LIVING LAB

Dashboards Creation and Management

October 2020, 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

October 2020, Course
https://www.snap4city.org/577

Paolo Nesi, paolo.nesi@unifi.it
https://www.Km4City.org
https://www.disit.org
DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS

FREE TRIAL

EXPERT SYSTEM KNOWLEDGE BASE STORAGE

BIG DATA ANALYTICS ARTIFICIAL INTELLIGENCE BUSINESS INTELLIGENCE MACHINE LEARNING

DATA FLOWS, WORKFLOWS MICROSERVICES MANAGEMENT

METHODOLOGIES COURSES AND COMMUNITY LIVING LABS DEVELOPMENT TOOLS
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)
Free Trial

- Register on 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)

<table>
<thead>
<tr>
<th></th>
<th>1st part (*)</th>
<th>2nd part (*)</th>
<th>3rd part (*)</th>
<th>4th part (*)</th>
<th>5th part (*)</th>
<th>6th part (*)</th>
<th>7th part (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>what</td>
<td>General</td>
<td>Dashboards</td>
<td>IOT App, IOT Network</td>
<td>Data Analytics</td>
<td>Data Ingestion processes</td>
<td>System and Deploy Install</td>
<td>Smart City API: Web &amp; Mob. App</td>
</tr>
<tr>
<td>PDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>duration</td>
<td>2:55</td>
<td>3:16</td>
<td>3:41</td>
<td>2:00</td>
<td>2:48</td>
<td>2:35</td>
<td>1:47</td>
</tr>
</tbody>
</table>

https://www.snap4city.org/577
General Overview of the full Course

• **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, etc.
• **6th part**: Snap4City Architecture, How To Install Snap4City
• **7th part**: Smart city API (internal and external) Web and Mobile App development tool kit

A number of the training sections include exerctitations

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)
• Recall on Snap4City Architecture
• Dashboard Usage and Authoring
  – Dashboard usage vs Widgets
  – Multi Data Map Widget
  – From Data to Graphic Widgets
  – Special Custom Widgets, Event Driven Custom Widgets, dynamic widgets
  – GIS Data Gathering /Connection
  – Special Custom Widgets, Event Driven Custom Widgets, dynamic widgets
• Unified Data Model (for All) and Data Inspection (for Admin)
  – Data Inspector vs Data Processes Details (for Admin)
• Dashboard Creation & Exercitation
  – Dashboard Creation, Exercitation
  – Synoptics and Custom Widgets Creation
  – Dashboards Intelligence on Web and Mobile Devices
  – Dashboard ChatRoom and Notifications
• Data Type Management GDPR Compliant
  – Dashboard Listing, Managing, Sharing, Delegation
  – Dashboard/widget Embedding into third party web pages, Dashboard Alerting
  – Dashboards GDPR Management
  – Personal Data Management GDPR Compliant: POI, Data, KPI
• Acknowledgments
**Living Lab Accelerating**

**GO!**

**Community Building**
- collaborations
- subscription to applications
- personal services

**City Operators**
- agreements
- networking

**Resource Operators**
- tutorials
- documentation

**Inhouse companies**
- workshops
- experiments

**Tech providers**
- Category Associations

**Corporations**
- Advertisers
- City Operators

**Community Building**
- City Users
- Advertisers
- Large Industries
-: hackathons
- events

**Apps & Dashboards**
- Manage Apps & Dashboards, User Engagement
- Promote Applications & Dashboards
- Monitor City Platform

**Connect IOT/IOE**
- Upload context
- Open Data

**Connect external Services**
- Data Ingestion and Analytic algorithms
- Advanced Smart City API, MicroServices

**Produce City IOT Applications & Dashboards**
- Produce Apps and Dashboards for City Users

**Produce Apps and Dashboards for City Users**
- Case Studies
- Research groups
- Start-ups
- Early Adopters

**Licensing, Gold services**
- partnerships

Snap4City (C), October 2020
Development Life Cycle
Smart City Services

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

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

Development
- Deploy
- Testing
- Publication Production

Snap4City (C), October 2020
Recall on Snap4City Architecture
Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

IOT Applications

Dashboards and Apps

My IOT Devices

Big Data Analytics, Artificial Intelligence
Snap4City Services also on IOT Edge!!!
DASHBOARDS: USAGE AND AUTHORING
Public Dashboards (see them on the Portal)
Video Wall

From Consolle Operator to the Video Wall

Snap4City (C), October 2020
Control Room

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

#Firenze

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 [https://www.snap4city.org](https://www.snap4city.org) 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/IOE, 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 a plethora of solutions to develop applications without vendor lock-in or technology lock-in, (ii) final users customizable / flexible mobile Apps and tools, (iii) city operators and decision makers specialized / sophisticated city dashboards and IOT/IOE 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 Fiware, an official library of J5 Foundation Node-RED, registered on EIND, present on EOSC marketplace, and BeeSmartCity MarketPlace, etc. Snap4City obtained the 1st place award by Select4Cities partners and PCP (Antwerp, Copenhagen and Helsinki).
Dashboards Usage vs Widgets
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 Usage & Recipe

- [https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=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**: Heatmaps, traffic, 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, 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
Helsinki vs Florence comparison

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

Widget Map (multi data map)

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0MQ==
Firenze - Trafair - AirQuality Heatmaps
This dashboard contains data derived from actual sensors and predictive values under validation

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

Snap4City (C), October 2020

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

Widget Map
(multi data map)

