LIVING LAB
Dashboards Creation and Management

19 January 2022, Course
https://www.snap4city.org/577
scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders

https://www.Snap4City.org

Dashboards Creation and Management

19 January 2022, Course
https://www.snap4city.org/577

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https://www.Km4City.org
https://www.disit.org
Tools for rapid implementation of sustainable Smart Solutions and Decision Support Systems

Dashboards and Apps - Control Rooms - Decision Support Systems - What-if Analysis - Visual Analytics

Prediction - Anomaly Detection - Environmental Model - 3D Model - KPI - Simulation - Early Warning - Synoptic - Digital Twin - Virtual Reality

Expert System Knowledge Base Storage - Big Data Analytics Explainable Artificial Intelligence Business Intelligence Machine Learning - Data Flows, Data Driven Workflows, Microservices Parallel Distributed Processing - Methodologies Courses and Community Living Labs Development Tools
Snap4City/Industry structure

- The Snap4xxxx solution is released in Open Source, VM and Docker with fully support of MultiTenant/multiple-O rganizations
  - Each Organization may be configured for a separate environment with a set of Maps, Menus, Users, Data, Dashboards, IOT Apps, MicroApplications, Custom Widgets, Models, resources, open data, etc.

- [https://www.Snap4City.ORG](https://www.Snap4City.ORG) is the main instance of Snap4xxxx solution managed by DISIT Lab. The main documentation is located and updated on Snap4City.org, GitHub, dockerHub and Node-Red Library. Snap4City.org is where the last tools are tested and news published.
  - Organizations on Snap4City.org have been created with contracts as for Platform as a Service, for testing and for providing SmartCity as a Service as well as Industry 4.0 as a Service
Most of Organizations on Snap4City.org also correspond to companies or institutions that have an installation of Snap4City tools on their Premise,
- such as: Pisa, SmartGarda Lake, Snap4, ALTAIR, etc.

This double way allows them to:
- test the news,
- share experiences with other groups,
- get visibility,
- work in the collaborative environment, and
- be better supported by Snap4City.org and DISIT Lab personnel.

Each instance of Snap4xxxx solution can decide to join the federation of SmartCity API to exploit shared data.
- This allows to exploit regional data for city installations applications (web, mobile, dashboards, etc.) without reloading them for example.

Main Organizations/areas
- Antwerp area (Be)
- Capeon (Sweden: Västerås, Eskilstuna, Karlstad)
- DISIT demo (multiple)
- Dubrovnik, Croatia
- Firenze area (I)
- Garda Lake area (I)
- Helsinki area (Fin)
- Livorno area (I)
- Lonato del Garda (I)
- Modena (I)
- Mostar, Bosnia-Herzegovina
- Pisa area (I)
- Pont du Gard, Occitanie (Fr)
- Roma (I)
- Santiago de Compostela (S)
- Sardegna Region (I)
- SmartBed (multiple)
- Toscana Region (I), SM
- Valencia (S)
- Venezia area (I)
- WestGreece area (Gr)
A Mobile App may refer to one Smart City API Server (for Area 1) via SUPER and receive data from the Federated SUPERS (Area 2) if navigation, queries, etc. are leading to discover out of the addressed KB.

- SUPER can be used for creating redundant and/or balanced distributed solutions for Federated KB. See Area 2, the two KB in the front.
- Federated SUPER ServiceMap can have overlapped KB even totally.
- A Mobile App can be developed to support multiple Smart City API servers, for balancing and

The usage of Super (ServiceMap) is not mandatory so that separate services can be produced as well

- SuperServiceMap and ServiceMap presents the same Smart City APIs.
Free Trial

• Register on [WWW.snap4city.org](http://WWW.snap4city.org)
  – Subscribe on DISIT Organization

• You can:
  – Access on basic Tools
  – Access to a large volume of Data
  – Create Dashboards
  – Create IOT Applications
  – Connect your IOT Devices
  – Exploit Tutorials and Demonstrations

IF you need to go more in deep you can ask us to pass at the next Role becoming full AreaManager with full rights of development, also for Data Analytics, machine learning, etc.
### On Line Training Material (free of charge)

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<th>2nd part (*)</th>
<th>3rd part (*)</th>
<th>4th part (*)</th>
<th>5th part (*)</th>
<th>6th part (*)</th>
<th>7th part (*)</th>
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<td>What</td>
<td>General</td>
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<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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<td>3:41</td>
<td>2:00</td>
<td>2:48</td>
<td>2:35</td>
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General Overview of the full Course 2021

• **1st part:** General Overview

• **2nd part:** Dashboards Creation and Management

• **3rd part:** IOT Applications development, IOT Devices, IOT Networks

• **4th part:** Data Analytics, in R Studio, in Python, how to Exploit and Manage Data Analytics in IOT Applications

• **5th part:** Data Ingestion, Data Warehouse, Data Gate, IOT Device Data ingestion, IOT App for Data Ingestion, Interoperability, etc.

• **6th part:** Snap4City Development, Extension, Administration, and Installation

• **7th part:** Smart city API (internal and external) Web and Mobile App development tool kit

A number of the training sections include exercitations

Updated versions on: [https://www.snap4city.org/577](https://www.snap4city.org/577)

See also courses in ITALIANO: [https://www.snap4city.org/485](https://www.snap4city.org/485)
2nd part Agenda

- Recall on Snap4City Architecture
  - Dashboard builder vs Kibana/Grafana
- Dashboard Usage and Authoring
  - Dashboard usage vs Widgets, Multi Data Map Widget, Data Kinds vs Graphic Widgets,
  - Special Widgets vs Special Data, Dashboard Menus of Organizations
- External Services (integration of) your of third party web pages
  - external service widget and family, Custom Widgets are seen as External Services, Event Driven Custom Widgets, dynamic widgets
- GIS Data Import, Export and Exploitation
- Unified Data Model (for All) and Data Inspection (for Admin)
  - Data Inspector vs Data Processes Details (for Admin), Digital Twin
- Dashboard Creation by Wizard & Exercitation
  - Dashboard Creation, Exercitation, Mechanisms of Selector for the Multi Data Map widget
- Dashboard Business Logic Via IOT Applications USAGE AND AUTHORING
  - IOT App Business Intelligence for Dashboards, Web and Mobile Apps
  - Widgets Interacting with IOT Apps virtual Sensors and Actuators
  - Dynamic Widgets data on Dashboard from IOT Applications
  - Synoptics and Custom Widgets Creation
- Flexible What-If Capabilities as Decision Support System
- Dashboard Event Management
  - Private Dashboard ChatRoom, Notifications from Dashboard and from any Data Condition
- Dashboard other Features
  - Dashboard Embedding into third party Web Sites/pages, controlling header and footer, etc.
- Dashboards Listing, Managing, Sharing, Delegation
  - Dashboard Listing, Managing, Sharing, Delegation
- Data Type Management GDPR Compliant
  - Dashboards GDPR Management, Personal Data Management GDPR Compliant: POI, Data, KPI
- DevDash: My Data Dashboard based on Kibana
- Acknowledgments

Snap4City (C), January 2022
Living Lab Accelerating

GO!

Collaborative Platform

- City Operators
- Resource Operators
- agreements
- networking
- tutorials
- documentation
- workshops
- experiments
- Inhouse companies
- Tech providers
- Category Associations
- Corporations
- Advertisers
- Community Building
- City Users
- personal services
- subscription to applications
- City Operators
- Resource Operators
- agreements
- networking
- tutorials
- documentation
- workshops
- experiments
- Inhouse companies
- Tech providers
- Category Associations
- Corporations
- Advertisers
- City Operators
- Resource Operators
- agreements
- networking
- tutorials
- documentation
- workshops
- experiments
- Inhouse companies
- Tech providers
- Category Associations
- Corporations
- Advertisers
- City Operators
- Resource Operators
- agreements
- networking
- tutorials
- documentation
- workshops
- experiments
- Inhouse companies
- Tech providers
- Category Associations
- Corporations
- Advertisers
Development Life Cycle
Smart City Services

Analysis & Design
- Analysis
- Design
- Data Discovery
- Data Ingestion

Data Analytics
- Data Analytics Development
- Special Tool Development
- IOT App Development

Development
- Dashboard Development
- Deploy
- Testing
- Publication Production
Recall on Snap4City Architecture
The usage of IOT Applications

- IOT Applications = Node-RED + Snap4City Libraries
- Used for:
  - Data Ingestion, Transformation, Extract, Load, and Adaptation (format and protocol), See Part 5 of the Course
  - IOT Edge Devices logic, for implementing logic on IOT Edge, including IOT Device control (see on Part 3 of the course)
  - Business Logic control of Dashboards, via Web Sockets secure
    - see Part 2 of the Course (this part)
  - Control and schedule of Data Analytic, and Machine Learning (see part 4 of the Course)
  - Firing and condition identification and alerting.
DASHBOARDS in Snap4City

Kibana vs Snap4City DashBoard Builder
Two Main Lines for Dashboarding

• Kibana (DevDash, My Dashboard (Dev) Kibana)

Ready to use
You can customize
Limited details

• Dashboard Builder of Snap4City

You need to create / customize
Full Control
Professional details

Snap4City (C), January 2022
My Dashboard (Dev) Kibana

• also called DevDash, AMMA, also accessible as Grafana
• For accessing and browsing data on OpenDistro (Elastic Search) storage and other sources supported
• **No Support for real time event driven widgets/panels, actuators and synoptics, no sophisticated maps, etc.**
• **Not suitable for control room**, decision makers, etc.
• **Not integrated with IoT App**, Custom widgets, animation, external services.
• **Oriented to developers**, complex production of custom views, etc.
• **Partial support of GDPR and deep control of access.**
Dashboard Builder of Snap4City

- For accessing and browsing data on: OpenDistro (ElasticSearch), Mongo, MySQL, Smart City API, Super and thus from federated Smart City API, etc.
- **Supports sensors/actuators**: data driven data, maps in extended manner, data driven widgets, large collection of widgets, direct IoT Connections, custom widgets, animated PIN on maps, a large set of panel/widgets, etc.
- **Very simple to be used for control room**, decision makers, situation rooms, operators, etc.
- **Very well integrated with IoT App**, Custom widgets, animation, external services.
- **Very simple to be customized** for non programmers since all the tools are visual.
- **Support for GDPR** and deep control of access.
- Can integrate Kibana/Grafana Views into a Widget
Dashboard Builder: Development

Create, save, load, delegate, grant access, change ownership

Dashboard Wizard

Dashboard Editor

Widget Collection

Micro Applications

External Services

Custom Widgets/Synoptics

Public Dashboard Collection

My Own Dash/App

Knowledge and Storage
Data from the Field and City + MyKPI ++

Knowledge Base, Km4City

IOT Applications

Data Transformation
Business Logic

Snap4City (C), January 2022
## Snap4City Dashboard Builder vs Kibana

<table>
<thead>
<tr>
<th>Features</th>
<th>Snap4City Dashboard Builder</th>
<th>Kibana, Grafana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Collection of Widgets</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Custom Widgets SVG of any kind, full defined process for customization</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Real time event driven widgets and data</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Business Logic for data transformation with visual programming: Node-RED</td>
<td>YES: visual/coding</td>
<td>coding</td>
</tr>
<tr>
<td>Maps with custom PIN, bubbles, animated and moving, etc.</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Maps with paths, shapes, traffic flow, scenarios, routing, heatmaps, what-if, ...</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Maps with Orthomaps from WFS, WMS, GIS connection, etc.</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>TV camera event integration and selection</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Widgets for business logic integration on real time: buttons, selector, switch, etc.</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Kiviat, Spider net, Calendar</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Typical Time Trends: day hours, month week, month days, .....</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Time Trend Compare: day, eek, month, year</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Selectors/Menus: text, icons, etc., also in connection with IOT APP, Node-RED</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Full control of graphic layout, font, colours, refresh per widget, etc.</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Iframe integration of third party widgets and web pages, nesting dashboards, embedding Kibana</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Connection among multiple Dashboards and Widgets</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Synchronization with Video Wall, and Operators Views</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Multiseries, bar lines, charts, pie, donut, simple selectors, trends, etc., also from business logic</td>
<td>YES</td>
<td>Limited</td>
</tr>
<tr>
<td>Single content, string, html, any data, etc.</td>
<td>YES</td>
<td>Limited</td>
</tr>
<tr>
<td>Special widgets: Weather forecast, civil protection, road plates, Twitter, etc...</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Digital Twin Local and Global</td>
<td>YES</td>
<td>Nothing</td>
</tr>
<tr>
<td>Faceted search</td>
<td>YES: selectors, forms, buttons</td>
<td>YES</td>
</tr>
</tbody>
</table>
Snap4City (C), January 2022

Public Dashboards (see them on the Portal)
DEMO

Section
Video Wall

From Consolle Operator to the Video Wall

e.g. 3X3 (HD)

Snap4City (C), January 2022
Control Room

https://www.snap4city.org/621
Citizens Engagement

https://www.snap4city.org/511
Snap4City - scalable Smart aNalytic APplication builder for sentient Cities

Smart Cities need to set up a flexible Living Lab to cope with the city evolution in terms of services and city users’ needs and sustainability. Snap4City solution provides a flexible method and solution to quickly create a large range of smart city applications exploiting heterogeneous data and enabling services for stakeholders by IoT/IIoT, data analytics and big data technologies. Snap4City applications may exploit multiple paradigms as data driven, stream and batch processing, putting co-creation tools in the hands of: (i) Smart Living Lab users and developers, (ii) users that customize IoT/IIoT applications for city status monitoring, control and decision support, (iii) city operators and decision makers specialized or sophisticated city dashboards and IoT/IIoT applications for city status monitoring, control and decision support. Snap4City satisfies all the expected requirements of Select4Cities challenge PCP and much more, and it is 100% open source, scalable, robust, respects user needs and privacy, provides Microservices and easily replaceable tools, compliant with GDPR, provides a set of tools for knowledge and living lab management, and it is compliant with more than 60 protocols including end-to-end encrypted communication. Snap4City is an official platform of FIVware, an official library of JS Foundation Node-RED, registered on EoC, present on EOSC marketplace, and BeeSmartCity MarketPlace, etc. Snap4City obtained the 1st place award by Select4Cities partners and PCP (Antwerp, Copenhagen and Helsinki).
Data vs Visual Representation, Visual Analytics
Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

IOT Applications

Dashboards and Apps

Data Channels

Big Data Analytics, Artificial Intelligence
From Data to Visualization
Visual Representations

- Slider with multiple steps for KPI
- Sparklines
- KPI
- Histogram
- Heatmap
- Flow maps
- Geo maps
- Donut chart
- Data grid
- Chord
- Cone
- Bubble matrix chart
- Bullet
- Box plot
- Stacked area
- Stacked line chart
- Stacked combinatorial chart
- Spider maps
- Sequence Sunburst
- Pivot
- Pie chart 1
- Pareto chart
- Radar
- Bubble maps
- Waterfall
- Sunburst
- Sankey

Snap4City (C), January 2022
• Visual Representation should provide hints hiding complexity
• Data vs Representation
  – Not all data can be represented by all Visual Representation
  • → From Data to possible representation and viceversa
1. increasing cognitive resources, using a visual resource to *expand human working memory*,
2. reducing search, representing a large amount of data in a small space,
3. enhancing the recognition of patterns, organize in space and time by relationships,
4. make easy perceptual inference of relationships that are otherwise more difficult to induce,
5. perceptual monitoring large number of potential events, and
6. Way to real time manipulation to explore data space in time and relationships.
Data and relationships

Big Data Analytics, Artificial Intelligence

Business Logic to change data, and user interface

Dashboards and Apps
Dashboards Usage vs Widgets
Dashboard Usage & Recipe

- [https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTQwNg==](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTQwNg==)

- **Selector Widget**: (of different kinds) present “Information”, according to the HighLevelType (HLT), as overlapped layers on Target
  - **Additive**: PIN (POI, sensors, etc.), Cycling Paths, shapes, ...
  - **Mutual Exclusive by group**:
    - Heatmaps,
    - traffic,
    - Scenarios + what-if,
    - etc.

