13 April 2021

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES
scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders

https://www.Snap4City.org

13 April 2021

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https://www.Km4City.org
https://www.disit.org
Dashboards and Apps

IOT Apps

API, External Services
Web Scraping

WorkFlow

Data Analytics, Artificial Intelligence

KPI, POI, MyKPI, ...

BIM

GIS

LD, LOD

Big Data

KB

FIWARE

ckan

IoT Broker

IoT Broker

IoT Broker

Opericus

Concept

Snap4City (C), April 2021
• Open Data:
  – Data gate, federation of Open Data Portals
  – IOT App, ETL proc (PULL)

• IOT Networks:
  – IOT Application processes, data driven or PULL
  – IOT Brokers (Push) → IOT Shadow

• Web Pages:
  – Web scraping, crawling processes

• Satellite data

• Social media: Twitter, Facebook,..
  – Twitter Vigilance, IOT App

• Mobile Apps
  – Smart City API

• Files upload: CSV, Excel, etc.
  – IOT Applications, ETL

• REST API, WS, FTP, LD, LOD, etc.
  – IOT Applications, ETL

• Data base accesses
  – GIS: WFS, WMS
  – ETL, IOT Application

Any kind of data and flows
Dashboards

Snap4City (C), April 2021
BIM Integration Dashboard

Florence
Smart City Control Room
Florence Metropolitan City

• Multiple Domain Data
  • mobility and transport, accidents, public transport, parking, traffic flow, Traffic Reconstruction, ...
  • civil protection, gov data, covid-19, social & social media, people flow, tourism, energy, ...

• Multiple dash/tool Levels & Decision Makers

• Historical and Real Time data
  • Billions of Data
  • Predictions, what-if analysis

• Services Exploited on:
  • Multiple Levels, Mobile Apps, API

• Since 2017
Mobility and Environment What-IF Analysis
This dashboard contains data derived from actual sensors and predictive values under validation

Estimation of the mean waiting time at bus stops
Tuscany Region
Firenze, Pisa, Livorno, Prato, etc.
Mobility and Transport
Traffic Flow Analysis

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

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==
User Behavior Analyser for Collective Profiling

Who

When

What

Where?

Why?

Where they go ahead

Snap4City (C), April 2021
Campaing on Sustainable Mobility

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

Sii smart. Sii-Mobility!
Scarica, viaggia, Vinci!

Dal 15 aprile al 15 luglio scegliere il trasporto pubblico ti premia! Scarica l’app “Toscana dove, cosa”, guadagna punti viaggiando in autobus e vinci tanti fantastici premi! Per maggiori informazioni visita il sito info.sii-mobility.org
Environment and Quality of Life
Air Quality Predictions

• Multiple Domain Data
  • Traffic Flow data, Pollutant, 3D City structure, weather, ...

• Multiple Decision Makers
  • City officers, energy industries

• Historical and Real Time data
  • Dashboards, What-IF analysis
  • Pollutant Predictions,
  • Traffic Flow Reconstruction

• Services Exploited on:
  • Dashboards, Mobile App

• Since 2020
Impact of COVID-19

- Multiple Domain Data
  - Traffic, environment, People, parking, stock options, Twitter, etc.
- Decision Makers Multiple Locations
  - NO2 predictions
  - Twitter analysis
- Historical and Real Time data
- Services Exploited on:
  - Dashboards
  - Social media,
  - Sentiment Analysis
- Since 2019, 2020

Cities: Firenze, Pisa, Livorno, Toscana

Since 2019, 2020

Snap4City (C), April 2021
Antwerp
People Monitoring on Pub Services

**DIGIPOLIS Antwerp**

- Multiple Domain Data
  - PAX Counters: museum, pub services, COVID-19

- Multiple Levels & Decision Makers

- Historical and Real Time data
  - 20 fixed PaxCounters
  - 2 Mobile PaxCounters
  - Business Intelligence Dashboards

- Services Exploited on:
  - Dashboards, Mobile Apps, API
  - Fully Controlled Devices by Digipolis

