100% OPEN SOURCE

EU GDPR COMPLIANT

PEN Test Passed

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SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Node-RED

SNAP4CITY

KM4CITY

SNAP4 Appliances and Dockers Installations

Be smart in a SNAP!

LIVING LAB

How to Design and Develop Smart Solutions

October 2022, Course
https://www.snap4city.org/577

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DEPARTMENT OF INFORMATION ENGINEERING | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

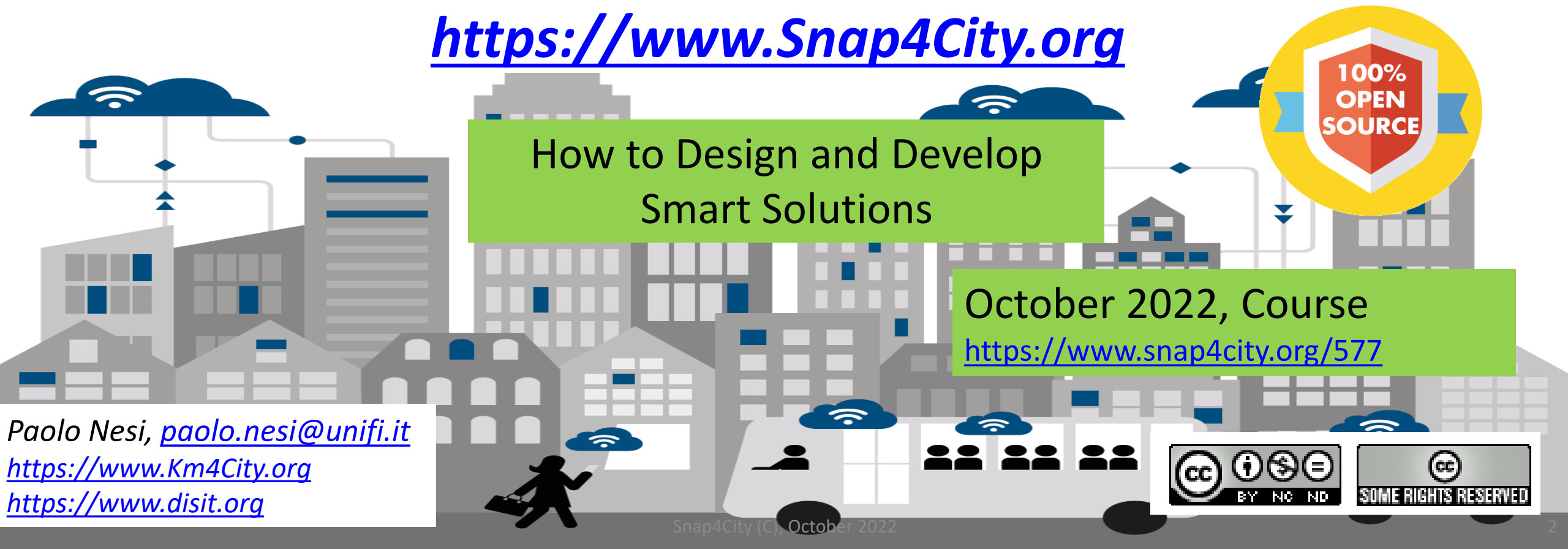
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

Powered by KM4CITY

scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders

https://www.Snap4City.org



How to Design and Develop Smart Solutions

October 2022, Course
https://www.snap4city.org/577

Paolo Nesi, paolo.nesi@unifi.it
https://www.Km4City.org
https://www.disit.org

ATTENTION!!!

- *These slides are only a overview of the training course of Snap4City, Snap4Industry, Snap4Tech.*
- *Full training course access to dedicated web page, slide, video, documents and on line documentation which are reporting many more details, examples and functionalities.*

On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App
PDF							
Interactive							
Video1							
Video2							
Video3							
Video4				none		none	none
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47

https://www.snap4city.org/577

Snap4City Platform

Technical Overview

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

Snap4City:

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

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

- Phone: +39-335-5668674
- Linkedin: https://www.linkedin.com/in/paolo-nesi-849ba51/
- Twitter: https://twitter.com/paolonesi
- FaceBook: https://www.facebook.com/paolo.nesi2

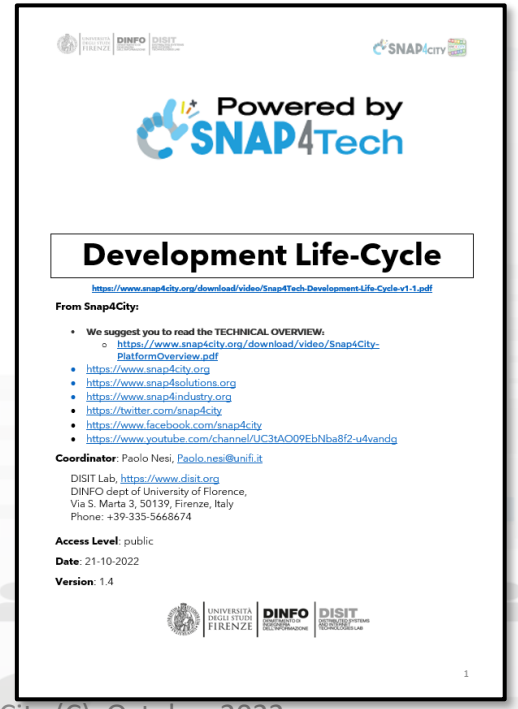
Access Level: Public.

Date: 05-04-2021

Version: 5.3

1

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



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Development Life-Cycle

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

From Snap4City:

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

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

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

Access Level: public

Date: 21-10-2022

Version: 1.4

1

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

https://www.snap4city.org/577

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Video1							
Video2							
Video3							
Video4				none		none	none
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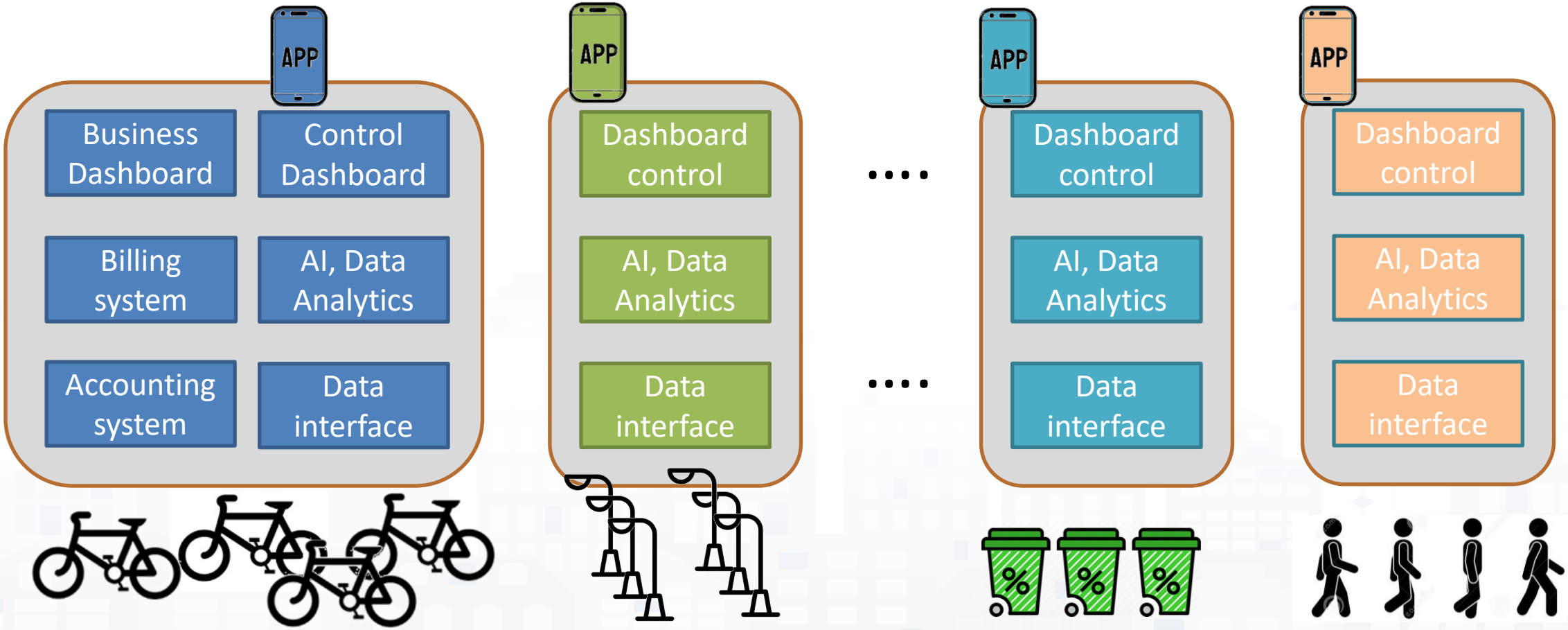
Avoiding to have a collection of verticals



Simplifying the development and integration of verticals

100% OPEN SOURCE

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FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

SNAP4CITY KM4CITY

SMART SOLUTIONS AND DECISION SUPPORT SYSTEMS

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

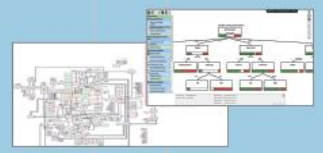
DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING

DASHBOARDS, WIDGETS
TEMPLATES

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

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

ANY: DATA, BROKER, NETWORK AND VERTICAL



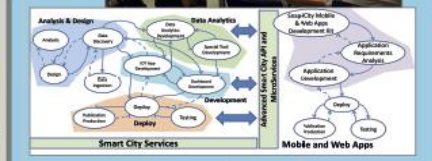
EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE

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

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

Native and External Applications

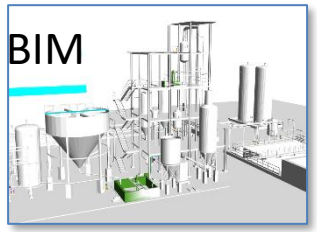
- Smart Parking
- Smart Light
- Smart Waste
- Smart Energy
- Social Media Analysis
- ...



METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS

Concept

BIM

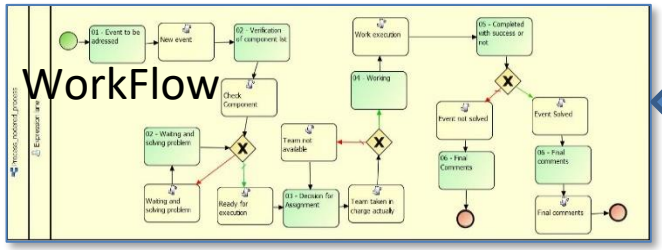


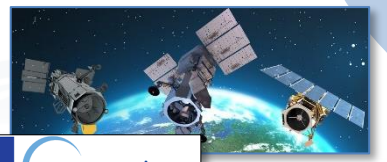
KPI, POI, MyKPI, …

API, External Services

Web Scraping

WorkFlow

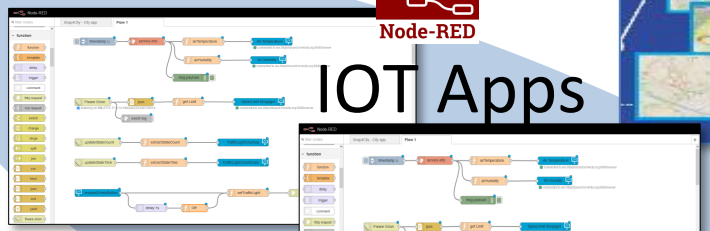




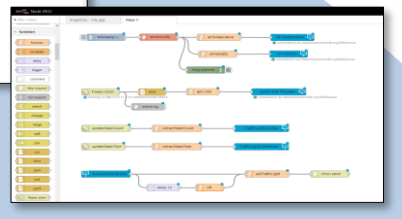
opernicus
Europe's eyes on Earth

Node-RED

IOT Apps



Data Analytics,
Artificial Intelligence



IOT Brokers

IOT Broker

IOT Broker

ckan

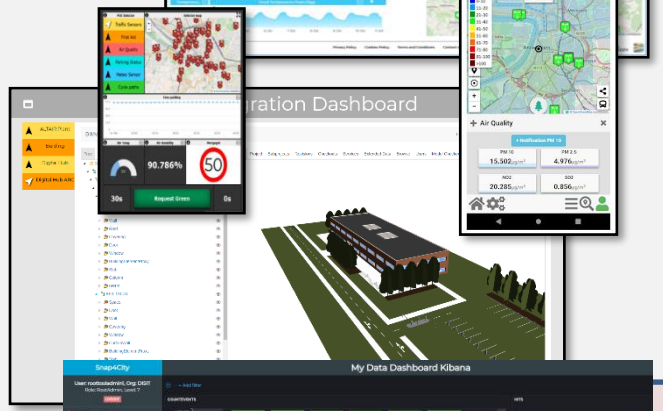
FIWARE

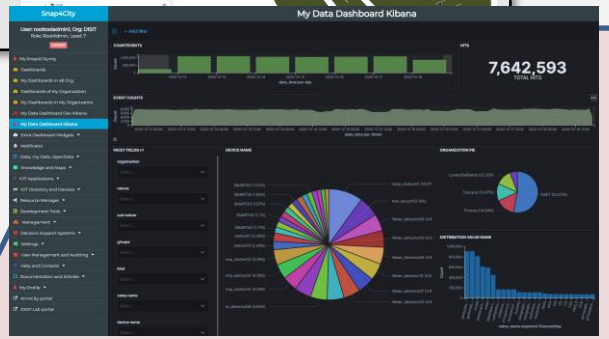
GIS

Big Data

KB

LD, LOD

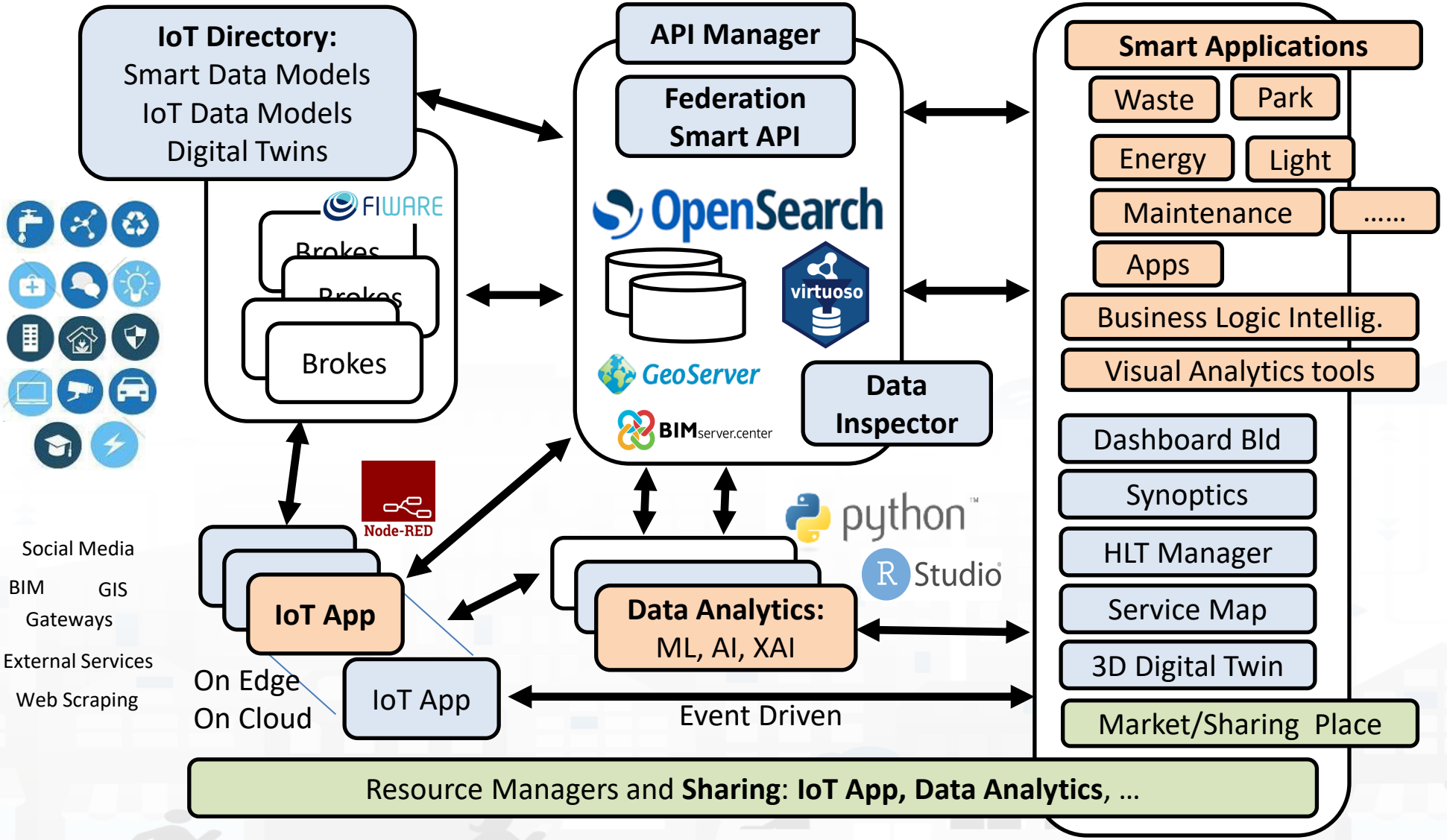




Dashboards and Apps

FI-WARE

Tech Arch


IoT Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokes
Brokes
Brokes
API Manager
Federation
Smart API
OpenSearch
virtuoso
GeoServer
BIMserver.center
Data
Inspector
Smart Applications
Waste
Park
Energy
Light
Maintenance
.....
Apps
Business Logic Intellig.
Visual Analytics tools
Dashboard Bld
Synoptics
HLT Manager
Service Map
3D Digital Twin
Market/Sharing Place
Node-RED
python
R Studio
Social Media
BIM
GIS
Gateways
External Services
Web Scraping
IoT App
IoT App
On Edge
On Cloud
Data Analytics:
ML, AI, XAI
Event Driven
Resource Managers and Sharing: IoT App, Data Analytics, ...

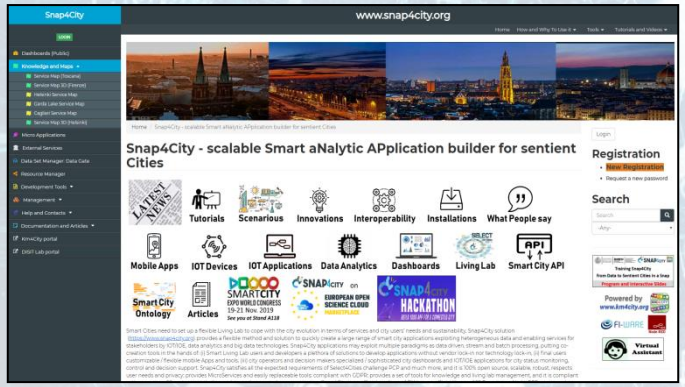
Principles

- **Smart Applications can be easily developed exploiting the cloud infrastructure by producing only:**
  - **IoT App** with almost no coding activities
  - **Data Analytics** in Python or Rstudio
  - **Dashboards** with almost no coding activities.
- **→ Orange parts of the previous figure slide are those usually developed,**
  - all the rest, is part of the provided microservices and infrastructure.

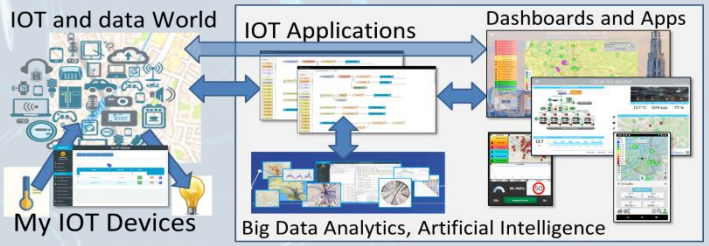
- **Third party applications can dialog with the solutions via**
  - **Smart City API**, Swagger: https://www.km4city.org/swagger/external/
  - **IoT Brokers**, for example for NGSI Orion Broker: https://www.km4city.org/swagger/external/?urls.primaryName=Orion%20Broker%20K1-K2%20Authentication%20API
  - **IoT App** any protocols: https://www.snap4city.org/65 They can also expose some specific API, custom made

How to adopt Snap4City

Https://www.snap4city.org



On your premise



Smart City as a Service

- Supporting Org
- 100% Open Source Platform: Github
- Further developments
- Publishing Appliances and Dockers
- Training courses, docs
- Consulting
- Forums
- Etc.

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Download and deploy

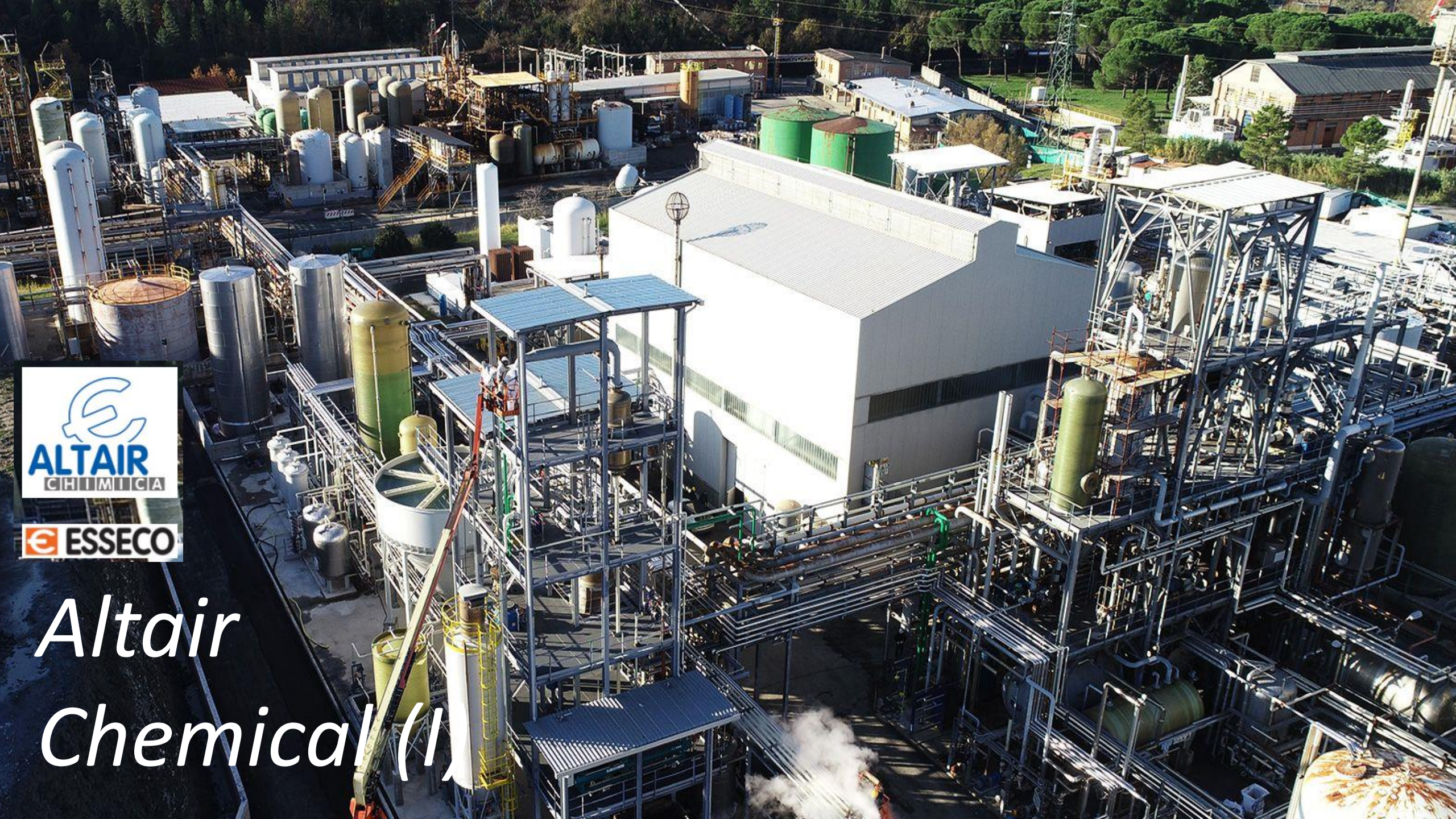
Installation on your premise

- **Virtual Machines or Dockers**
- Different configurations
  - From small to scalable
  - Exploiting your legacy tools
  - Interoperable with any tool
- No vendor lock-in, No tech lock-in

Mixed solutions! For example:

- Start on Cloud as Smart City as a Service
  - Migrate on premise on the fly
- Start on Cloud into a sand box
  - Pass to install on premise what you need

Achitectural example



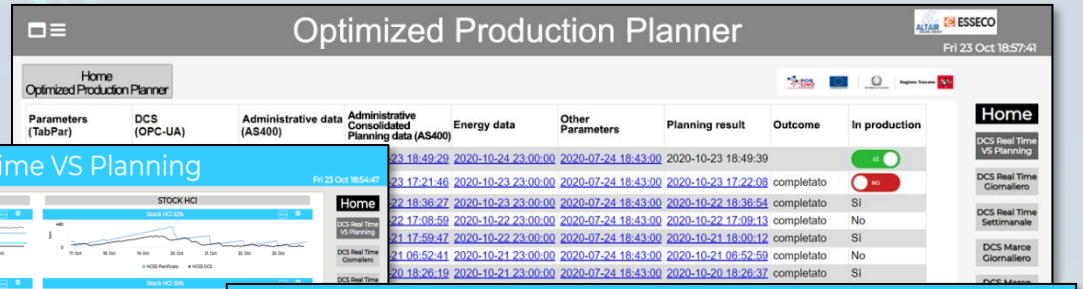
Altair Chemical (I)

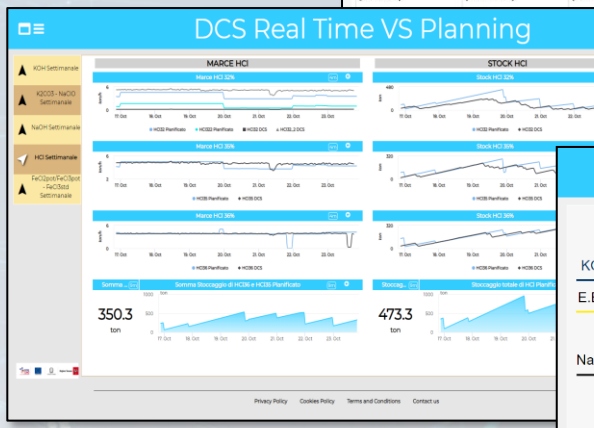
Snap4Altair Decision Support supervision and control, Industry 4.0

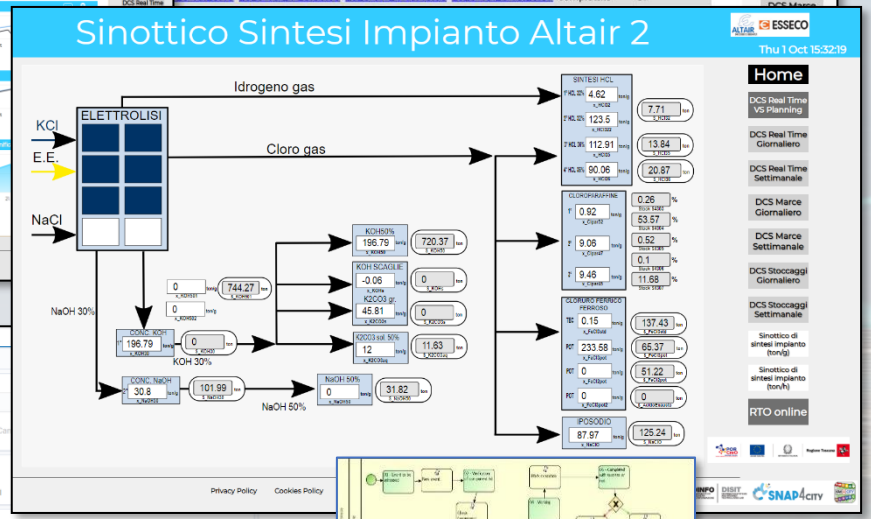
ALTAIR CHIMICA
ESSECO

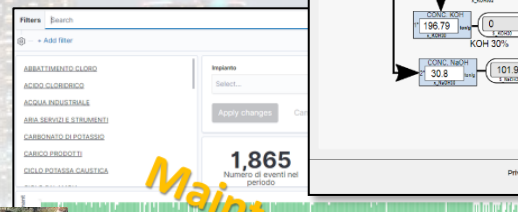
SNAP4INDUSTRY reference

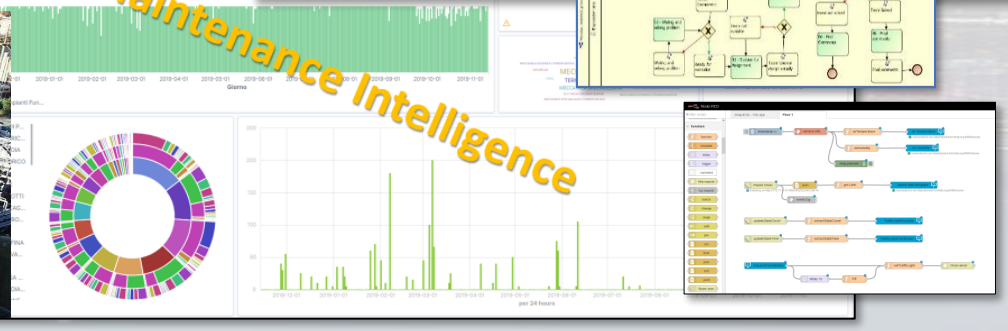
- **Multiple Domain Data**
  - Distributed Control System: energy, flows, storage, chemical data, settings, ..
  - Cost of energy, Orders,
  - Production Parameters
  - Maintenance data
- **Multiple Levels & Decision Makers**
  - Optimized planning on chemical model
  - Business Intelligence on Maintenance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





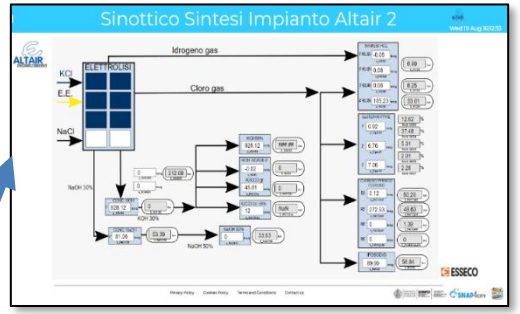






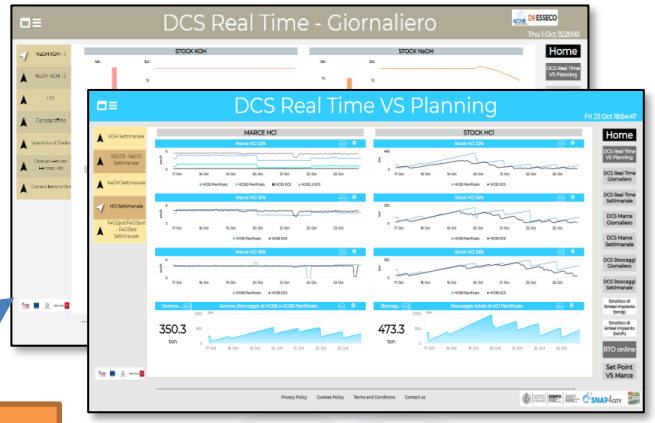
Plant Status

Production Plan



Real Time Production Synoptic

Production vs Planning



Data Storage

Decision Support

AS400

Orders

Data Ingestion

Energy Service

Transportation

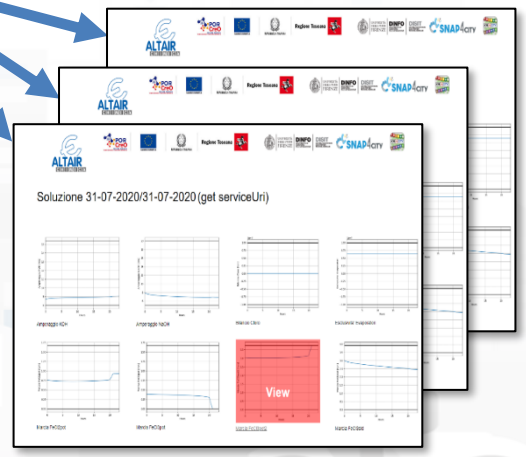
Other Costs

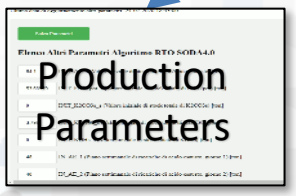
Production Plant Management

Optimized Production Planner

Possible Plan

Possible Plans

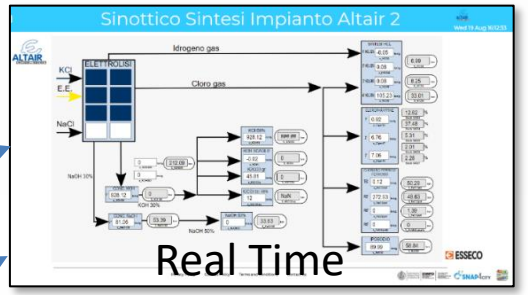




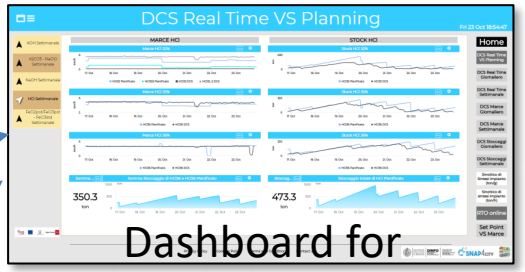
Plant Management

Solution

Plant Status

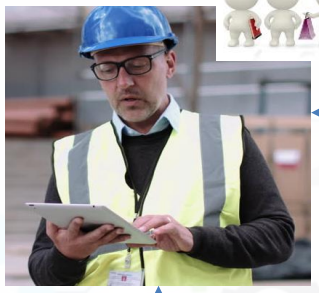


Real Time Production Synoptic



Dashboard for Production Control

Control Supervisor

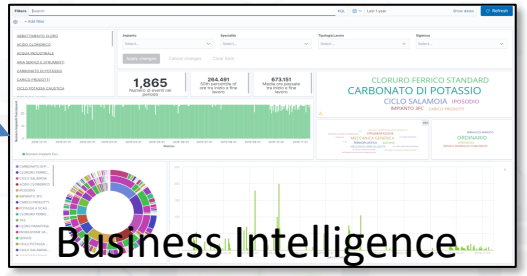


Business Logic

IoT App

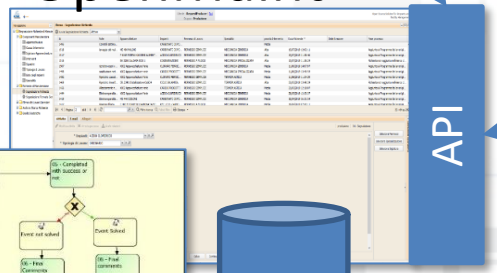
Data Storage

Elastic Search

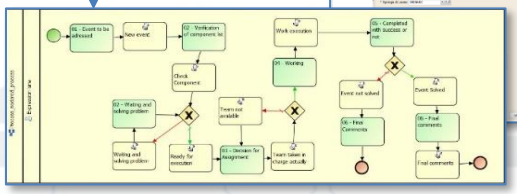


Business Intelligence Maintenance

OpenMaint



API



IoT App

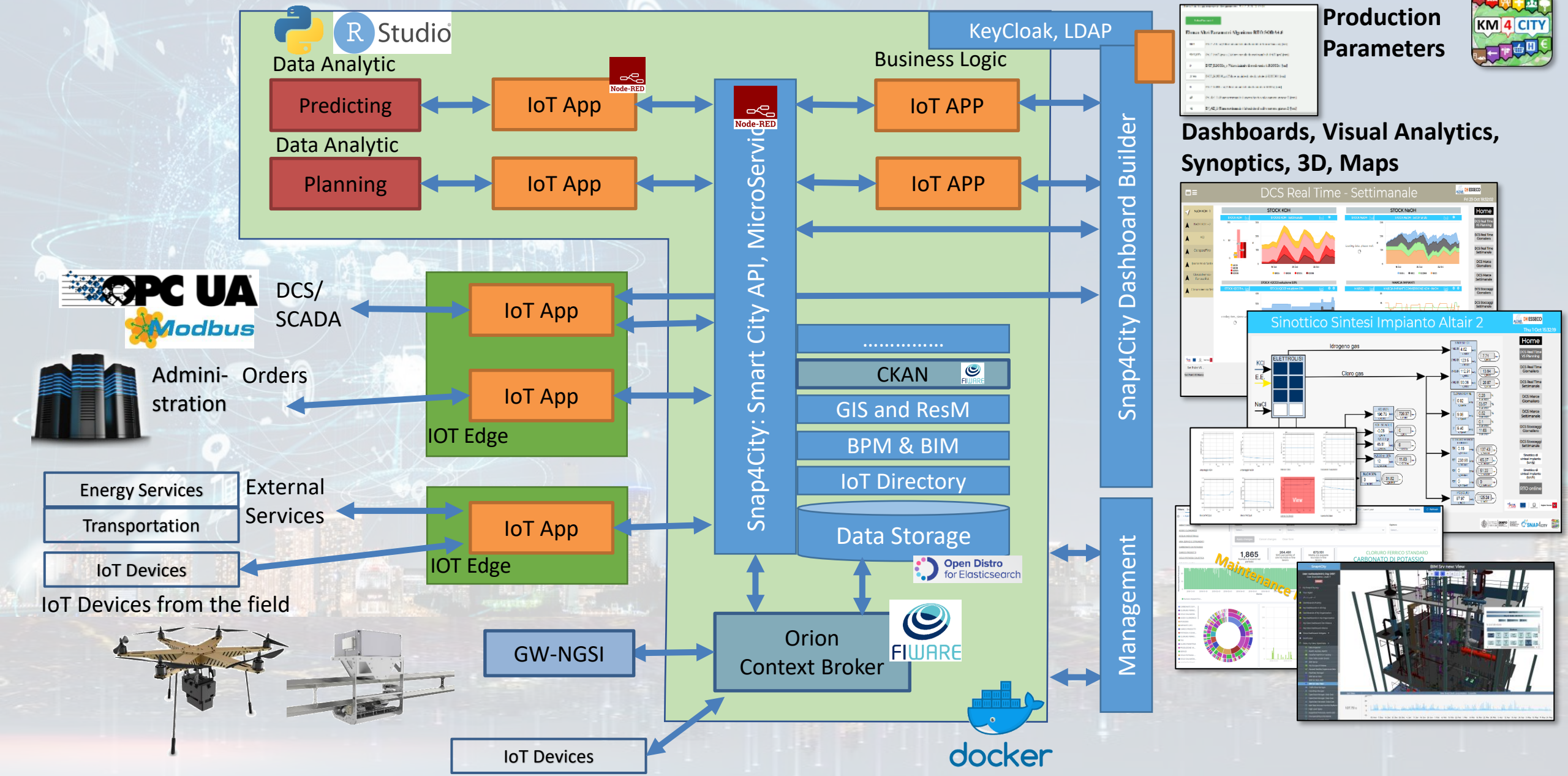
IoT App

Business Logic 2

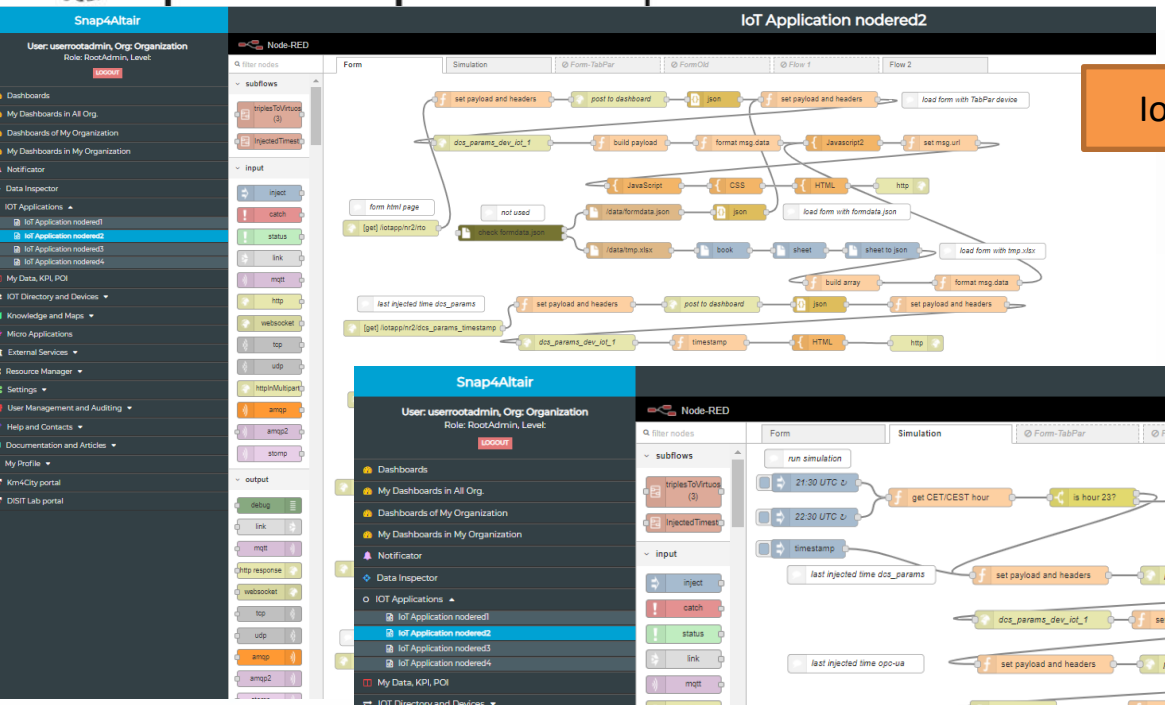
Predictive Maintenance

Predictive Training

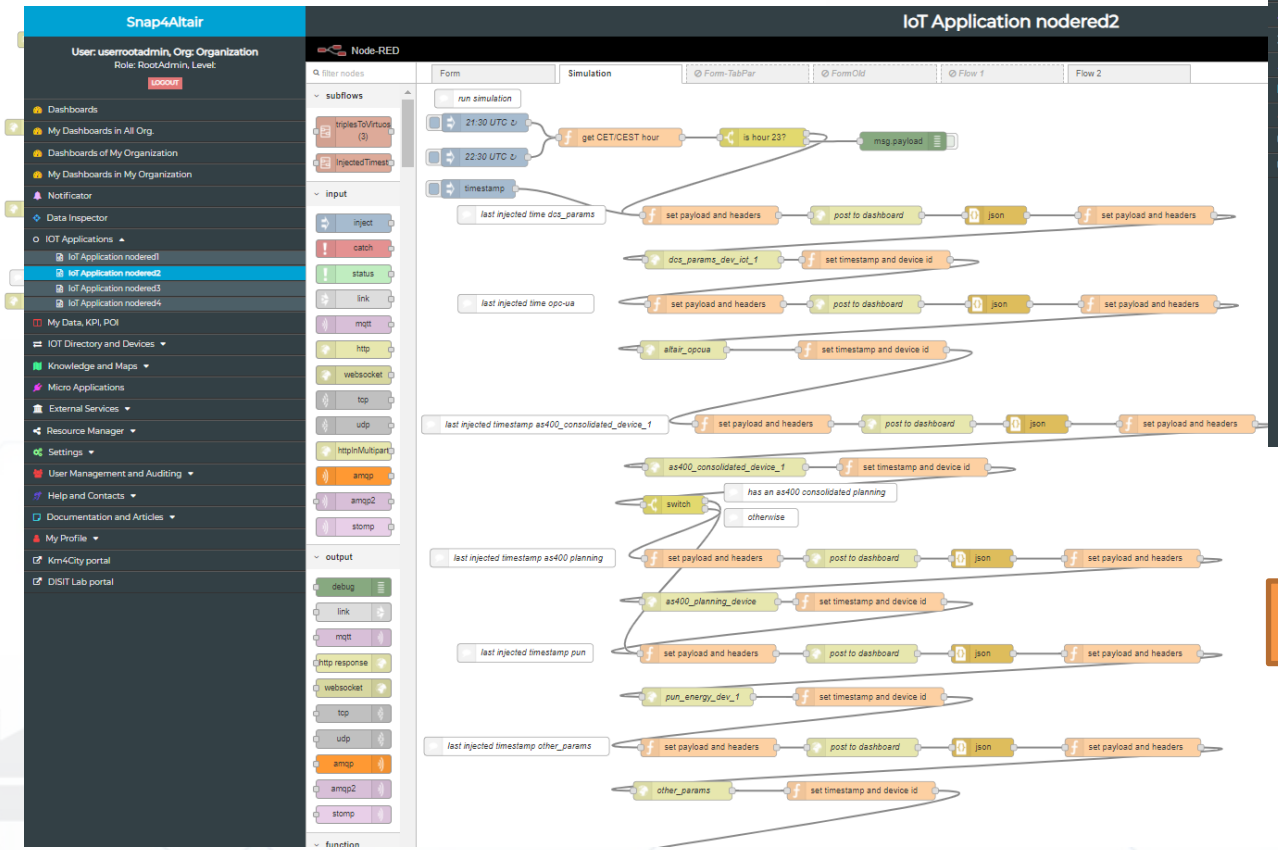
Snap4City/Industry Detailed Architecture

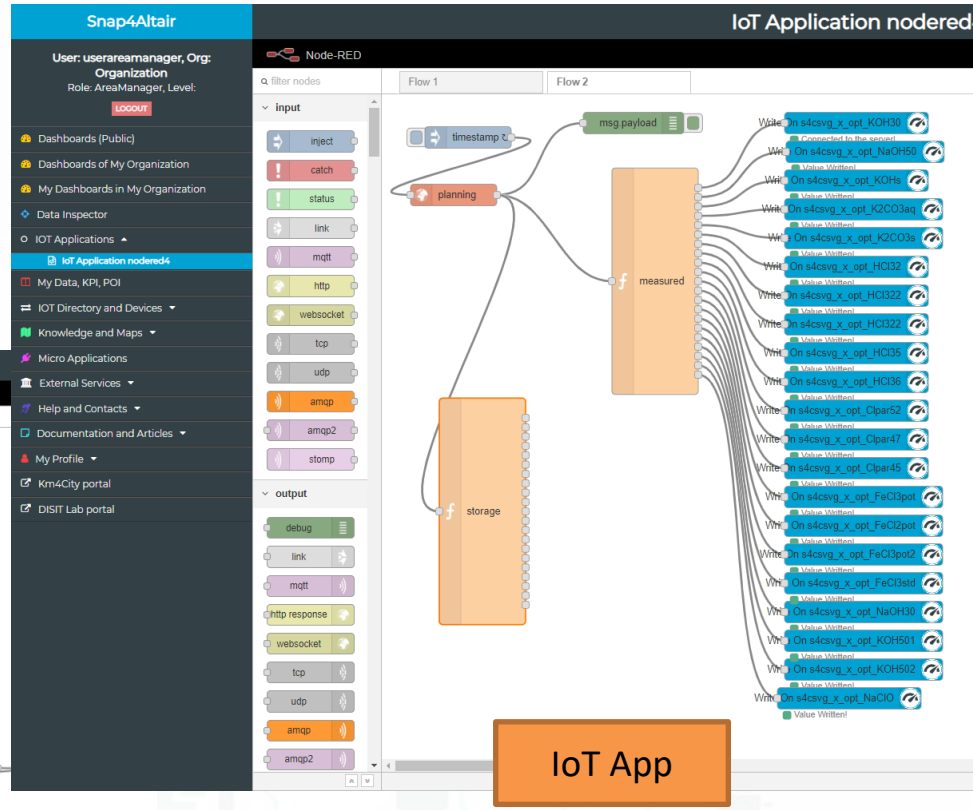


Some Flows



IoT App

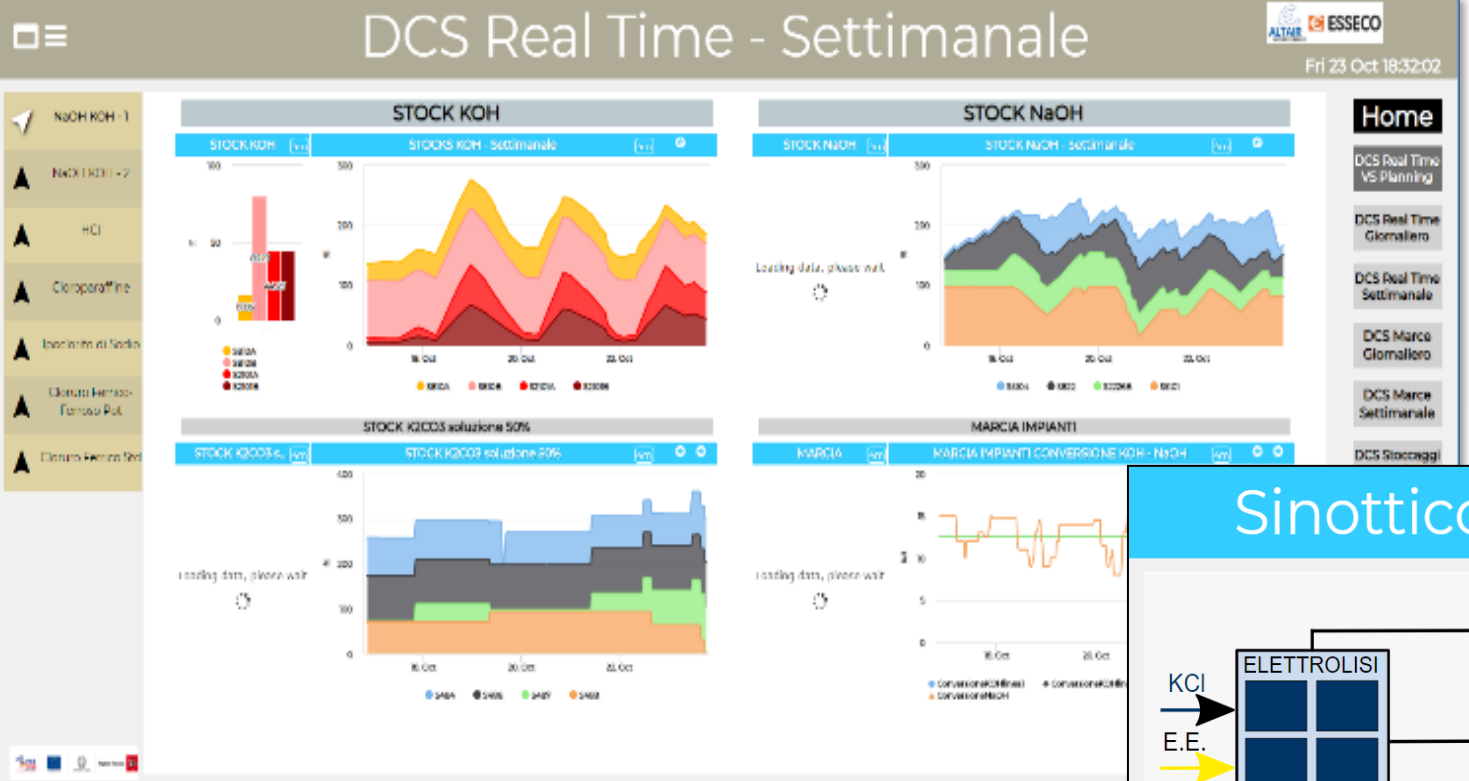




IoT App

IoT App

DCS Real Time - Settimanale



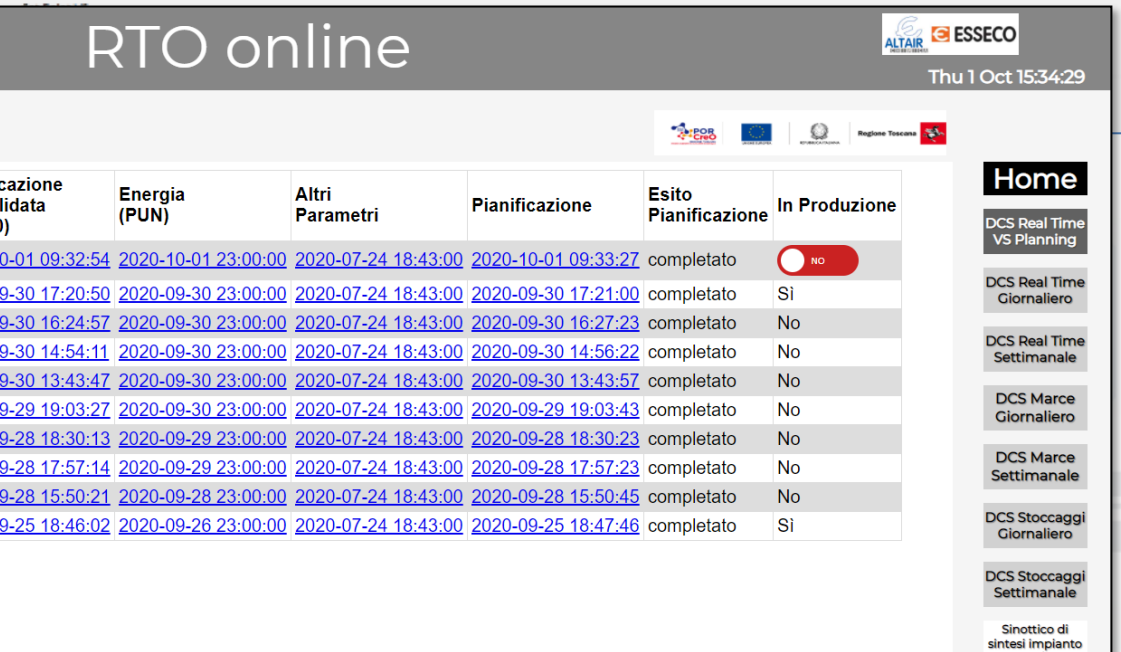
ALTAIR CHIMICA ESSECO

SNAP4INDUSTRY KM4CITY

Planning

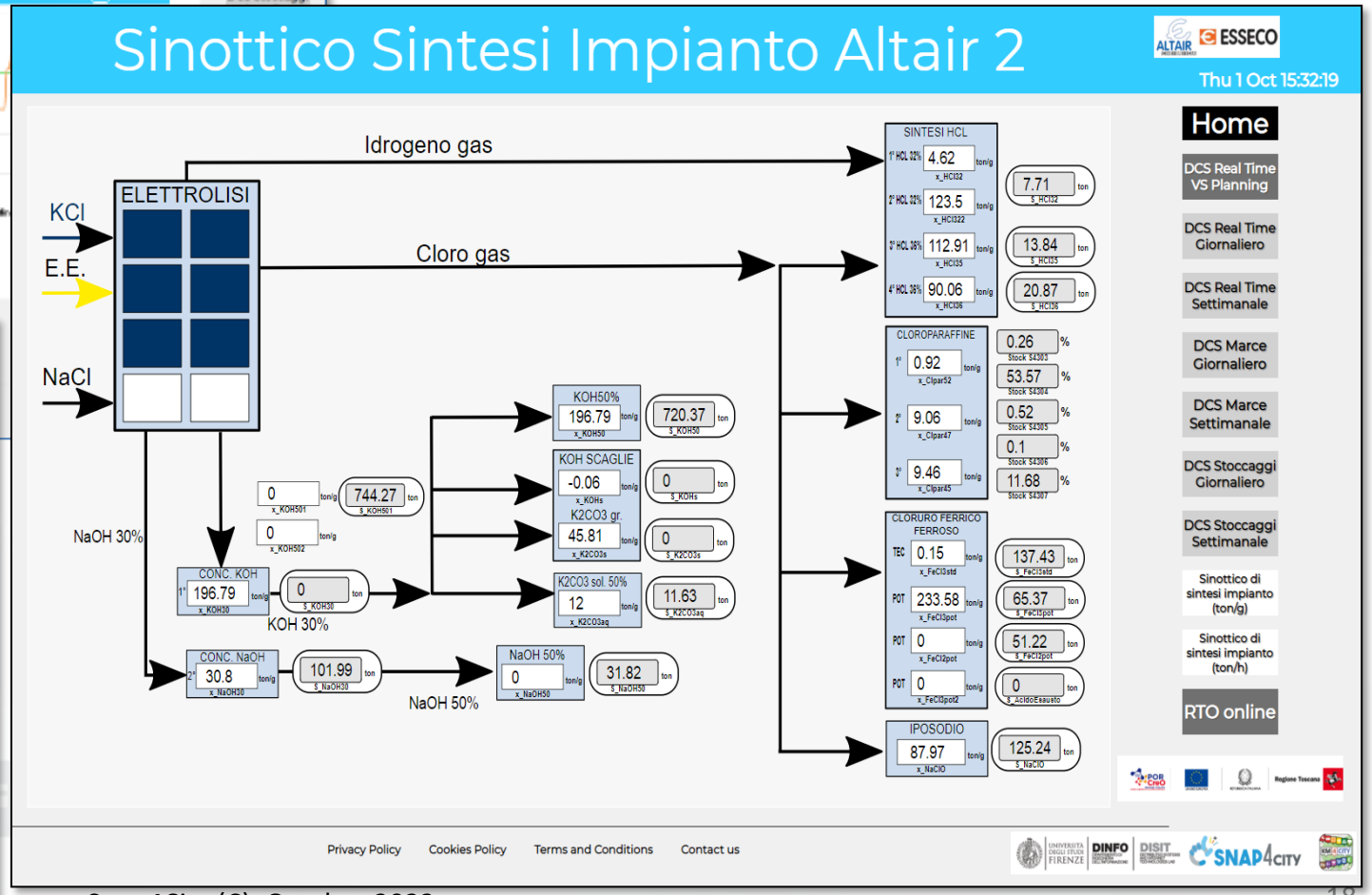
SNAP4ALTAIR

RTO online

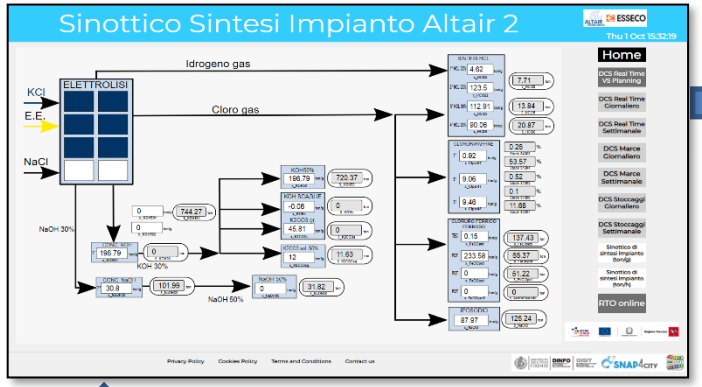


cazione lidata)	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
0-01 09:32:54	2020-10-01 23:00:00	2020-07-24 18:43:00	2020-10-01 09:33:27	completato	NO
9-30 17:20:50	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 17:21:00	completato	Sì
9-30 16:24:57	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 16:27:23	completato	No
9-30 14:54:11	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 14:56:22	completato	No
9-30 13:43:47	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 13:43:57	completato	No
9-29 19:03:27	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-29 19:03:43	completato	No
9-28 18:30:13	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 18:30:23	completato	No
9-28 17:57:14	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 17:57:23	completato	No
9-28 15:50:21	2020-09-28 23:00:00	2020-07-24 18:43:00	2020-09-28 15:50:45	completato	No
9-25 18:46:02	2020-09-26 23:00:00	2020-07-24 18:43:00	2020-09-25 18:47:46	completato	Sì