Time Trend

Multi-Widget Map - Demo

MultiSeries

- Staked, shaded or regular,
- Grouped by Value_unit, linear or Logarithmic
- From historical data and/or dynamic data from IOT Applications
Bars & Pies

How I met your mother

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
- Vertical and Orizontal
- From historical data and/or dynamic data from IOT Applications

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjQwMA==
Pie & Dunot

- Single level Pie and two levels Dunot
- Grouped ValueType, ValueUnit

Speedometers - Gauges

- Coloured custom
- Unit of measure
- Bounds

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU0MA==
### Table - Weather Metrics and Pollutants

<table>
<thead>
<tr>
<th>value type / value name</th>
<th>airHumidity+</th>
<th>airTemperature+</th>
<th>PM2_5</th>
<th>PM10+</th>
<th>O3+</th>
<th>CO+</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBIMET_SMART_01</td>
<td>39.9</td>
<td>16</td>
<td>235.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_02</td>
<td>48</td>
<td>13.3</td>
<td>97.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_03</td>
<td>56.6</td>
<td>13.4</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_04</td>
<td>51.4</td>
<td>10.9</td>
<td>14.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_05</td>
<td>84</td>
<td>10.6</td>
<td>13.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_06</td>
<td>0</td>
<td>21.9</td>
<td>2.7</td>
<td>4.41</td>
<td>244.88</td>
<td>0.15</td>
</tr>
<tr>
<td>IBIMET_SMART_07</td>
<td>2.7</td>
<td>2.7</td>
<td>5.01</td>
<td>54.8</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_08</td>
<td>22.3</td>
<td>9.6</td>
<td>12.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBIMET_SMART_09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Neutral or Colormapped, similarly to heatmaps
- Number/text

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

- Normalized, multiple value units
- Hystorical, KPI and Dynamic from IOT App


Monitoring My PAX Counter 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), October 2020
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==
A set of connected dashboards
Many different tools.
Fully interactive for touch screens

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)
  – 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
  – Special tools
    • Traffic flow
    • 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

Technical Selector: TECH MultiDataMap

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

3D Map beta Testing

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM2MA==#
**Weighted Circles Bubbles**

Roma Demo1 (mappe e dati real time)

[Map Image]

*Trasporti*
- Qualità dell'Aria

*Temperatura*
- 22.5 °C

[Dashboard Link]
External Service Widget and family
Dashboard Usage and Recipes

- **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 ultra HD screens....

- **Selector WEB**
  - Anything that can be shown on External Content WG, one or more
First aids overview - Tuscany
Service status of main first aid facilities

Snap4City (C), October 2020

External Services (registered)
Life in Toscana: Dashboard

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

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==
Helsinki White Dashboard

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

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

Real Time BUS Tracking
Roma example

Real Time BUS Tracking

Real Time Sensors via ServiceMap3D
3D data rendering

Bus Tracking (planned or real time)

3D view of POIs,
Real time Sensor values

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

Parking Monitoring Firenze

MicroApplications for Dashboards
Demo UC5 GIDA

GIDA 5G demo

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==
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
From Data to Graphic Widgets
What the Dashboards can directly exploit

Dashboards

From Dashboard to IOT App

From IOT App to Dashboard

Big Data Analytics, Artificial Intelligence
Access to all data

IOT Broker

IOT Device

Web Scraping

API, External Services

External Data Stores

LD, LOD

DataGate

ckan

GIS data, Maps,

Snap4City BigData Storage and KB

IOT Edge

Sensors/Actuators

IOT Application

IOT Broker

IOT Device

Snap4City BigData Storage and KB

Big Data Analytics,
Artificial Intelligence
Access to all data

Access to all data

88
How the Dashboards exchange data

- Req. ServiceURI
- Req. KPI, Metric ID
- Req. MyKPI ID
- GIS, HTTPs URLs
- ServiceURI (ID)
- MyKPI, Metric (ID)
- Dynamic Data, computed into IOT Application
- Rx. Dynamic Data
- Event Driven Synoptics
- Actions, Show
<table>
<thead>
<tr>
<th>High Level Types</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POI (Point of Interest)</strong></td>
<td>POI which define a data set from the Open Data or other collections</td>
</tr>
<tr>
<td><strong>MyPOI</strong></td>
<td>POI generated from the IOT Applications, Mobile App</td>
</tr>
<tr>
<td><strong>Sensor</strong></td>
<td>Real time data, IOT Devices, Time Series, elements of the a POI Collection, etc.</td>
</tr>
<tr>
<td><strong>Sensor Actuator</strong></td>
<td>IOT Device element to Act on the field, e.g.: irrigator, light, setpoint, volume, etc.</td>
</tr>
<tr>
<td><strong>Dashboard-IOT App</strong></td>
<td>Actions from Dashboards to IOT Applications</td>
</tr>
<tr>
<td><strong>KPI (metrics)</strong></td>
<td>KPI defined from direct access to data base, usually for Industry, on premise</td>
</tr>
<tr>
<td><strong>MyKPI</strong></td>
<td>time series also geolocalized over time generated from the IOT Applications, Mobile App</td>
</tr>
<tr>
<td><strong>My Personal Data</strong></td>
<td>data which can be stored in a safer from the IOT Applications</td>
</tr>
<tr>
<td><strong>My Data</strong></td>
<td>data which can be stored in a safer from the IOT Applications</td>
</tr>
<tr>
<td><strong>Complex Event</strong></td>
<td>Events: critical or entertainment</td>
</tr>
<tr>
<td><strong>Heatmap</strong></td>
<td>a) Heatmaps of different kind: PM10, NOX, people, accidents, etc.</td>
</tr>
<tr>
<td><strong>MicroApplication</strong></td>
<td>b) <strong>special tools</strong> such as: traffic flow, scenario, what-if analysis</td>
</tr>
<tr>
<td><strong>External Service</strong></td>
<td>Views of Snap4City web applications</td>
</tr>
<tr>
<td><strong>Special Widget</strong></td>
<td>External Web Pages or Tools: routing, traffic flow, people flow, etc.</td>
</tr>
<tr>
<td><strong>WFS/WMS (GIS)</strong></td>
<td>Clock, first aid, weather forecast, italian flag, Pub Transport quality, Twitter citations, etc.</td>
</tr>
<tr>
<td><strong>Synoptics</strong></td>
<td>data coming from GIS services</td>
</tr>
<tr>
<td><strong>Any kind of Custom Made Widgets created by using the SVG editor and dedicate tool.</strong></td>
<td></td>
</tr>
</tbody>
</table>

