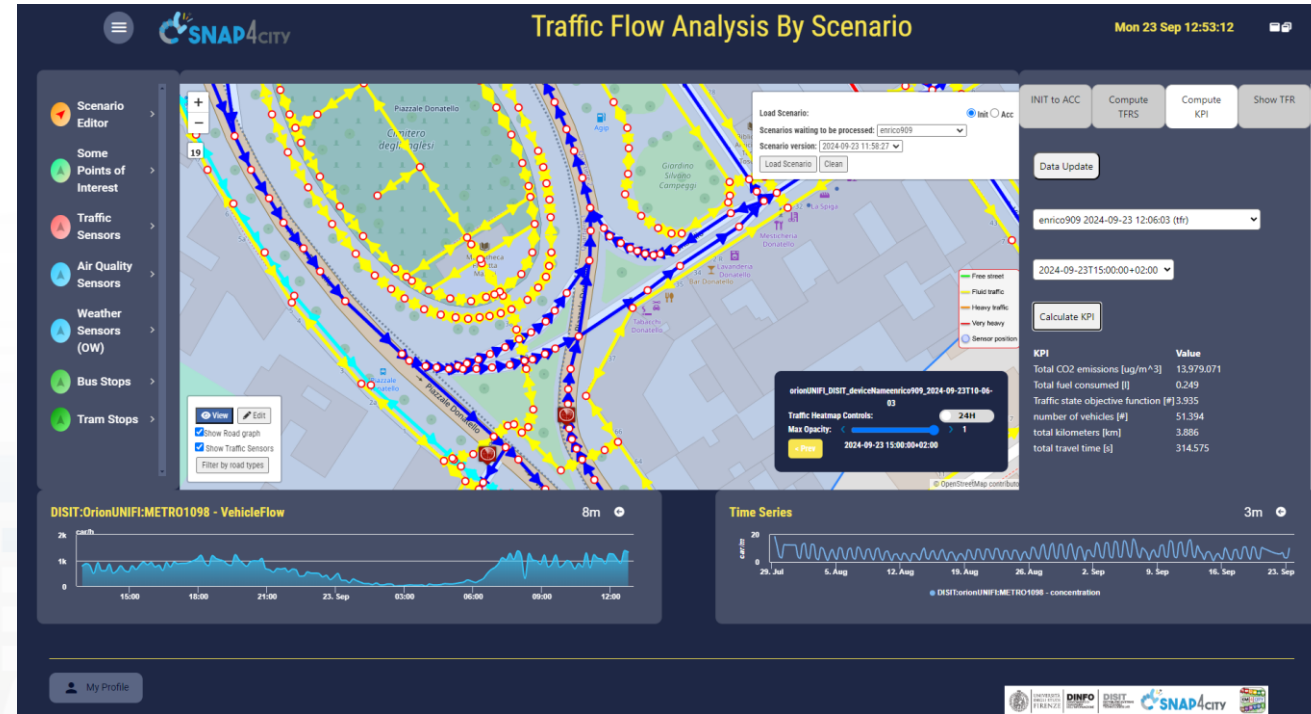
What you can do with advanced tools

- **Advanced Scenario Editor**

- Create complex and full detailed scenario, with road graph, sensors, of any kind, even new roads, restrictions, parameters, etc.

- Exploit these scenarios to create

- Simulation
- Business intelligence tools and visual/business analytic tools also working in real time
- Traffic flow reconstruction
- Traffic infrastructure optimisation
- Traffic light plan optimization
- Pedestrian analysis and simulation
- Match demand vs Offer, simulation and analysis
- Computation of SUMI, SUMP, 15 Min City Indexes, etc.
- Heatmaps computation
- Etc. etc.



Routing Optimization

Goals on planning:

- Reduction of costs on plan
- **waste collection optimization**, Reduction of Km
- **car pooling trajectories optimization** for maximize the pool usage
- **delivering optimization**, reduction of travel time, reduction of Km
- etc.

© Snap4City, May 2026, DISIT lab

Dynamic Routing on operation:

- React in operation to define immediate routing solutions: rescue teams, ambulance, etc.
- Recovery from failure

Trajectorywaste2 (Fri 17 May 18:34:37)

Gestione Prenotazioni Con Pool (Sun 16 Jun 23:14:32)

User	driver?	Inizio Pooling	Fine Pooling	Inizio Richiesto	Fine Richiesta	Distanza Pooling (m)	Distanza diretta (m)
boffa3	si	17/06/2024 10:19	17/06/2024 10:32	17/06/2024 10:19	17/06/2024 10:33	6059	4313
mary	No	10 12	10 20	07 10	07 30	2249	1883
michelangelosanto	si	17/06/2024 10:15	17/06/2024 10:33	17/06/2024 10:20	17/06/2024 10:29	4783	4292

Targa	Status	Distanza (metri)	Ha corse precedenti?	Posti totali	Data
vehicle_ZA981ZH	closed	49	No	8	16/06/2024 23:08
vehicle_ZA980ZH	closed	51	No	8	16/06/2024 23:12
vehicle_ZA982ZH	closed	220	No	8	16/06/2024 23:13



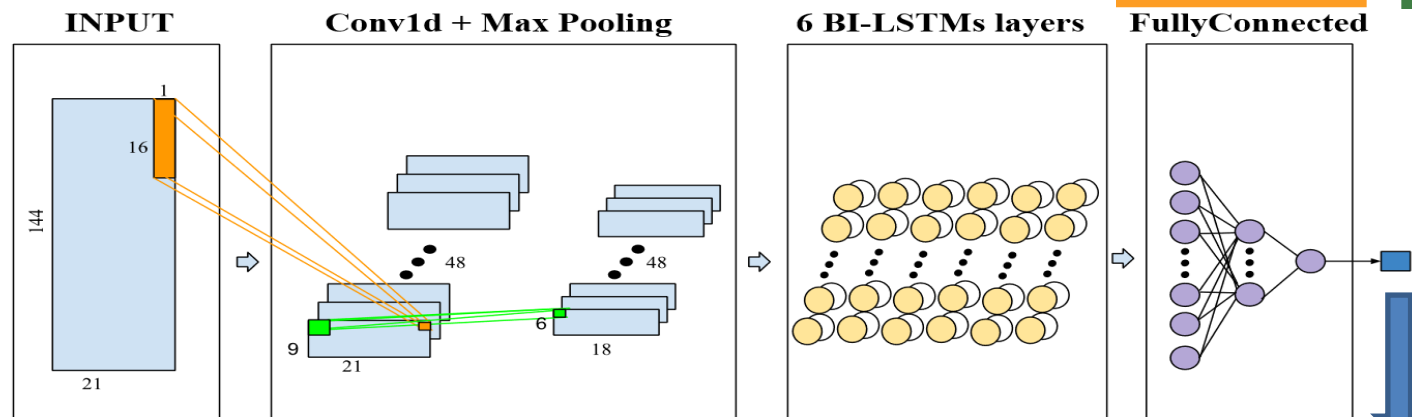
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INGEGNERIA
DELL'INFORMAZIONE

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

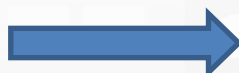


Short-Term Prediction of City Traffic Flow via Convolutional Deep Learning



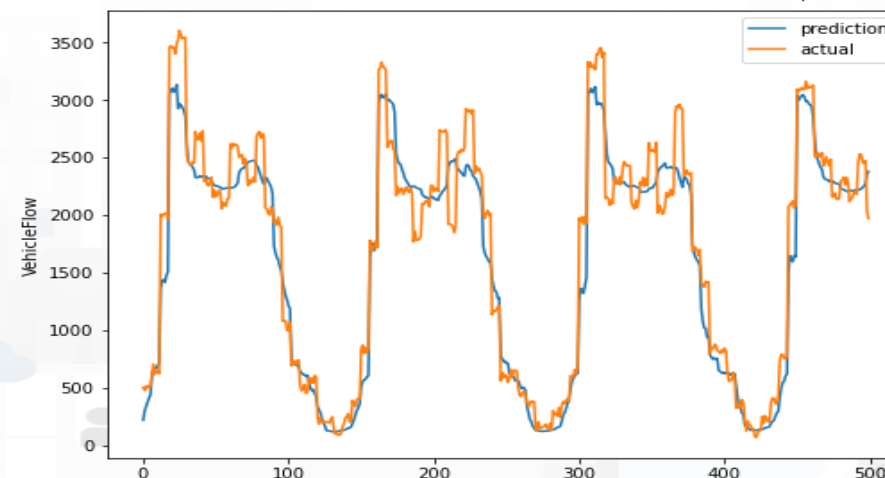
Urban data:

- Date-time
- Traffic
- Temporal
- Seasonality
- Pollution
- Weather

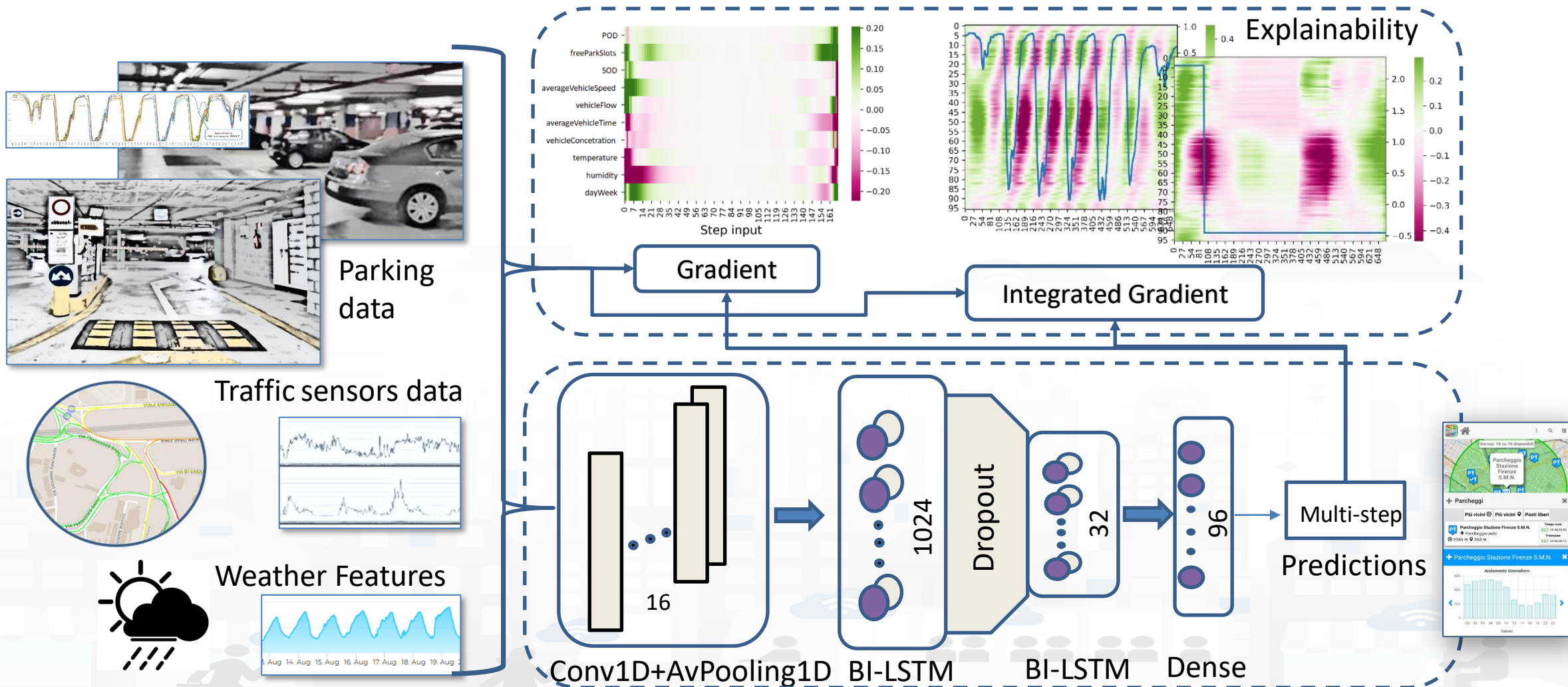


- RF
- XGBOOST
- DNN
- LSTM
- BI-LSTM
- Autoencoder BI-LSTM
- Attention CONV-LSTM
- CONV-BI-LSTM