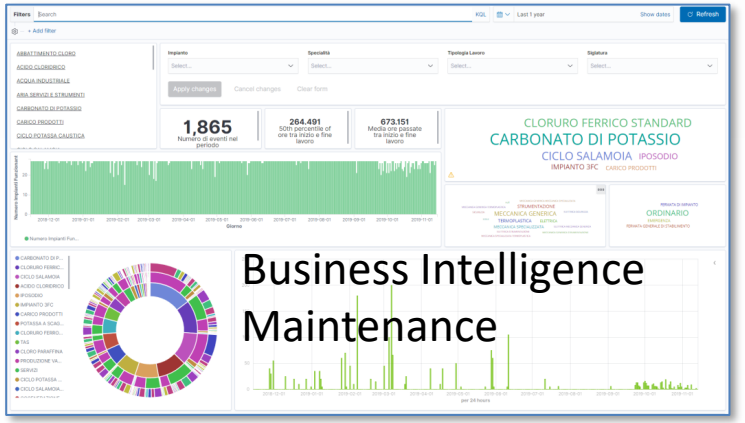
Sinottico Sintesi Impianto Altair 2



Workflow for Ticket management



Consumptions/productions

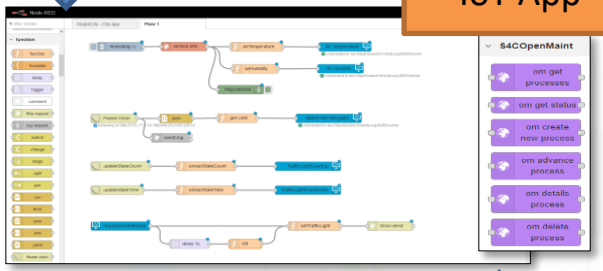


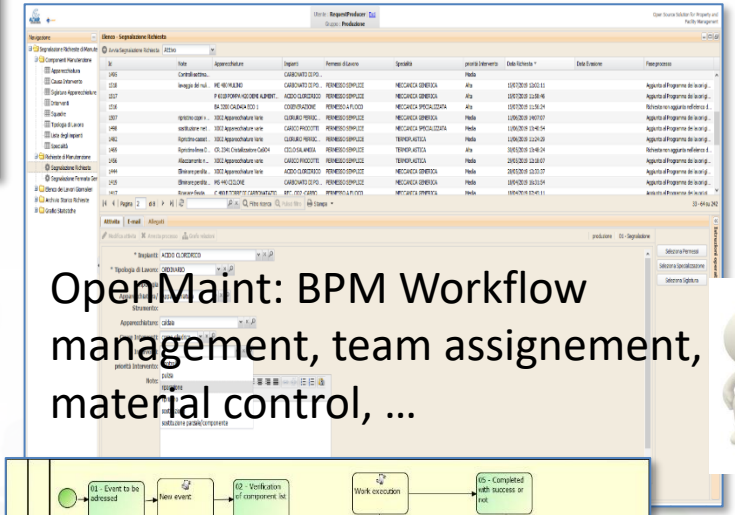
Events/actions

Business Intelligence
Maintenance

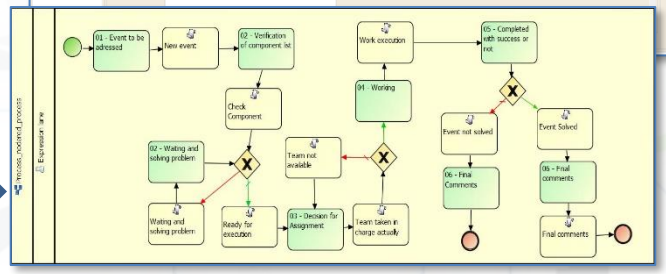
Dashboards and actions

IoT App

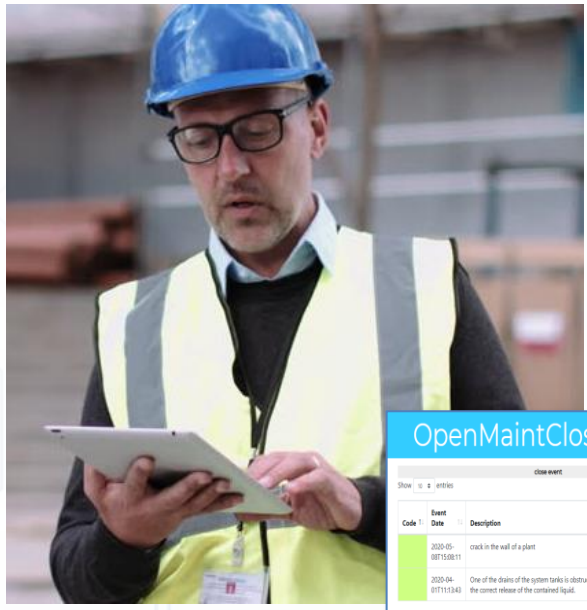


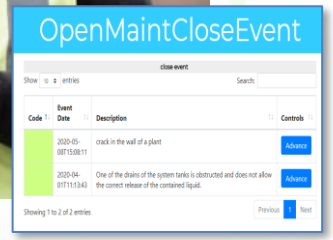


OpenMaint: BPM Workflow management, team assignement, material control, …

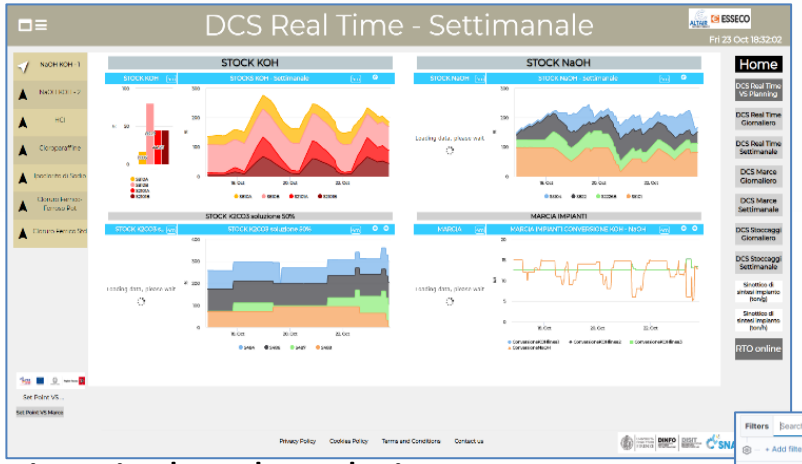


IOT App, Data event firing, event detection and firing Critical event management

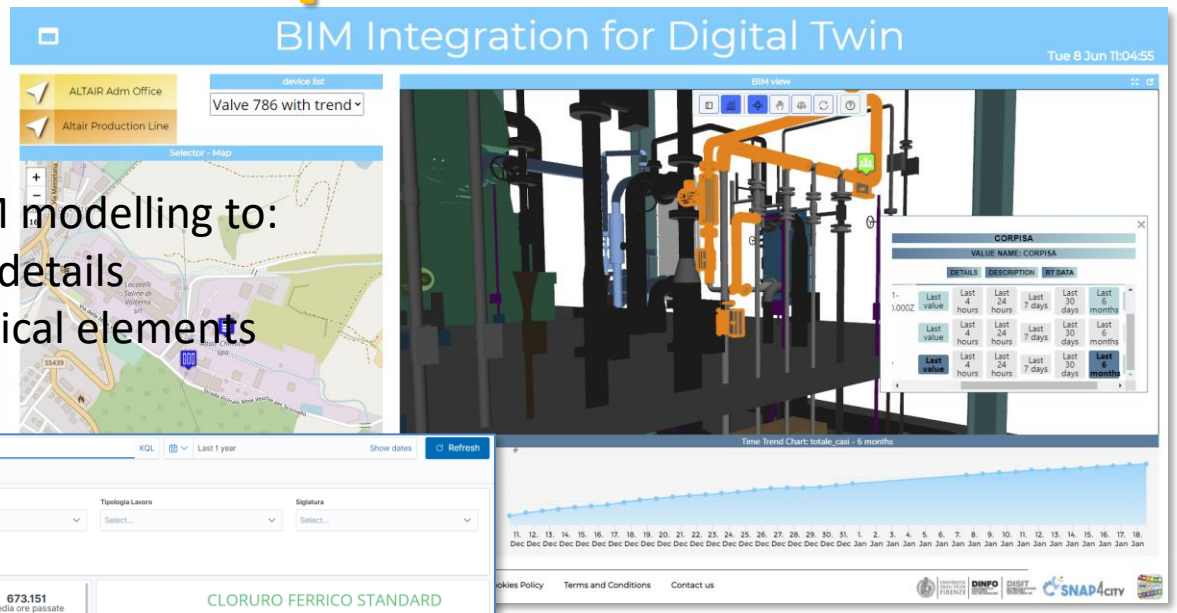




Closing the loop

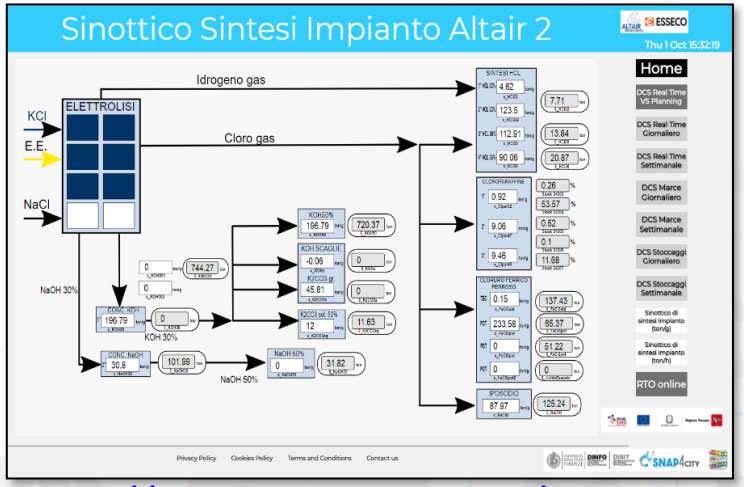


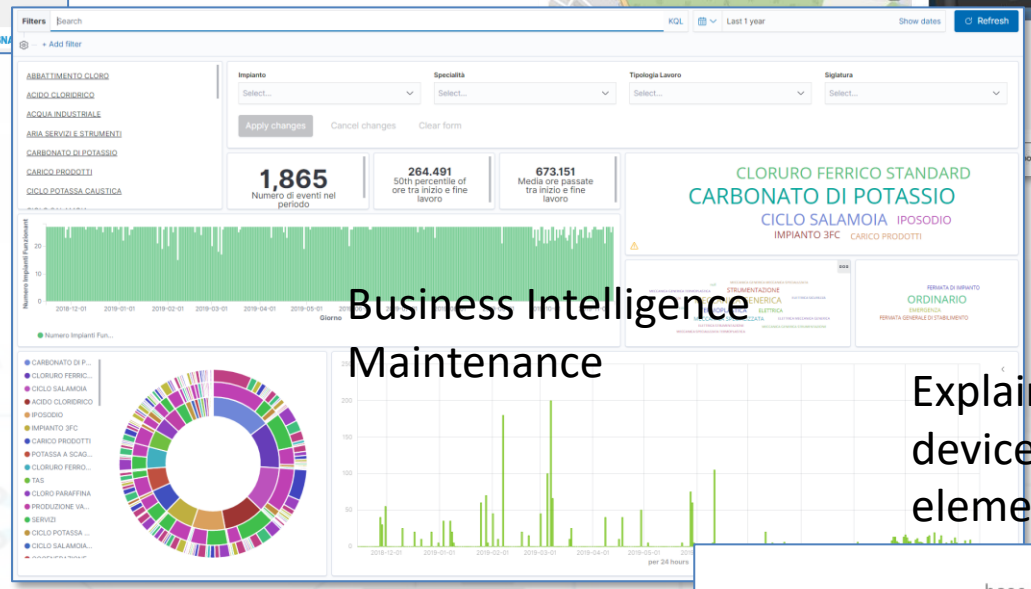
Historical and Real Time Data



Map and 3D BIM modelling to:
-- represent the details
-- associate physical elements with data

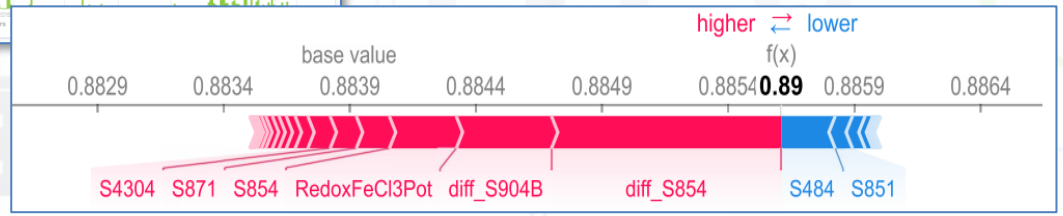
Synoptics for real time monitoring





Business Intelligence Maintenance

Explainable AI to map critical values of devices and detection to physical elements in the plant

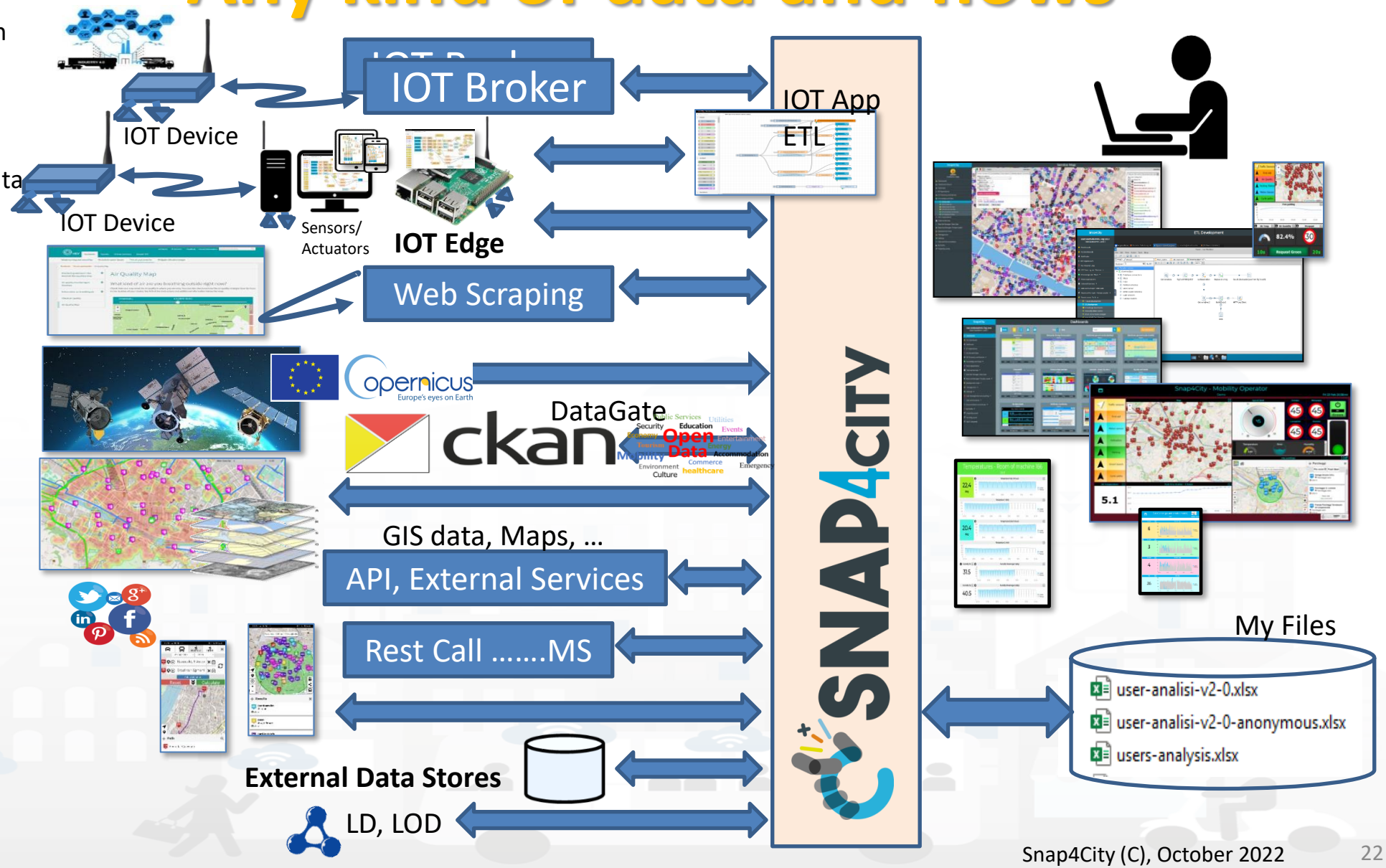


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

Snap4City: Protocols and Data Models Interoperability

Any kind of data and flows

- **Open Data:**
  - Data gate, federation of Open Data Portals
  - IOT App, ETL proc(PULL)
- **IOT Networks:**
  - IOT Application processes, data driven or PULL
  - IOT Brokers (Push) → IOT Shadow
- **Web Pages:**
  - Web scraping, crawling processes
- **Satellite data**
- **Social media: Twitter, Facebook,..**
  - Twitter Vigilance, IOT App
- **Mobile Apps**
  - Smart City API
- **Files upload: CSV, Excel, etc.**
  - IOT Applications, ETL
- **REST API, WS, FTP, LD, LOD, etc.**
  - IOT Applications, ETL
- **Data base accesses**
  - GIS: WFS, WMS
  - ETL, IOT Application



Standards and Interoperability (9/2022)

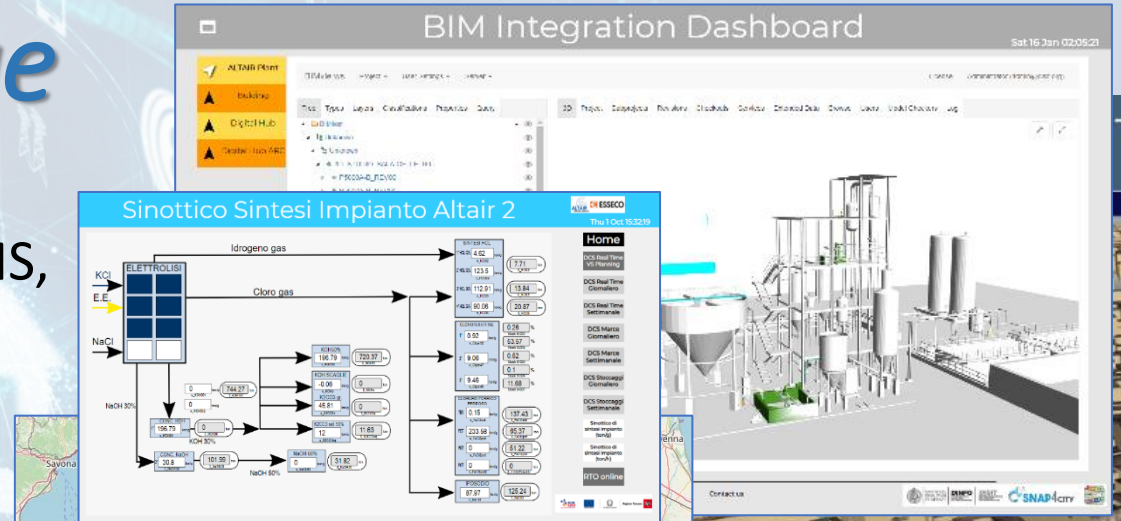
Compliant with:

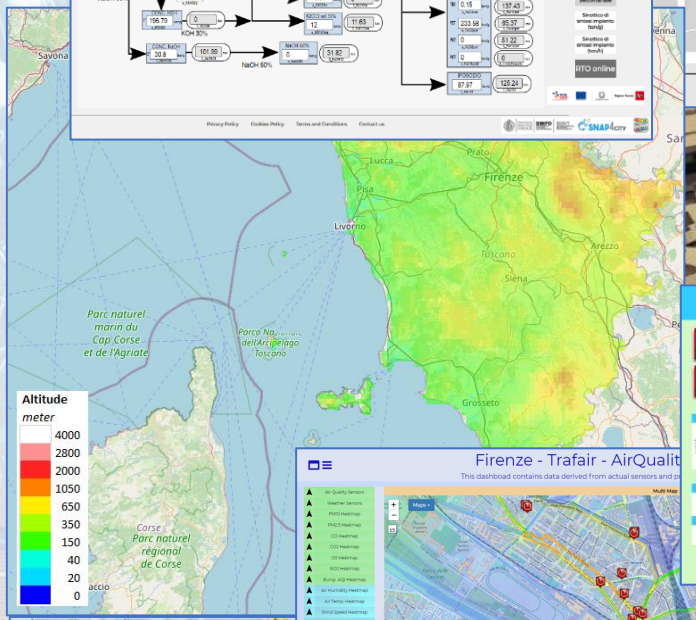
- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models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

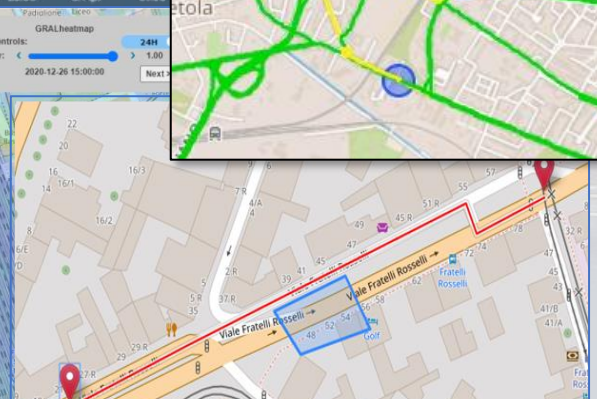
https://www.snap4city.org/65

Data Type Coverage

- POI, IOT Devices, shapes,..
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D, BIM, ..
- Dynamic icons/pins, ..
- OD Matrices of several kinds, ..
- Synoptics, animations, ..
- KPI, personal KPI,..
- social media data,
- routing, multimodal, constraints,
- decision scenarios, ….
- prediction models, ….
- etc.

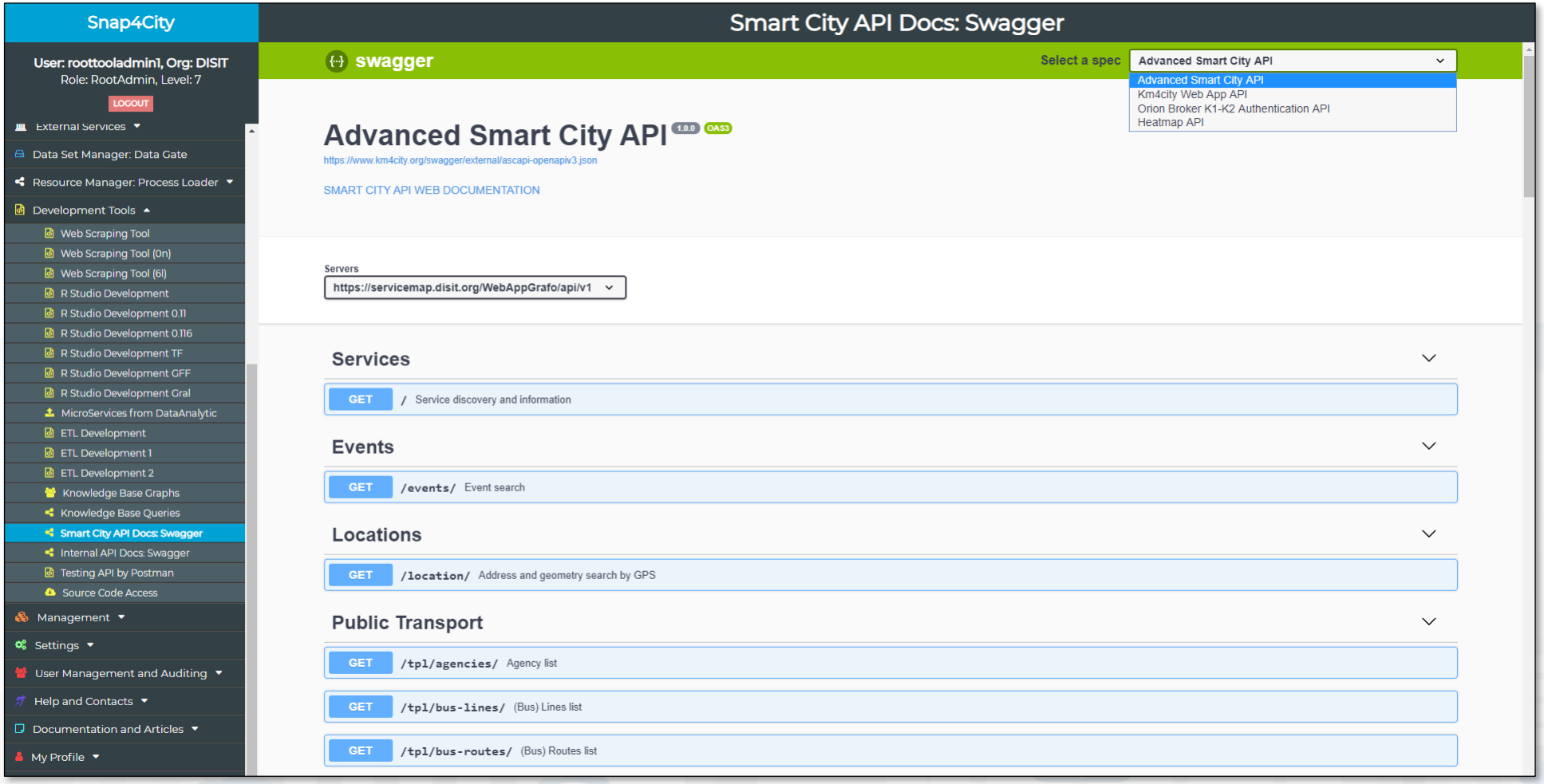






Snap4City (C), October 2022

External Smart City API



https://www.km4city.org/swagger/external/index.html

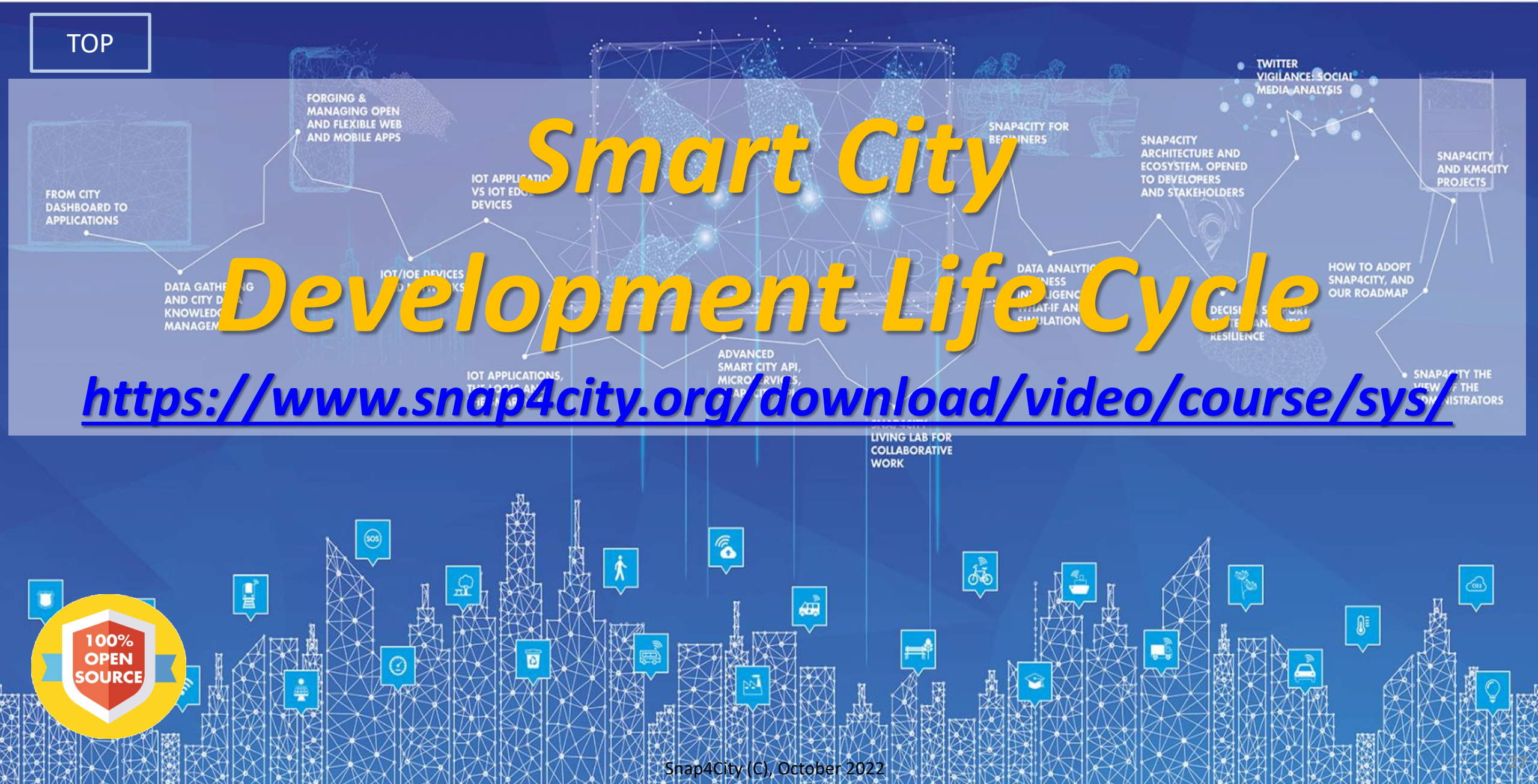
Authentication and SSO

- **Authentication in Snap4Tech is based on KeyCloak which is based on SAML, https://auth0.com/blog/how-saml-authentication-works/**
- **Different Versions of interoperability Authentication and Single Sign On, SSO**, are available on demand, with
  - **Spid**, Public Digital Identity System, https://www.spid.gov.it/en/
  - **EIDAS** (electronic IDentification Authentication and Signature), http://www.agid.gov.it/en/platforms/eidas, https://digital-strategy.ec.europa.eu/en/policies/eidas-regulation
  - **CIE, Electronic Identity Card https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-digital-identity_en**
  - **RealMe** NZ, https://www.realme.govt.nz/

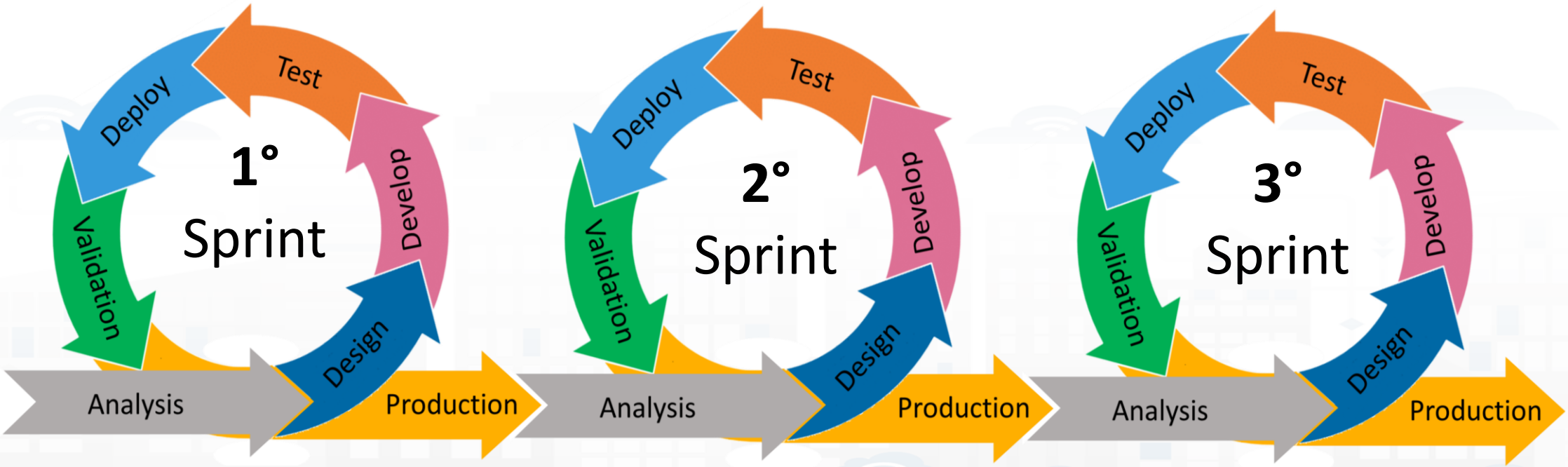
TOP

Smart City Development Life Cycle

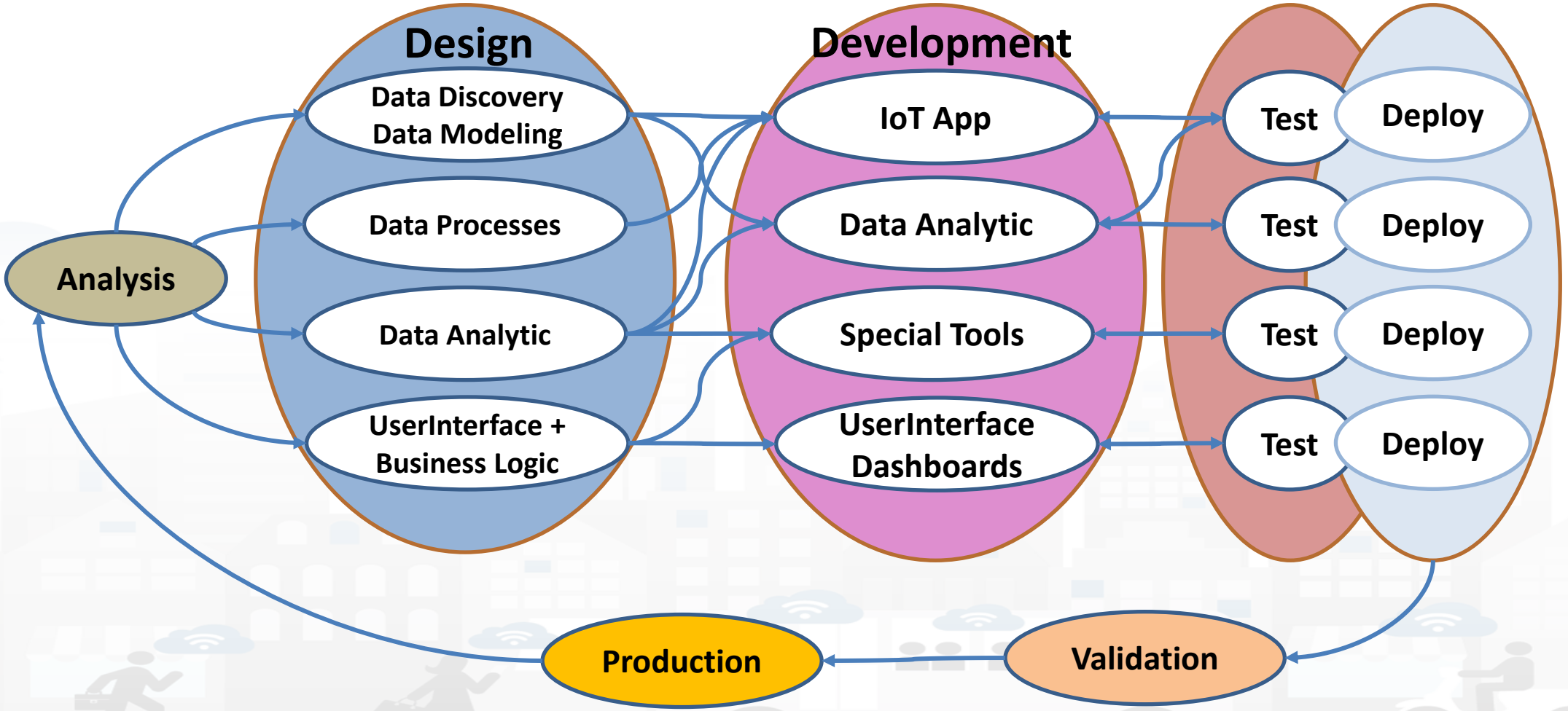
https://www.snap4city.org/download/video/course/sys/



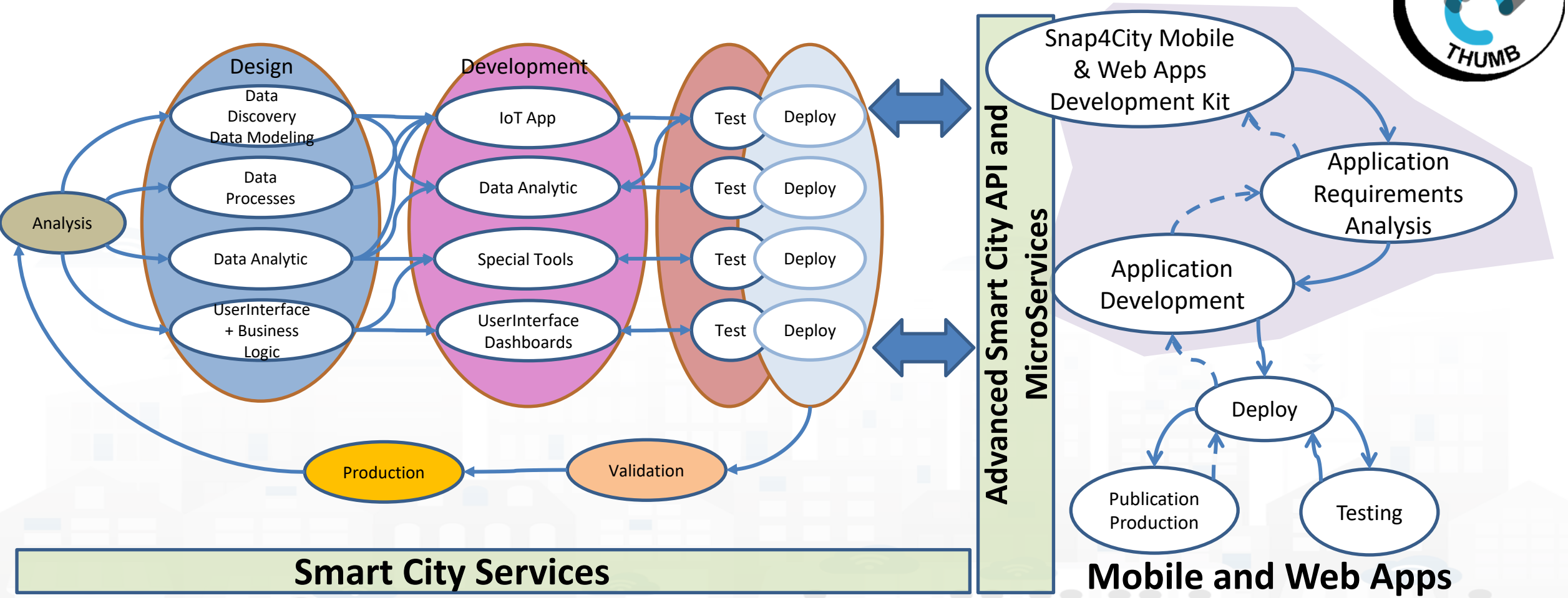
Development Life Cycle Smart Solutions



Development Life Cycle Smart Solutions

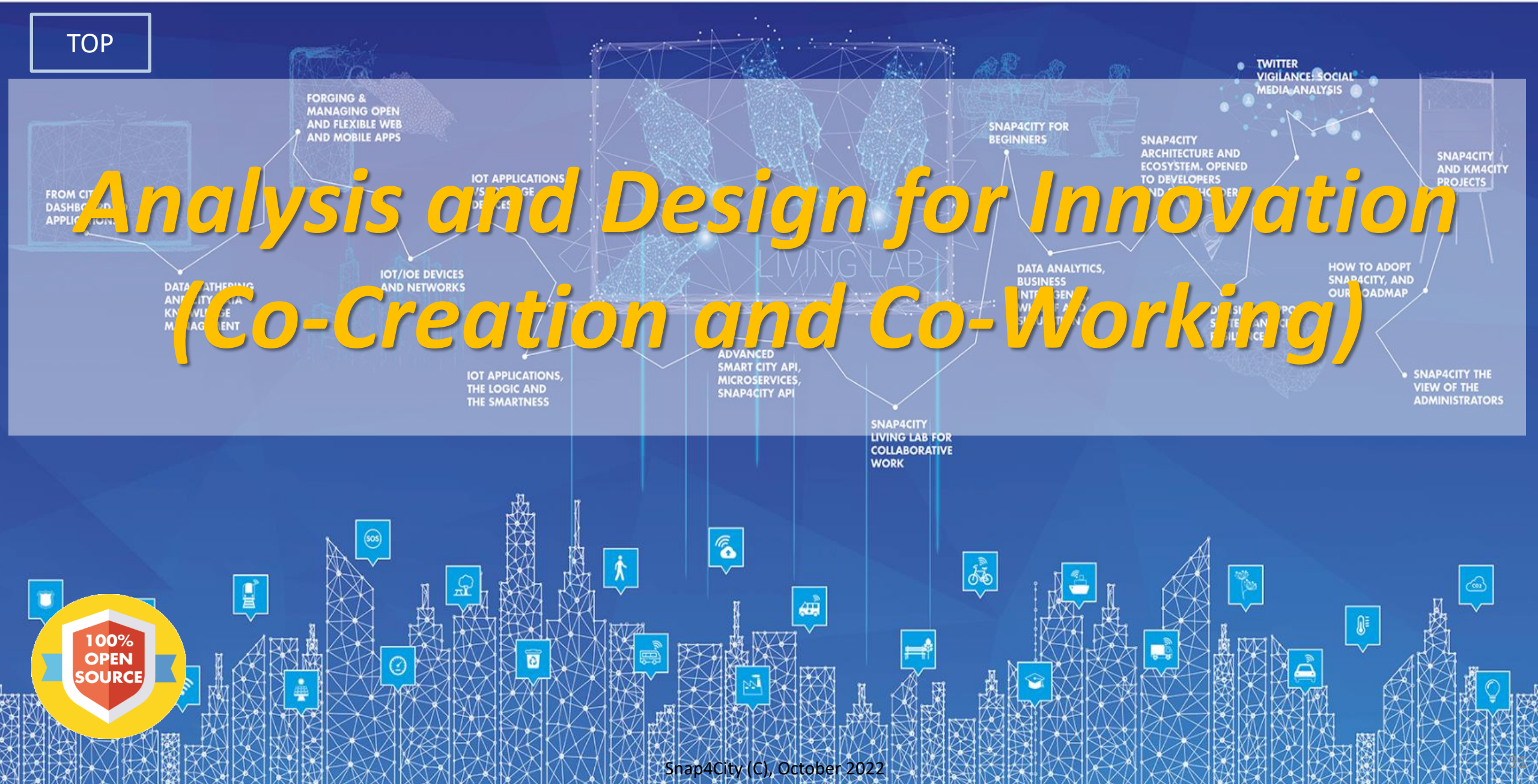


Develop Mobile & Web Applications Exploiting Snap4City Smart City Services

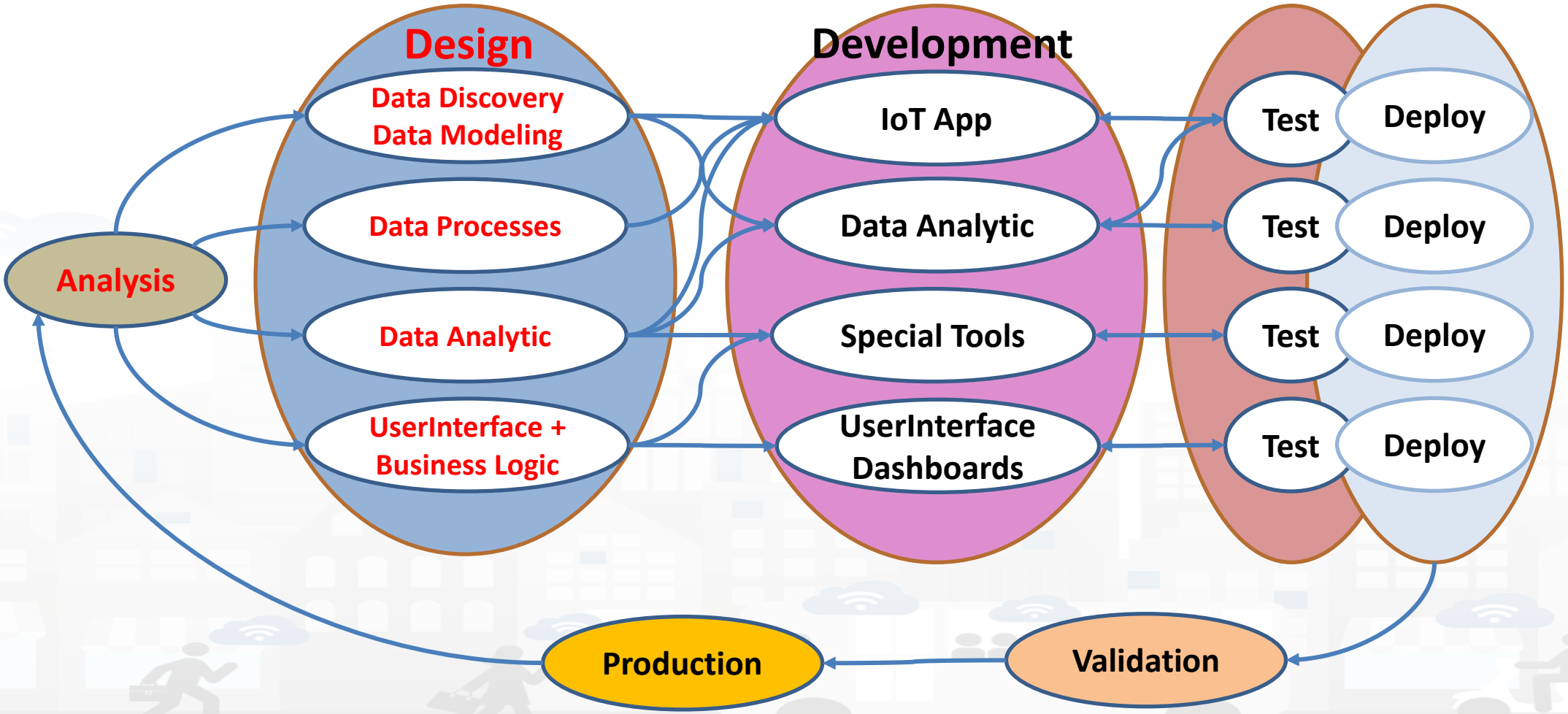


TOP

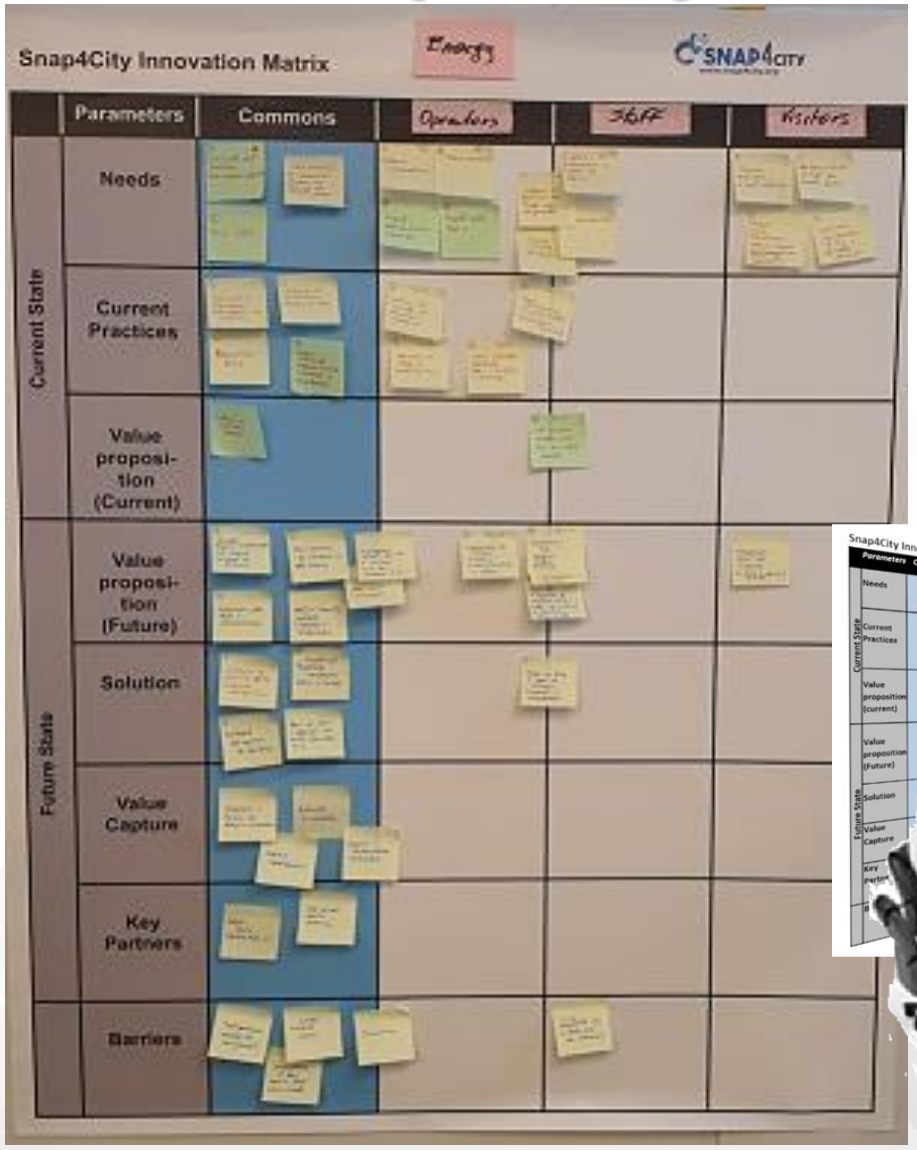
Analysis and Design for Innovation (Co-Creation and Co-Working)

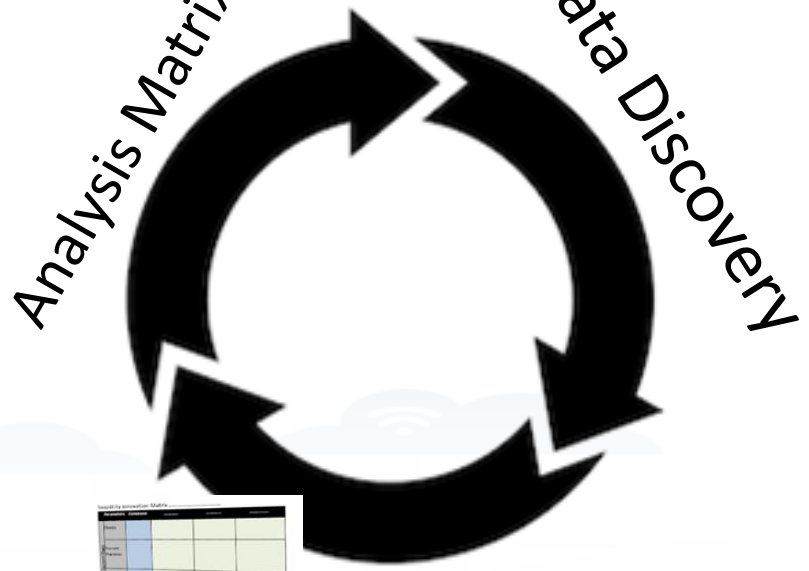


Development Life Cycle Smart Solutions



Snap4City Innovation Matrix and Process





Analysis

- **Performing workshops:** Innovation Matrix by domain
- **Entity Identification**: which is the **Dictionary**
  - **Data Models** for: User, Operator, Vehicle, Analysis, Server, Client, Mobile App, parking area, etc.
  - **IoT Devices** as: City user XX, Control Room Operator, Doctor Rossi, Cop 3726, Car FI796HG, IoT Device XY, Trip 34, Patient Health Record for Robert, etc.
  - **External API:** to interoperate with any other application and service.
  - **External Services:** to host into the user interface and Dashboards elements coming from third party applications
- **Scenarios** describing the application/task, textual definition, with some standard table as UML. The scenarios have to refer to identified entities.
- **Use Cases** describing the different cases into the single applications, by using UML formalization, there are specific Use Cases for each Scenario. Please focus on the most relevant, those that are adding value to your solutions. The others cam be given for granted in a first phase.
- **Requirements** by using standard tables, using identified Dictionary of Entities, prioritizing them, setting mandatory/preferred/optional, functional and non-functional, first/second/third release, etc.
- **Sequence Diagrams:** for some of the critical aspects- For example for describing the user interaction, and/or the interaction among major entities, putting in evidence which is the Entity starting the dialogue with respect to the other entities involved (e.g., a client requesting data to the server, a device sending data to the broker). UML sequence diagrams are a suitable formalization for the purpose.

TOP

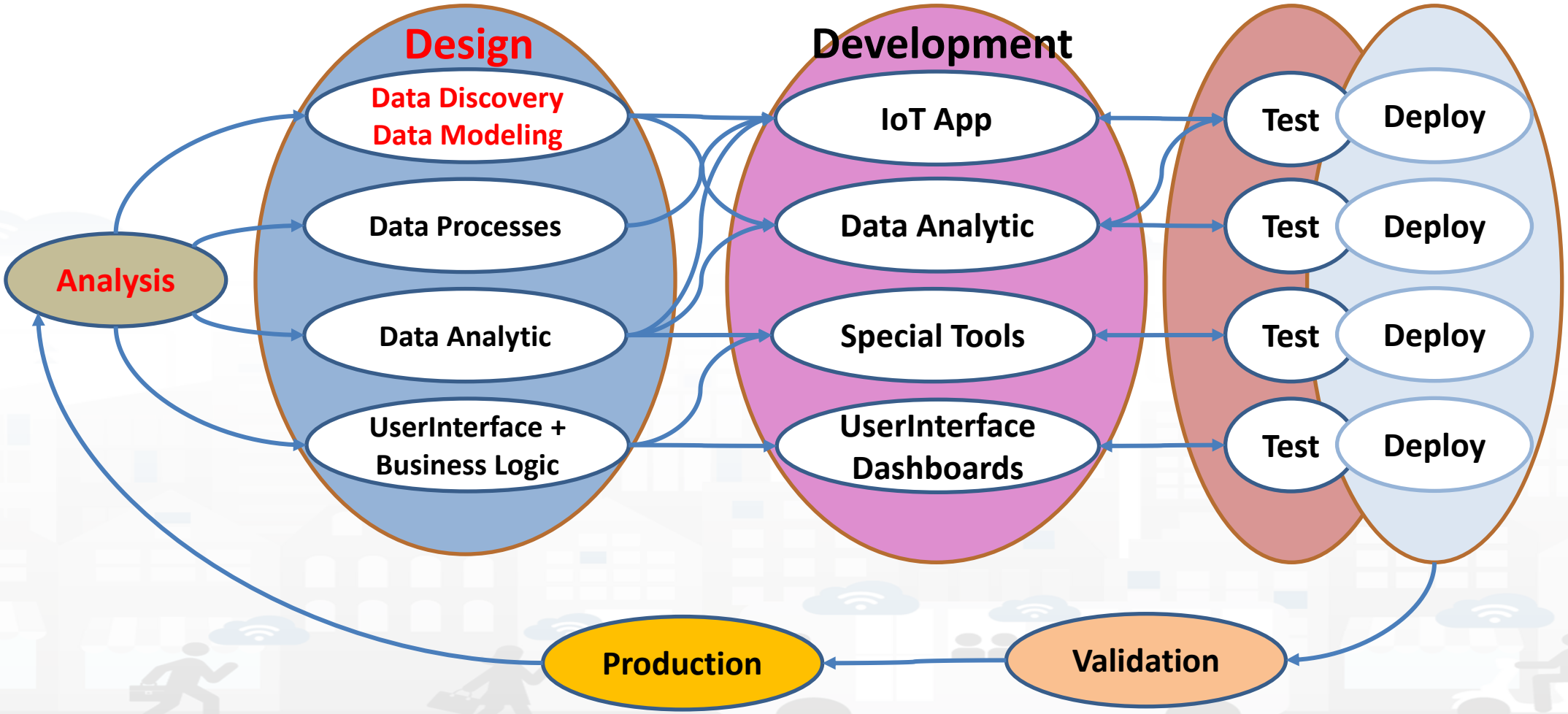
Design and Develop: Data Models & Processes

https://www.snap4city.org/download/video/course/iot/

https://www.snap4city.org/download/video/course/di/

Design: Data Discovery

Development Life Cycle Smart Solutions



Data Discovery

- Performed by analyzing data from:
  I. identified scenarios from the **Snap4City Innovation Matrix**
  II. main organizations (via interviews)
  III. other stakeholders (via interview and web pages)
  IV. regional, national and international sources:
    I. open data portals, weather sources,
    II. IOT networks, etc. via web pages and sites
  V. Mobile Applications (via Snap4City API)
  VI. Snap4City portal Https://www.snap4city.org
  VII. etc.

- Exploiting Snap4City experience, data and tools
- By following the Snap4City guidelines on Data Search on web and world reported in the training course and on Snap4City.org portal.

Design: from Data Modeling to Data Ingestion

What About IoT Devices, Time Series

IOT Device

IOT Device

Sends a message

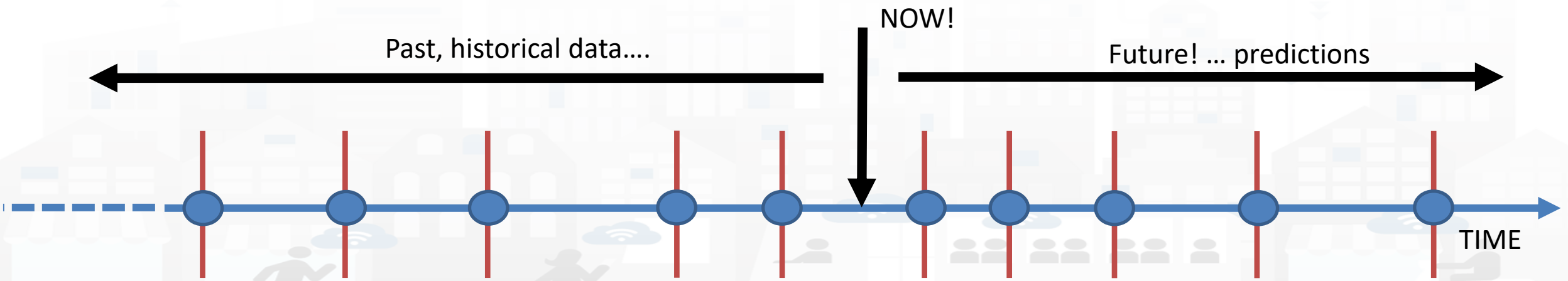
Message (
timestamp: 02-04-2020 at 10:30,
Temperature: 29.34,
Humidity: 35
)

dateObserved	Temp	Humidity
02-04-2020 10:30	34.5	23
02-04-2020 10:40	36.5	24
02-04-2020 10:50	36.0	22.5

- A set of data coming from an IoT Device with multiple sensor become a time series of values for devices.
  - For example: taking a new measure every 10 minutes (Red Lines)
  - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «dateObserved», which has to be **Unique.**
  - **Only one message per dateObserved is allowed**

Time Series: they are data streams

- As soon as you have registered an IoT Device
  - You are ready to get Future data, may be arriving in PUSH
  - Recall and store historical data as well, but they have to be
    - recalled in PULL with some IoT App.
    - Loaded in PULL with some File or Data Table Loader



IoT Devices

IoT Device Models

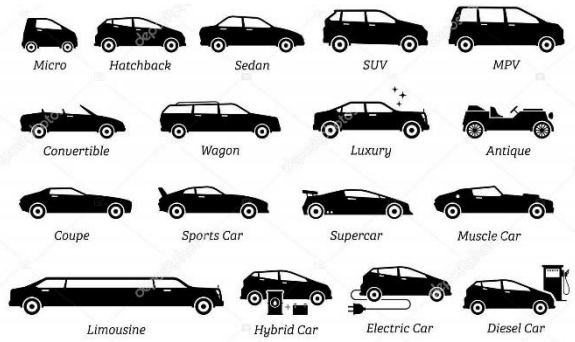
register

IoT Device
- Name:…..
- Model:…..
- Position: …….

IoT Device Variables
- **dateObserved: ……..**
- ID:
- Status: ready
- Temperature: 70%
- WaterLevel: 35%
- UsedCapsBox: 30%
- Power: OK
- …..

- Conceptually are IoT Devices with sensors/actuators, IN/IN-OUT
- They are classified in terms of nature/subnature
- For Searching and showing on maps and dashboards **HLT of IoT Devices** can be:
  - **IoT Device Models**, for example: «personal coffee machine»
  - **IoT Device** name, for example: «mycoffemachine1», «CM23»
  - **IoT Device Variable**, for example: «Temperature»

Mobile Devices



Mobile Device Models

register

Mobile Device

- Name:…..
- Model:…..
- Spec:…

Mobile Device Variables

- ID:
- **dateObserved: ……..**
- Status: ready
- Temperature: 70%
- Gasoline: 35%
- Velocity: 231,3 Km/h
- **Position: 44.3223, 11.3432**
- …..

