SNAP4CITY

www.snap4city.org
www.snap4solutions.org

www.km4city.org

Overview: IoT App. / Proc.Logic, Ingestion and Interoperability

February 2024, Course, Synt of Parts 3,5,6

https://www.snap4city.org/944
https://www.snap4city.org/577

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DIGITAL TWIN SOLUTIONS TO SETUP SUSTAINABLE DECISON SUPPORT SYSTEMS AND BUSINESS INTELLIGENCE

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

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

SNAP4CITY

KM4CITY

SNAP4 Appliances and Dockers Installations

Be smart in a SNAP!

SMARTCITY EXPO WORLD CONGRESS

100% OPEN SOURCE

EU GDPR COMPLIANT

PEN Test Passed

Powered by FIWARE

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Node-RED

Overview: IoT App. / Proc.Logic, Ingestion and Interoperability

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LIVING LAB
SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

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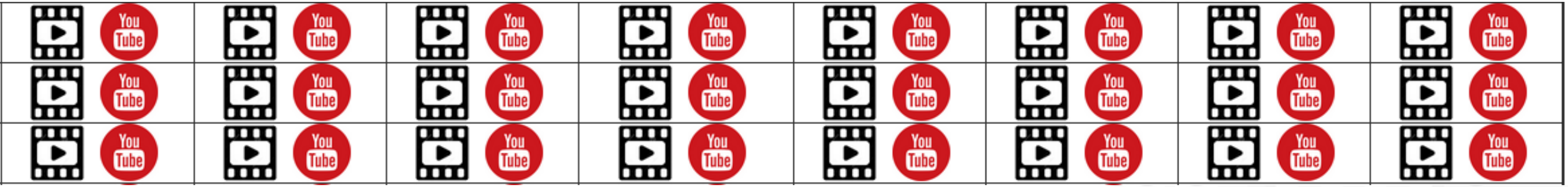
https://www.snap4city.org/944

On Line Training Material (free of charge)

1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
Overview	Dashboards	OT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
							
							



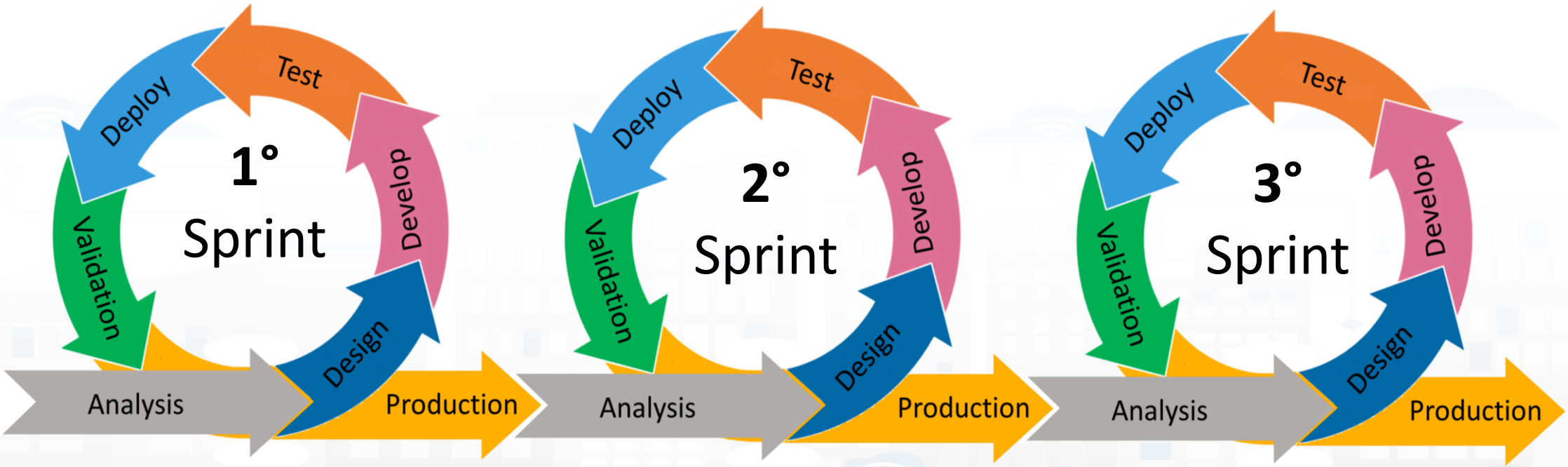
Note on Training Material

- **Snap4City for Dummies https://www.snap4city.org/1046**
- **Course**: https://www.snap4city.org/944
  - Introductionary course to Snap4City technology
  - Italian version CN MOST: https://www.snap4city.org/1068
- **Older version Course** https://www.snap4city.org/577
  - Full training course with much more details on mechanisms and a wider set of cases/solutions of the Snap4City Technology
- **Documentation** includes a deeper round of details
  - Snap4City Platform Overview:
    - https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf
  - Development Life Cycle:
    - https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf
  - Client Side Business Logic:
    - https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf
- **On line cases and documentation**:
  - https://www.snap4city.org/108
  - https://www.snap4city.org/78
  - https://www.snap4city.org/426

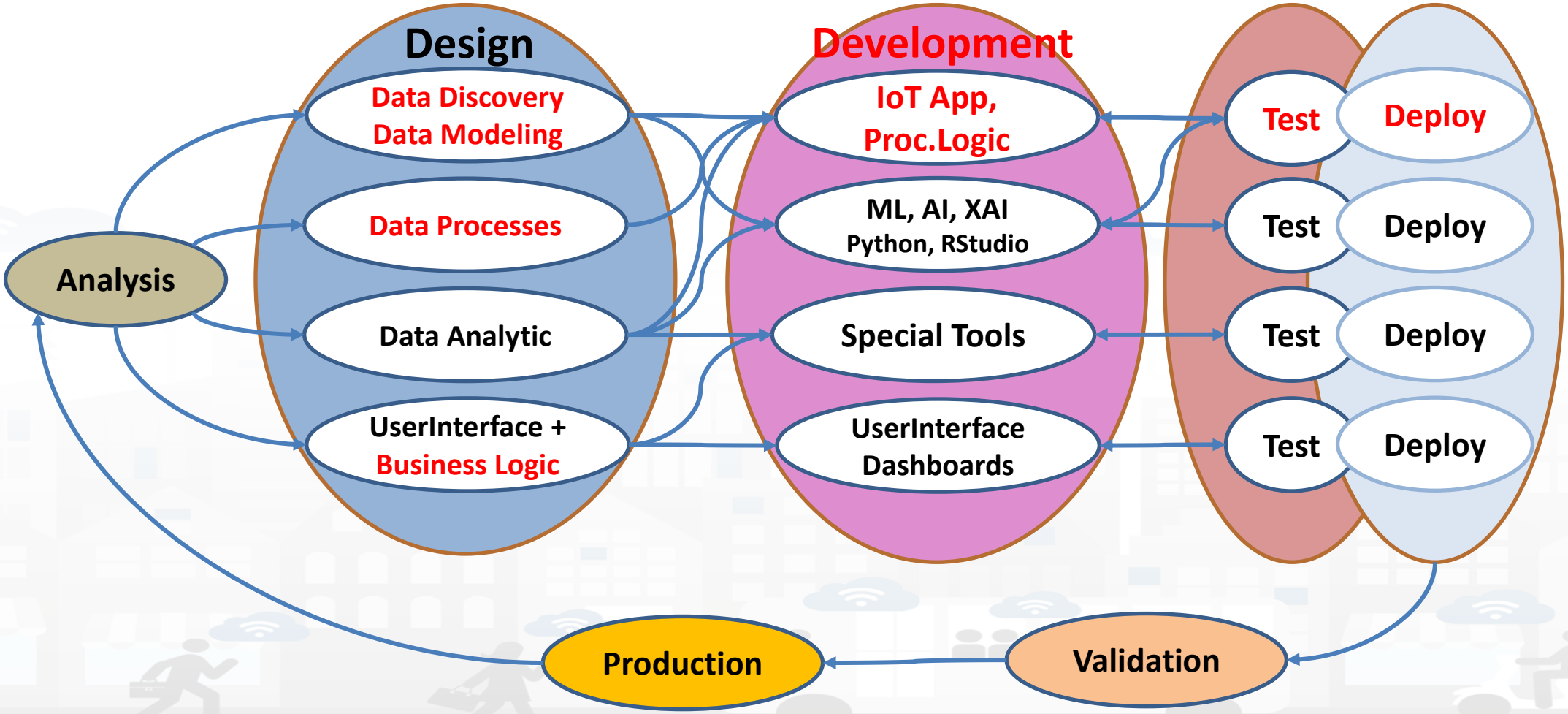
Agenda of this integrated overview part

- Recall of Snap4City Architecture
- Data Ingestion Strategy and Orientation
  - Basic entity elements
  - Knowledge Base: Modelling and ServiceURI as Entity Identifier
  - Models vs Devices/Entities and Registration
- Develop: Data Processes Proc.Logic / IoT App
  - Proc.Logic = Node-RED + Snap4City
  - An Integrated Example for Time Series
  - Verification of Data Ingestion
  - Exploiting Storage data by using: IoT App / Proc. Logic
  - Interoperability with respect to Hardware staff
  - High Performance Ingestion
  - Interoperability of Snap4City Platform
- Some Applicative examples
- Training Material
- Acknowledgements

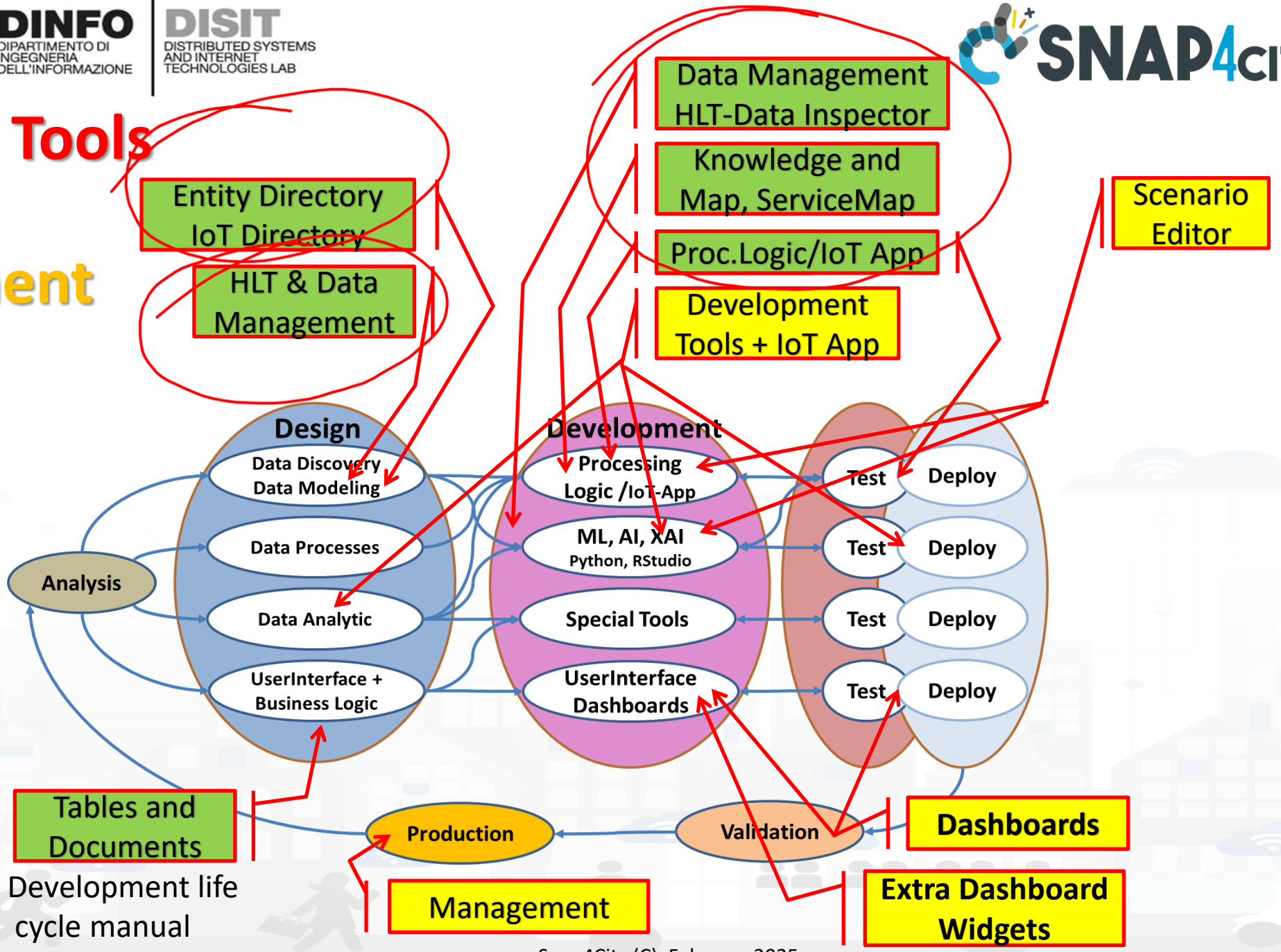
Development Life Cycle Smart Solutions



Development Life Cycle Smart Solutions



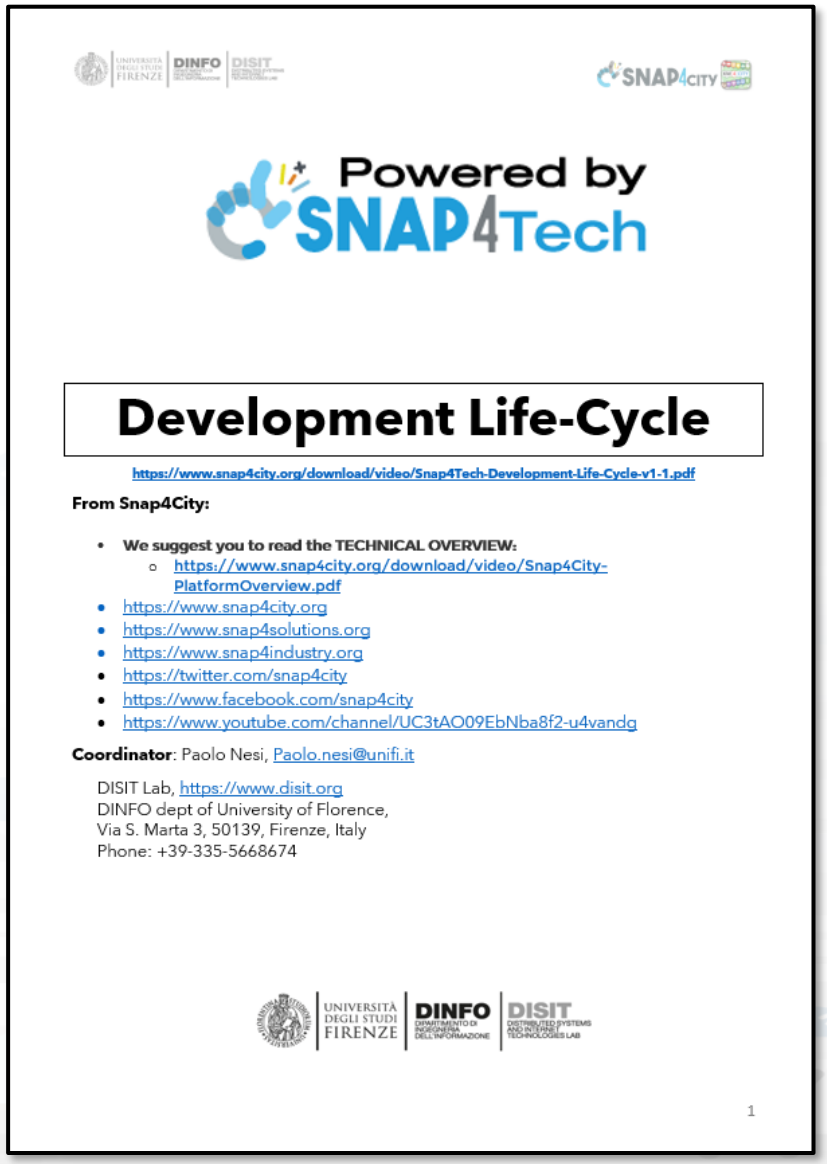
Snap4City Tools vs Development Life Cycle