- **MultiDataMap Widget (Target)**: (may be of different kind), this one may manage
  - Multiple representations on the same map
  - Each representation may provide specific interaction modalities and controls
Other Widgets in the dashboard

• **Button Widget** may be of different kind and may
  – Open external web pages, services, forum, surveys, etc.
  – Send messages on the field (IOT), etc.

• **External Content:**
  – Web pages (HTML + CSS + etc..), Video Streams
  – Many many other tools see next exercise

• **Single Content**
  – Single value: numeric, string, HTML, etc.

• **Time Trend**
  – Time Series: numeric values over time
Vista Helsinki

Snap4City (C), January 2022

Helsinki City Overview (H5a)

Please note that the data results are not always based on real data.

Widget Map (multi data map)

Time Trend

External Content

Single Content

Snap4City (C), January 2022
Helsinki vs Florence comparison

Please note that the data results are not always based on real data.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0MQ==
Unique Dashboard builder Multiple Styles

Snap4City (C), January 2022

Dashboard Usage and recipe: Event map target

• **Selector**
  – POI, Heatmap, traffic, etc.

• **Traffic Events:**
  – From gesture (manager)

• **Entertainment events:**
  – From several sources

• **Mobile Operator Events:**
  – From operators with Mobile Apps
Multi-Widget Map - Demo

Multi-Widget Map - Demo

Widget Map
(multi data map)

Time Trend


Snap4City (C), January 2022
Multi-Widget Map - Demo

https://www.snap4city.org/dashboardSmartCity/view/index.php?id_dashboard=MTA2NA==
Main Single Values Widgets
• Single Content
• Speedometer
• Gauge
• Single Bar

Most of the multi xxxx widgets can show also single values.
Speedometers- Gauges

- Coloured custom
- Unit of measure
- Bounds

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU0MA==
Time Series, Multi Series Widgets
• Time Trend

• Time Trend Compare
  – Comparing trends of the same time series

• Multi Series
  – Showing multiple trends of multiple time series with same unit

• Typical Time Trend
  – Showing the typical trend of a time serie: multiple modalities
- Staked, shaded or regular,
- Grouped by Value_unit, linear or Logarithmic
- From historical data and/or dynamic data from IOT Applications

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjUzMg=
Ordered Data Series

- A series or multiple series which are ordered by a number:
  - E.g., 1,2,3,4,5,......N
- For each number (position over X axis, a value on Y axis is provided)
- It is provided from the multiseries widget with setting parameters from MoreOptions
- Series can be also provided from IOT Apps
Time Trend Compare Widgets for Time Series
A tool for visual Analytics, Comparing

- **4 hours** wrt those before, or same hours of previous day
- **12 hours** wrt those before, or same hours of previous day
- **Day** wrt day before, or same day of previous week or month
- **Week** wrt to previous week, or
  - week starting on Monday
- **Month** wrt to previous month, or
  - previous month starting 1\textsuperscript{st} day, or
  - same month of the previous year
- **6 Months** wrt to previous 6 months, or
  - Aligned day 1 or same 6 months previous year day 1 or
  - 6 months previous year day 1 aligned 1\textsuperscript{st} or 2\textsuperscript{nd} semester
- **Year** wrt to previous year, or
  - previous year starting 1\textsuperscript{st} day, or
  - previous year starting same month
Calendar Widgets for Time Series
Showing: **Sum, Average or Median** value of a variable as a colored calendar:

- **Year**
  - 1 Year, 12 months, by weeks, per days
  - Time Range: 1D, 7D, 1M, 6M, 1Y

- **Month**
  - 30 days, 24 hours
  - Time Range: 1D, 7D, 1M, 6M, 1Y

- **You can scroll in history**

- **They manage HLT: Sensor, MyKPI and work receiving Dynamic data from IOT App**

https://www.snap4city.org/706

Dubrovnik Calendar: Tvcamera people counting

HeritData Dubrovnik Calendar

Trends of Counting
TV Positions

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4Nw==
Typical Time Trend, Visual Analytic on Time Series

https://www.snap4city.org/705
TypicalTimeTrend CO2

selectSensor
IBIMET_SMART09

selectSensor
IBIMET_SMART28

CO2 dayHour Trend
connected to ws://dashboard.km4city.

CO2 dayHour Trend
connected to ws://dashboard.km4city.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEzMA==
msg.payload = { "options": [ { "label": "IBIMET_SMART09", "value": "IBIMET_SMART09" }, { "label": "IBIMET_SMART27", "value": "IBIMET_SMART27" }, { "label": "IBIMET_SMART28", "value": "IBIMET_SMART28" }, { "label": "IBIMET_SMART29", "value": "IBIMET_SMART29" } ], "selected": "IBIMET_SMART09" }return msg;

msg.payload = [ { "metricHighLevelType": "Sensor", "metricName": "CO2", "smField": "CO2", "serviceUri": "http://www.disit.org/km4city/resource/"+msg.payload.selected } ]
return msg;

The flows are identical but the different visualization is set via MoreOptions.
Typical Time Trend, & dynamic time series
Typical Time Trend

- They:
  - need to be computed in advance on the basis of a Time Serie variable, and a reference period of computation.
  - represent typical trends of: min, max, average, median
  - You can change the data on view

- Formats:
  - **DayHour**: 7 time trends, one for each day of the week, each hour, 24 values.
    - As DayView or WeekView, start Monday
  - **MonthDay**: a value per day, 30 values of the month.
  - **MonthWeek**: a value per day aligned to week days: 28 values, 4 weeks.
    - 1st Monday of the month
    - 3rd Friday, etc.

• DayHour as DayView
• Any TTT which can include the data 16/11/2019
• Each TTT is computed on the basis of a Time range: from-to including that date
• **MonthDay:**
  – a value per day,
  – 30 values of the month.
  – Aligned from the first day of the month
  – computed on the basis of a Time range: from-to including that date
    • e.g.: 2 months
    • As min, max, average, median
    • You can change the data on view
• **MonthWeek:**
  – a value per day,
  – 30 values of the month.
  – Aligned from the first Monday of the first week of the month
  – computed on the basis of a Time range: from-to including that date
    • e.g.: 2 months
    • As min, max, average, median
    • You can change the data on view
Typical Time Trends

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA5MQ==
Typical Time Trend

• They can be generated from IOT App
  – 1) exploit MultiSeries block on Node-RED
  – 2) send sensors ServiceURI, or MyKPI ID or dynamic vector
  – 3) go on dashboard and set the parameters on More Option as described above.

• They can be used as low costs predictions: produced with a part of the temporal window in the future. For example,
  – 2 weeks in advance
  – Exploiting the 4 weeks in pasts
Bars, Pies, Donut, Tables Widgets

This is a pie chart describing my favorite bars.

And this is a bar graph describing my favorite pies.
- Stacked and grouped by Value_Name / Value_Type
- Oriented: Vertical and Horizontal
- ordered by value: crescent, descending
- From historical data and/or dynamic data from IOT Applications

[Snapshot of the dashboard]

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjQwMA==
• Single level Pie and two levels as Donut
• Grouped ValueType, ValueUnit
• Neutral or Colormapped, the same of heatmaps
• Number/text
Normalized, multiple value units
Hystorical, KPI and Dynamic from IOT App

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjUwNQ==
OLAP Data Cubes
The Data Cube

• Many different data Cube can be defined
The data cubes

- Using Dashboard Wizard with Widgets all the different transformations may be possible with different representations.
- The IoT App allows to make them Dynamic
• IoT Devices may have multiple Sensors
  – KPI and Sensors may have different ValueUnits (%, Kg, Km, um/m3, ppm, Kw, etc.)

• They are distributed in the maps
  – Multi Data Maps Widget can show multiple values and layers
You can select a mix of:

- HLT: MyKPI & Sensors (device, sensor_map) & Sensor (ValueName)
- DataType: Sensor_map, integer, Integer-mykpi, float, float-mykpi

The cube is created with all data.

The cube is visualized as a 3D multiseries (time) with the first DataType.
OLAP widget vs Dashboard Wizard

• The cube is visualized as a 3D multiseries (time) with the first DataType
  – Different DataType can be selected for slicing over TYPE
  – Different Date and Time can be selected for temporal slicing
Slicing on Time

- Drill down on time
- Drill up on time is performed on More Option on Editing only
Please note that if the data are sporadic in the time the streams are visualized as bars.
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzIyOA==
Combining Widgets
Roma Demo3 (Qualità dell'Aria)

Andamento nel tempo di NO2 rilevato nelle stazioni in Roma (di)

Dati in tempo reale inquinanti in Roma e provincia

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

Snap4City (C), January 2022
Match Widget vs Icon

Energy Dash
dimostrativo dati non veri

Normal recharging stations
ZTL gate
Florence WiFi POI

27 users
245722 kWh

58% 44.6% 37.9%

Monitoring My PAXCounter and Tracks (example)

Please note that the data results are not always based on real data.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0NQ==

Snap4City (C), January 2022
A set of connected dashboards
Many different tools.
Fully interactive for touch screens

https://www.snap4city.org/dashboardSmartCity/view/index.php?id_dashboard=OTM5
Most of the widgets are connected to an URL to jump to other views/dashboards.
Most of the widgets are connected to an URL to jump to other views/dashboards.
Mobility and Environment What-IF Analysis

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

Multi Data Maps Widget
Multi Data Map Widget

- The most powerful Data Map rendering tool, it supports:
  - **KB Sensor data**: POI, sensors, actuators, etc. (see in the following), moving devices
  - **WFS data** (see in the following)
  - **WMS background maps**
    - Ask to a **RootAdmin** for activating this feature on your MultiDataMap widgets once created the dashboard
    - Maps can come from GIS servers, and WMS
  - **WMS Heatmaps GeoTIFF**
  - **WMS Traffic Flow GeoTIFF**
  - **GTFS data from Public Transport**
  - **Special tools**
    - Scenario (see in the following)
    - What-IF (see in the following)

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==#
Orthomaps as graphic layers

• Orthomaps can be:
  – Directly exploited from public service via WMS protocol, from some GIS services as GeoServer
  – Loaded into the Snap4City GeoServer
  – Layered if they can be overlapped each other, such as map with gov border above.

• The Dashboard owner can
  – Select the Orthomaps to be used shown as default in the dashboard

• Each organization has its own set of Orthomaps

Menu Icon and PINs as Icons

Technical Selector: TECH MultiDataMap

https://www.snap4city.org/dashboardSmartCity/view/index.php?id=dashboard=MjMxOA==
Unique Dashboard builder Multiple Styles

Traffic Flow Manager on multiple cities

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

Roma Demo1 (mappe e dati real time)

Custom Dynamic Pins

Custom Pins on Map - test GP

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk5MA==
Multi Data Map: many kinds of data

- **Orthomaps**: plain maps and overlapped layers
- A range of **Pins Kinds** for marking Services, IOT Devices, etc.
- **Services**:
  - POI, MyPOI, IOT Devices, Sensors, Actuators, IOT Device Moving, etc.
  - Cycling paths
  - Areas shapes: gardens, etc...
  - GIS data
- **Heatmaps**: different types
- **Traffic Flows**: different kinds
- **Special data**:
  - What-If analysis: routing, public routing, traffic flow
  - Routing: private, public, pedestrian, public means
  - Scenarios definition
- **3D buildings**
- ....
**Pins on Multi Data Maps (1)**

- **Classic**: (default)
  - Text menu or Icon Menu
    - Custom color of the Menu only
  - Fixed on the basis of Nature and Subnature

- **Icon**: (accessible as Icon Mode of selector)
  - Also usable with Text Mode of the menu
  - Selectable from a large set
  - Coherent with Icon on Menu
  - Custom Color
Pins on Multi Data Maps (2)

• Bubble:
  – Text Menu or Icon Menu
  – Custom Color
  – Size depending on ServiceURI Attribute, IOT Device ValueName

• Custom: (accessible from Alternate View Mode)
  – Can be created by AreaManagers as Custom Widgets
    https://www.snap4city.org/663
  – Selectable from a set
  – Coherent with Menu, also usable with text menu
  – Variable/Dynamic colors/animations associated with ServiceURI Attribute, IOT Dev ValueName
3D - Multi Data Maps Widget
Global Digital Twin Modeling

• Rendering Maps with 3D shapes of buildings
  – They can be generated from OSM, shapes, and other sources, created by extruded shape from ground shape
  – Full control: pan, zoom, tilt, rotation, etc., simulation of light conditions
    • Plus Full control with right button and wheel of the mouse
  – Full control of pre-setting for direct show in loading

• Addition of multiple
  – Orthomaps below the buildings
  – Heatmaps, over orthomaps, but below buildings
  – Cycling paths and other shapes, polylines
  – Traffic Flows reconstruction models
  – POI, Sensors: PopUps with real time data
Digital Twin Global

3D Multi Data Map - Digital Twin Global - Firenze

demonstrator

Fri 10 Sep 09:27:16

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjUxMA==
Data Kinds vs Graphic Widgets
HLT, High Level Types
- POI, IOT, shapes,..
- maps, orthomaps, GTFS, GIS WFS/WMS, GeoTiff, ..
- calibrated heatmaps, ..
- traffic flow, typical trends, ..
- trajectories, events, ..
- 3D, BIM, Workflow, ..
- Dynamic icons/pins, ..
- OD Matrices, scenarios, ..
- prediction models, ....
- decision support, ....
- Synoptics, animations, ..
- social media, Routing, ..
- Satellite data, ..
- KPI, personal KPI,..
- etc.
**Data Models**: all devices sprunt from that model
- IoT Device Model, Mobile Device Model, Data Table Model

**Devices**: are instances of some model or sprunt from processes
- IoT Device, Mobile Device, Data Table Device, Sensor Device

**Variables**, Sensor/sensor-actuator, :
- IoT Device Variable, Mobile Device Variable, Data Table Variable, Sensor, Sensor-Actuator
- **Dashboard-IOT App**: messages from GUI to Business Logic on IoT App

**MyKPI**: dynamic GPS, info, single variable, Time Series, *(Classification)*
- **KPI**: former KPI model
- **MyPersonaData/MyData**: safes in which specific personal data are saved.