- They are a special case of IoT Devices
  - they are managed as IoT Devices in the system
- They are classified in terms of nature/subnature
- For Searching and showing on maps and dashboards, they are different
  HLT of Mobile Devices can be:
  - **Mobile Device Model**, for example: «sedan»
  - **Mobile Device** name, for example: «BMW JD7356HD», «Ford KO786KK»
  - **Mobile Device Variable**, for example: «velocity»

Design: from Data Modeling to Data Ingestion

IOT Network Manager vs Final User

Network of IOT Brokers

IOT Broker

External

Internal

IOT Directory

My IoT Device Model

IOT Network Manager

My IOT Device

Register

Registering

Discovering

Knowledge Base, Km4City

Knowledge and Storage Data from the Field and City

Browsing

ServiceMap Knowledge Base

Discovering

IOT Application

Final user Manager

Dashboard Wizard

The Data Models can be simply instantiated from

a) **FIWARE Smart Data Models**, versioning, and harvesting the standard repository

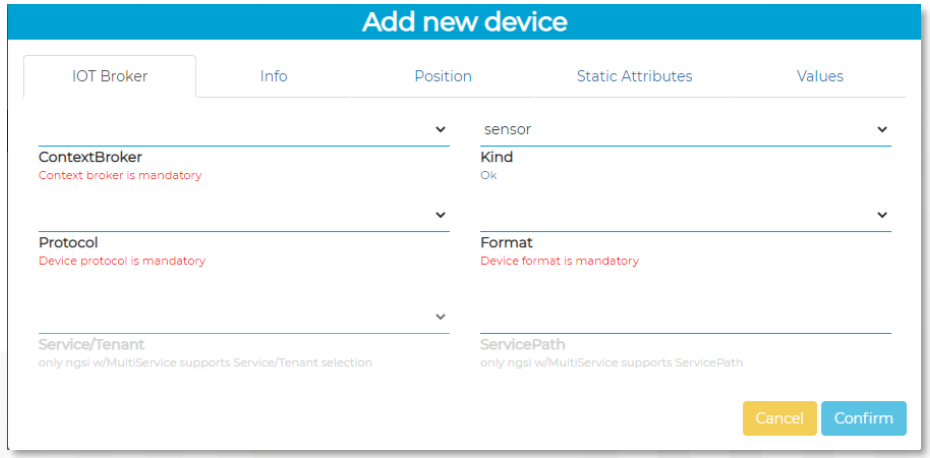
b) **IoT Device Model** which are accessible into the Snap4City environment

c) **Excel files by using Data Table tool**, which extracts the model from the excel table and automatically creates IoT Device Model, IoT Devices and data attached to them

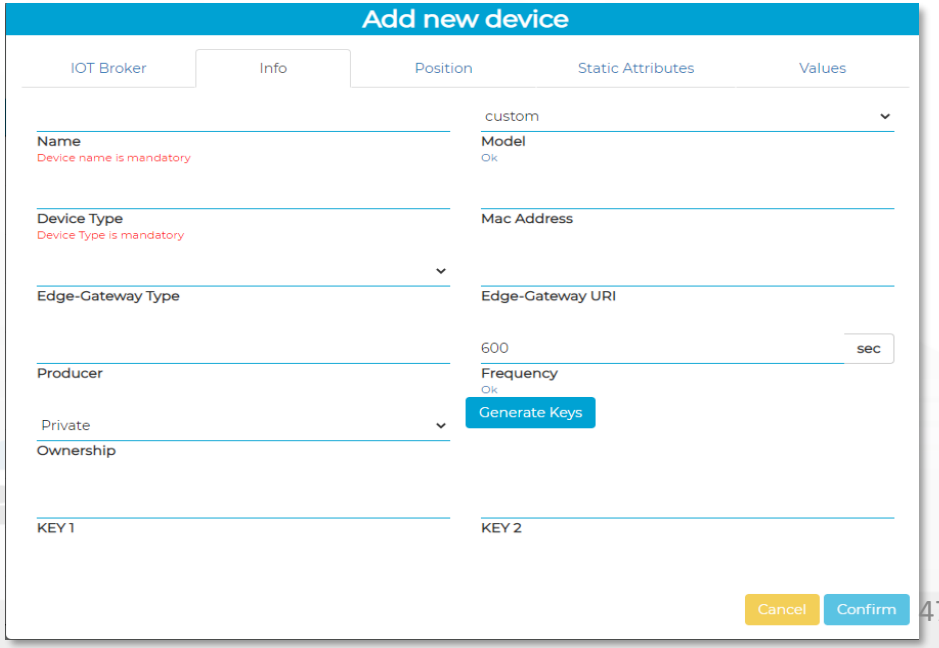
d) Creating a **custom IoT Device Model** in standard Snap4City format via **IoT Directory**

IOT Device Data Model (1)

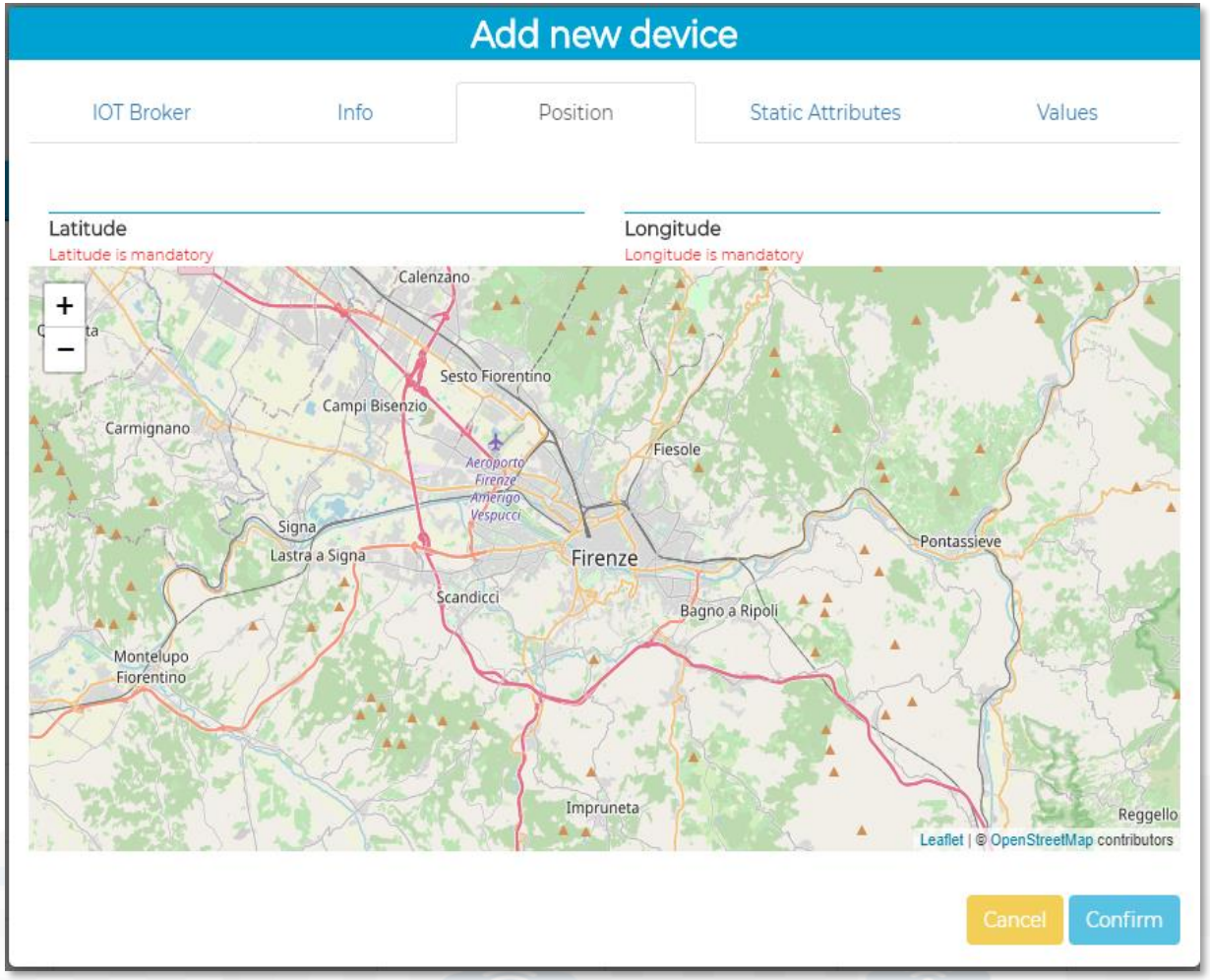
- IOT Broker
  - Name of the Brokers: among those registered
  - Protocol: NGSI, AMQP, MQTT, etc..
  - Format: CSV, JSON, XML.
  - Service/Tenant:……
  - ServicePath:……

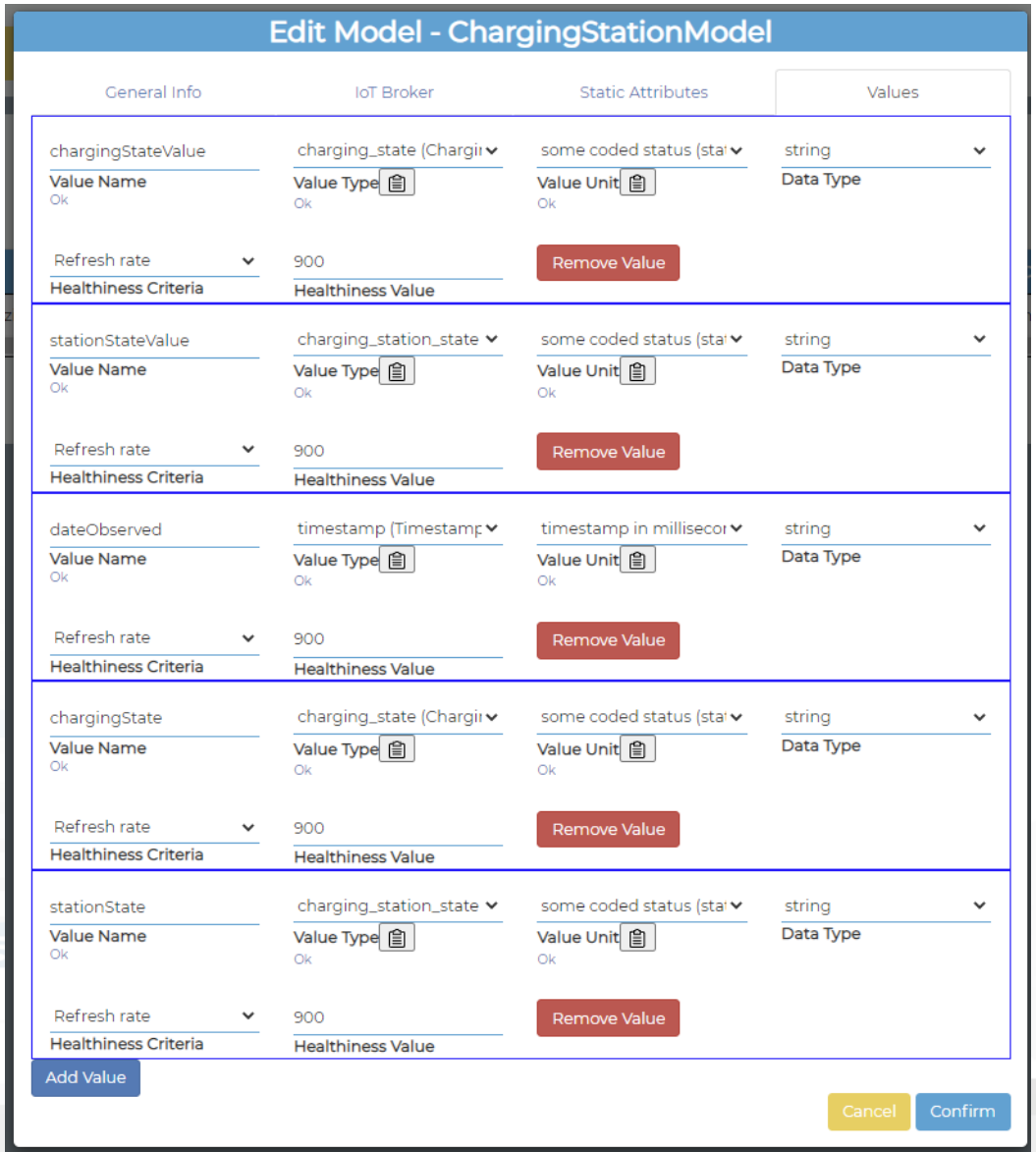


- Info
  - Name (Identifier)
  - Model: Custom or Model ID
  - DeviceType: ..a string..
  - MAC address: …optional…
  - Edge-GW: Raspberry, Android, …
  - Edge-GW: URI
  - Producer
  - Owner
  - Freq: ….. Sec
  - Keys: K1, K2



IOT Device Data Model (2)





IOT Device Model (3): Attributes

Where	IOT Device Model	IOT Device	A Temporal Instance
IOT Broker	**Broker: OrionUNIFI**		
IOT Broker	**Protocol: NGSI**		
Info	**ID: string**	ID: "park45"	**park45**
Position	**GPS: lat, long**	GSP Position: 43.12, 11.34	GSP Position: 44.12, 11.12
Static attribute	**Description: string**	Description: "parking massaia"	
Static attribute	**Location: string**	Location: "Via Massaia"	
Static attribute	**Civic Number: string**	Civic Number: 3	
Static attribute	**MaxCapacity: number, cars**	MaxCapacity: 456	
Values	**dateObserved: Timestamp**		23-12-2019T20:13:12…
Values	**FreeSlots: Integer, #**		345
Values	**Humidity: float, %**		25,5
Values	**Temperature: float, celsius**		34

Model meaning

- **ID:** is the unique identifier for reconnecting Temporal Instances with registered IOT Devices
- **Static Attributes:**
  - Are typically associated with instances of the IOT Device.
    E.g.:, You have a set of parking areas, each of them is located in a specific street, and has its one name, etc.
  - Different kinds of attributes can be set for each SubNature. Their definition has to be prepared into the Knowledge Base ☺ for automated indexing.
- **Values**: they are time varying variables (temporal values/instances)
  - They change over time, the timestamp of the time series is conventionally «dateObserved» in Snap4City
  - In new *SensorMobile* HLT, also GPS can be changing over time as in the MyKPI
- **NOTE for:**
  - **names/IDs**: Spaces or strange characters are not allowed in the. Please use simple alfphanumeric strings, it is a limitation of many solutions including Orion Broker and increase interoperability of your data.
  - **Values of attributes and variables**: can be UTF8, but similarly, they do not accept: () <> “ ‘ ; = into values
  - https://fiware-orion.readthedocs.io/en/master/user/forbidden_characters/index.html

Using the IOT Device Model notes!!!

- Once performed the **IOT Device Model**, a number of IOT Devices can be produce **using the model as a Template**

  - **NOTE:** the produced IOT Devices are not going to change if the IOT Device Model is modified.
  - *Your biscuit is not changing if the template is modified after the printout*

Custom Data Modeling example

Example 1

IoT Device Model: Driver
Nature:……
Subnature: ……
Lat,lon: Default (they do not need to be specified in the variables, they are provided by default, but values have to be imposed at the instantiation of the device from model), they are float
Device in Mobility: No (the variable do not need to be specified, while the value has to be set to state if the Lat,Lon are going to change, moving the device or not)

Value_name	Value Type	Value Unit	Data Type
dateObserved	**Timestamp**	**Timestamp in ms**	**String**
identifier	ID	text	String
name	entity	text	String
surname	entity	text	String
age	age	number	Integer
sex	status	some coded status	String
language	entity	text	String
email	entity	text	String
phone	entity	text	String
address	entity	text	String
locality	entity	text	String
city	entity	text	String
nationality	entity	text	String
civicNmber	entity	text	String
dateofBorn	DateTime	Timestamp in ms	String
gender	status	some coded status	String
driverHelthiness	Identifier	ServiceURI	String
driverEvent	Identifier	ServiceURI	String
driverAnalysis	Identifier	ServiceURI	String
Vechicle	Identifier	ServiceURI	String

Example 2

IoT Device Model: driverHelthiness Nature:…… Subnature: …… Lat,lon: …… Device in Mobility: ……			
Value_name	Value Type	Value Unit	Data Type
dateObserved	Timestamp	Timestamp in ms	String
kind			
levelAttentionFactor1			
levelAttentionFactor2			
driver	Identifier	ServiceURI	String

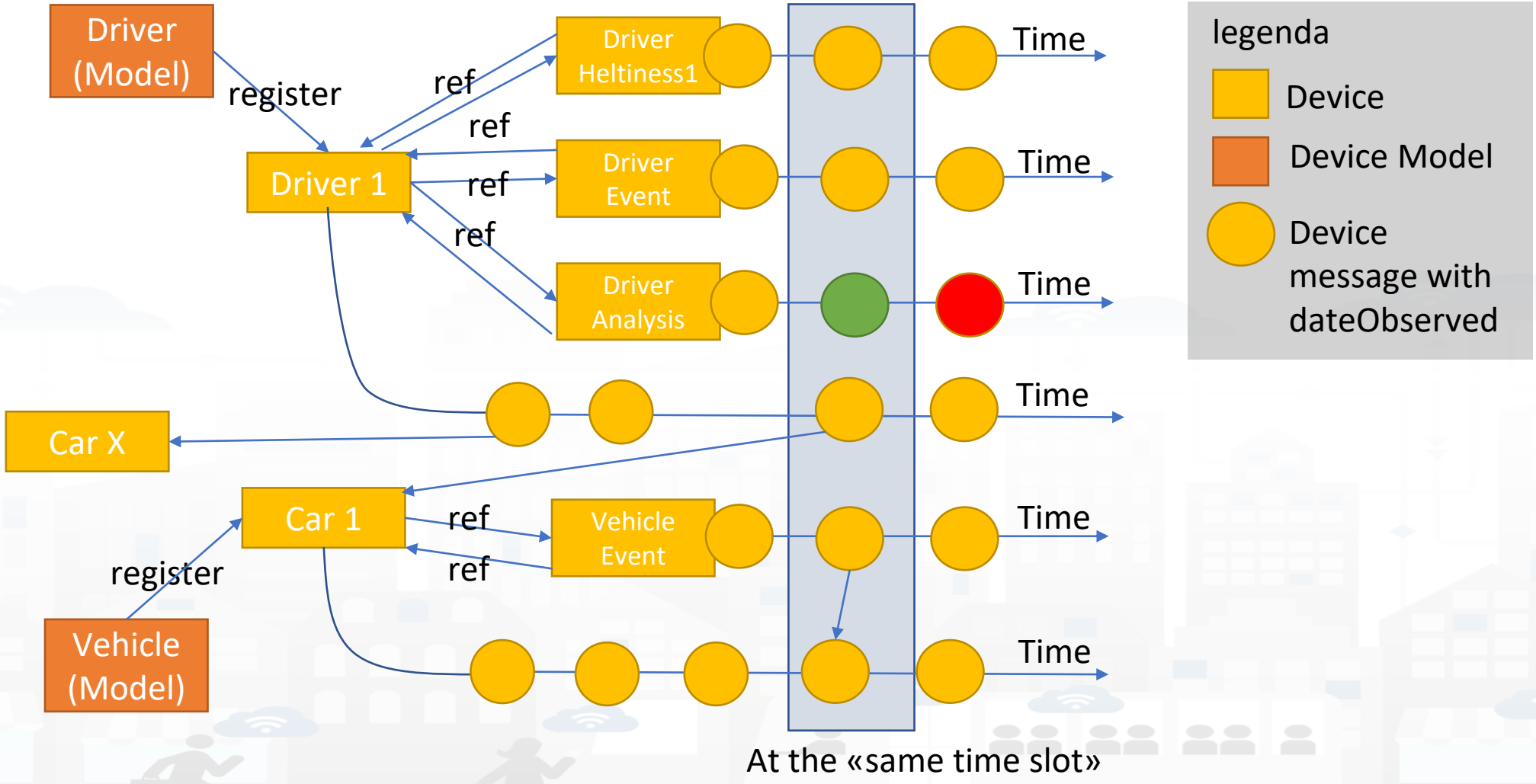
Example 3

IoT Device Model: Vehicle Nature:…… Subnature: …… Lat,lon: …… Device in Mobility: ……			
Value_name	Value Type	Value Unit	Data Type
dateObserved	Timestamp	Timestamp in ms	String
producer	entity	text	String
model	entity	text	String
plate	entity	text	String
companyID	entity	text	String
velocity	velocity	km/h	float
acceleration	acceleration	m/s2	float
Status	status	some coded status	String
energyLevel	energy level	percentage	Float
kmTotal	distance	km	Float
thankLevel	energy level	percentage	Float
vehicleEvent	Identifier	ServiceURI	String

Example 4

IoT Device Model: VehicleEvent Nature:…… Subnature: …… Lat,lon: …… Device in Mobility: ……			
Value_name	Value Type	Value Unit	Data Type
dateObserved	Timestamp	Timestamp in ms	String
eventID	ID	text	String
eventKind	status	some coded status	String
status	status	some coded status	String
vehicle	Identifier	ServiceURI	String

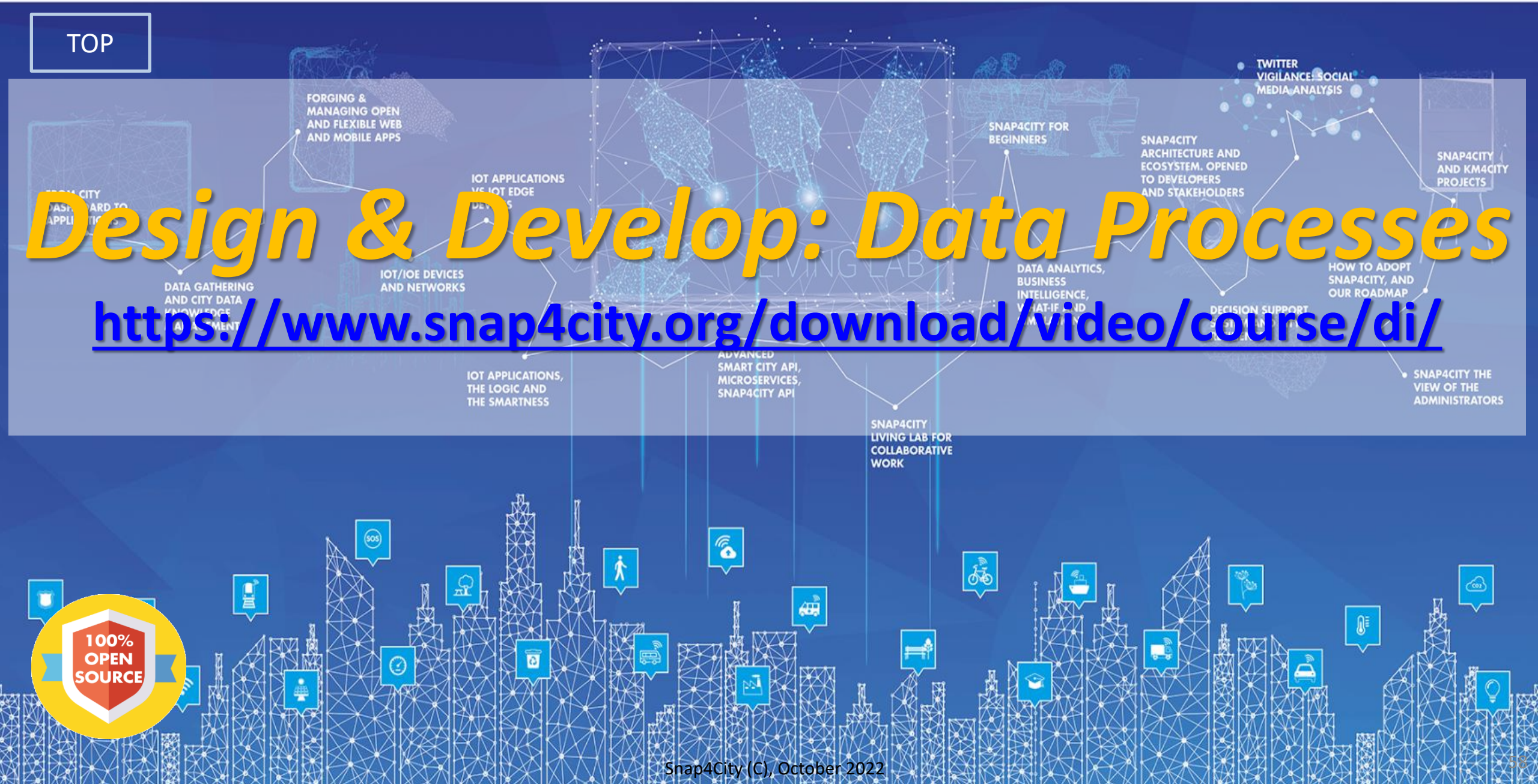
Example of Data Model Diagram



TOP

Design & Develop: Data Processes

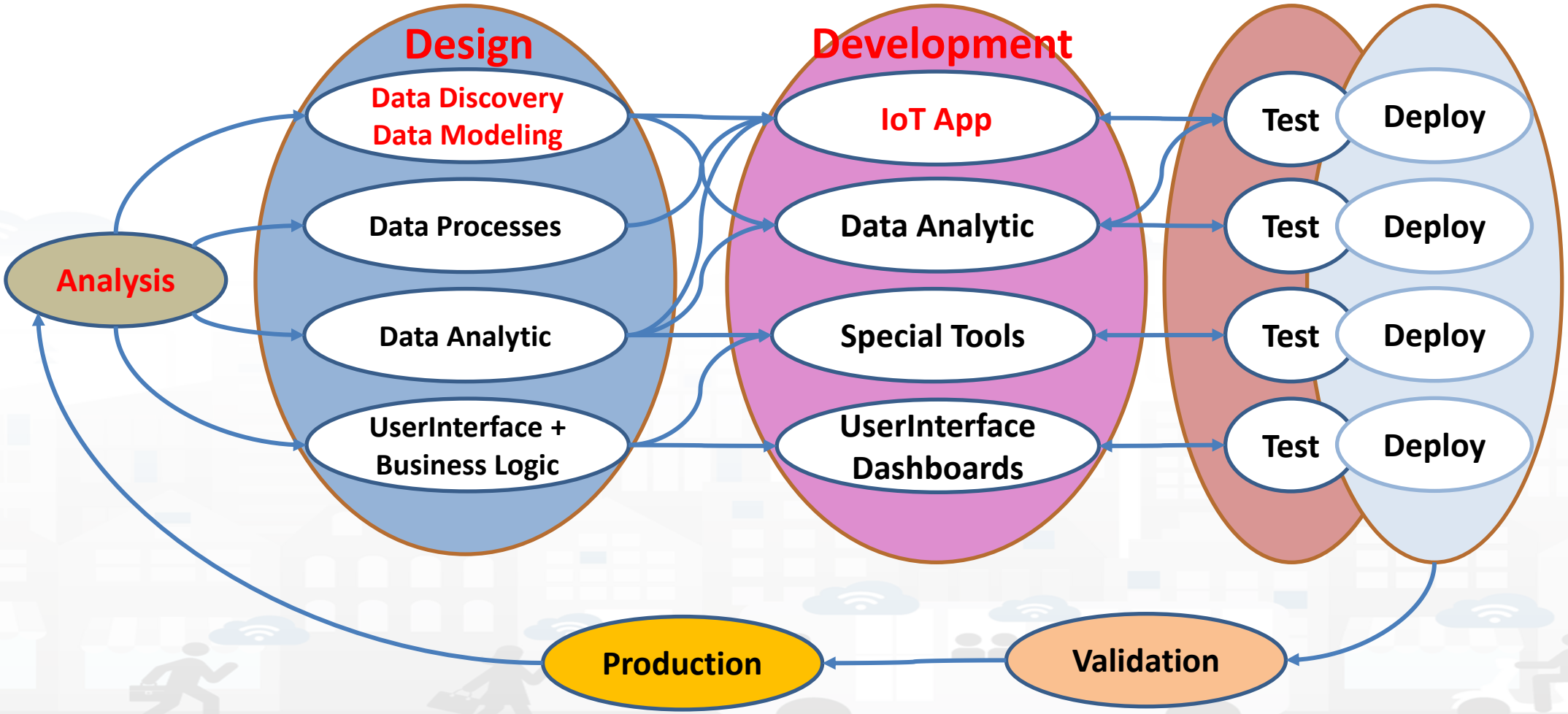
https://www.snap4city.org/download/video/course/di/



Activities for IoT App data processes

- **Data Ingestion, gathering, harvesting, grabbing**
- **Data Transformation, transcoding, decoding, converting**
- **Data load to storage, retrieve from storage**
  - the load is typically performed loading data on some Internal IoT Orion Broker V2, or on some MyKPI storage
  - the retrieval is typically performed using one of the several query / search nodes.
  - Many other kind of storage connections are accessible in Snap4City IoT App
- **Data Production, generation, reformatting, etc.**
- **Data Publication, post in other channels of any kind, etc.**

Development Life Cycle Smart Solutions

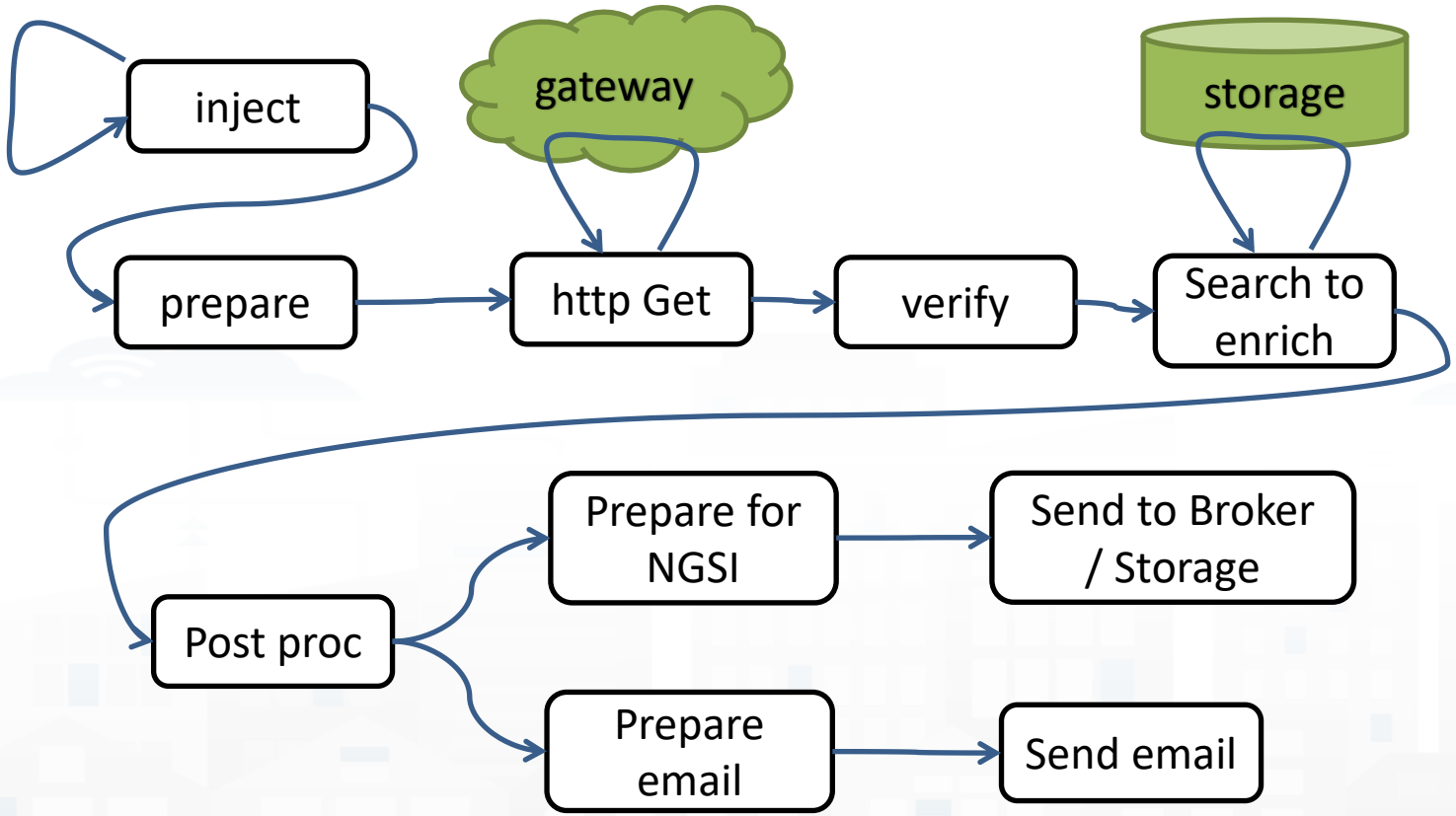


Design: Data Processes

How to Design

1. Business Logic is going to be implemented in IoT App, with a set of flows.
2. Decompose you problem and sequence diagram in single Data/event Flows, from client side and server side.
3. Identify the single Data/Event Flow, as those that start from a certain event (periodic or provoked from other messages), and that finish with: sending of data in the storage, change status, send an event, provide a message into a dashboard, send an email, etc.
4. Design the single Data/Event Flows with a mixt of possible **activities**.
    1. The design can be performed using data flow diagrams.
    2. It can have sequences, switch, serialization, packing, joining, distribution, communication, transformation, search, etc.
5. When the design of Data/Event Flow mechanism is clear the designers can pass to directly sketch the flow in Node-RED which is a visual programming.
6. Incrementally improve the IoT App Node-RED flows by adding nodes needed
7. Once obtained the IoT App Node-RED flows in the correct data model you can send data to the ingestion broker, but also perform many other actions on several services.

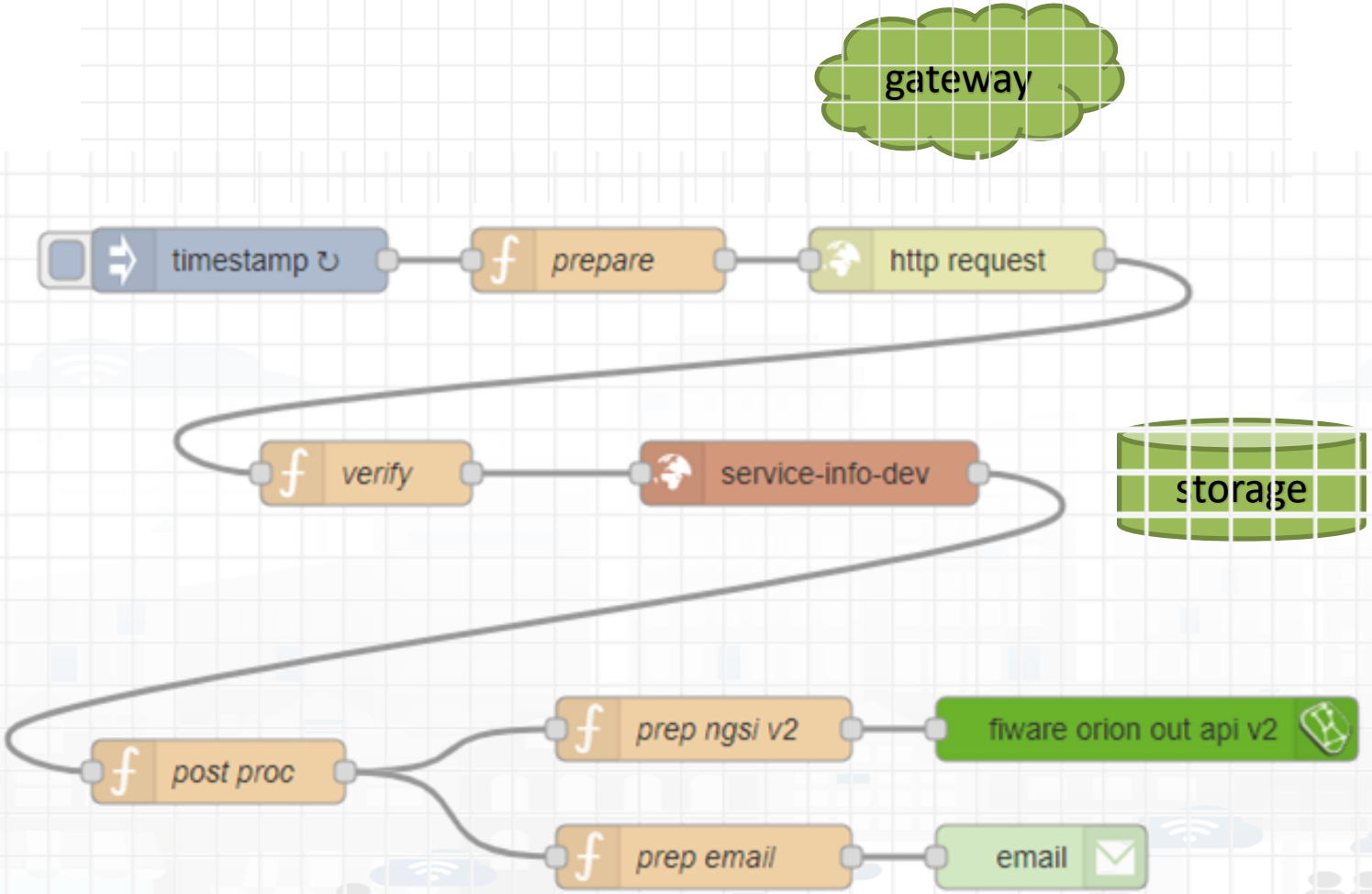
IoT App Design, for each Data/Event Flow



a. Periodically activate the flow
b. Call a gateway to get data
c. Verify the correctness of data
d. Enrich the data with other information coming from Cloud data into the storage
e. Transform the data in the correct forma
f. Send the data into the IoT Broker, and thus send the data in the storage on a specific IoT Device
g. Send also a notification via email

Develop: Data Processes

IoT App Design, for each Data/Event Flow



a. Periodically activate the flow
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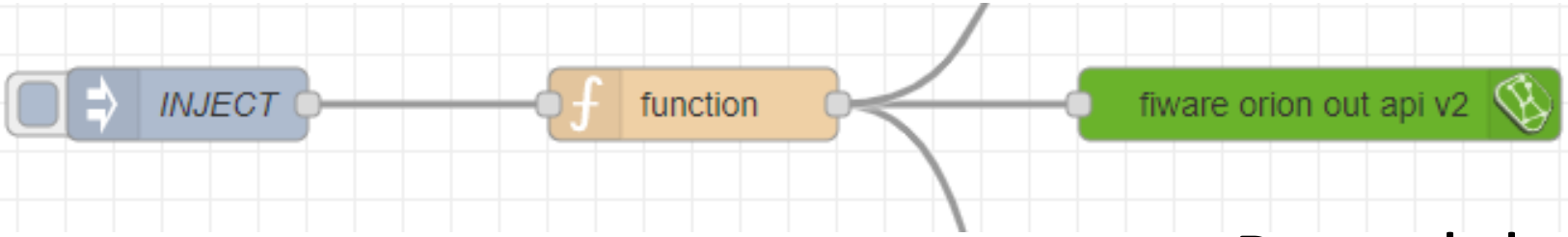
f. Send the data into the IoT Broker, and thus send the data in the storage on a specific IoT Device
g. Send also a notification via email

Implicit services are not drawn

A sample of Data Ingestion

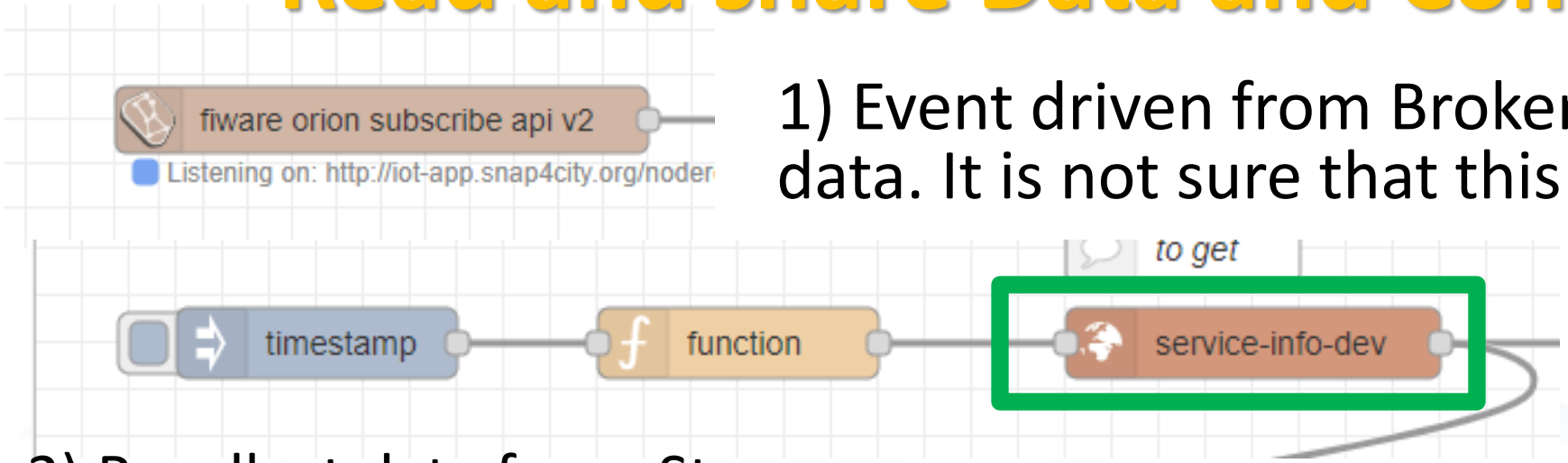


Function, example of NGSI V2 payload:

```
var time_now = new Date().toISOString();
var arandvalue = Math.random()
msg.payload =
        {"id":"mydev",
        "type":"mydevSensor",
        "anID":{"type": "integer", "value": "http://www.disit.org/km4city/resource/iot/...../anuser"},
        "VDDValue":{"type":"float","value":arandvalue},
        "dateObserved":{"type":"string","value":time_now},   // it is a time serie
        "latitude":{"type":"float","value":"28.61810"},      // it may move over time
        "longitude":{"type":"float","value":"11.34300"},     // it may move over time
        "status":{"type":"integer","value":34}
        }
return msg;
```

Posted data on IoT Brokers green nodes are automatically saved into the data Storage

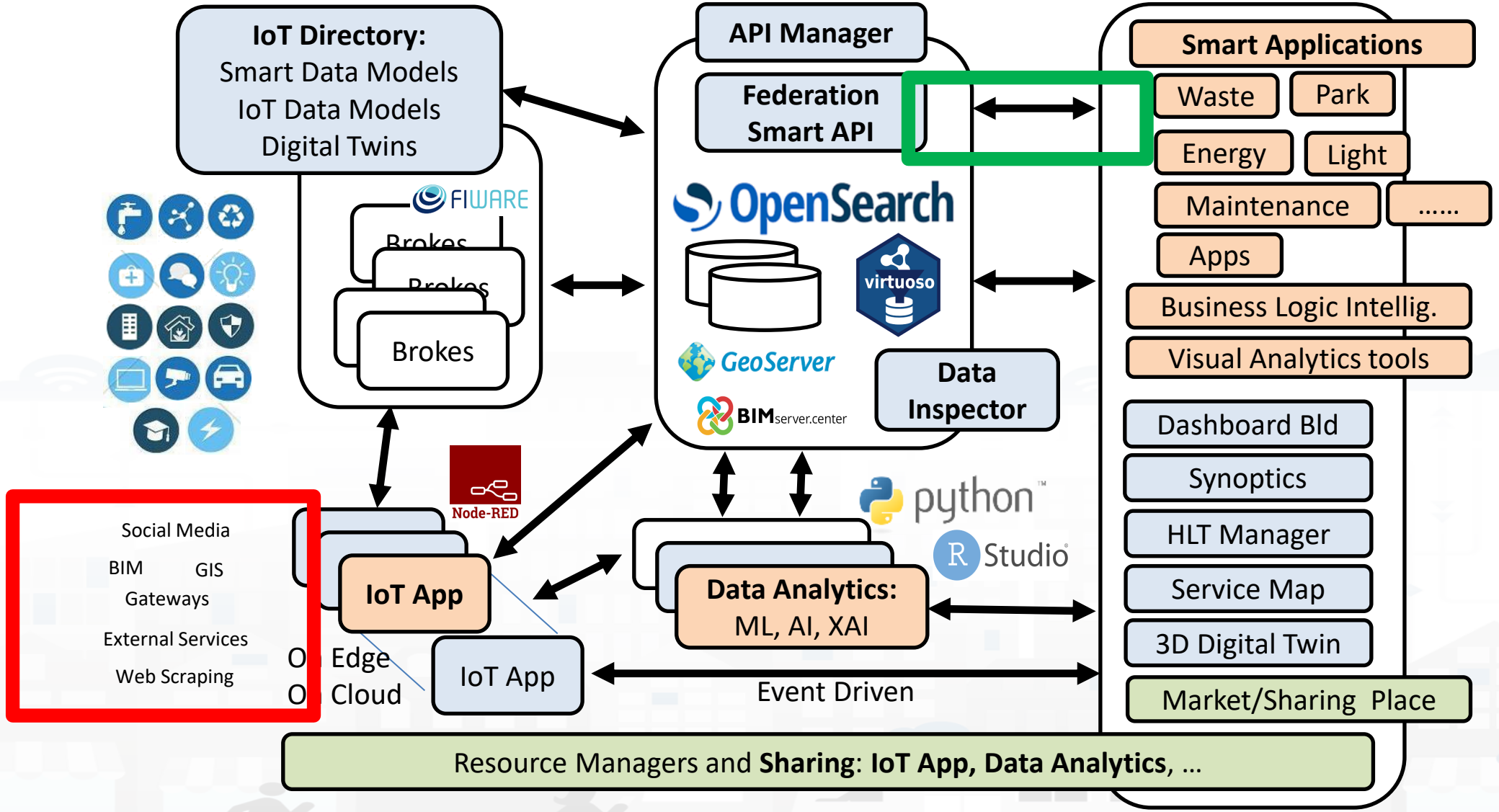
Read and share Data and Context Data



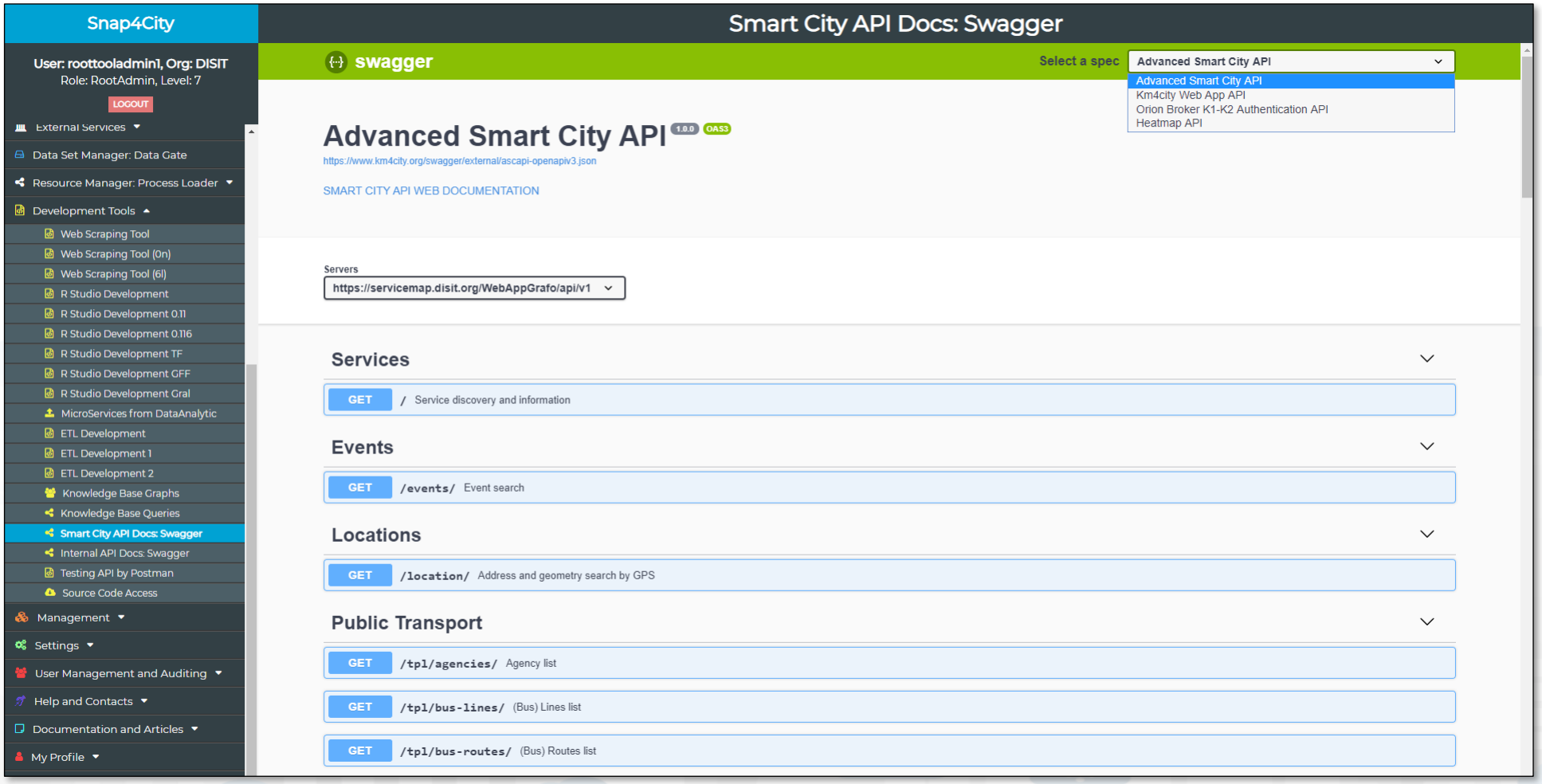
1) Event driven from Broker, read last context data. It is not sure that this change is on Storage

2) Recollect data from Storage
   - This node uses the Smart City API
- Any External Application can get the same data in authenticated authorized manner via Smart City API
- Smart City API is a better approach instead of producing a file outside or providing data via some local API service created from IoT Application (feasible but not protected)

Tech Arch


IoT Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokes
Brokes
Brokes
API Manager
Federation
Smart API
OpenSearch
virtuoso
GeoServer
BIMserver.center
Data
Inspector
Smart Applications
Waste
Park
Energy
Light
Maintenance
.....
Apps
Business Logic Intellig.
Visual Analytics tools
Dashboard Bld
Synoptics
HLT Manager
Service Map
3D Digital Twin
Market/Sharing Place
Node-RED
python
R Studio
Social Media
BIM
GIS
Gateways
External Services
Web Scraping
IoT App
IoT App
Edge
Cloud
Data Analytics:
ML, AI, XAI
Event Driven
Resource Managers and Sharing: IoT App, Data Analytics, ...

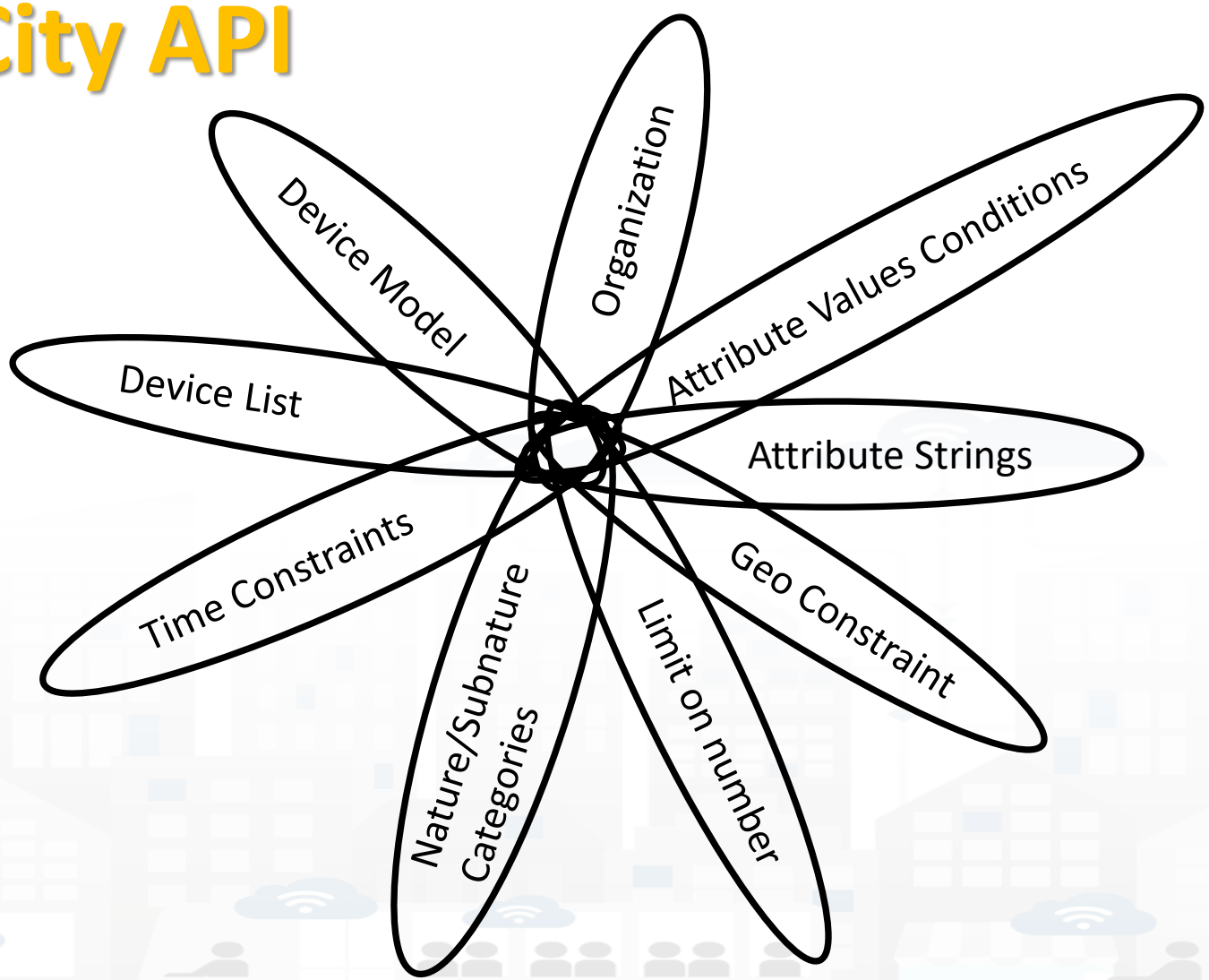
External Smart City API



https://www.km4city.org/swagger/external/index.html

Selection on Smart City API

- Combining different filters for selecting entities from Smart City APIs
- ***Be care***: some of the combinations may lead to empty result



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**
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-BOBOLI&format=json
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=json
      - 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**
    - **https://www.disit.org/superservicemap/api/v1?selection=59.36535064975547;13.457822799682619;59.39031474260852;13.566999435424806&model=SmartLightCapelon**&format=json
      - Please note that in this case the call is performed on the superservicemap, you can change to go directly on the right KB
      - You can 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=DOMESTICMOVEMENTS2013-2018_1620304406**
      - In this case, we have 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 get data single device (view on map, if format HTML and not JSON)**

  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

https://svealand.snap4city.org/ServiceMap/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7&format=json&fromTime=3-day

{ "Service":
{"type": "FeatureCollection",
"features": [
{
"geometry": { "type": "Point", "coordinates": [13.46701, 59.37458] },
"type": "Feature",
"properties": { "serviceUri": "http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7",
"serviceType": "Environment_Smart_street_light",
"name": "5C0272FFFE894AF7",
"typeLabel": "Smart street light",
"protocol": "ngsi",
"format": "json",
"model": "SmartLightCapelon2",
"producer": "Capelon",
"macaddress": "",
"brokerName": "orionCAPELON-UNIFI",
"ownership": "public",
"organization": "CAPELON",
"description": "",
"website": "",
"maintenanceUrl": "",
"maxCapacity": "",
"minCapacity": "",
"isMobile": "",
"nature": "Environment",
....
....

Query by value

Queries can be complex *by geo-area, by cathegory, by IoT Device Model, a list of ServiceURI (all the same kind), with filters by value on specific Variables (numeric, and textual in AND), QUERY:*

- https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=43.77;11.2&maxDists=700.2&model=CarPark

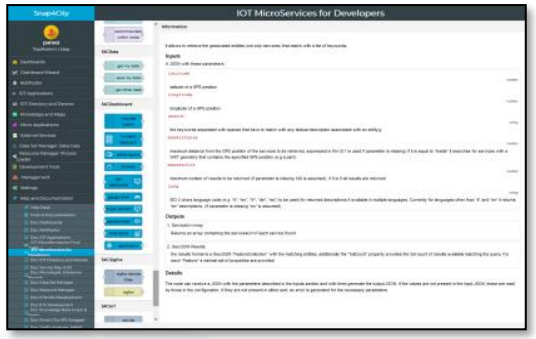
- https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=42.014990;10.217347;43.7768;11.2515&model=metrotrafficsensor&**valueFilters=vehicleFlow>0.5;vehicleFlow<300**

- https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=43.77;11.2&maxDists=200.2&model=metrotrafficsensor&valueFilters=vehicleFlow>10;vehicleFlow<400&serviceUri=http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO1;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO10;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO11;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO13;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO14;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO15;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO16;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO17;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO18;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO19;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO2;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO20;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO21;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO22;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO23;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO24;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO25;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO26

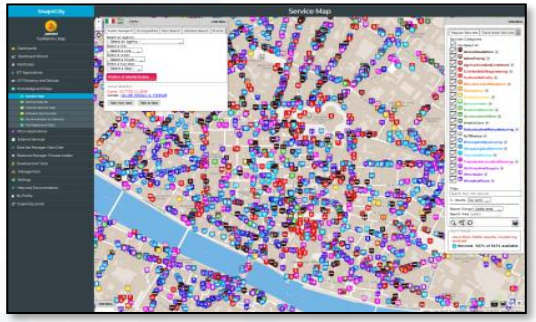
IOT Applications Development

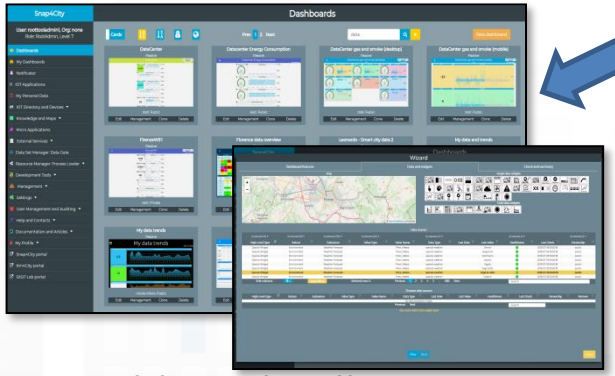
IOT Discovering

MicroServices collections



My IOT Applications





ServiceMap Discovery

Knowledge Base, Km4City

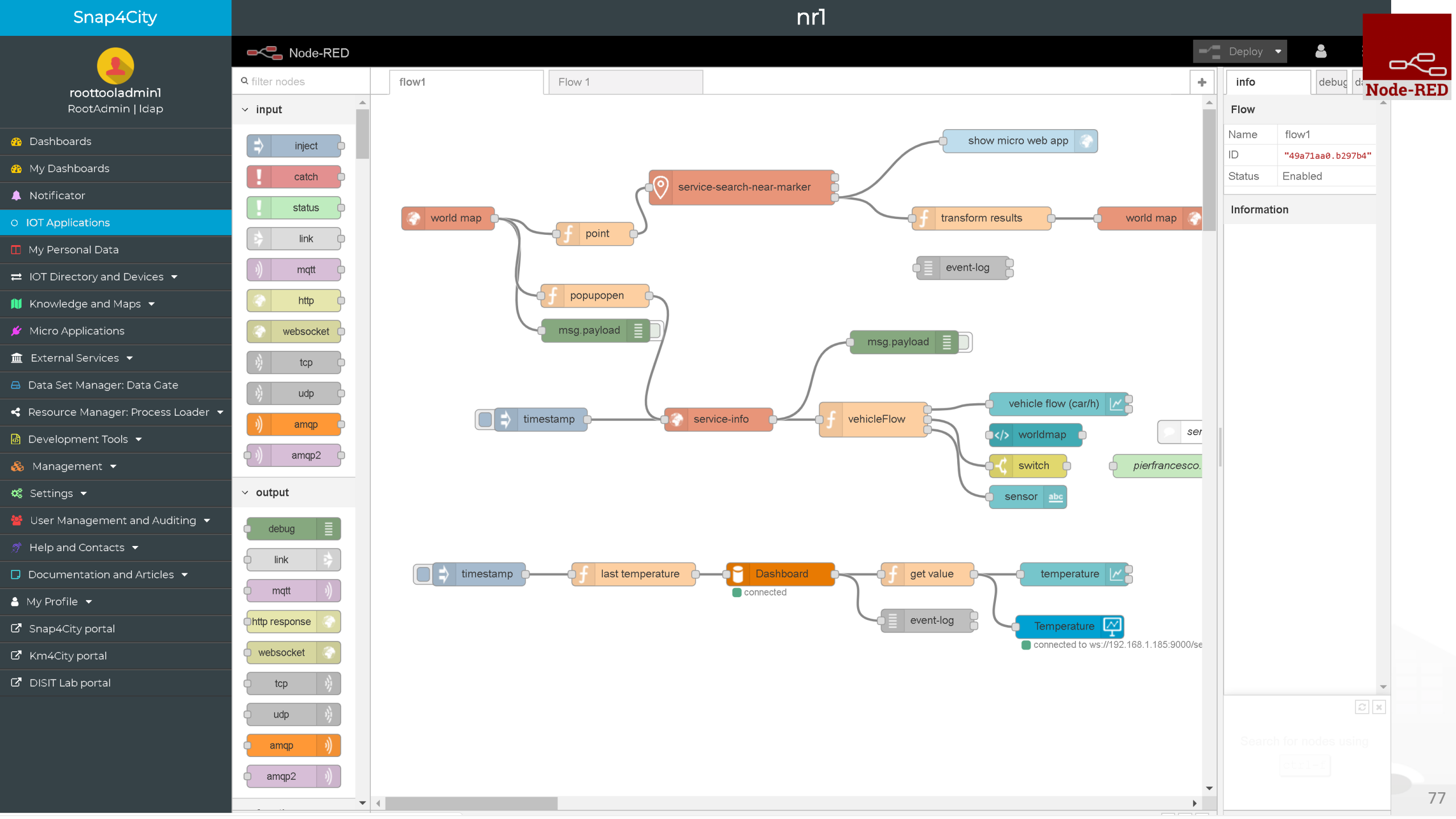
Dashboard Collection, Editor and Wizard

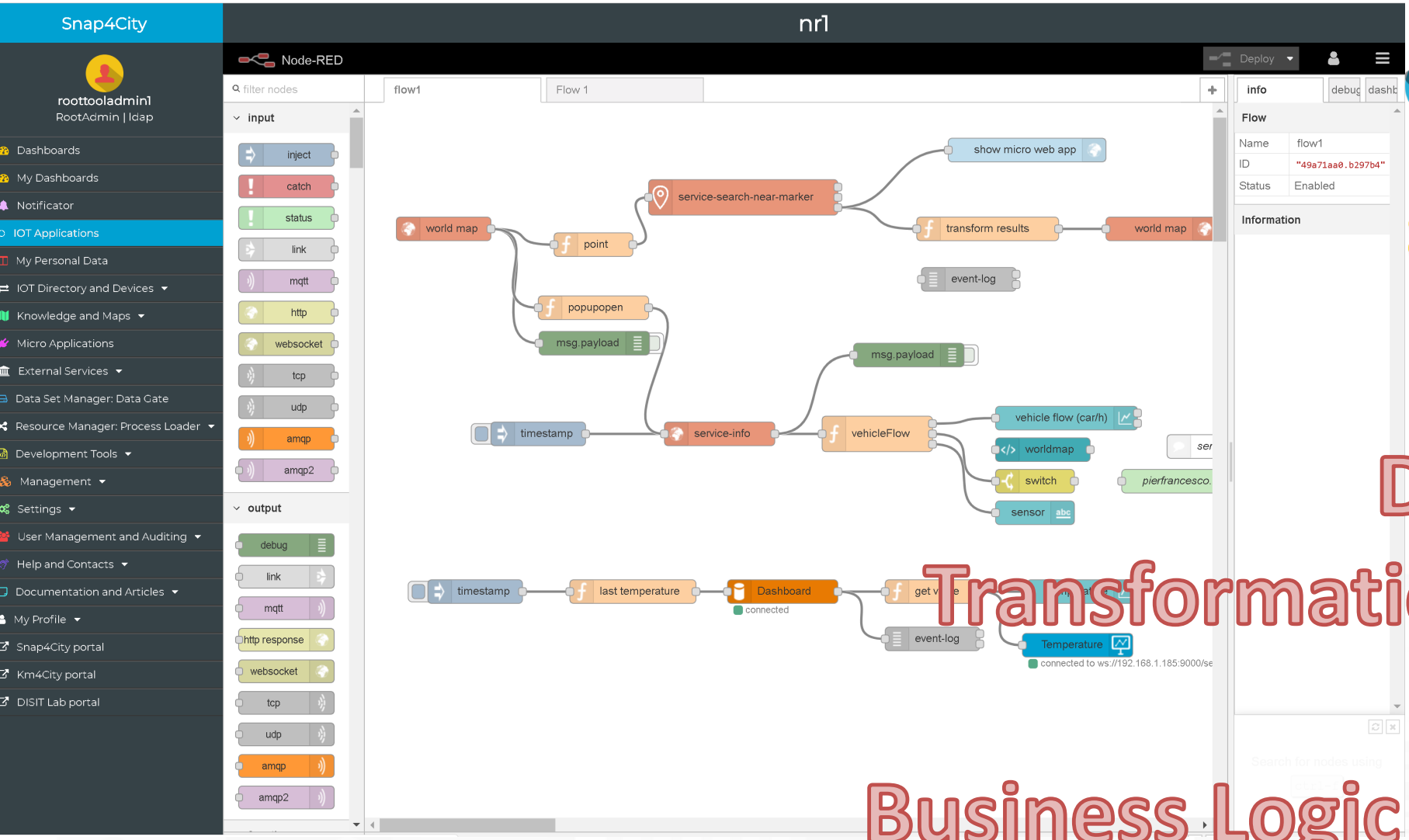
IOT App. Editor

Generating IOT App With Dashboard

Sharing/saving reusing IOT App

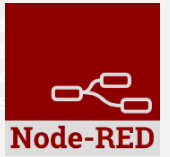
Resource Manager

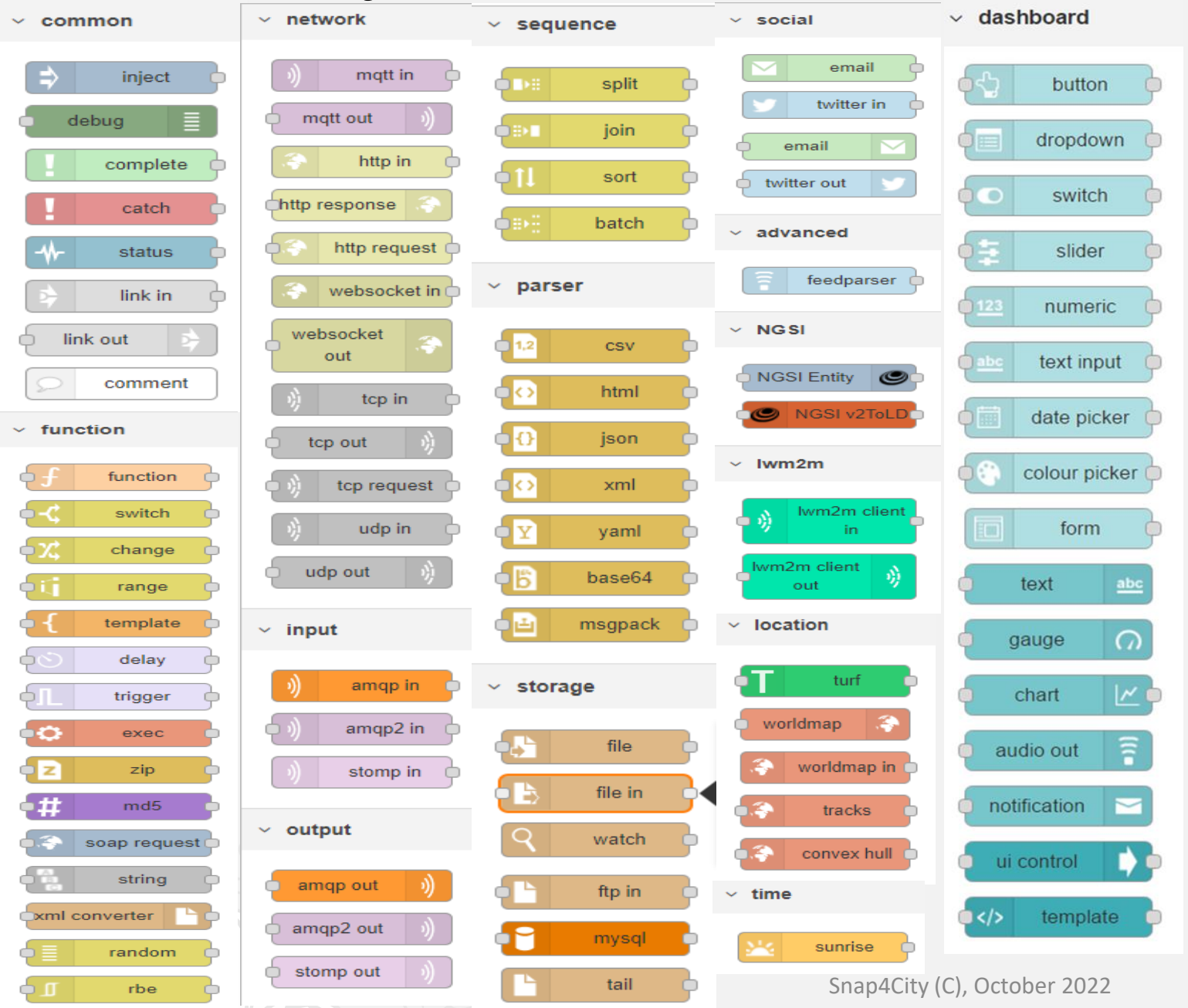

Snap4City
nr1
roottooladmin1
RootAdmin | ldap
Dashboards
My Dashboards
Notificator
IOT Applications
My Personal Data
IOT Directory and Devices
Knowledge and Maps
Micro Applications
External Services
Data Set Manager: Data Gate
Resource Manager: Process Loader
Development Tools
Management
Settings
User Management and Auditing
Help and Contacts
Documentation and Articles
My Profile
Snap4City portal
Km4City portal
DISIT Lab portal
Node-RED
Deploy
filter nodes
flow1
Flow 1
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
show micro web app
service-search-near-marker
world map
point
transform results
world map
event-log
popupopen
msg.payload
msg.payload
timestamp
service-info
vehicleFlow
vehicle flow (car/h)
worldmap
switch
sensor
timestamp
last temperature
Dashboard
connected
get value
temperature
event-log
Temperature
connected to ws://192.168.1.185:9000/se
info
debug
Flow
Name
flow1
ID
"49a71aa0.b297b4"
Status
Enabled
Information
Search for nodes using
Node-RED
77