Development life cycle manual

Development

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



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

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Phone: +39-335-5668674

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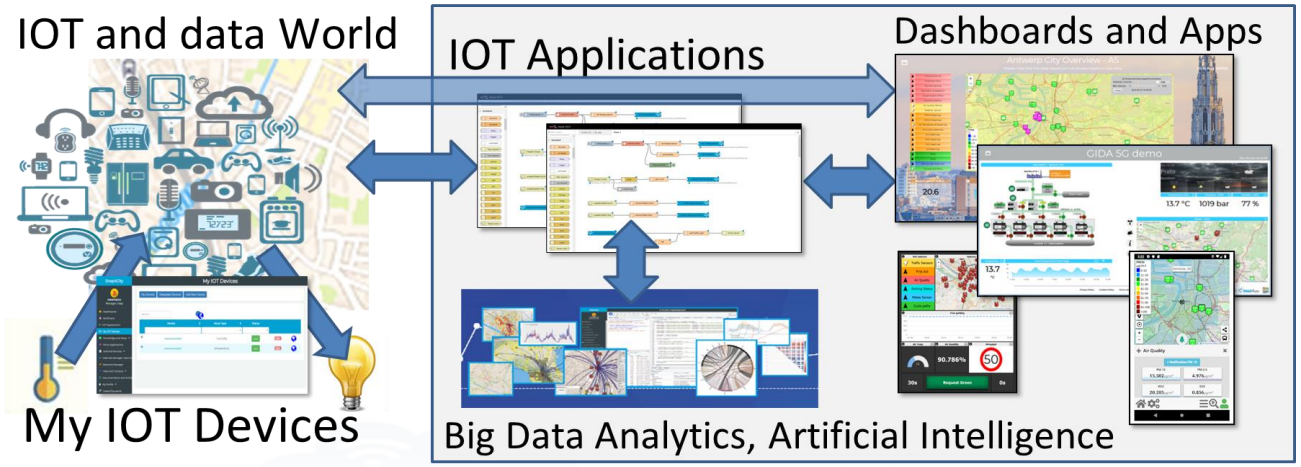
1

Free Trial

- Register on WWW.snap4city.org
  - Subscribe on **DISIT Organization**
- **You can:**
  - Access on basic Tools
  - Access to a large volume of Data
  - Create Dashboards
  - Create IOT Applications
  - Connect your IOT Devices
  - Exploit Tutorials and Demonstrations



IF you need to go more in deep you can ask us to pass at the next Role becoming full AreaManager with full rights of development, also for Data Analytics, machine learning, etc.

Recall on Snap4City Architecture

Digital Twin Solutions for Sustainability

100% OPEN SOURCE

Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

EØ15 digital ecosystem

NVIDIA

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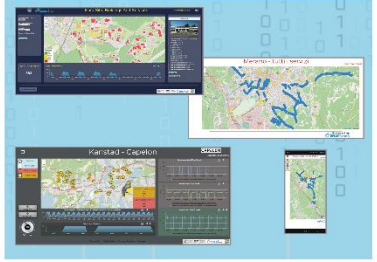
OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS

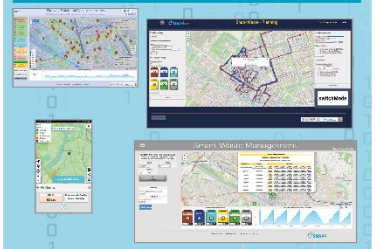
HORIZONTAL AI PLATFORM

MOBILITY AND TRANSPORT

SMART ENERGY AND SMART BUILDING



ENVIRONMENT AND WASTE MANAGEMENT



CITY USER'S SERVICES AND TOURISM MANAGEMENT

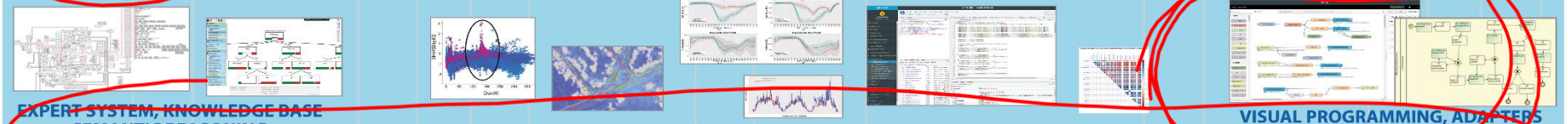
- DEVELOMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES
- LIVING LABS
- GUI CUSTOM STYLES
- FULL APPLICATIONS, DASHBOARDS AND VIEWS
- MOBILE APPS

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

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 ...

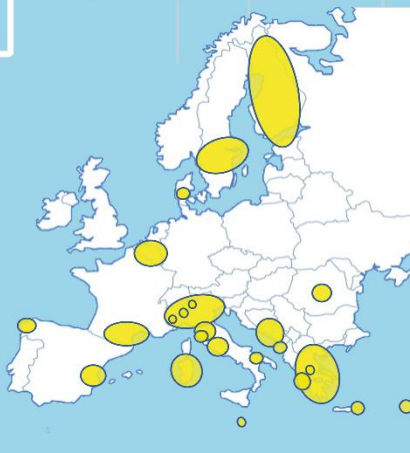


EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE

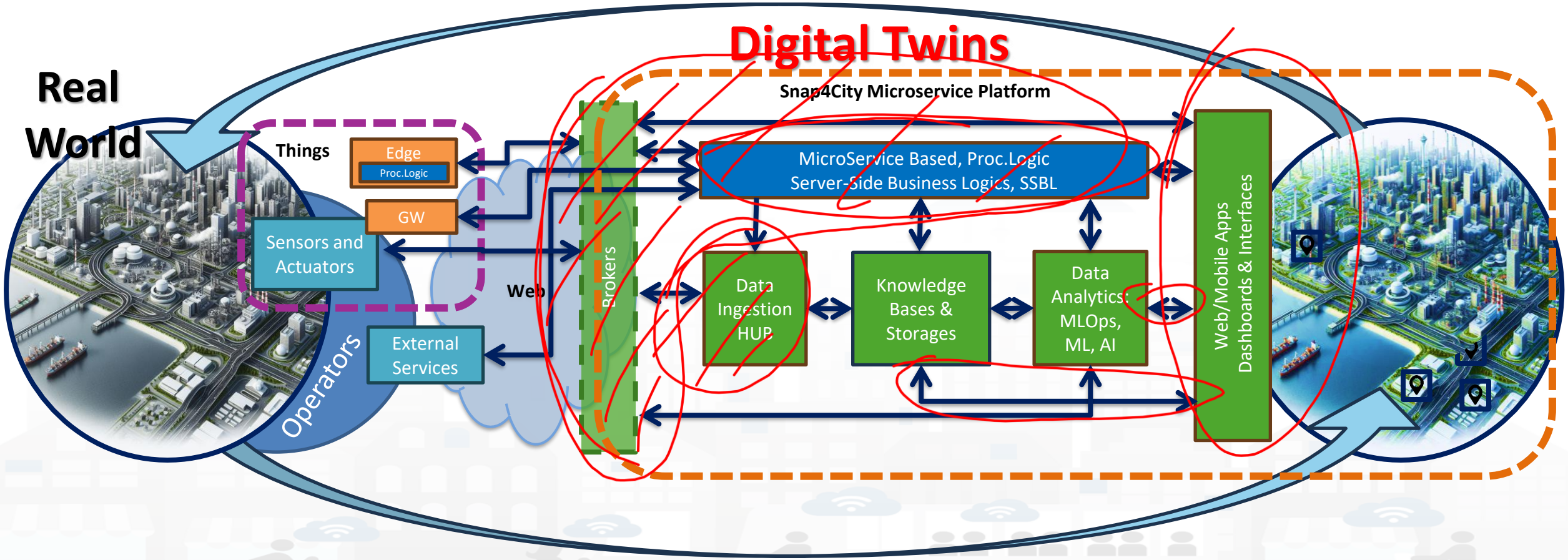
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING, GENERATIVE AI
OPERATIVE RESEARCH, STATISTICS

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

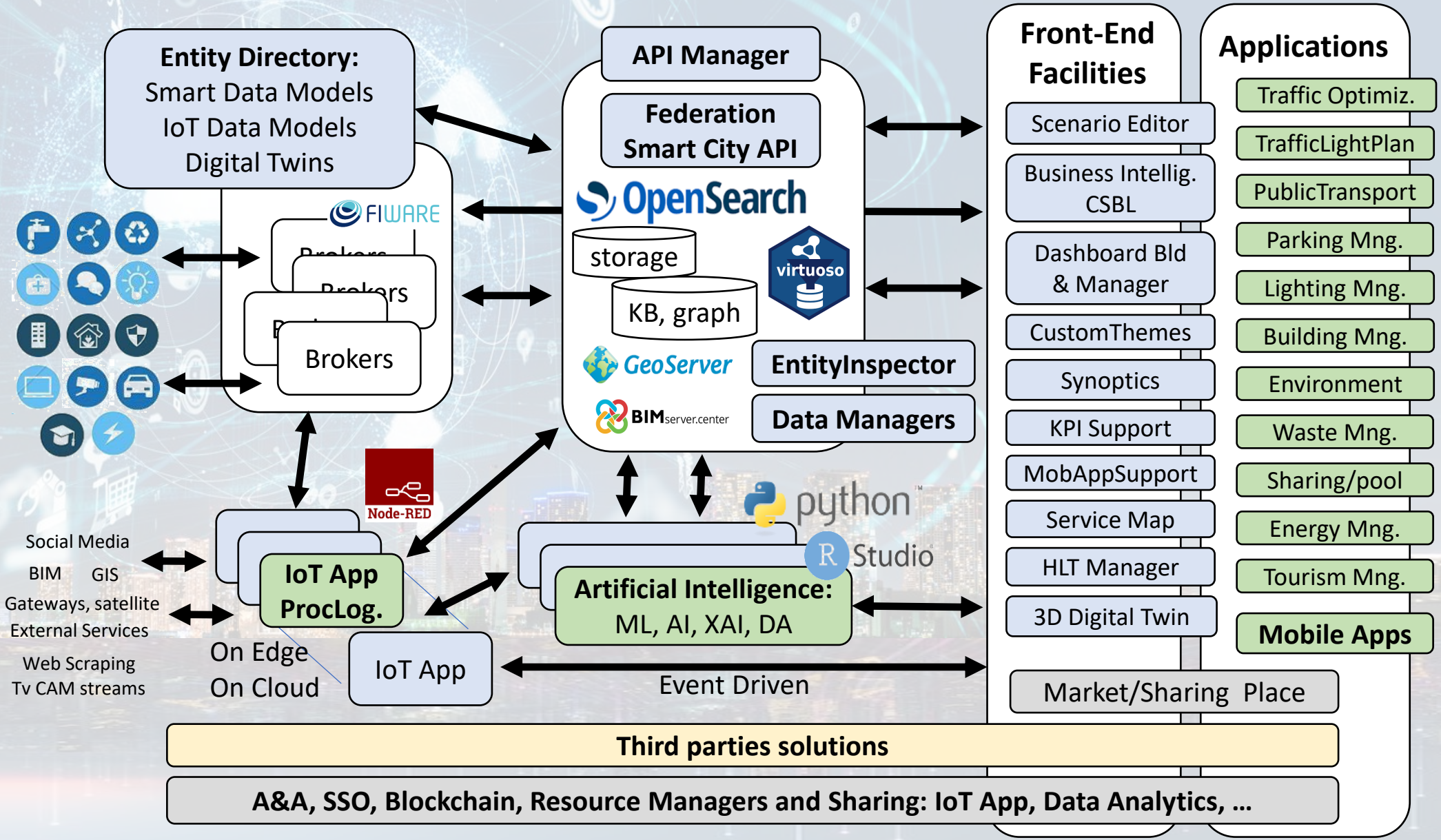
FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS



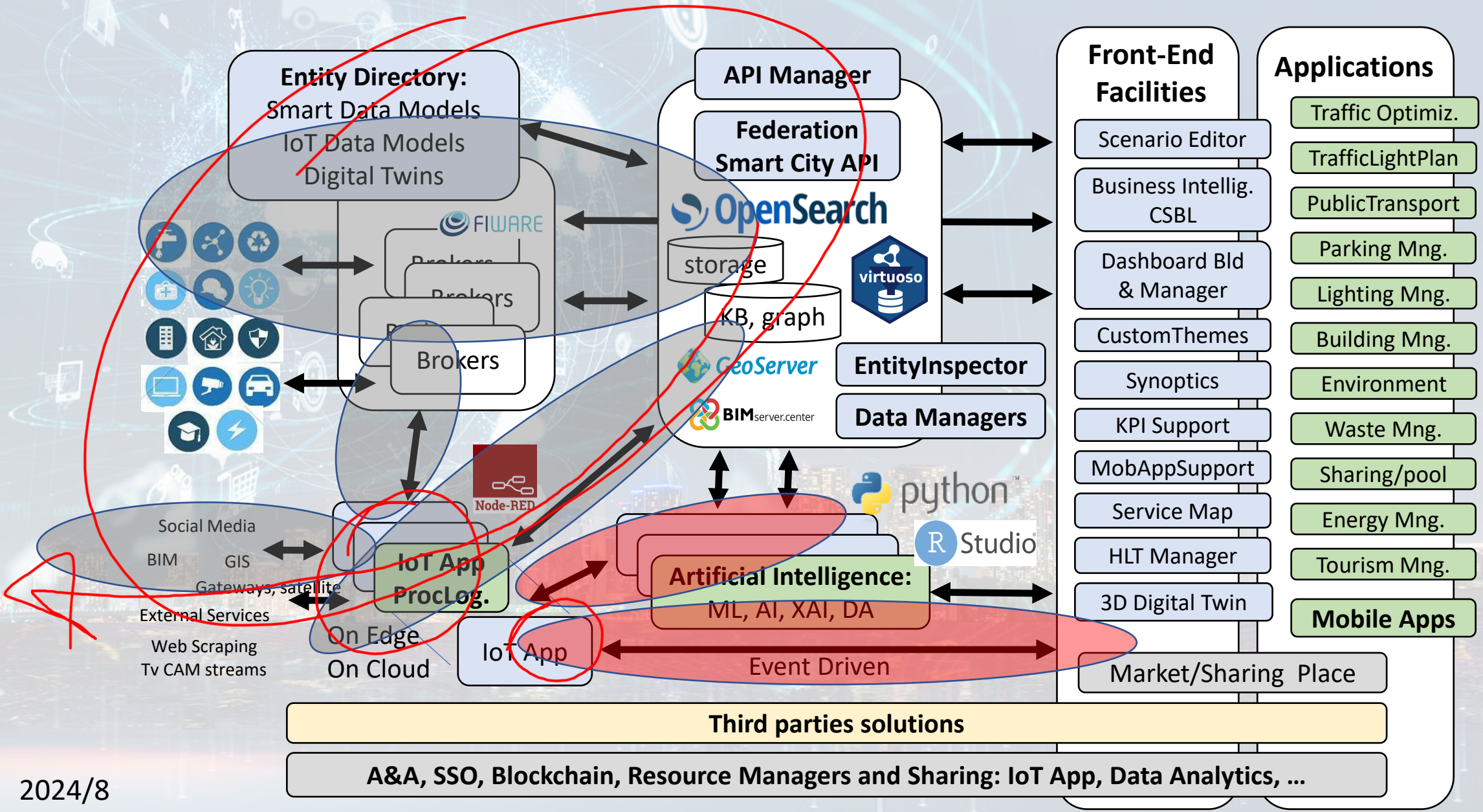
Digital Twin Development Platform



Technical Architecture



Technical Architecture



Data Ingestion Strategy and Orientation

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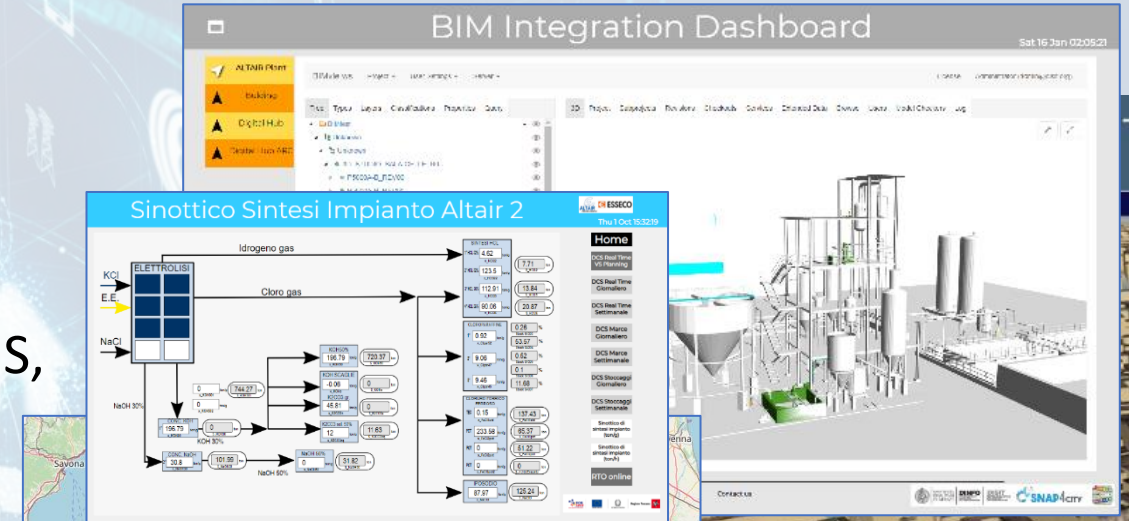
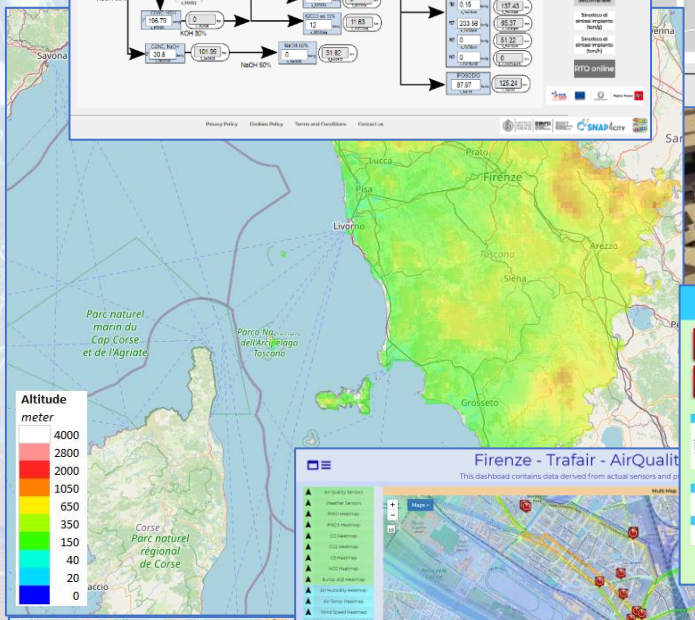
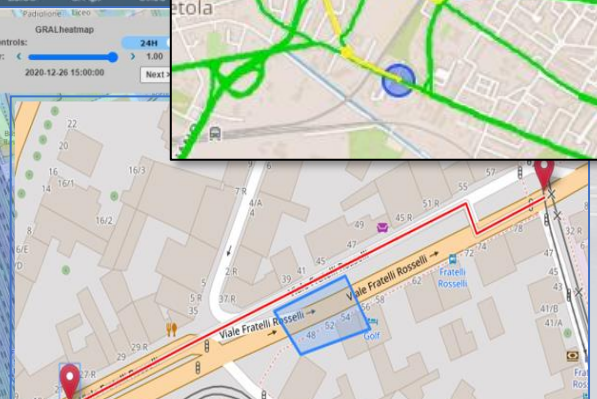
High Level Types

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







Standards and Interoperability (10/2024)

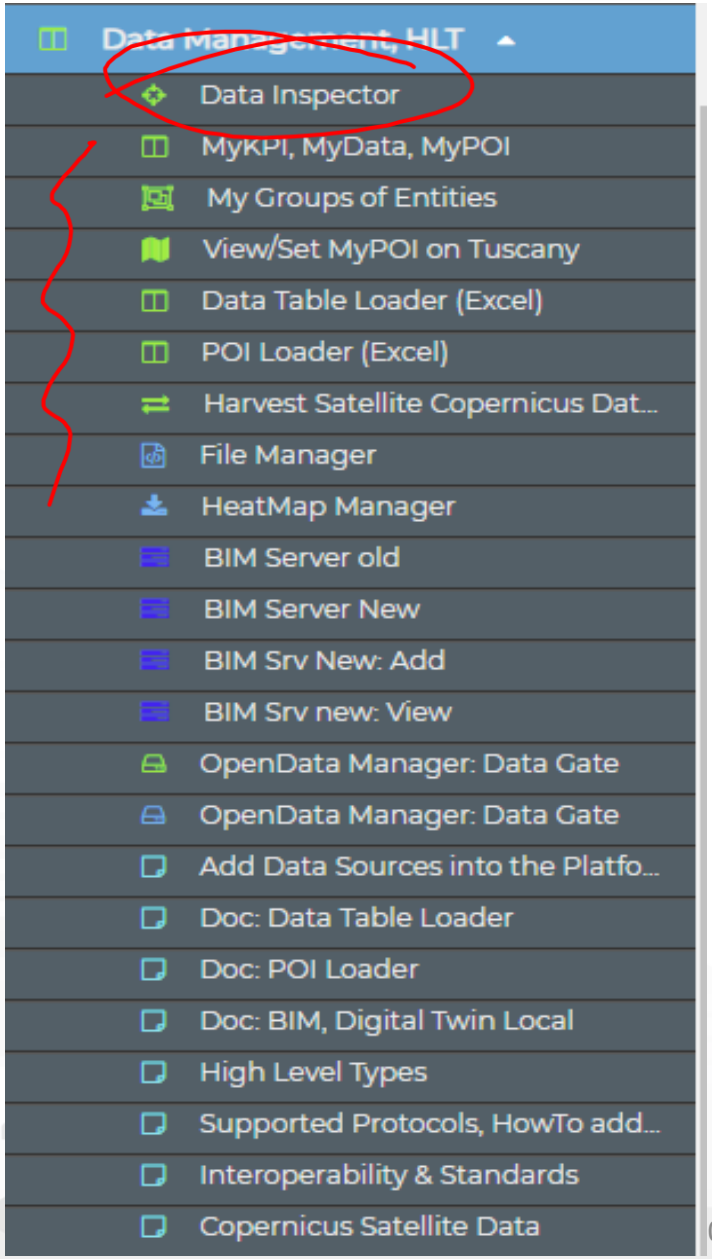
Compliant with:

- **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, SNMP, 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, VMS Milestone, TIM, HERE, ….
- **Formats**: JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser EMI, 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, NeTEx, ..
- **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

Snap4City vs Formats

- ***Snap4City is capable to ingest*** and work with ***any format***:
  - Data **exchange**: JSON, GeoJSON, XML, HTML, HTML5, DATEX, GTFS, binary, etc.
  - **GIS formats:** WMF, WFS, heatmaps, ….
  - **Table**: CSV, XLSX, XLS, database, …
  - **Road graphs:** OSM, triples, geoJSON, etc.
  - **graphics:** IFC, Shape, WKT, SVG, …
  - **archive** file formats: zip, rar, 7z, tgz, pdf, …
  - **image** formats: png, gif, tiff, geoTiff, ico, jpg, …
  - **ODM**: JSON and other formats
  - **Traffic Flow**: JSON and other formats
  - **Heatmaps**: GeoTIFF, JSON, etc.
  - **video** formats: mp4, avi, mov, RTSP, …
  - **3D elements**: GLB, DWG, IFC, etc.
- Search the format you need to cope on the search box of Snap4City portal!: **Snap4City Supported Protocols, adding new protocols**

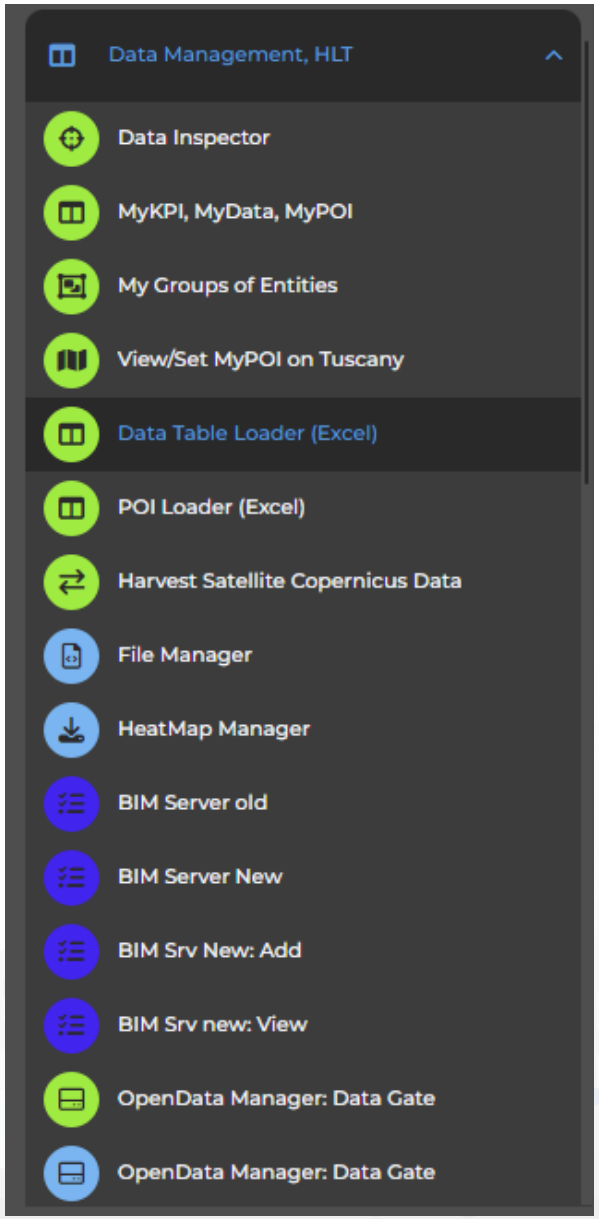


The main High Level Types

- **POI**: codified metadata, static GPS, + info, no time series
- **Entity Instance / IoT Device**: static GPS, Info, variable data, Time Series
  - Sensors and actuators
  - **Entity Mobile / IoT Device Mobile**: if dynamic GPS
- **MyKPI**: dynamic GPS, - info, single variable, Time Series
- ***Heatmaps**: matrices on some area, Time Series → **Entities***
- ***Traffic Flows**: road segments with flow density, Time Series → **Entities***
- ***OD Matrices:** different parameters, Time Series → **Entities***
- ***Vector Fields**: different parameters, Time Series, may be with Heatmaps*
- ***Scenarious:** different parameters, Time Series → **Entities***
- ***Routing, paths, trajectories, etc.…** different parameters,*
- ***3D shapes, elements, BIMs, TV Cam, …. different parameters, Entities***
- ***….***

HLT wrt to Time Series, GPS and Geometry

High Level Types	Evolution over time ?	May have GPS/Geom
POI, Point of Interest	**Sporadically, for versioning**	*Yes/Yes*
IoT Devices, KPI multivariable, WoT Entities	A set of values for each time instant of observation (dateObserved)	*Yes/Yes*
GIS data	**Sporadically, for versioning**	*Yes/Yes*
Satellite Data	An image for each time instant of observation (dateObserved)	*Yes/Yes*
Traffic Flow	A Traffic Flow network for each time instant of observation (dateObserved)	*Yes/Yes*
Heatmaps	An Heatmap for each time instant of observation (dateObserved)	*Yes/Yes*
OD Matrices	An ODM for each time instant of observation (dateObserved)	*Yes/Yes*
BIM Models	**Sporadically, for versioning**	*Yes/Yes*
MyKPI (single variable)	A value for each time instant of observation (dateObserved)	*Yes/no*
3D model data	**Sporadically, for versioning or for model kind for example**	*Yes/Yes*
Messages exchanged with Dashboards	*A set of values for each time instant of observation (dateObserved)*	*No/No*
Messages exchanged with Synoptics	*A set of values for each time instant of observation (dateObserved)*	*No/No*



Data Management, HLT

- Data Inspector
- MyKPI…..
- My Groups of Entities
- HeatMap Manager
- BIM Server…….
- Open Data…
- Depending on user's kind:
  - ODM, File, TV CAM, Traffic Flow, …..