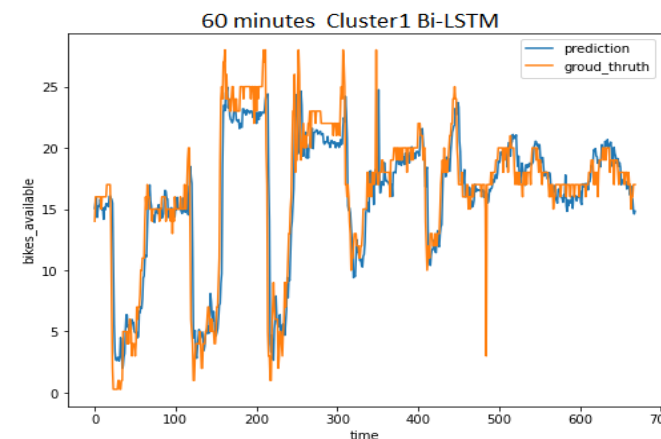
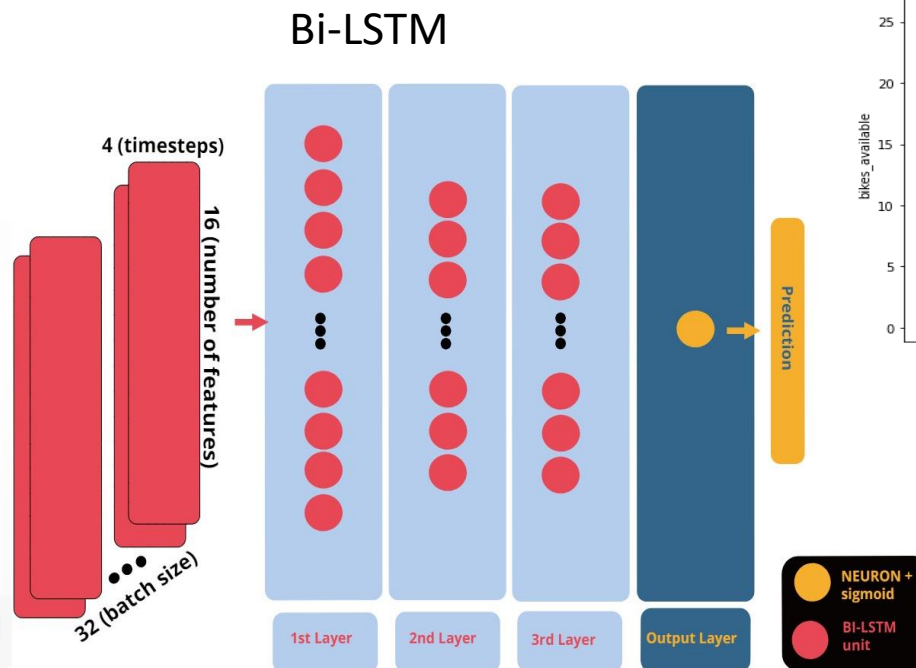
CONV-BI-LSTM



Deep Learning AI to surely Park!



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>



Bari TrafficFlow by Sumo Simulator

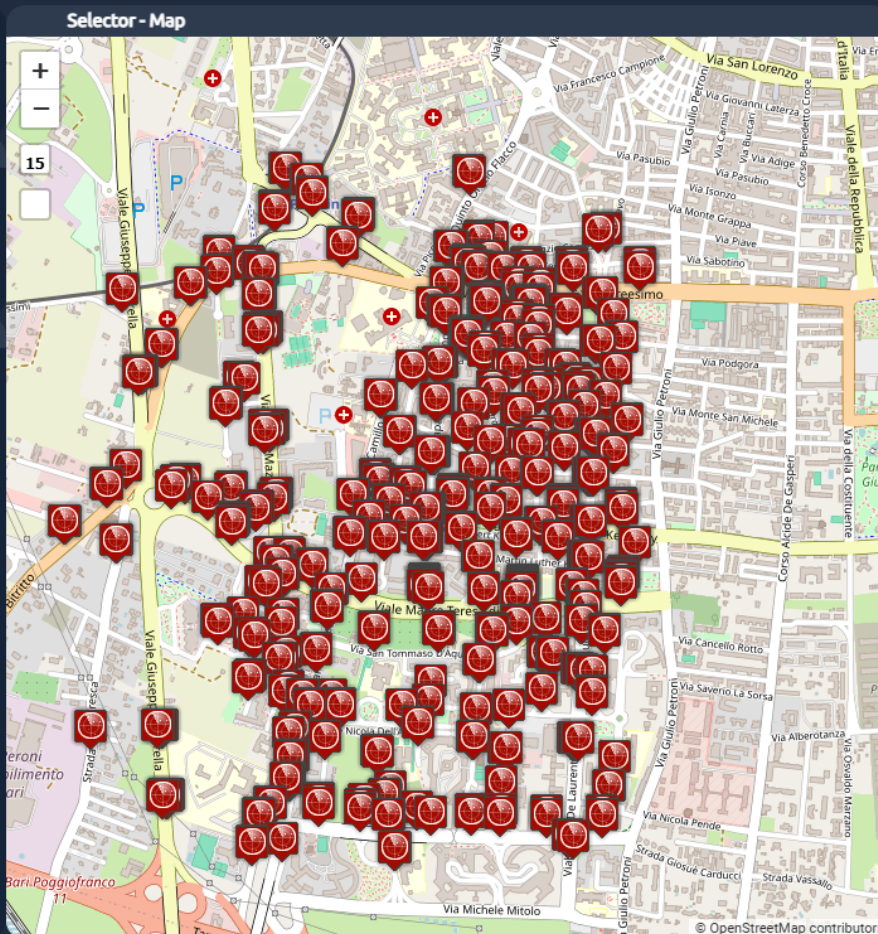


sumotrafficsensor

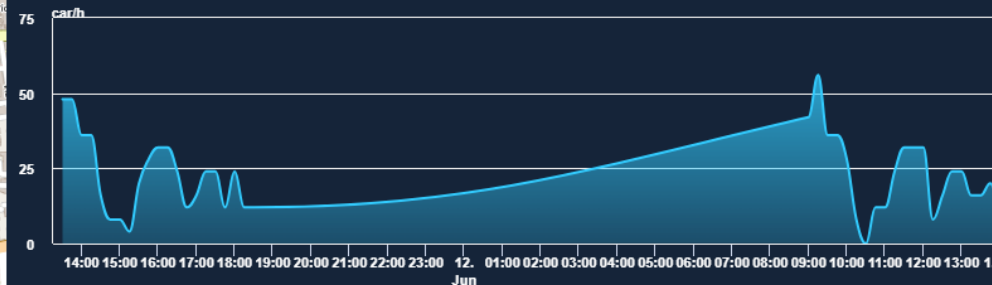
Flow

12

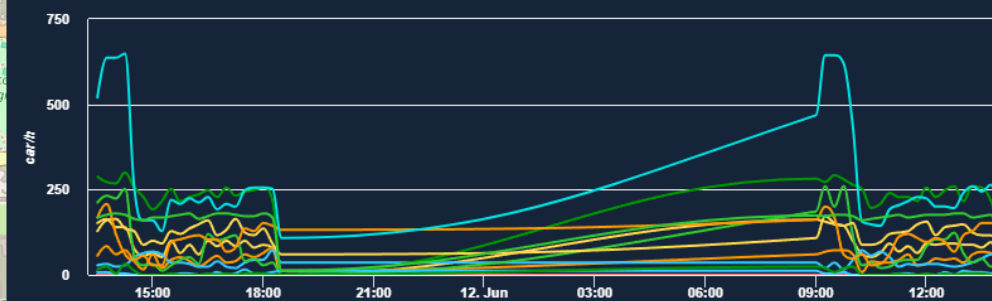
Bar Series



Zone4 e1 23 - Flow



Time trend comparison



- DISIT:orionUNIFI:bari-iot-simulation_zone1_e1_12 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone2_zone2_e1_4 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone1_zone1_e1_4 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone3_e1_68 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone1_e1_40 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone4_e1_35 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone3_e1_61 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone4_e1_17 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone4_e1_27 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone3_zone3_e1_29 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone1_zone1_e1_47 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone4_zone4_e1_10 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone2_zone2_e1_22 - flow
- DISIT:orionUNIFI:bari-iot-simulation_zone1_zone1_e1_6 - flow

Smart Parking

- payments, profiles
- Fines
- mobile for parking

Dash8 - To Be Fined Management

Fri 19 Sep 12:46:24

Fines 3m

Show 10 Search: First << Prev 1 Next >> Last

device	dateObserved	groupid	sensorid	slotType	vehicleType	Actions
parkingSlotOffRoad_9	2025-09-10T14:16:34.344Z	alberti_offRoad	offRoad_sensor_9	handicap	car	
parkingSlotOffRoad_8	2025-09-10T14:16:14.340Z	alberti_offRoad	offRoad_sensor_8	handicap	car	
parkingSlotOffRoad_7	2025-09-10T14:15:54.338Z	alberti_offRoad	offRoad_sensor_7	handicap	car	
parkingSlotOffRoad_3	2025-09-10T14:14:34.329Z	alberti_offRoad	offRoad_sensor_3	recharge_car	car	

Fine Form

* Parking ID: parkingSlotOffRoad_8
 * City: Limassol * Area: area_4
 * Datetime: 19/09/2025 12:45:23
 Vehicle brand: Suzuki Vehicle model: Sport
 Vehicle color: red * Vehicle plate: AA456BB * Vehicle Type: Moto
 Infraction Codes:
 P001 - No parking zone
 P002 - Double parking
 P003 - Blocking driveway
 P004 - Expired meter
 P005 - Fire hydrant zone
 * Infraction Points Deducted: 0
 * Vehicle Stop Status: REMOVED
 * Amount to be Paid (Euro): 43
 Upload Evidence
 Submit Cancel

Dash3 - Policy Area Management

Fri 12 Sep 15:38:29

Search Area
 Careggi 1
 Show area Show slots
 View mode: Shape Pin
 Slot/Area List
 parkingSlot_193593
 parkingSlot_193594
 parkingSlot_193595
 parkingSlot_193596
 parkingSlot_193597
 parkingSlot_193598
 parkingSlot_193599
 parkingSlot_193600
 parkingSlot_193601
 parkingSlot_193602
 parkingSlot_193603
 parkingSlot_193604
 parkingSlot_193663
 parkingSlot_193664
 parkingSlot_193665
 parkingSlot_193666
 parkingSlot_193667
 parkingSlot_193668
 parkingSlot_193669
 parkingSlot_193670
 parkingSlot_193671
 parkingSlot_193672
 parkingSlot_193673
 parkingSlot_193674
 parkingSlot_193822
 parkingSlot_193823
 parkingSlot_193824
 parkingSlot_193825
 parkingSlot_193826
 parkingSlot_193828
 parkingSlot_101870
 See parking area stats

Manage Area Policy
 policy_0
 permissionBus
 12:00-13:00
 Calendar: settembre 2025
 Policy price range €/hour
 0 - 0.30
 0.30 - 0.60
 0.60 - 0.90
 0.90 - 1.20
 1.20 - 1.50
 1.50 - 1.80
 1.80 - 2.10
 2.10 - 2.40
 2.40 - 2.70
 2.70 - 3.00
 > 3.00
 Set policy to selected area

Free Slots Of Careggi_01
 8m
 40 50
 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 10 Jan 01:00 02:00 03:00 04:00 05:00 06:00 07:00