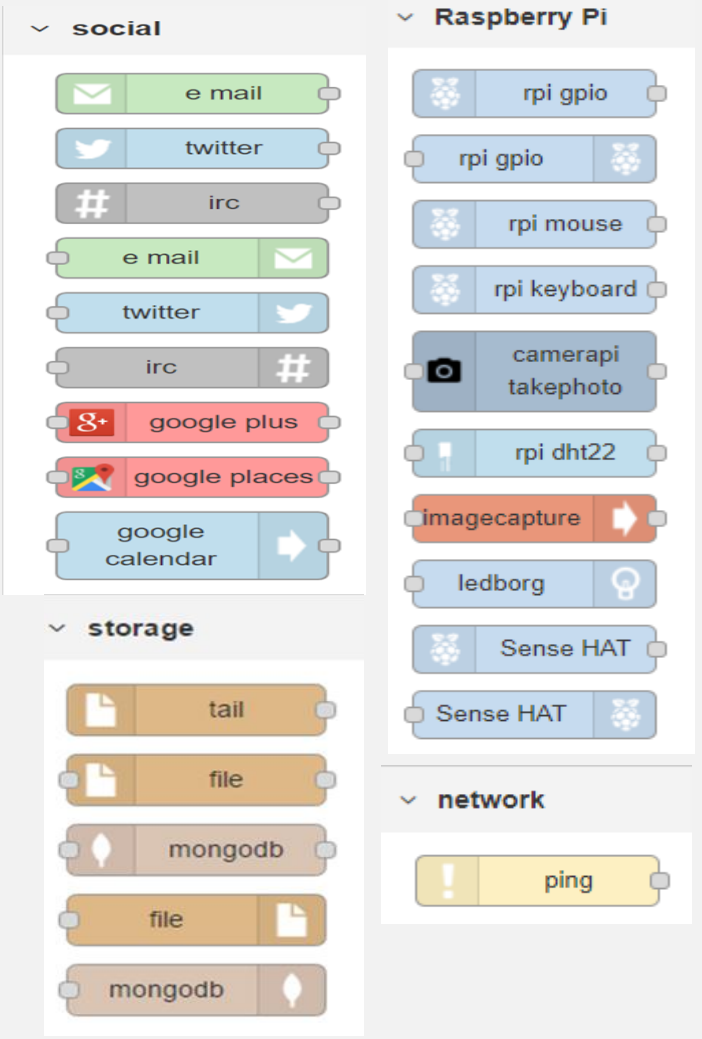
Data Adapation
Transformation, Conversion
Integration
Business Logic vs Dashboards
Data Analytics control
Everywhere: Cloud, on IoT Edge Devices

Basic Node.js Blocks on NodeRed on our Advanced IOT Apps





+ on IOT Edge Raspberry

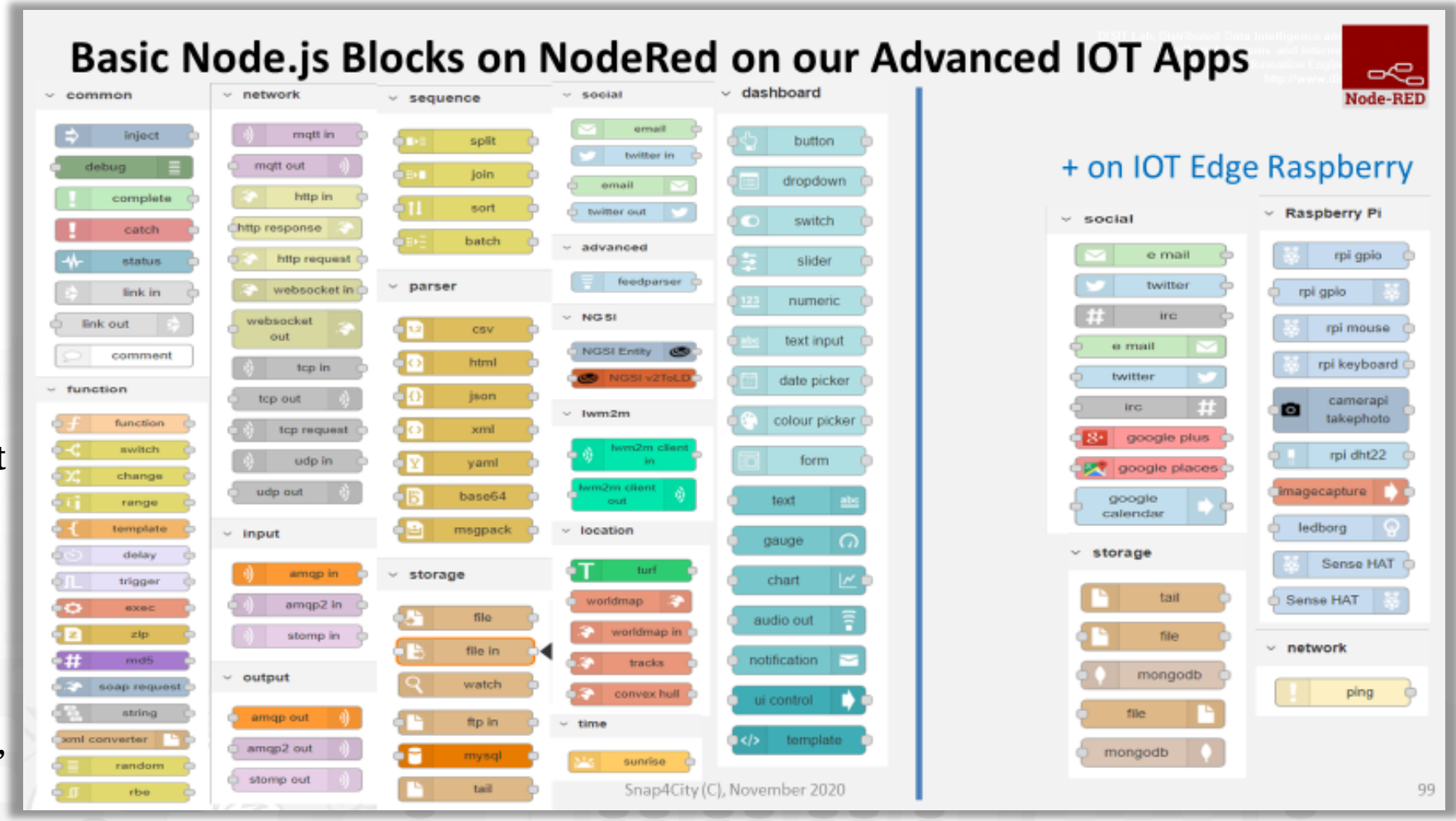


Node-RED Basic Blocks

It is provided with **a minimum set** of functionalities (the building blocks/nodes) while other blocks can be easily added loading them from a **large library** made available by the **JS Foundation**.

Despite to its diffusion, for the usage in the context of Smart City it was **not powerful** to cope with the **basic requirements** of the domain.

The classical nodes provided in the standard version can be classified as: input, output, function, social, storage, analysis, advanced, and dashboard.



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.

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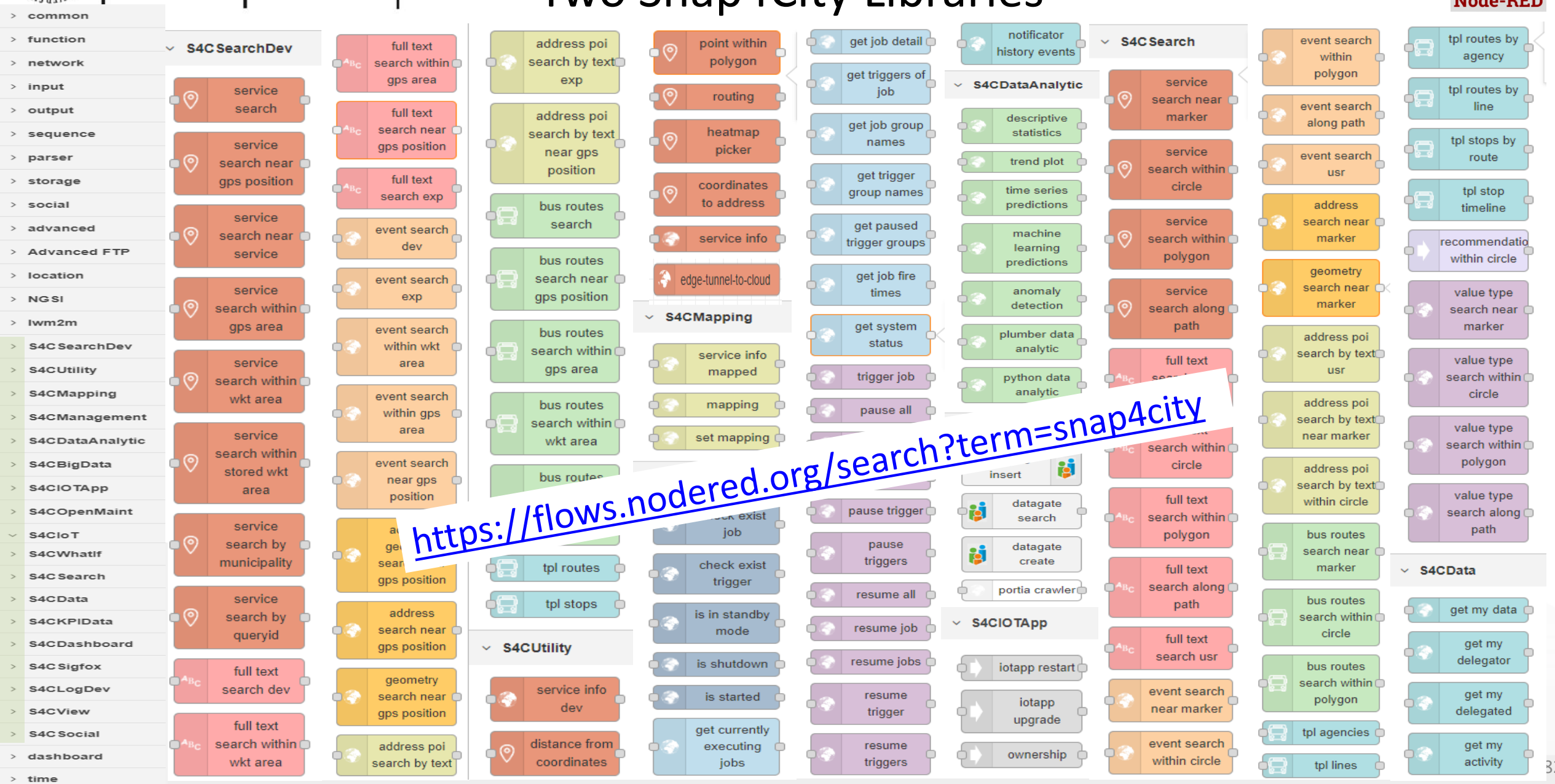
Sept 2022 collection

Two Snap4City Libraries

SNAP4CITY | Node-RED



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

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Sept 2022 collection

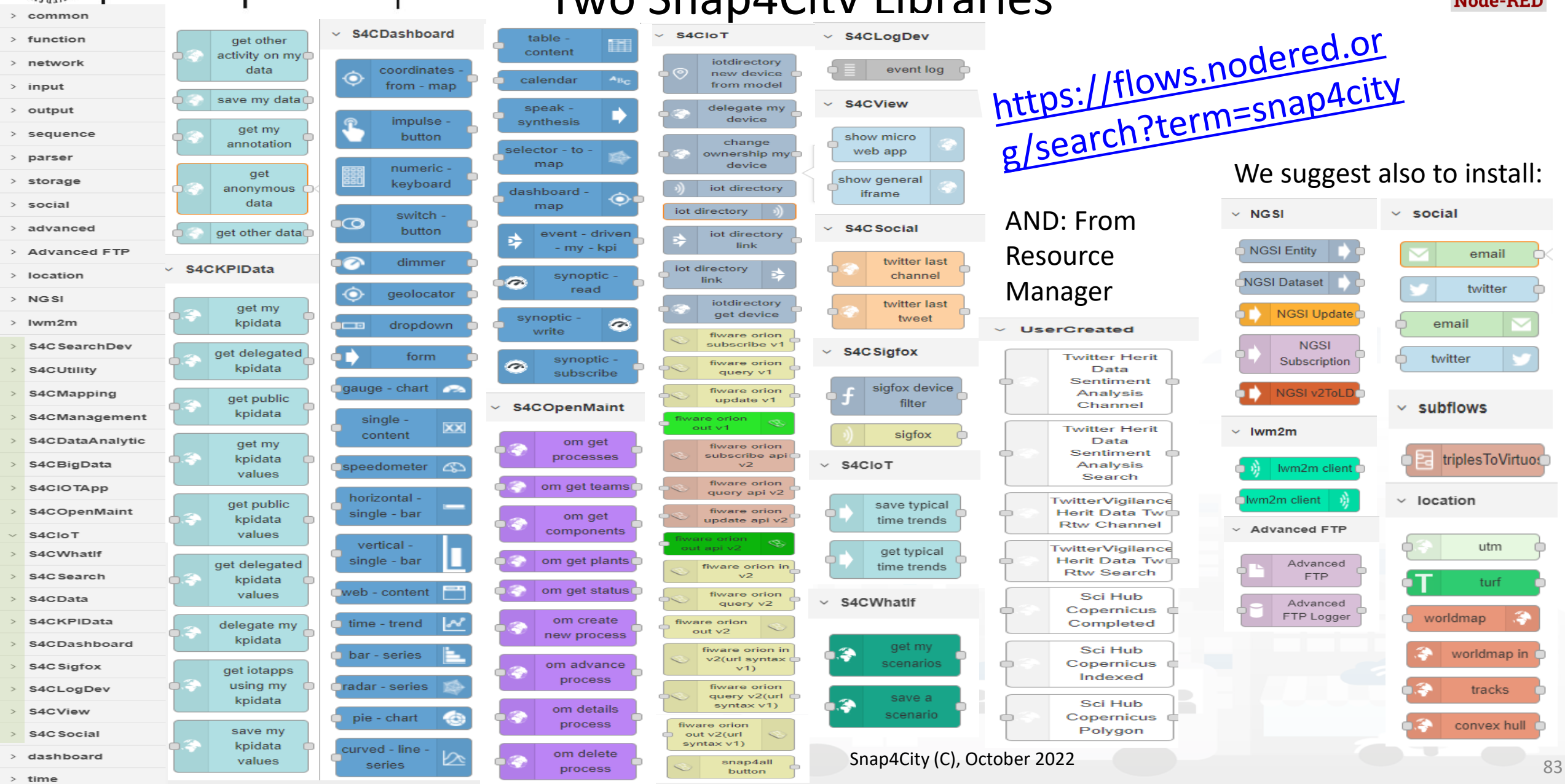
Two Snap4Citv Libraries

SNAP4CITY | Node-RED

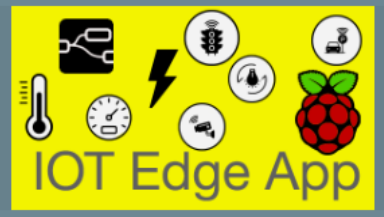
https://flows.nodered.org/search?term=snap4city

We suggest also to install:

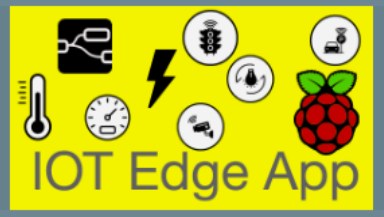
AND: From Resource Manager



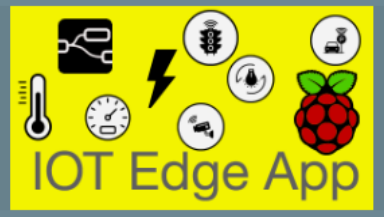
IOT Applications

2018-09-14T04:44


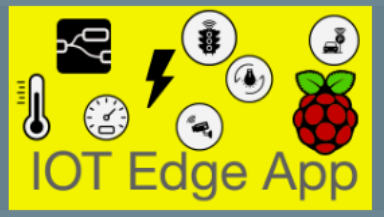
owner: badii
Management

2018-09-21T03:19


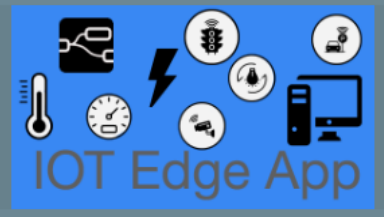
owner: panesi
Management

2018-10-19T16:07


owner: pb3
Management

2018-10-19T17:17


owner: pb3
Management

2018-10-22T11:57


owner: semolarudy
Management

application

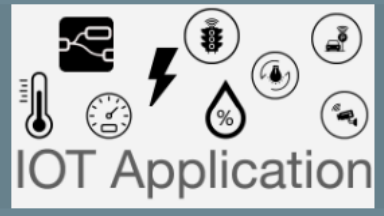

owner: tester5
Management

Bib APP


owner: semolarudy
Management

ChargingStations


owner: comunedashres
Management

Deprecated - SiiMobilityControlRoom


owner: badii
Management

SamsungGalaxyS4BarCode


owner: badii
Management

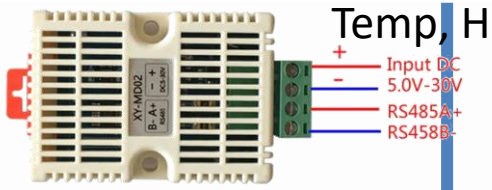
esercitazione


owner: tester2
Management

Iot-App


owner: tester14
Management

Devices

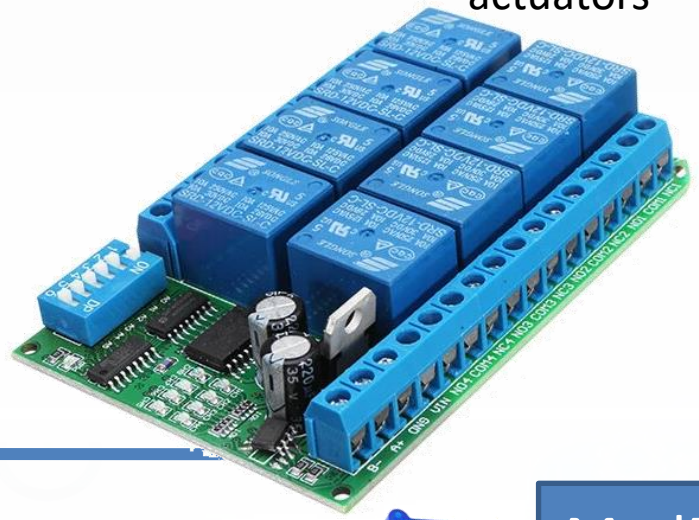


Temp, Humidity

Energy Metering

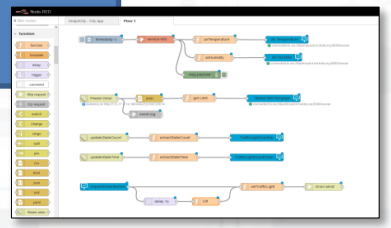
Modbus

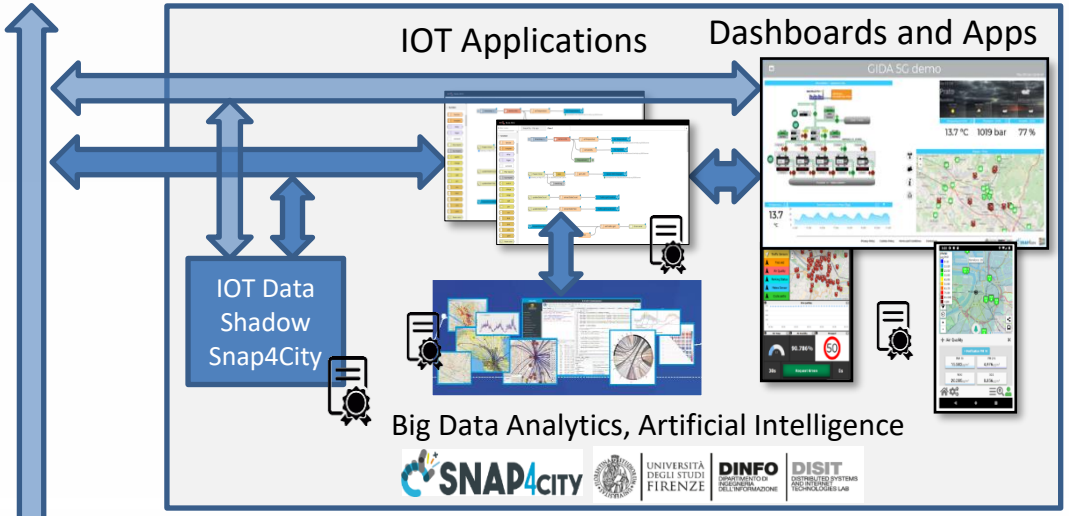
8 Relais, actuators



USB -- ModBus

ModBus to Snap4City Gateway Edge





- A large range of devices: sensors and actuators
- Over serial as RS485 and/or IP

Snap4Home

Sonoff: Controlling Energy Power

Philips Hue: Controlling Lights

Hue: Motion Control / Alarm

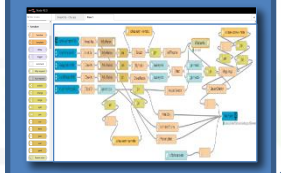
Measuring
Energy Consumption

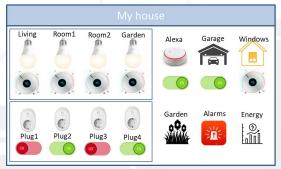
TP Link: Controlling / Measuring Energy Plugs

Alexa: Voice Control

IOT Edge:

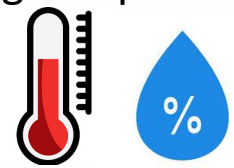
Raspberry pi: Node-RED + Snap4City





Local Control

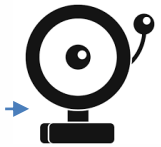
Measuring Temperature and Humidity



Garage Door

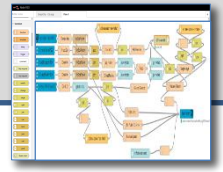
Window
Roller Shutters

Controlling Motors

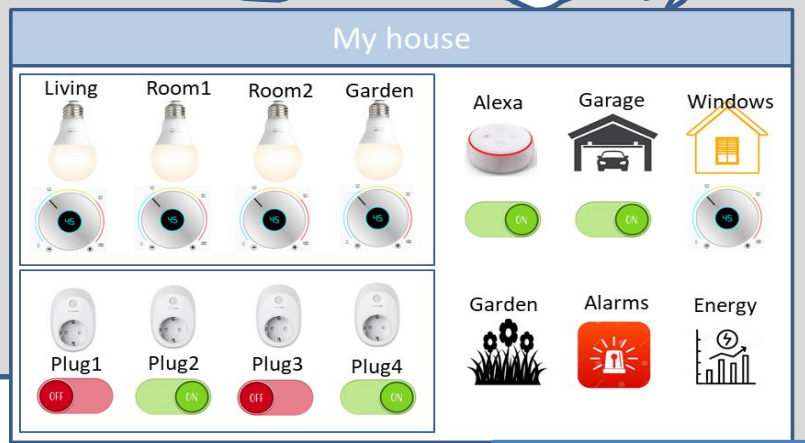


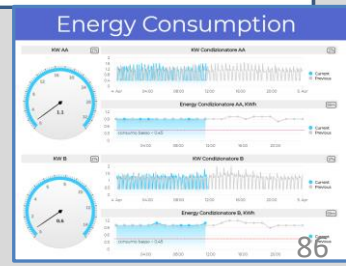
Alarm sound
and light

Controlling
Irrigators



SNAP4CITY





Environmental Contextual data from the city
Historical Data, Remote Control, Mobile App

https://www.snap4city.org/620

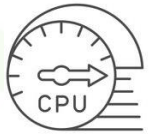
Snap4Home

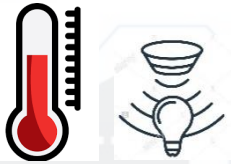
Hue Hub

Motion Control / Alarm

TP Link plugs: meter

Alexa: Voice Control





IOT Edge:

Raspberry pi: Node-RED + Snap4City MicroService Library

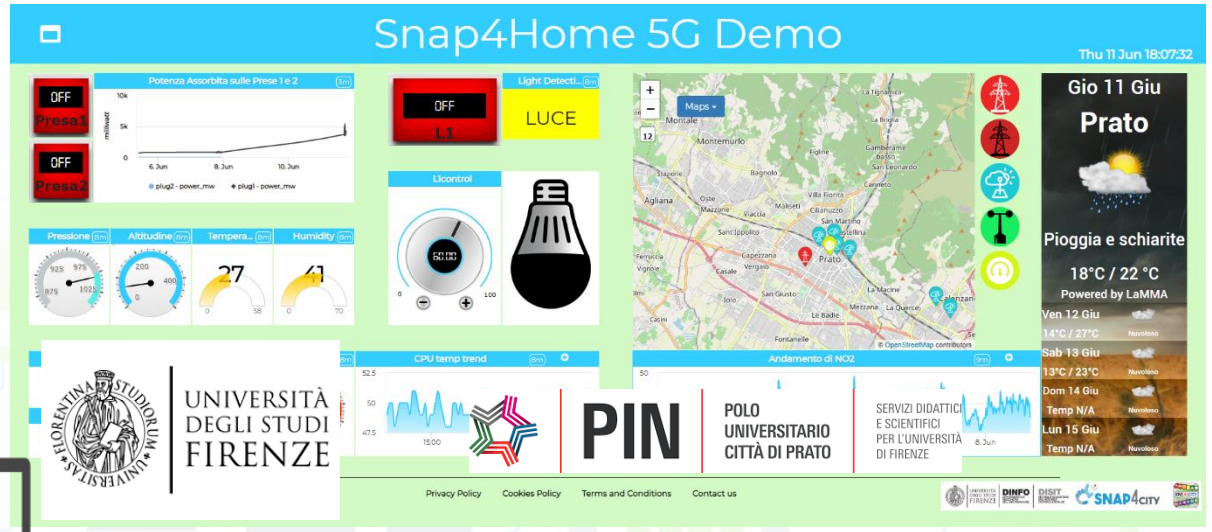
5G gateway

FIWARE Orion Broker

Dashboards

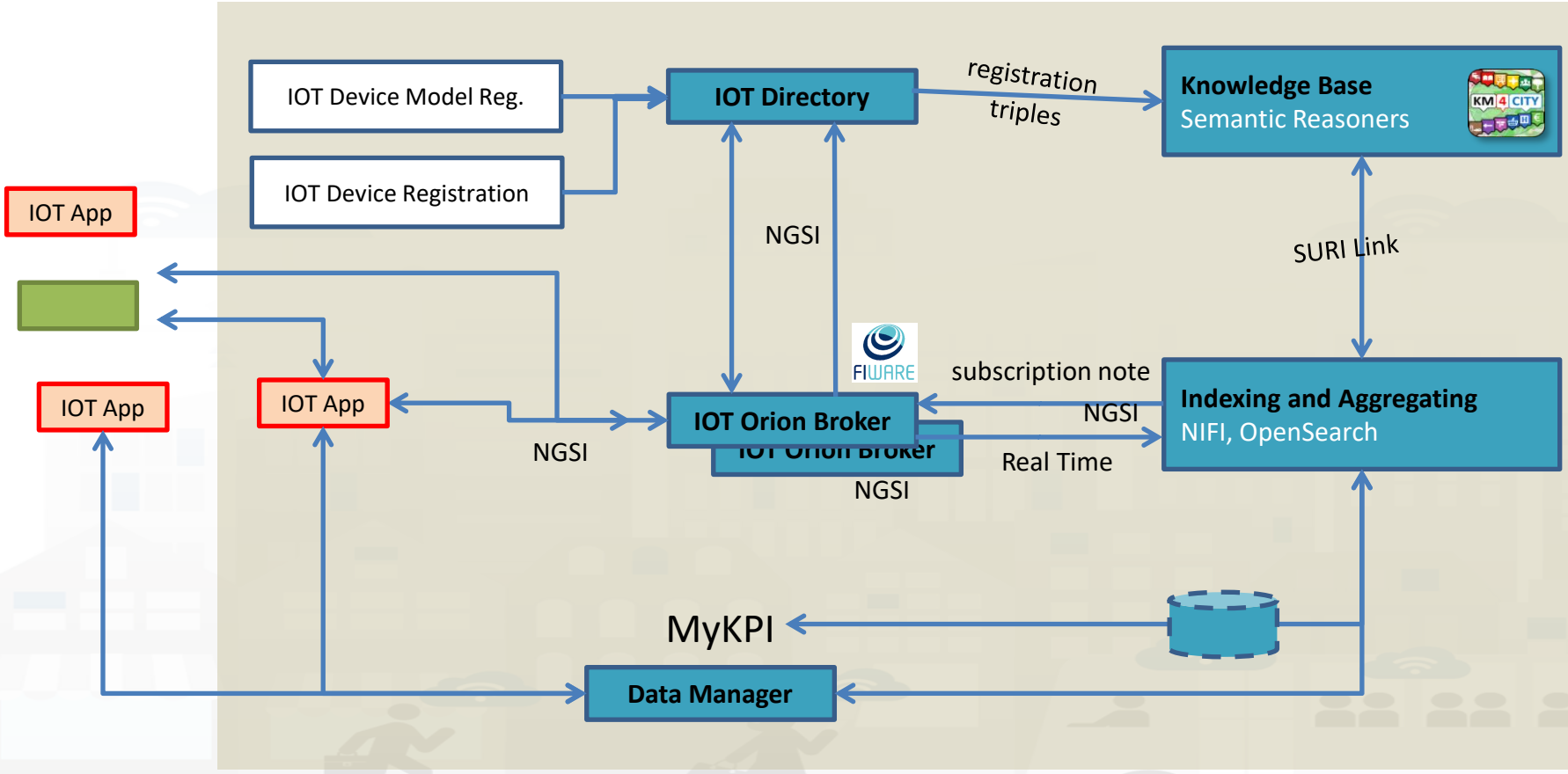
Advanced Smart City API

Environmental Contextual data from the city. Historical Data, Remote Control, Mobile App



https://www.snap4city.org/369

Main IoT Data In/Out flows

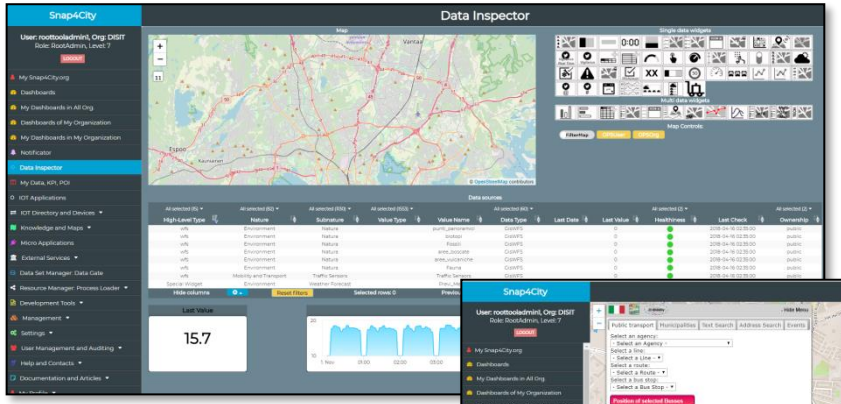


Checking data ingestion results

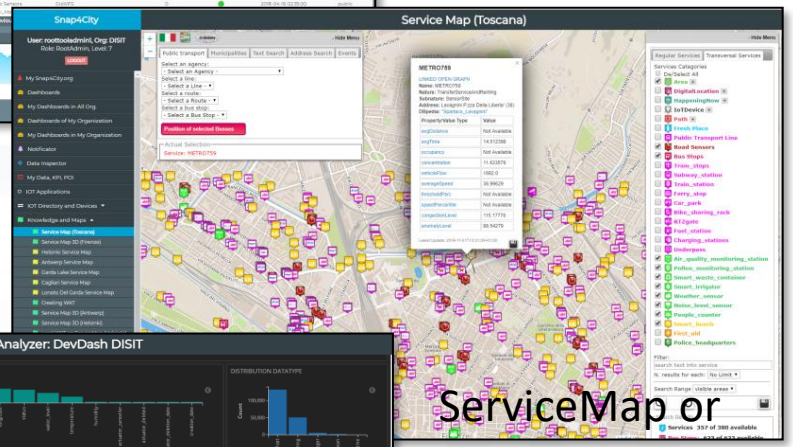
Knowledge base
Semantic reasoners

- All searches
- Metata
- Structure
- Last values of IOT Dev
- GTFS
- Only public IOT Dev

- **Data Inspector**
- **ServiceMap**, SCAPI
  - LOG / LOD viewer
  - Super Service Map
- IOT Directory
- SCAPI: Swagger
- IOT Broker



Data Inspector
Digital Twin view

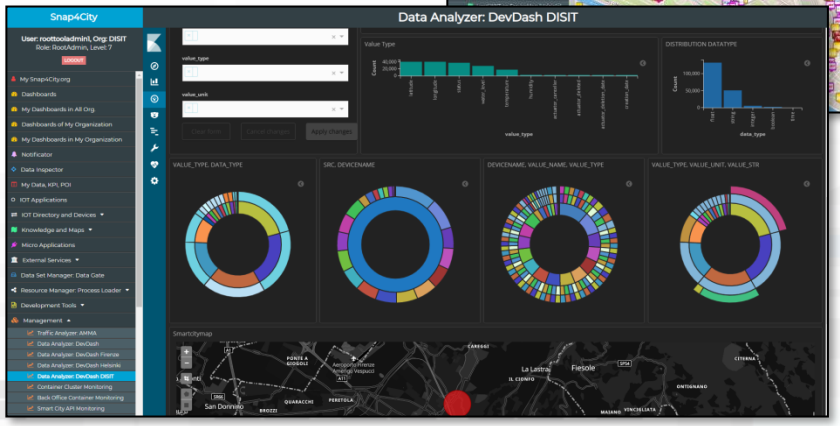


ServiceMap or
Super ServiceMap

Indexing and aggregating
NIFI, OpenSearch

- Faceted search
- Geo search
- Time Series
- Private and Public

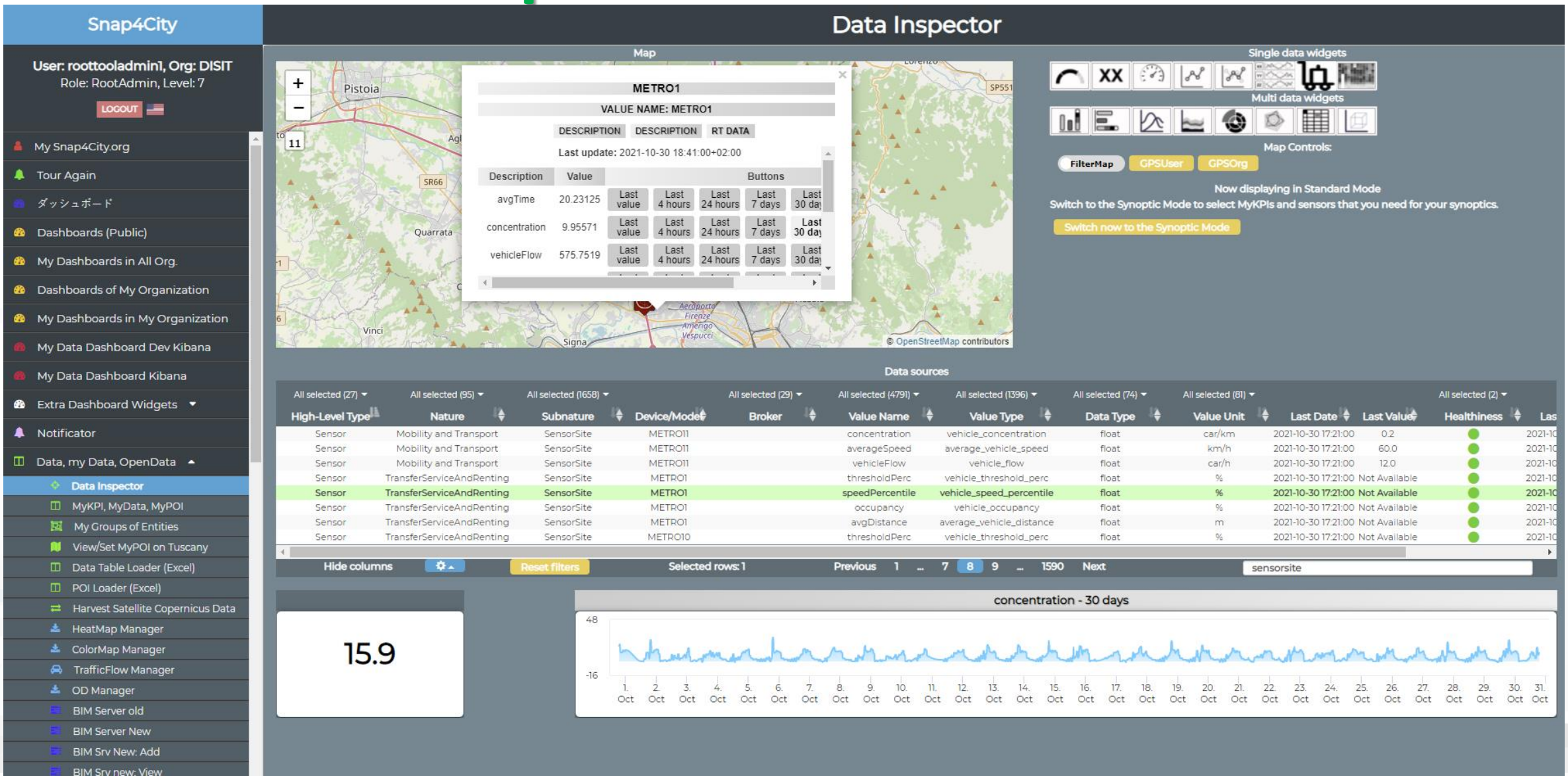
- **Data Inspector**
- **ServiceMap**, SCAPI
- **My Data Dashboard** (Kibana), DevDash
- OpenDistro x Elastic Search



My Data Dashboard
DevDash

Some functionalities are limited to certain roles

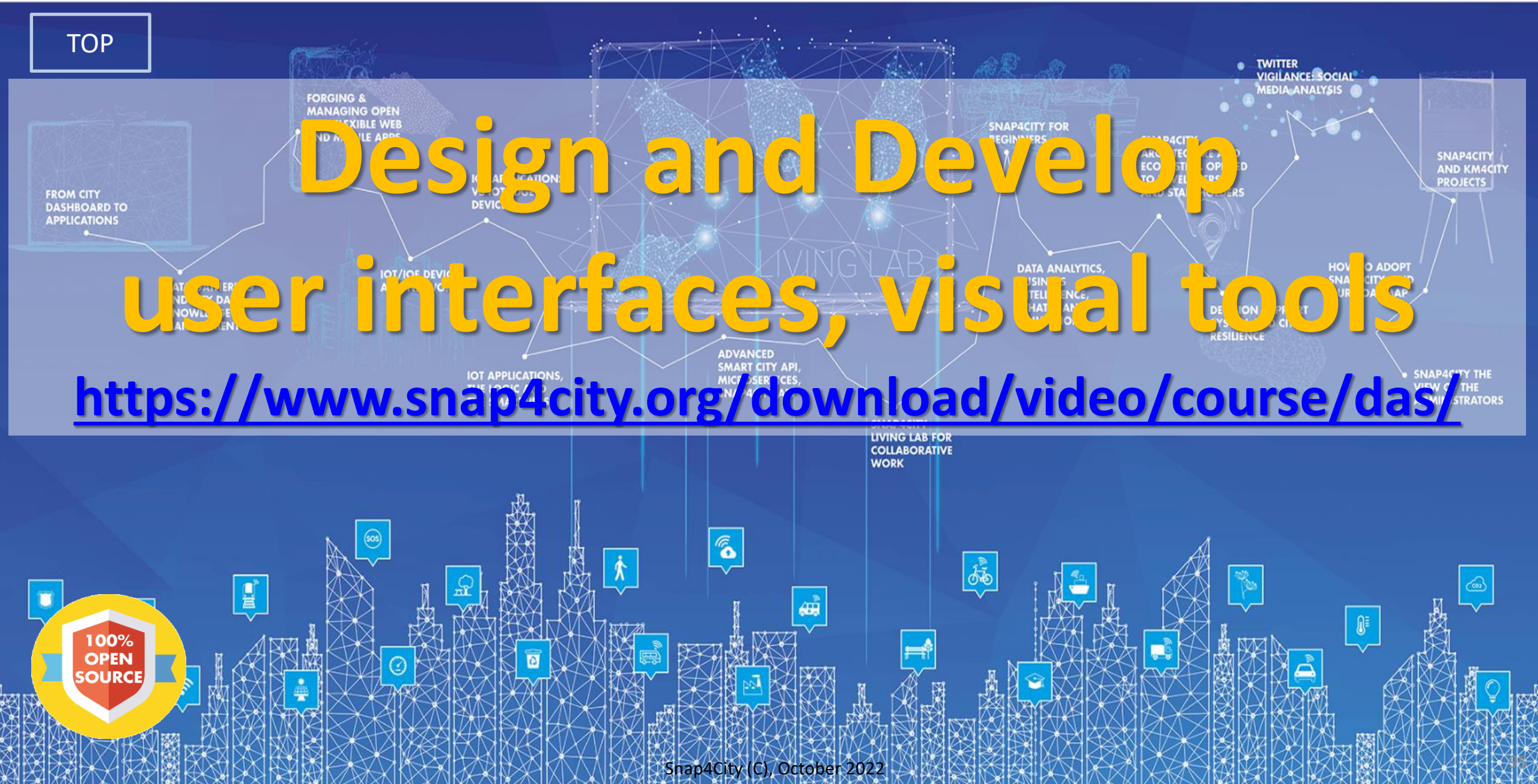
Data Inspector: HLT classification



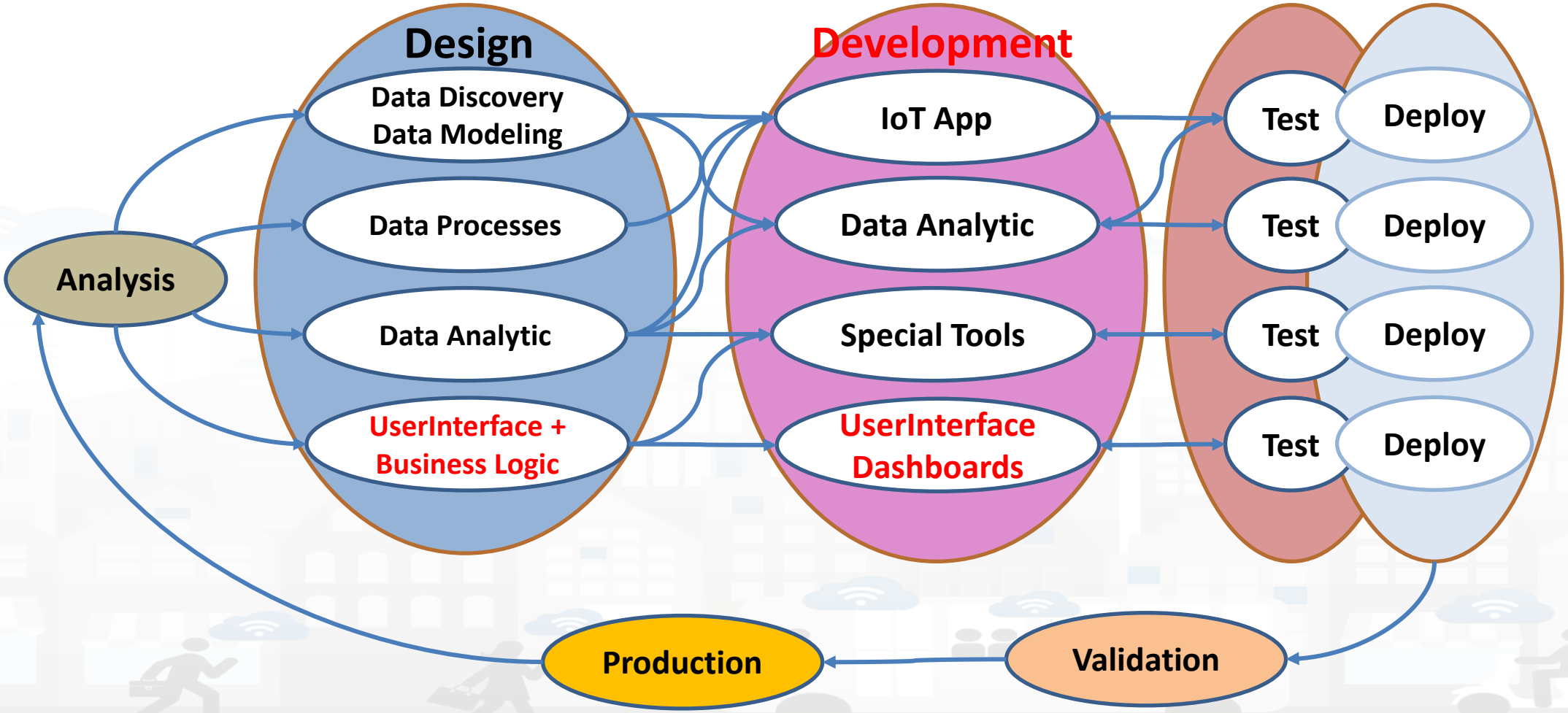
TOP

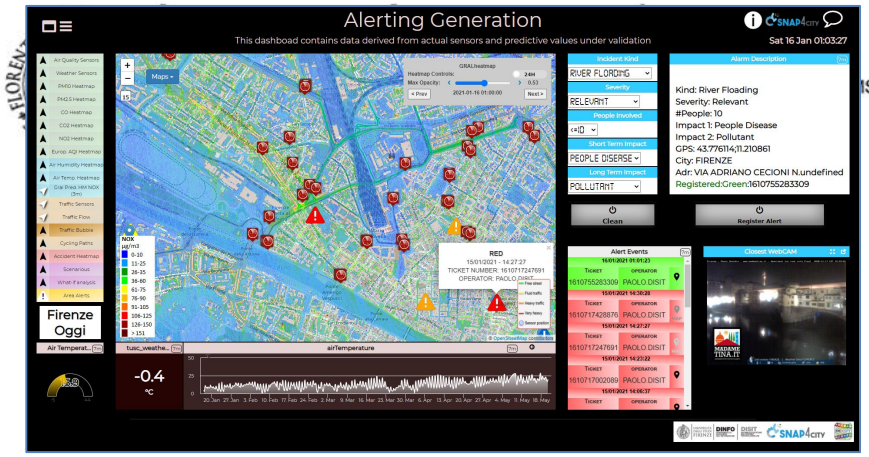
Design and Develop user interfaces, visual tools

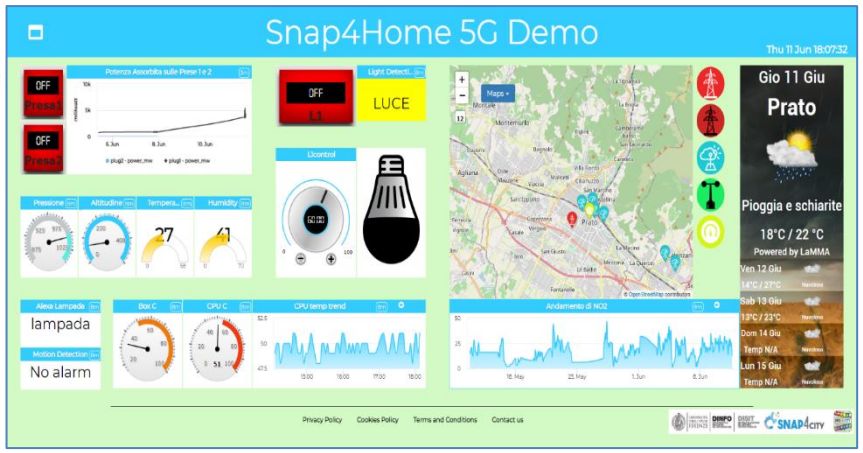
https://www.snap4city.org/download/video/course/das/

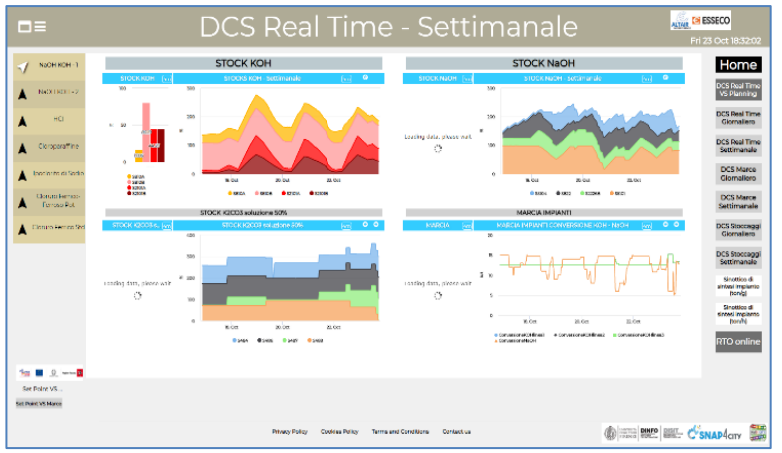


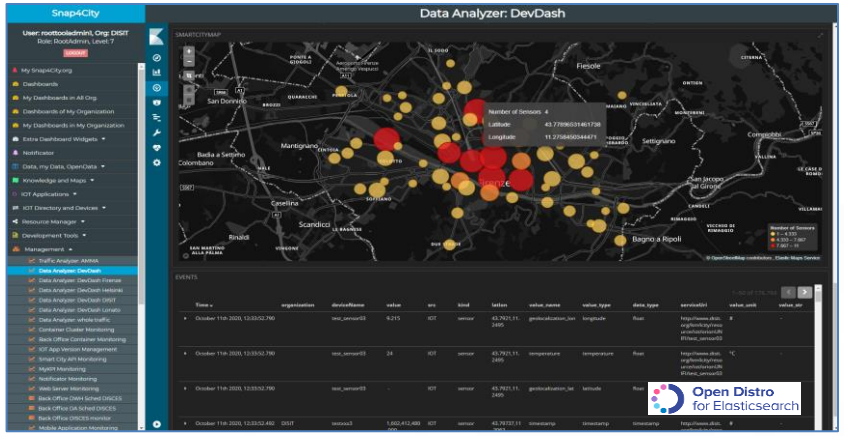
Development Life Cycle Smart Solutions

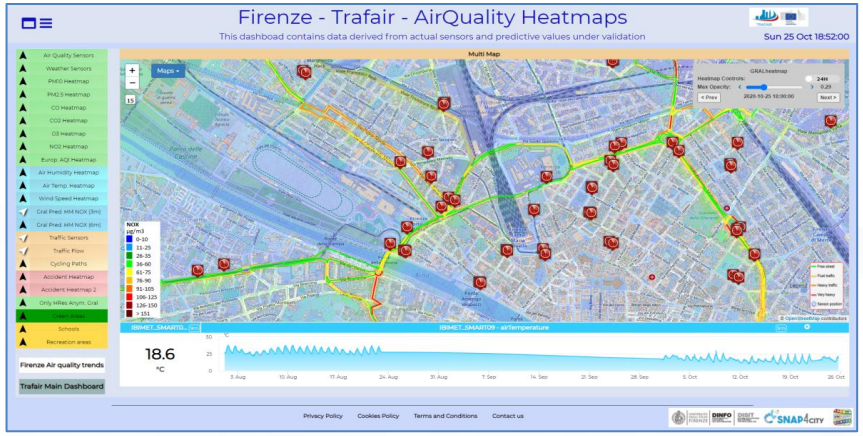


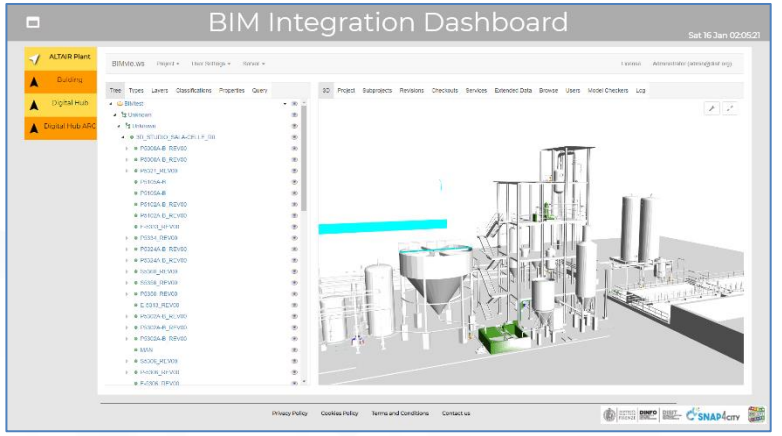

Alerting Generation
This dashboad contains data derived from actual sensors and predictive values under validation
Sat 16 Jan 01:03:27
Firenze Oggi
-0.4

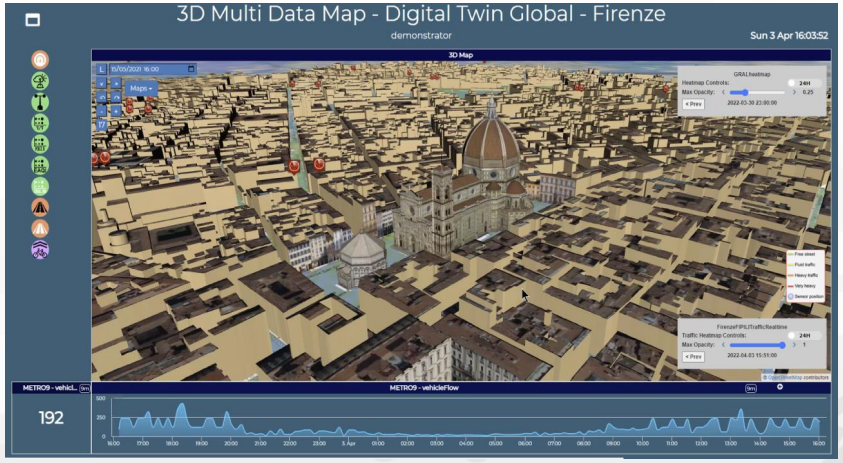

Snap4Home 5G Demo
Thu 11 Jun 18:07:32
LUCE
lampada
No alarm
Gio 11 Giu
Prato
Pioggia e schiarite
18°C / 22 °C

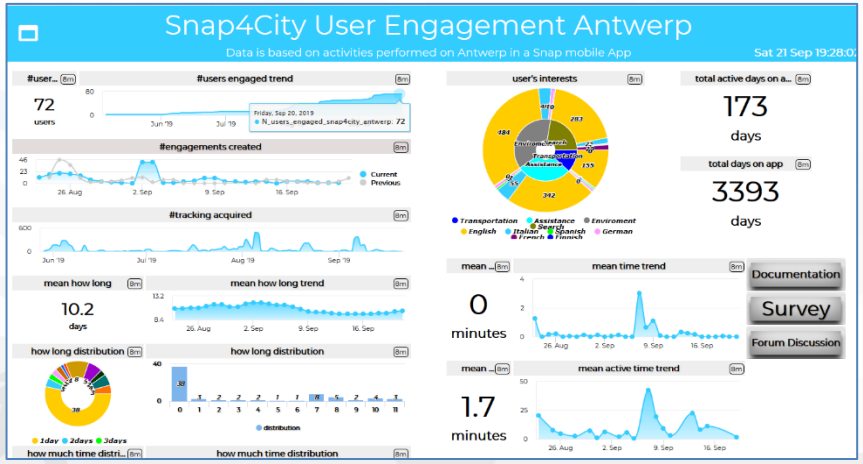

DCS Real Time - Settimanale
Fri 23 Oct 18:32:02
STOCK KOH
STOCK NaOH
Home

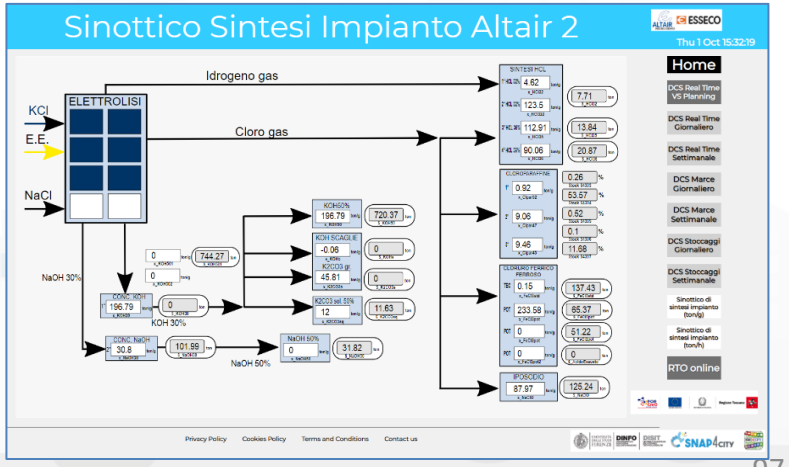

Data Analyzer: DevDash
Open Distro for Elasticsearch


Firenze - Trafair - AirQuality Heatmaps
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 25 Oct 18:52:00
18.6