- Since 2019
Snap4Altair Decision Support supervision and control, Industry 4.0

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

Multiple Decision Makers
- City Officer, operators

Historical and Real Time data
- Dashboards

Services Exploited on:
- Dashboards, API

Since 2019
Västerås
Smart Light Control of **CAPELON**

- **Energy Domain**
  - Smart Light
  - FiWare Orion Broker

- **Dashboards**
  - Map coverage on Sweden
  - Monitoring and real-time control

- **Historical and Real Time data**

- **Services Exploited on:**
  - Multiple Levels, API

- **Since 2020**
Dubrovnik

- Tourism Domain
  - Counting People
- Dashboards
  - Map coverage
  - Monitoring and real time control
- Tech:
  - Snap4City
  - Twitter Vigilance
  - Historical and Real Time data
- Since 2020

Snap4City (C), April 2021
Valencia, FSMLR

- **Tourism Domain**
  - Counting People
  - Environmental data
- **Dashboards**
  - Map coverage
  - Monitoring and real-time control
- **Tech:**
  - Snap4City
  - Twitter Vigilance
  - Historical and Real Time data
- **Since 2020**
Santiago di Compostela
Traffic Flow Reconstruction for the cities

Santiago di Compostela

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

• Dashboards & Services:
  • Environment & Weather, PM10, PM2.5, NO, SO2, CO, noise, etc.
    • Sensors values, Heatmap & Alerts on critical
    • FMI Enfuser prediction: PM10, PM2.5, ..
    • GRAL predictions PM10, validations
    • Private sensors in Jätkäsaari area (personal dashboards)
  • Mobility: Traffic Sensors, Operators, routing, multimodal routing, whatif
  • Social: Twitter Vigilance, early warning
  • Life in Helsinki: OD matrix people flow, Twitter Vigilance SA, hot places, etc.
  • Tourism and Culture

• Mobile App and MicroApplications:
  • Helsinki in a Snap (all stores)

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==
April 2021 collection
Two Snap4City Libraries

https://flows.nodered.org/search?term=snap4city
April 2021 collection
Two Snap4City Libraries

- **https://flows.nodered.org/search?term=snap4city**

**We suggest also to install:**

AND: From Resource Manager

<table>
<thead>
<tr>
<th>Snap4City (C), April 2021</th>
<th>NGSI</th>
<th>Social</th>
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</thead>
<tbody>
<tr>
<td>email</td>
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<tr>
<td>NGSI Entity</td>
<td>NGSI Update</td>
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<td>NGSI Dataset</td>
<td>NGSI Subscription</td>
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<td>tracks</td>
<td>convex hull</td>
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</tr>
</tbody>
</table>
Smart City Functional Architecture

Transport systems, Mobility, parking

Public Services, Government, events...

Sensors, IOT Cameras, Wi-Fi

Environment, Water, energy

Shops, services, operators

Social Media

Social Media Crawler and Manager

Data Sources, External Services
Pull Data

Data Sources, Brokers, External Services
Driven, Real Time

Data Ingestion, aggregation, regularization, reconcile: IOT Directory, NIFI, special tools

Knowledge base
Semantic Reasoners

Indexing and aggregating
Elastic Search

Federation
Search and Query, Smart City API, Web Socket Server, GIS, Facet, semantic

Data Analytics, Simulations, Special Tools
R Studio, Tensor Flow, Python, ...

IOT Applications, Business Logic
Node-RED + Snap4City MicroServices

Inform, announce, Act!, warning, alarms, What-IF, ...

Authentication, Authorization, Platform & Processes Management, Data Inspector, Digital Twin, ...

Rendering
Acting, Widgets, Synoptics, MicroApps
User interface, Drill down, maps, heatmaps

Snap4City (C), April 2021
One Snap4City Platform may serve Multiple Cities
<table>
<thead>
<tr>
<th>Main Data Sources</th>
<th>Antwerp</th>
<th>Helsinki</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>City official</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ICT official</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Citizen, tourist, visitor</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Business owner</td>
<td>X</td>
<td>X</td>
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<tr>
<td>City officials</td>
<td>X</td>
<td>X</td>
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<tr>
<td>City officials: Domain experts</td>
<td>X</td>
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<tr>
<td>City officials: City developers</td>
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<tr>
<td>Citizen</td>
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<td>Citizens with respiratory problems</td>
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<td>X</td>
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<td>Tourists</td>
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<td>Business owners</td>
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<td>Mobile</td>
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<tr>
<td>MicroApplication</td>
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<tr>
<td>Tool/Portal/ICT Developer</td>
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<tr>
<td>Dashboards</td>
<td>X</td>
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</tbody>
</table>