**POI**: static GPS, info about a location, *(Classification)*
- **MyPOI**: personal POI that can be leveraged to standard POI by administrator

**Heatmaps**: matrices on some area, Time Series, *(Classification)*

**Traffic Flow**: road segments with flow density, Time Series, *(Classification)*

**OD Matrices**: origin destination matrices, Time Series, *(Classification)*

**Complex events**: emergency, alarm, entertainment, CAP, ... special widgets
**HLT: Unified Classification for Data and Services**

- **External Service**: third party visualization tools, iFRAMED...
  - Also TV CAMs are rendered here, and substantially all the other Services

- **Synoptics**: graphic representations with animation connected to variables and/or MyKPI and/or IoTApp, etc.

- **BIM representations**: Digital Twin Local, ...

- **Micro Applications**: Snap4City, Km4City micro applications, iFRAMED

- **Special Widget**: a set of special visualization tool with their dedicated data type

- **WFS**: a specific tool for WFS GIS rendering, please note almost the same kind of data type can be visualized as Data above described
Data Inspector: HLT classification
**HLT: Unified Classification for Data and Services**

### Variables, names

<table>
<thead>
<tr>
<th>High Level Type</th>
<th>Nature</th>
<th>SubNature</th>
<th>Technical Source</th>
<th>Broker name</th>
<th>Value Name</th>
<th>Value Type</th>
<th>Data Type</th>
<th>Value Unit</th>
<th>Last Date/Time</th>
<th>Last Value</th>
<th>Healthiness</th>
<th>Ownership</th>
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<tbody>
<tr>
<td>IoT Device Variable</td>
<td>IoT Device Variable</td>
<td>IoT Sensor</td>
<td>devonTest1</td>
<td>onuUNIFI</td>
<td>temperature</td>
<td>float</td>
<td>int</td>
<td>°C</td>
<td>2020-10-15 10:00:00</td>
<td>2020-10-15 10:00:00</td>
<td>private (My Own)</td>
<td>private (My Own)</td>
</tr>
<tr>
<td>IoT Device Variable</td>
<td>IoT Device Variable</td>
<td>IoT Sensor</td>
<td>devonTest1</td>
<td>onuUNIFI</td>
<td>humidity</td>
<td>float</td>
<td>int</td>
<td>°%</td>
<td>2020-10-15 10:00:00</td>
<td>2020-10-15 10:00:00</td>
<td>private (My Own)</td>
<td>private (My Own)</td>
</tr>
<tr>
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<td>IoT Device Variable</td>
<td>IoT Sensor</td>
<td>adminTest1</td>
<td>onuUNIFI</td>
<td>temperature</td>
<td>float</td>
<td>int</td>
<td>°C</td>
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<td>2020-10-15 10:00:00</td>
<td>private (My Own)</td>
<td>private (My Own)</td>
</tr>
</tbody>
</table>

Snap4City (C), January 2022
How the Dashboards exchange data

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap
Super ServiceMap

• Req. ServiceURI

• Req. KPI, Metric ID

• Req. MyKPI ID

• Traffic Flow, MAPS, Heatmaps
  • GIS, HTTPs URLs
  • ServiceURI (ID)
  • MyKPI, Metric (ID)
  • Dynamic Data, computed into IOT Application
  • Rx. Dynamic Data

• Event Driven Synoptics
  • Actions, Show

API, External Services, MicroApp

MyKPI, MyPOI, ...

Metric, KPI

IOT Application

Dashboards

Snap4City (C), January 2022
What the Dashboards can directly exploit

Dashboards

IOT Broker

IOT Device

IOT Edge

GIS data, Maps,

Sensors/Actuators

Snap4City BigData Storage and KB

External Data Stores

LD, LOD

API, External Services

Web Scraping

DataGate

Big Data Analytics, Artificial Intelligence
Access to all data

From Dashboard to IOT App

From IOT App to Dashboard

Snap4City (C), January 2022
HLT: POI

Categories

- Accommodation
- Advertising
- AgricultureAndLivestock
- CivilAndEdilEngineering
- CulturalActivity
- EducationAndResearch
- Emergency
- Entertainment
- Environment
- FinancialService
- GovernmentOffice
- HealthCare
- IndustryAndManufacturing
- IoTDevice
- MiningAndQuarrying
- ShoppingAndService
- TourismService
- TransferServiceAndRenting
- UtilitiesAndSupply
- Wholesale
- WineAndFood

POI: static GPS, info about a location, (Classification), MyPOI: personal POI that can be leveraged to standard POI by administrator
**HLT: data**

- **Data Models**: all devices sprunt from that model
  - IoT Device Model, Mobile Device Model, Data Table Model
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  - **KPI**: former KPI model
  - **MyPersonaData/MyData**: safes in which specific personal data are saved.
HLT: data

Real Time Event Driven Historical Data

High Level Types

Snap4City (C), January 2022
**Trajectories**

- **Variables**, Sensor/sensor-actuator, :
  - Mobile Device Variable, Data Table Variable, Dashboard-IOT App: messages from GUI to Business Logic on IoT App
- **MyKPI**: dynamic GPS, info, single variable, Time Series, (Classification)

- Real Time Tracking
- Hystorical Tracks
- MicroApplications
**MyKPI: Time Series over GSP locations**

Moving Sensors
Moving devices
Tracking
MyKPI: Tracking of Devices and Mobiles

- Real Time Trajectories for
  - Mobile Phone
  - Moving IOT Devices
  - OBU, Vehicular Kits
  - Multiple tracks
  - Day by day

- Micro Application
MyKPI, MyPOI: Management as GDPR

Snap4City (C), January 2022
HLT: Heatmaps

ColorMaps For Calibrated

- **Type:** calibrated
- **Type:** Gaussian

FAQ Index:

1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor
**Heatmaps (flexible Data Analytics)**

- **Main:**
  - Heatmaps are Time series
- **A) Gaussian Heatmaps**
- **B) Calibrated heatmaps**
  - From KmxKm to 4x4 mt
  - PM10, PM2.5, SO2, NO2, Noise, NO, O3, Enfuser, GRAL,.... Copernicus
  - Any programmed ColorMap
  - Animations
  - Piking values in any place, values on their position.
  - On Web and Mobile App
HeatMap Manager: managing, colormaps

- Historical data, time series
- Huge amount of data and points per heatmap
- Data coming from: sensors, IOT App, Copernicus Satellite, ...
- Multiple formats
- High speed computing
- WMS (GIS) compliant
- Animations
- Color maps: from few (5) to dense color scale (1000)
- Picking any place
- Smart City API to get them
- MicroServices for IOT Applications
High Level Types

Snap4City WFS Tools

- Points
- Shapes, paths
- Heatmaps

GIS WFS WMS connected

WFS (GIS)
HLT: WFS (GIS)

- POI (Point of Interest)
- Wfs (GIS)

GIS WFS Servers
HLT: Special Tools

- Scenarious
  - Full text search of roads and geolocations.
  - Multiple areas, days
  - Global map of OSM

- What-IF
  - Conditional routing
  - Dynamic routing
  - Multiple paths

- Traffic Flows

Special Widgets vs Special Data
HLT: Complex events

High Level Types

Traffic Events

Operator

Entertainment Events

Snap4City (C), Janury 2022
HLT: Special Widgets
The Organization and its Dashboard menu
Dashboard Menu a Short Cut for other.....

- Each Organization on Snap4City may define its own Menu on Dashboards
  - The Menu can be activated or not in each single Dashboard of the ORG
- Definition includes a list of Items and Subitems, each of which with
  - colors & icons
  - Links to web pages/dashboards to be activated and modality
  - User Roles at which it has to be proposed
  - Etc.

TC 1.23 – Dashboard Menu management per Organization
Roma Demo3 (Qualità dell'Aria)

Andamento nel tempo di NO2 rilevato nelle stazioni in Roma

Valori inquinanti in tempo reale, mappa

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjcyNg==
Digital Twin Global and Local BIM Server
Snap4BIM: from 3D model to real time data

Snap4City (C), January 2022
BIM as Digital Twin in Snap4City

• You can create 3D BIM representation by using standard tools mainly for IFC format but also in other different formats as AutoDesk.
  – They can be loaded into a BIM Servers

• Snap4BIM is an application for
  – Connecting BIM models with ServiceURI data into Snap4City, Snap4Industry, so that they can be: IoT Devices, POI, etc.
    • Observing PIN from any view
    • Positioning PIN in any place of the 3D space
  – Accessing to any element of the 3D model and to any position with the 3D interactive viewer.
  – Controlling the user interface interaction.
  – Showing the data, and selecting the 3D elements

• Snap4City/Industry can pass from any PIN on map to BIM / Digital Twin Local and related data in click
Snap4BIM: from 3D model to real time data
BIM view of the Altair Chemical Plant

Snap4BIM interactive editor
Digital Twin Local, 3D vs Real Time Data

BIM Integration for Digital Twin
information

• HOW To: Manage BMP and BIM: main features of openMAINT, BMP, BIM
• BIM integration in Snap4City: Digital Twin Local
• Digital Twin (local and global): Snap4City view
• DOC: Global Digital Twin for Florence by Snap4City, 3D city view
External Services (integration of)
your of third party web pages
Dashboard Usage and Recipes

• [https://www.snap4city.org/dashboardSmartCity/view/index.php?id=dashboard=MTc3NA==](https://www.snap4city.org/dashboardSmartCity/view/index.php?id=dashboard=MTc3NA==)

• External Content Widget (optional zoom feature):
  – External Services: Web Pages, web sites, web tools (registered or not)
    • Tools: Twitter Vigilance, Origin Destination Matrices, WiFi Tool, ...
    • GIS & MAPs: ServiceMap, ArcGIS, ServiceMap3D, GoogleMap, etc. etc.
    • TV CAM Proxy adapted, VideoCam Streams, ...
  – MicroApplications
    • More than 300 micro applications based on Snap4City and Km4City Tech.
  – Synoptics and Custom widgets
  – Snap4City pages: Form discussion, help desk, user manual, ...
  – Snap4City Dashboards for nested views, MultiDashboards views
    • Ultra HD screens, UHD or even wider....

• Selector WEB
  – Anything that can be shown on External Content WG, one or more
External Services (registered)
HLT: External Services

High Level Types
External Services

- **Twitter Vigilance:**
  - Daily and real time
  - Volume and sentiment analysis
- **Services on Maps, GIS, ArcGIS**
- **Real time sensors on 3D**
- **Web HTML5 Applications**
- **Origin Destination Matrix**
- **Real Time fleets**
- **Routing, Multimodal tools**
- **IPCAM connector**
- **Synoptics**
- **Third party tools!**
- **.....**
- **Other tools also internal**
  - Traffic Flow Reconstruction
  - User behaviour monitoring
  - Tracking tools
  - Heatmaps tools
  - Trajectories tools
HLT: MicroApplications
MicroApplications for Dashboards

Snap4City (C), January 2022
HTML5 MicroApplications

- Events
- Air Quality
- Pollution
- Hospital First Aid
- Public Transportation
- POIs

See many others on web

Snap4City (C), January 2022
Special data are managed with Special Tools

- GTFS, also on MDM
- Origin Destination Matrices

HLT: MicroApplications, ExternalServices
• Are **Web Pages** *by you or by Third Parties*. They can be embedded into an **External Content Widget** only if they:
  – are HTTPS page for the limitation of the browser,
  – do not present limitations to be “iframed” imposed by third party, that is always possible to be imposed by the page owner.

• You can **exploit/integrate External Services** by:
  – put them into an External Content Widget
  – Call them from a Widget Button to be open into another Tab of the browser or into an External Content Widget.
  – Call them from a Selector Web Widget, if you have multiple of them with a menu you can make a selection among several of them to be open into an External Content Widget
  – Call of them from the Dashboard Menu, to be open into the current or separate Tab of the Browser
IPCAM Service

• Examples:
  – ...
  – To access with credentials you need to add setting on an IP Cam Table on Dashboard Builder!
First aid overview - Tuscany

Service status of main first aid hospitals

Careggi hospital (Florence) - Map
Santa Chiara hospital (Pisa) - Map

External Content
ServiceMap

Life in Toscana: Dashboard

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==
Life in Toscana: Dashboard

Real Time BUS Tracking

Snap4City (C), January 2022
Roma Demo2

Real Time BUS Tracking


Snap4City (C), January 2022
Bus Tracking (planned or real time)

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

Parking Monitoring Firenze

Synoptics, Custom Widgets as External Services
Demo UC5 GIDA

GIDA 5G demo

13.4°C 1020 bar 87%

Custom Widget
Loaded on Ext. Content

13.6°C

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjlyNg==
Custom Dashboards and Widgets (interactive, Animations, etc.)
-- SVG for graphic design
-- MyKPI for collecting data
Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls
• **Virtual Actuators** (sensor-actuator)
  - From: Dashboard
  - To: IOT App, MyKPI, other Synoptics

• **Virtual Sensors**
  - From: MyKPI, Sensors, IOT App, other Synoptics
  - To: Dashboards

https://www.snap4city.org/663

Snap4City (C), January 2022
Snap4Home 5G Demo

Thu 11 Jun 18:07:32

Gio 11 Giu
Prato

Pioggia e schiarite
18°C / 22 °C
Powered by LaMMA
Ven 12 Giu
14°C / 27°C

Sab 19 Giu
13°C / 23°C

Dom 14 Giu
Temp N/A
Lun 15 Giu
Temp N/A

Privacy Policy    Cookies Policy    Terms and Conditions    Contact us

Snap4City (C), January 2022
Event Driven Custom Widgets

https://www.snap4city.org/663 for the manual
Alert Registration

Alerting Generation

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

Incident Kind
- RIVER FLOODING

Severity
- RELEVANT

People Involved
- 10

Impact 1: People Disease
Impact 2: Pollutant

GPS: 43.77614;11.210861

City: FIRENZE

Adr: VIA ADRIANO CECONI N. undefined
Registered: Green:1610755283309

SNAP4City (C), January 2022
From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensors

MyKPI

Sensor

New Shared Variables

Constant Values

Web Socket Secure

Snap4City (C), January 2022
• Virtual Actuators (sensor-actuator), Read and Write Variable
  – From: Dashboard; To: IOT App, MyKPI, other Synoptics
  – And from IOT App to Dashboard
• Virtual Sensors (only Read Variable)
  – From: MyKPI, Sensors, IOT App, constants, other Synoptics
  – To: Dashboards
15MinCityIndex Dashboard

This Dashboard contains data estimated by the Snap4City 15Min index on the basis of Open Data accessible.