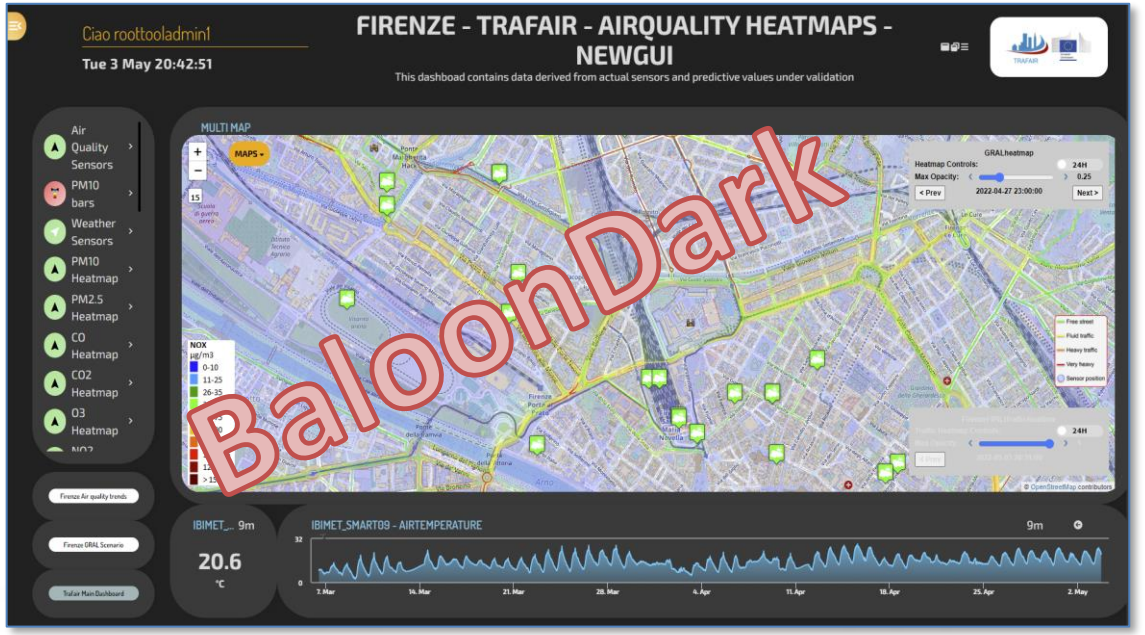

BIM Integration Dashboard
Sat 16 Jan 02:05:21

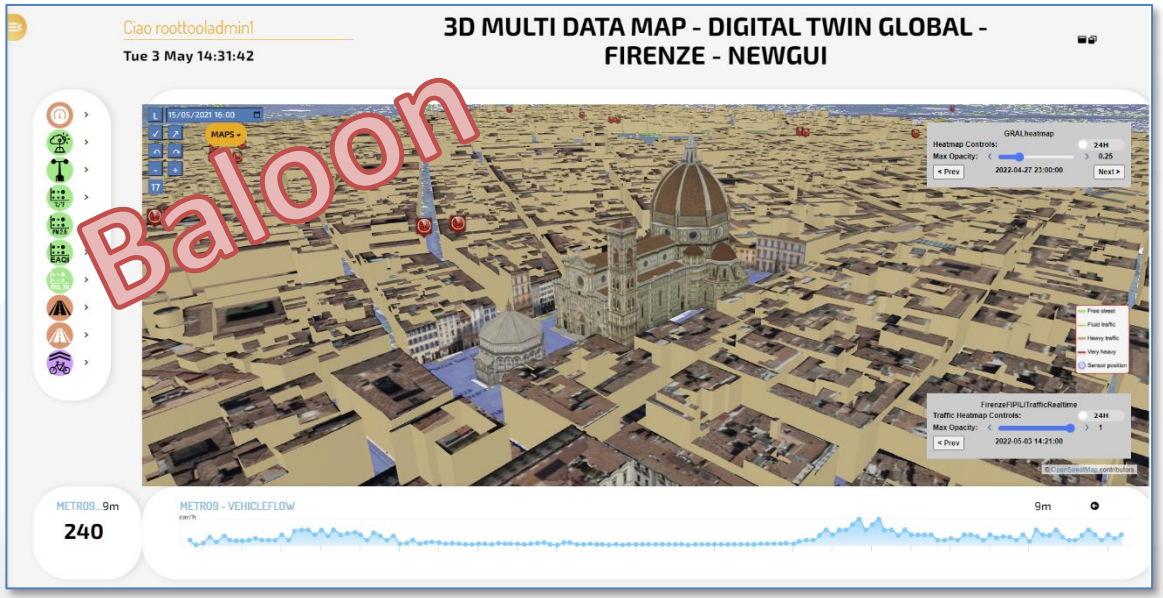

3D Multi Data Map - Digital Twin Global - Firenze
demonstrator
Sun 3 Apr 16:03:52
192

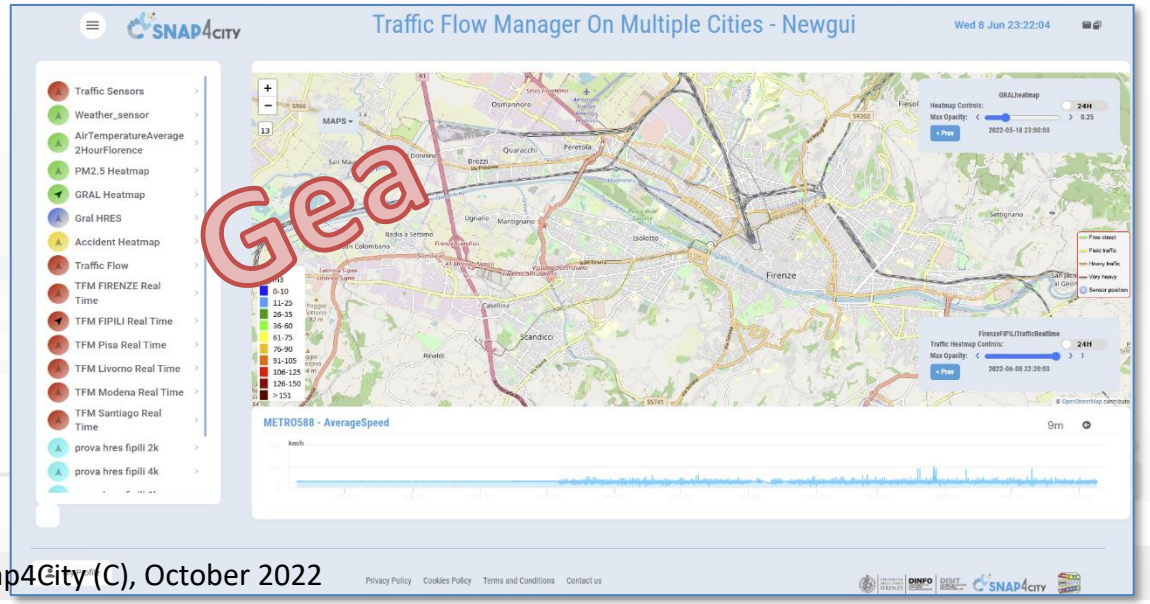

Snap4City User Engagement Antwerp
Data is based on activities performed on Antwerp in a Snap mobile App
Sat 21 Sep 19:28:0
72
173
days
3393
days
10.2
days
0
minutes
1.7
minutes
Documentation
Survey
Forum Discussion


Sinottico Sintesi Impianto Altair 2
Thu 1 Oct 15:32:19
Home
Idrogeno gas
Cloro gas
ELETTROLISI
KCl
E.E.
NaCl
NaOH 30%
KOH 30%
NaOH 50%

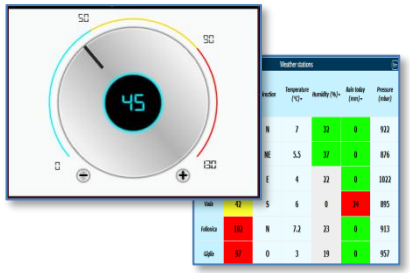
Different Themes

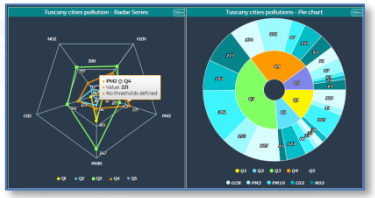


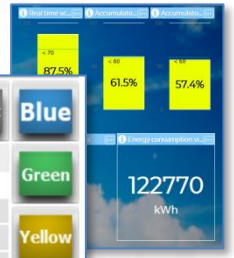


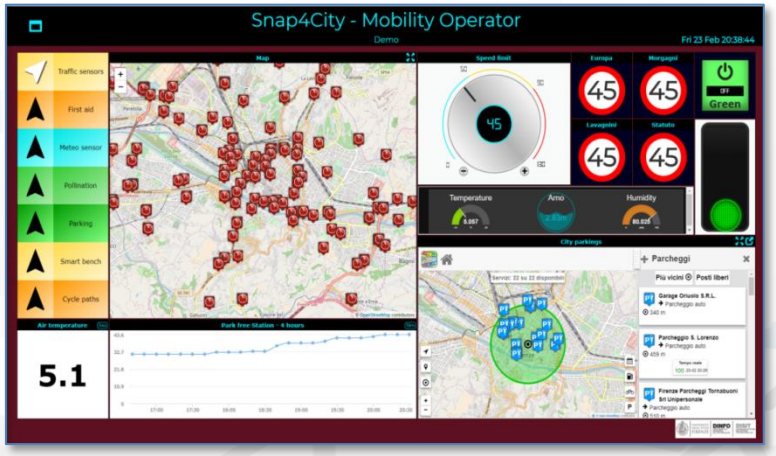


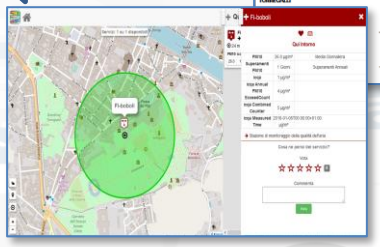
Dashboard List and Editor

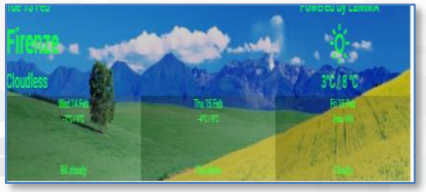


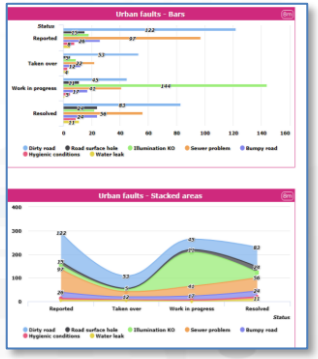




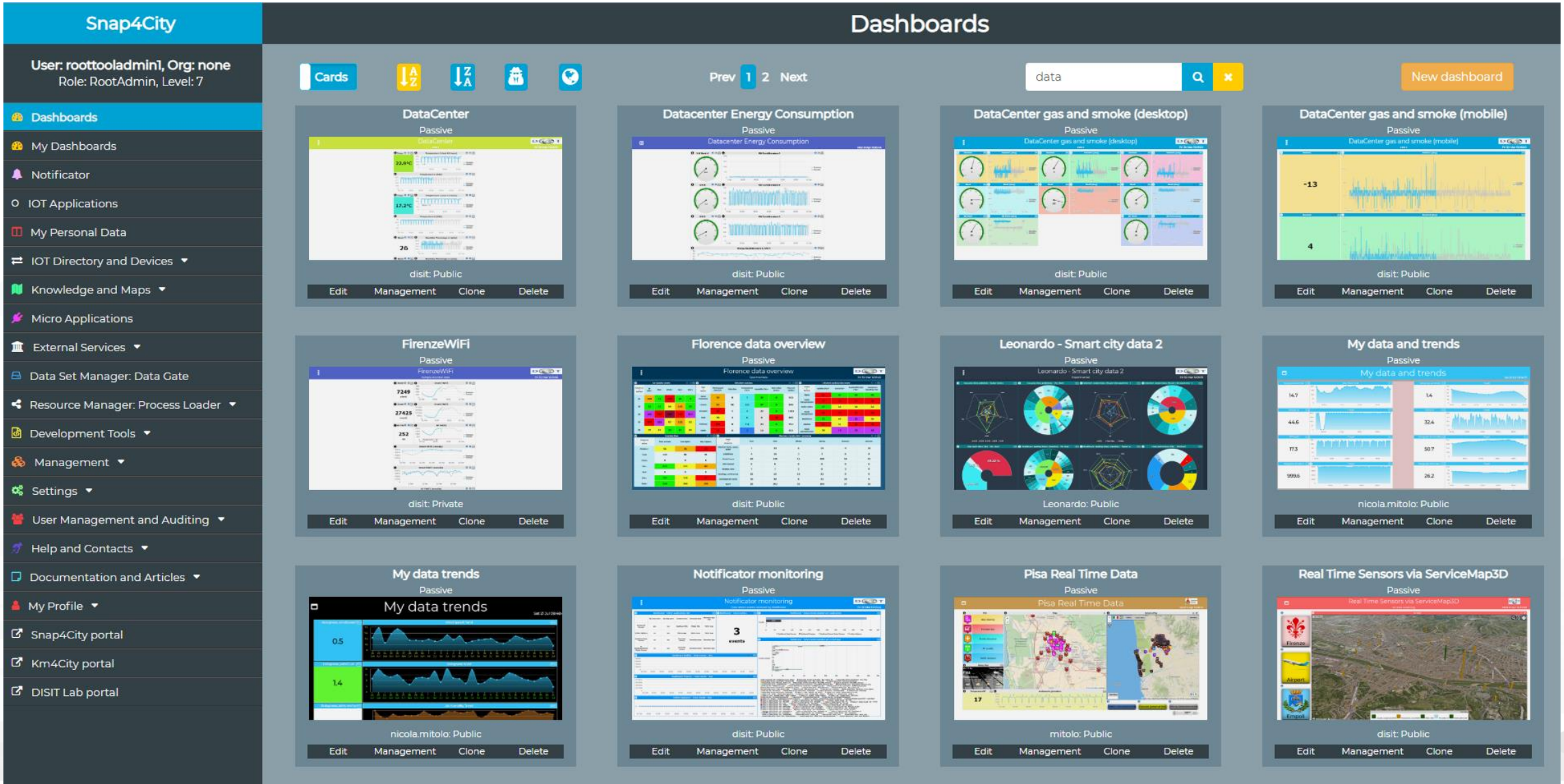








Dashboard List and Editor



A Dashboard Design Schema is provided

In the following section, the schema that should be adopted to design each single Dashboard/view of the solution.

IV.B.7. Example of Dashboard Schema

For each Dashboard or View we suggest to specify:

Name	Vehicle dashboard
	
Aim	Display vehicle information and measured values
Purpose	Monitoring
Status	Draft
Missing	None
Preferred size	PC
Style	PA
Chat enabled	No
Kind	Active
Data vs Widget	**Map Widget** • Description: map showing the vehicle position over time • Kind: monitoring only • Preferred Data representation: map • Data: Vehicle.latitude, Vehicle.longitude **DataTable Widget** • Description: table reporting the vehicle events • Kind: monitoring only • Preferred Data representation: table • Data: VehicleEvent.eventID, VechicleEvent.dateObserved, VehicleEvent.status, VehicleEvent.kind **SingleContent Widget** • Description: single content showing the total km travelled by the vehicle • Kind: IoT App • Preferred Data representation: single number • Data: Vehicle.kmTotal **Synoptic Widget** • Description: battery shaped synoptic to represent the available energy percentage • Kind: monitoring only

	• Preferred Data representation: animated synoptic • Data: Vehicle.energyLevel **Time series Widget** • Description: to plot the evolution of the velocity and acceleration values over time • Kind: SC Business Logic • Preferred Data representation: time series plot • Data: Vehicle.velocity, Vehicle.acceleration
Client Side Business Logic	• **To be developed in JavaScript into the Dashboard Widget** • Event driven: .....

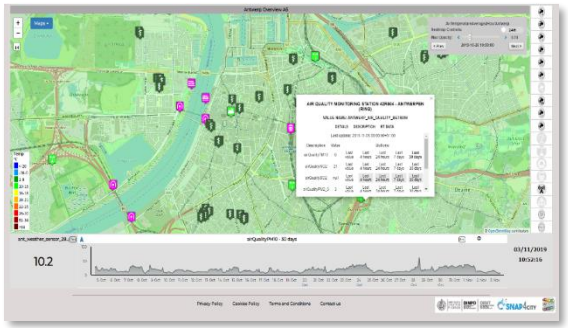
Server Side Business Logic	• **To be developed in IoT App with S4C Dashboard Nodes**
	• IoT Application →
	  ○ Event driven: .....
	• IoT Application →
	  ○ Event driven: .....

As can be seen in the example dashboard schema above, several information must be specified:

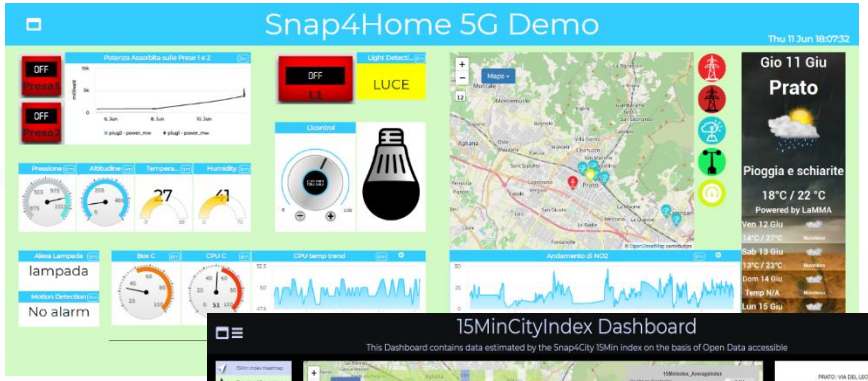
- Name: name or ID of the dashboard
- Mockup: a graphical example showing the overall appearance of the dashboard. This can be realized using some graphic painting tool (a screenshot of an empty dashboard can be used as background element)
- Aim: a description of the dashboard
- Purpose: it can be monitoring, simulation, what-if, data entry, etc. Multiple values are possible.
- Status: it can be draft, developed, finalized, accepted
- Missing: in this field list all missing element that should be included in future
- Preferred Size: specify the preferred viewing size of the dashboard, such as PC, HD, mobile, or an explicit resolution size (row x column)
- Style: the base style to be used for the dashboard. Available styles include Gea, Ballon, PA, Ballon Dark, etc.
- Chat enabled: yes or no
- Kind: passive or active. A passive dashboard show data taken from storage only, without sending actions toward an IoT App; however, passive dashboards may have selectors, maps, etc., and a lot of interactive visualization that do not requires neither changes in the status on server, nor sending commands to the server side. Differently, active dashboards, are those that send or receive commands to/from the server side, via some client-side Business Logic, server side Business Logic on IoT Apps, or both
- Data vs Widget: for each widget required in the dashboard, some information must be specified according to the following schema:
  - Name: the name of the widget to be used
  - Description: a brief description of the widget and its use
  - Kind: monitoring, IoT App, or Client-Side business logic (note that, the last two entries characterize an active dashboard)
  - Data: the data the be used in the widget, typically retrieved from some IoT device. Multiple entries can be accepted.
- Client Side business logic: to be specified if present
  - Description of the effects: a description of the implemented client-side business logic effects
- Server Side business logic: to be specified if present
  - IoT App: description of the involved IoT App
  - Event driven: indicate to which events the IoT App responds

Dashboard Kind

- **Passive Dashboards**: showing data taken from Storage only, no actions toward IoT App
  - Passive dashboards may have Selectors, maps, etc., and a lot of visualization without changing the status on Server, no sending commands to the Server Side.



- **Active Dashboards, which can be those sending or receiving commands to/from the logic coded somehow and in particular for**
  - **Server Side Business Logic** → logic on IoT Apps with Snap4City Dashboard Nodes, which is easier to be programmed begin based on Node-RED visual programming.
  - **Client Side Business Logic** → logic on JavaScript on specific Dashboard Widgets only for skilled developers of Snap4City Platform. We suggest first prototype by using Server Side Business Logic, then pass to Client Side Business Logic in JavaScript.
  - Both kind of Business Logics may be active on the same Active Dashboard.



How the Dashboards exchange data

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

Req. ServiceURI

Metric, KPI

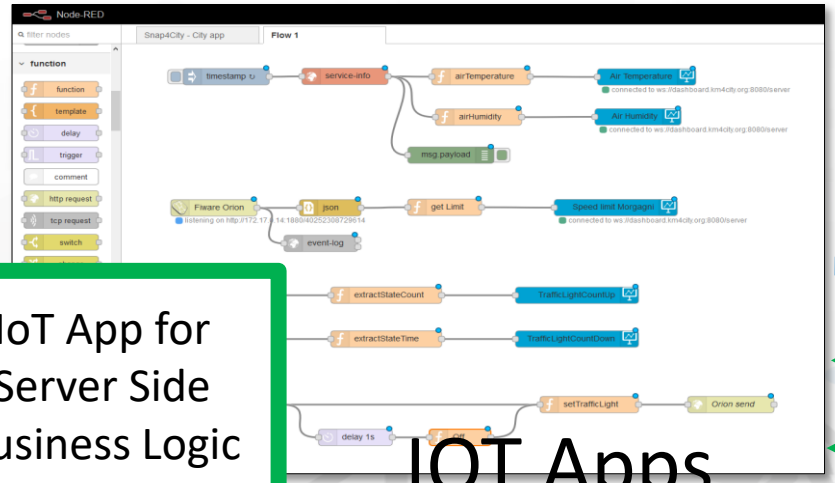
MyKPI, MyPOI, …

Req. KPI, Metric ID

Req. MyKPI ID

API, External Services, MicroApp

Traffic Flow, MAPS, Heatmaps GIS, HTTPs URLs



IOT Apps

ServiceURI (ID)
MyKPI, Metric (ID)
Dynamic Data, computed into IOT Application

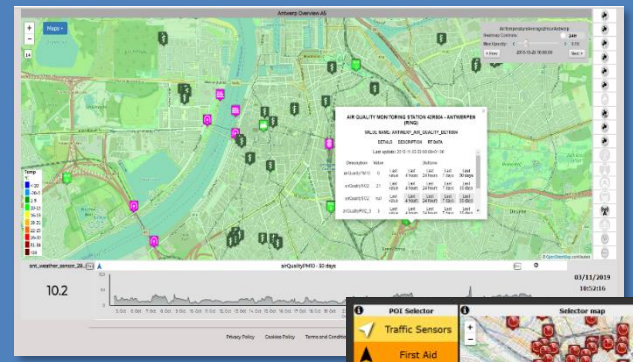
Rx. Dynamic Data

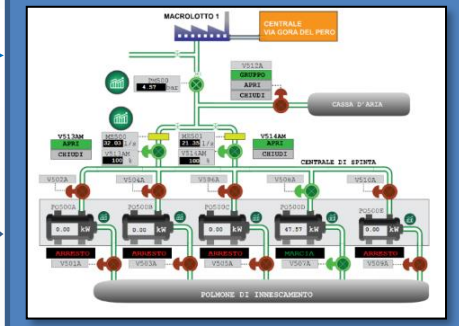
Event Driven Synoptics

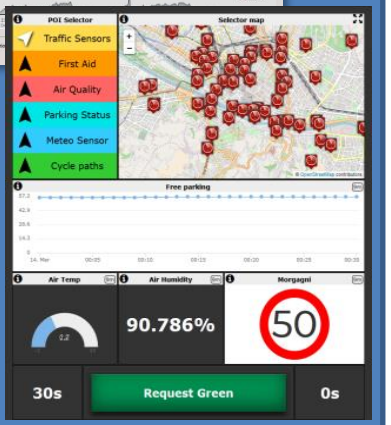
Actions, Show

IoT App for Server Side Business Logic

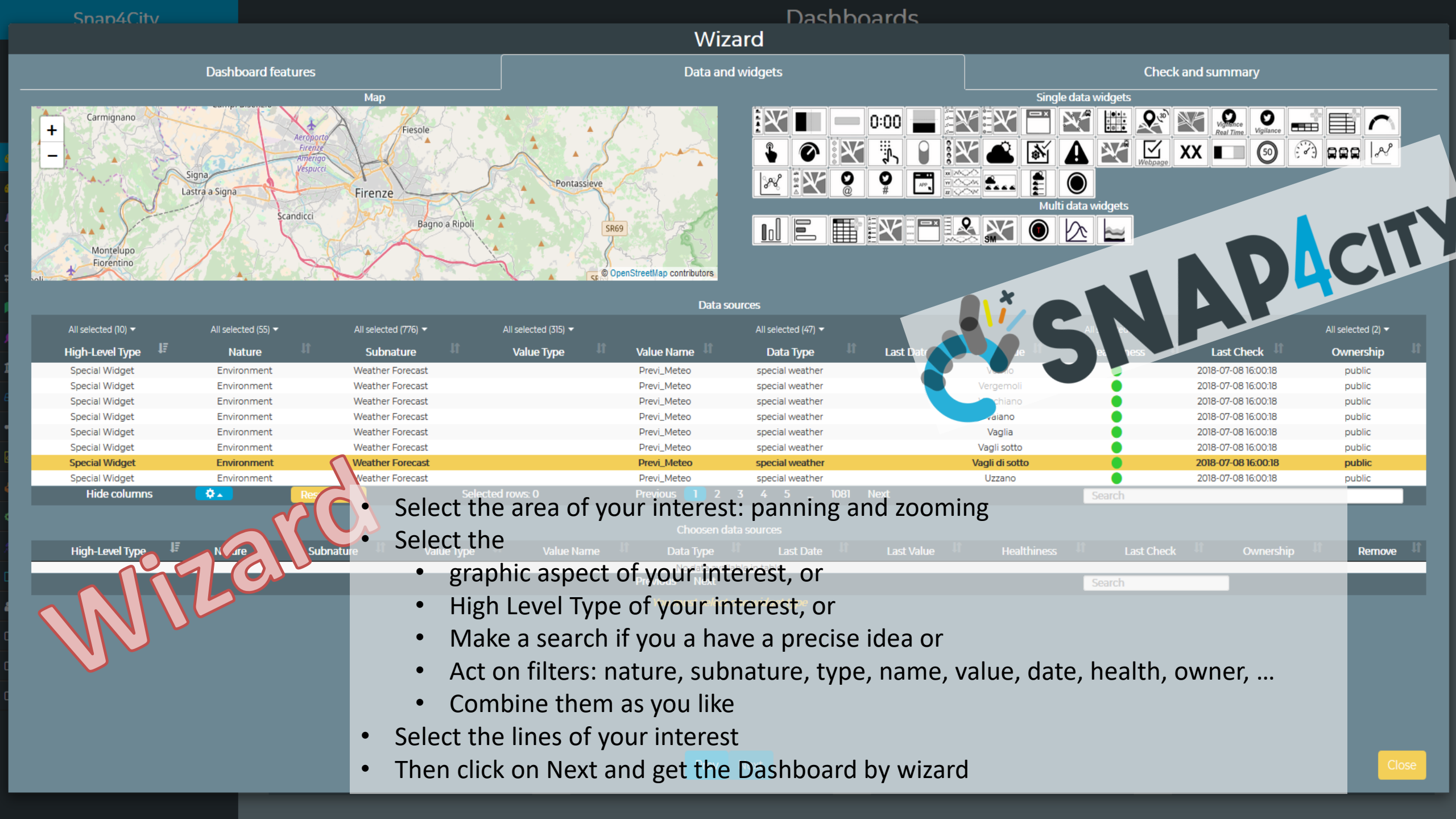
Dashboards



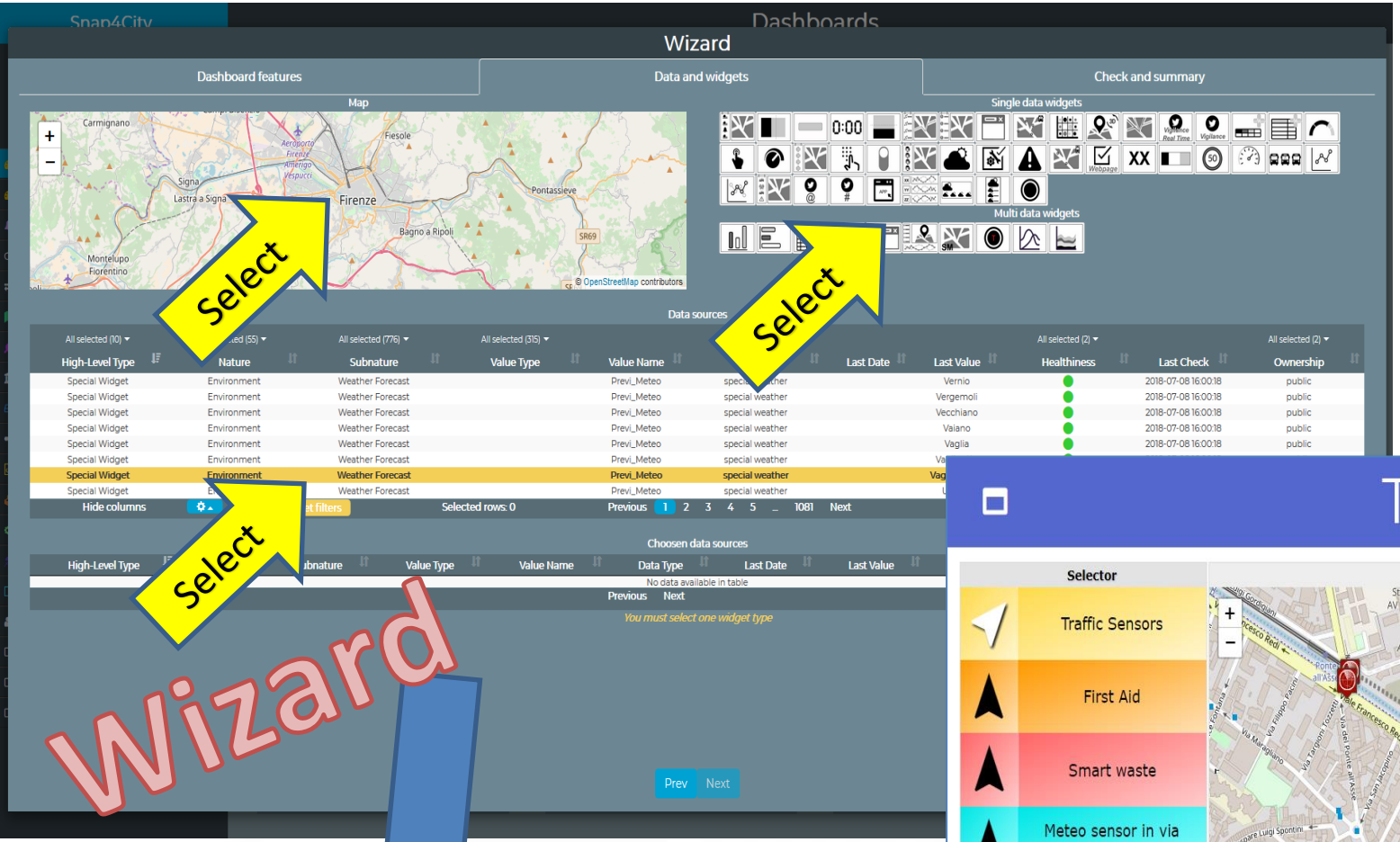


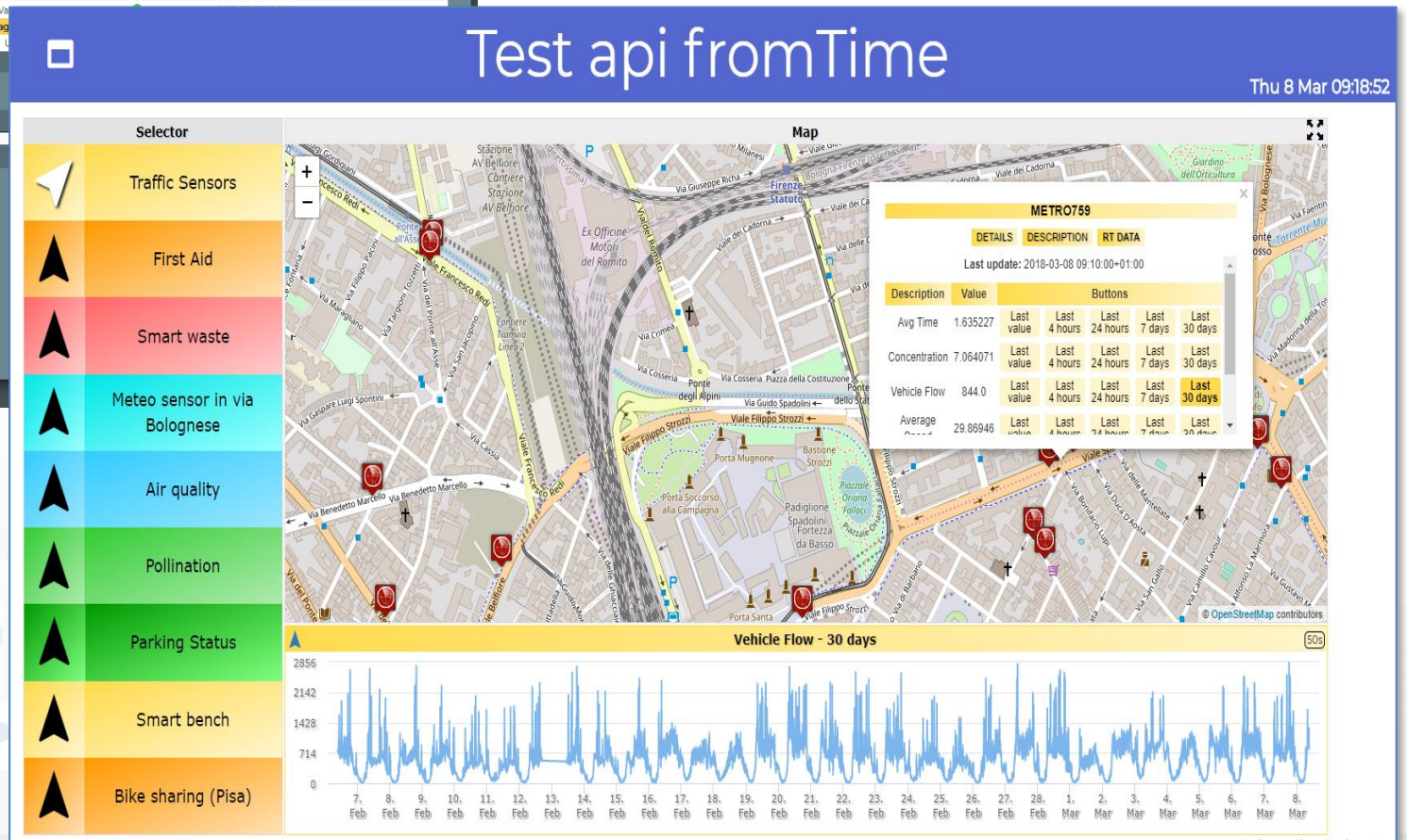


+ Client Side Business Logic in JavaScipt (when needed)


Wizard
Dashboard features
Data and widgets
Check and summary
Map
Single data widgets
Multi data widgets
Data sources
Wizard
SNAP4CITY
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
Close

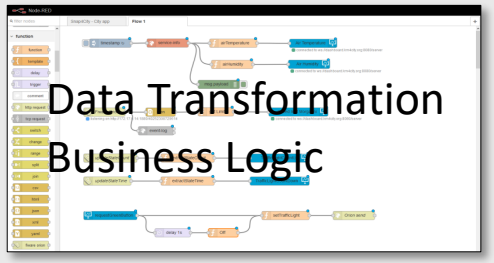
Dashboard Wizard





The Wizard help you in selecting only possible combination of data vs graphic representation

Dashboard Builder: Development



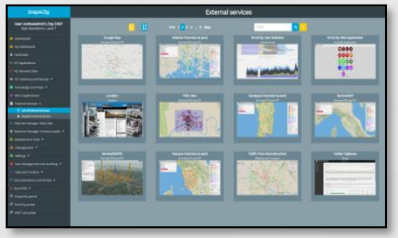
Data Transformation
Business Logic

IOT Applications

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

Widget Collection

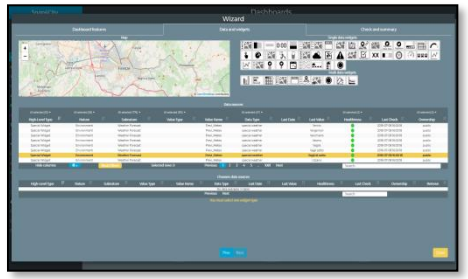
Micro
Applicat
ions



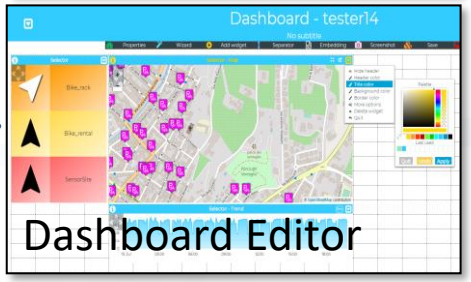
External
Services

Custom
Widgets/
Synoptics

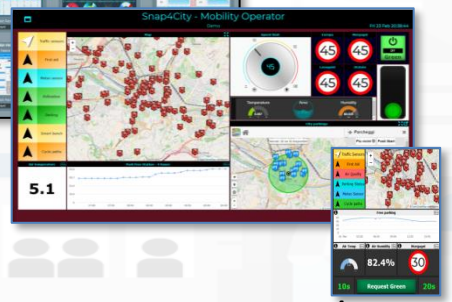
Dashboard Wizard



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



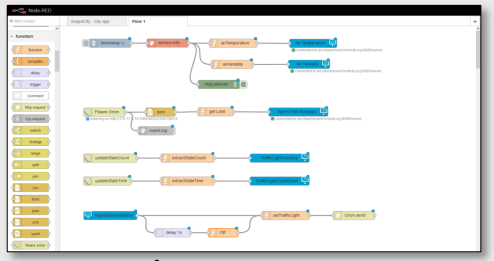
Dashboard Editor



Public
Dashboard
Collection

My Own Dash/App

Custom Widget / Synoptic / PIN Development

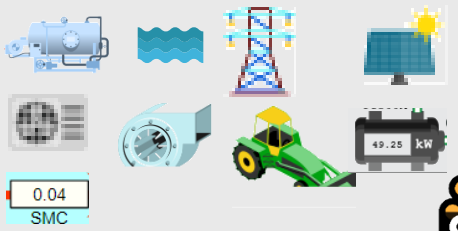


IOT Applications

Knowledge Base,
Km4City

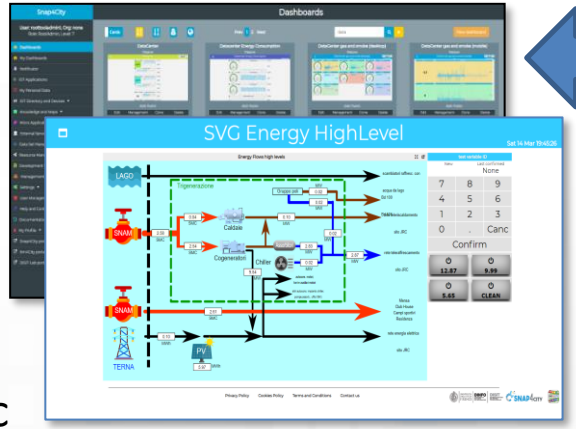
Knowledge and Storage
Data from the Field and
City

SVG Symbols Collection



SVG

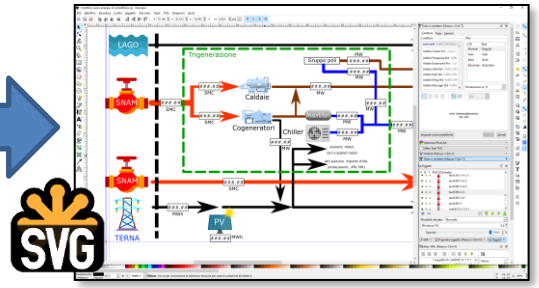
Public
Dashboard
Collection



My Own Dash/App

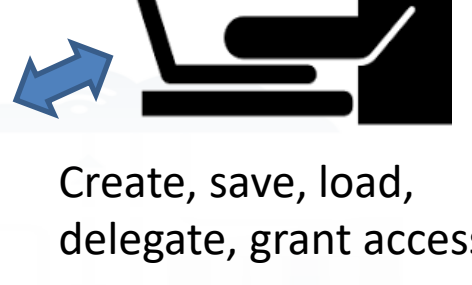
Inkscape editor on your computer

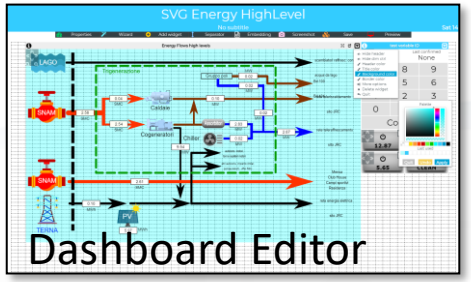
SVG



SVG

Create, save a Custom
Widget in SVG





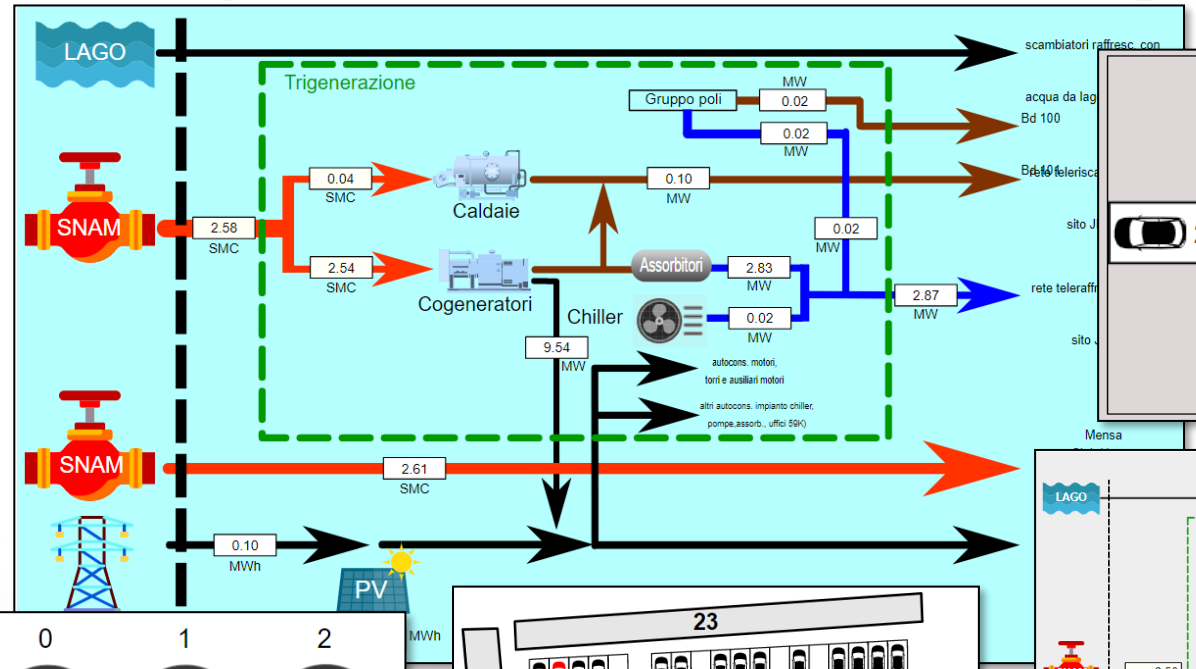
Dashboard Editor

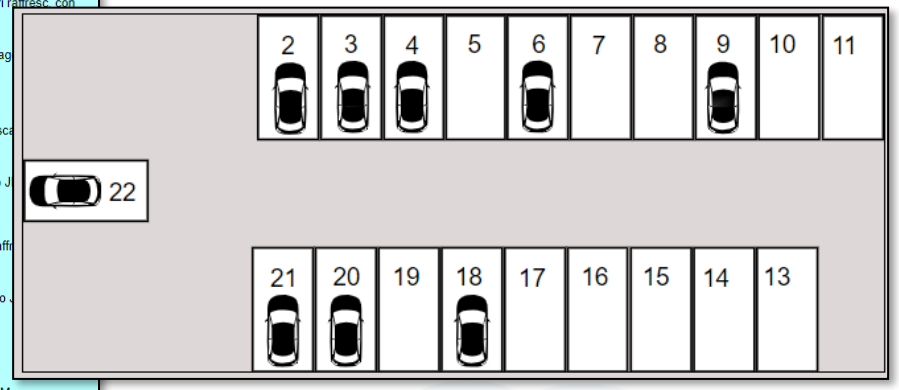
Create, save, load,
delegate, grant access

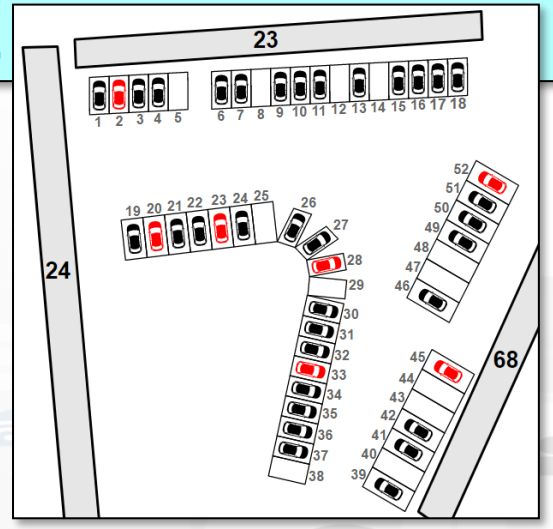
1. Create and Load a Custom SVG
2. Select/Reuse an SVG
3. Make and Instance of Synoptic by Associate Variables with MyKPI
4. Create on Dashboard a Widget based on Synoptic HLT such as Ext. Srv.:
   - https://www.snap4city.org/synoptic/v2/synoptic.html?id=xxxx

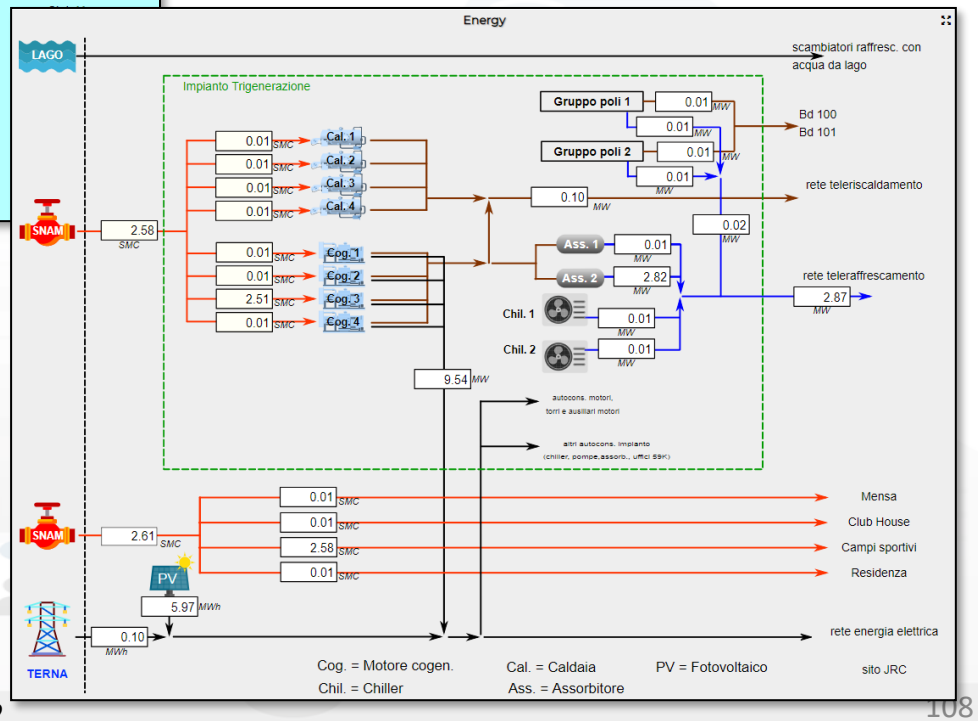
Special Custom Widgets

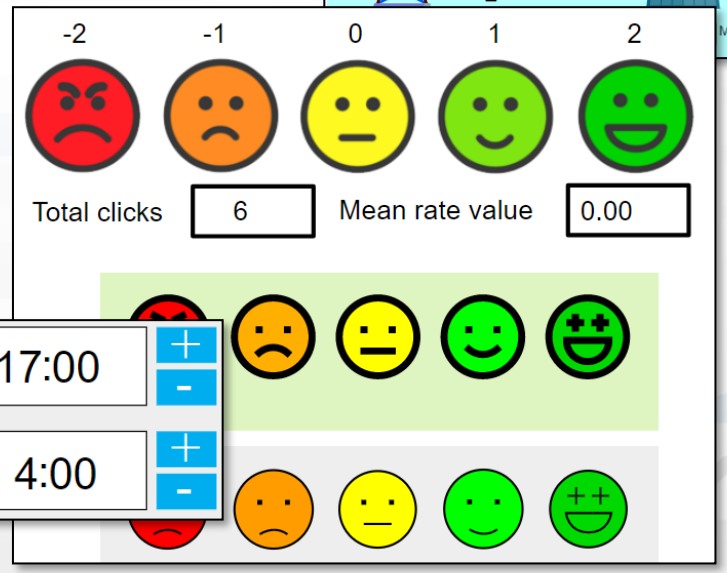
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls

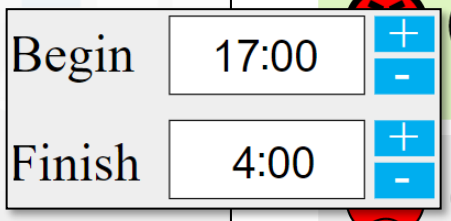












From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensors

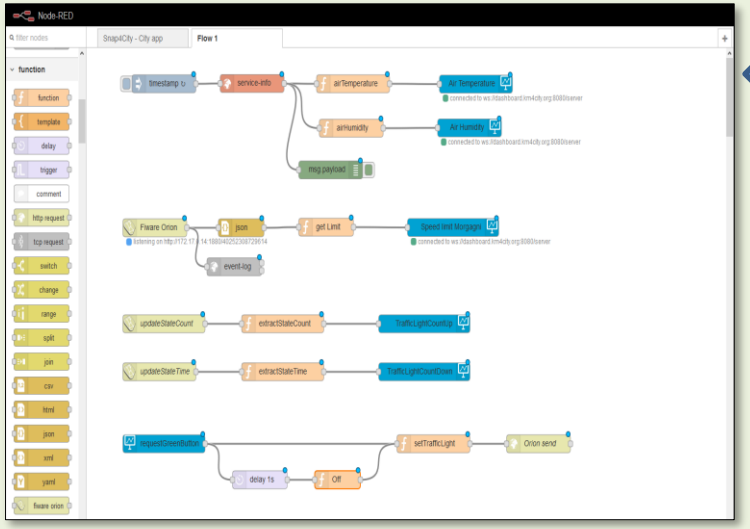
MyKPI

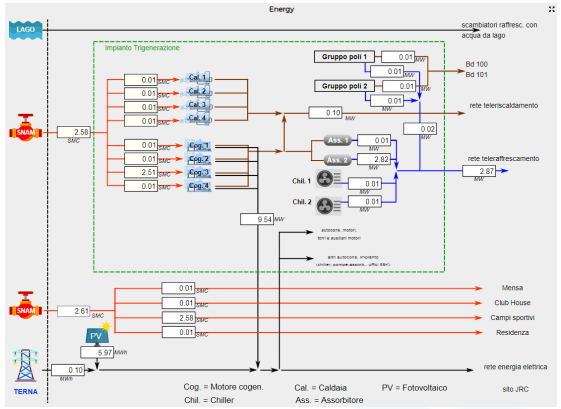
Sensor

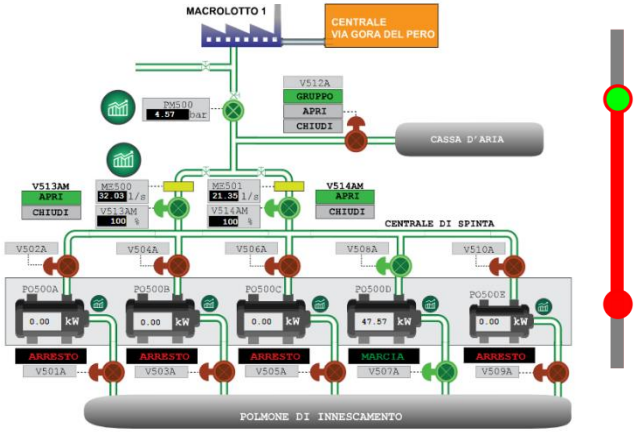
[ ]

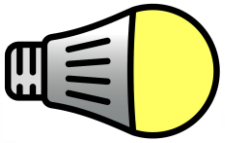
New Shared Variables

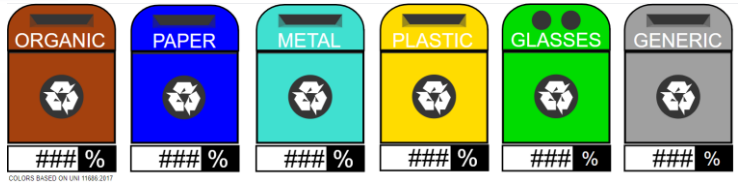
Constant Values

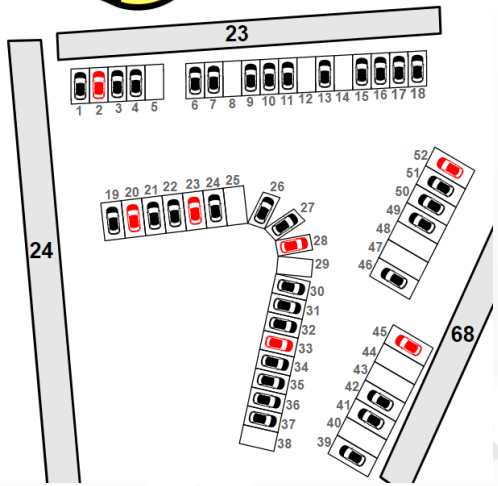


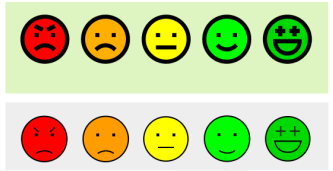


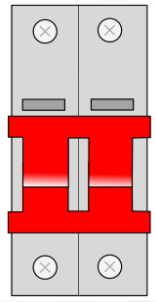


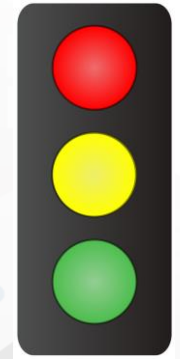








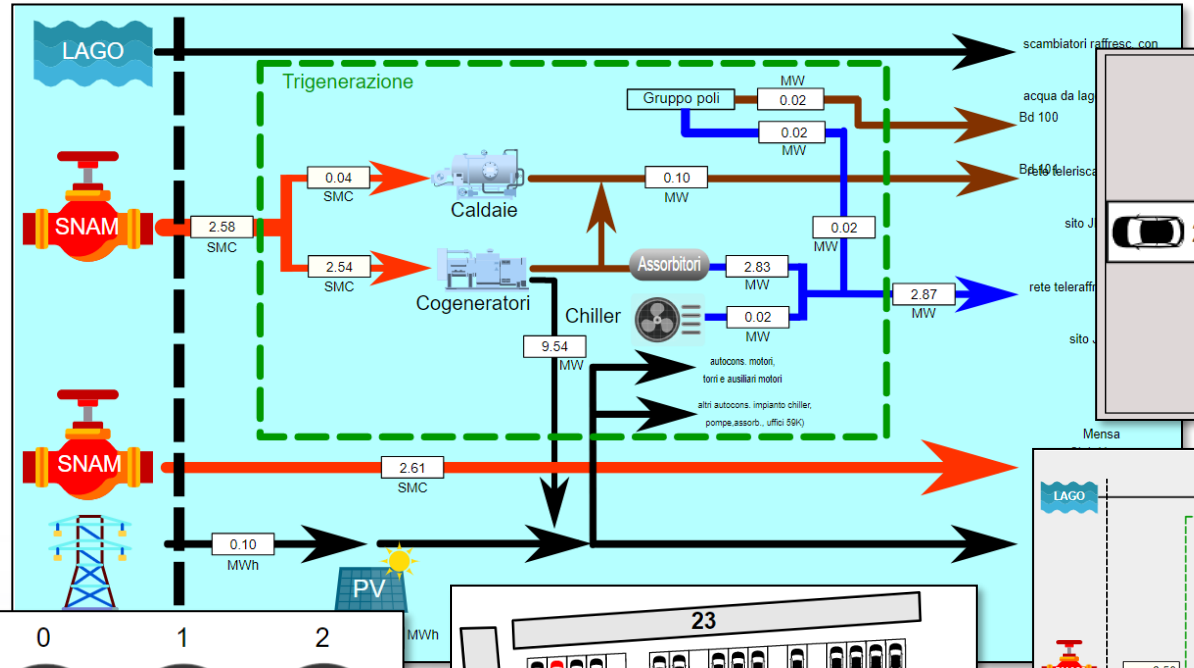


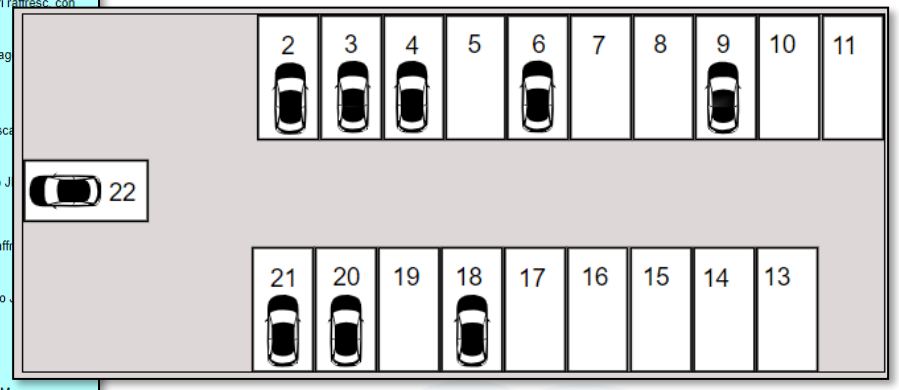


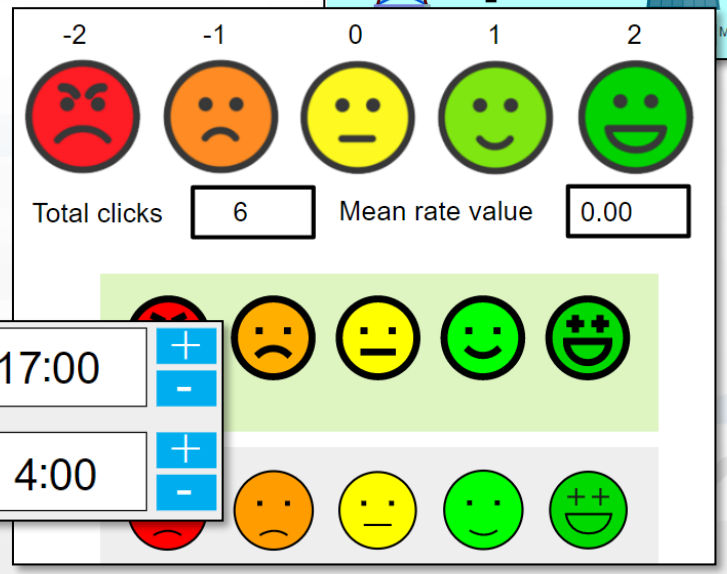
Web Socket Secure

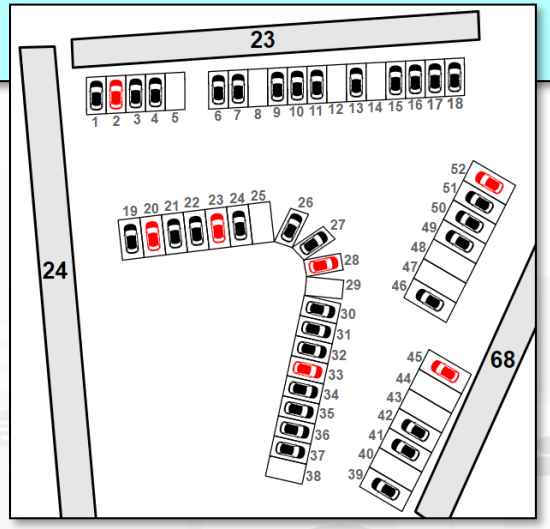
Special Custom Widgets

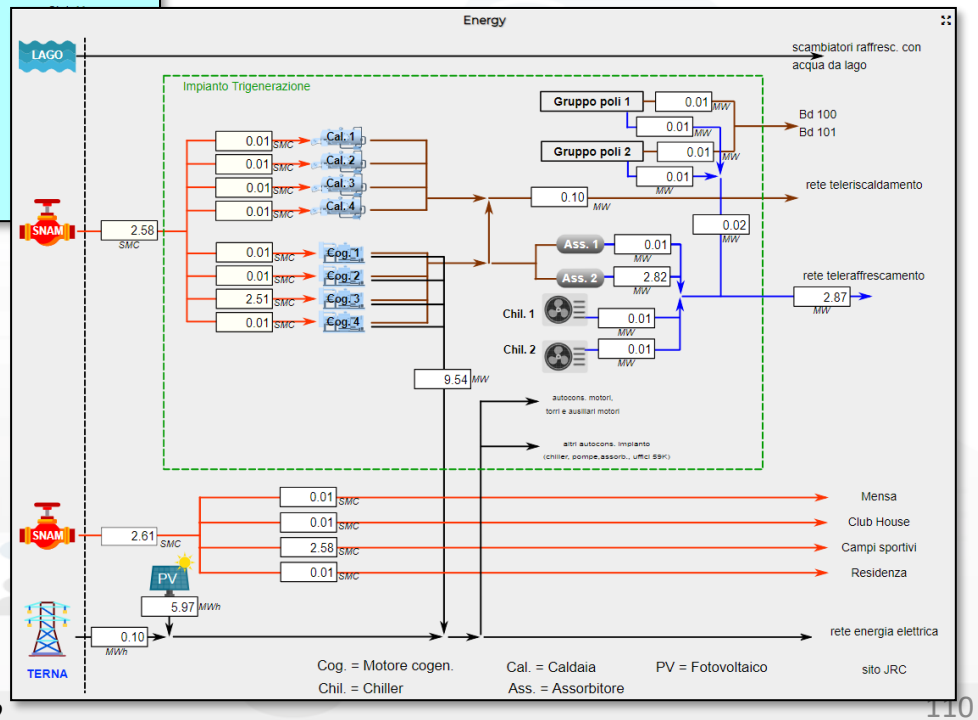
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls







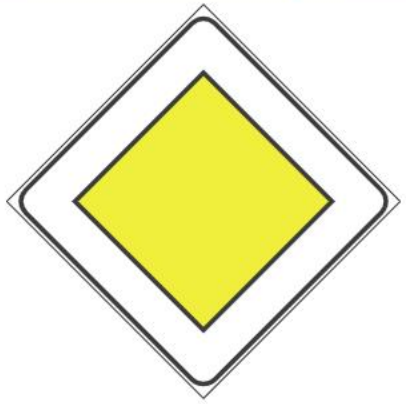




SVG Custom Widgets Examples

Sat 16 Jan 01:07:39

Precedence Italians Road signals

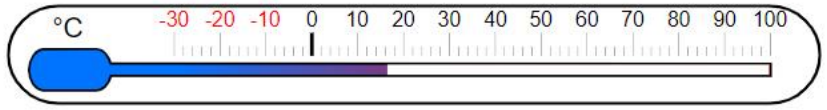


Select a code from 0 to 11 to change the road sign

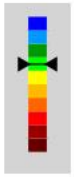
New		Last confirmed: None
7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

s... Smart Light Luminosity

Air Temperature in Florence



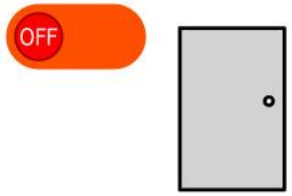
PM10 level - Bologna



fan Fan velocity

Symbols Legenda

open/... M...



Dynamic Prohibition...

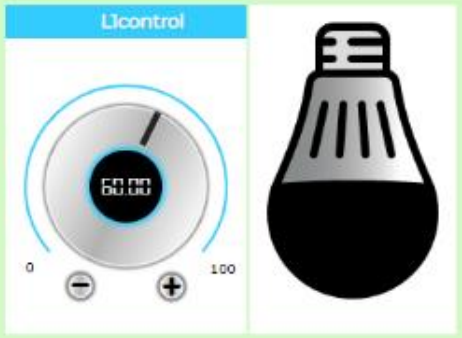
Prohibition Traffic Signs Co...