Snap4City (C), October 2020
**HLT: POI**

- 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)
HLT: Sensors

- 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)

Real Time Event Driven Historical Data
HLT: Sensors

- Sensors can arrive in platform as follows (see Nature)
  - as processes in PULL
    - As aPeriodic processes
  - From IOT Devices to KB (knowledge base). Registered via IOT Directory, arriving via IOT Broker and saved into the Data Shadow,
    - IOT data driven process in PUSH
- From Dashboard to IOT Devices (echo) is a virtual sensor

Sensor Actuators (HLT),
- IOT data driven process in PUSH
HLT: KPI (key Performance Indicator)

- 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)

Real Time
Event Driven
Historical Data

Snap4City (C), October 2020
MyPOI may become POI with the action of Admin
MyKPI as Trajectories

- 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)

High Level Types

- Real Time Tracking
- Historical 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

![Image of devices and applications]
MyKPI, MyPOI: Management as GDPR
HLT: Heatmaps

- 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)

Type: calibrated

ColorMaps For Calibrated

Type: Gaussian
Heatmaps (flexible Data Analytics)

- **Main:**
  - Heatmaps are Time series
- **A) Gaussian Heatmaps**
- **B) Calibrated heatmaps**
  - From 200x200 to 4x4 mt
  - PM10, PM2.5, SO2, NO2, Noise, NO, O3, Enfuser, GRAL,....
  - Any programmed Color map
  - 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
- 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
**HLT: Special Tools**

- **Scenarios**
  - Full text search of roads and geolocations.
  - Global map of OSM

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

- **Traffic Flows**

• 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)
HLT: WFS (GIS)

- 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)
Special Widgets, for Specific Data
HLT: Complex events

- 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)
HLT: Special Widgets

- 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)
Widgets Interacting with IOT Apps
virtual Sensors and Actuators
IOT Data Driven

Snap4City IOT Brokers

Managing Public and Private IOT/IOE Devices

Towards any IOT Device and/or Dashboard

Snap4city Platform storage for «Data Shadow» and much more

Dashboards also provide rendering for sensor values

Real Time

Real Time + Historical

Sensors

Actuator

Sensor Actuator

From Dashboard to IOT Device

From IOT Device to KB

Sensors

IOT Applications
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)
From Dashboard to IOT Devices

- **Widgets:**
  - Impulse Button
  - Button
  - Switch
  - Dimer/Knob
  - KeyPad
  - geolocator

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

From Dashboard to IOT App

MyKPI variable

Synoptics

IOT Application

Nature

Snap4City (C), October 2020
Dashboard - IOT App

IOT Application

Nature

From IOT App to Dashboard

Snap4City (C), October 2020
Single Content Widget (flexibility)

From Dashboard Editor and IOT Applications, accepts in input:

• Numbers
• String
• HTML code

https://www.snap4city.org/578
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 😊
• 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.
Controlling Maps from IOT Apps

- Show points on maps
- Get Points
- Tracks
- See examples on:
  - https://iot-app.snap4city.org/nodered/nrve0e3/ui/#!/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
External Services (integration of) your of third party web pages
Special data are managed with Special Tools

- GTFS
- Origin Destination Matrices

HLT: MicroApplications, External Services
HLT: External Services

- 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)
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
• **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,
  – 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!

Custom Dashboards and Widgets (interactive, Animations, etc.)

- SVG for graphic design
- MyKPI for collecting data
HLT: MicroApplications

- 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)
HTML5 MicroApplications

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

See many others on web

Snap4City (C), October 2020
Special Custom Widgets
Demo UC5 GIDA

GIDA 5G demo

13.6°C 1020 bar 87%

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==
Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls

Snap4City (C), October 2020
DCS Real Time - Settimanale

ALTAIR Chimica

Snap4Altair

Sinottico Sintesi Impianto Altair 2
Event Driven Custom Widgets
From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensors

MyKPI

Sensor

[ ]

New Shared Variables

Constant Values

Snap4City (C), October 2020
Other examples

• 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
Dynamic Widgets data on Dashboard from IOT Applications

Snap4City (C), October 2020
How the Dashboards exchange data

- Req. ServiceURI
- Req. KPI, Metric ID
- Req. MyKPI ID
- 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

Snap4City BigData Storage and KB

Metric, KPI

MyKPI, MyPOI, ...