[Map with various data points and indicators]


Snap4City (C), January 2022
15 Min City Index on Bologna

15 minuti index – Bologna Città Metropolitana (beta)


Snap4City (C), January 2022
GIS Data Import, Export and Exploitation
• **Snap4City is interoperable with**
  – ESRI ArcGIS Enterprise, Portal, Pro/MAP, ...
  – other GIS tools supporting WFS, WMS, GeoJSON, GML

• **Snap4City is interoperable since:**
  – **Provides** info/data in WFS, WMS
  – **Exploits** data/info from WFS, WMS
  – **Import** data/info from WFS/WMS

• The Snap4City platform can be installed on premise using **Snap4City Appliance** [https://www.snap4city.org/471](https://www.snap4city.org/471)
  – **StartSNAP4CITYVM** includes the Dashboard Builder that is capable to work with WFS WMS protocols for the integration with GIS platforms as ESRI ArcGIS, QGIS, directly or using **Snap4City GIS player**.
  – **KBSSMVM** includes the Smart City API and WFS API which can be used to data harvest from any GIS servers and GIS desktop tool
Case ESRI ArcGIS

GIS Server can be: ESRI ArcGIS Enterprise, QGIS, GeoServer, ..
GIS Player can be: ESRI ArcGIS Pro, ArcGIS Portal, Snap4City WFS player, ...

• GIS:
  • Geographic Information System
• WMS:
  • Web Map Service
• WFS:
  • Web Feature Services

GIS
WFS
WMS
GIS
WFS
WMS
GIS Player

Dashboard System

Data Ingestion

WMS/WFS APIs

Smart City APIs

Big Data and Semantic Storage

IOT Apps

Big Data Analytics, Artificial Intelligence

IOT & Real Time Streams

All Real Time Streams

Dashboards and Apps

Any External Service

Snap4City (C), January 2022
**ArcGIS ESRI as External Service**

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- ArcGIS Portal accesses to ArcGIS Enterprise server
- Snap4City Dashboard uses as External Service: ArcGIS ESRI Portal

Snap4City (C), January 2022
GIS data on Dashboard via Snap4City GIS Player

• DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
• Snap4City has its WFS Player https://main.snap4city.org/widgets/venezia/index.php
• Snap4City Dashboard uses as External Service: Snap4City GIS viewer via WFS/WMS: https://main.snap4city.org/view/index.php?iddashboard=MTIxNg==

Snap4City (C), January 2022
DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed

Snap4City has its WFS / WMS widget / Player

Snap4City Dashboard shows WFS/WMS data via Special GIS Widget Map:

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

- Snap4City can use Selector to select WFS / WMS sources to be shown from ESRI ArcGIS (as well as from any other WFS service) on Widget map

The Snap4City Widget Map allows to mix WFS GIS sources with Smart City API
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTM5NA==
Dashboard with Orthomaps and shapes layers based on WMS, GeoJSON

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed, and GeoServer
- Snap4City main MultidataMap Widget can load WMS background images and shapes, the Orthomaps
- Also Heatmaps calibrated are provided from GeoServer using WMS protocol
- Maps in this case are directly taken from ESRI Server, free of charge
- https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==#

Snap4City (C), January 2022
Snap4City via WFS on top of Smart City API provide data to ESRI ArcGIS Enterprise or ArcGIS Pro, and thus the data become accessible on ArcGIS ESRI Portal

- Snap4City provides a WFS service on top of SmartCity API. Thus providing data to any GIS/WFS client, including ESRI ArcGIS Enterprise, ArcGIS Pro, QGIS, etc.
- In the example, our ingested Helsinki Data have been harvested from ESRI ArcGIS via WFS.
- Once ingested on ESRI ArcGIS can be visualized, by using ArcGIS Portal
- Snap4City Dashboard can show ESRI ArcGIS Portal (A) as External Services in a dashboard.
  - https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIwNg==

Snap4City (C), January 2022
To test you need to have installed ArcGIS pro on your pc and connect with Snap4City WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

On PC:

(i) Get data via WFS connected to ESRI ArcGIS Enterprise or other sources

(ii) Download data via WFS ... from...
To test it you need to have installed ArcGIS pro on your pc and connect with our WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

Heatmap taken from Snap4City GeoServer via WMS protocol
ESRI ArcGIS has an IOT solution based on ESRI GeoEvent, for real time data

- You need to have
  - ArcGIS Enterprise + GeoEvent Server + SpatioTemporal Big Data Store

- Limitations on the number of protocols addressed

- Snap4City solution solves the limitations by ingesting data from a plethora of protocols and sources and
  - (a) posting the IOT data into their Spatio-Temporal Big Data Store
  - (b) collecting data from several protocols and posting them into ESRI GeoEvent in MQTT,
  - (c) making them available via WFS protocol.
Snap4City vs GIS, WFS/WMS

• GIS data:
  – Ingested via WFS/WMS protocols, and then managed as the other data. Data ingestion from GIS server can be performed via ETL processes, or directly from Dashboards
  – Shown on Dashboards via third party GIS tools as External Services
  – Shown on Dashboards using Special GIS Widget Map which directly access to GIS data via WFS/WMS
  – Heatmaps and Maps are distributed via a GeoServer

• Snap4City can interact with ArcGIS Real Time Events via MQTT protocol as well
MultiDataMap: Heatmaps and special tools (as cycling paths, traffic flow, what if scenario, routing), MyData, MyKPI (not RT), MyPOI, POI, Sensors (include selector new, or tech (with some limitations)

- they may also include maps, orthomaps, and 3D (in beta), please ask to Snap4City Staff to activate those features in your widget/dashboard

WFS: WFS, POI (manually added) (include selector)

ServiceMap: POI, with integrated menu (usable with selector web)

Web page https://www.snap4city.org/408

- IOT App: means that the widget data can be created and manipulated dynamically from the IOT App
- All the X represent feature available from Wizard production of Dashboard
- (*) means that the production is still manual and not via wizard
- (X) in progress
- "sensors" are data ingested via IOT Brokers, or ETL that in any case are indexed into the KB, may be on HBASE or on OpenDistro (Elastic Search)
- "MyKPI" data ingested via Mobile Apps, IOT Apps, manually, etc.; They may be on MySQL, and recently are coming to OpenDistro (Elastic Search)
- "MyPersonalData" are ingested via IOT Apps, or manually; They may be on MySQL only
- "KPI, Metrics" are ingested via SQL, NoSQL queries (ODBC, JDBC, Mongo, SPARQL, etc.) from Database sources and are on MySQL
- etc.
Unified Data Model, Digital Twin and Data Inspector
Data Inspector: all you need to know about data, data sources and ingestion processes
Data Inspector (open on your left side menu)

• Cross Filtering on the basis of:
  – MAP: pan and zoom → lock, center on GPS coordinates of the user
  – Data Source Classification:
    • faceted filtering
    • full text search
  – Click on data source to see it on map, and see the graphics representation, just to learn how widgeting it.

• Selecting a Data Source on Map:
  on its Pin you can see:
  – Real time data
  – Time trend: 4 hours, 12 hours, 1 day, 1 week, 30 days.
  – Full status and description (only for Administrators)
**Semantic Variables, names**

<table>
<thead>
<tr>
<th>High Level Types</th>
<th>Nature</th>
<th>SubNature</th>
<th>Dev/Model name</th>
<th>Broker name</th>
<th>Value Name</th>
<th>Value Type</th>
<th>Data Type</th>
<th>Value Unit</th>
<th>Last Date/Time</th>
<th>Last Value</th>
<th>Healthiness</th>
<th>Last Check</th>
<th>Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Snapshot</strong></td>
<td>Snap4City (C), January 2022</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Unified Data and Services Model/Classification

**Semantic Nature**

- SubNature
- SubNature

**Technical meaning**

- Value Type
- Value Unit
- Value Unit

- Exists a Dictionary for the 4 categories
- They are related each other and not all values are possible
- Right setting lead to right rendering on graphs and automated combinations and processing
- The Dictionary is used by many tools
For example

Technical meaning

Value Type

Power

Value Unit
mW

Value Unit
KW

Data Type
Integer

Data Type
Float

Link to Friend Sensor as ServiceURI:

Value Type

Value Unit
URL

Value Unit
KW

Data Type
String, URL

Data Type
Float

Snap4City (C), January 2022
<table>
<thead>
<tr>
<th>Main HLT diff.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HLT: MyKPI</strong></td>
<td><strong>HLT: IoT Device, Sensor Device, Data Tab Device</strong></td>
</tr>
<tr>
<td><strong>Nature</strong>: Industry and manufacturing</td>
<td><strong>Nature</strong>: Industry and manufacturing</td>
</tr>
<tr>
<td><strong>Subnature</strong>: Chemical</td>
<td><strong>Subnature</strong>: Chemical</td>
</tr>
<tr>
<td><strong>Value Name</strong>: CloroParaffine</td>
<td><strong>Value Name</strong>: Irrigator fioriera Gag</td>
</tr>
<tr>
<td><strong>Value Type</strong>: Density percentage</td>
<td><strong>Value Type</strong>: Battery Level</td>
</tr>
<tr>
<td><strong>Value Unit</strong>: %</td>
<td><strong>Value Unit</strong>: V</td>
</tr>
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<td><strong>Data Type</strong>: float</td>
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<tr>
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<td><strong>Last Date</strong>: 2020-04-01 12:59:00</td>
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<td><strong>Last Value</strong>: 87.0</td>
<td><strong>Last Value</strong>: 5.18</td>
</tr>
<tr>
<td><strong>Healthiness</strong>:</td>
<td><strong>Healthiness</strong>:</td>
</tr>
<tr>
<td><strong>Last Check</strong>: 2020-04-03 10:28:12</td>
<td><strong>Last Check</strong>: 2020-04-03 03:28:12</td>
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<tr>
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<td><strong>Ownership</strong>: public/private</td>
</tr>
<tr>
<td><strong>Organization</strong>: Firenze</td>
<td><strong>Organization</strong>: Firenze</td>
</tr>
</tbody>
</table>

*Single Variable for MyKPI*

*an IoT Device may have multiple Sensors/variables*

Snap4City (C), January 2022
### How to Ingest

All of them can be shown on Dashboards, what about manipulate them!!!!

<table>
<thead>
<tr>
<th>HLT, High Level Types++</th>
<th>GPS</th>
<th>Static</th>
<th>Dynamic</th>
<th>MacroCat</th>
<th>Single</th>
<th>Time Series</th>
<th>Trajectory</th>
<th>HTTP</th>
<th>How to ingest/change/management</th>
</tr>
</thead>
<tbody>
<tr>
<td>IoT Device Model</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Broker, IOT App, Data Table, API, UserInterf,</td>
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<tr>
<td>Mobile Device Model</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Broker, IOT App, Data Table, API, UserInterf,</td>
</tr>
<tr>
<td>Data Table Model</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Data Table, then as IoT Device</td>
</tr>
<tr>
<td>IoT Device</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Broker, IOT App, Data Table, API, UserInterf,</td>
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<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Into the corresponding device</td>
</tr>
<tr>
<td>Mobile Device Variable</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td></td>
<td>Broker, IOT App, Data Table, API, UserInterf,</td>
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<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>Into the corresponding device</td>
</tr>
<tr>
<td>Data Table Device</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Data Table, then as IoT Device</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
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<td>Into the corresponding device</td>
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<td>Sensor Device</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
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<tr>
<td>Sensor / Sens. Actuator</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
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<td></td>
<td>Into the corresponding device</td>
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<td>MyKPI</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
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<tr>
<td>KPI (metrics) data</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, API, Metrics SQL calls</td>
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<tr>
<td>My Personal Data</td>
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<td>Yes</td>
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<td>Dashboard, IOT App, UserInterf, API, ...</td>
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<tr>
<td>POI (Point of Interest)</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
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<td>DataGate, ETL, IOT App, API, ...</td>
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<tr>
<td>MyPOI data</td>
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<tr>
<td>Dashboard-IOT App (msg)</td>
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<tr>
<td>Complex Event (msg)</td>
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<td></td>
<td></td>
<td>Dashboard, ETL, Special, IOT App, ...</td>
</tr>
</tbody>
</table>
All of them can be shown on Dashboards, what about manipulate them!!!!