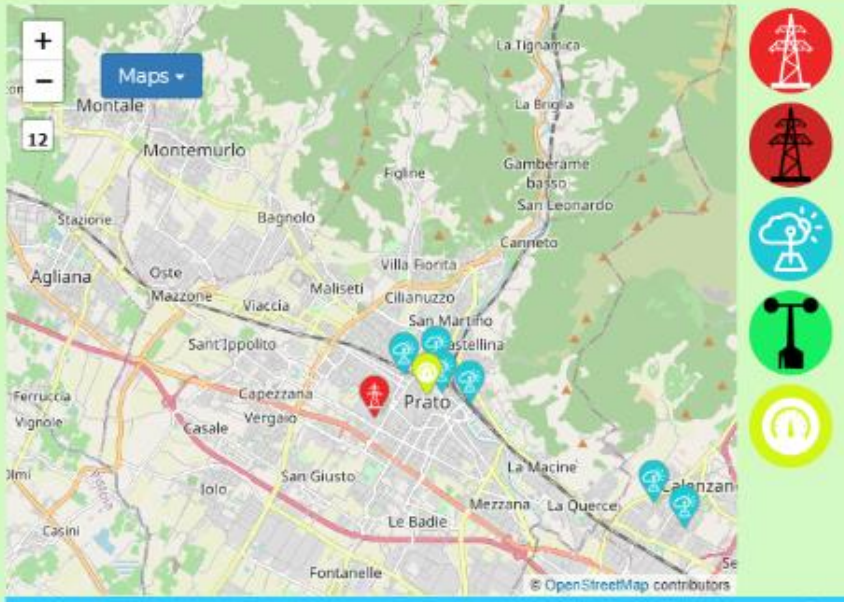
New		Last confirmed: None
7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

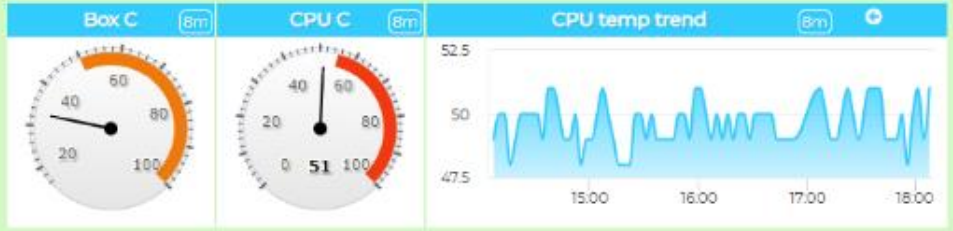
Prohibition Traffic Signs Legenda

Snap4Home 5G Demo

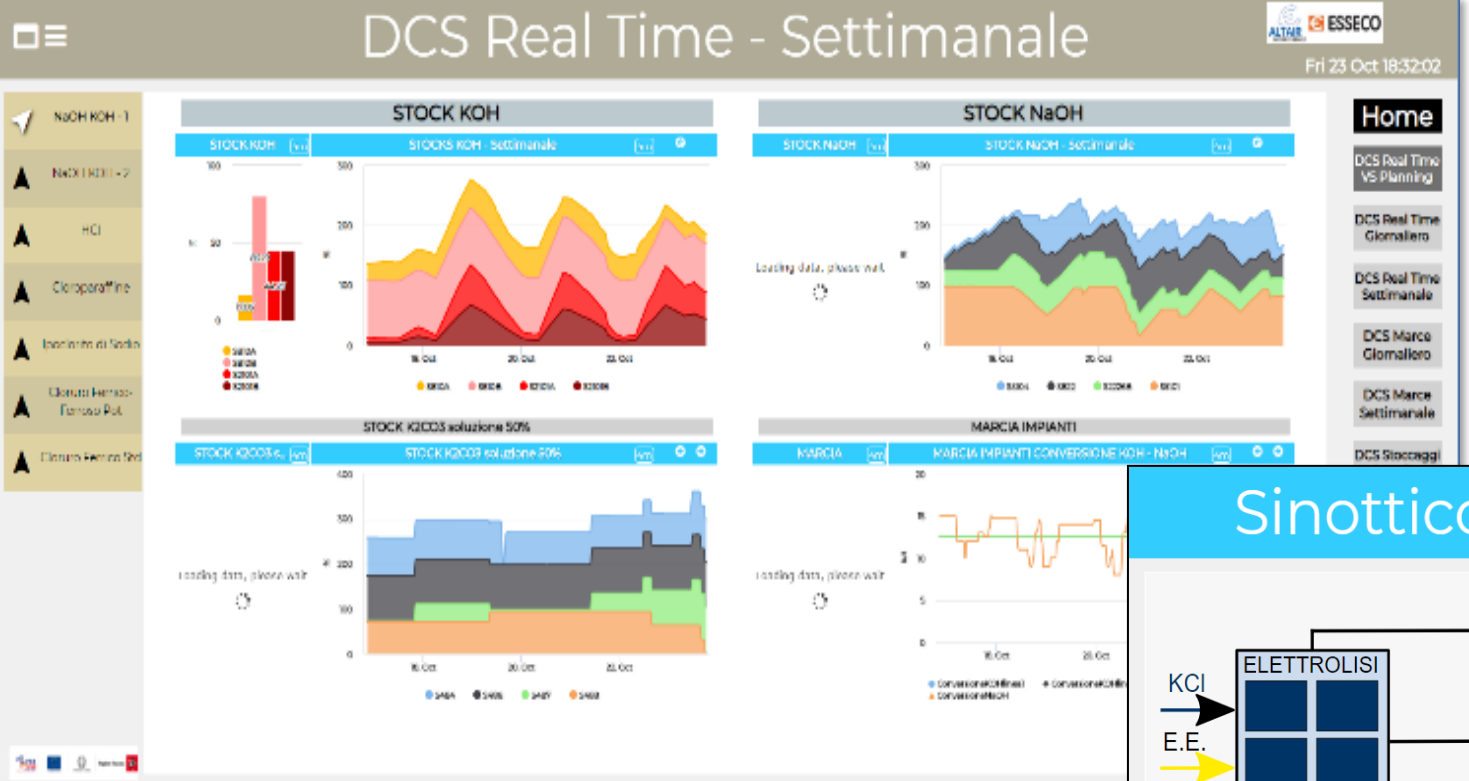
Thu 11 Jun 18:07:32

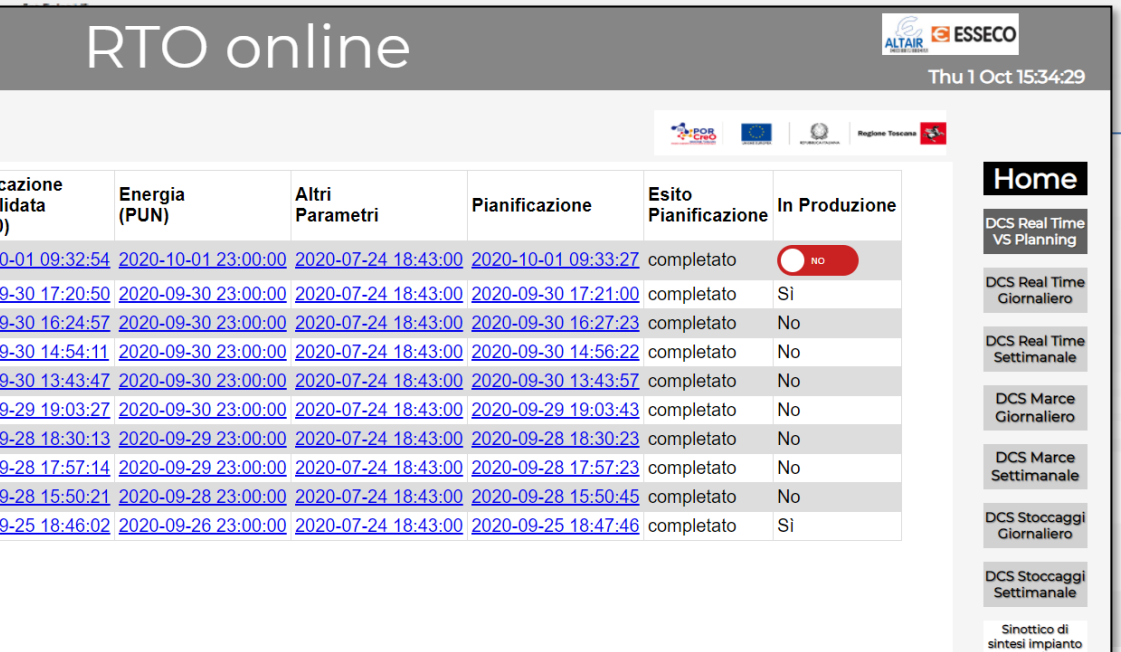




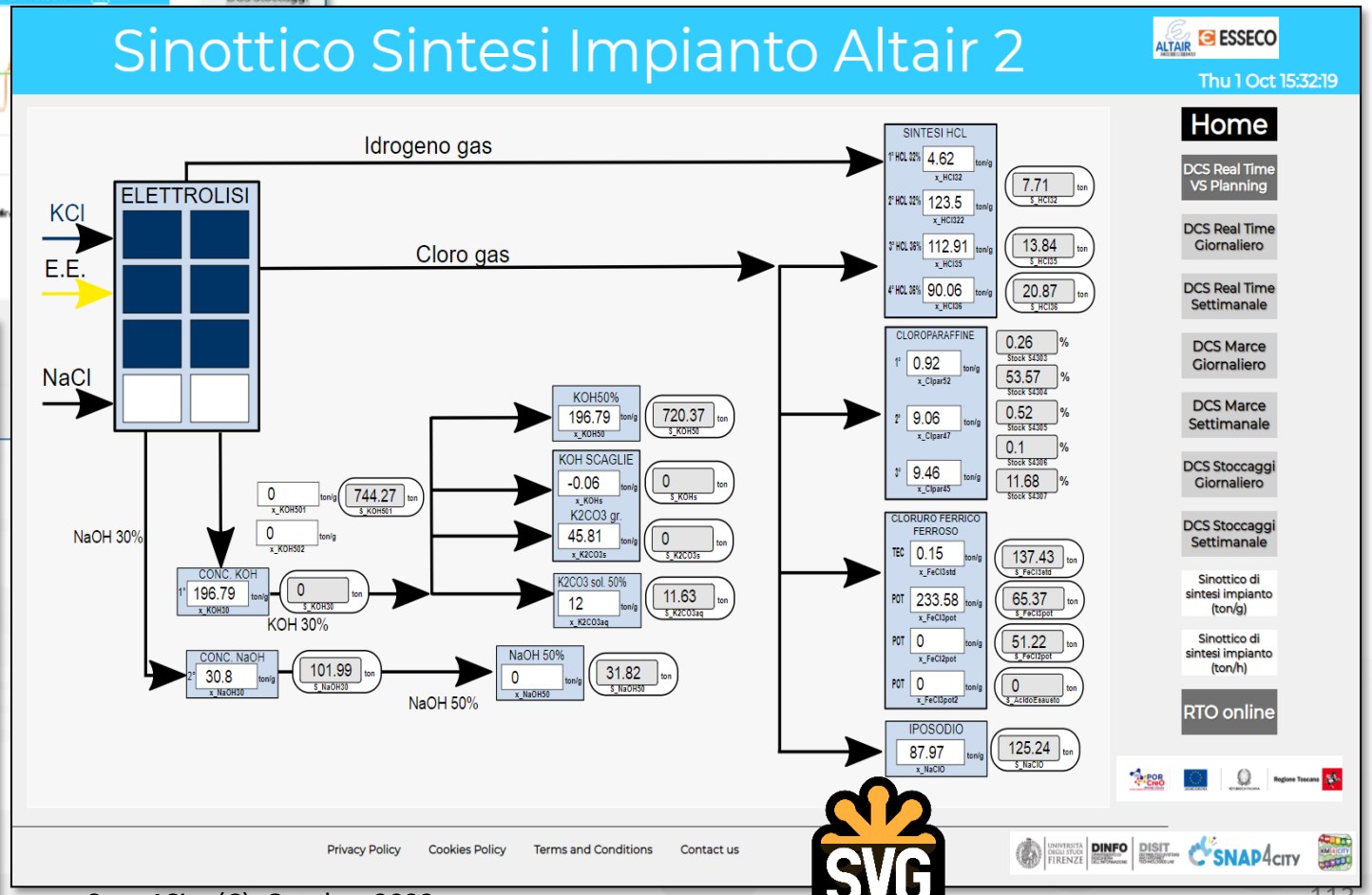


open fiber WIND 3 ZTE estra

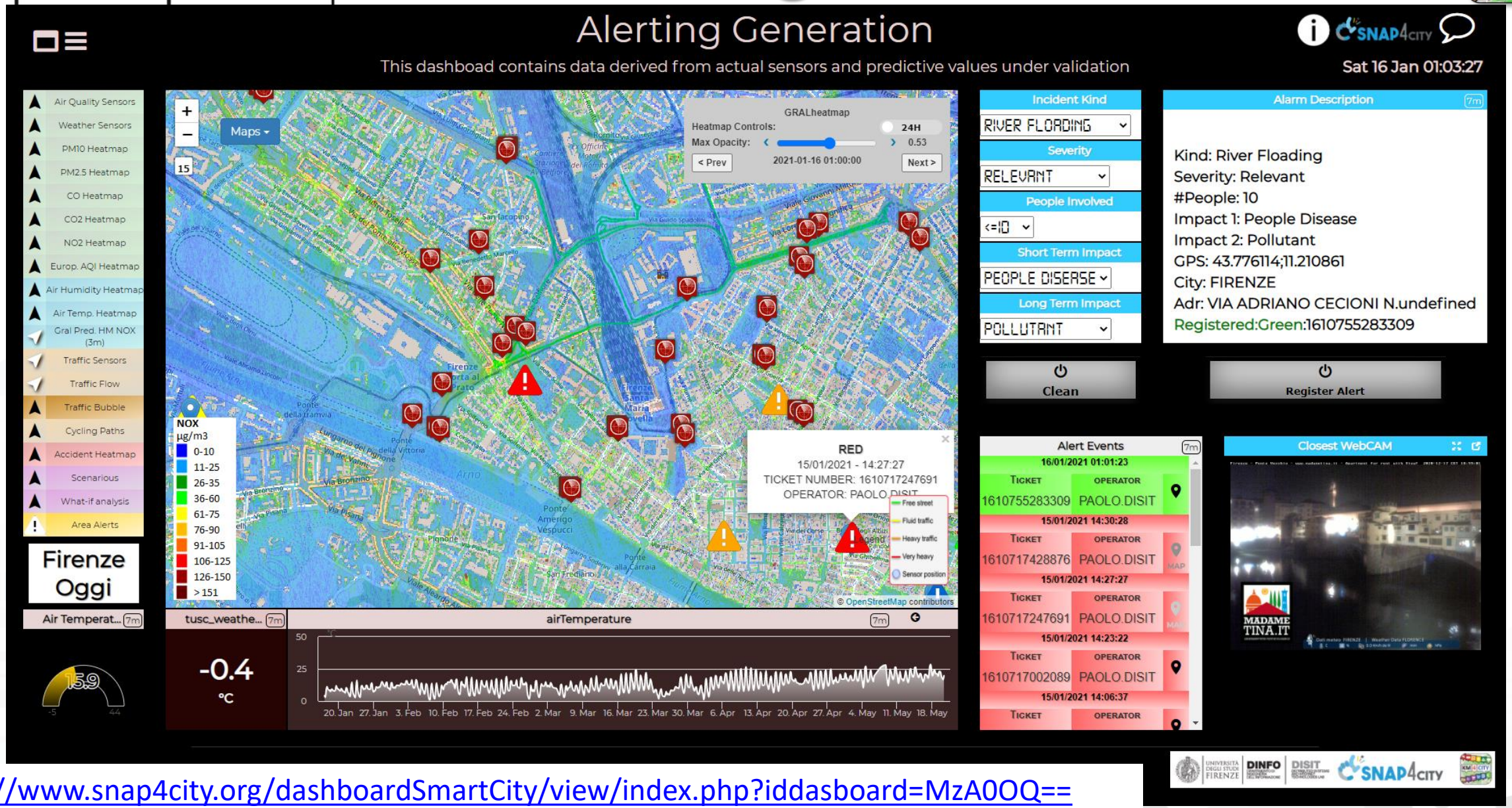




cazione lidata)	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
0-01 09:32:54	2020-10-01 23:00:00	2020-07-24 18:43:00	2020-10-01 09:33:27	completato	NO
9-30 17:20:50	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 17:21:00	completato	Sì
9-30 16:24:57	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 16:27:23	completato	No
9-30 14:54:11	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 14:56:22	completato	No
9-30 13:43:47	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 13:43:57	completato	No
9-29 19:03:27	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-29 19:03:43	completato	No
9-28 18:30:13	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 18:30:23	completato	No
9-28 17:57:14	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 17:57:23	completato	No
9-28 15:50:21	2020-09-28 23:00:00	2020-07-24 18:43:00	2020-09-28 15:50:45	completato	No
9-25 18:46:02	2020-09-26 23:00:00	2020-07-24 18:43:00	2020-09-25 18:47:46	completato	Sì



Alert Registration



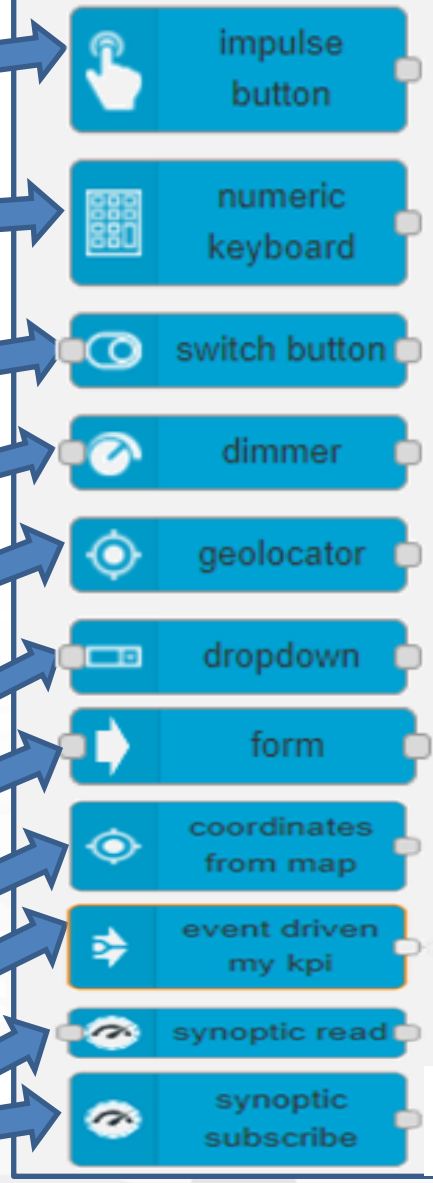
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA0OQ==

Dashboard-IOT App

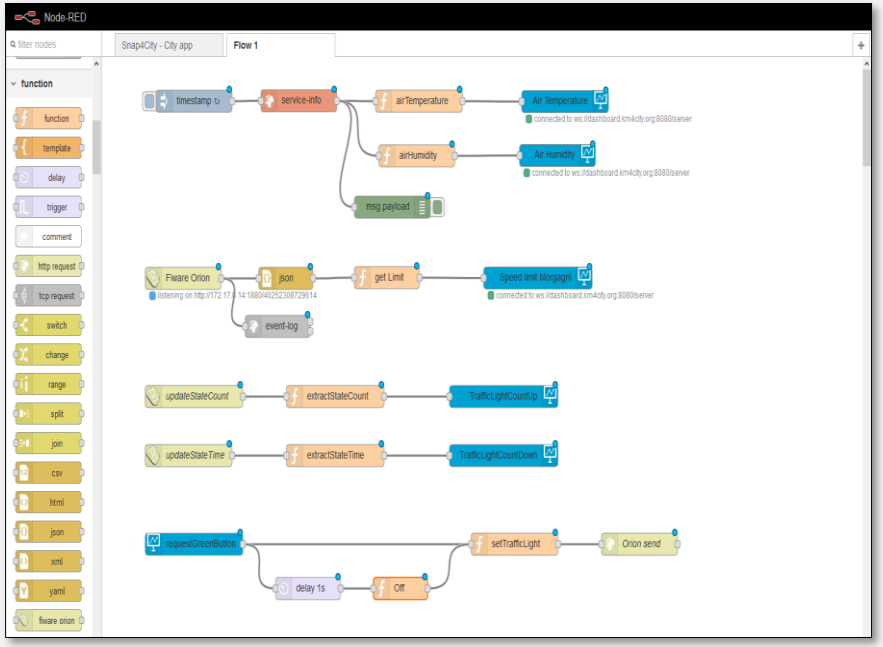
MapClick

MyKPI variable onchange

Synoptics



From Dashboard to IOT App



IOT Application

dashboard - map

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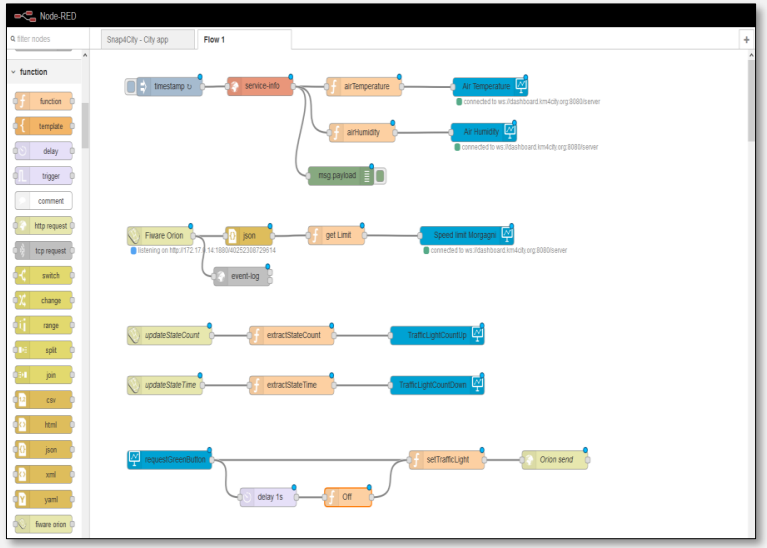
Nature

SNAP4CITY | Node-RED

Dashboard-IOT App

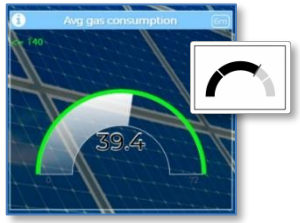
From IOT App to Dashboard

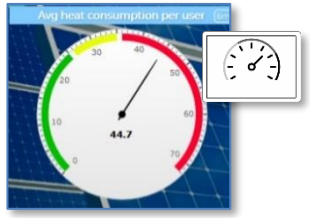


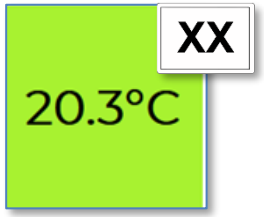
IOT Application

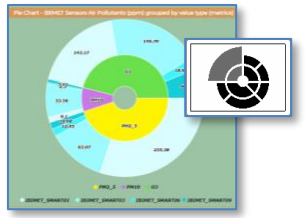
- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- calendar
- speak synthesis
- synoptic write
- Selector - Map

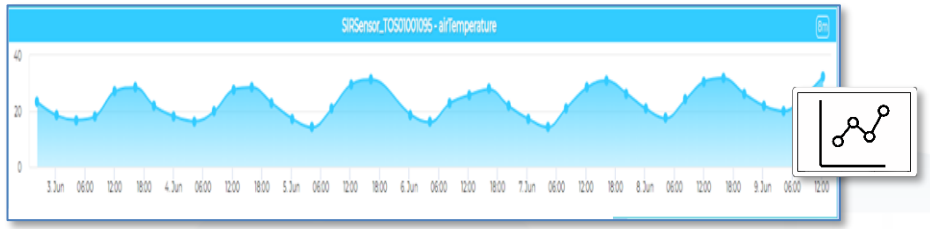
- Snap4D3
- dashboard - map
- event table
- device table

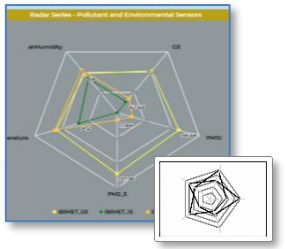


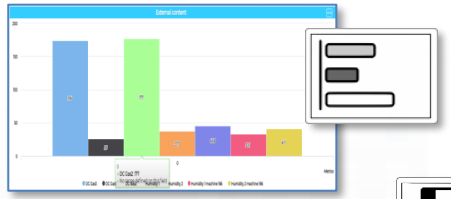


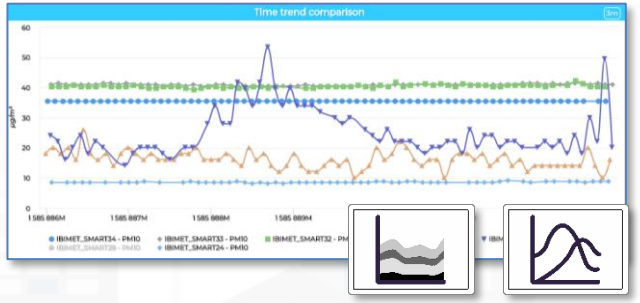


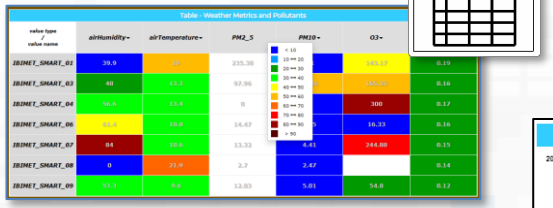


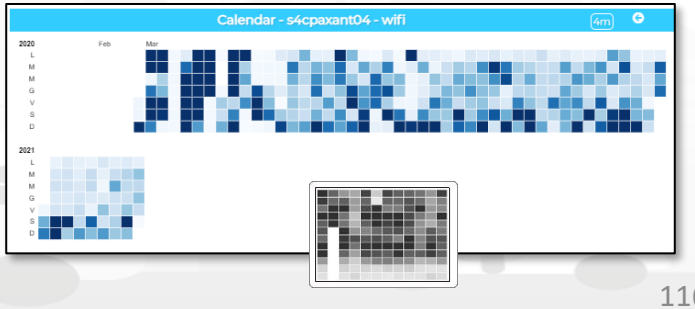




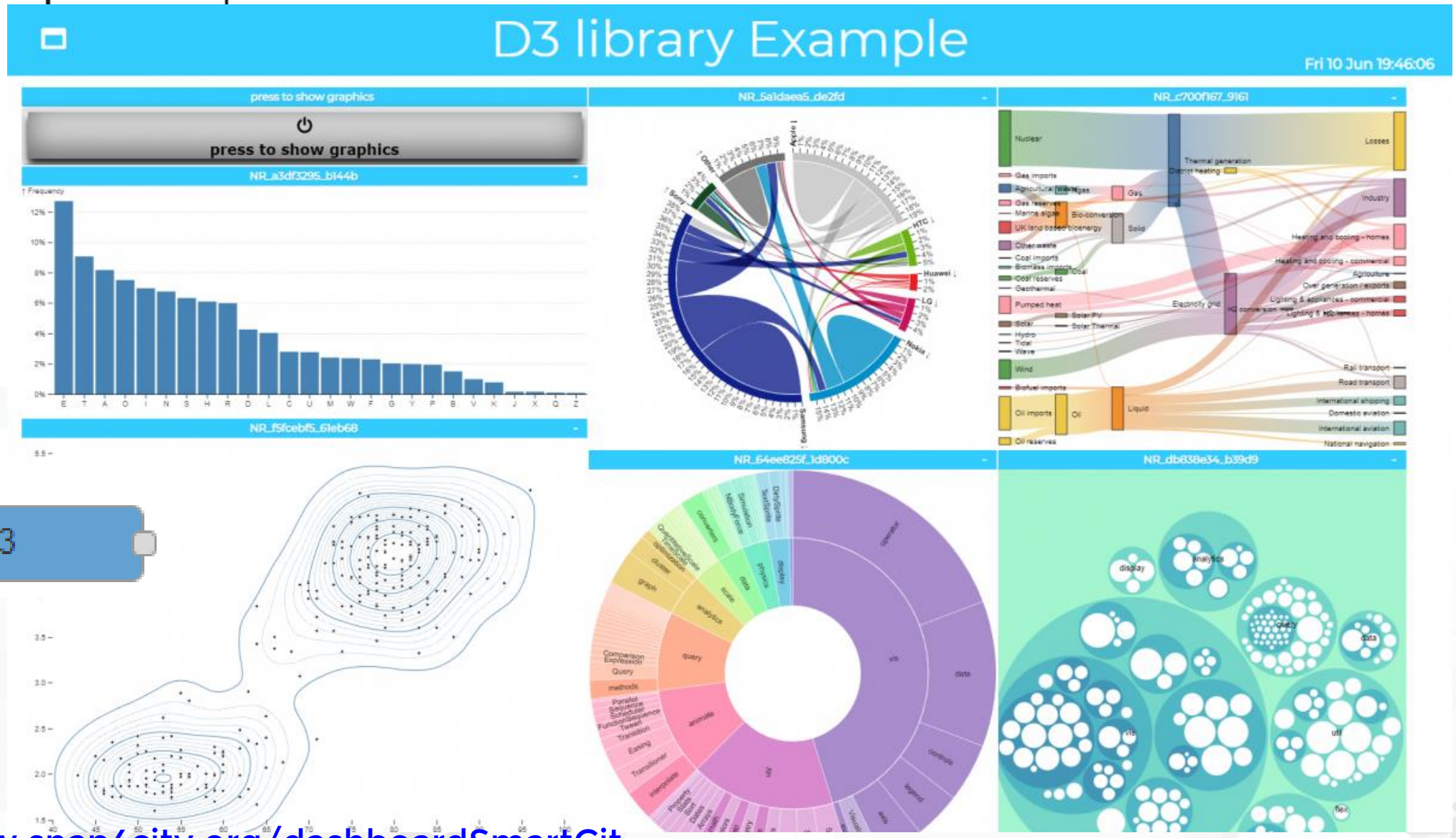






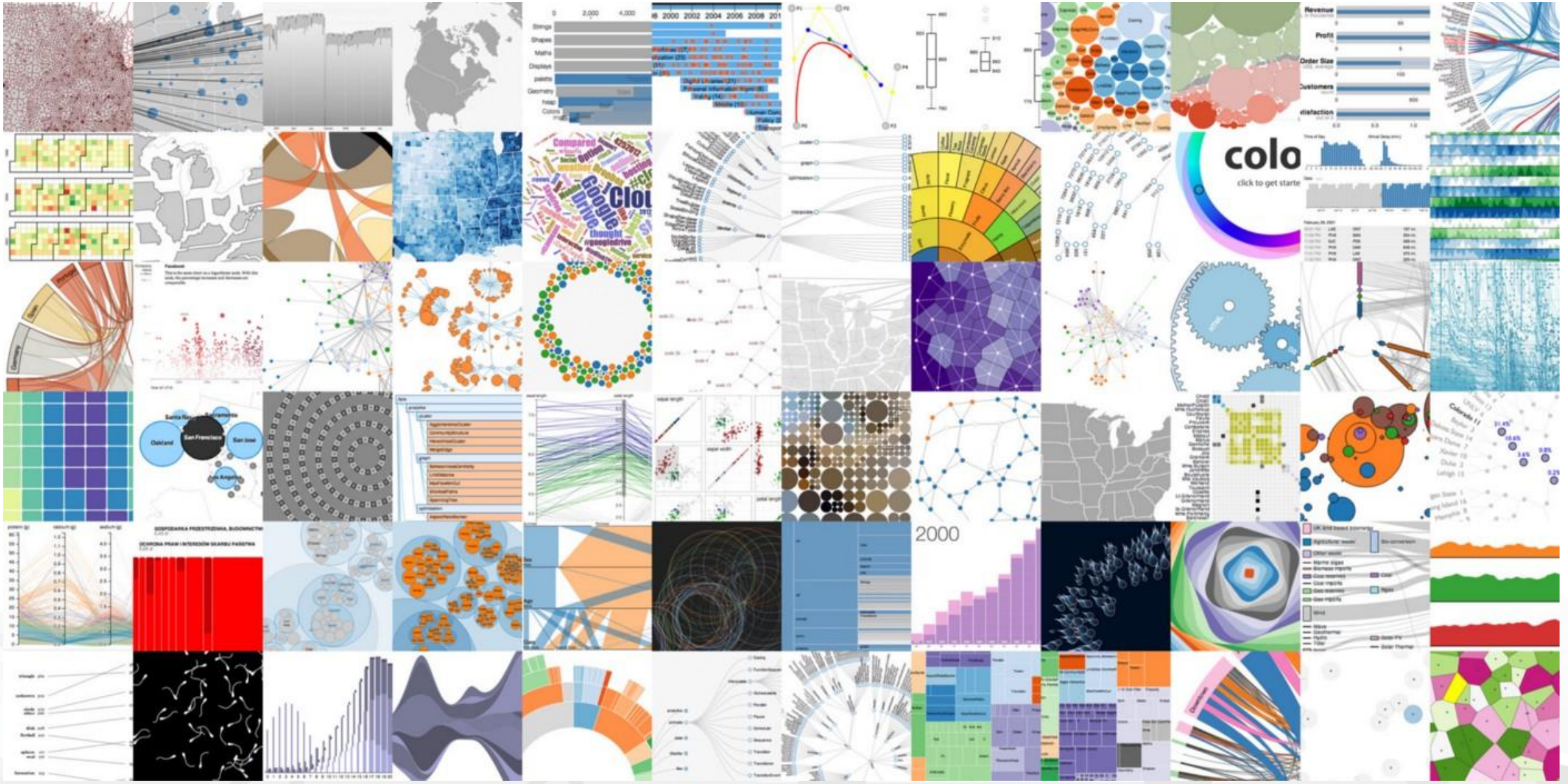


+ D3.JS Widgets



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzQ4OQ==

D3.js graphs

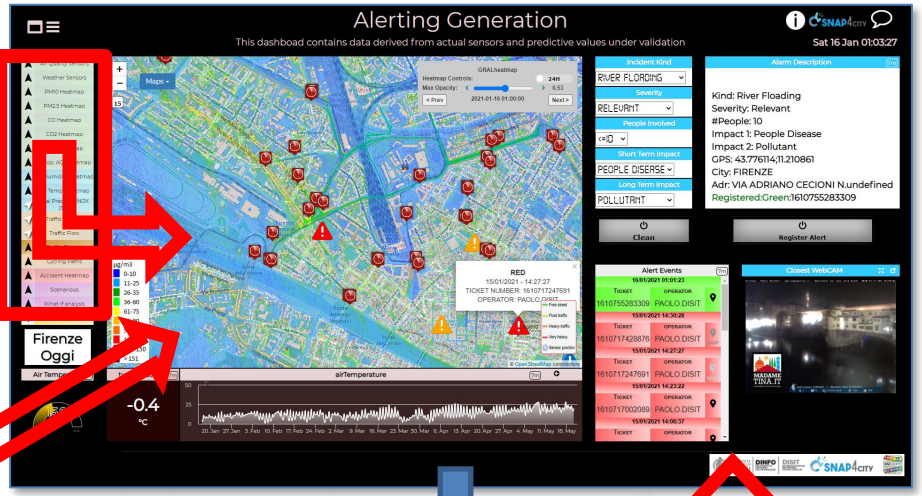


Maps Server Side Business Logic vs IOT Apps

Any Snap4City data and sources: IoT Devices, Variables, Heatmaps, traffic, tools, KPI, etc.

data

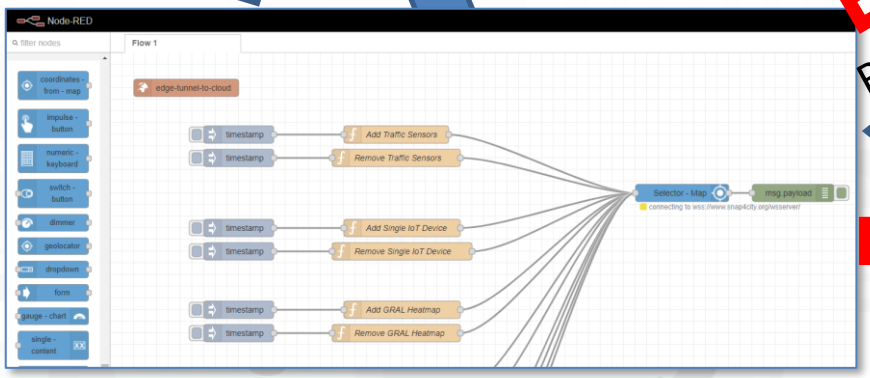
Selector



data

Data, changed data

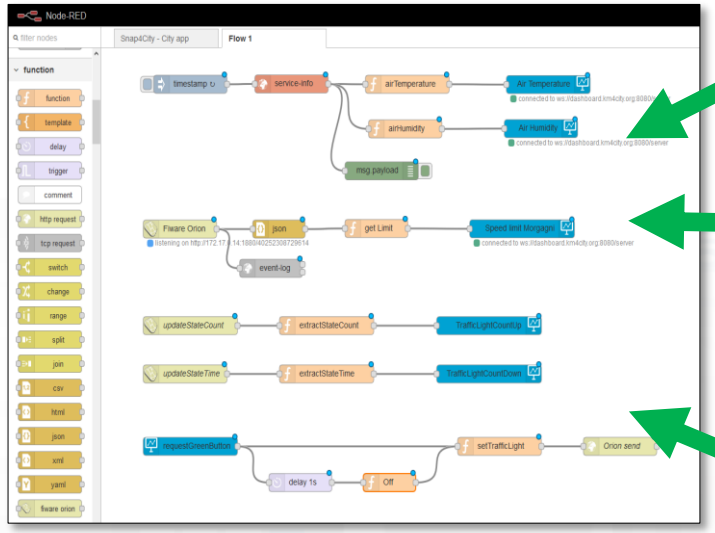
References, commands, selections



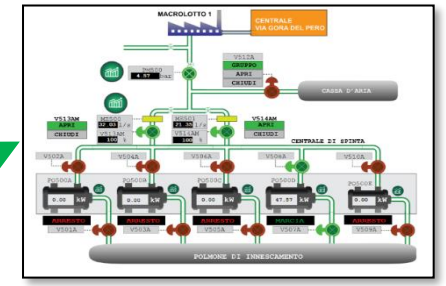
selections, positions, ServiceURI

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

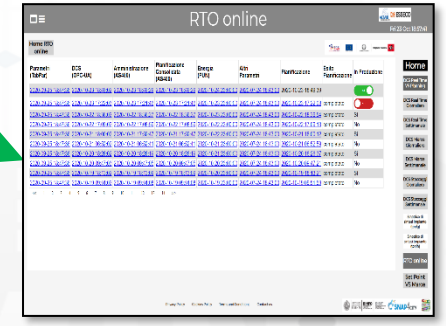


Synoptics
Custom
Widgets



Widgets
Maps
Buttons
Keypads
Controls
..

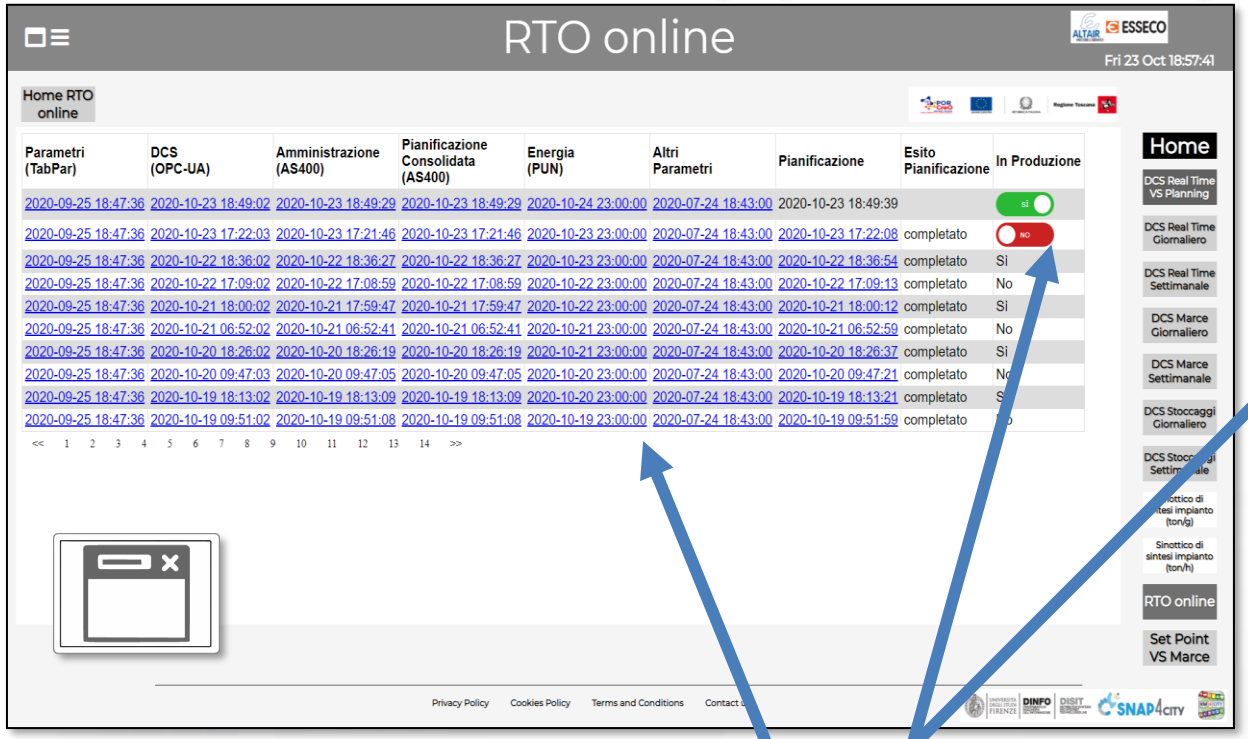
HTML pages
HTML Forms
Tables
..

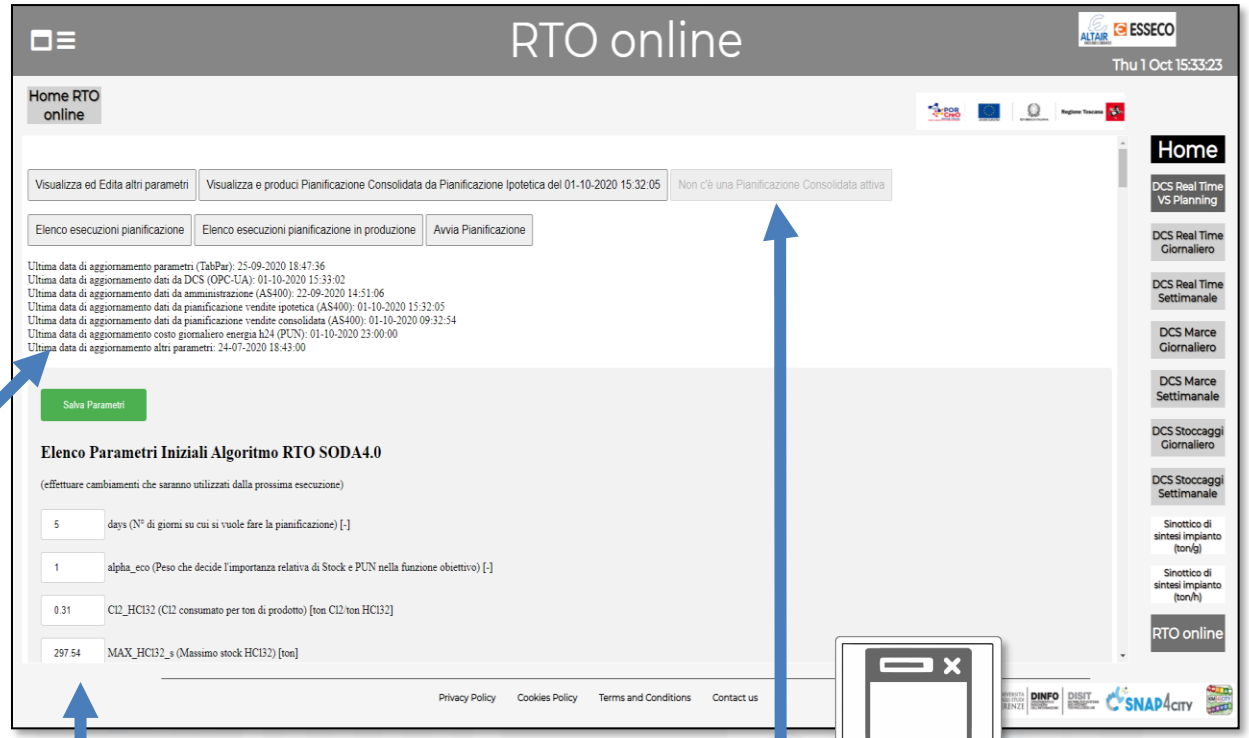


https://www.snap4city.org/394

https://www.snap4city.org/596

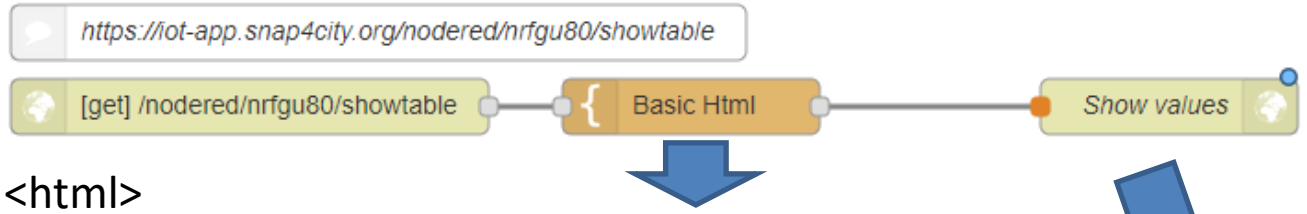
IOT App with Dynamic Web Pages



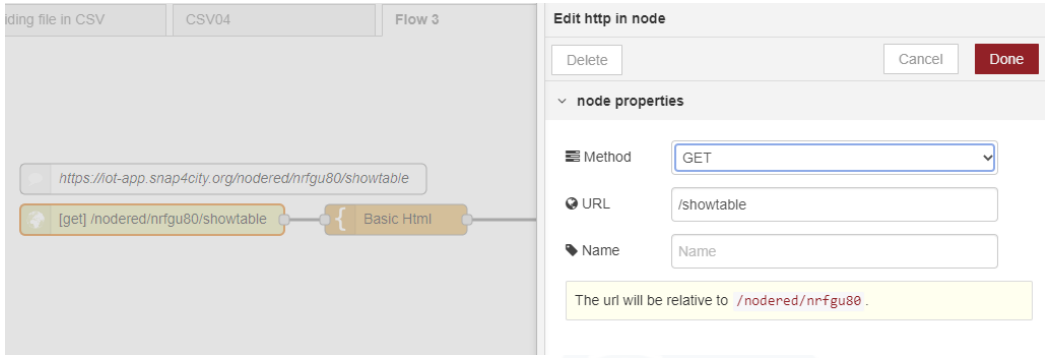


- **HTML pages** can
  - be dynamically generated from the IOT App
  - provide forms to produce data to the IOT App, also including interactive elements
  - collect file from users, and produce files to web and to the system
  - have CSS and AJAX controls

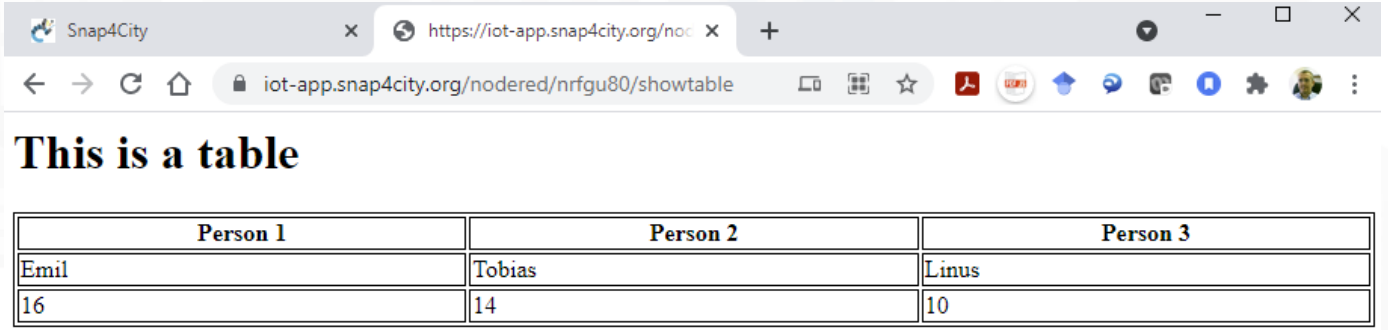
From IoT App to generate HTML pages, forms




```
<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>
```



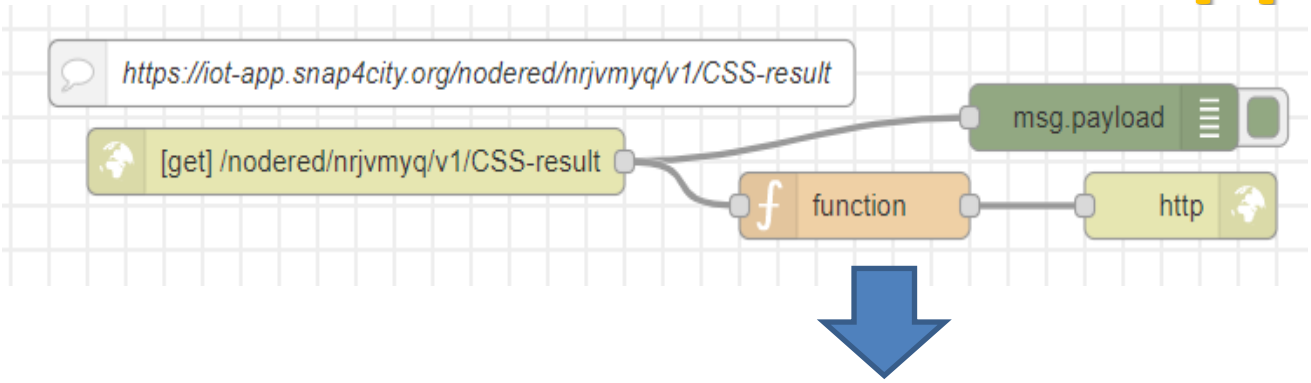
Edit “HTTP IN NODE” as above, also to get the ID of your IoT APP.
The ID is used in the URL of the generated page



HTML & Tables on Dashboards

- 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

From IoT App to API Get



Function receives:

{"prova":"1","test":"mio"}

It can interpretes the REST call to provide at the next Node the result

Call on Browser:

https://iot-app.snap4city.org/nodered/nrjvmyq/v1/CSS-result/?prova=1&test=mio

Domain Prefix

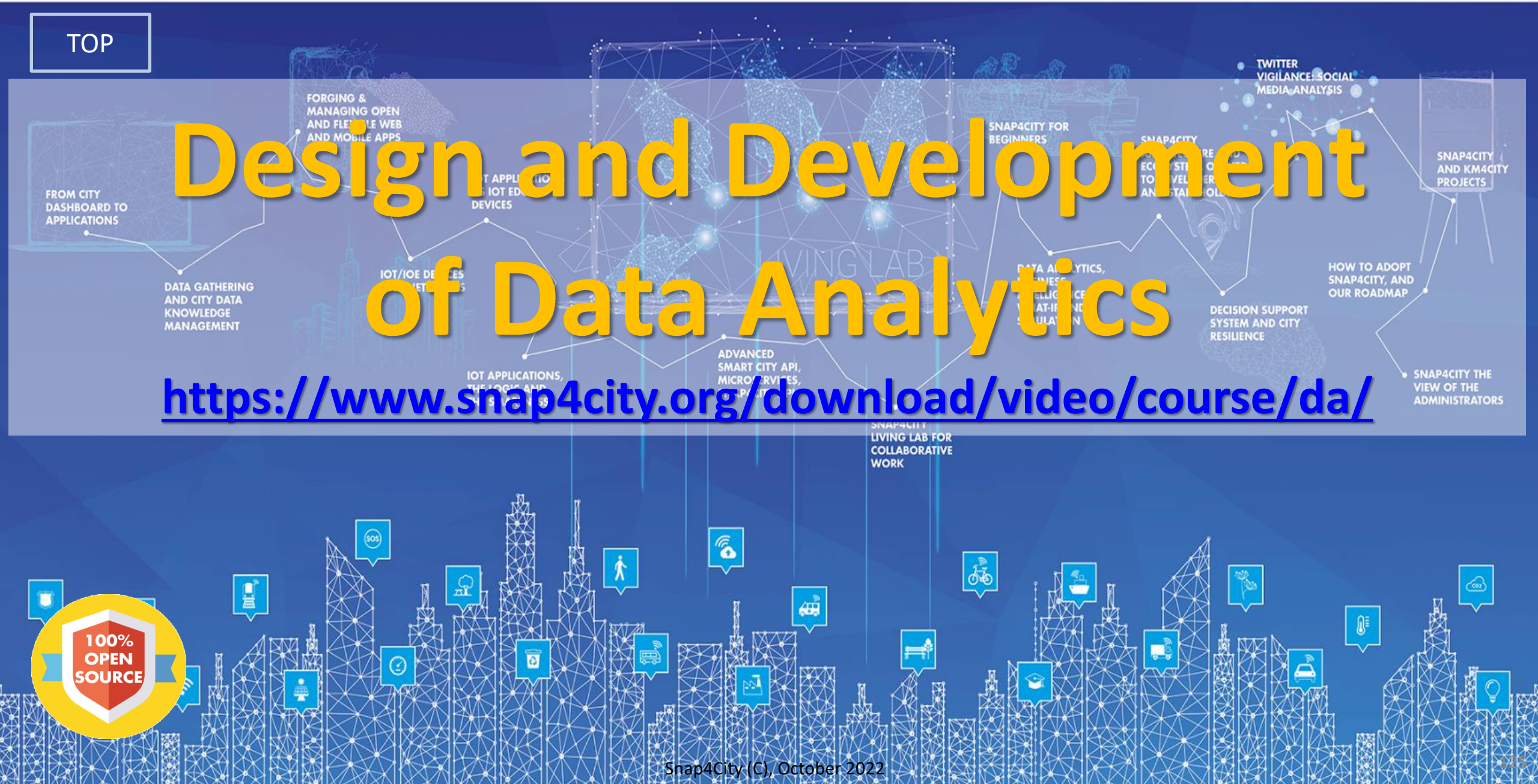
IoT App ID

Your custom

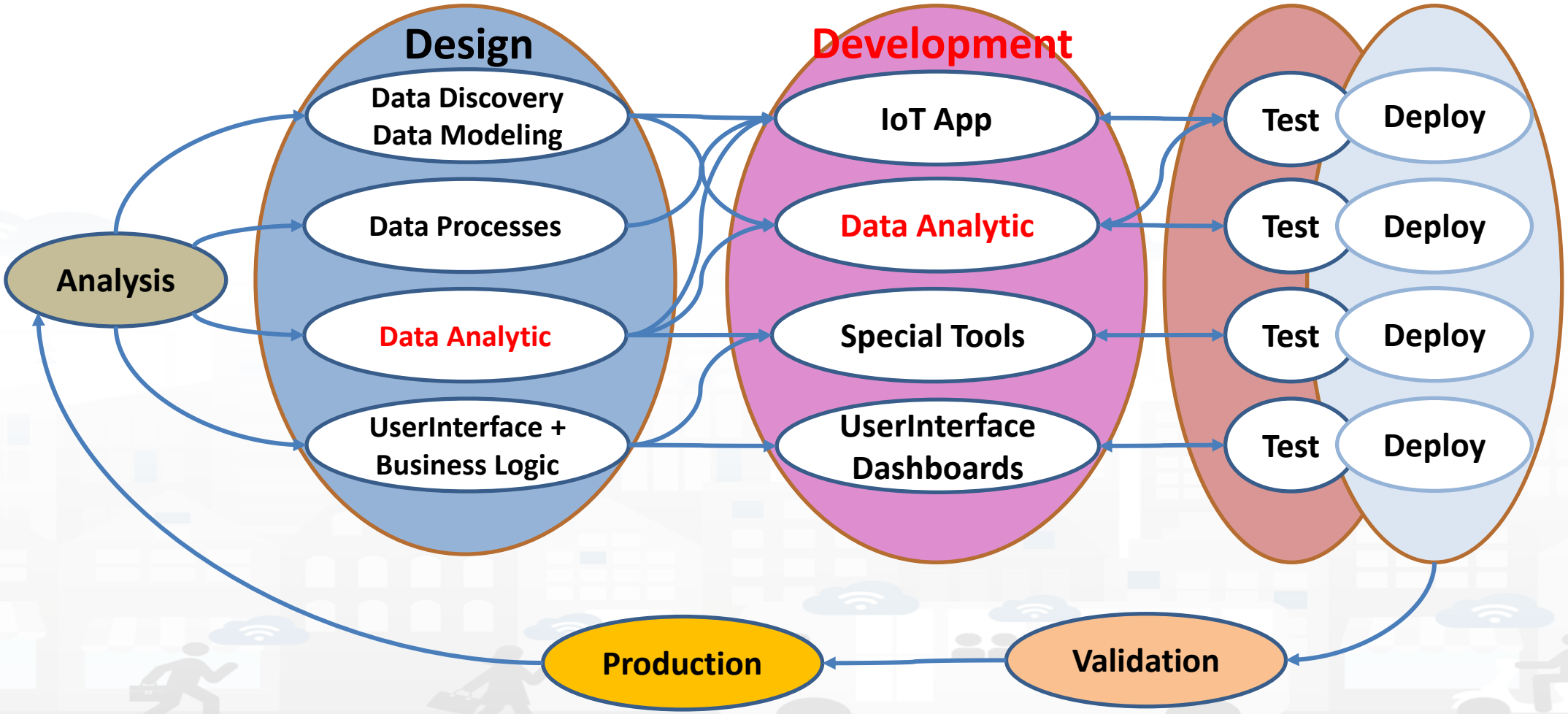
TOP

Design and Development of Data Analytics

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

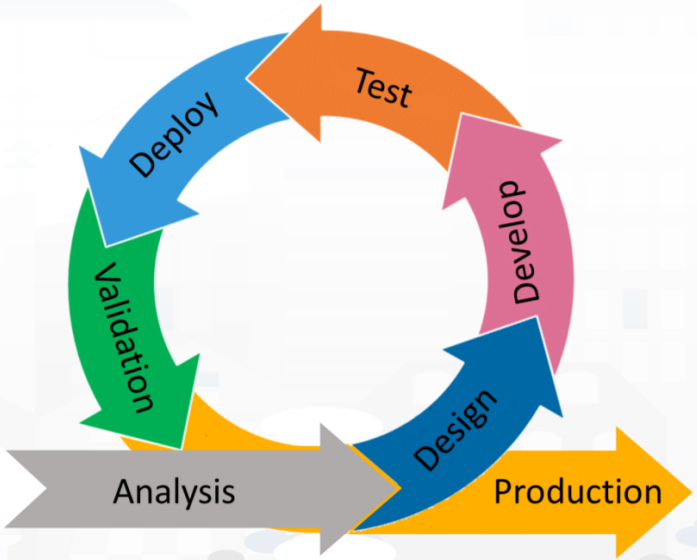


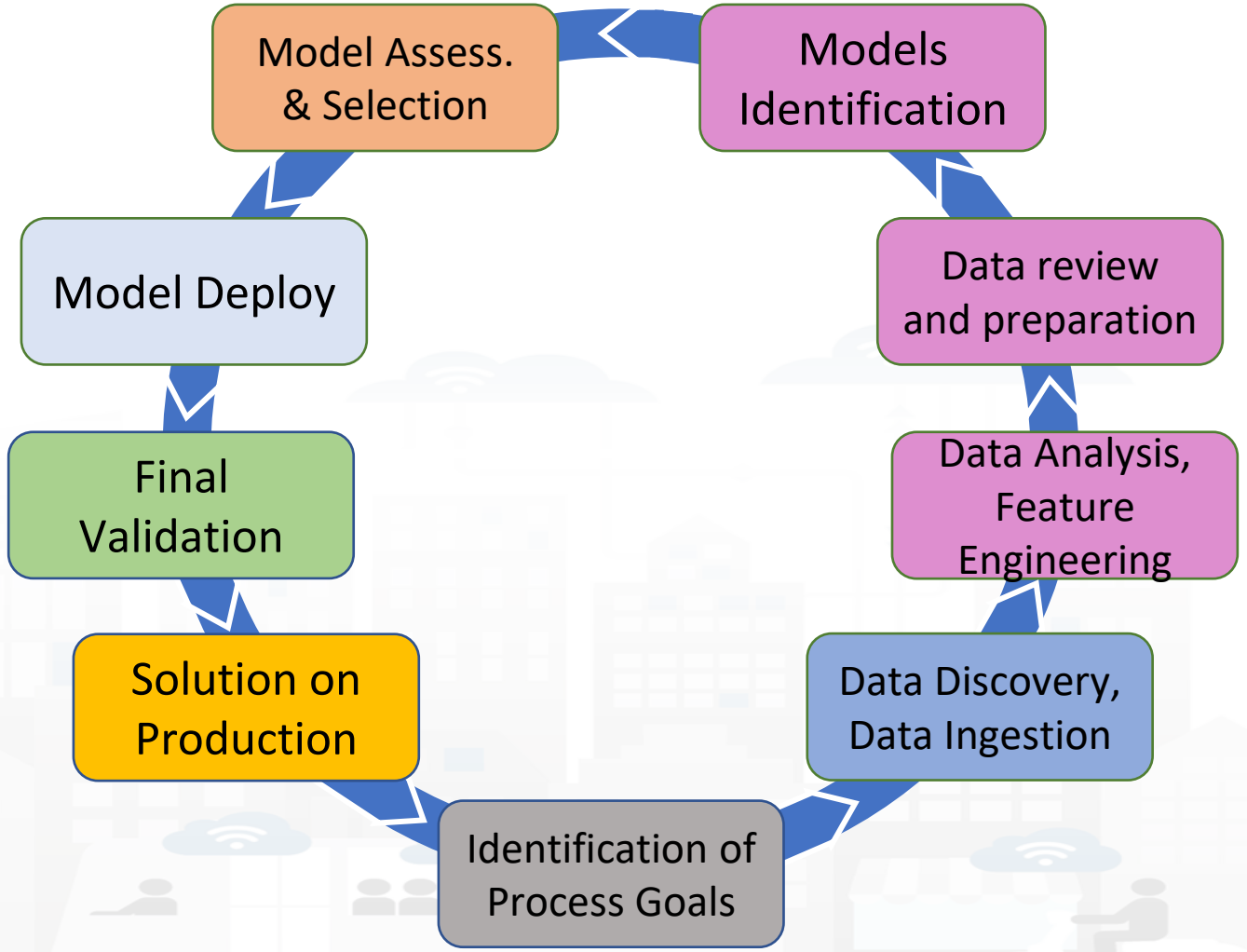
Development Life Cycle Smart Solutions



Data Analytics Development Life Cycle

- Detailed development process on specific training course slides





Data Analytics on Cloud: Snap4City Infrastructures

Data Analytics on Snap4City platform

Swagger

Ontology Schema

LOG.disit.org

Knowledge Base, Km4City

Big Data Store Facility

Smart City API from Knowledge Base and other tools

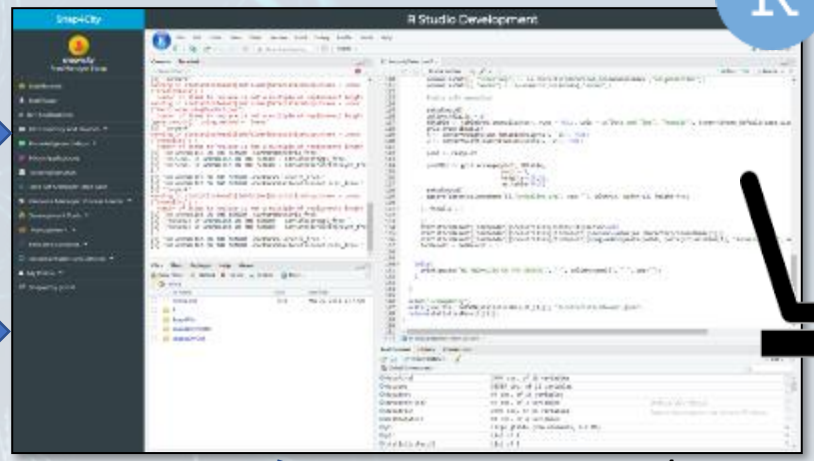
TensorFlow

NVIDIA CUDA

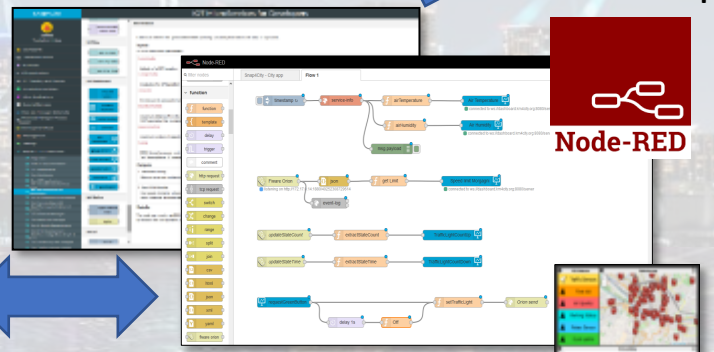
python

jupyter

R Studio



Creating MicroServices

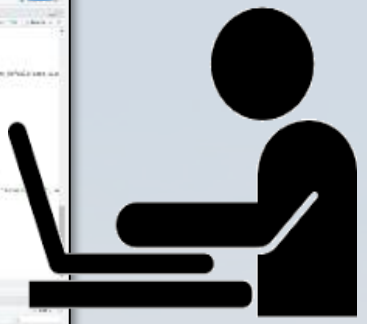


Node-RED

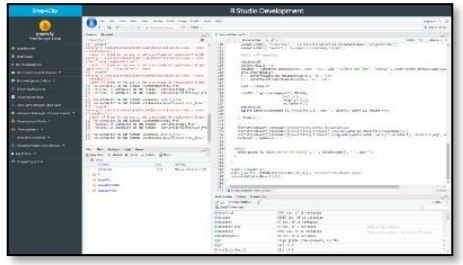
Using them into IOT Applications

Saving / Sharing reusing

Resource Manager



Development

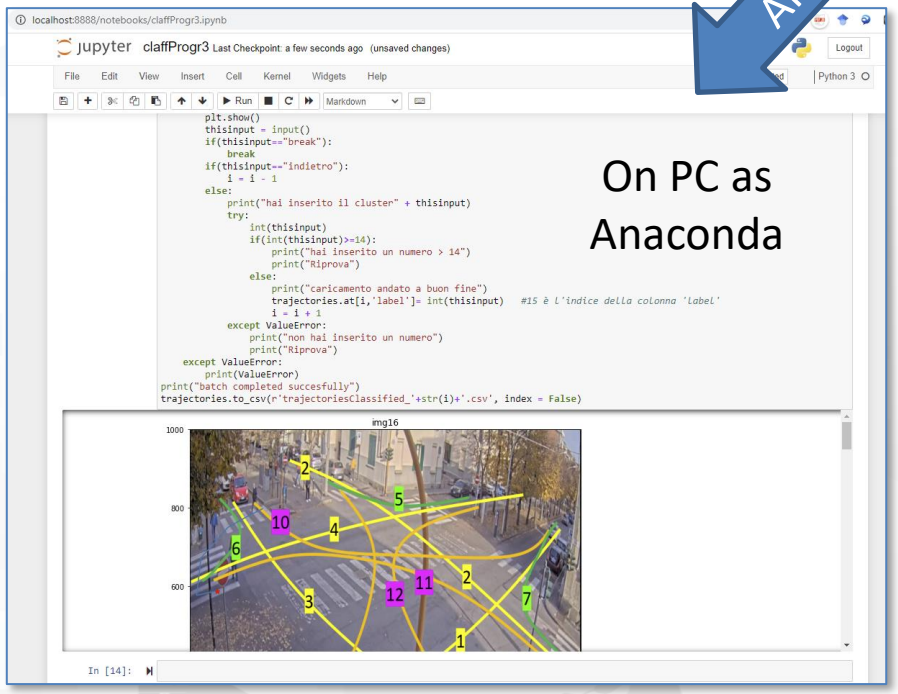


API

Big Data Store Facility

API

On Server
Or
On PC



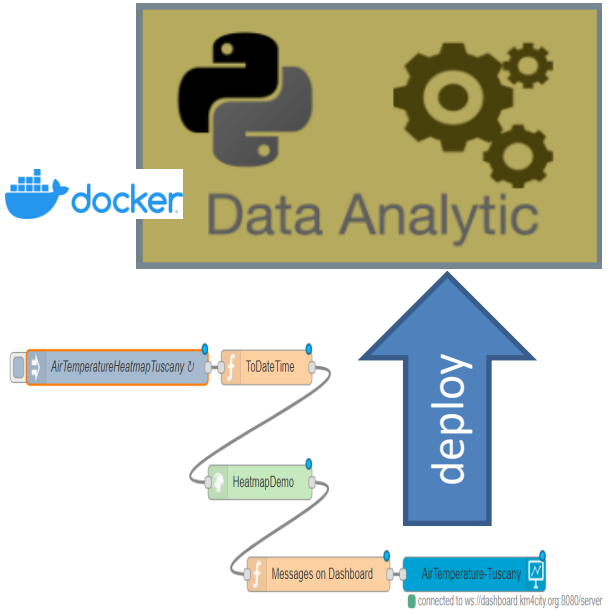
On PC as Anaconda

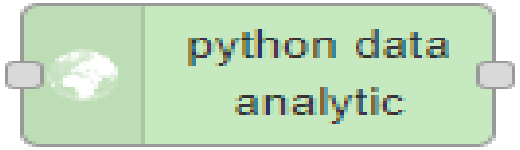
Once finalized

File.py
AI Model
Mapping
Data..