IOT Application

Dashboards
Dynamic Widget data

- **ServiceURI (ID)**
  - metriclevelType: "sensor"
  - metriclevelName: "tusc_weather_sensor_ow_3166548"
  - metricType: "airTemperature"

- **MyKPI (ID)**
  - metriclevelType: "sensor"
  - metriclevelName: "tusc_weather_sensor_ow_3166548"
  - metricType: "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
<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>MyPersonal Data</th>
<th>MyData</th>
<th>MyKPI</th>
<th>Table Data Driven</th>
<th>Senso</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>
<td>X</td>
</tr>
<tr>
<td>XX</td>
<td>Speed Limit</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Speedometer</td>
<td></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></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></td>
<td>X</td>
<td>X (DD)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single and Multiple Bars, stacked or not</td>
<td></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</td>
<td></td>
<td>X (cs)</td>
<td>X</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></td>
<td>X</td>
<td>X (DD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Time trend Compare</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SpiderNet, radar, Kiviat</td>
<td></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></td>
<td>X (cs)</td>
<td>X</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></td>
<td>X (cs)</td>
<td>X</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 is 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 reloading

TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications (partially obsolete)
GIS Data Import, Export and Exploitation
Interoperability ESRI

- **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.
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

Dashboards and Apps
• 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), October 2020
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](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=MThxNg==](https://main.snap4city.org/view/index.php?iddashboard=MThxNg==)
• 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==](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**
(D) 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 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?iddashboard=MjIwNg=](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjIwNg=)
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 Elastic Search
• "MyKPI" are data ingested via Mobile Apps, IOT Apps, manually, etc.; They may be on MySQL, and recently are coming to 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.
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 (in建て)

Valori inquinanti in tempo reale, mappa

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjcyNg==
Unified Data Model 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)
## Unified Data and Services Model/Classification

<table>
<thead>
<tr>
<th>High Level Type</th>
<th>Nature</th>
<th>SubNature</th>
<th>Value Type</th>
<th>Value Name</th>
<th>Data Type</th>
<th>Value Unit</th>
<th>Last Date</th>
<th>Last Value</th>
<th>Issue</th>
<th>Last Check</th>
<th>Ownership</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>MykRo</td>
<td>Environment</td>
<td>Weather_sensor</td>
<td>Grad Celsius</td>
<td>Battery Temperature</td>
<td>float</td>
<td>°C</td>
<td>2020-01-23 12:37:34</td>
<td>26</td>
<td>✔</td>
<td>2020-04-10 10:13:00</td>
<td>private</td>
<td>Firenze</td>
</tr>
<tr>
<td>MykRo</td>
<td>Environment</td>
<td>Weather_sensor</td>
<td>Grad Celsius</td>
<td>Battery Temperature</td>
<td>float</td>
<td>°C</td>
<td>2019-04-23 05:54:21</td>
<td>24</td>
<td>✔</td>
<td>2020-04-10 10:13:00</td>
<td>private</td>
<td>Firenze</td>
</tr>
<tr>
<td>MykRo</td>
<td>Environment</td>
<td>Smart_water_container</td>
<td>Level Percentage</td>
<td>Em_GDP</td>
<td>percentage-m-kpl</td>
<td>%</td>
<td>2010-03-01 00:00:00</td>
<td>✔</td>
<td>2020-04-03 10:13:00</td>
<td>private</td>
<td>Firenze</td>
<td>DIGIT</td>
</tr>
<tr>
<td>MykRo</td>
<td>Environment</td>
<td>People_counter</td>
<td>Battery percentage</td>
<td>borrowed_tgso2win_ex_pav_black BATTERY</td>
<td>percentage-m-kpl</td>
<td>%</td>
<td>2019-05-08 10:33:56</td>
<td>4.192</td>
<td>✔</td>
<td>2020-04-03 10:13:00</td>
<td>private</td>
<td>Firenze</td>
</tr>
<tr>
<td>MykRo</td>
<td>Environment</td>
<td>People_counter</td>
<td>Battery Percentage</td>
<td>borrowed_tgso2win_ex_pav_green BATTERY</td>
<td>percentage-m-kpl</td>
<td>%</td>
<td>2019-05-19 08:56:56</td>
<td>4.072</td>
<td>✔</td>
<td>2020-04-03 10:13:00</td>
<td>private</td>
<td>Firenze</td>
</tr>
<tr>
<td>MykRo</td>
<td>HealthCare</td>
<td>Health_citizen</td>
<td>tassobioenergy</td>
<td>compartimenta</td>
<td>float-m-kpl</td>
<td>m</td>
<td>2017-01-01 00:03:00</td>
<td>✔</td>
<td>2020-04-03 10:13:24</td>
<td>private</td>
<td>Firenze</td>
<td>DIGIT</td>
</tr>
</tbody>
</table>

**Semantic**

- **Nature**: Property or characteristic of a system
- **SubNature**: More specific category of a system's nature
- **Value Type**: Type of data (e.g., temperature, percentage)
- **Value Name**: Name of the value
- **Data Type**: Type of data (e.g., float, percentage)
- **Value Unit**: Unit of the value
- **Last Date**: Last date the value was recorded
- **Last Value**: Last recorded value
- **Issue**: Indicates if the value is valid
- **Last Check**: Last date the value was checked
- **Ownership**: Who owns the data
- **Organization**: Where the data was collected