HeatMap Manager

Snap4City

Switch To New Layout (Beta)

User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7

LOGOUT

- My Snap4City.org
- Tour Again
- www.snap4solutions.org
- 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
- Notificator
- Data Management, HLT
  - Data Inspector
  - MyKPI, MyData, MyPOI
  - My Groups of Entities
  - View/Set MyPOI on Tuscany
  - Data Table Loader (Excel)
  - POI Loader (Excel)

HeatMap Manager

Show 15 Search:

Map name	Color Map	Owner	Nature	Subnature	Organization	Details	Management	View Data	Delete
15MinIndex_AbitantiPerPunto	VIEW EDIT 15minsubindex	VIEW	CulturalActivity	Cultural_centre	DISIT	VIEW	EDIT	VIEW PREVIEW	DEL
15MinIndex_AverageIndex	VIEW EDIT 15minsubindex	VIEW			DISIT	VIEW	EDIT	VIEW PREVIEW	DEL
15MinIndex_AverageIndexBologna	VIEW EDIT 15minsubindex	VIEW			DISIT	VIEW	EDIT	VIEW PREVIEW	DEL
15MinIndex_CityIndexMP1	VIEW EDIT 15minsubindex	VIEW			DISIT	VIEW	EDIT	VIEW	DEL
15MinIndex_CultureAndCultsIndex	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_CultureAndCultsIndexBologna	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_EconomyIndex	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_EconomyIndexBologna	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_EducationIndex	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_EducationIndexBologna	VIEW EDIT 15minsubindex	VIEW							
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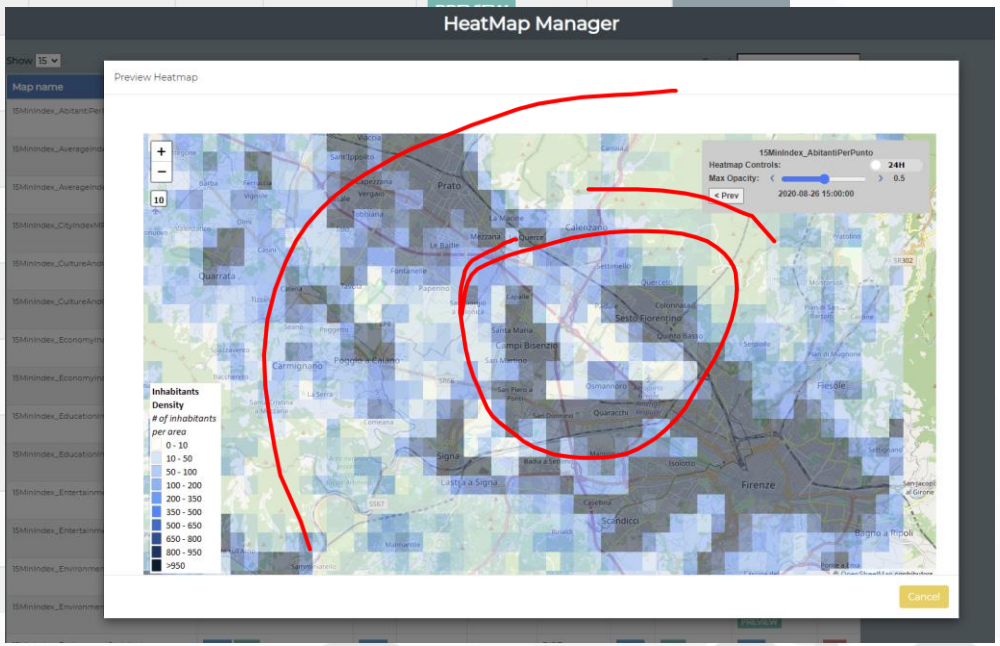
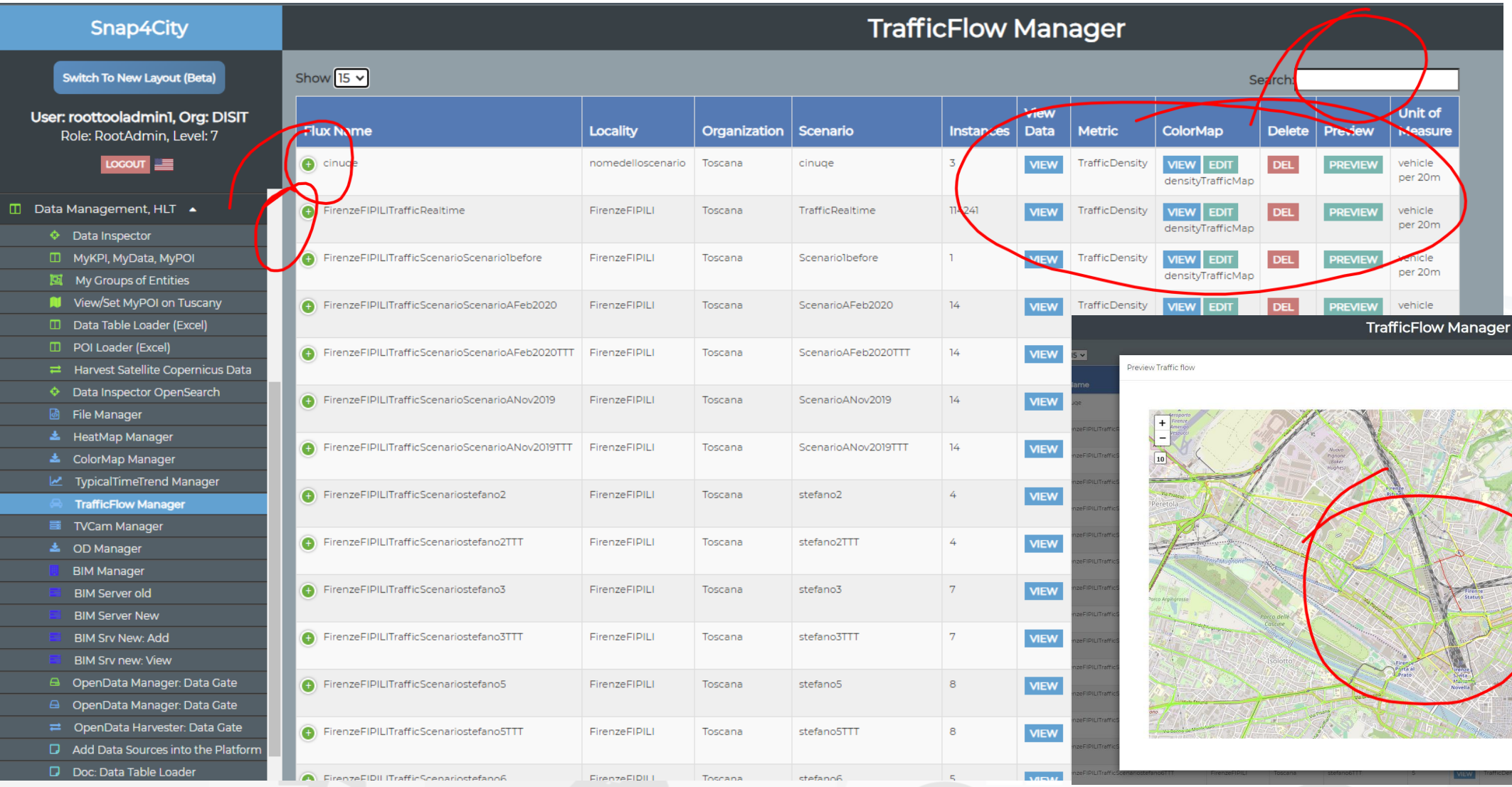


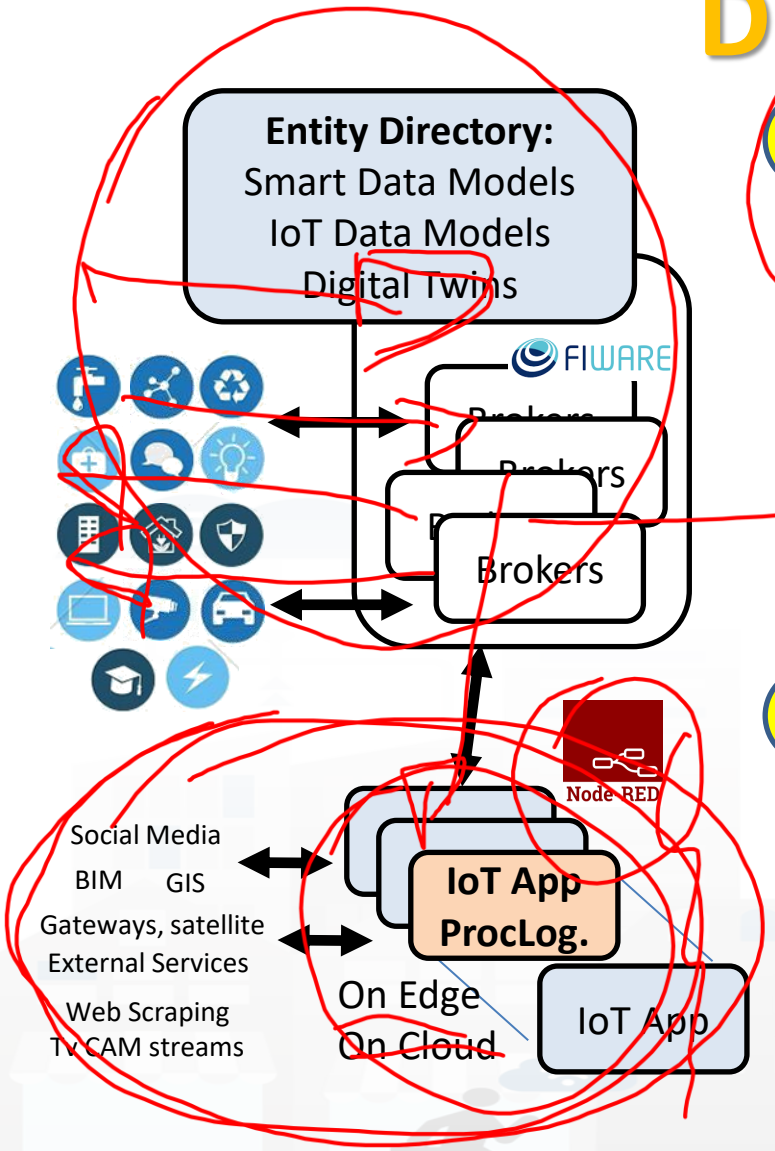
TrafficFlow Manager



SubStantially

- **Entities** are used to model Digital Twins and thus:
  - POI, MyPOI, KPI, MyKPI, IoT Devices, etc.
  - **including: metadata info, time series, GPS position, geometries, hyper Links, and Actions which are links to tools/functions/processes to Act on them**
- **Complex Data** such as used to model spec. aspects as Traffic Flow, Heatmaps, ODM, BIM, TV cameras, 3D elements, .. :
  - Are placed on map as an Entity plus **additional information** into a dedicated <data> Manager
  - **Entity includes**: **metadata info, time series, GPS position, geometries, hyper Links, and Actions which are links to tools/functions/processes to Act on them**

Data Ingestions Strategy



1

1) Via ***internal Brokers***: NGSI V1/V2, MQTT (beta), JSON

- the data messages arriving in **PUSH** on the platform,
  - if compliant to a known Model **and** referring to a known Device/Entity
  - They are AUTOMATICALLY: *stored, indexed,* and ready to be used by Wizard, Dashboards, Views and Applications