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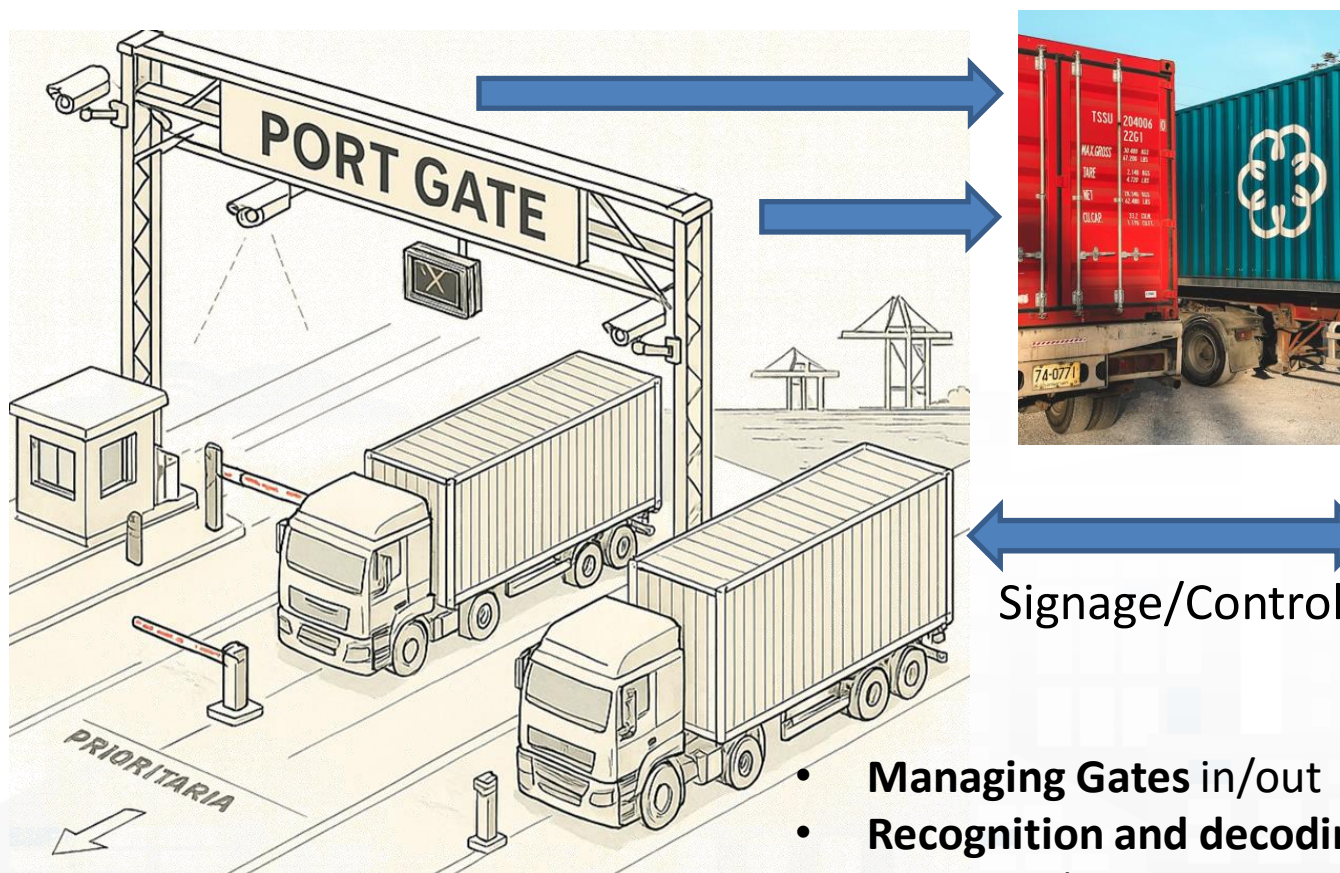
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SNAP4CITY

Trucks' Plates and Container ID Recognition



Interoperability

Snap4City Platform



- **Managing Gates in/out**
- **Recognition and decoding**
 - BIC code: FCIU 964484 8
 - ISO code: 45G1
 - Seal status: on/off
 - Multi-national Plates: EX 398AE

Mobility Demand vs Transportation Offer



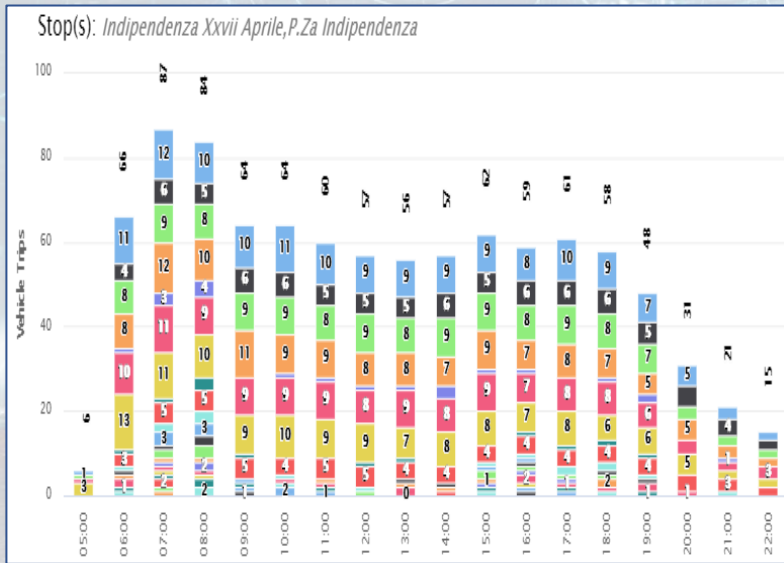
MOST
CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

What-if Analysis on Collective Transportation: DORAM

- Simulation / analysis of Mobility Demand wrt Transportation Offer
 - GTFS/TransModel vs ODM, taking into account road graph and services
- Definition of scenarios impact on
 - Traffic, Pollutant, parking, public transport, private flows, etc.
 - KPI analysis

Public Services



Welcome to DORAM powered by SNAP4CITY. Services: 36 on 36 available. The public transportation system has been analyzed in the City, considering the service offer vs. mobility demand. The top-thirty most crowded stops are presented on the right panel and on the map. Please, select your desired scenarios or a stop on the map to perform other analysis.

Type the stop name ... Search

Stop panel

Scenario Selector

Choose a scenario: Actual scenario Load

Actual scenario: Describes the current status of the public transportation network. (More Info)

Daily Individual Trips > 52000

Stops > 1900

Residential Buildings > 31000

Service Providers > 32000

Mobility Operators > 10

Transport Modes = 3

The Most Crowded Stops

Select a time slot: 05:00 to 01:59 Search

Indipendenza Xxvii Aprile
P.Za Indipendenza

Daily Pick-ups: 377
Daily Drop-offs: 407
Daily Vehicle Trips: 979

Stazione Nazionale

Daily Pick-ups: 321
Daily Drop-offs: 358
Daily Vehicle Trips: [unlabeled]



Welcome to DORAM powered by SNAP4CITY

Services: 36 on 36 available

The public transportation system has been analyzed in the City, considering the service offer vs. mobility demand. The top-thirty most crowded stops are presented on the right panel and on the map. Please, select your desired scenarios or a stop on the map to perform other

Stop(s): *Indipendenza Xxvii Aprile, P.Za Indipendenza*

Hour	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
Total Trips	6	66	87	84	64	64	60	57	56	57	62	59	61	58

Scenario Selector

Choose a scenario: Actual scenario

Actual scenario: Describes the current status of the public transportation network. (More Info)

- Daily Individual Trips > 52000
- Stops > 1900
- Residential Buildings > 31000
- Service Providers > 32000

The Most Crowded Stops

Select a time slot: 05:00 to 01:59

Indipendenza Xxvii Aprile

P.Za Indipendenza

Daily Pick-ups: 377

Daily Drop-offs: 407

People

Pick-ups

Drop-offs

Vehicle Arrival

Pick-ups/Vehicle Arrival

Drop-offs/Vehicle Arrival

<https://www.snap4city.org/odanalyzer/#b>



Ext

STOP PAUSE HELP

26 FPS (17-26)

slow
slow
fast
Delay: 30.0 ms

Stats

time: 0.000 s
 payload: 0.0 KB
 simulate: 0.00 ms
 snapshot: 0.00 ms

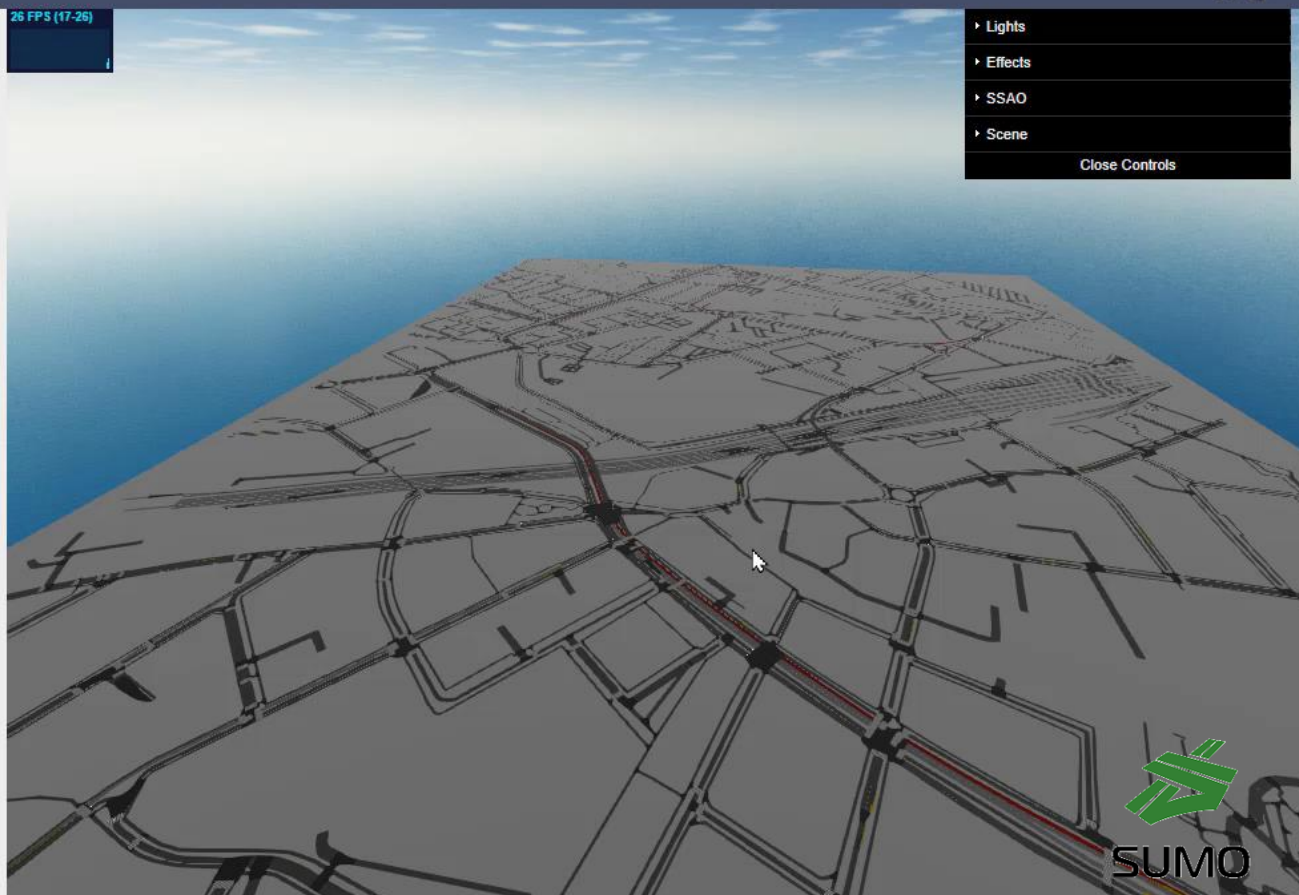
Vehicle Summary

Quick Find

ID Edge / Lat, Long (float, float) / X,Y (int, int)