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<thead>
<tr>
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<th>Dynamic</th>
<th>MacroCat</th>
<th>Single</th>
<th>Time Series</th>
<th>Trajectory</th>
<th>HTTP</th>
<th>How to ingest/change/management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heatmap matrix</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
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<td>IOT App, MicroService, UserInterf, API, ...</td>
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<tr>
<td>Traffic Flow</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<td>IOT App, MicroService, UserInterf, API, ...</td>
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<tr>
<td>OD Matrix</td>
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<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
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<td>IOT App, MicroService, UserInterf, API, ...</td>
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<tr>
<td>External Service (web pag)</td>
<td>Yes</td>
<td>--</td>
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<td>Synoptics (groups)</td>
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<td>(Yes)</td>
<td>(Yes)</td>
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<td>(Yes)</td>
<td>(Yes)</td>
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<td>BIM View</td>
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<td>Special, API, ...</td>
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<tr>
<td>MicroApplication (webapp)</td>
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<td>Dashboard, IOT App, API, FTP, ...</td>
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<td>Special Widget (complex)</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<td>ETL, special, IOT App, API, ...</td>
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<tr>
<td>WFS/WMS (GIS data)</td>
<td>Yes</td>
<td>[yes]</td>
<td>[yes]</td>
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<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>GIS tools, or GeoServer, IOT App, ...</td>
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<tr>
<td>Tools (functional)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>(Yes)</td>
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<td>(Yes)</td>
<td></td>
<td></td>
<td></td>
<td>MDM Scenario, What-If, etc.</td>
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</tbody>
</table>
Data Inspector vs Data Processes Details
(some features are only accessible to *Admin roles)
Advanced Features of the Data Inspector

• Some features accessible only for the Owner and *Admin, such as:
  – Specific information on the basis of the High Level Type
  – Values connected to the data (structure of the single data)
  – Details regarding the ingestion process
  – Eventual image representing the City Entity, for example the sensor
  – Ownership (licensing) details regarding the data owner

• So that you can access on all of them in the Snap4City version if you install on premise.

• A part of these features can be activated for the Organization Managers, namely: «ToolAdmin» roles.
Click with the mouse on it

HLT: Sensor
- Specific values of selected sensors on the same device
- Information of the values of the other sensors on the same device
- View Trends, marking problems, healthiness by point according to a Fuzzy model
- Marking problems for future machine learning processes (separate tool)
### Healthiness

**HLT: Sensor**

#### Data Sources Details

<table>
<thead>
<tr>
<th>Device</th>
<th>Values</th>
<th>Healthiness</th>
<th>Process</th>
<th>Image</th>
<th>Licensing</th>
<th>User</th>
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<td>Delay:</td>
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<td>Healthiness Criteria 2:</td>
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<td>(2020-07-19 23:03:31)</td>
<td>false</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **Two different criteria**
  - **H1**: at least an event in the last 24 hours
  - **H2**: machine learning for most of Sensors devices

_Some functionalities are limited to certain roles_
• Two different criteria
  – **H1**: at least an event in the last 24 hours
  – **H2**: machine learning for most of Sensors devices

Some functionalities are limited to certain roles
Details regarding the IOT Ingestion process

- For IOT Device data
- IOT Broker details

Some functionalities are limited to certain roles
Details regarding the Ingestion process

- For ETL processes
- Scheduling details and status

Some functionalities are limited to certain roles
Some functionalities are limited to certain roles
Snap4City (C), January 2022

**HLT: From Dashboard to IOT APP**

- Click with the mouse on it
HLT: Dashboard-IOT App (From Dashboard to IOT APP)
HLT: Sensor-Actuator (From Dashboard to IOT Device)
Some functionalities are limited to certain roles
The fields shown may be present or not depending on the HLT and on the information received.
Data Inspector recent and future features

- Specific views for the HLT
- Details on Healthiness
- More details on the Ingestion Process
- Capabilities of setting and changing the Healthiness criteria
- For data related to IOT App vs Dashboard, how the link to them
- A view about the data relationships, precisely to show the data used in dashboard, and used in IOT App, etc.
- For Sensors: a link to DevDash to see the time trend and relationships with other sensors and devices on the same Organization (for all in the case of RootAdmin)
- A reverse link from the SmartAppGraph to the Data Inspector data of various kind
DASHBOARD CREATION
by Wizard
Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

My IOT Devices

IOT Applications

Big Data Analytics, Artificial Intelligence

Dashboards and Apps
Dashboard Development

- Widget Collection
  - Micro Applications
  - External Services
  - Custom Widgets/Synoptics

- Dashboard Wizard
  - Create, save, load, delegate, grant access

- Dashboard Editor
  - Public Dashboard Collection
  - My Own Dash/App

- Knowledge Base, Km4City
- Knowledge and Storage
  - Data from the Field and City + MyKPI ++

IOT Applications

Snap4City (C), January 2022
Dashboard List and Editor

Snap4City (C), January 2022
From Templates to Wizard and Dashboards

- to create a new Dashboard
- to add widgets and/or groups of them on any Dashboard
Select the area of your interest: panning and zooming
Select the
- graphic aspect of your interest, or
- High Level Type of your interest, or
- Make a search if you a have a precise idea or
- Act on filters: nature, subnature, type, name, value, date, health, owner, …
- Combine them as you like
- Select the lines of your interest
- Then click on Next and get the Dashboard by wizard
ICONS of Widgets

Single data

Multi data

Map Controls

Snap4City (C), January 2022
The Wizard helps you in selecting only possible combinations of data and graphic representations.
CONTEXTUAL MENU to edit features

Use Wizard to add more widgets
Manual Addition of Widgets

Dashboard - tester14

Metric and widget choice

- Widget category
  - Actuator
  - Data viewer

Generic widget properties

- Title
- Background color
- Content font size
- Content font color
- Header color
- Header text color

Specific widget properties

- Metric and widget choice
  - Widget category: Data viewer
  - Metrics category: Shared metrics
  - Metric: Bolognese_Pressione
  - Metric description: Pressione atmosferica via Bolognese
  - Metric type: Modal

- Widget type: widgetGaugeChart
- Widget link: widgetGaugeChart...
Dashboards summary and further exercises

- **Suitable** as: City Dashboard, App interface, and Control Room Dashboards, Situation Room Dashboard, Operator Dashboard
- **Created** visually compounding graphic Widgets
  - Each widget can be set to have an autonomous update
  - Each metric/data-source may have associated with an alarm: blinking and sending events to people and machines in different manners
- **Can be**: public or private, private dash can be delegated or passed in ownership
- See the following tutorials
  - [HOW TO: create a Dashboard](#) in Snap4City
  - [HOW TO: add data sources to the Snap4City Platform](#)
  - US1. Using City Dashboards
  - US2. Using and Creating Snap4City Applications with Dashboards
  - US4. Creating City Dashboards and related Event Monitoring and Actions
Dashboards Creation Exercitation
DEMO Section
To Start we are going to use Direct Dashboards

Dashboards accessing data available on Platform, including your own data coming from Mobile App, already registered!!!
In this exercitation we are going to use the main Dashboard Templates.
Exercitation on dashboard building

1. Create a Dashboard for the visualization of sensors values: actual and their trend

2. Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend

3. Create a Dashboard for the visualization of MyKPI regarding my trajectories and eventually those of other users.
1) Create a Dashboard for the visualization of sensors values: actual and their trend

- The sensors to be selected should
  - Be located downtown in Florence around a POINT of YOUR interest: home, work, study, etc.
  - Report data regarding: environment, traffic, parking, pollution, etc.

- We suggest to:
  - Understand how to work with data by using the Data Inspector
  - Create a new Dashboard by Wizard
  - Customize look and fill of the Dashboard and widgets

- Time: 20 minutes
1) Create a Dashboard for the visualization of sensors values: actual and their trend

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  – Be located downtown in Florence around a POINT of YOUR interest: home, work, study, etc.
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• We suggest to:
  – Understand how to work with data by using the Data Inspector
  – Create a new Dashboard by Wizard
  – Customize look and fill of the Dashboard and widgets

• Time: 10-20 minutes
• You can add more Widgets by:
  – Wizard
  – Editor manually
2) Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend

- **The HLT to be selected** should
  - Be located downtown in Florence
  - Could be of different kind of nature. At least 5 of them
  - Data regarding: environment, traffic, parking, pollution, etc.

- **We suggest to:**
  - Start creating the New Dashboard by Wizard
  - Customize look and fill of the Dashboard and widgets

- **Time:** 10-20 minutes
- **There are different modalities to get similar results**
2) Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend

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• We suggest to:
  – Start creating the New Dashboard by Wizard
  – Customize look and fill of the Dashboard and widgets

• Time: 10-20 minutes
• There are different modalities to get similar results
Result could be similar to

• Not all combinations provide the same effective result
• You can
  – customize the resulting dash
  – add other widgets by wizard
  – see how a Selector is built
  – …

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjYxMg==
3) Create a Dashboard for the visualization of MyKPI regarding my trajectories and [eventually those of other users]

- We suggest to:
  - Open Dashboard Wizard
  - Search for your trajectory on mobile looking for MyKPI
  - Create a Dashboard exploiting the Widget Tracker
  - Customize look and fill of the Dashboard and widgets, change color of the header, etc.

- Time: 10-15 minutes
3) Create a Dashboard for the visualization of MyKPI regarding my trajectories and [eventually those of other users]

- We suggest to:
  - Open Dashboard Wizard
  - Search for your trajectory on mobile looking for MyKPI
  - Create a Dashboard exploiting the Widget Tracker
  - Customize look and fill of the Dashboard and widgets, change color of the header, etc.

- Time: 10-15 minutes
Result could be similar to

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjYxNA==
MyKPI: Tracking of Devices and Mobiles

- Real Time Trajectories for
  - Mobile Phone
  - Moving IOT Devices
  - OBU, Vehicular Kits
  - Multiple tracks
  - Day by day

- Micro Application

![Diagram](image.png)
Tuscany in a Snap Mobile App on Android
Real time device tracking

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1Ng==

Moving and changing Dynamic PIN

Snap4City (C), January 2022
How to create moving devices with dynamic pin

1. IOT Device Mobile is needed
2. Updates on Latitude and Longitutude have to arrive into the platform
3. Dashboard
   - MultiDataMap has to activate the Connection to WS service on MoreOptions
   - Selector on the specific PIN has to be set as

https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/MyMobileDeviceTest&format=json&fromTime=3-day
Mobility and Environment What-IF Analysis

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

Mobility and Environment What-IF Analysis

This dashboard contains data derived from actual sensors and predictive values under validation.
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- See the following tutorials
  - [HOW TO: create a Dashboard](#) in Snap4City
  - **US1. Using City Dashboards**
  - **US2. Using and Creating Snap4City Applications with Dashboards**
  - **US4. Creating City Dashboards and related Event Monitoring and Actions**
Mechanisms of **Selector** for the **Multi Data Map widget**
The Selector for Multi Data Maps

- **Different styles**
  - Icon and Text menu
  - Custom Menu Icon
  - Icon Menu buttons
  - Etc.

- **Features**
  - Removable header
  - Colours custom
  - Transparencies
  - Mixed modalities

- **Note:**
  - Manus can be realized also with a set of Buttons

---

*The Selector is the Map Controller*
Custom Dynamic Pins

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk5MA==
More Options of the Selector

- Setting:
  - Heatmaps
  - Bubbles
  - Icons
  - Custom
  - Traffic flow
  - Cycling path
  - What-if
  - Etc. etc.

The More Option data and table are automatically created / initialized by Wizard.

It can be adjusted for:
- -- adding more selections
- -- tuning the services
- -- exploiting nicer views
The Selector is the Map Controller

More Options Edit

- Query ID
- REST CALL
- Command
- Heatmap

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search

Search and Query,
Smart City API
Facet, semantic search

The Query is produced by Wizard but can be manually changed
How to Get the «Query» used in More Options (1)

- Query ID
  - only Read and Read/Write of the query

- REST CALL of the Smart City APIs
  - JSON
  - HTML (do not use into MoreOptions)
The example of email from ServiceMap

snap4city@gmail.com
a me ▼

Thanks a lot for using Service Map by DISIT at http://servicemap.disit.org

Your query "Service FI-MOSSE" has been saved.

Description No description provided.

You can access to the query results on Service Map by clicking on these links:

Link for read only result in format json: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=c33d6672960a1d5db83f27cf00c0e919&format=json'

Link for read only result in html: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=c33d6672968a1d5db83f27cf00c0e919&format=html'

Link for overwrite this query on Service Map: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=f75d163130b1c8af9c7927cc7b857d70'

Link to obtain results in format json : 'https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUrl=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=json'

Link to obtain results in format html: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUrl=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=html'

or copy paste it on your browser.

You can share the link with your friends.

Best regards
ServiceMap.disit.org team
You can contact us at info@disit.org or visit our web page at http://www.disit.org

Snap4City (C), January 2022
**How to Get the «Query» used in More Options (2a)**

- REST CALL by category → JSON (Options in RED), they are REST ASCAPI calls
  - Requesting a category, so that to see all Services of the same category (subNature)
    - http://svealand.snap4city.org/ServiceMap/api/v1/?selection=59.581458578537955;16.71183586120606;59.62875017053684;16.875171661376957&categories=Street_light&maxResults=100&format=json
      - Please note that in the MoreOption dashboard the GPS area is neglected
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?selection=43.64471;11.005751;43.89471;11.505751&categories=Green_areas&maxResults=200&format=json
      - Please note that in the MoreOption dashboard the GPS area is neglected
    - Custom PINS note: “selection” coordinates are used for collecting attributes in custom PINS. Other options such as “maxDists” cannot be used in custom PIN. All parameters can be used in other cases.
    - Different KB links are identified by their ASCAPI links: svealand.snap4city.org, servicemap.disit.org, ….
  - Requests to SuperServiceMap for the network of Federated KBs by using /api/………..
    - Without prefixed KB to obtain merged results from more KBs. For example as:
      - /api/v1/?categories=Air_quality_monitoring_station&format=json
      - Please note that the direct links to the superservicemap can be of the form:
        - https://www.disit.org/superservicemap/api/v1/? ………………….
How to Get the «Query» used in More Options (2b)

- REST CALL by ServiceURI → JSON (ServiceURI in RED), they are ASCAPI calls
  - Requesting single Service
  - Different KBs links are identified by their ASCAPI links: svealand.snap4city.org, servicemap.disit.org,
  - Requesting all IoT Devices that have been produced by the same Model
      - Please note that in this case the call is performed on the superservicemap, you can change to go directly on the right KB
      - Please specific both category and model to be more precise and focused.
    - https://www.disit.org/superservicemap/api/v1/?selection=36.8092847020594;12.216796875000002;42.71473218539458;32.03613281250001&categories=Travel_information&format=json&fullCount=false&maxResults=500&model=DOMESTIC_MOVEMENTS2013-2018_1620304406
      - In this cases is a double filtering for model and for categories, plus other constraints
      - Please note that in the MoreOption dashboard the GPS area is neglected
How to Get the «Query» used in More Options (2c)

• Requesting view on map single device
  – Request to see the single device:
    • https://svealand.snap4city.org/ServiceMap/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7&format=json&fromTime=3-day
    • With ServerURI: http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7
    • From KB: https://svealand.snap4city.org