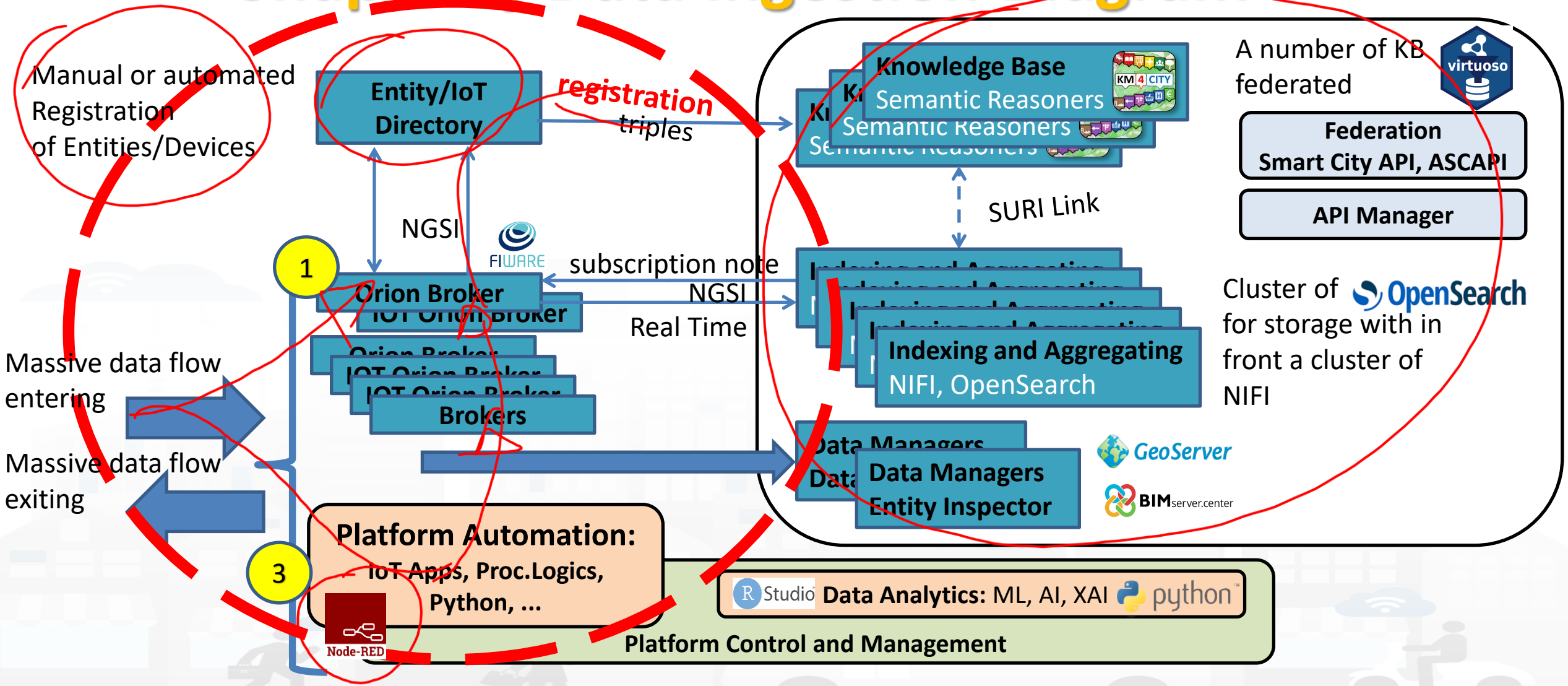
- 2) Via ***external Brokers***: NGSI V2, NGSI LD (beta), JSON
  - the data messages arriving in **PUSH** on the external broker,
    - Have to be **mapped** to a known Model **and** referring to a known Device/Entity
    - To be AUTOMATICALLY: *stored, indexed,* and ready to be used by Wizard, Dashboards, Views and Applications

3

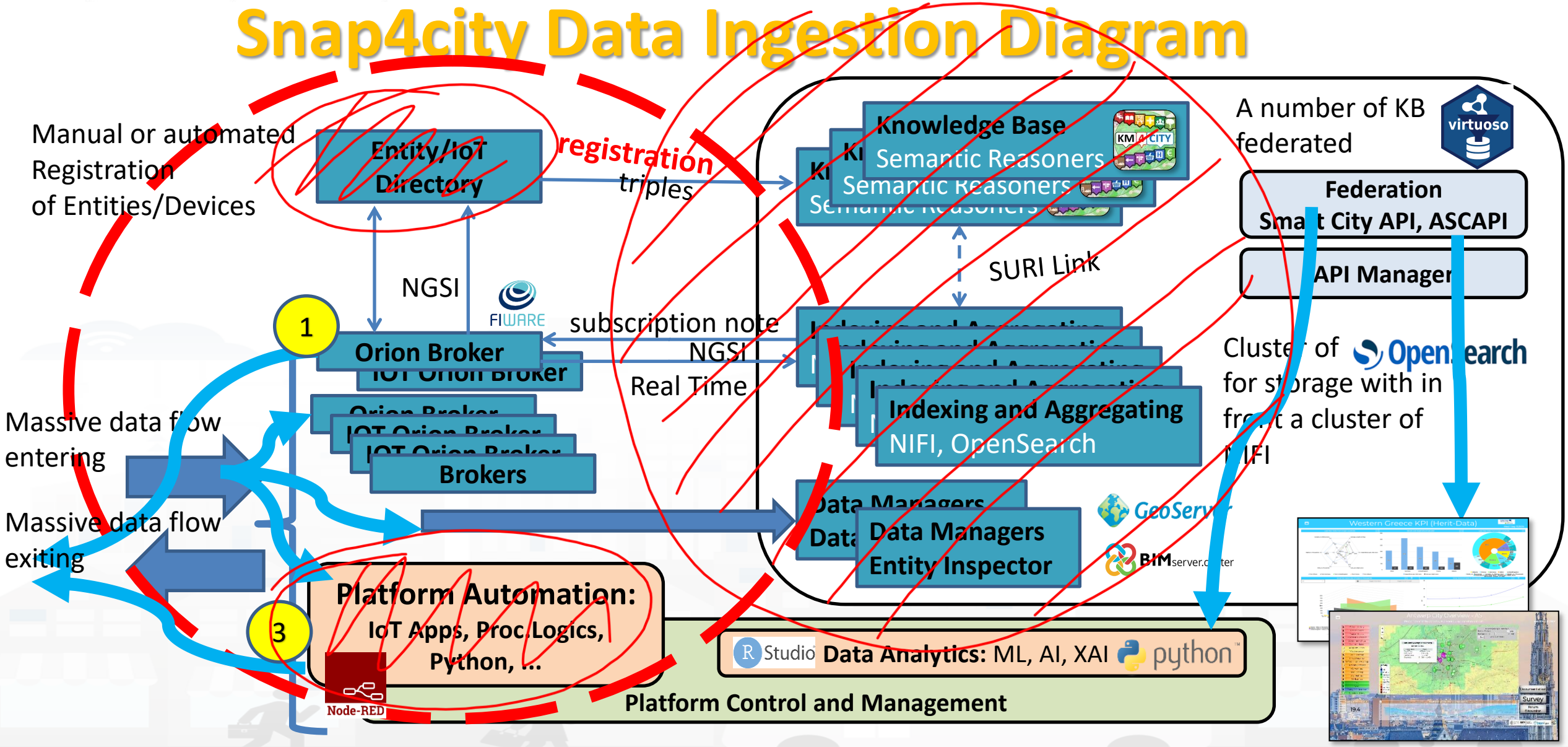
3) Via **any other broker, GateWay, API, server, WebService, database, protocol and/or format of the many available on Snap4City, in PUSH/PULL have to be**

- **mapped** on an Snap4City IoT/Entity Model and Entity/Device Instance
- **ingested in real time or batch**, by a process implemented as
  - an **IoT App/Proc.Logic, on container, on cloud or Edge**
  - a **Python or other language**, **on container, on cloud or Edge**

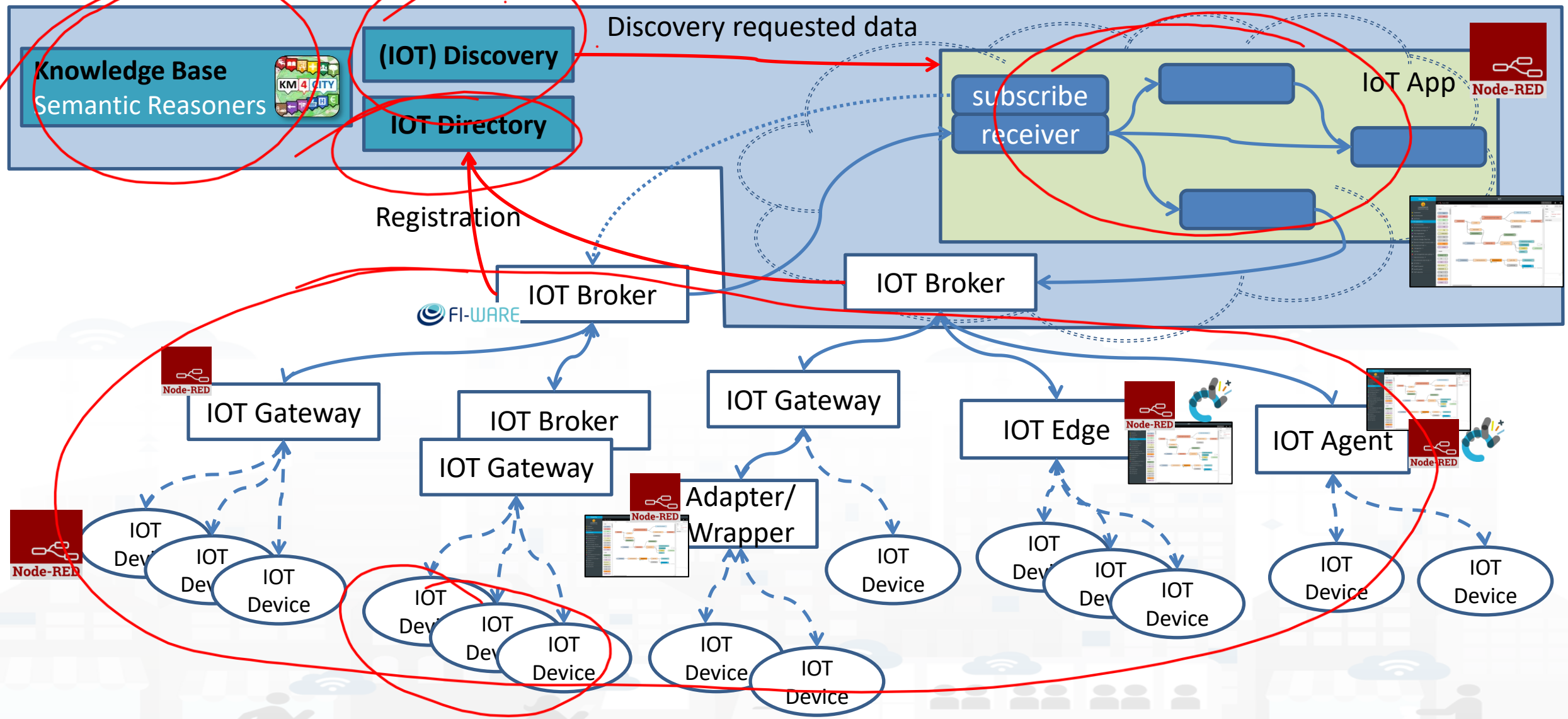
Snap4city Data Ingestion Diagram



Snap4city Data Ingestion Diagram



IoT Network

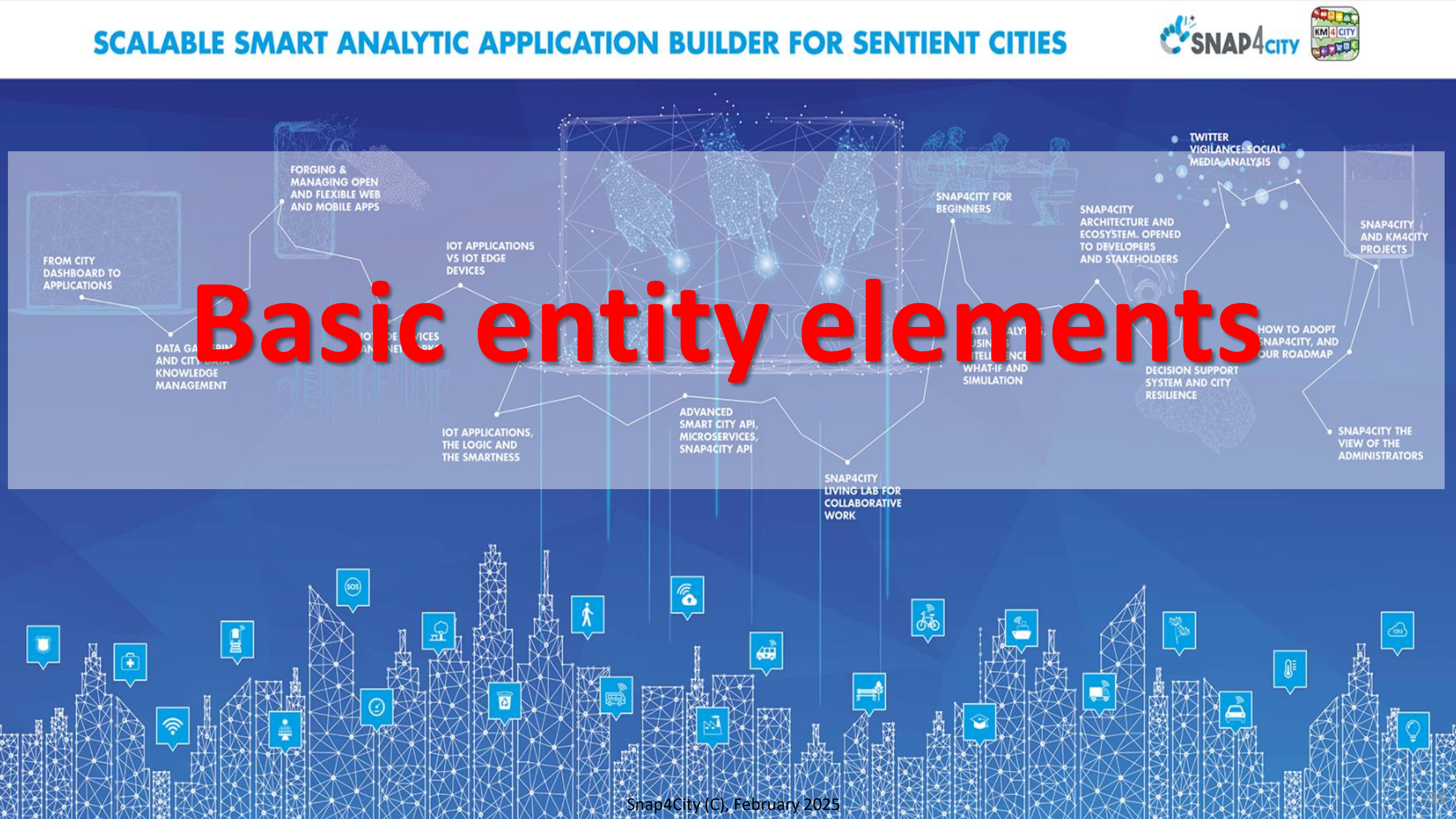

Knowledge Base
Semantic Reasoners
(IOT) Discovery
IOT Directory
Discovery requested data
subscribe
receiver
IoT App
Node-RED
Registration
IOT Broker
FI-WARE
IOT Broker
IOT Gateway
IOT Broker
IOT Gateway
IOT Gateway
Adapter/
Wrapper
IOT Edge
IOT Agent
IOT Device