**Technical meaning**

- **RealTime**: Data is up-to-date
- **Status**: Data is in a specific state
- **For Admin**: Data is intended for administrative use

**For Admin**

- **Ownership**: Who owns the data
- **Organization**: Where the data was collected
Unified Data and Services Model/Classification

**Semantic Nature**

- SubNature
- SubNature

**Technical meaning**

- Value Type
- 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
## Two Examples

<table>
<thead>
<tr>
<th>HLT: MyKPI</th>
<th>HLT: Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature: Industry and manufacturing</td>
<td>Nature: From IOT Device to KB</td>
</tr>
<tr>
<td>Subnature: Chemical</td>
<td>Subnature: IOT Sensor</td>
</tr>
<tr>
<td>Value Type: Density percentage</td>
<td>Value Type: Battery Level</td>
</tr>
<tr>
<td>Value Unit: %</td>
<td>Value Unit: V</td>
</tr>
<tr>
<td>Data Type: float mykpi</td>
<td>Data Type: float</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value name: CloroParaffine</th>
<th>Value name: Irrigator fioriera Gag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Date: 2019-02-25</td>
<td>Last Date: 2020-04-01 12:59:00 «dateObserved»</td>
</tr>
<tr>
<td>Last Value: 87.0</td>
<td>Last Value: 5.18</td>
</tr>
<tr>
<td>Healthiness:</td>
<td>Healthiness:</td>
</tr>
<tr>
<td>Last Check: 2020-04-03 10:28:12</td>
<td>Last Check: 2020-04-03 03:28:12</td>
</tr>
<tr>
<td>Ownership: private</td>
<td>Ownership: public</td>
</tr>
<tr>
<td>Organization: Firenze</td>
<td>Organization: Firenze</td>
</tr>
</tbody>
</table>
# 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/manage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Event (msg)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Dashboard, ETL, Special, IOT App, ...</td>
</tr>
<tr>
<td>API (Ext. Srv., any prot.)</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>ETL, Special, IOT App, ...</td>
</tr>
<tr>
<td>External Service (web pag)</td>
<td>Yes</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td>ETL, Special, IOT App, Web Scraper, ...</td>
</tr>
<tr>
<td>KPI (metrics) data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, API, Metrics SQL calls</td>
</tr>
<tr>
<td>MicroApplication (webapp)</td>
<td>Yes</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td>Dashboard, IOT App, API, FTP, ...</td>
</tr>
<tr>
<td>Dashboard-IOT App (msg)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, API, ...</td>
</tr>
<tr>
<td>My Personal Data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
</tr>
<tr>
<td>MyKPI data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
</tr>
<tr>
<td>MyPOI data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
</tr>
<tr>
<td>Heatmap matrix</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IOT App, MicroService, UserInterf, API, ...</td>
</tr>
<tr>
<td>Sensor data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>IOT Directory, IOT App, UserInterf, API, ...</td>
</tr>
<tr>
<td>Sensor Actuator data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Dashboard, IOT App, UserInterf, API, ...</td>
</tr>
<tr>
<td>POI (Point of Interest)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>DataGate, ETL, IOT App, API, ...</td>
</tr>
<tr>
<td>Special Widget (complex)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>ETL, special, IOT App, API, ...</td>
</tr>
<tr>
<td>Synoptics MyKPI (groups)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>Yes</td>
<td>Special, API, ...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Tools (functional)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>(Yes)</td>
<td>Yes</td>
<td>As MyPersonalData, ...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WFS/WMS (GIS data)</td>
<td>Yes</td>
<td>[yes]</td>
<td>[yes]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GIS tools, or GeoServer, IOT App, ...</td>
</tr>
</tbody>
</table>
Legenda: How to ingest/change/manage

- **Dashboard**: by creating a Dashboard Widget that can act/change the values with actuators (2nd Day Slides)
- **API**: you can use the Smart City API to change / provide the values (see 3rd Day Slides)
- **IOT App**: by developing an IOT Application on Node-RED exploiting Snap4City MicroServices (4th Day Slide, and in part in these slides)
- **DataGate**: you can use the DataGate tool to ingest the data, and publish them
- **ETL**: by developing an ETL process, and put it in execution via DISCES
- **IOT Directory**: you can use the IOT Directory tool to change the parameters, and set up the ingestion process, via IOT Brokers, IOT Devices, IOT Edge.
- **Special**: by using a special tool for developing a process, or for creating SVG Synoptics
- **UserInterf**: there is a number of Tools with Graphic User Interface that you can use to change the values, see in the menu on the left.
- **Web Scraper**: by creating a Web Scraping process and exploiting the results into an IOT Application
- **As MyPersonalData**: they are substantially MyPersonalData
- **From third party tools**: they can be manipulated by using third party tools

Snap4City (C), October 2020
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**

Knowledge Base view
- Specific values of selected
- 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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Value Type**: meanPeople
- **Healthiness Criteria**: 
- **Delay**: 81347
- **Data Type**: float
- **Period**: 900
- **Last Update**: 2020-07-10T13:06:34.734+02:00
- **Healthiness Criteria 1**: (2020-07-19 23:03:31) false
- **Healthiness Criteria 2**: (2020-07-19 23:03:31) false

**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
Two different criteria

- **H1**: at least an event in the last 24 hours
- **H2**: machine learning for most of Sensors devices
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
HLT: From Dashboard to IOT APP

- Click with the mouse on it
# HLT: Dashboard-IOT App (From Dashboard to IOT APP)