SEARCH

CAR	BIKE	TRAIN
TRAM	PERSON	BUS
LIGHT		



▸ Lights

▸ Effects

▸ SSAO

▸ Scene

Close Controls

Wid

Prepare Simulation Execute Simulation KPI Simulation

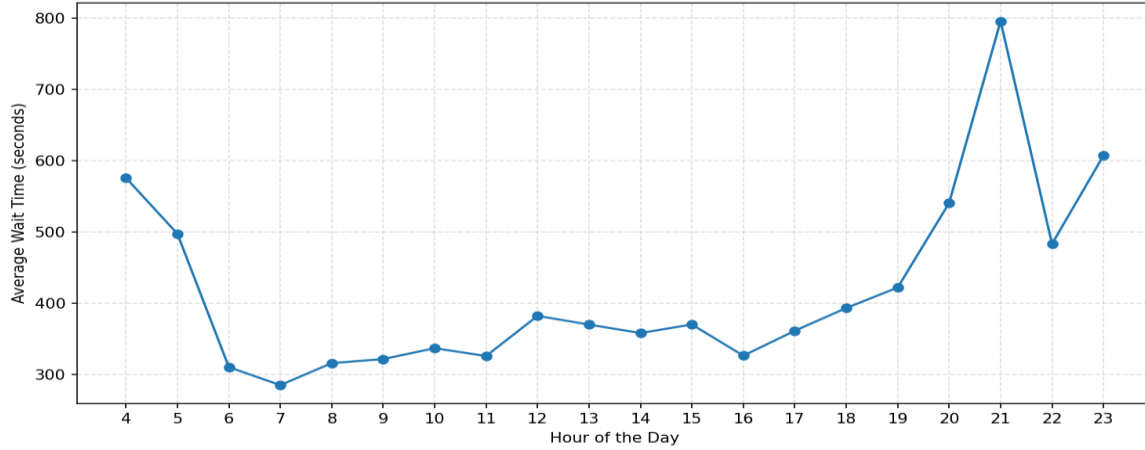
Simulation:
 firenzeodbus

Execute

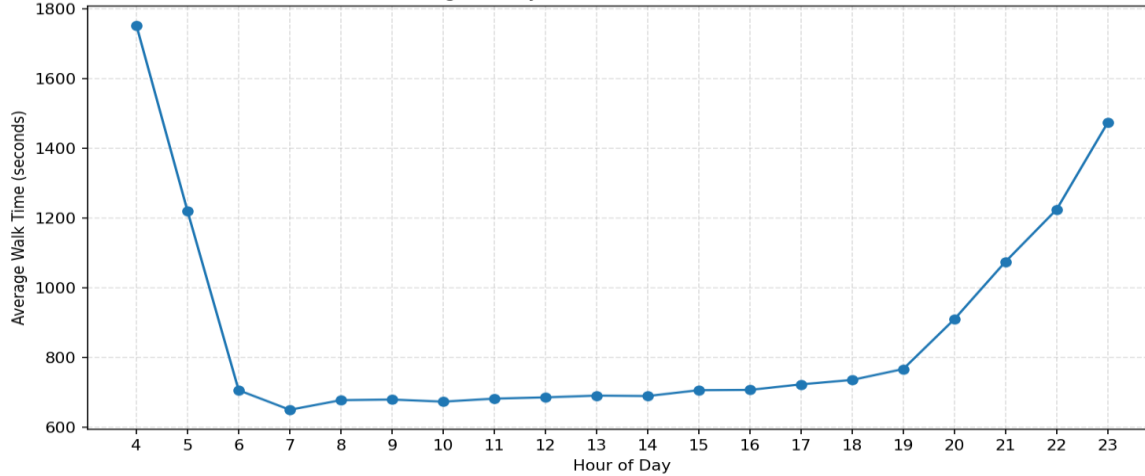
Simulation: 2025/06/22 11:53:27

The typical working day

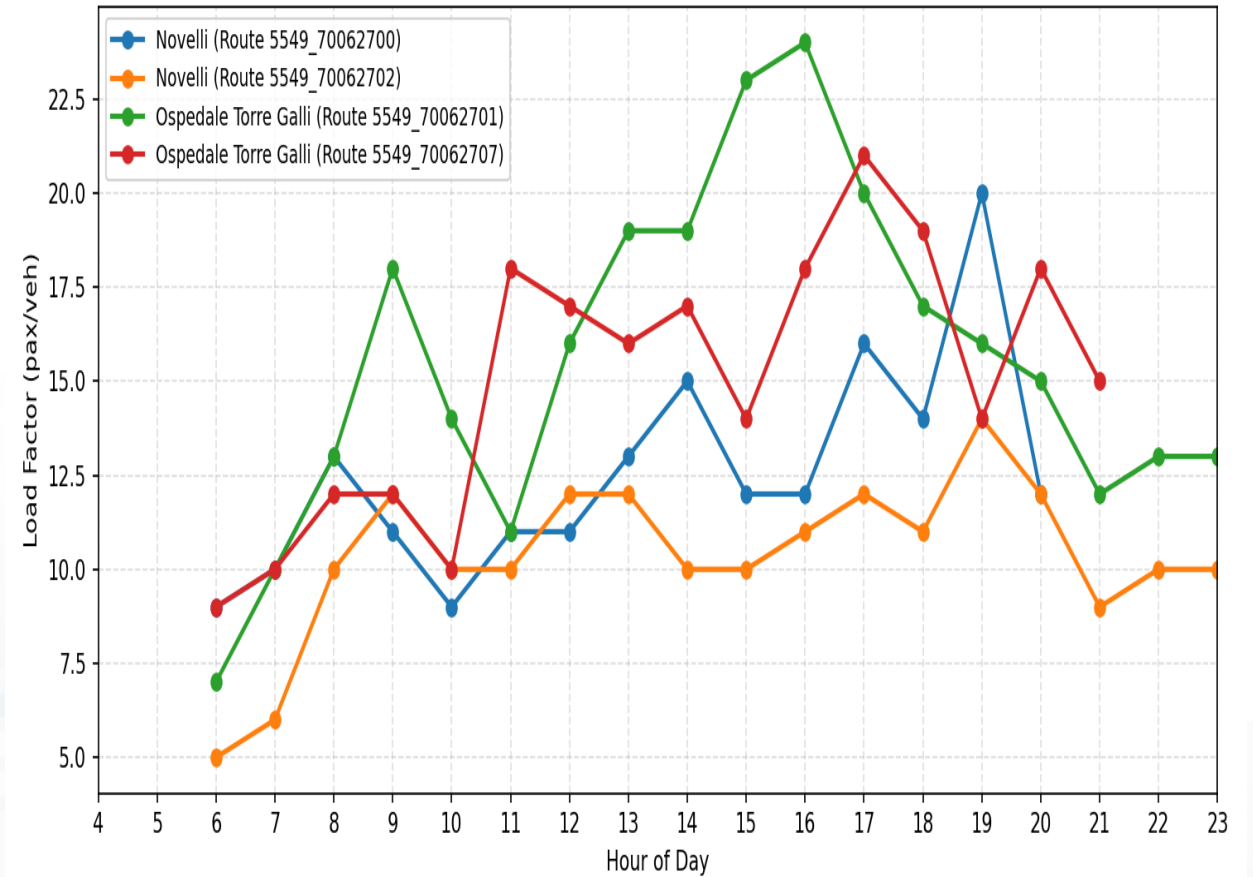
Average Hourly Ride Wait Time (Hour 04:00-23:59)



Average Hourly Walk Time (Hours 04:00-23:59)



Line 6



Traffic Light Plan Optimization



FROM CITY
DASHBOARD TO
APPLICATIONS



SNAP4CITY
AND KM4CITY
PROJECTS

ADOPT
CITY, AND
ADMAP

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

MOST

CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

11 SUSTAINABLE CITIES
AND COMMUNITIES



Traffic Lights

<https://www.snap4city.org/1015>

9:30

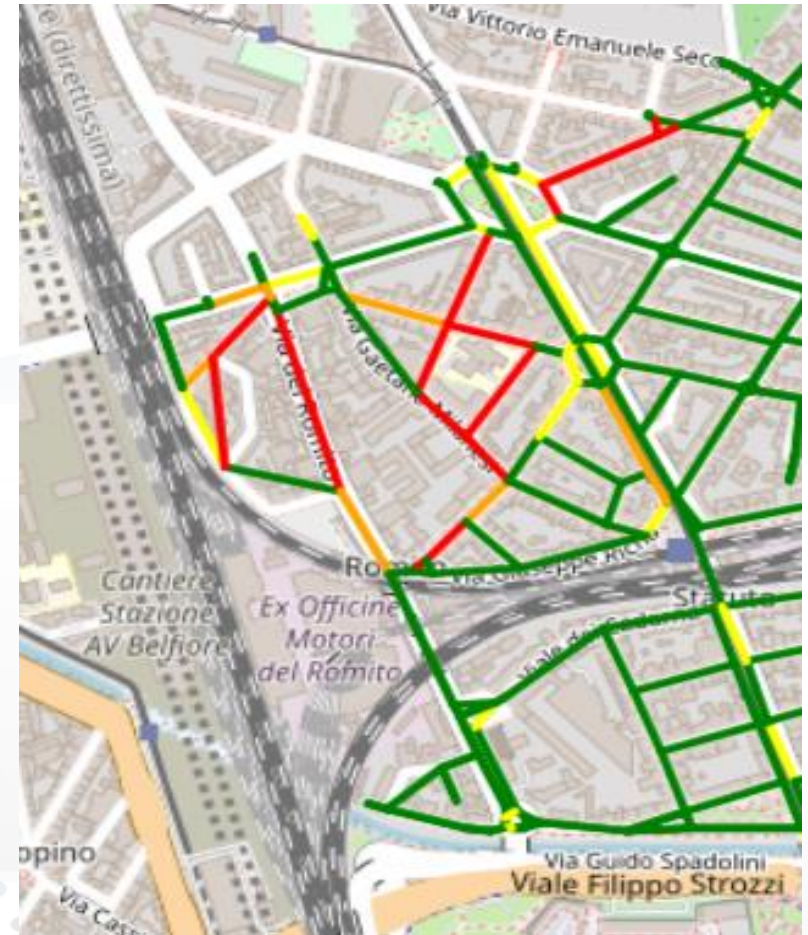
Traffic Light Optimisation

- **Traffic Light Plan:**

- General construction of Traffic Light Plans for the area
- TLP are loaded on the basis of the expected conditions: football game, ferial and festive, school period, morning and afternoon, etc.
- Single Junction TLP can be:
 - adjusted exploiting local data, on demand signals, etc.
 - Actuated on the basis of the measures of traffic

- **Issues:**

- Making multijunction synchronization to keep under control of quality of Service for TRAMWAYS and/or Busses Rapid Transit, BRT/HRB



Optimization of Traffic Light Plan

Traffic Flow Analysis By Scenario Fri 25 Oct 17:56:16

Scenario Editor
Some Points of Interest
Traffic Sensors
Air Quality Sensors
Weather Sensors (OW)
Bus Stops
Tram Stops

Load Scenario: Init Acc
Scenarios waiting to be processed: StatutoCase1
Scenario version: 2024-10-25 16:36:59

FortezzaCase1

DISIT:OrionUNIFI:METRO1098 - VehicleFlow 8m

Time Series 3m

car/h

5. Aug 19. Aug 2. Sep 16. Sep 30. Sep 14. Oct

© DISIT:orionUNIFI:METRO1098 - concentration

S. Bilotta, Z. Fereidooni, L.A. Ipsaro Palesi, P. Nesi, "Macroscopic GA-based Multi-Objective Traffic Light Optimization Prioritizing Tramways", Applied Soft Comp. Journal, Elsevier, 2025.

Traffic Infrastructure Optimization

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA G...
AND C...
KNOWL...
MANAG...