Basic Concepts of Data Ingestion for 1 3

- **Basic entity elements**
  - Static and Real-Time / Time Series
  - Classification of Entities
  - References among Entities
- **Knowledge Base: Modelling and ServiceURI as Entity Identifier**
  - Entity Indexing and Unified Identifications
- **Models vs Devices/Entities and Registration**
  - Entity Models / IoT Device Models
  - Entity Instanced / IoT Device Instances
  - Messages over time/version
  - Variable as Attributes

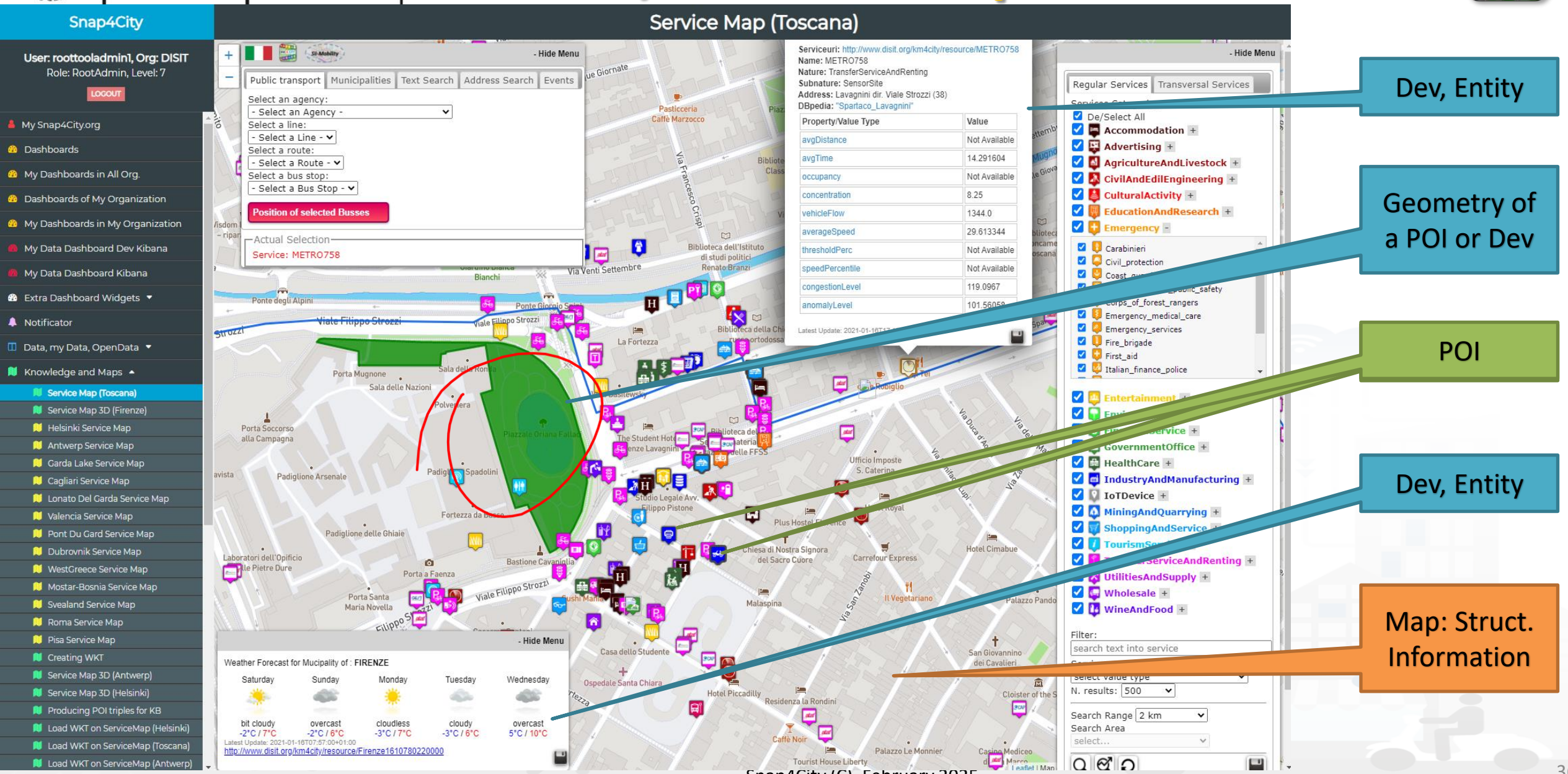
Terminology

Former name	new name, from 2023	What
IoT Device Model	Entity Model	A data model
IoT Device	Entity Instance	A data instance ready to get message for time series
IoT Device Variable, metric	Entity Variable	A variable of an Entity Instance or of an Entity Model
IoT Device Message, device message	Entity Message	A data message
IoT Directory	Entity Directory	The tool for managing models, entities, data models, etc.
IoT Applications, **IoT App**	Processing Logic	= Node-RED + Snap4City Libraries The tool for visual programming, node-red JavaScript, data flow, ingestion logic, data transformation, data loading, interoperability, business logic.
Dashboards	Views and Dashboards	The Snap4City Dashboards are effectively Views of some Web Application, with all the interaction and connection the developer would create among them.
LOG	LOGraph	not all Snap4City platform are provided with the LOGraph, it is optional and can be installed in a second phase



Basic entity elements

KB, ServiceMap



Dev, Entity

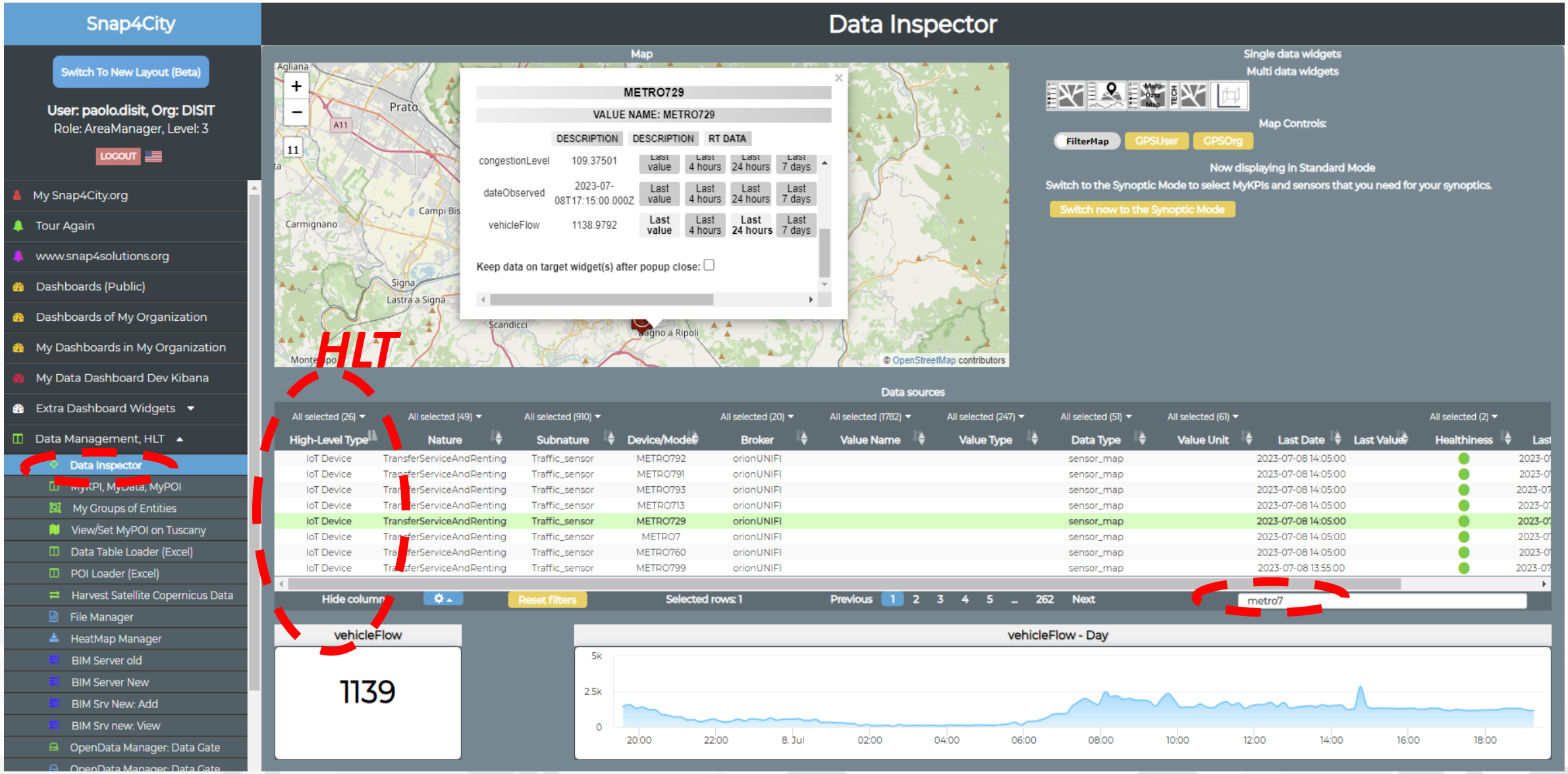
Geometry of a POI or Dev

POI

Dev, Entity

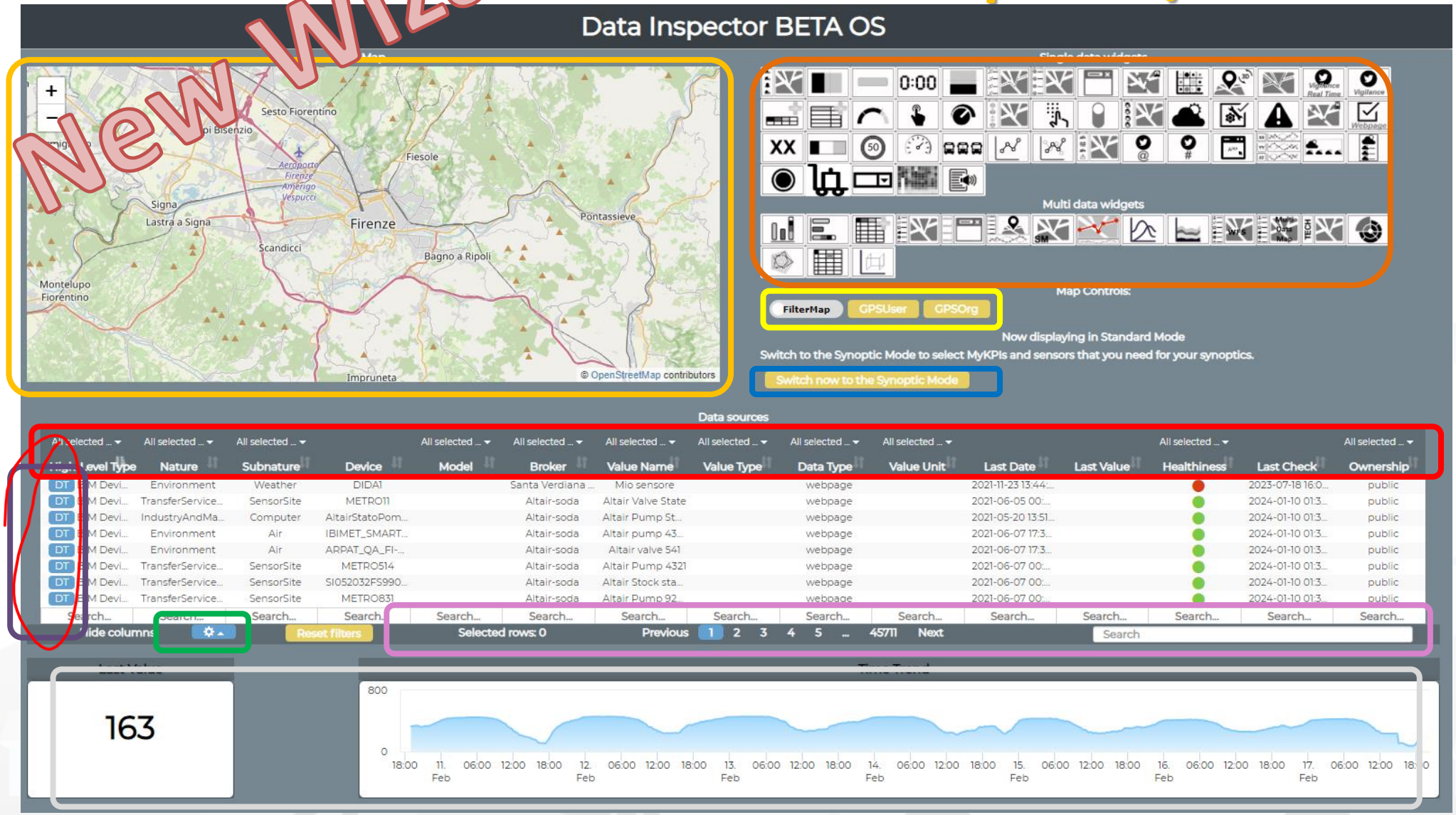
Map: Struct. Information

Data Inspector



New Data Inspector/Wizard

New Wizard



Filtering/Searching for individual fields (even for some fields not displayed as geographic coordinates)

Geographic Filtering

Text Search on all fields

Menu for choosing the fields to display in the table

View on Map(via PREVIEW)