## Data sources Details

<table>
<thead>
<tr>
<th>Device</th>
<th>Values</th>
<th>Healthiness</th>
<th>Image</th>
<th>Licensing</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Coordinates:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Level Type:</td>
<td>Dashboard-IOT App</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature:</td>
<td>From Dashboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subnature:</td>
<td>Mobile PARK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value Name:</td>
<td>nReaObv</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device ServiceURI or Data:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor ServiceURI or Data:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DataSource:</td>
<td>From Dashboard to IOT App</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ownership:</td>
<td>private (My Own)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizations:</td>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Link to IoT App**

**List of Dashboard**
HLT: Sensor-Actuator (From Dashboard to IOT Device)
Some functionalities are limited to certain roles

- Click with the mouse on it
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)
SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

DASHBOARD CREATION
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

Knowledge Base, Km4City

IOT Applications

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

Micro Applications

External Services

Custom Widgets/Synoptics

Dashboard Wizard

Create, save, load, delegate, grant access

Dashboard Editor

Public Dashboard Collection

My Own Dash/App
Dashboard List and Editor
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), October 2020
The Wizard helps you in selecting only possible combination of data vs graphic representation.
Wizard

Dashboard - tester14

Use Wizard to add more widgets

CONTEXTUAL MENU to edit features
Manual Addition of Widgets

Dashboard - tester14

Add new widget to dashboard

Metric and widget choice

- Widget category
  - Actuator
  - Data viewer

Generic widget properties

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

Specific widget properties

- Metric and widget choice
  - Widget category: Data viewer
  - Metrics category: Shared metrics
  - Metric: Bologna_Pression
  - Metric description: Pressione atmosferica via Bologna Meteo
  - Widget type: widgetGaugeChart
  - Widget link: widgetGaugeChart

Snap4City (C), October 2020
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

Dashboard template
Click on a template to choose it, click on it again to unselect it

- **Selector and POI**
  - Preset widget choice

- **Selector, POI, trend**
  - Preset widget choice

- **Data and trends**
  - Preset widget choice

- **Events vs. map**
  - Manual widget choice

- **My Private Data**
  - Manual widget choice

- **MicroApp**
  - Preset widget choice

- **Fully custom**
  - Manual widget choice

- **IOT devices**
  - Manual widget choice

- **IOT applications**
  - Manual widget choice

- **Empty Dashboard**
  - Empty dashboard
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

- 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: 10-20 minutes
Result could be similar to

• 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

• The HLT to be selected should
  – Be located downtown in Florence
  – Could be of different kind HLType, and 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
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

[Link to demo](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==

Snap4City (C), October 2020
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
my example of dashboard
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.
• Setting:
  – Heatmaps
  – Bubbles
  – Traffic
  – What-if
  – Etc. etc.
Dashboards

• **Suitable** as: City Dashboard, App interface, and Control Room Dashboards, Situation Room Dashboard, Operator Dashboard

• **Created** visually compounding graphic Widgets
  – Each widget has 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
  – **US1.** Using City Dashboards
  – **US2.** Using and Creating Snap4City Applications with Dashboards
  – **US4.** Creating City Dashboards and related Event Monitoring and Actions
Synoptic and Custom Widgets Creation
Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls
IOT Applications

Knowledge Base, Km4City

Knowledge and Storage Data from the Field and City

SVG Symbols Collection

Public Dashboard Collection

My Own Dash/App

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.:

Inkscape editor on your computer

Create, save a Custom Widget in SVG

Create, save, load, delegate, grant access

Snap4City (C), October 2020
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

SVG Symbols Collection

From any open library

Select MyKPI and Sensor Data for Synoptics cases

Instantiate as Custom Widgets / Synoptics Connect with WebSockets

Final Dashboard
From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensors

MyKPI

Sensor

[ ]

New Shared Variables

Constant Values
Select the Sensors and MyKPI to be used on Synoptics

Click

See listed and save them
Custom Widgets Templates

Snap4City (C), October 2020
## Instantiating a Custom Widget Synoptic

### Snap4City (C), October 2020

**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

---

### Snap4City GUI

<table>
<thead>
<tr>
<th>User: root</th>
<th>oadmin1, Org: DISIT, Note: Root Admin, Level: 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>My Snap4City.org</td>
<td></td>
</tr>
<tr>
<td>Dashboards</td>
<td></td>
</tr>
<tr>
<td>My Dashboards in All Org.</td>
<td></td>
</tr>
<tr>
<td>Dashboards of My Organization</td>
<td></td>
</tr>
<tr>
<td>My Dashboards in My Organization</td>
<td></td>
</tr>
<tr>
<td>Extra Dashboard Widgets</td>
<td></td>
</tr>
<tr>
<td>App</td>
<td></td>
</tr>
</tbody>
</table>

### New Synoptic

#### Synoptic

- **Template:** Activate in Time new SVC - Public - Antw.  
- **Name:**

#### Read variables

- **s4cag_Begin**
- **s4cag_Finish**

#### Write variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>s4cag_Begin</td>
<td></td>
</tr>
<tr>
<td>s4cag_Finish</td>
<td></td>
</tr>
</tbody>
</table>
Custom Dashboards and Widgets (interactive, Animations, etc.)