11 SUSTAINABLE CITIES
AND COMMUNITIES



MOST

CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

TO ADOPT
4CITY, AND
ROADMAP

• SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

<https://www.snap4city.org/1014>



Traffic Infrastructure Optimization

☰
SNAP4CITY
Traffic Infrastructure Optimization
Mon 14 Oct 19:45:10

- ▶ Scenario Editor
- ▶ Some Points of Interest
- ▶ Traffic Sensors
- ▶ Air Quality Sensors
- ▶ Weather Sensors (OW)

Load Scenario: Init Acc

Scenarios waiting to be processed: AlessandroScenario30

Scenario version: 2024-09-26 11:52:20

Load Scenario Clean

Road Types:

<input checked="" type="checkbox"/> abandoned	<input type="checkbox"/> Select All	<input type="checkbox"/> Unselect All
<input checked="" type="checkbox"/> corridor	<input checked="" type="checkbox"/> bridleway	<input checked="" type="checkbox"/> bus_guideway
<input checked="" type="checkbox"/> emergency_access_point	<input checked="" type="checkbox"/> crossing	<input checked="" type="checkbox"/> bus_stop
<input checked="" type="checkbox"/> motorway	<input checked="" type="checkbox"/> emergency_bay	<input checked="" type="checkbox"/> disused
<input checked="" type="checkbox"/> primary	<input type="checkbox"/> highway	<input checked="" type="checkbox"/> island
<input checked="" type="checkbox"/> residential	<input checked="" type="checkbox"/> motorway_link	<input type="checkbox"/> path
<input checked="" type="checkbox"/> services	<input checked="" type="checkbox"/> primary_link	<input checked="" type="checkbox"/> private
<input checked="" type="checkbox"/> traffic_island	<input checked="" type="checkbox"/> rest_area	<input checked="" type="checkbox"/> raceway
<input checked="" type="checkbox"/> secondary	<input checked="" type="checkbox"/> yes	<input checked="" type="checkbox"/> secondary_link
	<input type="checkbox"/> no	<input checked="" type="checkbox"/> service
	<input checked="" type="checkbox"/> tertiary	<input checked="" type="checkbox"/> tertiary_link
	<input checked="" type="checkbox"/> trunk_link	<input checked="" type="checkbox"/> track
	<input checked="" type="checkbox"/> unclassified	<input checked="" type="checkbox"/> via_ferrata
	<input type="checkbox"/> pedestrian	<input checked="" type="checkbox"/> bus_guideway
	<input type="checkbox"/> ohm.military.Trench	

INIT to ACC
Optimize Scenario
Optimization results

Data Update

deviceNameAlessandroScenario30_2024-09-26 09-56-51

v1

Fetch Data

Optimization completed!

Objective	Before	After
Traffic State	5.28	5.161000000000005
Fuel	0.6710494492002909	0.3491240463440088
CO2	17002.113327545154	13283.979223768334

Before

After

Smart Energy and Smart Building

- Energy consumption reduction,
- increment of efficiency,
- Areas and building sustainability
- Improve accessibility to services,
- security and safety





App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCenter Trello Km4City major tools Impostazioni YouTube Google Forms News Tutti i preferiti

Cabinets On Stockholm By Capelon

Tue 31 Oct 22:53:17

Capelon Cabinet (iot-search)

Ac...9m ActualState0Count - St... 9m

12

Radar Series 4m

Selector - Map

CAPELON CABINET (IoT-SEARCH) ADDED TO MAP

:CCabinet_9ee9e983-E4fb-33c9-9562-2d99cb48a4fa - Burni... 9m

Time Trend 4m

ASM Merano Stadtwerke Meran

Elenco lampade Visualizzazione dati Log eventi Grafici Impostazioni

N. Punto Luce	11307
DevEui	7083D58F10085D7
Via	RomStraÙe
Regolazione	
Ore di servizio	
Conta energia	
Potenza attuale	
Stato	Inattivo
Nome errore	null
RSSI	
SNR	
Data	01/11/2023 12:01:18

Regolazione

Stato Linea

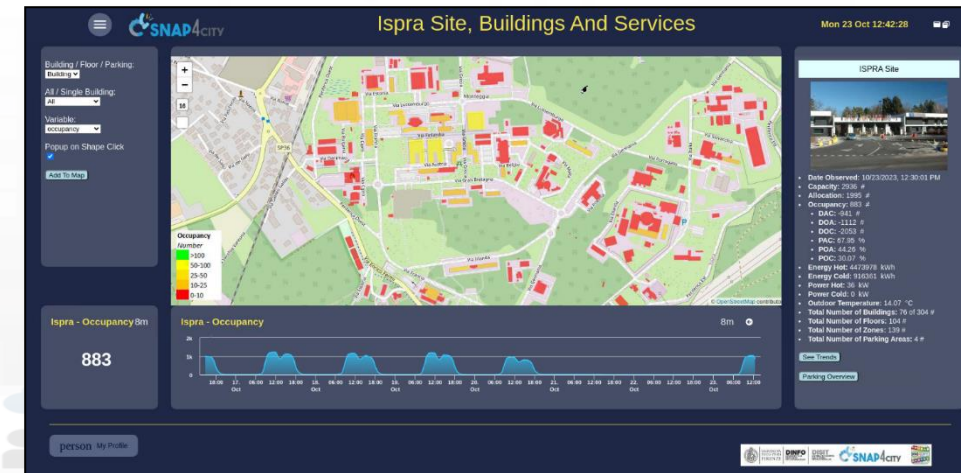
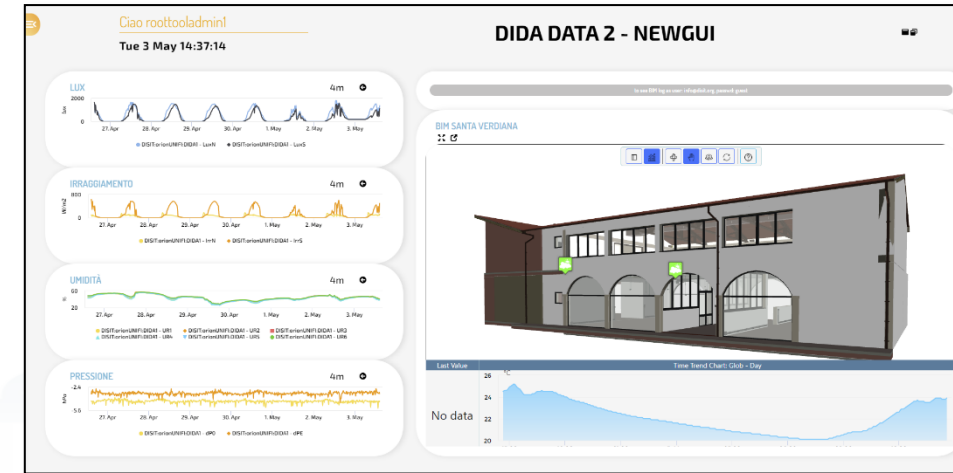
Non Attivo Stato Linea verso Sinigo

Non Attivo Stato Linea verso Merano Centro

Smart Light Management

Snap4Building Domain (2024/8)

- **Goals:**
 - increase efficiency, cost reduction, sustainability
 - Accessibility to services, Security/Safety
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
 - Monitoring: usage, energy, environmental conditions, people flows, services, etc.
 - Early detection/warning, alarm, of critical conditions, notifications, decision support
 - Production of suggestions/prescriptions, nudging
 - Managing smart services: cabinets, dispenser, lockers, etc.
 - Global and local 3D/2D representations of area and buildings
 - Integration with Video Management Systems
 - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
 - Reduction of energy costs via optimization
- Algorithms and computational solutions, see next slide



Building / Floor / Parking:
Building ▾

All / Single Building:
All ▾

Variable:
occupancy ▾

Popup on Shape Click

[Add To Map](#)

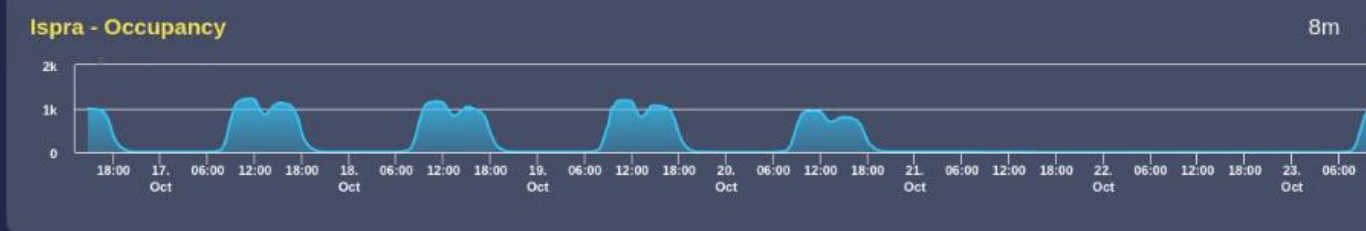


ISPRA Site

- Date Observed: 10/23/2023, 12:30:01 PM
- Capacity: 2936 #
- Allocation: 1995 #
- Occupancy: 883 #
 - DAC: -941 #
 - DOA: -1112 #
 - DOC: -2053 #
 - PAC: 67.95 %
 - POA: 44.26 %
 - POC: 30.07 %
- Energy Hot: 4473978 kWh
- Energy Cold: 916361 kWh
- Power Hot: 36 kW
- Power Cold: 0 kW

Ispra - Occupancy 8m

883



Building 27B Trends

ISPRA JRC Site

SNAP4CITY

Ispra Floor, Zone And Room Details

Fri 6 Oct 18:41:54

Allocation Number

- >50
- 25-50
- 13-25
- 5-13
- 0-5

Floor PT of Building 58A

- Date Observed: 10/6/2023, 6:30:02 PM
- Capacity: 37
- Allocation: 31
- Occupancy: 1
 - DAC: -6 #
 - DOA: -30 #
 - DOC: -36 #
 - PAC: 83.78 %
 - POA: 3.23 %
 - POC: 2.7 %

[See Trends](#)

Select a Zone metric: Allocation

Room 017

- Date Observed: 10/6/2023, 12:01:00 PM
- Zone Id: 58A_PT_B
- Capacity: 1
- Allocation: 0
- mq: 12.16
- Average hourly temp. Xi: 24.07°C
- Average hourly temp. Xs: 20.92°C
- Average hourly temp. Xn: 6.04°C

SNAP4CITY

Building 58A PT Trends

Mon 9 Oct 13:51:30

Actual 4m

Capacity - Allocation - Occupancy 4m

Organization: Orion-1: Floor2_58A_PT - Occupancy 9m

Temp. 9m

21.7 °C

Percentage Per Zones - Monthly Time Trend Comparison 4m

Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m

SNAP4CITY

Smart Building

Wed 1 Nov 11:03:31

Building ID: **Orion-1: Esplanade**

Variable: **occupancy**

Pop up on Shape Click

Allocation	Usage	Buttons
capacity: 150	100	100
allocation: 150	100	100
occupancy: 125	100	100

Building Unit Biomedica

- Date Observed: 11/10/2023, 10:11:01
- Capacity: 150 #
- Allocation: 150 #
- Occupancy: 125 #
- DAC: 100 #
- DOA: 30 #
- DOC: 60 #
- PAC: 50 %
- POA: 1 %
- POC: 60 %
- Energy Hot: 160 kWh
- Energy Cold: 140 kWh
- Power Hot: 24 kW
- Power Cold: kW
- Outdoor Temperature: 19 °C

Energy Production 1m

17.8 kW

Energy Production Weekly Trend 1m

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Environment and Waste Management