Data and Trend visualization

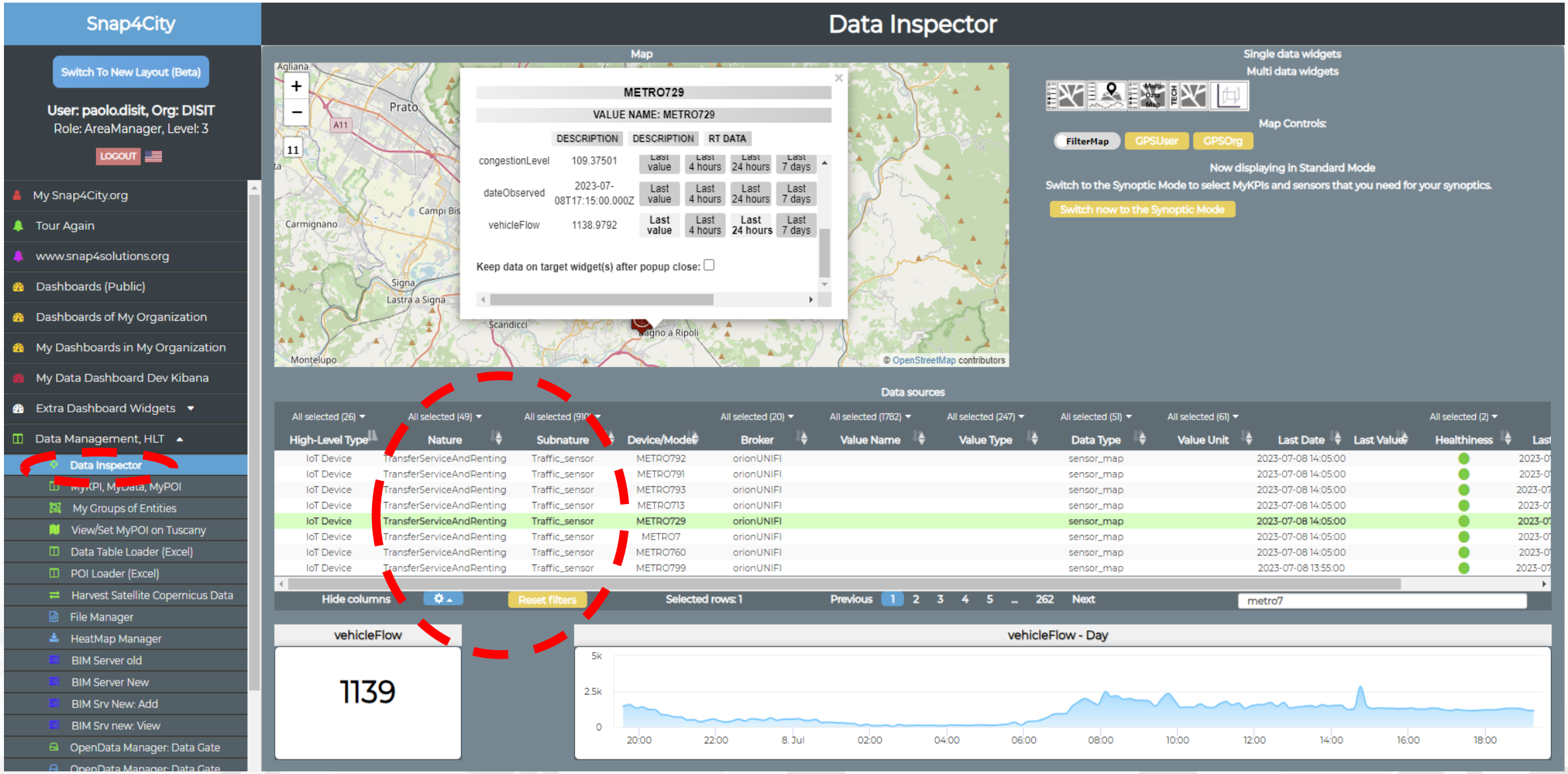
Opening Digital Twin

Pass to Synoptic mode

Select the graph representation

Classification by Nature/SubNature
Semantic Classification of Entities

Data Inspector



Any Entity has a Semantic *Classification*

Nature

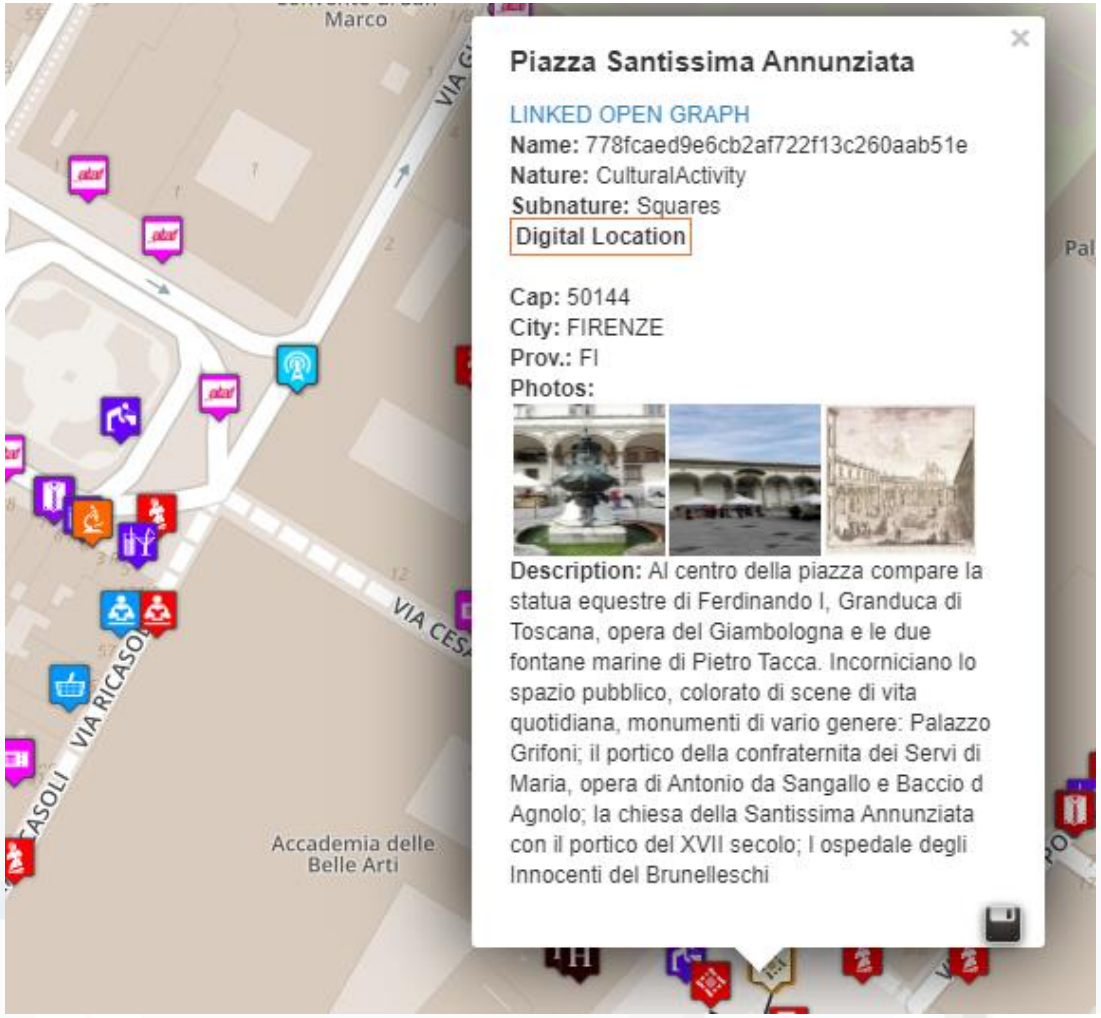
- Accommodation +
- Advertising +
- AgricultureAndLivestock +
- CivilAndEdilEngineering +
- CulturalActivity +
- EducationAndResearch +
- Emergency +
- Entertainment +
- Environment +
- FinancialService +
- GovernmentOffice +
- HealthCare +
- IndustryAndManufacturing +
- IoTDevice +
- MiningAndQuarrying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

SubNature

EducationAndResearch

- Educational_support_activities
- Higher_education
- Language_courses
- Performing_arts_schools
- Post_secondary_education
- Pre_primary_education
- Primary_education
- Private_high_school
- Private_infant_school
- Private_junior_high_school

SKOS

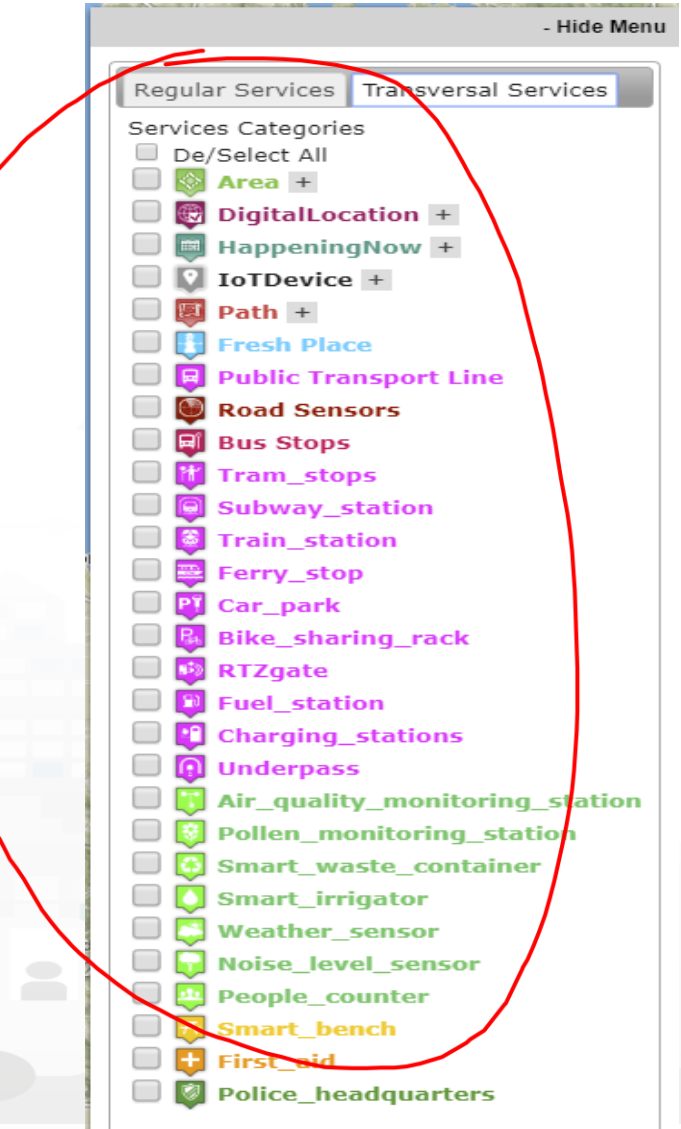


Point of Interests, POI

mainly static data

Access to Point of Interest information, POI

- **POI**: point of interest
- **type**: macro (nature) and subcategories (subnature)
- **Position**: GPS, address, telephone, fax, email, URL, …
- **Description**: textual, multilingual, with images, …
- **Link** to dbPedia, Linked Open Data
- **Links to other services**
  - **Not Real time data if any, please use Entities / devices connected:** sensors data, timeline, events, prices, opening time, rules of access, status of services, status of queue, etc..
- *See transversal services on ServiceMap*
  - *Regular and in test platform*



POI, Point of Interest

- They are
  - classified in terms of nature/subnature
  - relevant services with codified metadata to simplify the massive management of huge amount of POIs
  - mapped on Knowledge Base on **specific GPS location**
  - Do not move over time
  - represented as PIN
- Do not have Time Series for variable over time
- May sporadically change over time

Time Series can be:
IoT Devices, MyKPI, Entities, etc.

What About a Time Series

IOT Device

Entity: IOT Device

Sends a message

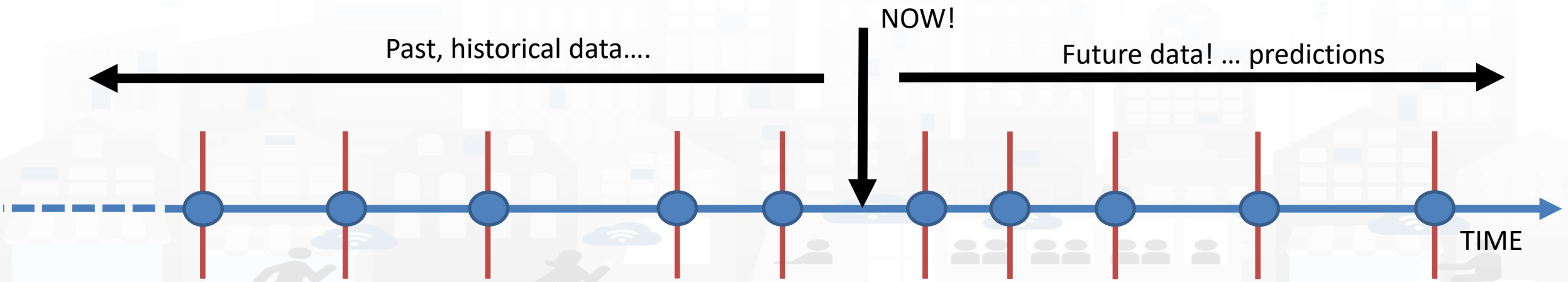
Message (
timestamp: 02-04-2020 at 10:30,
~~Temperature~~: 29.34,
Humidity: 35
)

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 a variable changing over time → time series
  - 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/Proc.Logic
    - Loaded in PULL with some File or Data Table Loader



A time series

The messages posted on Entity Instances / IoT Devices can produce different effects on time series.