-- SVG for graphic design
-- MyKPI for collecting data

https://www.snap4city.org/504
Case 1
MyKPI Sensor
WS
WS

Case 2
WS
WS

Case 3
WS Server
New Shared Variables
2500 Msg/s
Case 1

Case 1 SVG ws3


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


40 messages per second
Dashboards’ Intelligence on Web and Mobile Devices
Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

IOT Applications

Dashboards and Apps

My IOT Devices

Big Data Analytics, Artificial Intelligence
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
Two Snap4City Libraries

Aug 2020 collection

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

Snap4City (C), October 2020

We suggest also to install:

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
Dashboard Chatroom
ChatRoom Per Dashboard

Chat Management
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’s 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: 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
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 management system for ticketing
  - video wall management,
  - etc. etc.
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), October 2020

Smart City IoT Platform Respecting GDPR Privacy and Security Aspects

CLAUDIO BADII, PIETREFRANCOSE BELLINI, ANGELO DIFINO, AND PAOLO NESI (Member, IEEE)
Department of Information Engineering, University of Florence, 50139 Florence, Italy
Corresponding author: Paolo Nesi (paolo.nesi@unifi.it)

This work was supported in part by the European Union’s Horizon 2020 Research and Innovation Program under Agreement 889396.

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 sensitive nature of some of these data, privacy and security aspects have to be taken into account by designers and developers. 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 Dashboards, 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 penetration 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/Things/Everything in the hands of public administrations and Living Labs, and selected a number of solutions. Consequently, at the end of the process of 3 years of work, Snap4City has been identified as the winning solution.

INDEX TERMS End-to-end, GDPR, IoT, security, smart city.

I. INTRODUCTION IoT (Internet of Things) is becoming a disruptive technology, especially for city users of metropolitan areas. The pervasiveness of IoT Devices, integrated in common objects, is becoming increasingly deeper. The addresses’ space for these devices would be enough to point any sensors of any devices at any moment without restrictions. Dense products that implement Low-Power Wide Area Networks (LPWAN) technologies for IoT introduced by SigFox and Semtech (LoRa, Long Range) have been gaining interest and have been under intense deployment campaigns worldwide [1]. At the same time, short-range IoT devices based on technologies such as IEEE 802.15.4 or Bluetooth Low Energy, BLE, [23] are sold in increasing quantities and are already able to support scenarios for smart homes, energy metering, and Industrial automation. On the other hand, the start of the diffusion of 5G devices and services is creating high expectations in networking IoT technologies, as the killer application of previous technologies in metropolitan areas.
Dashboards Listing, Managing, Sharing, Delegation
Dashboard List and Editor

Snap4City

User: root@oadmin1, Org: none
Role: DataAdmin, Level: 7

Dashboards

- My Dashboards
- Notification
- IOT Applications
- My Personal Data
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal
- KM4City portal
- DISIT Lab portal

New dashboard

DataCenter gas and smoke (mobile)

DataCenter gas and smoke (desktop)

DataCenter Energy Consumption

DataCenter gas and smoke (mobile)

DataCenter gas and smoke (desktop)

DataCenter Energy Consumption

Dashboard

DataCenter

DataCenter

DataCenter

DataCenter

Florence WiFi

Florence data overview

Leonardo - Smart city data 2

Leonardo - Smart city data 2

Leonardo - Smart city data 2

Leonardo Public

My data trends

My data trends

Notificator monitoring

Pisa Real Time Data

Real Time Sensors via ServiceMapID

DataFrame

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete

Edit
Management
Clone
Delete
Dashboard Listing and Features

- Edit
- Management
- Clone
- Delete
- (add Thumbnail is inside Edit)
Dashboard Management

• Change Ownership

• Public or Private

• Delegation access to other users

• Delegation Access to other Groups [Higher roles cross Organization]
Dashboard other features
Additional Properties from Edit Dashboard

- Embedding Dashboards into
  - a Dashboard
  - third Party Web Page
- Header or not
- Responsive or not
- Size
- Background Image
- Add / change Screenshot (Thumbnails)
- Chat or not
- Menu on left upper corner or not
- Pop Up Alarming when you need.
- ...etc..
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
Dashboard Pop Up
Alerting when needed
Dashboard Info 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==
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

Management

Ownership | Visibility | Delegations | Group Delegations

Dashboard: Smart Bench

Add new delegation
Delegated username

Delegated username can’t be empty

Current user delegations

<table>
<thead>
<tr>
<th>Delegated user</th>
<th>Remove</th>
</tr>
</thead>
<tbody>
<tr>
<td>comunedashres</td>
<td></td>
</tr>
</tbody>
</table>

Close
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

<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>Date 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 Pressure</td>
<td>Pressure</td>
<td>integer</td>
<td>6/29/2019, 7:59:53 AM</td>
<td>0</td>
<td>private</td>
<td>dist_comsumer</td>
<td>DELETE, UPDATE</td>
<td>VALUES, META DATA, CHANGE OWNERSHIP</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench Light</td>
<td>light</td>
<td>float</td>
<td>6/29/2019, 7:59:53 AM</td>
<td>0</td>
<td>private</td>
<td>dist_comsumer</td>
<td>DELETE, UPDATE</td>
<td>VALUES, META DATA, CHANGE OWNERSHIP</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench CO2</td>
<td>airQualityCO2</td>
<td>float</td>
<td>6/29/2019, 7:59:53 AM</td>
<td>412</td>
<td>private</td>
<td>dist_comsumer</td>
<td>DELETE, UPDATE</td>
<td>VALUES, META DATA, CHANGE OWNERSHIP</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench Total Sitings</td>
<td>totalSittings</td>
<td>integer</td>
<td>6/29/2019, 7:59:53 AM</td>
<td>0</td>
<td>private</td>
<td>dist_comsumer</td>
<td>DELETE, UPDATE</td>
<td>VALUES, META DATA, CHANGE OWNERSHIP</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>My KPI</td>
<td>Entertainment</td>
<td>Smart Bench</td>
<td>Smart Bench Total Transits</td>
<td>totalTransits</td>
<td>integer</td>
<td>6/29/2019, 7:59:53 AM</td>
<td>0</td>
<td>private</td>
<td>dist_comsumer</td>
<td>DELETE, UPDATE</td>
<td>VALUES, META DATA, CHANGE OWNERSHIP</td>
<td></td>
</tr>
</tbody>
</table>