Goals



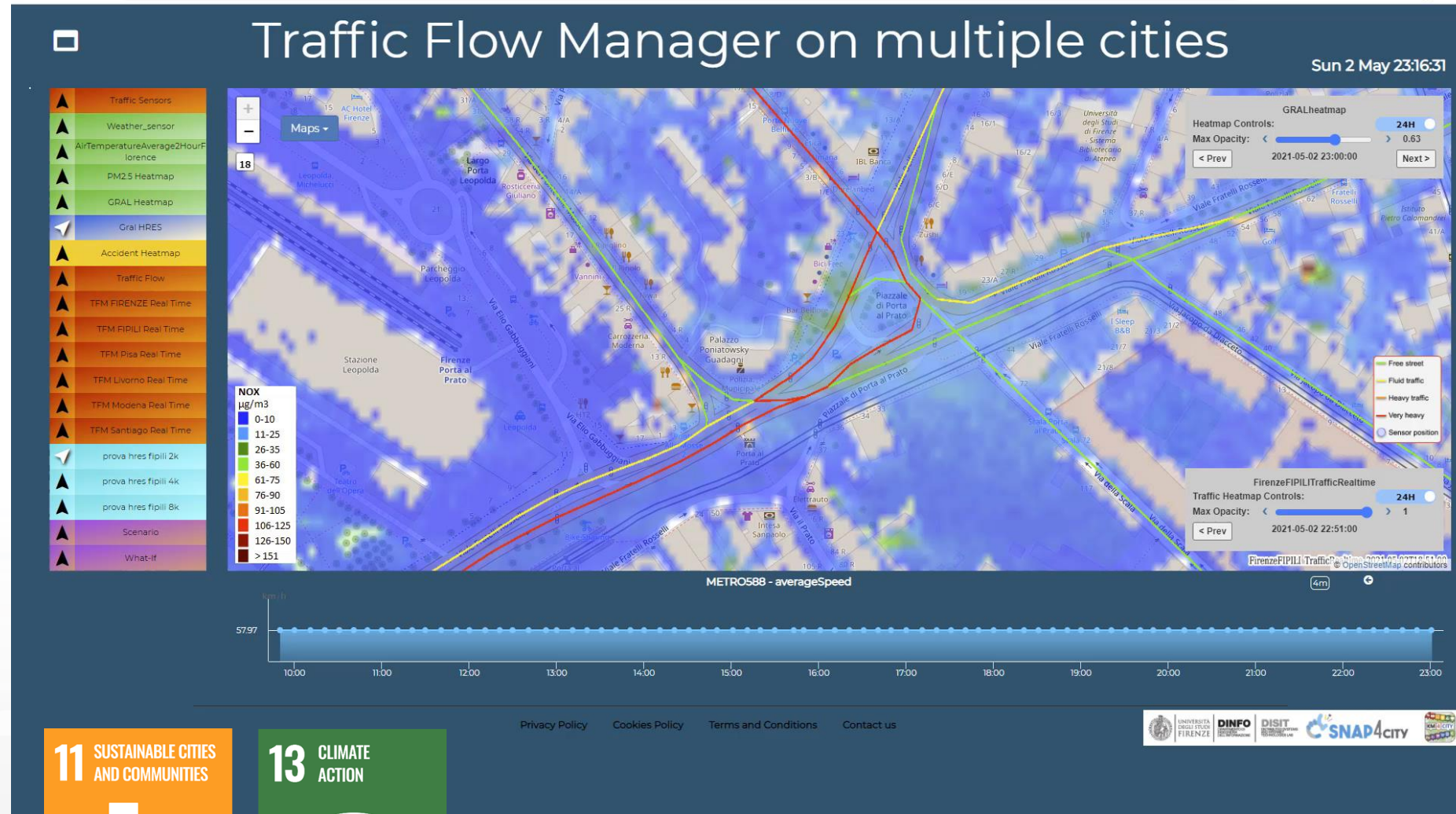
- *Control of emissions*
- *Reduction of emissions*
- *Early warning*
- *Meet the EC targets*
- *Reduction of EC taxation*

• Prediction

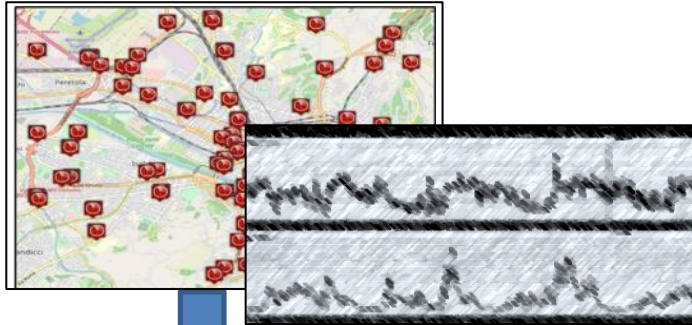
- **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
- **NO2 progressive average** (Long term)

• Project:

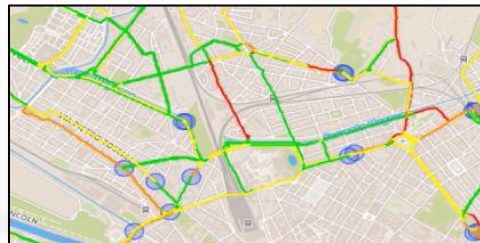
- **Trafair CEF EC**
- Mixed solutions of Fluidinamics modeling and AI



Estimating City Local CO2 from Traffic Flow Data



Computing Traffic Flow
into CO2 sensor area



Traffic Flow data

- Traffic Flow is one the main source of CO2 (**ton of CO2 x Km x Vehicle**)
 - **K1: Fluid Flow**
 - **K2: Stop and Go**
- **Dense estimation of CO2 into the city** is very useful to know to target EC's KPIs

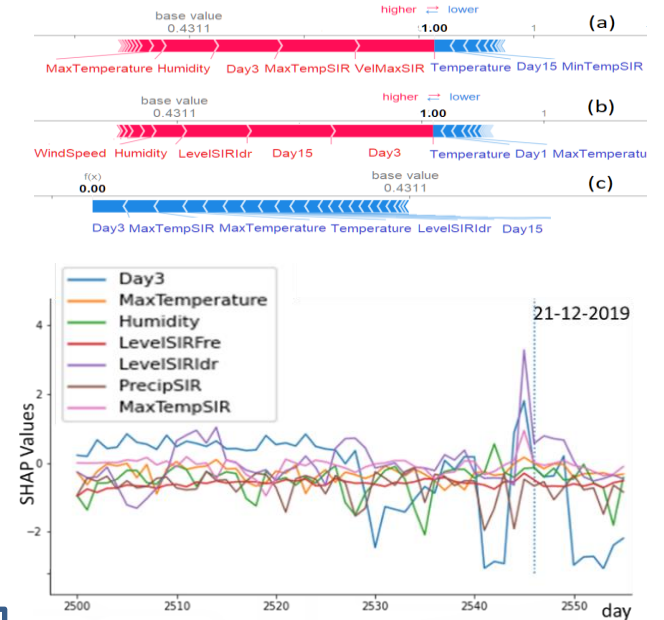
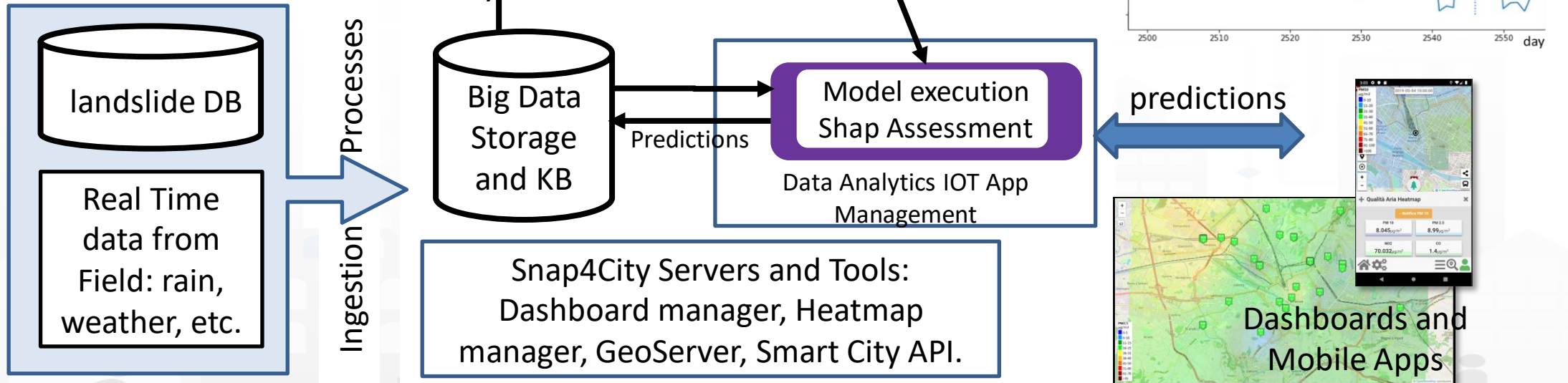
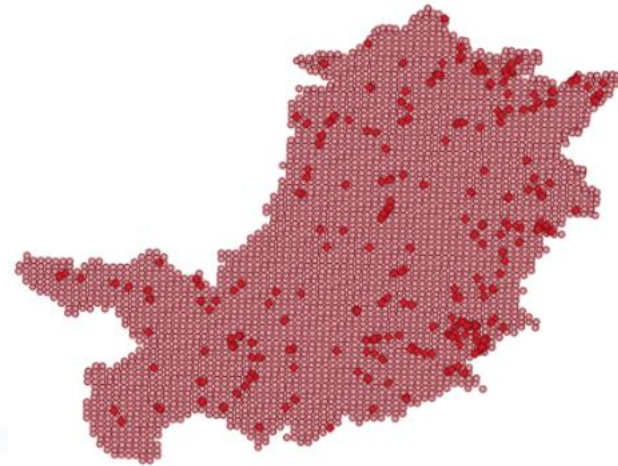


Computing CO2 on the basis of
traffic flow data



CO2 estimation

Predicting Land slides



Waste Collection Optimization

11 SUSTAINABLE CITIES AND COMMUNITIES



3 GOOD HEALTH AND WELL-BEING



Snap4Waste - Planning

Profile settings

testProfile2

Algorithm stopping criteria

- Max iterations
- Max runtime (s) 40
- Iter. with no improvement

Edit trucks Trucks: 1

Bin selection settings

Minimum fill rate 49 %
Max nearby distance 0 meters
Choose bin kind: Generic

Save profile Preview

Preview

Loading preview.
Bins found: 380 + 0 nearby bins
Bins weight: 87382 Kg + 0 Kg from nearby bins
Total: 87382 Kg
Trucks used:
• 8 trucks of type truck_0,
Capacity per truck: 11000 Kg

Optimize



Switch Mode: view

statsGeneration-2024-10-19T23-46-39

Loaded from: Past Execution

Progress: 100%

More details

Route statistics		
	Avg	Total
Travel time	1h 43m	96h 53m
Route duration	3h 51m	215h 46m
Weight collected (Kg)	9891.80	553941
Bins collected	38.21	2140
Routes length (Km)	25.95	1453.35

Navigate route

Truck-type_0-Route-000

Jump to

1 2

- Weight collected: 9941 Kg
- Bins collected: 64 bins
- Route duration: 6h 24m
- Route length: 42.64 Km

Show nearby bins

Save routes

Trajectorywaste2 Fri 17 May 18:34:15

SNAP4CITY

DISIT:orionUNIFI:113043.960_485172.926-Rest

Please select a date: 02/09/2020

Please select a ride among: 3

Selector - Map

DISIT-OrionUNIFI:114985.283_488088.814-Rest - Weight

My Profile

11 SUSTAINABLE CITIES AND COMMUNITIES

3 GOOD HEALTH AND WELL-BEING



Trajectorywaste2 Fri 17 May 18:34:37

SNAP4CITY

DISIT:orionUNIFI:113043.960_485172.926-Rest

Please select a date: 02/09/2020

Please select a ride among: 3

Selector - Map

DISIT-OrionUNIFI:114985.283_488088.814-Rest - Weight

My Profile

Optimal Routing Collection

City Users' Services and Tourism Management

- Improve Quality of Life and quality of services,
- Over tourism mitigation, sustainability
- Costs reduction of services
- Improve accessibility to services: citizens, Tourists, commuters, etc.
- Improve Security/Safety of city users





1 IMPROVE QUALITY OF LIFE 	2 OVERTOURISM MITIGATION 	3 SUSTAINABILITY 	4 LOWER SERVICE COSTS 	5 ACCESSIBILITY & SAFETY
--	---	---	--	---