ZIP

Load
File.py
or .zip





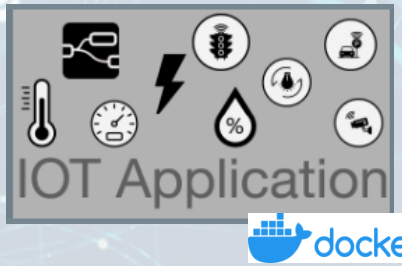
To make the .PY usable as MicroService you need to adapt it to get and send data in/out with Node-RED from a Container.
If you provide a .zip file the main .py inside has to be called doScript.py

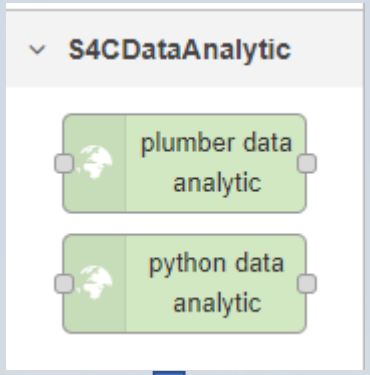
Data Analytic Container

1

Develop .py **or** .r program on (i) Snap4City platform online, or (ii) your Development Machine.
The code has to respect the guidelines provided. For example see:
https://www.snap4city.org/641
https://www.snap4city.org/645

2 Open an Advanced IoT App / Node-RED

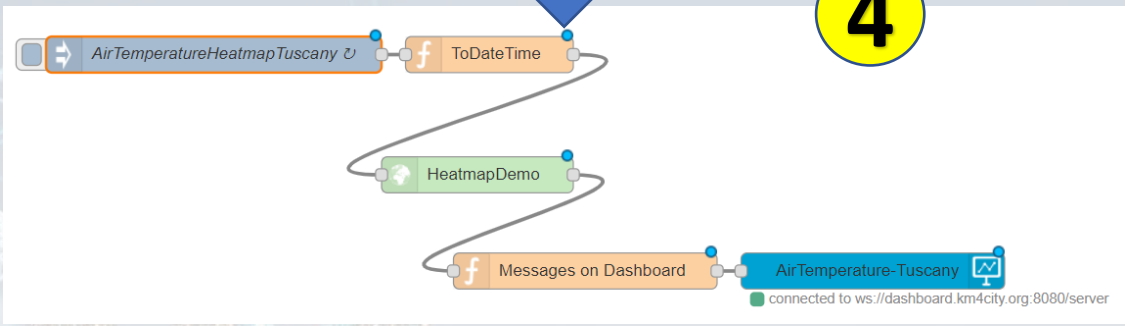




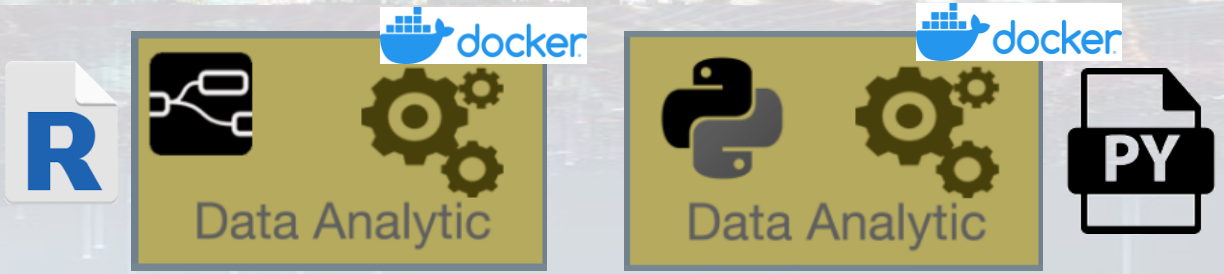
3

Use Snap4City Data Analytic Node, and load in the code you developed

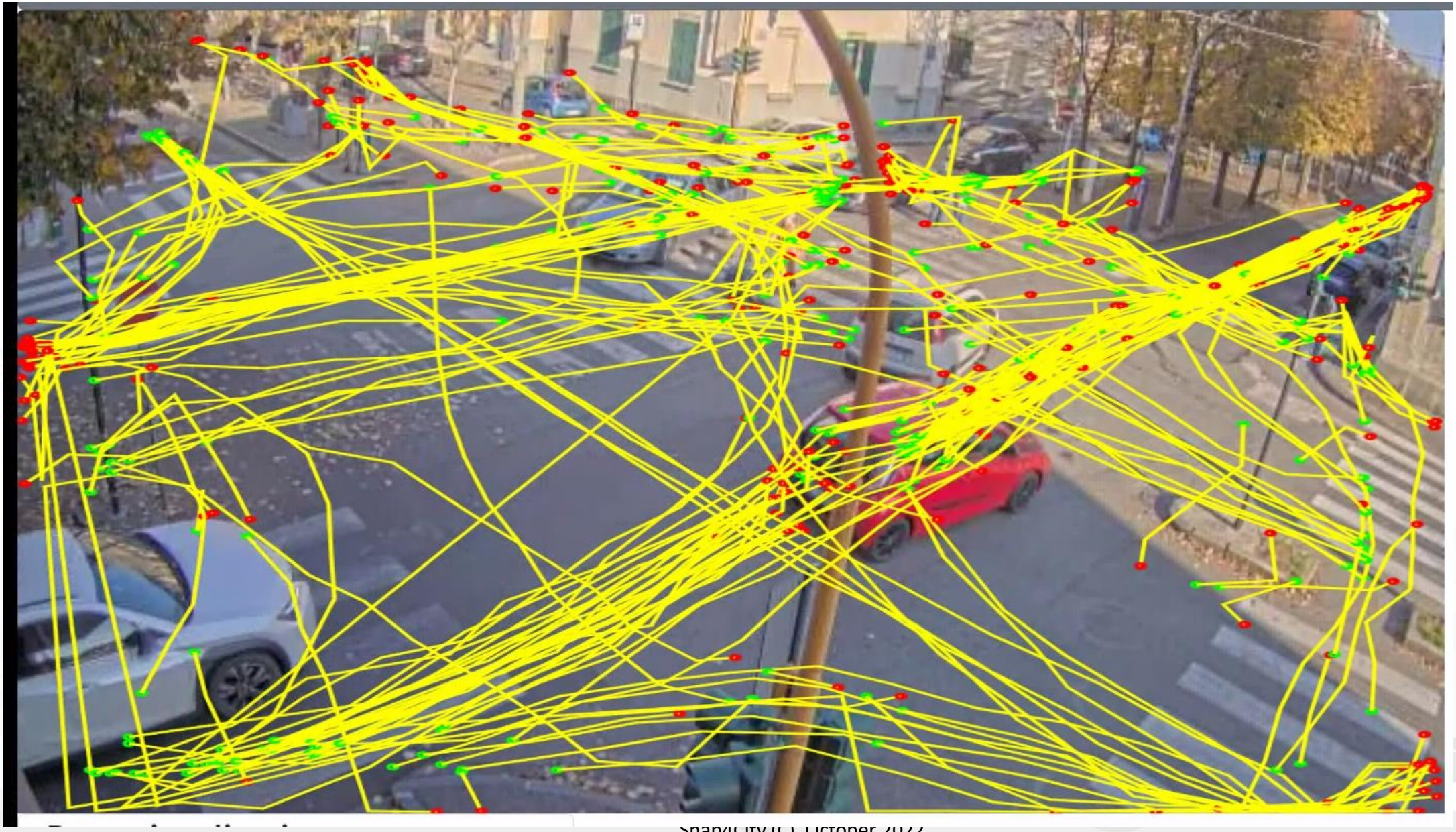
4

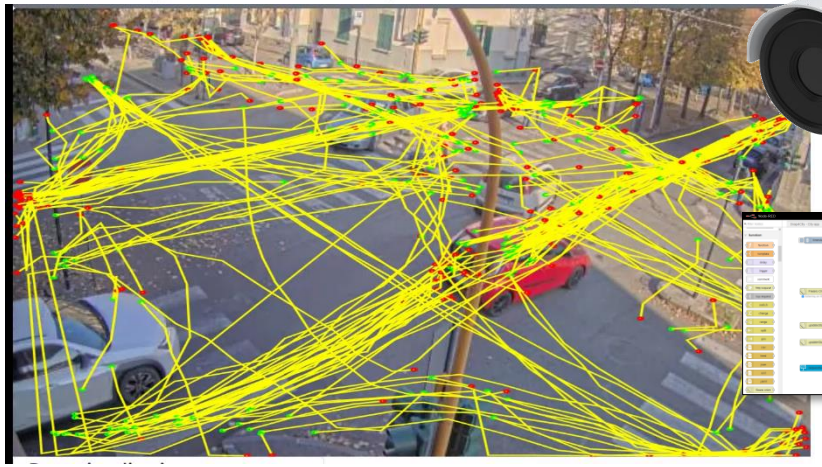


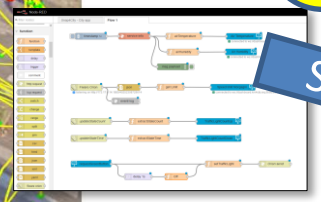
5 Deploy the IoT App → Snap4City Container Manager based on Marathon/Mesos is creating a Container for your Data Analytic code



analytics example







IoT edge on
TV Camera

1

Send data to Broker

Send Trajectories

2

IOT Broker

Device: CrossVenaria2
with trajectories

Save data

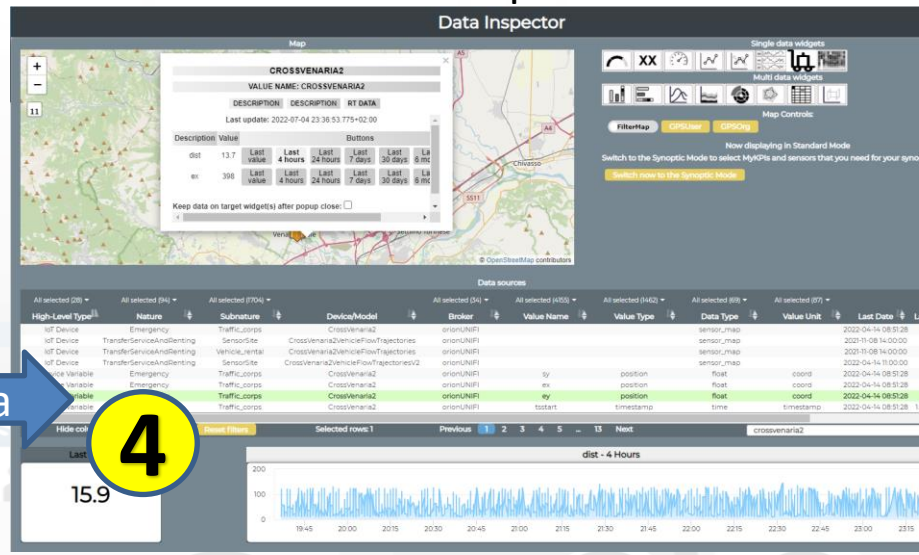
3

Big Data
Store
Facility

show data

4

Data Inspector



IoT edge on
TV Camera

Send data to Broker

IOT Broker

Devices:
- CrossVenaria2VehicleFlowTrajectoriesV2
- VenariaConteggio

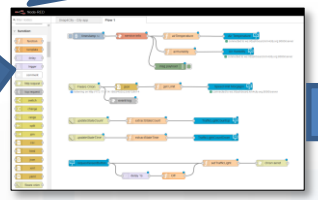
Send Trajectories

Save data

f Save Counting per Cluster

e Send data to Broker

Periodically



b Activate

a python data analytic

Data **d** lytic

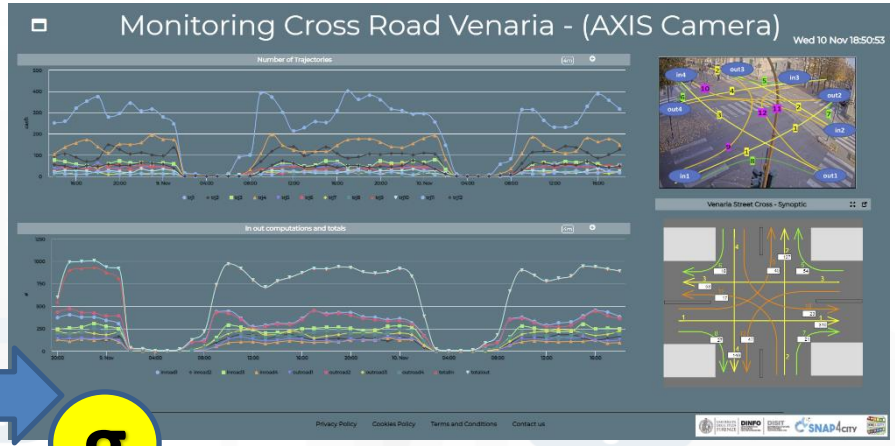
c Get data

From Trajectories
To clusters

Device:
CrossVenaria2
with
trajectories

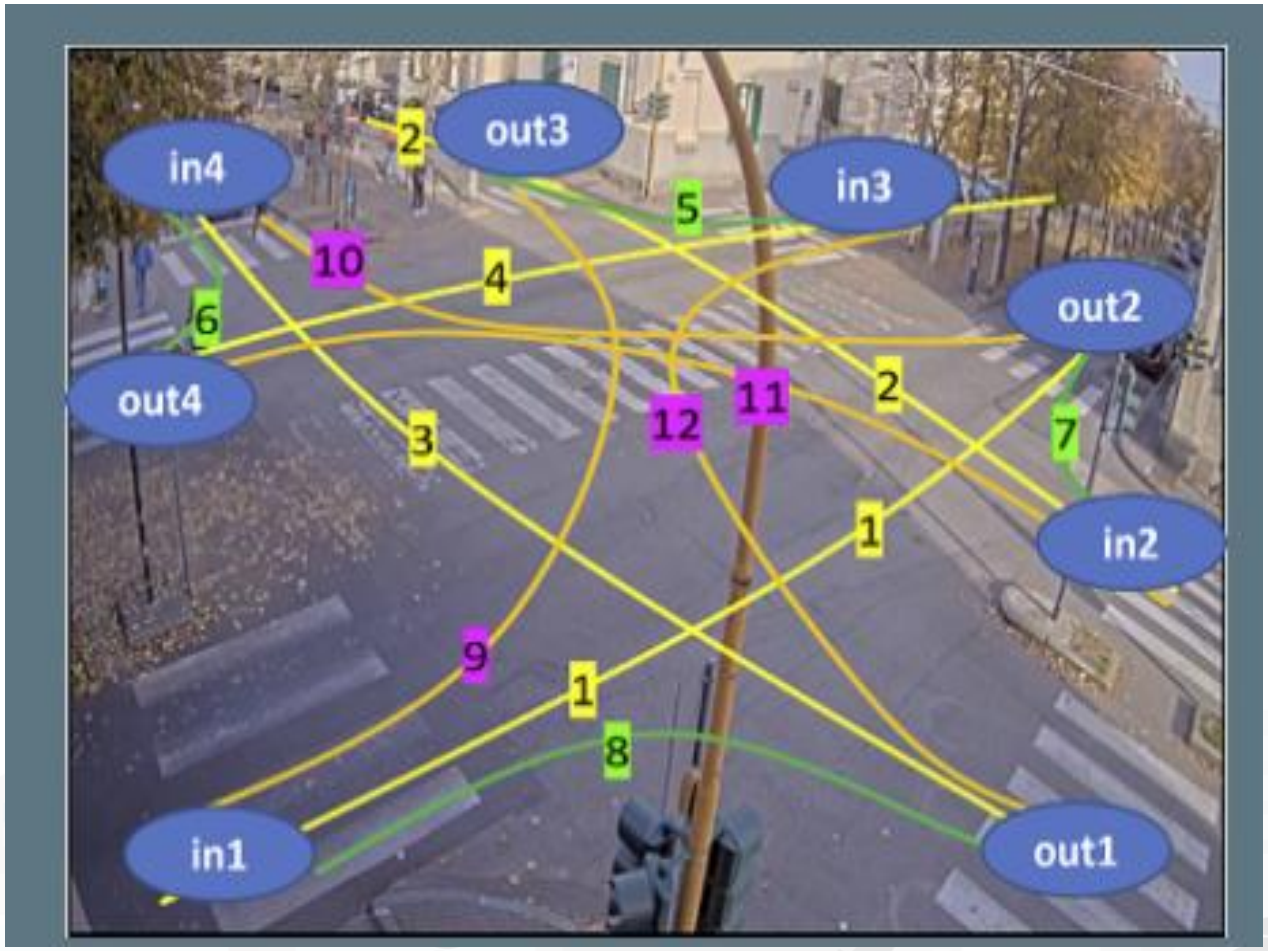
Big Data
Store
Facility

show data

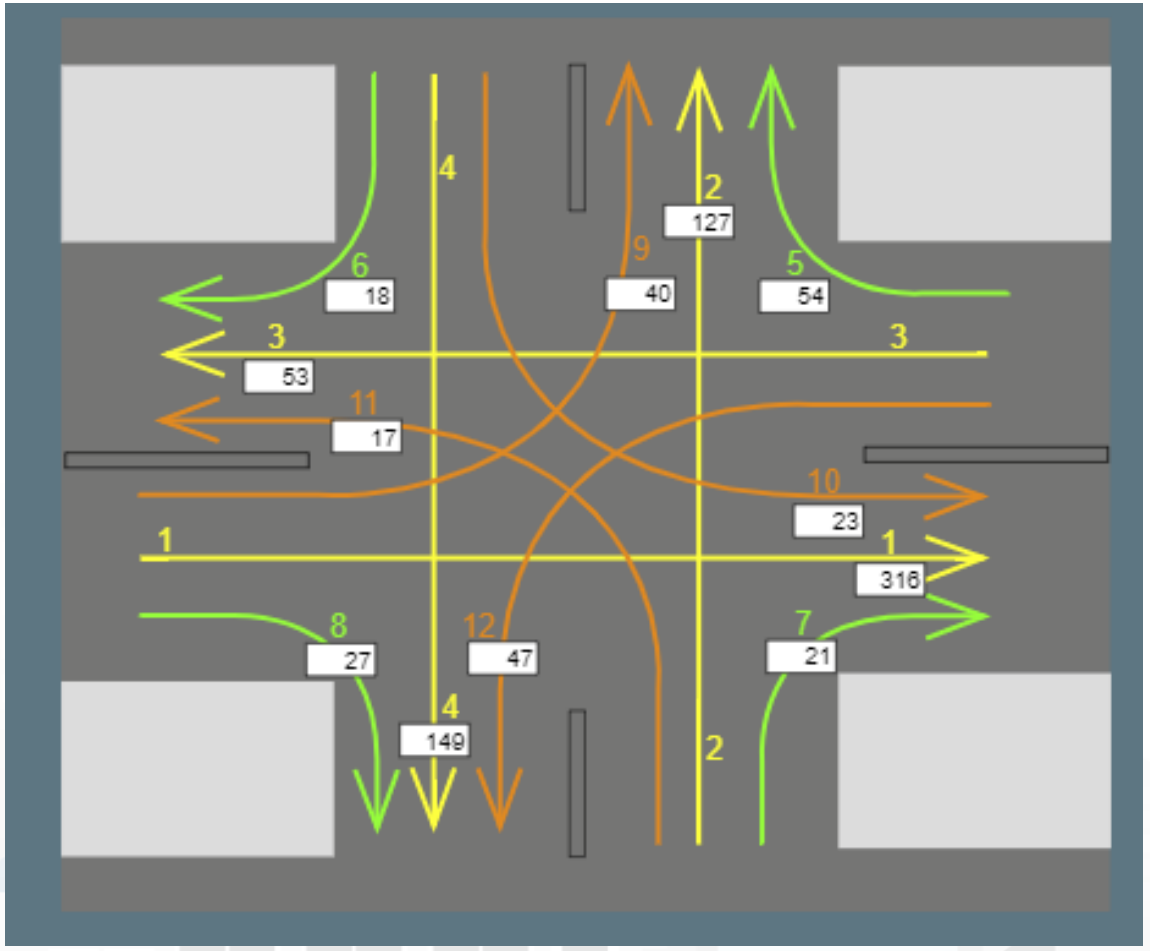


g Create and use a Dashboard

Real time Clustering: legenda and synoptic



Legenda



Synoptic with real time data

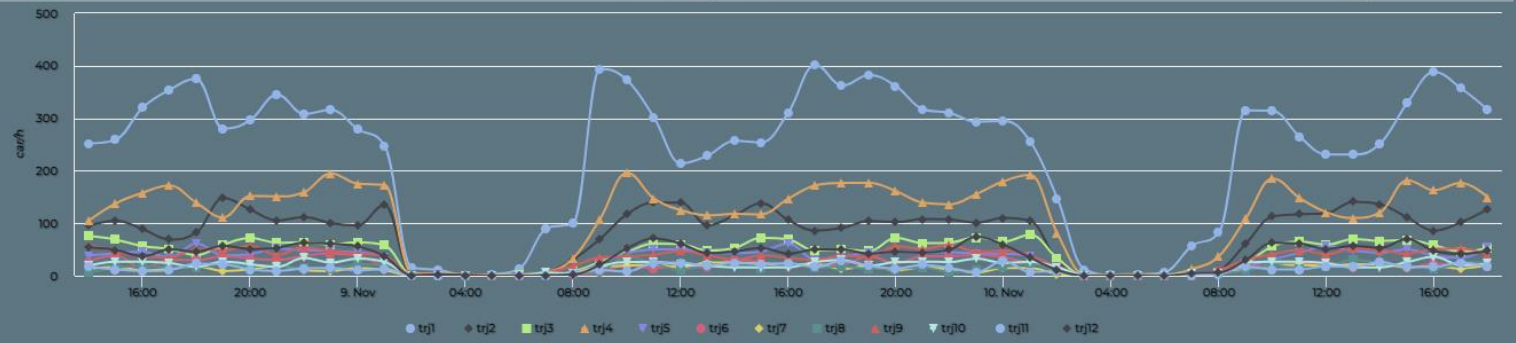
An example

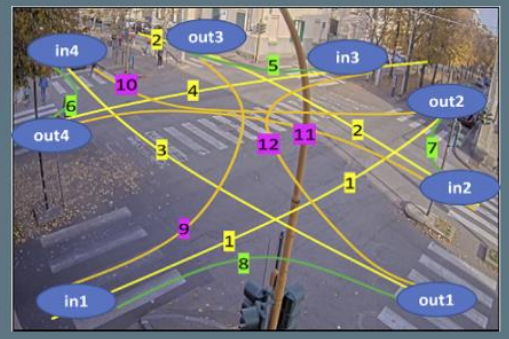
Traffic Flow Analysis via TV Camera and Clustering on cloud

Monitoring Cross Road Venaria - (AXIS Camera)

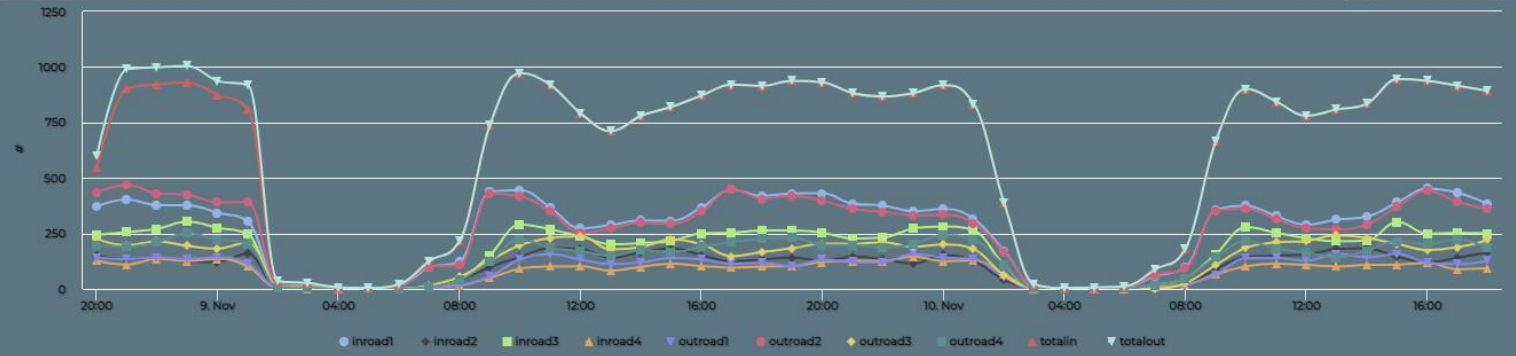
Wed 10 Nov 18:

Number of Trajectories

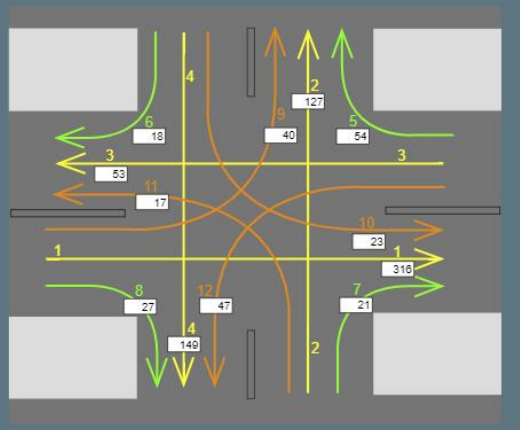




In out computations and totals



Venaria Street Cross - Synoptic



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Data Analytics on Dedicated Machine

Data Analytics on Snap4City platform

Swagger

Ontology Schema

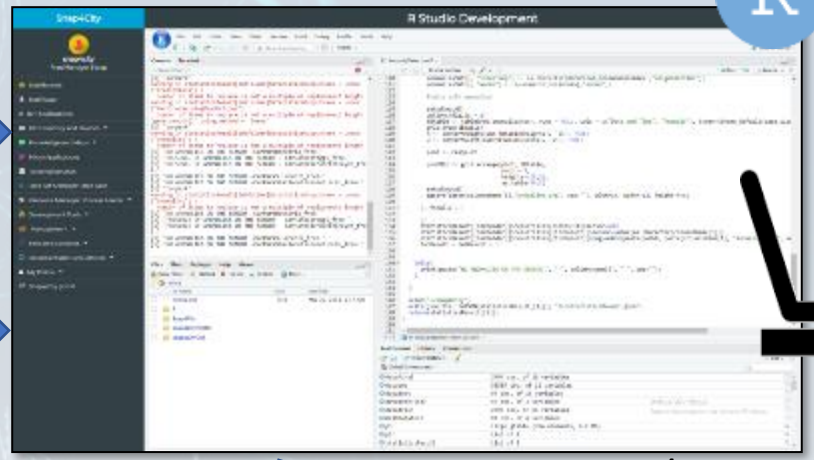
LOG.disit.org

Big Data Store Facility

Smart City API from Knowledge Base and other tools

TensorFlow

NVIDIA CUDA



python

jupyter

R Studio

Saving / Sharing reusing

TensorFlow

NVIDIA CUDA

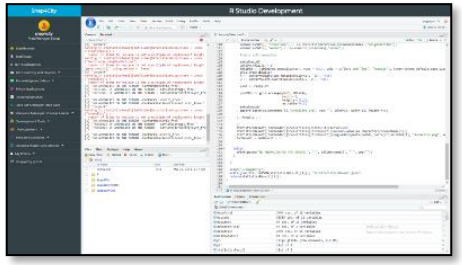
- Python *file.py* ……..
- Rscript *file.r* …….

Resource Manager

Development

python jupyter

R Studio



API

Big Data Store Facility

Save data

Get data

EXECUTION

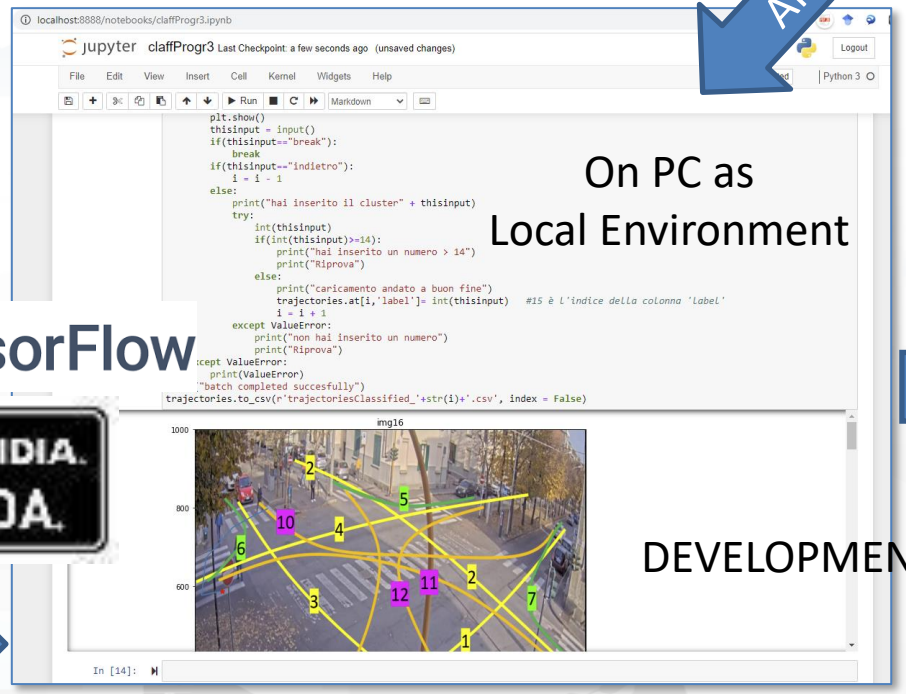
TensorFlow

CUDA

- Python file.py……..
- Rscript file.r…….

API

On Server
Or
On PC



On PC as
Local Environment

TensorFlow

CUDA

DEVELOPMENT

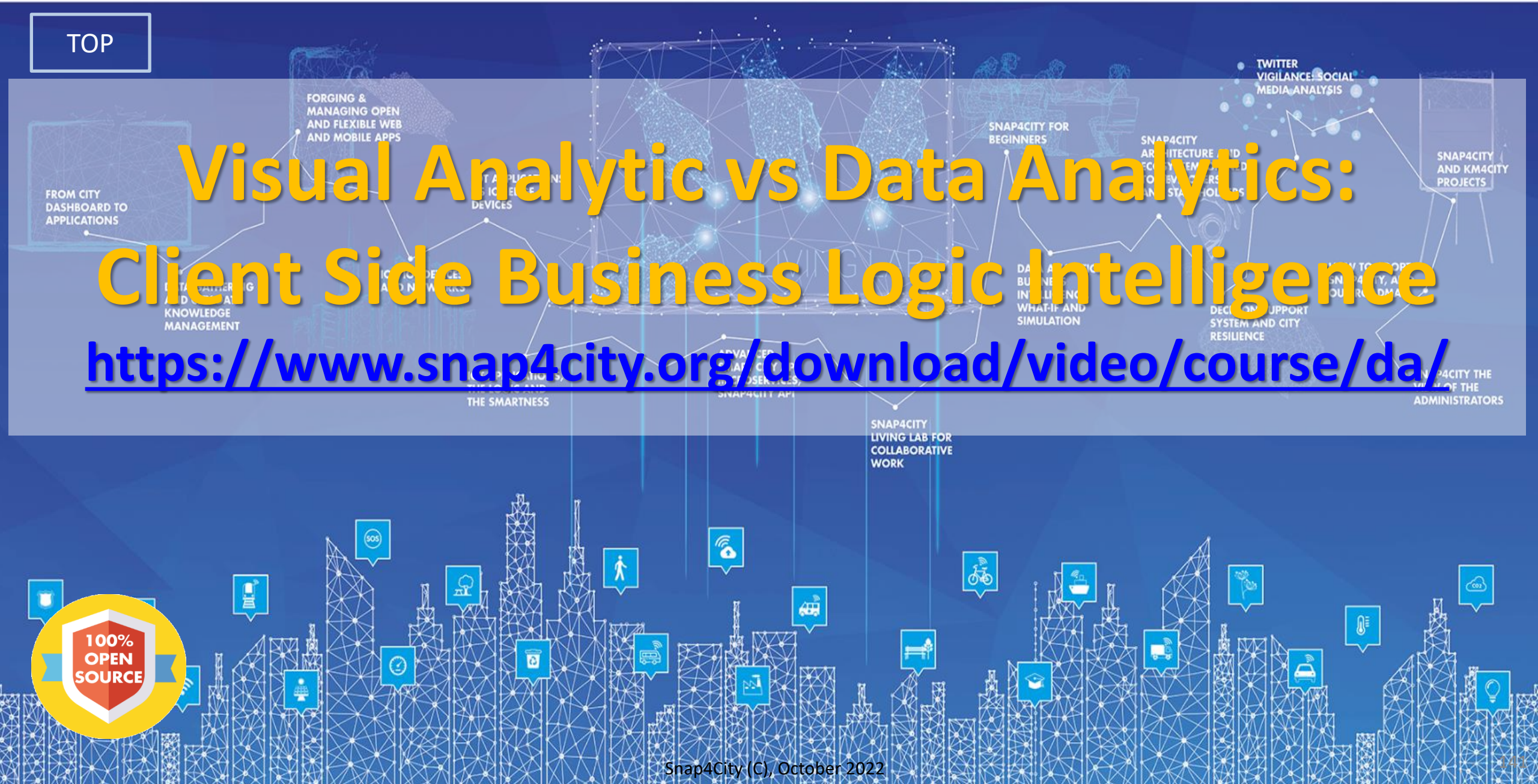
Once finalized

Process: file .R or .Py (ith their model, data) can be put in execution with local scheduler or Cron

TOP

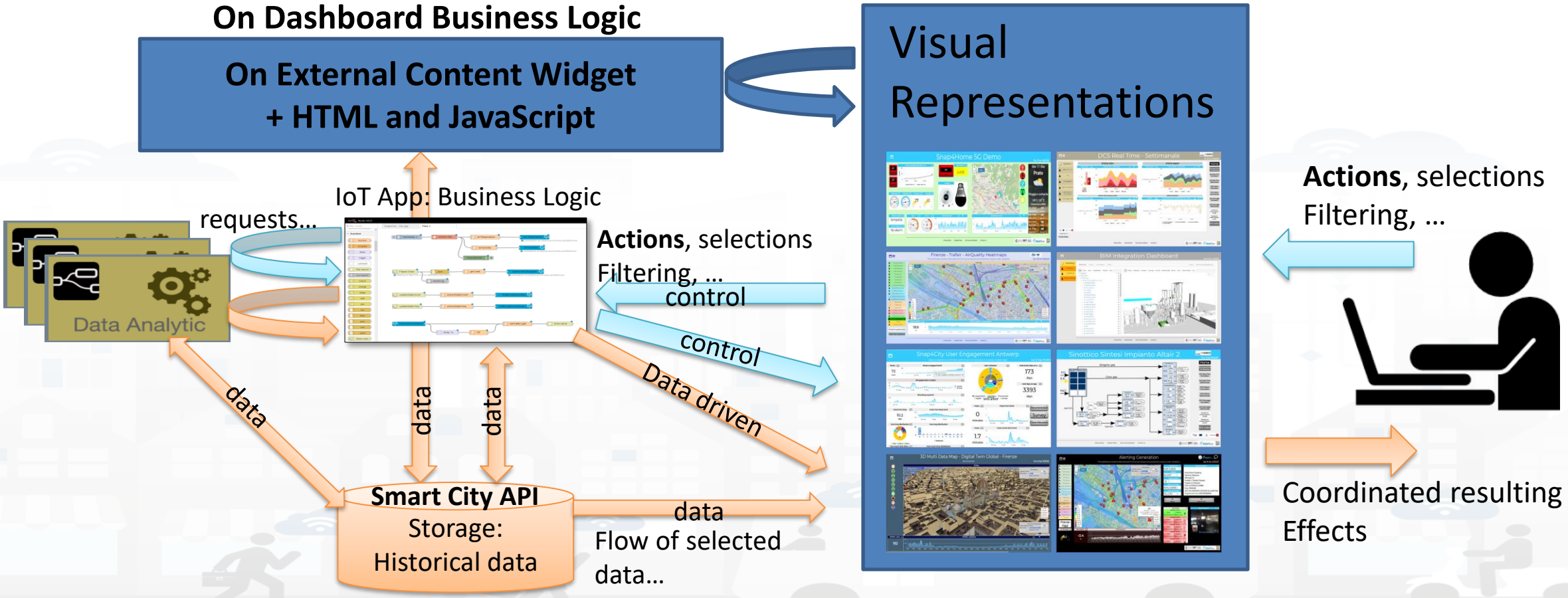
Visual Analytic vs Data Analytics: Client Side Business Logic Intelligence

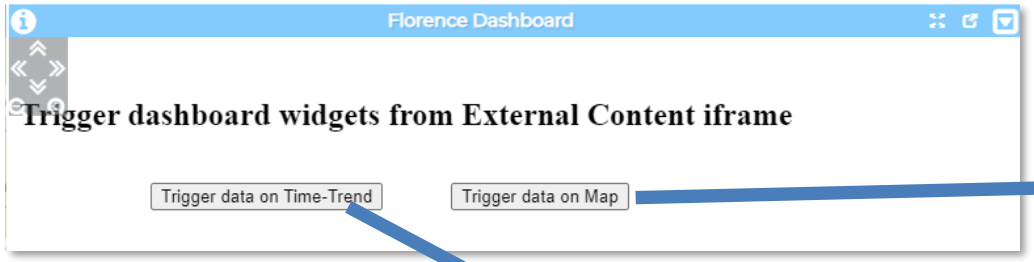
https://www.snap4city.org/download/video/course/da/

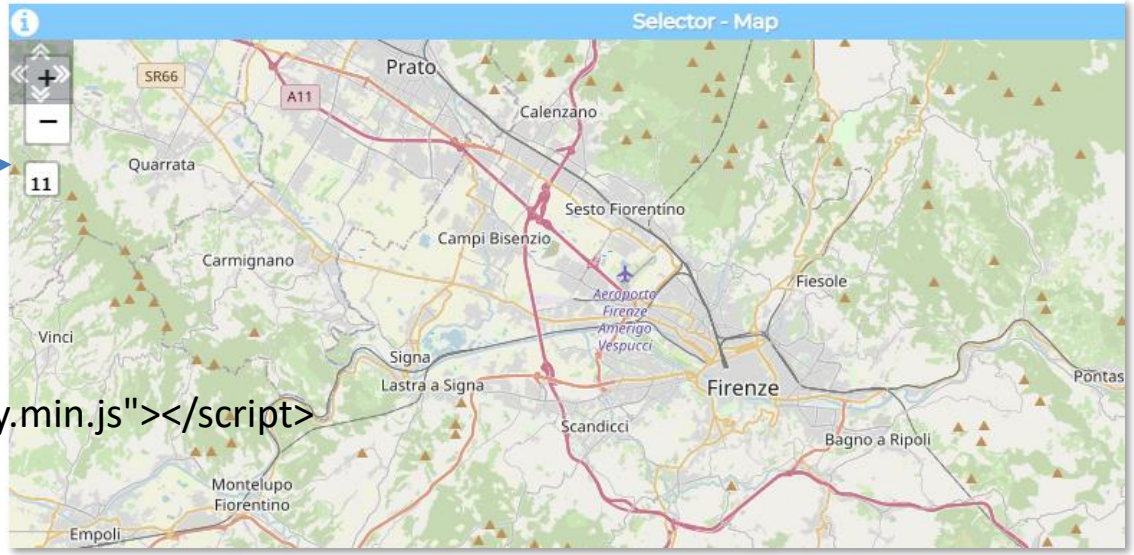


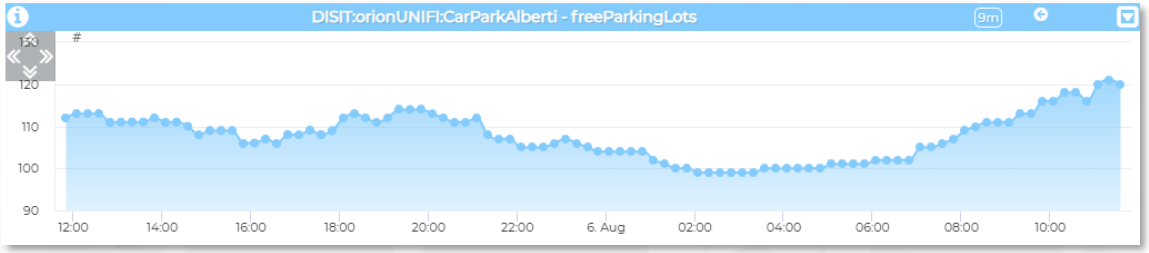
Visual Analytics

- implementing sophisticated ***Business Intelligence Tools***
- Open to receive a range of possible Actions, to produce a large combination of results in terms of data and representations.







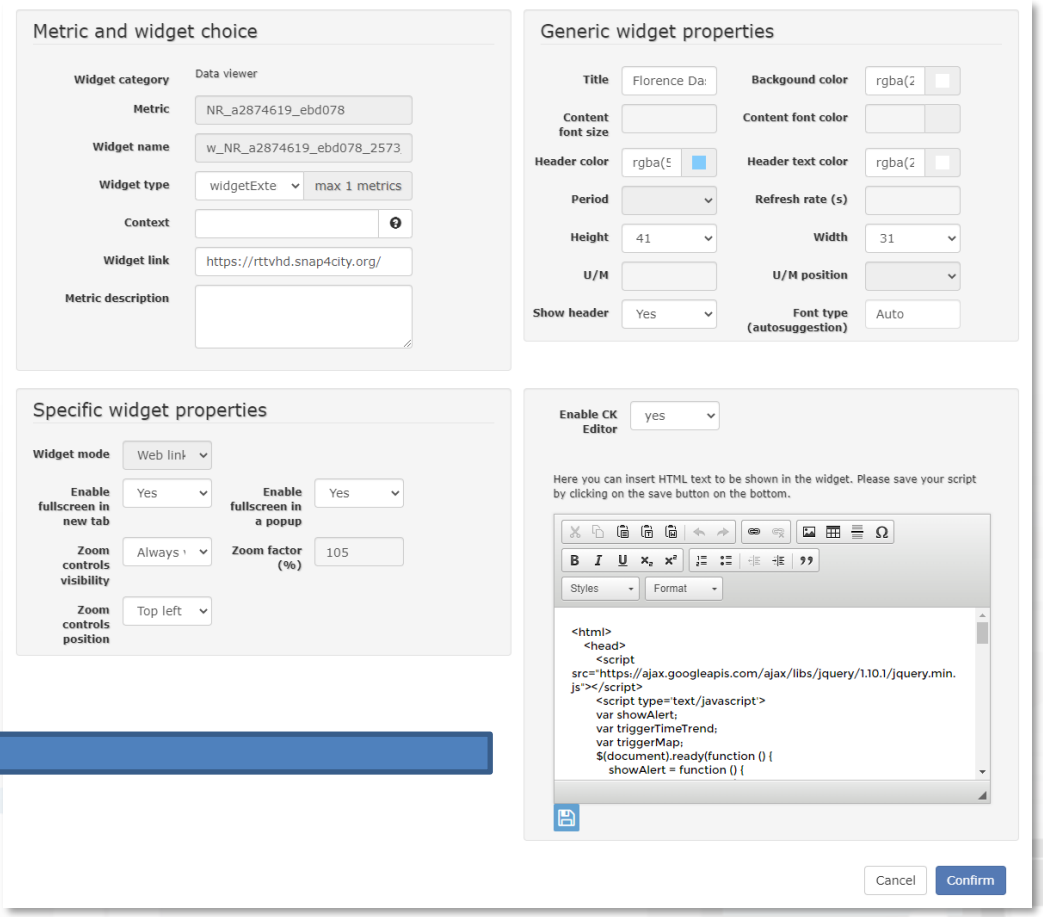



```
<html>
  <head>
    <script src="https://ajax.googleapis.com/ajax/libs/jquery/1.10.1/jquery.min.js"></script>
    <script type='text/javascript'>
            …….
    </script>
  </head>
  <body>
    <h2>Trigger dashboard widgets from External Content iframe</h2>
    <div>
      <!-- <button onclick="showAlert()">Alert Button GP</button>   -->
      <button id="triggerTTrend">Trigger data on Time-Trend</button>
      <button id="triggerMap">Trigger data on Map</button>
    </div>
  </body>
</html>
```

Trigger based

```
<script type='text/javascript'>
var showAlert;
var triggerTimeTrend;
var triggerMap;
$(document).ready(function () {
    showAlert = function () {
        var myText = "Test alert";
        alert (myText);
    }
    $('#triggerTTrend').click(function (event) {
        .................
        parent.$('body').trigger({      .................          });
    });
    $('#triggerMap').click(function (event) {
        .................
        parent.$('body').trigger({      .................          });
    });
});
</script>
```

Enforcing HTML and JavaScript on MoreOptions of the External Content Widget



Trigger map

```
$('#triggerMap').click(function (event) {
        let coordsAndType = {};
        coordsAndType.eventGenerator = $(this);
        coordsAndType.desc = "CarPark";
        coordsAndType.query =
"https://servicemap.disit.org/WebAppGrafo/api/v1/?selection=43.64471;11.005751;43.89471;11.505751&categories=Car_park&maxResults=200&format=j
son&model=CarPark";
        coordsAndType.color1 = "#ebb113";
        coordsAndType.color2 = "#eb8a13";
        coordsAndType.targets = "w_DISIT_orionUNIFI_CarParkAlberti_2573_widgetTimeTrend33703";    // the Time Trend Widget ID once pop up open
        coordsAndType.display = "pins";
        coordsAndType.queryType = "Default";
        coordsAndType.iconTextMode = "text";
        coordsAndType.pinattr = "square";
        coordsAndType.pincolor = "#959595";
        coordsAndType.symbolcolor = "undefined";
        // coordsAndType.altViewMode = altViewMode;
        coordsAndType.bubbleSelectedMetric = "";
        parent.$('body').trigger({
           type: "addSelectorPin",
           target: "w_Map_2573_widgetMap33705", // the Time Trend Widget ID of the event performed on clik
           passedData: coordsAndType
        });
    });
```

Trigger Time trend

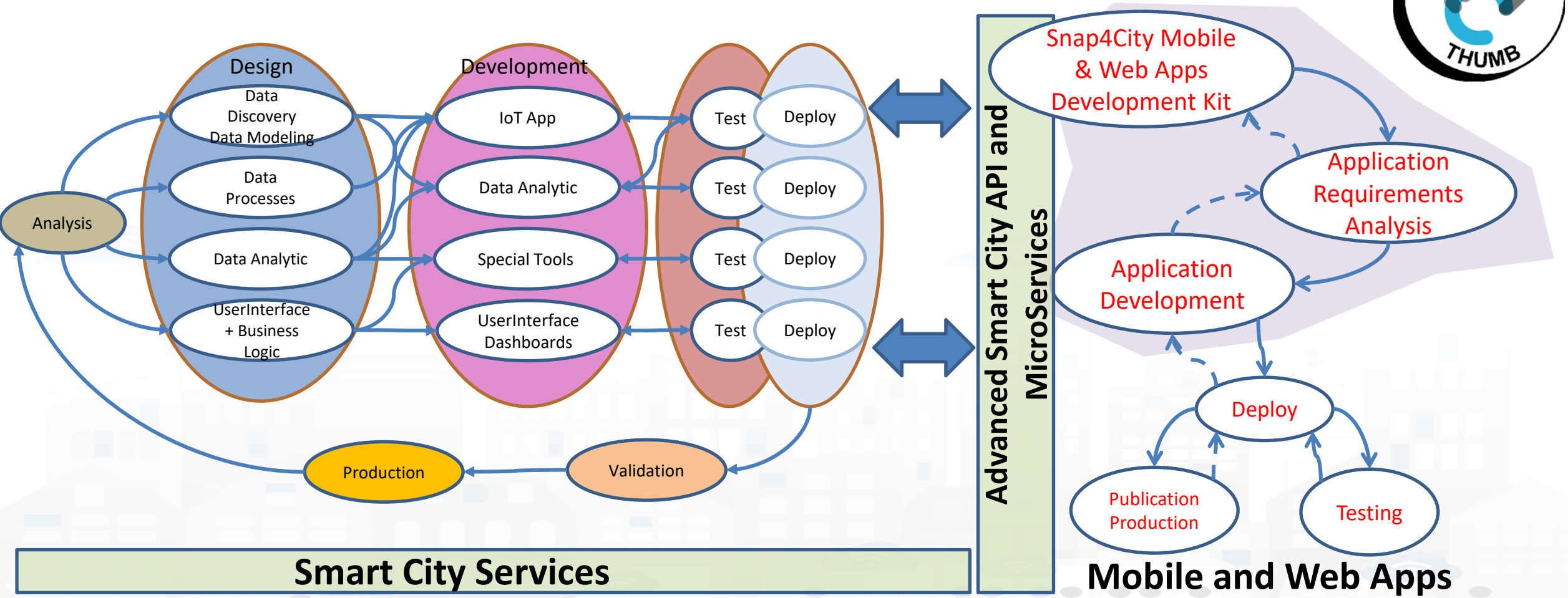
```
$('#triggerTTrend').click(function (event) {
    parent.$('body').trigger({
        type:
"showTimeTrendFromExternalContentGis_w_DISIT_orionUNIFI_CarParkAlberti_2573_widgetTimeTrend33703",
        eventGenerator: $(this),
        targetWidget: "w_DISIT_orionUNIFI_CarParkAlberti_2573_widgetTimeTrend33703",
        range: "7/DAY",
        color1: "#34eb6e",
        color2: "#114a23",
        widgetTitle: "Free Parking Lots data from External Content",
        field: "freeParkingLots",
        serviceUri: "http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/CarParkPal.Giustizia",
        marker: "",
        mapRef: "",
        fake: false
    });
});
```

TOP

Design and Develop web and mobile Apps

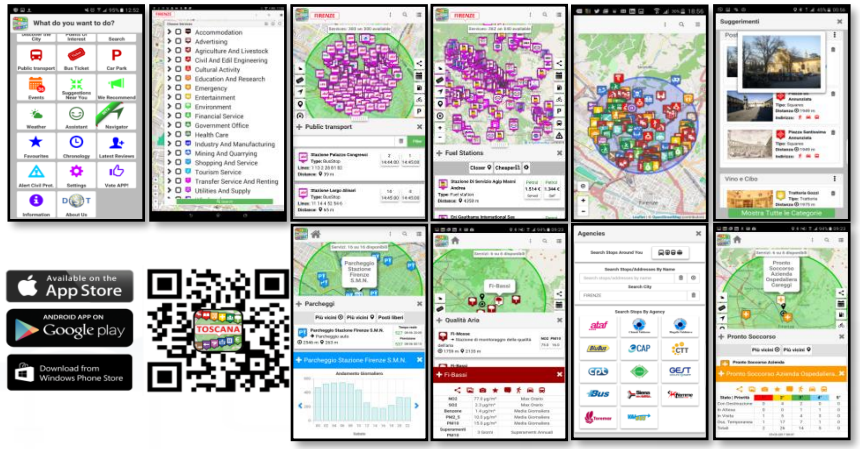
https://www.snap4city.org/download/video/course/app/

Develop Mobile & Web Applications Exploiting Snap4City Smart City Services

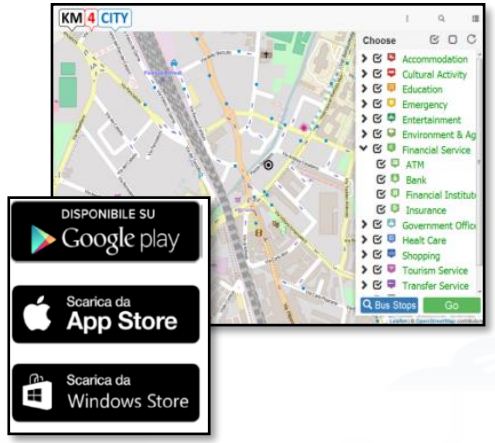


Developing Web and Mobile Apps, MicroApps,..