• REST CALL into the query of the more options for GIS services
  – Requests from GIS servers by using WFS API and services
    • https://os.cittametropolitana.fi.it/imobids/trafficsensors/1758EB9B47A3904E05673BFE61AB1776C4C0050E7BD7FB195EA33CC56767BE/ows?service=WFS&version=1.1.0&request=GetFeature&typeName=TrafficSensors
How to Get the «Query» used in More Options (3)

• ServiceMap (specific KB) and Query service
  – The Query performed is saved and can be recalled with a QueryID, valid for that specific KB, and not accessible via SuperServiceMap / Federated KB
  – The QueryID is communicated via email
  – Specific REST Call with HTML is also provided to change the Query in server associated with the QueryID received

• Query ID (only Read and Read/Write of the query)
  • [https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=1c811893d40a2bb07a2078ffe299ced&format=json](https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=1c811893d40a2bb07a2078ffe299ced&format=json)
  • Cannot be used for Custom PINs.
  • Cannot be used to get data via ServiceMap since the Query ID is KB based
Special Commands in «Query» of More Options (4)

• Commands for Special Tool:
  – Traffic Flow tool: https://firenzetraffic.km4city.org/trafficRTDetails/roads/read.php
  – Scenario tool: /scenario/
  – Whatif tool: /whatif/

• Heatmaps, see Data Analytic part of the training for the several versions which can be used:
  – https://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=PM2_5Average24HourFlorence
  – https://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=denseNO2_Firenze_IDW
  – WMSServer that is a GeoServer may be different for different installations of Snap4City
The Selector is the Map Controller

- Targeting the data to be shown on other data Widgets
DASHBOARDS Business Logic
Via IOT Applications
USAGE AND AUTHORING
IOT App as Business Logic of Dashboards

IOT Networks
- IOT Brokers
- IOT Gateways
- IOT Edge Devices
- IOT Devices

IOT Applications
- Big Data Analytics, Artificial Intelligence

Dashboards and Apps

Snap4City (C), January 2022
IOT Data Driven

Snap4City Platform storage for «Data Shadow» and much more

Towards any IOT Device and/or Dashboard

Dashboards also provide rendering for sensor values

Snap4City IOT Brokers

Managing Public and Private IOT/IOE Devices

Real Time

Real Time + Historical

Sensors

Actuator

Sensor Actuator

From Dashboard to IOT Device

From IOT Device to KB

Sensors

Snap4City (C), January 2022
IOT App Business Intelligence for Dashboards, Web and Mobile Apps
How the Dashboards exchange data

- ServiceMap Super ServiceMap
  - Req. ServiceURI
- Snap4City BigData Storage and KB
- MyKPI, MyPOI, ...
- Metric, KPI
- API, External Services, MicroApp
- IOT Broker Orion Quantum Leap
  - Req. KPI, Metric ID
  - Req. MyKPI ID
  - Traffic Flow, MAPS, Heatmaps
  - GIS, HTTPS URLs
  - ServiceURI (ID)
  - MyKPI, Metric (ID)
  - Dynamic Data, computed into IOT Application
    - Rx. Dynamic Data
    - Event Driven Synoptics
    - Actions, Show

Dashboards

IOT Application
Advanced IOT Applications

• Synoptics can ……
  – do all 😊
• Widgets can
  – send/receive dynamic data,
  – change data sources, etc.
  – Provide interactive maps
• HTML pages can
  – be dynamically generated
  – provide forms to produce data for IOT Applications
  – Collect files on web and system
  – produce files on web ad system
  – have CSS and AJAX control

https://www.snap4city.org/394
https://www.snap4city.org/596
IOT App with Dynamic Web Pages

• HTML pages can
  – be dynamically generated from the IOT App
  – provide forms to produce data to the IOT App, also including interactive elements
  – collect file from users, and produce files to web and to the system
  – have CSS and AJAX controls

Snap4City (C), January 2022
From IoT App to HTML pages

Edit “HTTP IN NODE” as above, also to get the ID of your IoT APP. The ID is used in the URL of the generated page.

```
<html>
<style>table, th, td { border:1px solid black;}</style>
<head></head>
<body>
<h1>This is a table</h1>
<table style="width:100%">
  <tr>
    <th>Person 1</th>
    <th>Person 2</th>
    <th>Person 3</th>
  </tr>
  <tr>
    <td>Emil</td>
    <td>Tobias</td>
    <td>Linus</td>
  </tr>
  <tr>
    <td>16</td>
    <td>14</td>
    <td>10</td>
  </tr>
</table>
</body> </html>
```
• HTML page can expose forms to collect data for the IoT App.

• The table can be
  – constructed with the style you prefer according to HTML, CSS, etc.
  – dynamically generated on the basis of the values you collect/generate, receive, recover from storage in the flow
  – updated by send a message on the node
  – show on Dashboard by using the link (URL) into an External Content Widget

• In alternative there is to the Widget Table with less flexibility
Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

IOT Applications

Dashboards and Apps

Data Channels

Big Data Analytics, Artificial Intelligence
Alert Registration

Alerting Generation

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

Kind: River Flooding
Severity: Relevant
People: 10
Impact 1: People Disease
Impact 2: Pollutant
GPS: 43.77614;11.210861
City: FIRENZE
Adr: VIA ADRIANO CECONI
Registered: Green:61075528339

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA0OQ==
Control Room Operator
Would like to:
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., ...
- **Act and monitor** Dynamic Plates
- **Act and monitor** red lights

Driver, Policeman
Would like to:
- **Monitor** traffic, Parking, env., speed limit, ...
- **Act and monitor** red lights
IOT Application with City Dashboard
Simple development

- Virtual Sensors and Virtual Actuators
- From Dashboard to IOT App and viceversa
- From Dashboard to IOT Brokers/Devices and viceversa
IoT Applications

- **Data ingestion**: more than 70 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.
- **Data access**: save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, etc.
- **Data Transformation/transcoding**: binary, hexadecimal, XML, JSON, String, any format
- **Integration**: CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIMServer, any external service REST Call, etc.
- **Manipulation of complex data**: heatmaps, scenarios, typical time trend, multi series, calendar, maps, etc.
- **Access to Smart City Entities and exploitation of Smart City Services**: transport, parking, POI, KPI, personal data, scenarios, etc.
- **Data Analytic**: managing Python native, calling and scheduling Python/Rstudio containers as snap4city microservices (predictions, anomaly detection, statistics, etc.)
- **User interaction on Dashboard**: get data and message from the user interface, providing messages to the user (form, buttons, switches, animations, selector, maps, etc.)
- **Custom Widgets**: SVG, synoptics, animations, dynamic pins on maps, etc.
- **Event management**: Telegram, Twitter, Facebook, SMS, WhatsApp, CAP, etc.
- **Hardware Specific Devices**: Raspberry Pi, Android, Philips, video wall management, etc.
Two Snap4City Libraries

We suggest also to install:

AND: From Resource Manager

https://flows.nodered.org/search?term=snap4city
IOT Applications vs Dashboards

• IOT Applications, realized by using Snap4City Node-RED and integrated with Snap4City Nodes/MicroServices block, can be behind dashboards to get data from them with Virtual Sensors and Actuators.
  – Dashboards may be connected to multiple IOT Applications and IOT devices
  – IOT Applications may be connected with multiple Dashboards and IOT devices

• A network of Dashboards, IOT Apps and IOT Devices and data is easily realized exchanging data via secure connections.

• Training Cases:
  – US2. Using and Creating Snap4City Applications with Dashboards
  – US9. Creating Snap4City IOT Applications, different formats, protocols, brokers, communications
Widgets Interacting with IOT Apps
virtual Sensors and Actuators
**HLT: Sensors-Actuators**

- Complex Event
- Dashboard-IOT App
- External Service
- Heatmap
- KPI (Key Performance Indicator)
- MicroApplication
- My Personal Data
- MyKPI
- MyPOI
- POI (Point of Interest)
- Sensor
- Sensor Actuator
- Special Widget
- Wfs (GIS)
Dashboard Widgets vs IOT Apps

• IOT App may create new Dashboards with new Widgets inside

• Some of the Dashboard Widgets interacting with IOT App can be ONLY created by starting from the IOT App
  – The creation is performed by putting the Node/Block in the IOT App and creating the widget in a Your Dashboard

• The removal of the Node/Block is removing the Widget as well. While the removal of the Widget in Dashboard is not removing the Node/Block into the IOT App

• The change of name of the Widget in Dashboard and/or in IOT App may create disconnections each other
From Dashboard to IOT Devices/App

• **Widgets:**
  – Impulse Button
  – Button
  – Switch
  – Dimer/Knowb
  – KeyPad
  – Geolocator
  – Selection/Dropdown
  – Form
  – Map Picking

• **Registered** on some IOT brokers with NGSI mutual authentication
Dashboard-IOT App

Nature

From Dashboard to IOT App

IOT Application

MapClick
MyKPI variable onchange
Synoptics
Geolocation of Mobile Device

- Complete message
  - Returns a JSON containing all information about geolocation
- Latitude
  - Returns the latitude
- Longitude
  - Returns the longitude
- Accuracy
  - Returns the accuracy of latitude and longitude
- Altitude
  - Returns the altitude
- Altitude Accuracy
  - Returns the altitude accuracy
- Heading
  - Returns the heading
- Speed
  - Returns the speed

Web Browser GPS data rendering the Snap4City Dashboard can be passed to IOT Applications and saved 😊
Multi Data Map GPS Location Picking vs IOT App

1) Click

2) GET event with:
   -- Lat, Long
   -- Service URI

3) The click on the map passes GPS coordinates into IOT App. Thus you can use them to:
   – search for location
   – picking the value of one or more heatmaps
   – dynamically change data on widgets and dashboards
   – Etc.
Multi Data Map ServiceURI selection vs IOT App

1) Click on PIN
2) GET event with:
   - Lat,Long
   - ServiceURI

3) The click on the map passes GPS coordinates into IOT App and the ServiceURI. Thus you can use them to:
   - search for location
   - picking the value of one or more heatmaps
   - dynamically change data on widgets and dashboards
   - Get all the ServiceURI information and exploit them on Business Logic
   - Etc.
SVG Custom Widgets Examples 2

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk4Ng==
• Selecting MSG to be sent on the Business Logic IOT Application

```javascript
msg.payload = {value:JSON.parse(msg.payload).selected};
return msg;
```

Snap4City (C), January 2022
msg.payload = {
    "form": {
        "options": [
            {
                "label": "enter text", "value": ", "type": "text", "required": true
            },
            {
                "label": "enter number", "value": ", "type": "number", "required": false
            },
            {
                "label": "enter email", "value": ", "type": "email", "required": false
            },
            {
                "label": "enter password", "value": ", "type": "password", "required": false
            },
            {
                "label": "enter check", "value": "checked", "type": "checkbox", "required": false
            },
            {
                "label": "enter check2", "value": ", "type": "checkbox", "required": false
            },
            {
                "label": "enter switch", "value": "on", "type": "switch", "required": false
            },
            {
                "label": "enter switch2", "value": ", "type": "switch", "required": false
            },
            {
                "label": "enter date", "value": ", "type": "date", "required": false
            },
            {
                "label": "enter time", "value": ", "type": "time", "required": true
            }
        ],
        "selected": []
    }
}
return msg;
msg.payload={ "form": { "options": [  
{ "label": "enter text", "value": "", "type": "text", "required": true },  
{ "label": "enter number", "value": "", "type": "number", "required": false },  
{ "label": "enter email", "value": "", "type": "email", "required": false },  
{ "label": "enter password", "value": "", "type": "password", "required": false },  
{ "label": "enter check", "value": "checked", "type": "checkbox", "required": false },  
{ "label": "enter check2", "value": "", "type": "checkbox", "required": false },  
{ "label": "enter switch", "value": "on", "type": "switch", "required": false },  
{ "label": "enter switch2", "value": "", "type": "switch", "required": false },  
{ "label": "enter date", "value": "", "type": "date", "required": false },  
{ "label": "enter time", "value": "", "type": "time", "required": true },  
], "selected":[]} }
return msg;

"selected":['a text","123","paolo.nesi@unifi.it","aaaaaa", "checked","","on","","2021-03-19","09:38"]
Single Content Widget (flexibility)

From Dashboard Editor and IOT Applications, accepts in input:

- Numbers
- String
- HTML code

https://www.snap4city.org/578
Send Voice Messages on Dashboards

- Connectable on all «String» Variables
- Controllable from IoT Applications
- Simple Play button on Dashboard Widget
- Configured as:
  - Voice Language
  - Voice timbre: male, female, ...
  - Voice Tone
  - Voice Volume
  - ..
Controlling Maps from IOT Apps

- Show points on maps
- Get Points
- Tracks
- See examples on:

  https://iot-app.snap4city.org/nodered/nrve0e3/ui/#1/0

  https://www.snap4city.org/409
  https://www.snap4city.org/417
Dashboards vs IOT Applications

• See a lot of more detailed examples into the Tutorial on IOT Applications
  – https://www.snap4city.org/577
Dynamic Widgets data on Dashboard from IOT Applications
How the Dashboards exchange data

- Snap4City BigData Storage and KB
- IOT Broker Orion Quantum Leap
- API, External Services, MicroApp
- ServiceMap
  - Super ServiceMap
  - Req. ServiceURI
  - Req. KPI, Metric ID
  - Req. MyKPI ID
  - Traffic Flow, MAPS, Heatmaps
  - GIS, HTTPS URLs
  - ServiceURI (ID)
  - MyKPI, Metric (ID)
  - Dynamic Data, computed into IOT Application
  - Rx. Dynamic Data
  - Event Driven Synoptics
  - Actions, Show
- MyKPI, MyPOI, ...
- Metric, KPI

Dashboards

Snap4City (C), January 2022
Dynamic Widget data

- **ServiceURI (ID)**
  - metricId: "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166548"
  - metricIdLevelType: "Sensor"
  - metricIdName: "tusc_weather_sensor_ow_3166548"
  - metricIdType: "AirTemperature"

- **MyKPI (ID)**
  - metricId: "https://svc.synaps.disit.org/vwc/eventSrv/33852522/format=json"
  - metricIdLevelType: "Sensor"
  - metricIdName: "tusc_weather_sensor_ow_3182522"
  - metricIdType: "AirTemperature"