Improve Quality of Life and quality of services



Over tourism mitigation, sustainability



Costs reduction of services



Improve accessibility to services: citizens, Tourists, commuters,

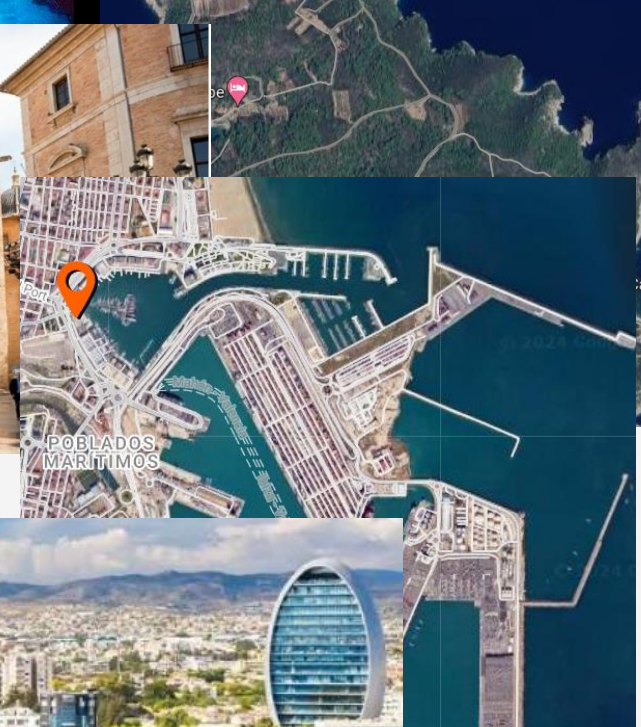
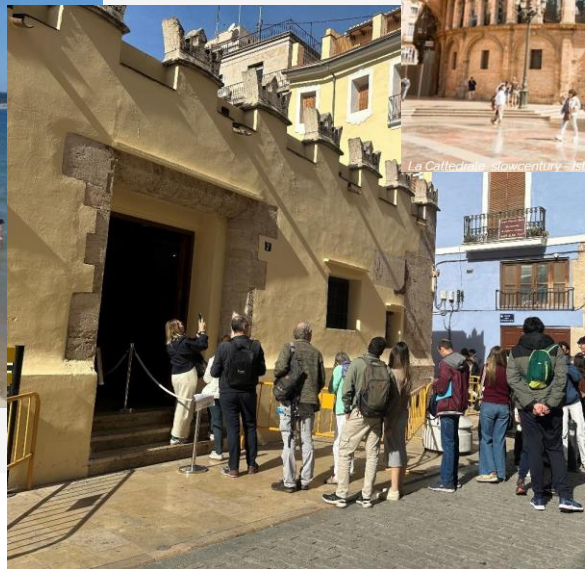
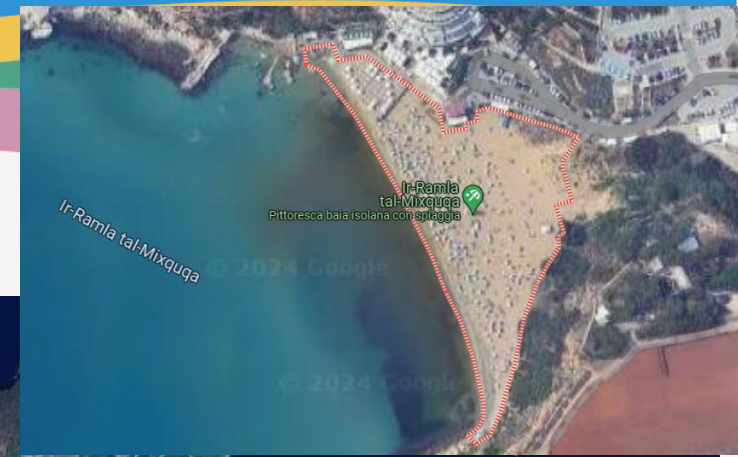


Improve Security/Safety of city users

SMART CITIES. BETTER SERVICES. HIGHER QUALITY OF LIFE.

• Pilots of Snap4City on:

- Greece - READ S.A.: Rodi
- Italy - FRI, UNIFI: Firenze
- Spain - FV, FSMLR: Valencia
- Cyprus - ANELEM: Limassol
- Bulgaria - VEDA: Varna
- Croatia - RERA SD: Splitsko-dalmatinska županija
- Malta - MRDDF: La Valletta



TOURISMO Florence - People Counting

Fri 29 Aug 17:14:01

TOURISMO

Interreg
Euro-MED

Co-funded by
the European Union

▶ PAX Counting Sens

▶ Hourly ODM

▶ Daily ODM

FIRENZE-LIBELIUMPASSERA

VALUE NAME: FIRENZE-LIBELIUMPASSERA
 Last update: 2025-08-29 17:00:34.591+02:00

Description	Value	Button			
ALLdetections	265	Last	4h	24h	7d 30d
BLEdetections	12	Last	4h	24h	7d 30d
WIFIdetections	252	Last	4h	24h	7d 30d
dateObserved	2025-08-29T15:00:34.591Z	Last	4h	24h	7d 30d

Keep data on target widget(s) after popup close:

S. SPIRITO - ALL detections (Wi-Fi plus BT)

People counting weekly trend

Legend: PISTI - All, S. Felicita - All, Piazza della Passera - All, S. Trinita - All, Piazza S. Spirito - All

People counting - Cumulative weekly trend values

Legend: PISTI - All, S. Felicita - All, Piazza della Passera - All, S. Trinita - All, Piazza S. Spirito - All

Main Dashboard

Mobility and Weather

Documentation

Privacy Policy

Cookies Policy

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Contact us





SNAP4CITY Turismo: Dome Trajectory Analysis

Mon 13 Oct 23:11:10

Selector

Duomo Sensors

directions

Map

FIRENZE-TCPIAZZADUOMO5minutes - peopleCounted

Percentuale distribuzione traiettorie

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Assistants on taking decision and for training/development



Logged in as:
edoardo_tester

 Your Profile

Logout

New Chat

EdoChat1

EdoChat2

EdoChat3

EdoChat4

prova

chatNuova

chatTest1LLAMA

chatTest2LLAMA

testGianniLLAMA

testTastoInvioPreChanges

ChatTestPostPSWINVIO


<https://www.snap4city.org/1116>


SnapAdvisor

Current chat: debug0

Visualize references

Personal
Advisor LLM

 Come creo una dashboard?

 Per creare una dashboard, puoi utilizzare la piattaforma Snap4City. La dashboard si compone di un insieme di widget grafici che possono essere impostati separatamente assegnando una serie di parametri, come origine dati, dimensioni, colori, forma, font, allarmi, relazioni con altri, ecc. (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Inoltre, la piattaforma offre la possibilità di creare vere e proprie applicazioni interattive, multipagina/multidashboard, e non semplici storie monopagina da scrollare. Puoi anche condividere la dashboard con altri utenti anche fuori dalla Smart City Control Room tramite canali autenticati e protetti in HTTPS, in accordo al GDPR (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Per vedere alcuni esempi di dashboard, puoi visitare il sito <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjU0Mg==> (SOURCE: Snap4 City 1st Overview v4 8 annot). Tuttavia, non ho trovato informazioni dettagliate sulla procedura di creazione di una dashboard. Se hai bisogno di ulteriore assistenza, ti consiglio di contattare direttamente il team di supporto di Snap4City. Non so dirti altro in merito.

Write a message...



SnapAdvisor

- **working on your private content** and thus producing answers.
 - Select a subset of documents
- **domain control**: you can decide the knowledge base (internal wikis, PDFs, APIs),
- **explainability** capability, provide references to your documents
- **multilingual via content**
- **modularity**: it is possible to pass from one collection of documents to another, and multiple users can work on the advisor asking for different topic on different collections/domains at the same time, independently as needs change, without any interferences among them.
- **lower hallucinations**

<https://www.snap4city.org/1116>

Build the Future of Your City



Scan to access the Scalable Smart Analytic
Application Builder for Sentient Cities.

www.snap4city.org / www.snap4solutions.org



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

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



OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS

HORIZONTAL AI PLATFORM

MOBILITY AND TRANSPORT

SMART ENERGY AND SMART BUILDING

ENVIRONMENT AND WASTE MANAGEMENT

CITY USER'S SERVICES AND TOURISM MANAGEMENT

SNAPADVISOR

BUSINESS INTELLIGENCE - SIMULATIONS - VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS



DASHBOARDS, WIDGETS
TEMPLATES



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



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

- DEVELOPMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES



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

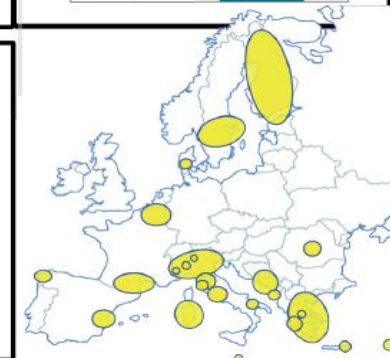
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING, GENERATIVE AI
OPERATIVE RESEARCH, STATISTICS

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

FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS



- NATIVE AND EXTERNAL APPLICATIONS
- Smart Parking
 - Smart Light
 - Smart Waste
 - Smart Energy
 - Smart Building
 - Smart Tourism
 - ...



Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

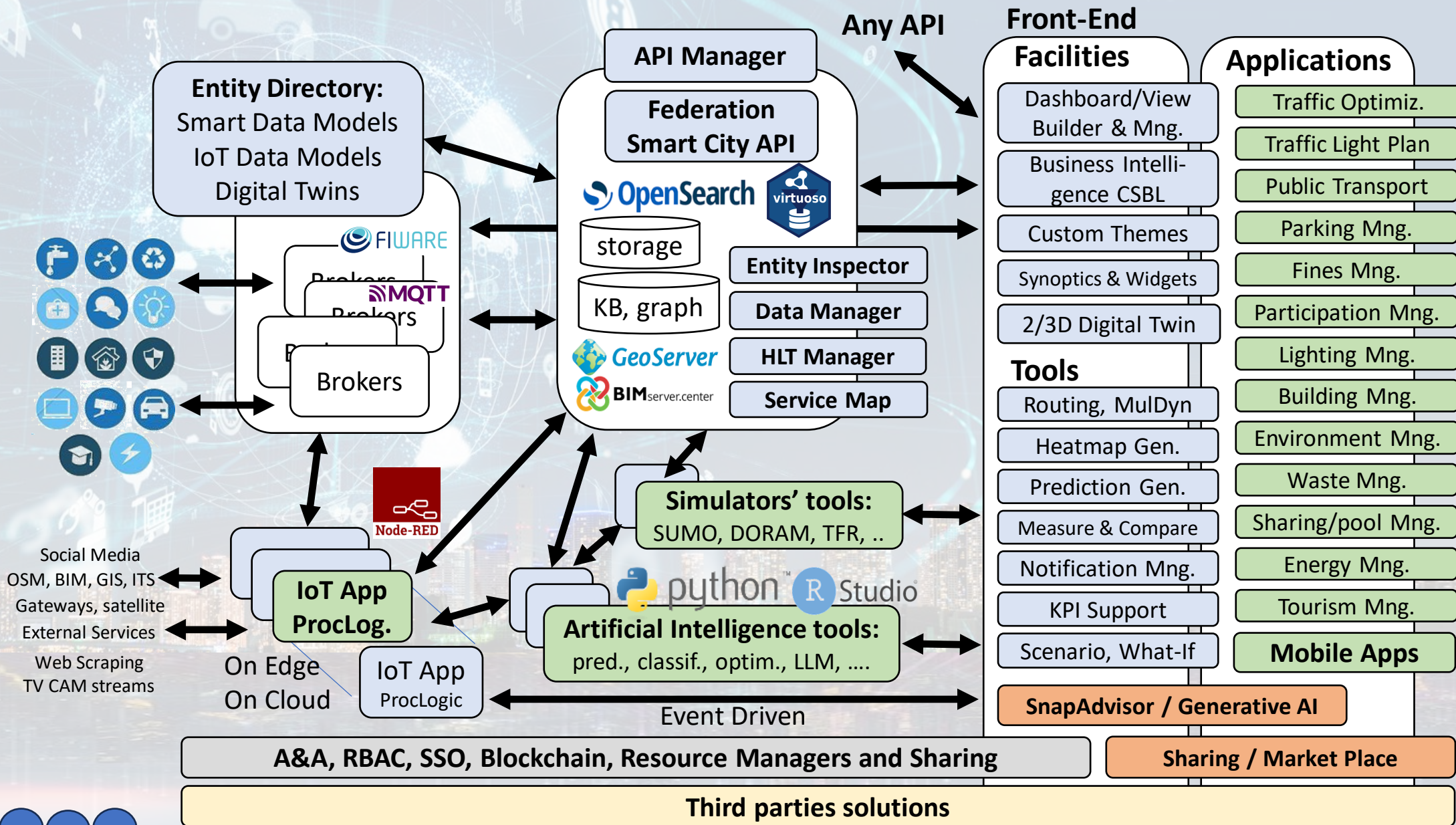
Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

Technical Architecture



Visual Development Tools



My IOT Sensors and Actuators

Add My New Device

Select Latitude/Longitude on Map

Entities/Devices Management

ID	NAME	TYPE	STATUS	LOCATION	OPERATIONAL	LAST UPDATE
...