**KPI Delegation Details**

**Username Delegated**

Insert Time | Controls
---|---

No data available in table

Showing 1 to 6 of the My KPI Delegation

First | Last
Management of MyKPI, MyPOI, ...

Snap4City (C), October 2020
Recalling Exercize number 3
Accessing Multiple Trajectories

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

Snap4City (C), October 2020
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.
Acknowledgements
DISIT Lab, Distributed Data Intelligence and Technologies
Department of Information Engineering (DINFO)
http://www.disit.dinfo.unifi.it
http://www.disit.org

Roadmap

Twitter Vigilance
Social Media Analytics, Sentiment Analysis
User engagement
Bike Sharing
Data Analytics ++
Social Predictions
OBD2
Sardinia Region
Smart City Strategies and plan

GHOST SIR
(2016-19)

IOT/IOE
Km4City 1.6.6
(2018-20)
- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

Km4City 1.6.4
(2016-21)
- Mobility Demand / Offer Analytics and Strategy

Km4City 1.6.2
(2016-21)
- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

Km4City 1.5
(2015-18)
- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.4
- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis

2013 Km4City Ontology 1.1
- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD
- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

2015

2016
FIWARE
- Infomobility
- Mobile App
- Routing
- Multimodality

2017
GREEN IMPACT
POR FESR 2014-2020
- Industry 4.0
- Critical Plant
- Monitoring

2018
- IOT/IOE, IOT App
- Living Lab
- Maker Support
- IOT Edge
- Smart City IOT
- GDPR,
- Privacy & Security

2019
- Smart Lonato
- PCP Award
- Smart Waste

2020
- Smart Mobility
- 6 Pilots
- Data Analytics
- Extended platform
- Smart Tourism

2021
- CAPELON
- Sweden
- Smart Mobility
- PISA, PUMS
- Living lab

2022
- CEF
- TRAFAIR (2018-21)

5G tech
Energy
Industry 4.0
Synoptics

IOT/IOE
SII
- MOBILITY SCN
(2016-21)

H2020
- Traffic and Mobility Impact on Pollution
- NOX predictions

H2020
(2016-21)
- Mobility Demand / Offer Analytics and Strategy

CEF
SIF
- Smart Bed
- Industry 4.0

H2020
(2018-20)
- Mobility Demand / Offer Analytics and Strategy

H2020
POR FESR 2014-2020
- Industry 4.0
- Critical Plant
- Monitoring

H2020
(2017-19)
- Sardinia Region
Smart City Strategies and plan

SNAP4City
H2020
(2018-20)
- Smart Health
- Industry 4.0

CEF
SIF
- Smart Lonato
- PCP Award
- Smart Waste

2019
- GREEN IMPACT
- Industry 4.0
- Critical Plant
- Monitoring

2020
- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis

2015
- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD
- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

2013 Km4City Ontology 1.1
Main running projects

- Sii-Mobility → mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFAIR → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart Garda Lake → Castelnuovo del Garda
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant
- SmartBed (laid) → smart health
- Green Field Peas (soda) → Industry 4.0, Chemical plant
- 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

Snap4City (C), October 2020
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.
DISIT thanks to

Herit Data: Tourism and Mng.  https://herit-data.interreg-med.eu/
Snap4City: IOT/IOE smart city  www.snap4city.org
Trafair: CEF project with several Cities  http://trafair.eu/
Mosaic: Mobility and transport model
Km4City:  http://www.km4city.org
REPLICATE H2020, SCC1, EC flagship  http://replicate-project.eu/
Sii-Mobility SCN MIUR:  http://www.sii-mobility.org
Feedback: retail and GDO Big Data analytics
5G with 3G-Wind, Open Fiber, Estra
Coll@bora Social Innovation, MIUR:  http://www.disit.org/5479
RESOLUTE H2020, EC:  http://www.resolute-eu.org
TRACE-IT, RAISSS, TESYSRAIL, ...
Mobile Emergency:  http://www.disit.org/5404
Further readings

- HOW TO: create a Dashboard in Snap4City
- HOW TO: add a device to the Snap4City Platform
- HOW TO: add data sources to the Snap4City Platform
- HOW TO: define privacy rules for personal data, produced by the end-users' own device
- HOW TO: Develop Smart Applications, Snap4City development Life Cycle
- HOW TO: HLT vs Ingestion, and HLT vs Widgets
- HOW TO: Develop an IOT Application for Data Ingestion
- HOW TO: Upload data into Knowledge Base, ServiceMap (triple upload)
- HOW TO: Create a set of Devices with BulkProcessing
- HOW TO: Create an IOT Device Model
- HOW TO: Create an IOT Device Instance from IOT Directory tool