**Main Data Sources**

- POI, OSM
- Sensors data, OSM
- Spec. Portal
- Traffic Service
- Traffic Forecast
- Snap4City PAX Counters
- Snap4City Mobile App
- Snap4City Portal
- Twitter Vigilance
- Twitter Trends
- Self assessment
- Trajectories from mobile PAX Counters

**Discovery near to me**

- X
- X
- X
- X
- X

**Discovery along a path**

- X
- X
- X
- X
- X

**Discovery in an area, shape**

- X
- X
- X
- X
- X

**Full Text search**

- X
- X
- X
- X
- X

**Routing**: pedestrian

- X
- X
- X
- X
- X

**Routing**: pedestrian quite

- X
- X
- X
- X
- X

**Routing**: private vehicles

- X
- X
- X
- X
- X

**Discovery in a shape**

- X
- X
- X
- X
- X

**browsing Public Transport**

- X
- X
- X
- X
- X

**Full Text search**

- X
- X
- X
- X
- X

**Routing**: pedestrian

- X
- X
- X
- X
- X

**Routing**: pedestrian quite

- X
- X
- X
- X
- X

**Routing**: private vehicles

- X
- X
- X
- X
- X

**heatsmaps**: weather (Temp, Humidity)

- X
- X
- X
- X
- X

**heatsmaps**: environmental variables, PM10, PM2.5, NO2, EAQi

- X
- X
- X
- X
- X

**heatsmaps**: safe on bike (Antwerp)

- X
- X
- X
- X
- X

**heatsmaps**: Enfuser prediction, PM10, PM2.5, AQI

- X
- X
- X
- X
- X

**heatsmaps**: piking values any place

- X
- X
- X
- X
- X

**heatsmaps**: GRAL prediction, PM10

- X
- X
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- X

**heatsmaps**: Micropollution in Smart Zone

- X
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**Services Suggestions on mobiles**

- X
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**Alerts on critical cases: several variables**

- X
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**The most used services**

- X
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**Twitter Trends Daily**

- X
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**The auditing of user and living lab**

- X
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**Self assessment**

- X
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**Trajectories from mobile PAX Counters**

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**The auditing of user and living lab**

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**Self assessment**

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**Trajectories from mobile PAX Counters**

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### On Line Training Material (free of charge)

<table>
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<th>what</th>
<th>1st part (*)</th>
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<th>7th part (*)</th>
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<tbody>
<tr>
<td>General</td>
<td>Dashboards</td>
<td>IOT App, IOT Network</td>
<td>Data Analytics</td>
<td>Data Ingestion processes</td>
<td>System and Deploy Install</td>
<td>Smart City API: Web &amp; Mob. App</td>
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#### Interactive

<table>
<thead>
<tr>
<th>Video1</th>
<th>Video2</th>
<th>Video3</th>
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[https://www.snap4city.org/577](https://www.snap4city.org/577)
• Snap4City - Powered by FIWARE Solution:
  • https://marketplace.fiware.org/pages/solutions/b8905e91973b420189cce972
    – NGSI V1, V2 The IOT Orion Broker
    – IOT Orion Broker can connect JSON, MQTT, Lightweight M2M, LoraWAN, OPC, SigFOX, etc. see FiWare https://www.fiware.org
• Snap4City - FIWARE Training Services:
  • https://marketplace.fiware.org/pages/solutions/03bccd83a0e1b0398ba7a0bf
• Snap4City - FIWARE Consultancy Services:
  • https://marketplace.fiware.org/pages/solutions/907f5ecc63927f643dd8421b
• Snap4City is compatible with all the above protocols
  – via IOT Orion Broker,
  – via IOT Applications.
  – via direct connection on ETL processes on their corresponding IOT brokers, and/or
• Snap4City is also compatible with many other protocols, see the table reported in page: https://www.snap4city.org/65

Snap4City (C), April 2021
Acknowledgements
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• Km4City is an open technology and research line of DISIT Lab exploited by a number of projects. Some of the innovative solutions and research issues developed into projects are also compliant and contributing to the Km4City approach and thus are released as open sources and are interoperable, scalable, modular, standard compliant, etc.
Be smart in a SNAP!

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