Service Map (Toscana)

Data Inspector

My Data Dashboard Dev Kibana

29,146,065

Proc.Logic / IoT App

Data Analytics, IoT Application

15MIndex

Jupyter2-[75] Hub - Python

Jupyter2-[75] Hub - Python

My Dashboards in My Organization

3D MAP GLOBAL DIGITAL TWIN - NEWGUI

Client-Side Business Logic - Test

FIRENZE - TRAFFAIR - AIRQUALITY HEATMAPS - NEWGUI

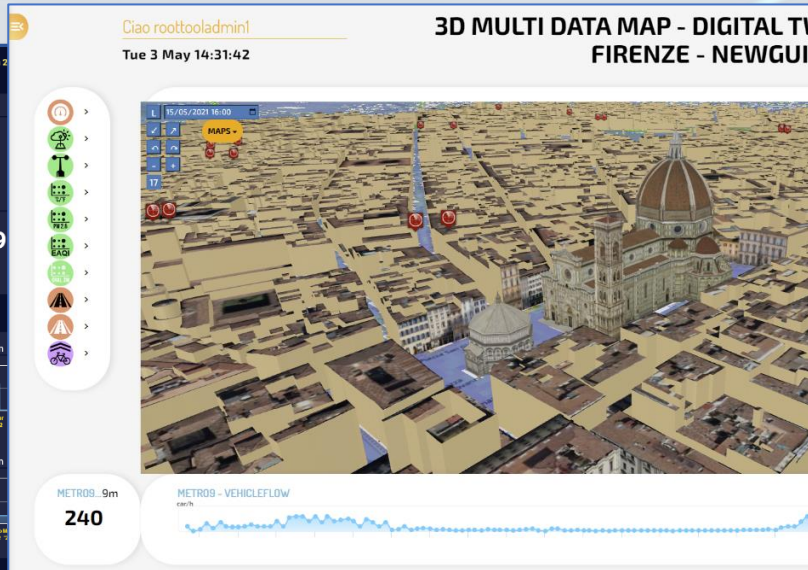
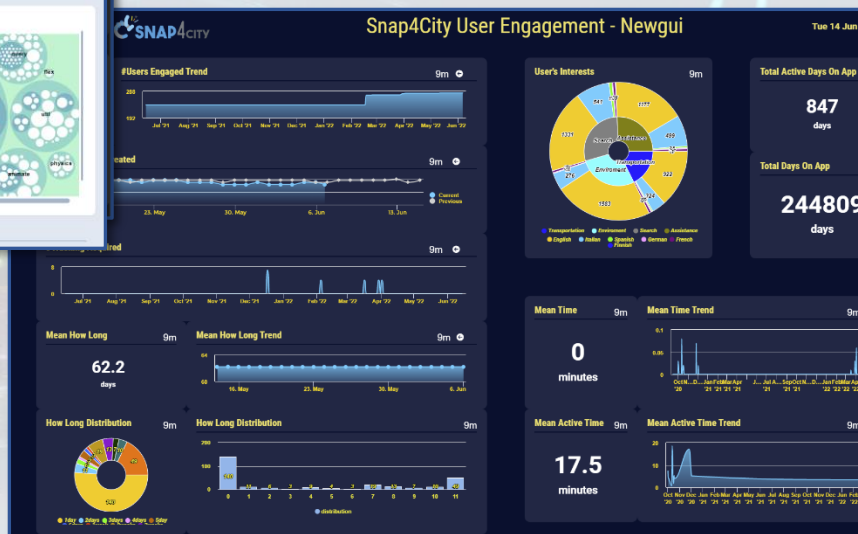
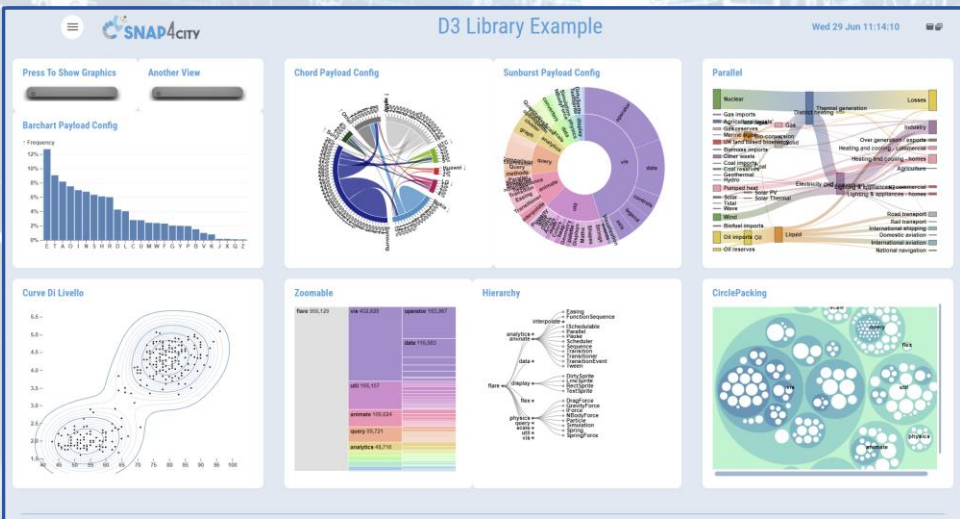
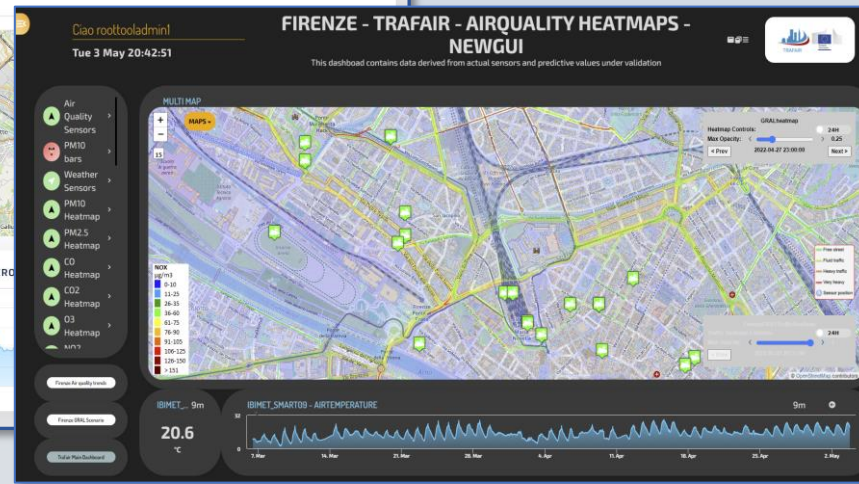
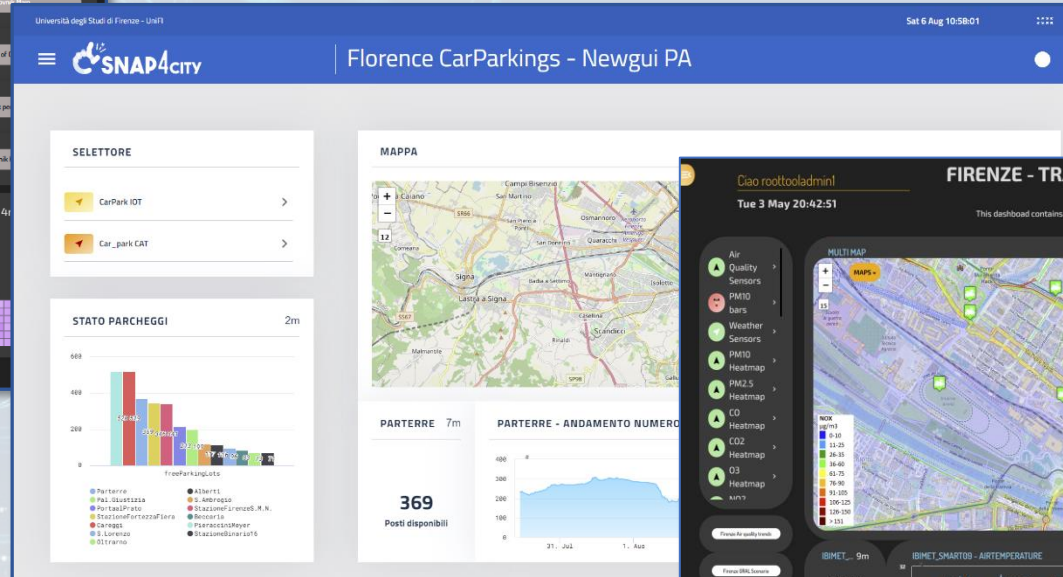
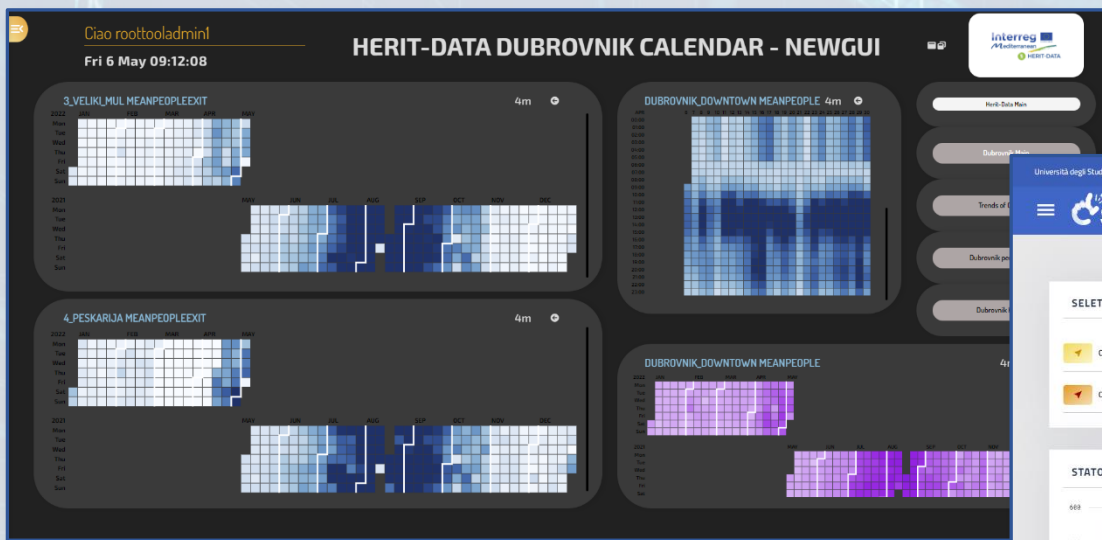
Custom Widgets / Synopsics

A&A, SSO, Blockchain, Res

Data Analytics



Different Themes



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

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

<https://www.snap4city.org/944>



On Line Training Material (free of charge)

1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
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

Development

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



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>

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Be smart in a SNAP!



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