- **Dynamic Data in JSON (single or Vector), computed into IOT Application**

**TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications**

Snap4City (C), January 2022
<table>
<thead>
<tr>
<th>Widgets ICONS</th>
<th>Widget Name, Description</th>
<th>IOT App</th>
<th>Dashboard-IOT App</th>
<th>KPI (metric)</th>
<th>MyPersonalData</th>
<th>MyData</th>
<th>My KPI</th>
<th>Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX</td>
<td>Single Content</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Speed Limit (see custom for more)</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Speedometer</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Gauge</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Single Bar, V/H</td>
<td>X</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Single and Multiple Bars, stacked or not, ordered</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MultiSeries, shaded, staked and non staked, TTT</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Time Trend (single)</td>
<td>X</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Time Trend Compare</td>
<td>X</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SpiderNet, radar, Kiviat</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pie, Donut, 2 layers Donut</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Table</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Calendar</td>
<td>X (cs)</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
• IOT APP column in previous table:
  – X: means that from the IOT App you can send a new value or array to the widget directly, without the need to have it stored into Sensor or MYKPI variable, etc.
  – CS, widget supports Change Source, in the sense that: from the IOT App is possible to send a command to the Widget to change the data source. E.g., selecting sources among: Sensors (service URI), MyKPI (ID), any value produced on the IOT App directly. (cs) recent additions

• Dashboard IOT App column in previous table:
  – X: there is a MicroService / node on IOT App to act on those widgets on dashboard. The data are visualized.
  – DD, widget is Data Driven, in the sense that new data in push can be sent and the widget is updated in real time on web page without web page realeoading
Synoptic, Custom Widgets and PINS Creation
Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls
Create, save a Custom Widget in SVG

Create, save, load, delegate, grant access

1. Create and Load a Custom SVG
2. Select/Reuse an SVG
3. Make and Instance of Synoptic by Associate Variables with MyKPI
4. Create on Dashboard a Widget based on Synoptic HLT such as Ext. Srv.:
How to create a custom Widget

• User manual on: https://www.snap4city.org/595
Create, save a Custom Widget in SVG

Upload as Custom Widget Template

List of Custom Widgets / Synoptics

Dashboard Editing/wizard

From any open library

SVG Symbols Collection

Select MyKPI and Sensor Data for Synoptics cases

CW with a single READ Variable are automatically usable as PINS

Instantiate as Custom Widgets / Synoptics
Connect with WebSockets

Final Dashboard
# Help on Custom Widgets

<table>
<thead>
<tr>
<th>Custom Widget name and image</th>
<th>Explanation</th>
<th>Variable(s)</th>
<th>Accepted values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate in Time new SVG</td>
<td>Set the begin and the end hours by using the small + and - buttons. Click SET to send the defined hours to the server.</td>
<td><code>s4csvg_begin</code> (read and write variable)</td>
<td>starting hour in the form HH:mm to be set by clicking the + and - button</td>
</tr>
<tr>
<td>BEGIN 17:00</td>
<td>Default value: ###,###</td>
<td><code>s4csvg_finish</code> (read and write variable)</td>
<td>ending hour in the form HH:mm to be set by clicking the + and - button</td>
</tr>
<tr>
<td>END 14:30</td>
<td>Default value: ###,###</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Conditioner SVG</td>
<td>Change the image according to the value received.</td>
<td><code>s4csvg_airconditioner_status</code> (read variable)</td>
<td>0 = OFF, 1 = cold, 2 = hot</td>
</tr>
<tr>
<td>Blinking Alarm SVG</td>
<td>The image blink or stop to blink according to the value received.</td>
<td><code>s4csvg_blinking_alarm</code> (read variable)</td>
<td>0 = OFF (fixed image), 1 = blinking</td>
</tr>
<tr>
<td>Example: <a href="https://www.snap4city.org/dashboards/Mj44NO==">link</a></td>
<td>Default value: 1, blinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double Pole Isolator SVG</td>
<td>By clicking the SVG, the status of the switch changes accordingly and the corresponding value is sent to the server.</td>
<td><code>s4csvg_isolator_onoff</code> (read and write variable)</td>
<td>0 = OFF (position down), 1 = ON (position up)</td>
</tr>
<tr>
<td>Example: <a href="https://main.snap4city.org/view/index.php?iddashboard=Mj44Ng==">link</a></td>
<td>Default value: undefined state, the SVG shows the overlapped position up and position down images.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faces Widget</td>
<td>By clicking a coloured face the corresponding value is sent to the server.</td>
<td><code>s4csvg_userFeedback: value sent to the server by clicking the corresponding face (write variable)</code></td>
<td>-2 = very bad, -1 = bad, 0 = so-and-so, 1 = quite-good, 2 = good</td>
</tr>
<tr>
<td>Example: <a href="https://www.snap4city.org/dashboards/MiU0NA==">link</a></td>
<td>Default value: no value sent. The SVG shows the five</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References:

[SNAP4City](https://www.snap4city.org/663)
From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensor

New Shared Variables

Constant Values

MyKPI

Sensors

[ ]

Web Socket Secure

Snap4City (C), January 2022
Select the Sensors and MyKPI to be used on Synoptics

See listed and save them
Custom Widgets Templates

Snap4City (C), January 2022
Instantiating a Custom Widget Synoptic

- [ ]
  - leave it empty to connect later directly from/to IOT APP
- MyKPI
  - Read/write data, your KPI, and real-time values
- Sensors
  - Your data collected as sensors only rendering data
- New Shared Variables
  - ..... Only for Case 3: Synoptic vs Synoptic Communications
  - No protection of data value
Custom Dashboards and Widgets (interactive, Animations, etc.)
-- SVG for graphic design
-- MyKPI for collecting data

https://www.snap4city.org/504
Dashboard on Browser

Internet

Storage and IOT App on cloud or on Premise

WS Server

New Shared Variables

2500 Msg/s

Case 1

WS

WS

MyKPI Sensor

Dashboard on Browser

Case 2

WS

WS

MyKPI Sensor

Case 3/4

WS

WS

MyKPI Sensor

Dashboard on Browser
Case 1


10 WS messages per second
Case 2: Event Driven 100%


40 messages per second
Dashboard on Browser

Internet

WS Server on cloud or on Premise

New Shared Variables

2500 Msg/s

Case 3/4

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjgyNg==
Flexible What-If Capabilities as Decision Support System
Mobility and Environment What-IF Analysis
This dashboard contains data derived from actual sensors and predictive values under validation

What-If Analysis Concepts

- What is going to happen at Services if certain conditions/cases are going to occur
  - Formalize: Conditions/cases, Services
  - Scenarios of Cases+Services Vs Solutions are Studios
  - to define, save, load:
    - Scenarios and Studios
    - Save and compare several effects
    - Comparison on the basis of KPI
Impact on Routing

- Scenario with multiple shapes
- Conditional Routing
  - avoiding areas or
  - reducing traffic in those areas
  - Multiple stop points
Computation of Traffic Flow Evolution
Traffic Flow Manager on multiple cities

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==
What happen to Public Transport

Mobility and Environment What-IF Analysis

This dashboard contains data derived from actual sensors and predictive values under validation.
## What-If Analysis

<table>
<thead>
<tr>
<th>Available data and techniques</th>
<th>What happened</th>
<th>What is going on now</th>
<th>What is going to happen</th>
<th>What-If: what is going to happen if a scenario occurs in the future</th>
<th>Which is the best solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Data, HD</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Real Time Data, RTD</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>HD + RTD + Short term Predictions, STP(.)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>HD + RTD + Analytical Model, AM(.) + Scenario Model, SM(.)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>(Yes)</td>
<td>No</td>
</tr>
<tr>
<td>HD + RTD + Short and Very Long Term Predictions, SVLTP(.) + AM(.) + SM(.) + Simulation, S(.)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HD + RTD + SVLTP(.) + AM(.) + SM(.) + S(.) + KPI(.) based Decision</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Decision Support System and Resilience via FRAM
Main Approach

• Three main layers
• Complex System modeling: function, processes, resources, time, events, etc.
  – Functional Resonance Analysis Method, FRAM
  – Resilience Analysis Grid, RAG
• Decision Support System, DSS
  – System Thinking, Goal Models
  – Risk analysis
  – UTS/ITS decision supports
• Data, big data access and exploitation
  – Data Analytics, Internet of Things, sensors, flows
  – People flow and behavior
  – Social Media
Improve city resilience, reducing risks and decision support

- assessing city resilience level
- improving city resilience, providing objective hints
- improving city users awareness with personal city assistants and participatory tools
Dashboarding City Resilience

Data and Service Aggregator
• **FRAM Model**
  – Macro FRAM processes
  – Metrics for Process complexity assessment
  – Operational Semantic for executing FRAM model
  – Connection with SmartDS
  – Connection with BigData open to multiple sources of data and workgroup results, Km4City

• **Collaborative work, web tool**
• **Open for all**
• **Validated on ERMG: European Guidelines**
Functional Resonance Analysis Method

Time: This is simultaneously a resource and a constraint

Controls: That which supervises or adjust function performance

Input: That which engages function operation and is used to produce the function output

Preconditions: System conditions that must be met before function can be carried out

FRAM Functional Resonance Analysis Method
• Understand system interdependencies
• Monitor sources of variability
• Investigate system architecture and events

Output: That which is produced by the function and becomes the input for other functions

Resources: That which is needed and/or consumed by the function to process the input
• Success and failure are equivalent in the sense that they both emerge from performance variability.

• Variability, intended as a way for people to adjust tools and procedures to match operating conditions.

• Emergence of either success or failure is due to unexpected combination of variability from multiple functions.

• The unexpected “amplified” effects of interactions between different sources of variability are at the origin of the phenomenon described by functional resonance.
• Success and failure are equivalent in the sense that they both emerge from performance variability.
• Variability, intended as a way for people to adjust tools and procedures to match operating conditions.
• Emergence of either success or failure is due to unexpected combination of variability from multiple functions.
• The unexpected “amplified” effects of interactions between different sources of variability are at the origin of the phenomenon described by functional resonance.
Smart Decision Support System based on System Thinking plus

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

http://smartds.km4city.org

Snap4City (C), January 2022
Dashboard Event Management
Alerting and events evidence on Dashboards

• Pop Up **Alarming** at the opening of the Dashboard, exploiting API and MicroService call when you need

• **Calling on the private Chat Room** of the dashboard.

• **Alerting via IOT Apps**, which may assess the firing conditions on the data and on the values/actions performed on Dashboards
  – Sending alerts via several channels
  – Blinking on Single Content Widgets, or on SVG Alarm of any shape

• Connection with **Ticketing System, Incident Management**

• Connection with **Notificator** (only for on premise)
  – Defining thresholds and blinking on Dashboard Widgets

• ...etc..
Dashboard Pop Up
Alerting when needed
Dashboard Info/Alarm Message

- Each Dashboard may have a custom IOT APP to control the data and the general services via APIs.
- The IOT App logic can Turn on/off the **Info Message** and customize its HTML text dynamically on the basis of the problem detected.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjg5Nw==
Private Dashboard ChatRoom
Private ChatRoom per Dashboard

Chat Management

DataCenter

10°C

10°C

10%
Chat Rooms

- **Activated** by the Dashboard creator which can invite a number of users of the platform to
  - Exchange Comments and Pictures
  - access on web and mobile
  - provoke notifications

- Accessible only under authentication
- The administrator can access to the log for review and log of the discussions.
- Chat Room capability is available as an additional appliance
Dashboard Chat Rooms

• Each Dashboard may have only one separate ChatRoom

• The Dashboard Owner can
  – Activate the Chat Room on Dashboard header in Edit
  – Add users of the platform to the chat room

• The **Chat** Room
  – Allows to Exchange Comments and Pictures
  – Can be Accessed on web and mobile
  – May Provoke notifications on the header of the Dashboard
  – Is accessible only under authentication

• The Administrators can access to the Log for review of the discussions
Notifications from Dashboard and from any Data Condition
Smart City Monitoring: notifications, alerting

Notification with IOT App may
• Fire on any kind of condition exploiting on IOT App logic
• produce messages/events on
  • Facebook, Telegram,
  • SMS, MMS, IOT Devices, ..
  • email, LOGS, FTP, ..
  • dashboards, mobiles, ...
  • Workflow/incident management system for ticketing
  • video wall management,
  • etc. etc.
Smart City Monitoring: Notificator

• Each single metrics and Widget may activate a notification on Notificator
• Notificator tool is attached to Dashboard Builder and it is available on Premise and for high roles
• Blinking on Dashboards
Integration with Ticketing Systems
Workflows, Incident Management
Integration with Ticketing Systems Workflow

• Snap4City is integrated with OpenMaint Ticketing system. An Open Source solution for ticketing and workflow management, incident management.

• Any ticketing systems can be integrated with Snap4City, by means of IOT Applications and Dashboards

• https://www.snap4city.org/597

Snap4City (C), January 2022
Example of Integrated workflow

OpenMaint: BPM Workflow management, team assignment, material control, ...

IOT App, Data event firing, event detection and firing Critical event management

Dashboards and actions

Consumptions/productions

Events/actions

Business Intelligence Maintenance

Snap4City (C), January 2022
Snap4City can:

- Create new tickets
- Manage steps, workflow
- Collecting feedbacks and results from teams
- Manage all phases of the workflow on the fields via IOT Apps and logics
- The integration if via API and MicroServices into IOT App.
Dashboard Other Features
Additional Properties from Edit Dashboard

- Embedding Dashboards into
  - a Dashboard
  - third Party Web Page
- Header or not
- Footer or not
- Responsive or not
- Size: any
- Background Image: any
- Add / change Screenshot (Thumbnails)
- Menu on left upper corner or not
Example of Dashboard without header

- To embed a dashboard without the header you can use the command
  - embedPolicy can be: auto | manual

- Then:
  - header will be hidden
  - footer will be reduced to the logo only, centered in the view
Dashboard Embedding into third party Web Sites/pages
Dashboard Embedding

- go in Dashboard Edit
  - Get code for embedding
  - Providing domain on which you embed
  - See Iframe preview
- Dashboard properties
  - we suggest set Responsive
  - deciding on header On Off
  - Adjust size of Iframe and dashboard for tuning
Dashboards Listing, Managing, Sharing, Delegation
Dashboard List and Editor
Dashboard Listing and Features

- Edit (open Dashboard Builder)
- Management (see later)
- Clone (clone the Dashboard)
- Delete (delete the Dashboard)
- (add Thumbnail is inside Edit, as snapshot)
• Cloned: Same dash with title having «- Cloned» at the end
  – You can: Clone, change name, pass to your colleague, edit, etc.
• Be careful that exploited resources are not cloned
Dashboard Management

- Change Ownership
  - Towards any user
  - Knowing the nickname

- Visibility
  - Public or Private
  - please note that data has to be published as well to make them accessible
Dashboard Management

• Delegation access to other users
  – See next example

• Delegation Access to other Groups [Higher roles cross Organization]
  – See next example
Monitoring Dashboard Usage

• Key Performance Indicators
  – Number of Accesses
  – Minutes of exposition

• Time Periods:
  – Day by Day
  – Week by Week
  – Month by Month
  – 6 months by 6 months
  – Year by Year
Smart Applications via Dashboard Management
For each Dashboard (Name, ID, ORG, Users, etc.. )

- W widgets
  - For each Widget
    - Name,
    - A data (1 ...N)

- I IoT Applications
  - ....