Mobile Apps



Web App HTML5, MicroApplications



Embed into Web pages

City User

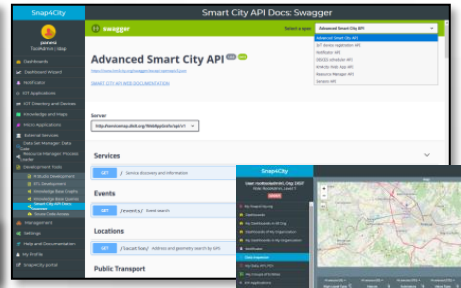
Advanced Smart City API

Mobile Application Monitoring Administrator

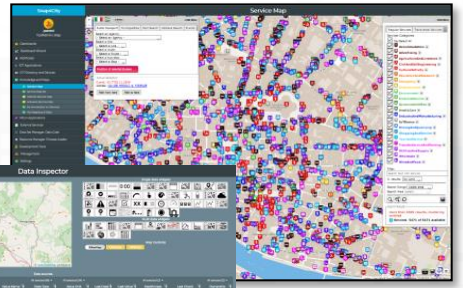
Knowledge Base, Km4City

GitHub

Snap/Km4City Open Source development tool kit



Swagger

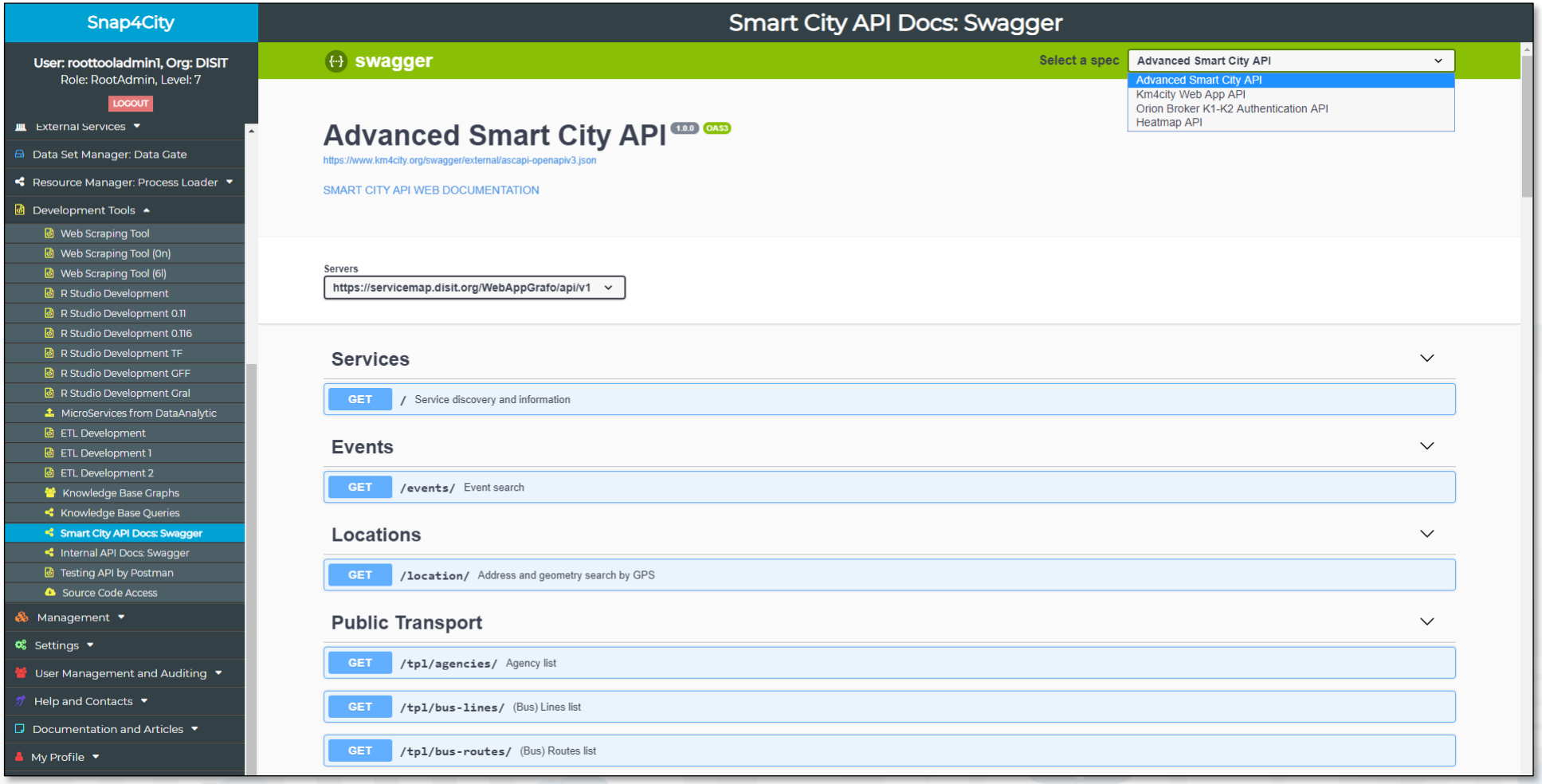


ServiceMap

DataInspector

Developer

External Smart City API



https://www.km4city.org/swagger/external/index.html

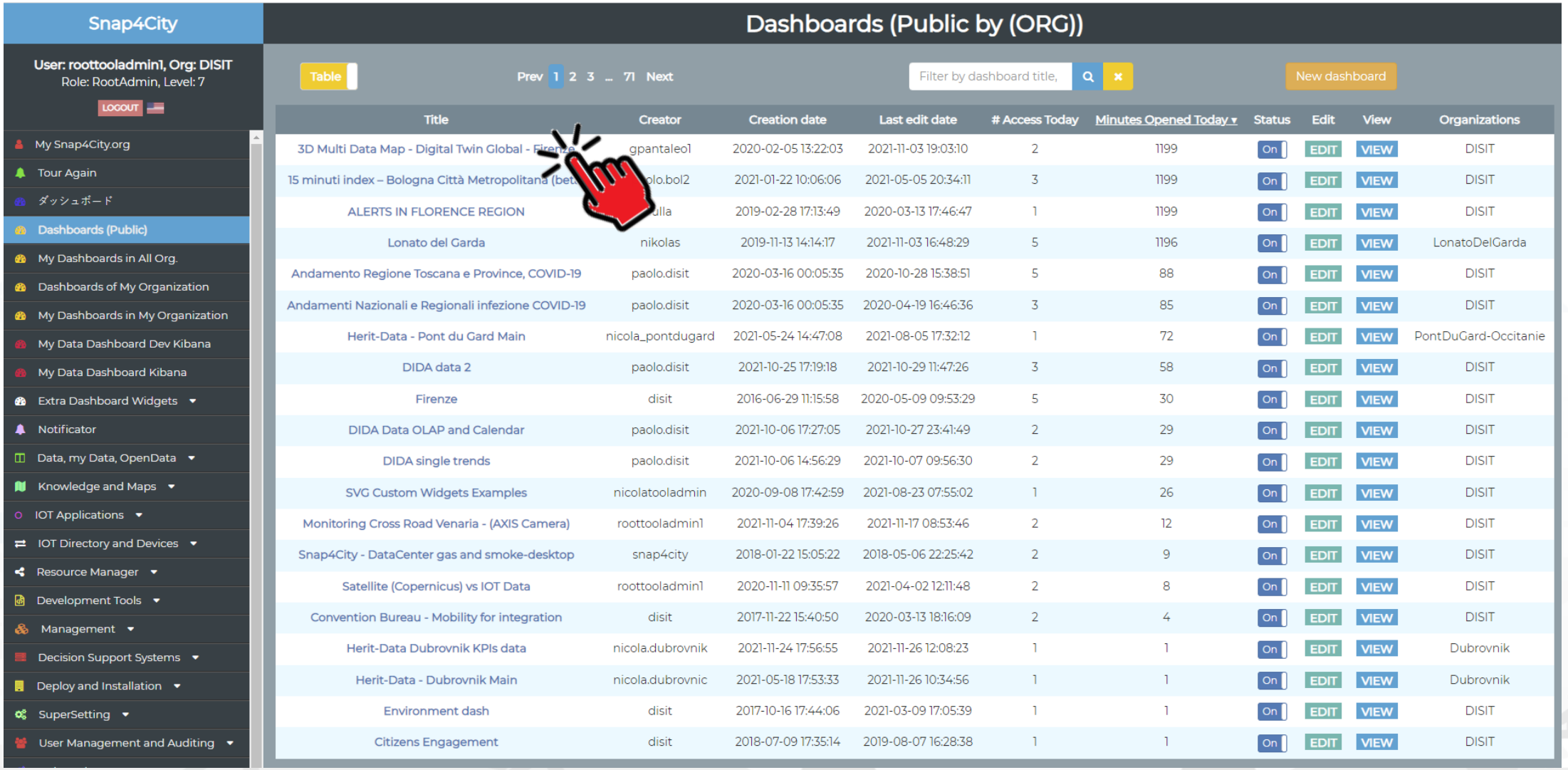
TOP

Design and Control of Smart Applications

only for user with RootAdmin role

partially accessible also for all Dashboard owners

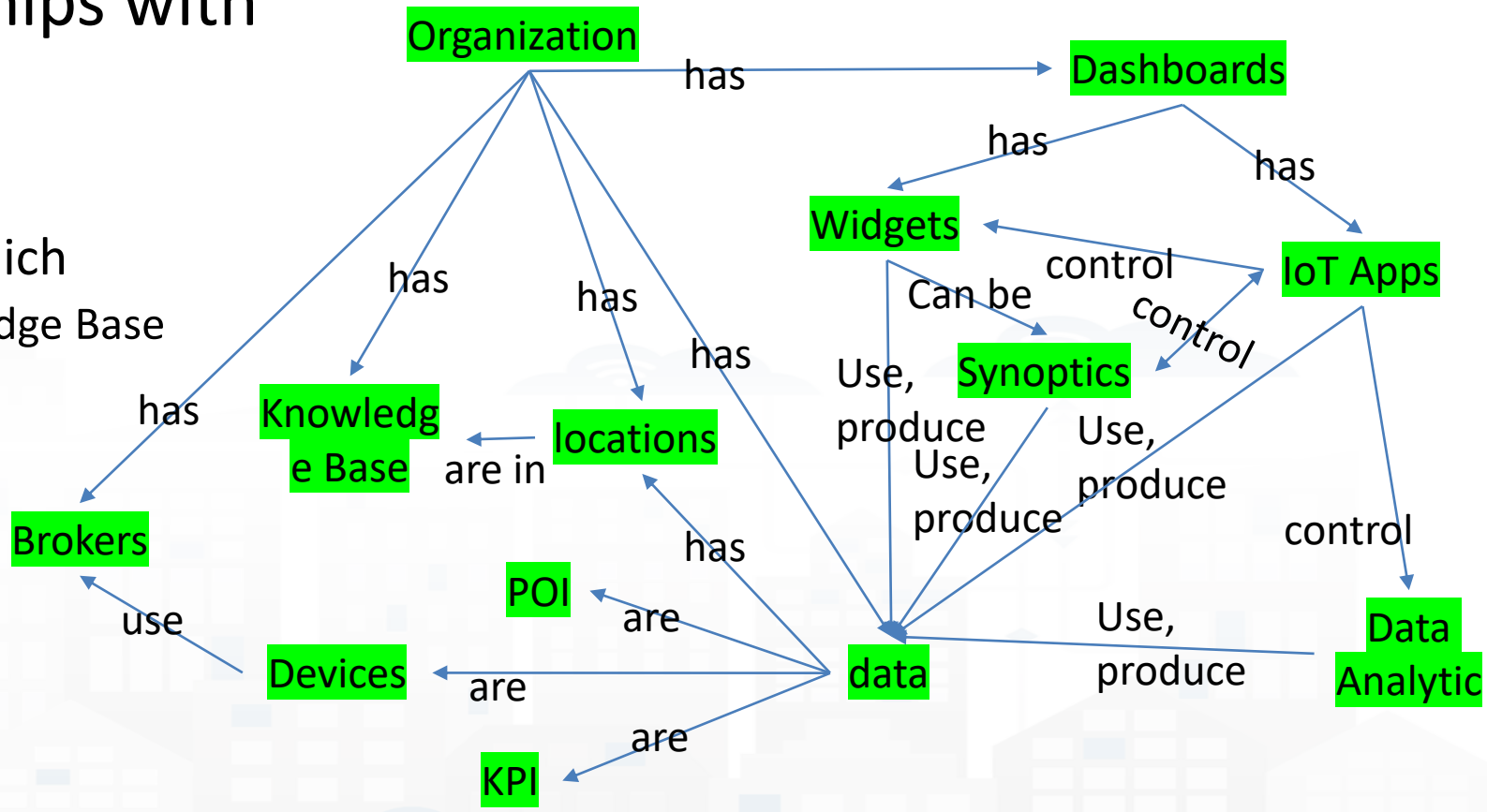
Dashboard manager for RootAdmin



Title	Creator	Creation date	Last edit date	# Access Today	Minutes Opened Today	Status	Edit	View	Organizations
3D Multi Data Map - Digital Twin Global - Firenze	gpantaleo1	2020-02-05 13:22:03	2021-11-03 19:03:10	2	1199	On	EDIT	VIEW	DISIT
15 minuti index – Bologna Città Metropolitana (bet	olo.bol2	2021-01-22 10:06:06	2021-05-05 20:34:11	3	1199	On	EDIT	VIEW	DISIT
ALERTS IN FLORENCE REGION	ulla	2019-02-28 17:13:49	2020-03-13 17:46:47	1	1199	On	EDIT	VIEW	DISIT
Lonato del Garda	nikolas	2019-11-13 14:14:17	2021-11-03 16:48:29	5	1196	On	EDIT	VIEW	LonatoDelGarda
Andamento Regione Toscana e Province, COVID-19	paolo.disit	2020-03-16 00:05:35	2020-10-28 15:38:51	5	88	On	EDIT	VIEW	DISIT
Andamenti Nazionali e Regionali infezione COVID-19	paolo.disit	2020-03-16 00:05:35	2020-04-19 16:46:36	3	85	On	EDIT	VIEW	DISIT
Herit-Data - Pont du Gard Main	nicola_pontdugard	2021-05-24 14:47:08	2021-08-05 17:32:12	1	72	On	EDIT	VIEW	PontDuGard-Occitanie
DIDA data 2	paolo.disit	2021-10-25 17:19:18	2021-10-29 11:47:26	3	58	On	EDIT	VIEW	DISIT
Firenze	disit	2016-06-29 11:15:58	2020-05-09 09:53:29	5	30	On	EDIT	VIEW	DISIT
DIDA Data OLAP and Calendar	paolo.disit	2021-10-06 17:27:05	2021-10-27 23:41:49	2	29	On	EDIT	VIEW	DISIT
DIDA single trends	paolo.disit	2021-10-06 14:56:29	2021-10-07 09:56:30	2	29	On	EDIT	VIEW	DISIT
SVG Custom Widgets Examples	nicolatooladmin	2020-09-08 17:42:59	2021-08-23 07:55:02	1	26	On	EDIT	VIEW	DISIT
Monitoring Cross Road Venaria - (AXIS Camera)	roottooladmin1	2021-11-04 17:39:26	2021-11-17 08:53:46	2	12	On	EDIT	VIEW	DISIT
Snap4City - DataCenter gas and smoke-desktop	snap4city	2018-01-22 15:05:22	2018-05-06 22:25:42	2	9	On	EDIT	VIEW	DISIT
Satellite (Copernicus) vs IOT Data	roottooladmin1	2020-11-11 09:35:57	2021-04-02 12:11:48	2	8	On	EDIT	VIEW	DISIT
Convention Bureau - Mobility for integration	disit	2017-11-22 15:40:50	2020-03-13 18:16:09	2	4	On	EDIT	VIEW	DISIT
Herit-Data Dubrovnik KPIs data	nicola.dubrovnik	2021-11-24 17:56:55	2021-11-26 12:08:23	1	1	On	EDIT	VIEW	Dubrovnik
Herit-Data - Dubrovnik Main	nicola.dubrovnic	2021-05-18 17:53:33	2021-11-26 10:34:56	1	1	On	EDIT	VIEW	Dubrovnik
Environment dash	disit	2017-10-16 17:44:06	2021-03-09 17:05:39	1	1	On	EDIT	VIEW	DISIT
Citizens Engagement	disit	2018-07-09 17:35:14	2019-08-07 16:28:38	1	1	On	EDIT	VIEW	DISIT

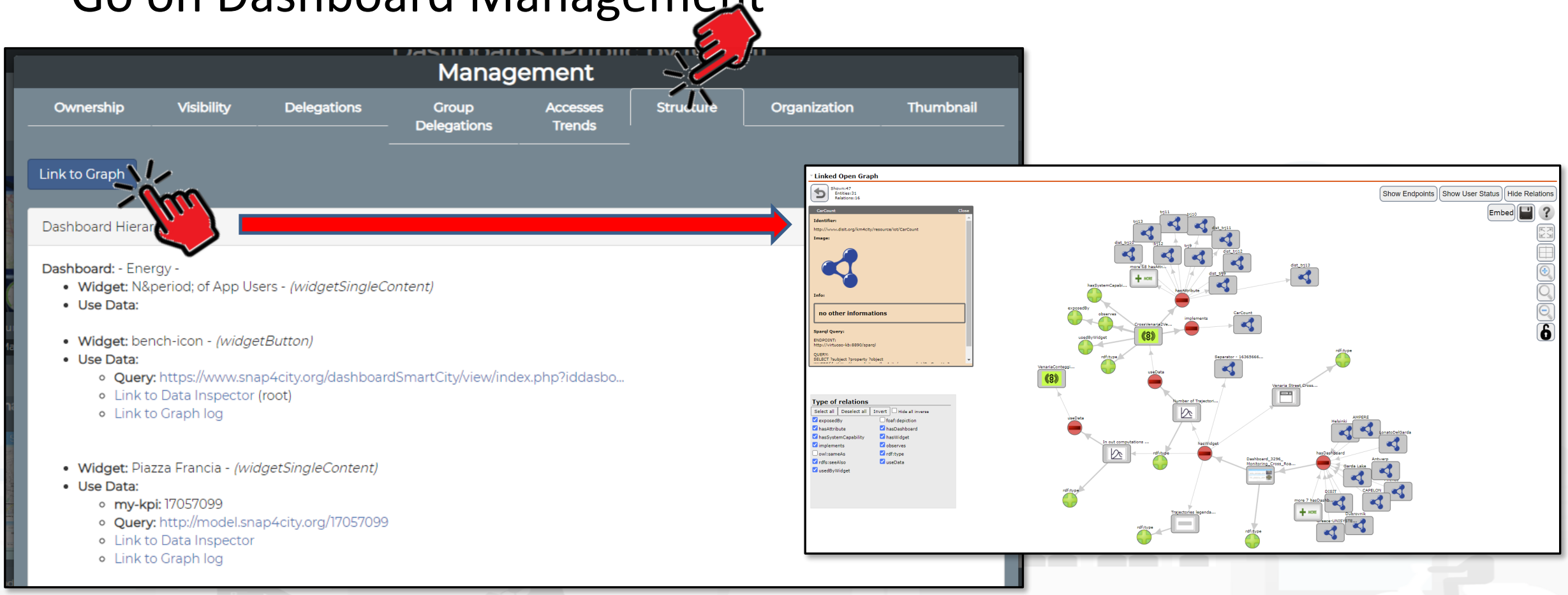
Semantic Reasoning on Smart Applications

- Dashboards have relationships with
  - Org. at which they belong
  - Widgets with
    - data they use, and each of which
      - is connected with the Knowledge Base
      - May be: device, kpi, etc.
  - IoT Apps with
    - Data they use
    - Data Analytic
    - Widget they control
  - .....



For All Dashboard owners: Graph and Structure

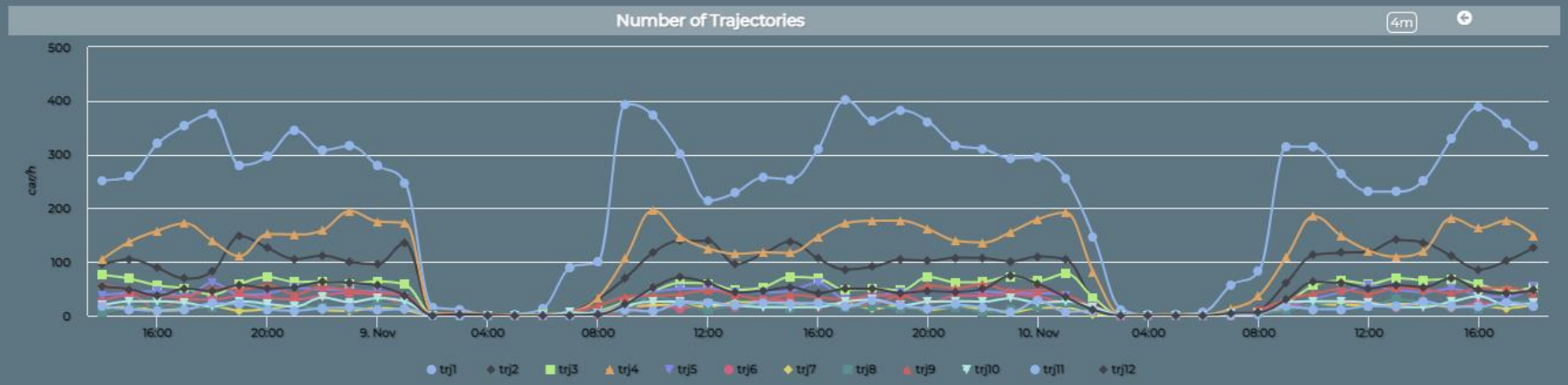
- Go on Dashboard Management

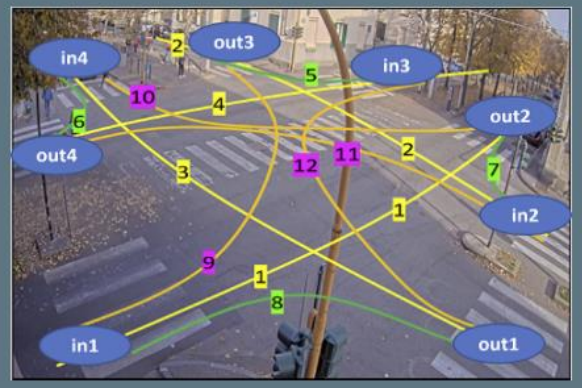


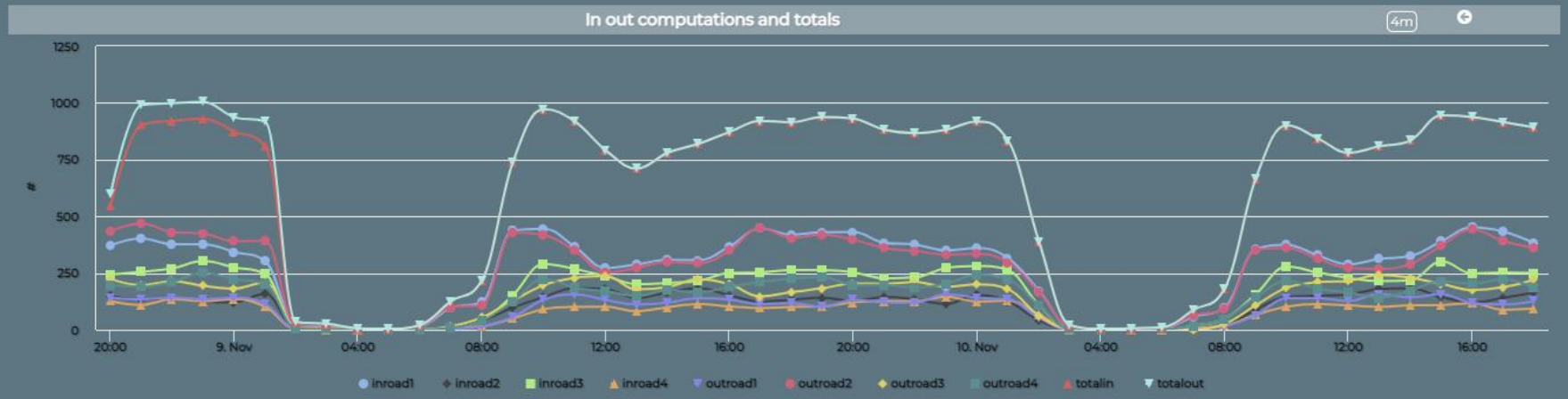
Venaria Reale

Monitoring Cross Road Venaria - (AXIS Camera)

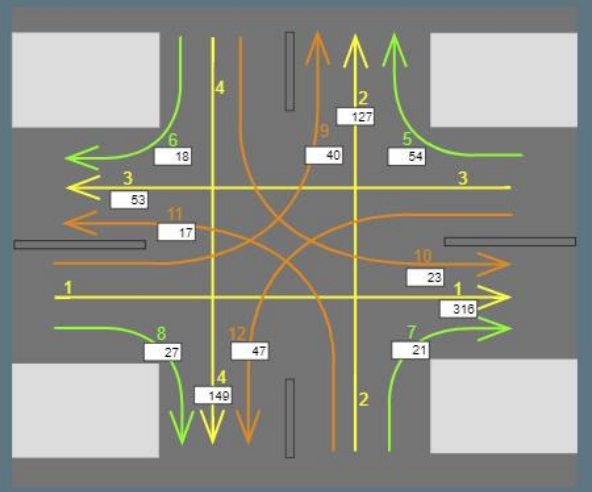
Wed 10 Nov 18:50:53







Venaria Street Cross - Synoptic



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI5Ng==

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Linked Open Graph

Shown:47
Entities:31
Relations:16

Show Endpoints | Show User Status | Hide Relations | Embed

CarCount Close

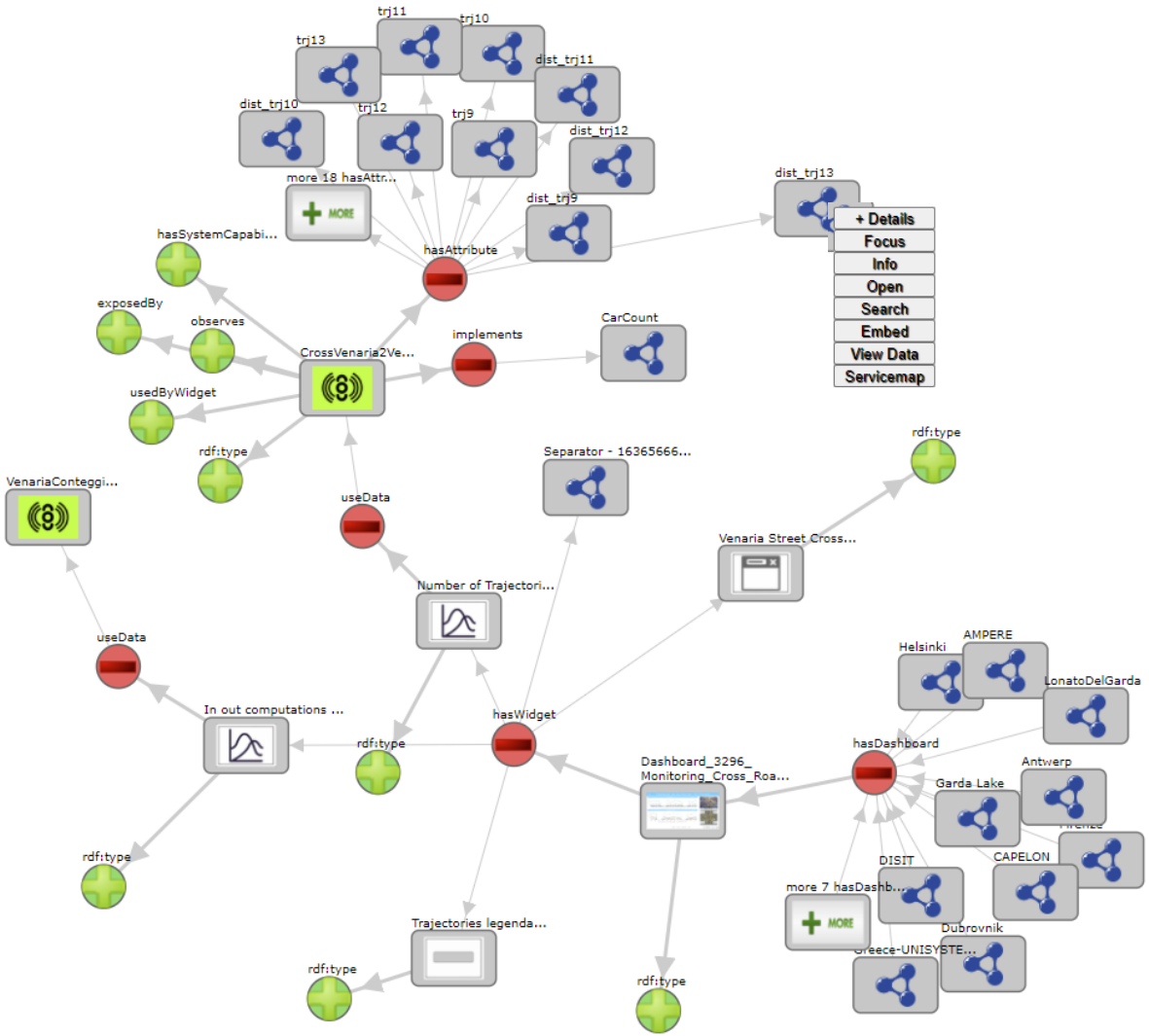
Identifier:
http://www.disit.org/km4city/resource/iot/CarCount

Image:

Info:
no other informations

Sparql Query:
ENDPOINT:
http://virtuoso-kb:8890/sparql

QUERY:
SELECT ?subject ?property ?object

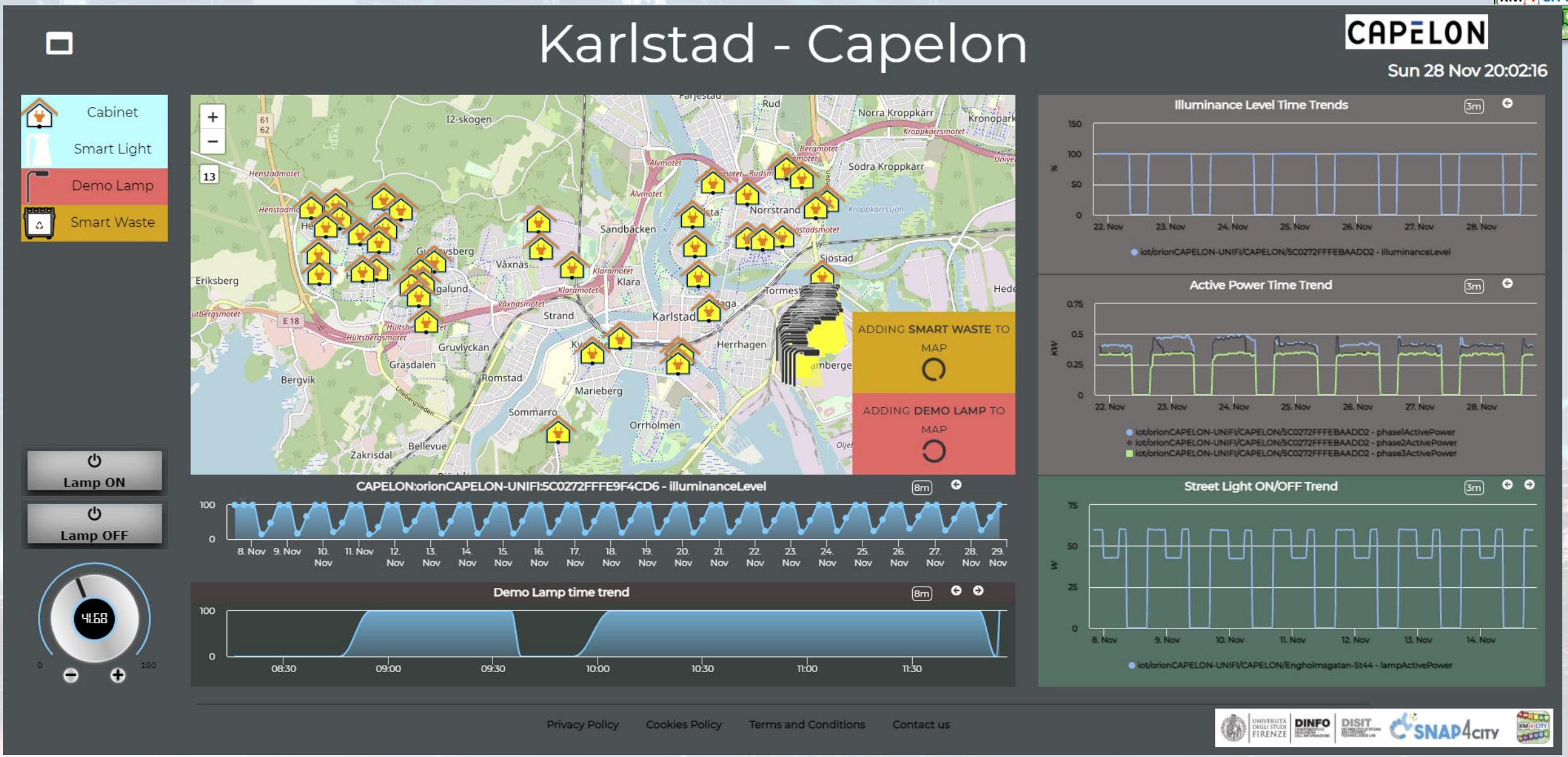


Type of relations

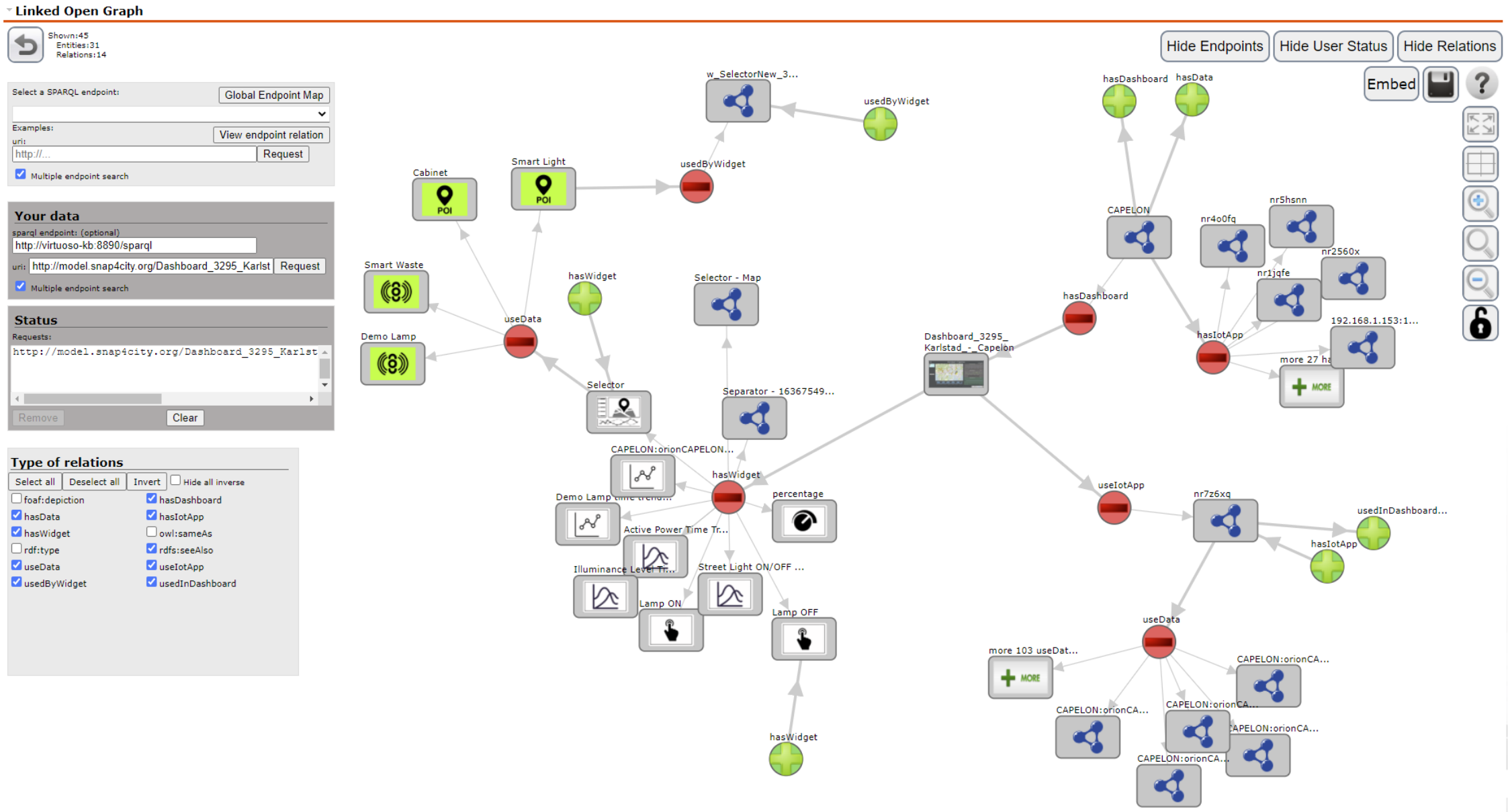
Select all | Deselect all | Invert | Hide all inverse

- [x] exposedBy
- [x] hasAttribute
- [x] hasSystemCapability
- [x] implements
- [ ] owl:sameAs
- [x] rdfs:seeAlso
- [x] usedByWidget
- [ ] foaf:depiction
- [x] hasDashboard
- [x] hasWidget
- [x] observes
- [x] rdf:type
- [x] useData

Karlstad Street Lights



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI5NQ==


Linked Open Graph
Shown:45
Entities:31
Relations:14
Select a SPARQL endpoint:
Global Endpoint Map
Examples:
View endpoint relation
uri:
http://...
Request
Multiple endpoint search
Your data
sparql endpoint: (optional)
http://virtuoso-kb:8890/sparql
uri:
http://model.snap4city.org/Dashboard_3295_Karlst
Request
Multiple endpoint search
Status
Requests:
http://model.snap4city.org/Dashboard_3295_Karlst
Remove
Clear
Type of relations
Select all
Deselect all
Invert
Hide all inverse
foaf:depiction
hasData
hasWidget
rdf:type
useData
usedByWidget
hasDashboard
hasIotApp
owl:sameAs
rdfs:seeAlso
useIotApp
usedInDashboard
Hide Endpoints
Hide User Status
Hide Relations
Embed
w_SelectorNew_3...
usedByWidget
Cabinet
Smart Light
usedByWidget
Smart Waste
hasWidget
Selector - Map
Demo Lamp
useData
Selector
Separator - 16367549...
CAPELON:orionCAPELON...
hasWidget
Demo Lamp time trend...
percentage
Active Power Time Tr...
Illuminance Level Tr...
Street Light ON/OFF ...
Lamp ON
Lamp OFF
hasWidget
hasDashboard
hasData
CAPELON
nr4o0fq
nr5hsnn
nr2560x
nr1jqfe
hasDashboard
hasIotApp
192.168.1.153:1...
more 27 ha...
MORE
Dashboard_3295_
Karlstad_-_Capelon
useIotApp
nr7z6xq
usedInDashboard...
hasIotApp
useData
more 103 useDat...
MORE
CAPELON:orionCA...
CAPELON:orionCA...
CAPELON:orionCA...
CAPELON:orionCA...
CAPELON:orionCA...

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTk2Mw==

Check Data Analytics Tuscany

Testing - Irene

Sun 28 Nov 22:43:30

Air Quality

AirQualityNO2-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

AirQualityPM10-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

AirQualityPM2.5-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

Tuscany CAQI

Interpolation and EAQI/CAQI Heatmap Completed 2021-09-30T14:00:00

Tuscany EAQI

Interpolation and EAQI/CAQI Heatmap Completed 2021-09-30T14:00:00

Weather

AirHumidity-Tuscany

Interpolation and Heatmap Completed 2021-09-05T02:00:00

AirQualityO3-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

AirTemperature-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

AirQualityCO-Tuscany

Interpolation and Heatmap Completed 2021-09-30T14:00:00

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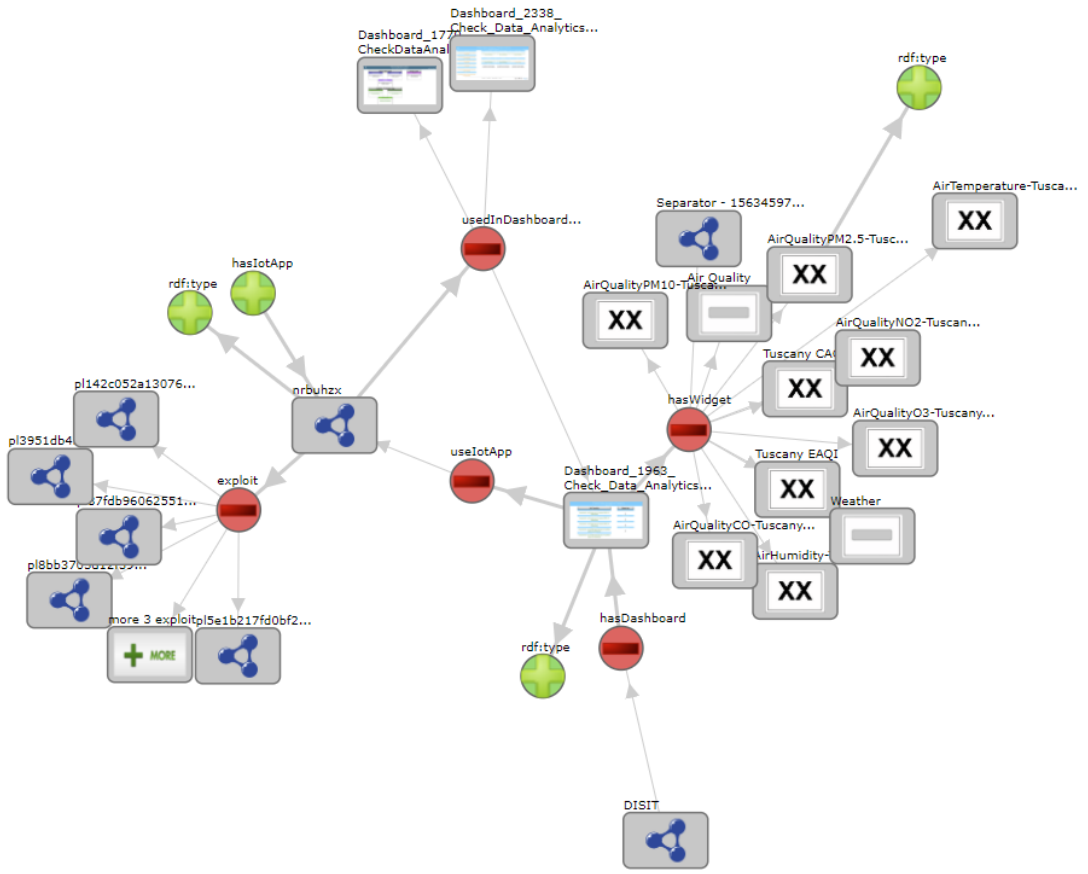
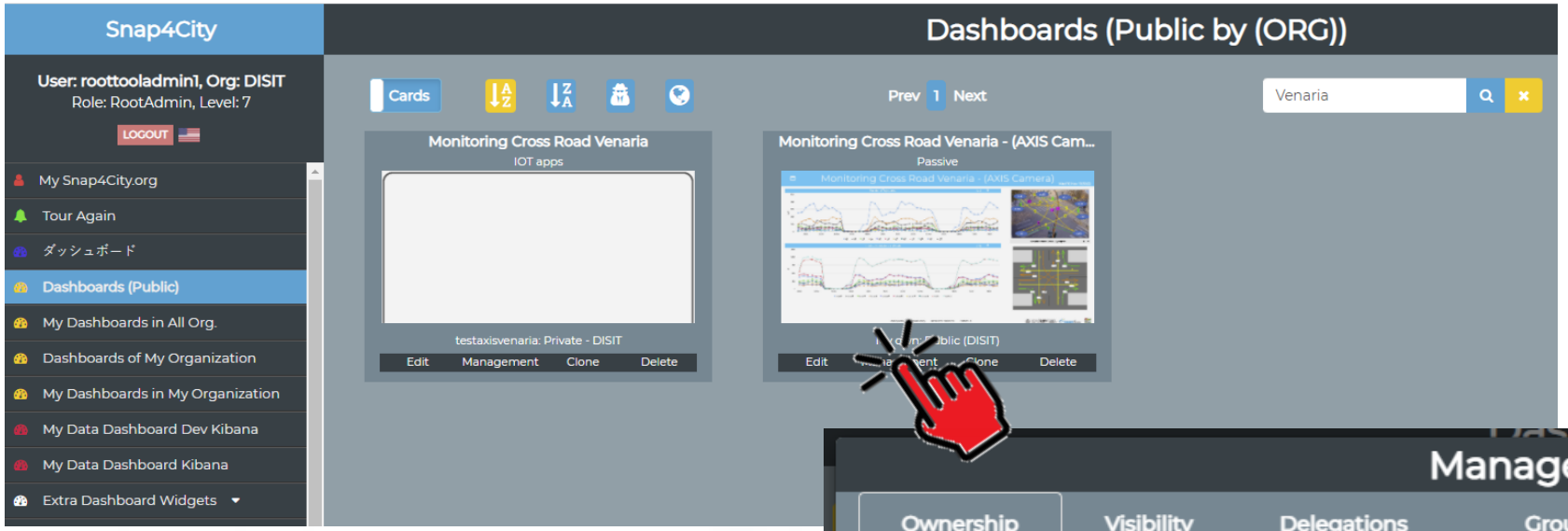
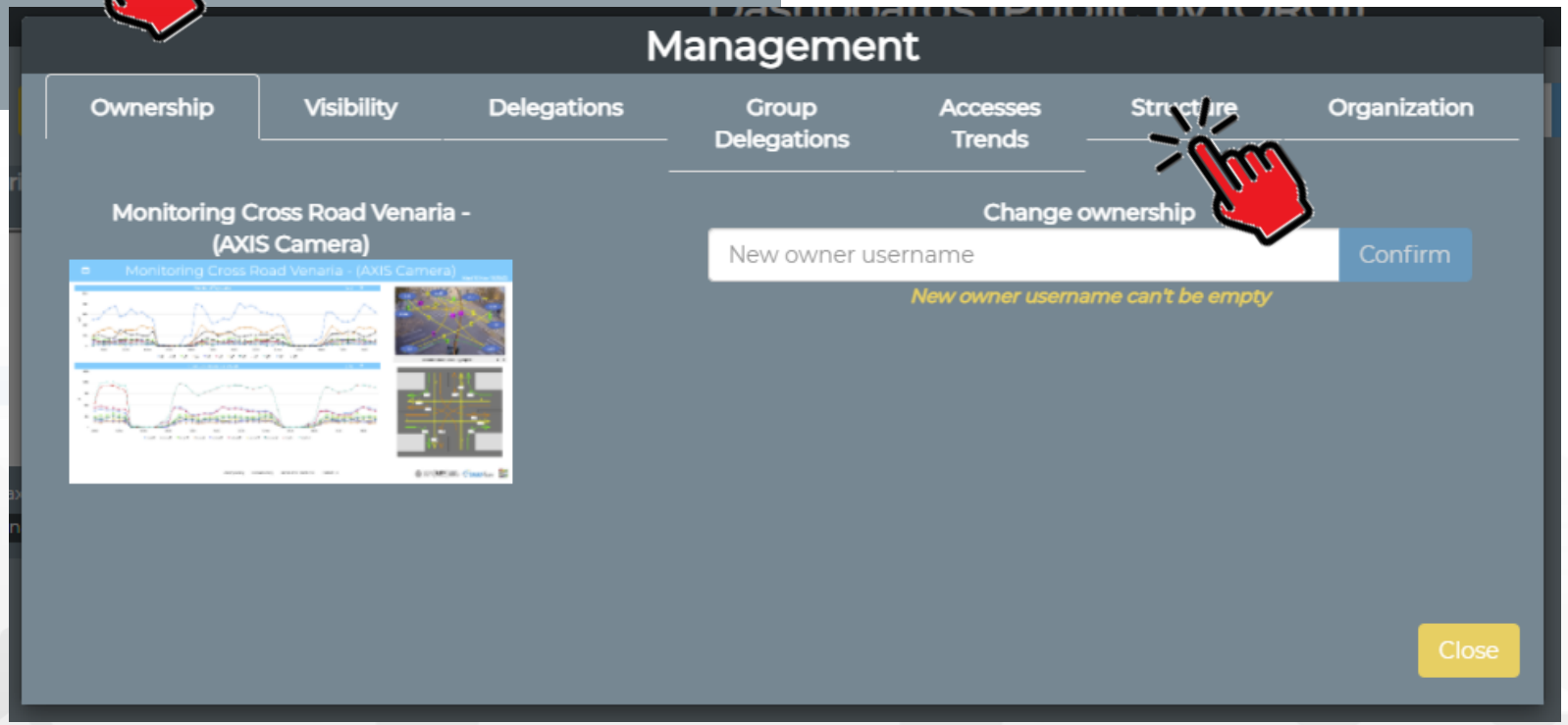


Dashboard Structure for all users

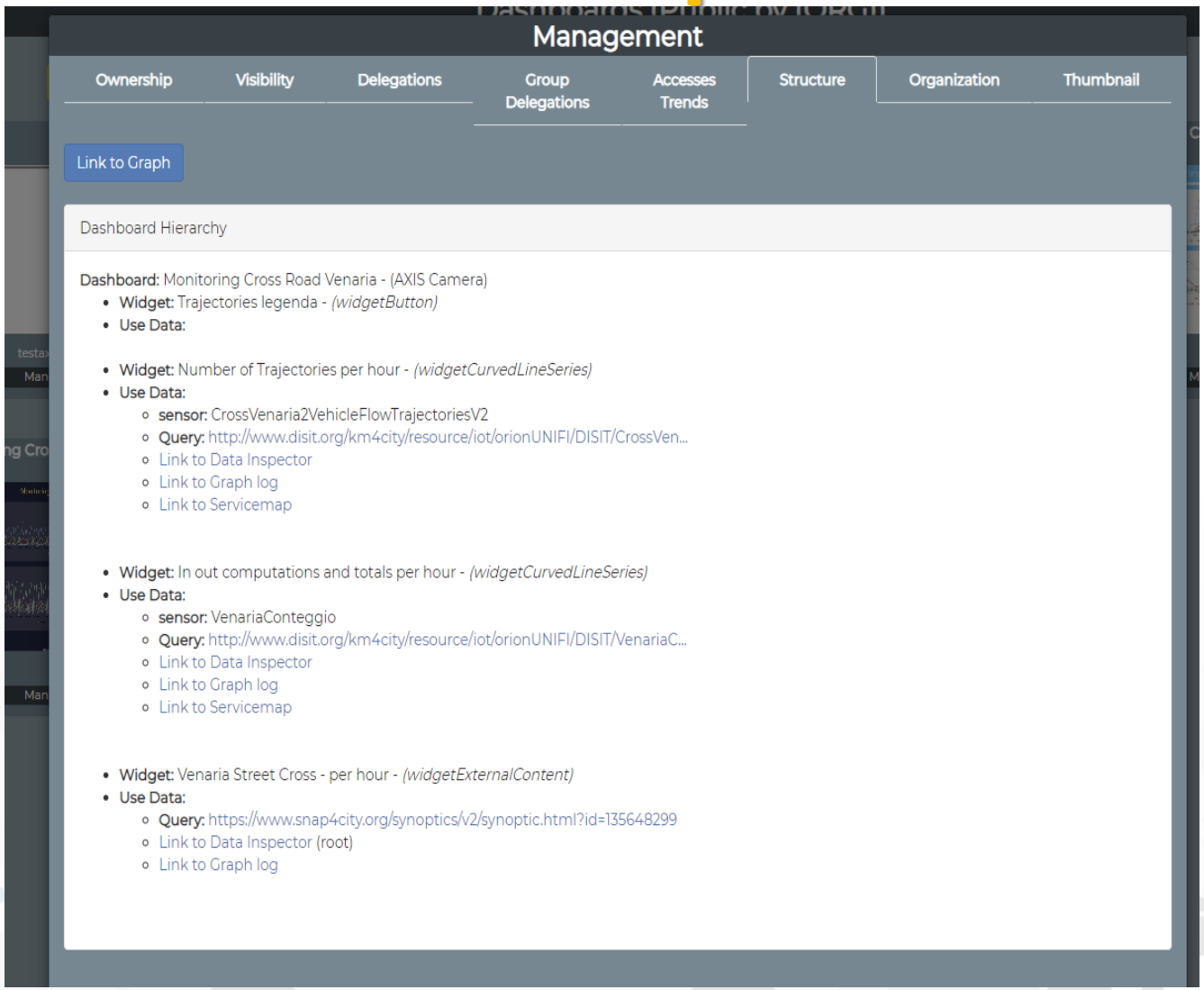

Snap4City
User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7
LOGOUT
My Snap4City.org
Tour Again
ダッシュボード
Dashboards (Public)
My Dashboards in All Org.
Dashboards of My Organization
My Dashboards in My Organization
My Data Dashboard Dev Kibana
My Data Dashboard Kibana
Extra Dashboard Widgets
Dashboards (Public by (ORG))
Cards
Prev 1 Next
Venaria
Monitoring Cross Road Venaria
IOT apps
testaxisvenaria: Private - DISIT
Edit Management Clone Delete
Monitoring Cross Road Venaria - (AXIS Cam...
Passive
Edit Clone Delete

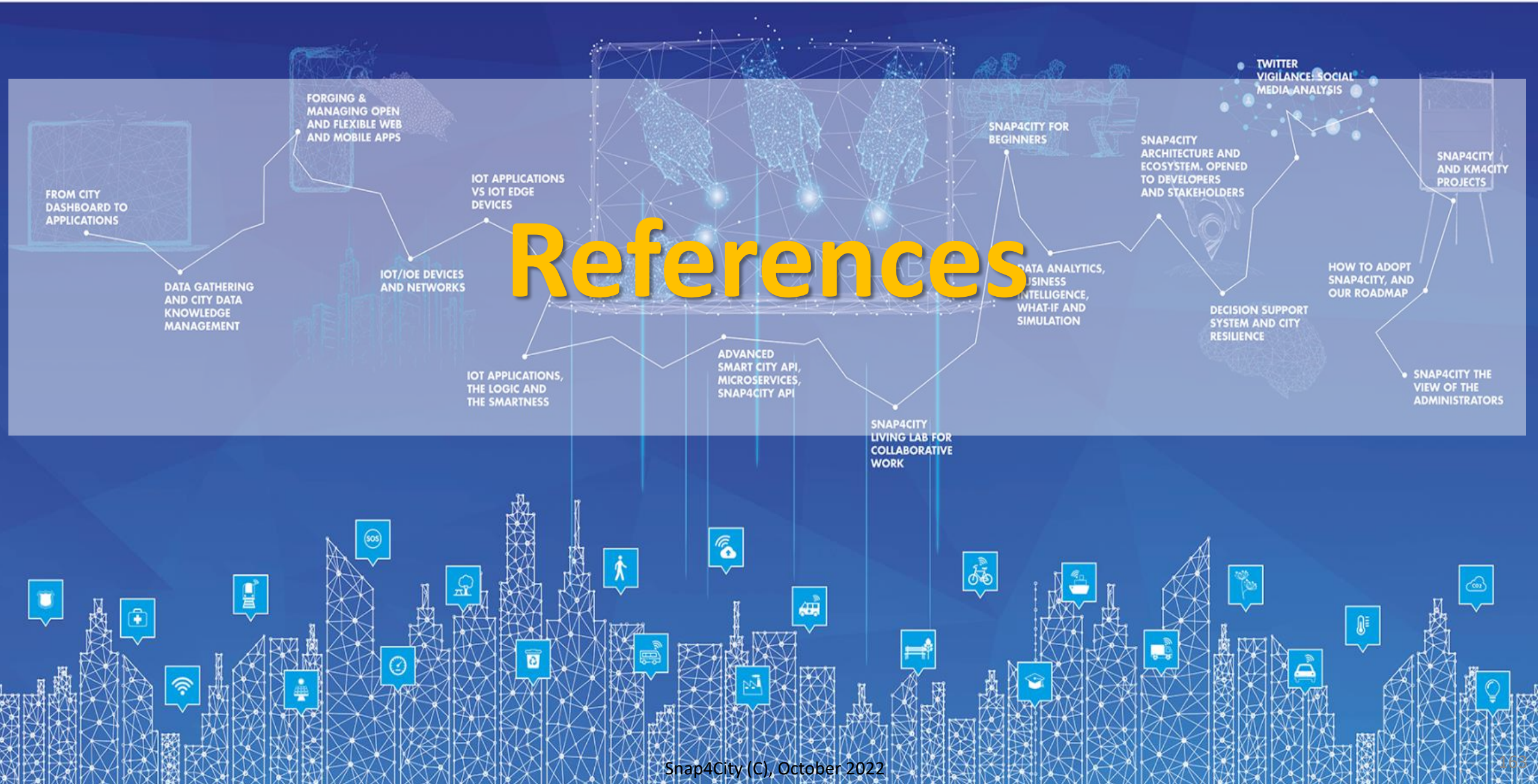

Management
Ownership
Visibility
Delegations
Group Delegations
Accesses Trends
Structure
Organization
Monitoring Cross Road Venaria - (AXIS Camera)
Change ownership
New owner username
Confirm
New owner username can't be empty
Close

Dashboard Structure and Components

4 Widgets

- Button
  - It is the image
- Curved LineSeries
  - …. Set of data….
- Curved LineSeries
  - ….set of data…
- External Content
  - With synoptic

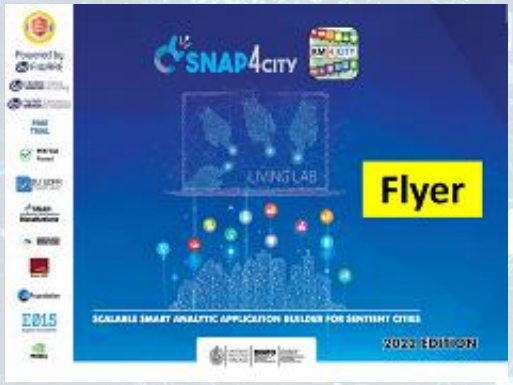



FROM CITY DASHBOARD TO APPLICATIONS
DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT
FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS
IOT/IOE DEVICES AND NETWORKS
IOT APPLICATIONS VS IOT EDGE DEVICES
IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS
ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API
SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK
SNAP4CITY FOR BEGINNERS
DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION
SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS
DECISION SUPPORT SYSTEM AND CITY RESILIENCE
TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP
SNAP4CITY AND KM4CITY PROJECTS
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

References

2022 booklets

- Snap4City



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

- Snap4Industry

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

- Solutions
- Data Analytics

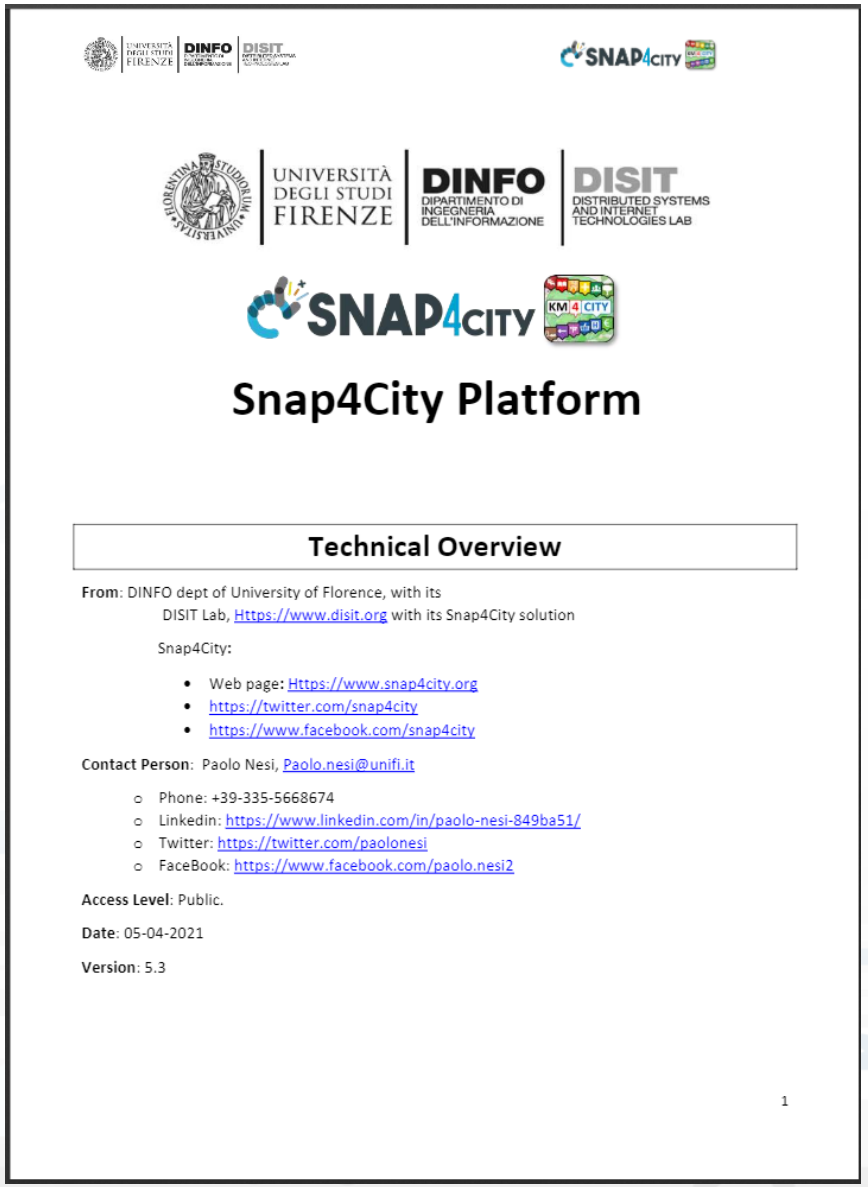
https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

https://www.snap4city.org/577

On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App
PDF							
Inter active							
Video1							
Video2							
Video3							
Video4				none		none	none
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47

Overview



Snap4City Platform

Technical Overview

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

Snap4City:

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

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

- Phone: +39-335-5668674
- Linkedin: https://www.linkedin.com/in/paolo-nesi-849ba51/
- Twitter: https://twitter.com/paolonesi
- FaceBook: https://www.facebook.com/paolo.nesi2

Access Level: Public.

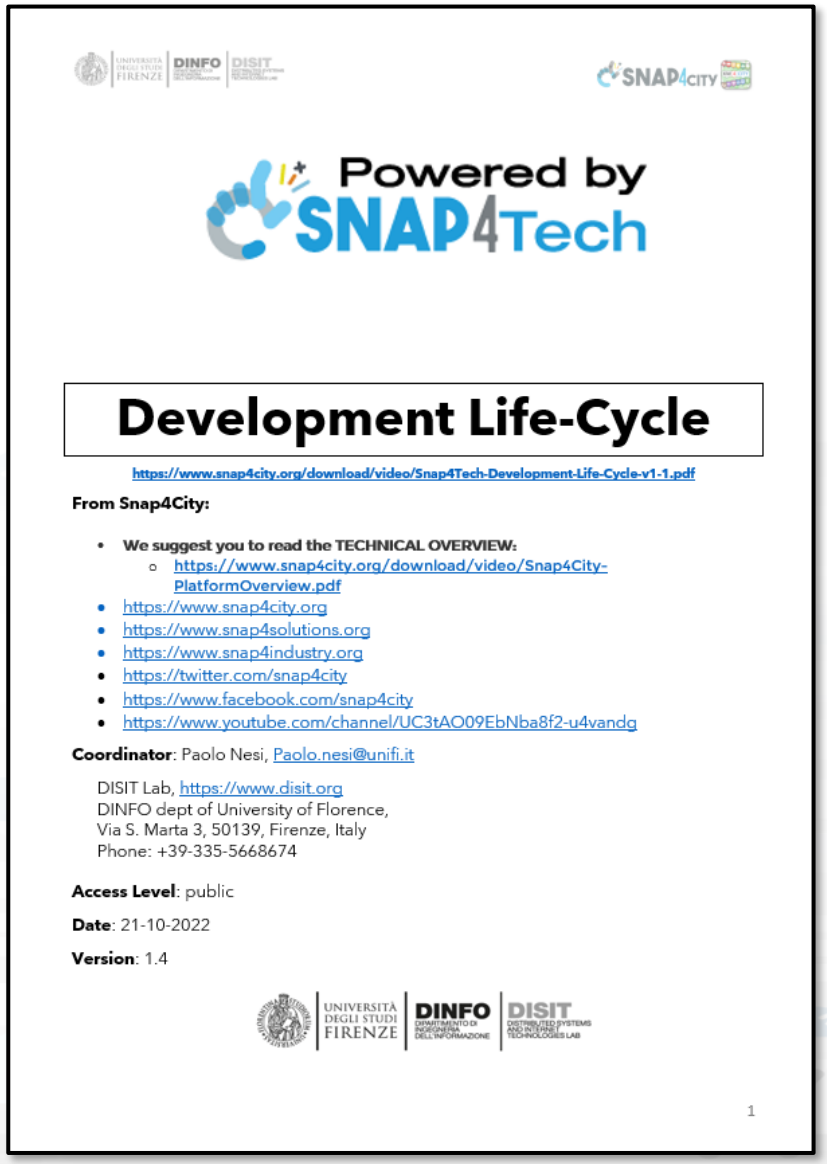
Date: 05-04-2021

Version: 5.3

1

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

Development



Powered by SNAP4Tech

Development Life-Cycle

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

From Snap4City:

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

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

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

Access Level: public

Date: 21-10-2022

Version: 1.4

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TOP

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KM 4 CITY

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SNAP4
Appliances and Dockers
Installations

CONTACT

www.snap4city.org

DISIT Lab, DINFO: Department of Information Engineering
Università degli Studi di Firenze - School of Engineering

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