Thus:

- Different Dashboards may share the same data
- Different Widgets in different Dashboards may share the same data...
- Critical courses,..... More relevant data....

Access from Dashboard Management
Dashboard Management: Graph of Smart Application
Data Type Management

GDPR Compliant
GDPR: General Data Protection Regulation

Users may decide to:
− provide access to who, for do what, until when consented
− accept terms of use by signed consent for data management service

From each service, the user is capable to:
− See what we collect in terms of Data Type: traces, logs, paths, profiles, accesses, IOT devices, sensors, maps, etc.
− Download, delete, inspect Data
− Auditing and Revoke access or grant access right to each single Data
− Delete all Data in single shot or singularly (forget all about me)
GDPR: General Data Protection Regulation

If personal data are published by the owner:
- the data are released anonymously,
  → also in this case they can be revoked at any time:

Snap4City is also compliant to GDPR Technical Constraints as it:
- Performs Secure connections in any private data exchange
- Encrypts data store for all private data
- Decouples data and personal IDs
- Audits private data usage
Manage Profile and MyPersonalData

For each Data Type:

- Start as private → making them public (anonymous) and revoke
- The Owner is the only one that can: (1) modify values; (2) change the ownership
- Define/revoke Delegation to Access
- Delete/forget per Data Type and “me all”!
- Auditing
## GDPR vs Snap4City

### GDPR Compliance Verification Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Verif.</th>
<th>Reqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signed consent</td>
<td>UI</td>
<td>R8</td>
</tr>
<tr>
<td>User profile management and control</td>
<td>UI</td>
<td>R13</td>
</tr>
<tr>
<td>Data Type private as default</td>
<td>UI</td>
<td>R8</td>
</tr>
<tr>
<td>Rights to access per element</td>
<td>UI</td>
<td>R9</td>
</tr>
<tr>
<td>Rights to transfer per element</td>
<td>UI</td>
<td>R10</td>
</tr>
<tr>
<td>Rights to erase per element and total</td>
<td>UI</td>
<td>R13</td>
</tr>
<tr>
<td>Rights to revoke/change per Data Type</td>
<td>UI</td>
<td>R10</td>
</tr>
<tr>
<td>An interface for Right management for Data Type</td>
<td>UI</td>
<td>R9</td>
</tr>
<tr>
<td>Clear Terms of Use and Privacy Policy</td>
<td>UI</td>
<td>--</td>
</tr>
<tr>
<td>Auditing Tools for Data Type</td>
<td>UI</td>
<td>R14</td>
</tr>
<tr>
<td>Publish as Anonymous</td>
<td>UI</td>
<td>R9</td>
</tr>
<tr>
<td>Encrypt personal users’ data</td>
<td>Code</td>
<td>R12</td>
</tr>
<tr>
<td>Secure Authentication and Authorization</td>
<td>Code</td>
<td>R3</td>
</tr>
<tr>
<td>Data protection by Design</td>
<td>Code</td>
<td>R17</td>
</tr>
<tr>
<td>Secure connection</td>
<td>Code</td>
<td>R6</td>
</tr>
<tr>
<td>Security Control, data breach control, anonymization, etc.</td>
<td>PEN Test</td>
<td>R15, R16, R18</td>
</tr>
</tbody>
</table>

Details on the paper cited in the following slide

Snap4City (C), January 2022
https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8966344

Smart City IoT Platform Respecting GDPR Privacy and Security Aspects

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This work was supported in part by the European Union’s Horizon 2020 Research and Innovation Program under Agreement 898986.

ABSTRACT The Internet of Things (IoT) paradigm enables computation and communication among tools that everyone uses daily. The vastness and heterogeneity of devices and their composition offer innovative services and scenarios that require a new challenging vision in interoperability, security and data management. Many IoT frameworks and platforms claim to have solved these issues, aggregating different sources of information, combining their data flows in new innovative services, providing security robustness with respect to vulnerability and respecting the GDPR (General Data Protection Regulation) of the European Commission. Due to the potentially very sensible nature of some of these data, privacy and security aspects have to be taken into account by design and by default. In addition, an end-to-end secure solution has to guarantee a secure environment at the final users for their personal data, in transit and storage, which have to remain under their full control. In this paper, the Snap4City architecture and its security solutions that also respect the GDPR are presented. The Snap4City solution addresses the full stack security, ranging from IoT Devices, IoT Edge on-premises, IoT Applications on the cloud and on premises, Data Analytics, and Dashboarding, presenting a number of integrated security solutions that go beyond the state of the art, as shown in the platforms comparison. The stress test also included the adoption of penetrations tests verifying the robustness of the solution with respect to a large number of potential vulnerability aspects. The stress security assessments have been performed in a piloting period with more than 1200 registered users, thousands of processes per day, and more than 1.8 million of complex data ingested per day, in large cities such as Antwerp, Helsinki, and the entire Tuscany region. Snap4City is a solution produced in response to a research challenge launched by the Select4Cities H2020 research and development project of the European Commission. Select4Cities identified a large number of requirements for modern Smart Cities that support IoT/5G/IoT (Internet of Things/Everything) in the hands of public administrations and Living Labs, and selected a number of solutions. Consequently, at the end of the process after 3 years of work, Snap4City has been identified as the winning solution.

INDEX TERMS End-to-end, GDPR, IoT, IoT security, smart city.
Personal Data Management, GDPR compliant: POI, Data, KPI
Managing Personal: KPI, Data, POIs

Which can be:

– Acquired from any source: SQL, SPARQL, API, etc., ODBC, JDBC, etc.
– Computed by means of IOT App, Data Analytics, ETL
– Stored/retrieved into personal safe or general storage
– Edited from tool, or from IOT App
– Added Manually or Automatically
– Shown via Dashboard
# Smart Bench Data Delegation

## My Data, KPI, POI

<table>
<thead>
<tr>
<th>No.</th>
<th>High Level Type</th>
<th>Nature</th>
<th>Sub Nature</th>
<th>Value Name</th>
<th>Value Type</th>
<th>Last Date</th>
<th>Last Value</th>
<th>Ownership</th>
<th>Username</th>
<th>Controls</th>
<th>Data</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench Transits</td>
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<td>dist.comsumer</td>
<td>VIEW</td>
<td>ANNULLA</td>
<td>DELIVERED USERS</td>
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<td>2</td>
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<td>Smart Bench Light</td>
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<td>DELIVERED USERS</td>
</tr>
<tr>
<td>3</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench CO2</td>
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<td>4</td>
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<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench Total Sittings</td>
<td>totalSittings</td>
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<td>DELIVERED USERS</td>
</tr>
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<td>ANNULLA</td>
<td>DELIVERED USERS</td>
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<td>VIEW</td>
<td>ANNULLA</td>
<td>DELIVERED USERS</td>
</tr>
</tbody>
</table>

### KPI Delegation Details

- **Username**: 
- **Delegated**: *

### My KPI Delegation

<table>
<thead>
<tr>
<th>No.</th>
<th>Username Delegated</th>
<th>Values of KPI Data: No. 17062424</th>
<th>KPI Name</th>
<th>Smart Bench Temperature</th>
<th>Insert Time</th>
<th>Controls</th>
<th>Delegated *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Smart Bench Temperature</td>
<td>1/19/2021 7:59:53 PM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Management of MyKPI, MyPOI, …
Recalling Exercize number 3

My Personal Tracker
Accessing Multiple Trajectories

You can revoke at any instant from Web and mobile App.

Snap4City (C), January 2022
MicroApplications: several new

- Personal POI, KPI, Trajectories/trips
Advanced GDPR Aspects

- Snap4City has a model for Group of Smart City Entities that can be:
  - IOT Devices/sensors, My Data, MyKPI, Dashboards, MyPOI, ...
- The user can create its own Groups
  - Each Group may contain a number of Smart City Entities
- This allows to delegate in access a complete Scenario with one delegation only. For example:
  - An user registered a set of device of an industrial plant with a 200 variables, some of them Sensors other KPI,
  - The user has also realized 10 Dashboards showing those data and some results from IOT Apps as well
  - The user can group these entities in a GROUP: for example Plant56.
  - Thus the user can delegate in access data of different kinds and Dashboards at a person producing a unique delegation action instead of performing a delegation for each entities that in this case could be hundreds. The same for revoking the access to that user.
  - This will avoid the user to remember all dependencies of a scenario, since they will be all listed. In the future these dependencies could be estimated automatically
Dashboard GDPR Management
Details for Main Data Kinds

• My Personal Data, My KPI and My POI
  – to manage your personal MyKPI, MyPOI and trajectories, if any: view, edit, delete, delegation in access, revoke delegation, make public, change ownership

• My Personal Engagement
  – to manage your personal engagements received on the Mobile Apps, auditing, if any: view, delete

• My IOT Devices
  – to manage your IOT Devices in which it is possible to: edit, delete, make public, delegate in access, revoke delegation, change ownership

• My IOT Applications
  – to manage your IOT Applications in which it is possible to: delete, restart, change ownership.

• My Dashboards
  – to manage your Dashboards in which it is possible to: edit, delete, change ownership, delegate in access, revoke delegation, see list of delegations, make public.
Example: Delegated Dashboard but not all data
Dashboard Delegation
DevDash: My Data Dashboard based on Kibana and customization
DevDash: My Data Dashboard Kibana
Business Analysis Dashboards
For all kind of users: DevDash

- Dynamic Filtering, Adaptable, ...
- Full data details, drill down,...
- Synergic with Data Inspector which addresses data relationships, processing and information
- Only Your Data for
  - Manager and Area Managers
- All Accessible Data for
  - ToolAdmin and RootAdmin
• Multi faceted Search by
  • Devices
  • Organization
  • Drill on Time
  • Drill on Map
  • Value Types
  • Data Type
  • Value name
  • Data table
  • Etc.

• Respect Privacy and GDPR
My Data Dashboard Customization

- My Data Dashboards (for Developers and for Managers) can be customized by RootAdmin.
  - Authority for Customization can be also extended to other role on Premise solutions

- Customizations is based on Full editing Capabilities of OpenDistro (Kibana Elastic Search 7.1), and with multiple indexes of Snap4City
Acknowledgements
2020
- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform

2021
- PC4City (2020-21)
  Monitoring Terrain
- CAPELON
  - Smart Light
  - Sweden
- Km4City 1.6.7
- Winner of Open Data Challenge of enel x

2022
- Smart Ambulance (2021-22)
- Enterprise (2021-22)
- Almafluida
  Industry 4.0 (2021-22)
- AMPERE (2021-22)
  Industry 4.0
- SYN-RG-AI
  SmartCity
- PRETTO
  Industry 4.0
- Asymmetrica
  Smart City
- UniSystems
  Smart City
- Smartea
  Smart City
- ITALFERR
  Smart City
Main Organizations/areas

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

- **2021**
- **https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf**

Snap4City (C), January 2022
Main running instances (11/21)

- Sii-Mobility → mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFAIR → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart Garda Lake → Castelnuovo del Garda, SMARTEA
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant, control and plan
- SmartBed (Laid) → smart health
- Green Field Peas (Soda) → Industry 4.0, Chemical plant
- MobiMart and PISA Agreement → data aggregation, mobility and transport, Living Lab
- Lonato del Garda → smart parking, environment
- Herit Data → tourism, culture and management
- ISPRA JRC → site management and services
- Capelon (Sweden) → smart light solutions
- PC4City → land slide monitoring and predictions
- Italmatic → industry 4.0 production control
Acknowledgements

• Thanks to the European Commission for founding. All slides reporting logo of Snap4City [https://www.snap4city.org] of Select4Cities H2020 are representing tools and research founded by European Commission for the Select4Cities project. Select4Cities has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation Programme (grant agreement n° 688196).

• TRAFAIR is a CEF project. All slides reporting logo of TRAFAIR project are representing tools and research founded by the EC on CEF programme [http://trafair.eu/]

• Thanks to the European Commission for founding. All slides reporting logo of REPLICATE H2020 are representing tools and research founded by European Commission for the REPLICATE project. REPLICATE has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation Programme (grant agreement n° 691735).

• Thanks to the European Commission for founding. All slides reporting logo of RESOLUTE H2020 are representing tools and research founded by European Commission for the RESOLUTE project. RESOLUTE has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation Programme (grant agreement n° 653460).

• Thanks to the MIUR for co-founding and to the University of Florence and companies involved. All slides reporting logo of Sii-Mobility are representing tools and research founded by MIUR for the Sii-Mobility SCN MIUR project.

• Km4City is an open technology and research line of DISIT Lab exploited by a number of projects. Some of the innovative solutions and research issues developed into projects are also compliant and contributing to the Km4City approach and thus are released as open sources and are interoperable, scalable, modular, standard compliant, etc.
https://www.snap4city.org/577

<table>
<thead>
<tr>
<th>On Line Training Material (free of charge)</th>
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<tbody>
<tr>
<td><strong>what</strong></td>
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<tr>
<td>1st part (*)</td>
</tr>
<tr>
<td>2nd part (*)</td>
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<td>3rd part (*)</td>
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<td>6th part (*)</td>
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<tr>
<td>7th part (*)</td>
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<tr>
<td><strong>PDF</strong></td>
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<tr>
<td>General</td>
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<tr>
<td>Dashboards</td>
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<td>IOT App, IOT Network</td>
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<tr>
<td>Data Analytics</td>
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<tr>
<td>Data Ingestion processes</td>
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<tr>
<td>System and Deploy Install</td>
</tr>
<tr>
<td>Smart City API: Web &amp; Mob. App</td>
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</tbody>
</table>

| **Interactive**                           |
| Video1                                    |
| Video2                                    |
| Video3                                    |
| Video4                                    |
| duration                                  |
| 2:55                                      |
| 3:16                                      |
| 3:41                                      |
| 2:00                                      |
| none                                      |
| 2:48                                      |
| none                                      |
| none                                      |

Snap4City (C), January 2022
Be smart in a SNAP!

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