Omitting the message would allow the broker to reuse the last data to fill it, as for V5, which appear

- valid in all messages on graphs
- With holes in tables

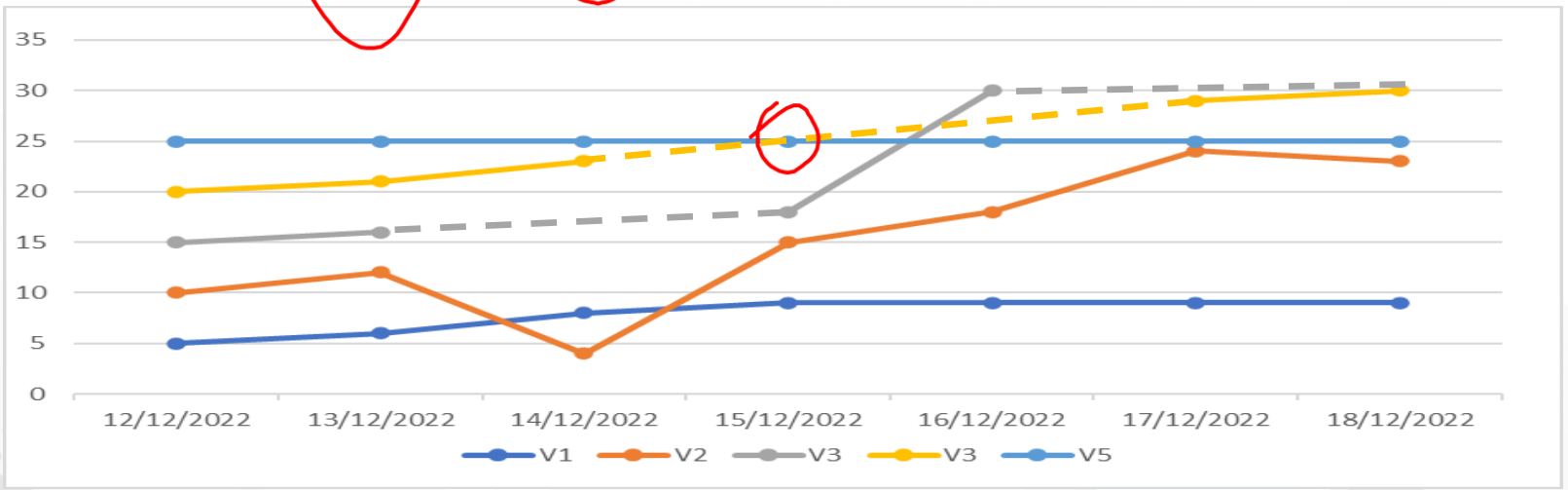
Putting null values (as in V3) would produce a missing data and thus would lead to create:

- interpolate line on graphs: dashed are actually continuous lines in Dashboards
- Empty values in the tables

device42 Entity Messages over time

Color for missed

12-12-2022	13-12-22	14-12-22	15-12-22	16-12-22	17-12-22	18-12-22
V1: 5	5	6	8	9	9	9
V2: 10	10	12	4	15	18	24
V3: 16	15	16	null	18	30	null
V4: 20	20	21	23	null	null	29
V5: 25	25	25	25	25	25	25



IoT Devices, Entities Instances, WoT

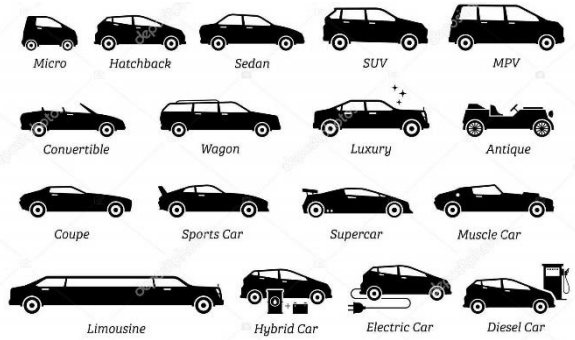
IoT Device Models

IoT Device
- Name: CM23
- Model: Lavazza
- Position: ……

IoT Device Variables
- dateObserved: ……
- ID: CM23
- Status: ready
- Temperature: 70°
- WaterLevel: 35%
- UsedCapsBox: 30%
- Power: OK
- …..

- Conceptually are 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 Devices/Entities can be:
  - **(IoT Device) Entity Models**, for example: «personal coffee machine»
  - **Entity** name, for example: «mycoffemachine1», «CM23»
  - **Entity Variable**, for example: «Temperature»

Mobile Devices/Entities



Mobile Entity Models

Mobile Entity/device

- Name: BMWJD7356HD
- Model: BMW 318
- Spec:…

Mobile Entity/device Message

- ID: BMWJD7356HD
- **dateObserved: ……..**
- Status: ready
- Temperature: 70%
- Gasoline: 35%
- Velocity: 231,3 Km/h
- **Position: 44.3223, 11.3432**
- …..

- They are a special case of devices/entities
  - they are managed as Devices/Entities 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/entities can be:
  - **Mobile Entity Model**, for example: «sedan»
  - **Mobile Entity Instance** name, for example: «BMW JD7356HD», «Ford KO786KK»
  - **Mobile Entity Variable**, for example: «velocity»

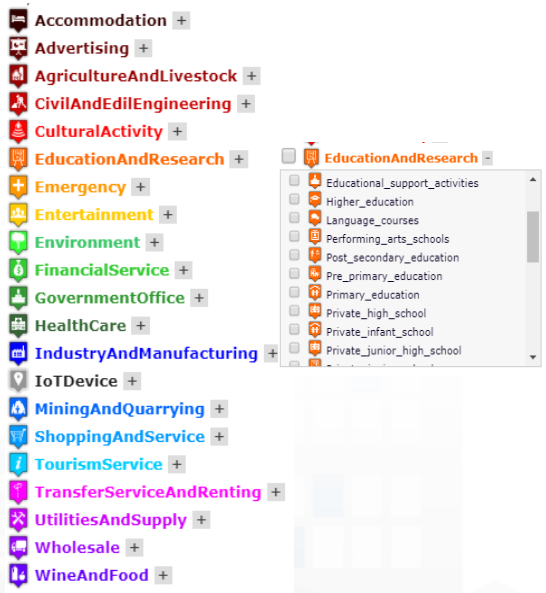
Sensor/Sensor-Actuator

IoT Device

- Name: CM23
- Model: Lavazza
- Position: …….

Sensors

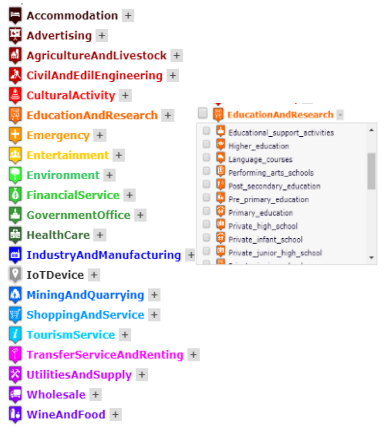
- **dateObserved: ……..**
- ID: CM23
- Status: ready
- Temperature: 60°
- WaterLevel: 35%
- UsedCapsBox: 30%
- Power: OK
- …..



- They are classified in terms of nature/subnature
- For Searching and showing on maps and dashboards **HLT of Sensors/Sensor-Actuator** can be:
  - **Sensor Device** name, for example: «mycoffemachine1», «CM23»
  - **Sensor/sensor-actuator** is a variable of a Sensor Device, for example: «Temperature»
- They do not have a model, while, in KB, have a reference process from which their real time data are collected from the field, from gateways, etc..

KPIs, Key Performance Indicators

- They are classified in terms of nature/subnature
- **Typically associated with**
  - **City or infrastructure, so that the GPS can be city center**
  - Some date: 2019, march 2019, etc.
- **For example:**
  - Number of Arrivals from France in March 2019
  - Average price for **** hotels in 2019, downtown
  - Net income of the region
  - CO2 saved in the April 2020
  - Total number of vehicles sold in 2020
  - Stock option value of Airport
- **Note that in most cases:**
  - They are time series, change over time, by year
  - they can be managed as ***Virtual IoT Devices***



Data from INSETE

Basic Sizes of Incoming Tourism

Basic Sizes of Incoming Tourism of the Region of Western Greece 2019

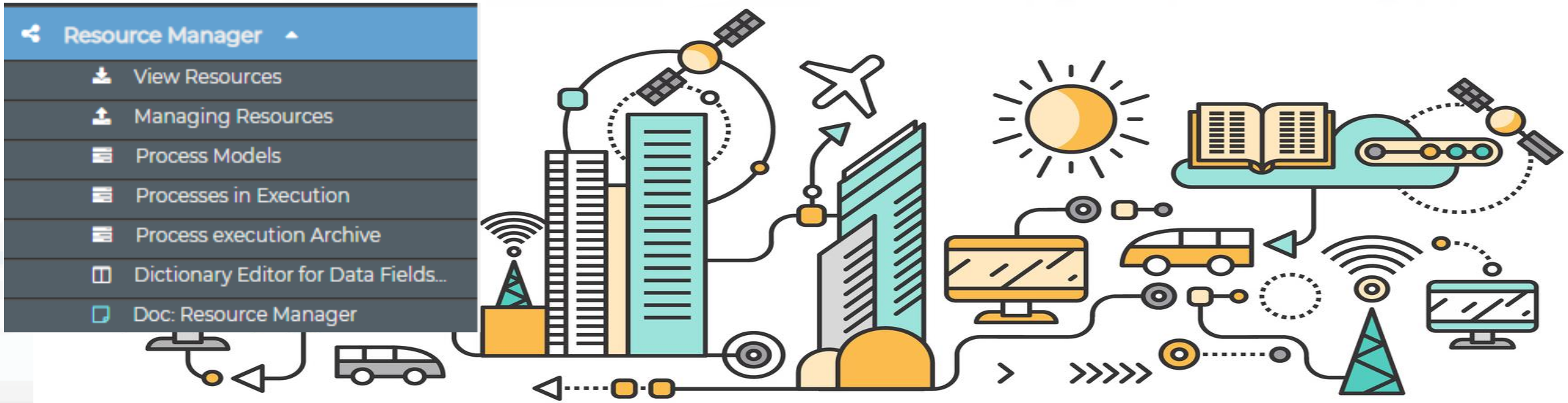
Regions	Countries Origin	Visits (in thousands)	Receipts (in € million)	Nights (in thousands)	Expenditure / Visit (in €)	Cost / Night (in €)	Average Length of Stay
West Hellas	Albania	132.9	26.5	225.8	199.7	117.5	1.7
	United Kingdom	47.7	17.9	345.8	375.2	51.8	7.2
	Germany	70.3	36.4	672.4	517.9	54.1	9.6
	France	55.4	16.5	321.6	298.1	51.4	5.8
	Other	510.7	160.0	2,964.9	313.3	54.0	5.8
	Total	**817.0**	**257.4**	**4,530.4**	**315.0**	**56.8**	**5.5**
	% of the total	**2.2%**	**1.5%**	**1.9%**			

Source: BoG Border Research, INSETE Intelligence Editing

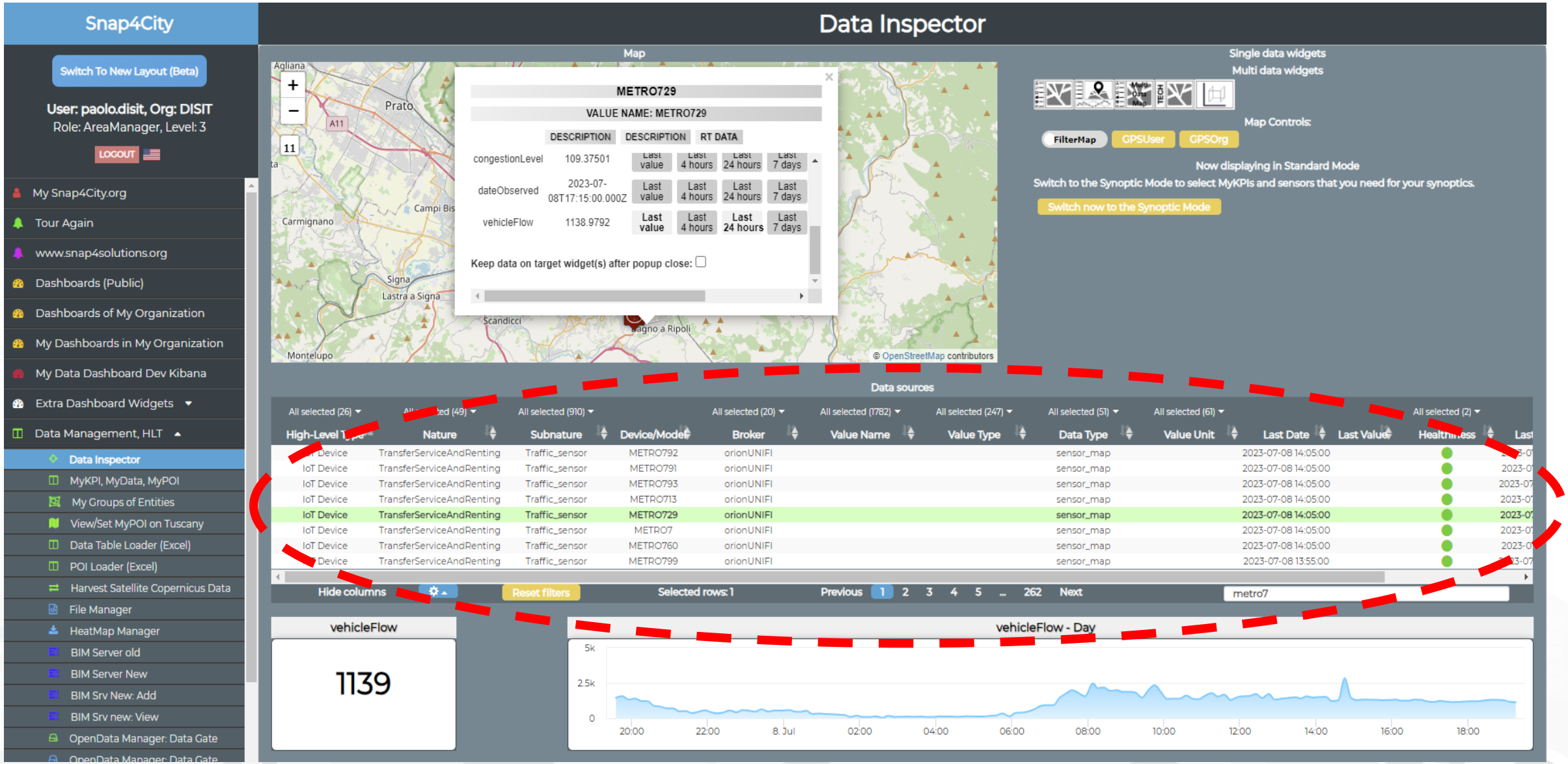
Basic Sizes of Incoming Tourism of the Region of Western Greece 2018

Regions	Countries of Origin	Visits (in thousands)	Receipts (in € million)	Nights (in thousands)	Expenditure / Visit (in €)	Cost / Night (in €)	Average Length of Stay
West Greece	Albania	138.7	29.0	222.9	209.2	130.1	1.6
	United Kingdom	42.6	13.5	180.6	317.6	74.9	4.2
	Germany	71.3	26.0	466.5	365.1	55.8	6.5
	France	44.2	13.5	262.9	304.7	51.2	6.0
	Other	402.5	129.8	2,050.7	322.4	63.3	5.1
	Total	**699.2**	**211.8**	**3,183.5**	**302.9**	**66.5**	**4.6**
	% of the total	**2.0%**	**1.4%**	**1.4%**			

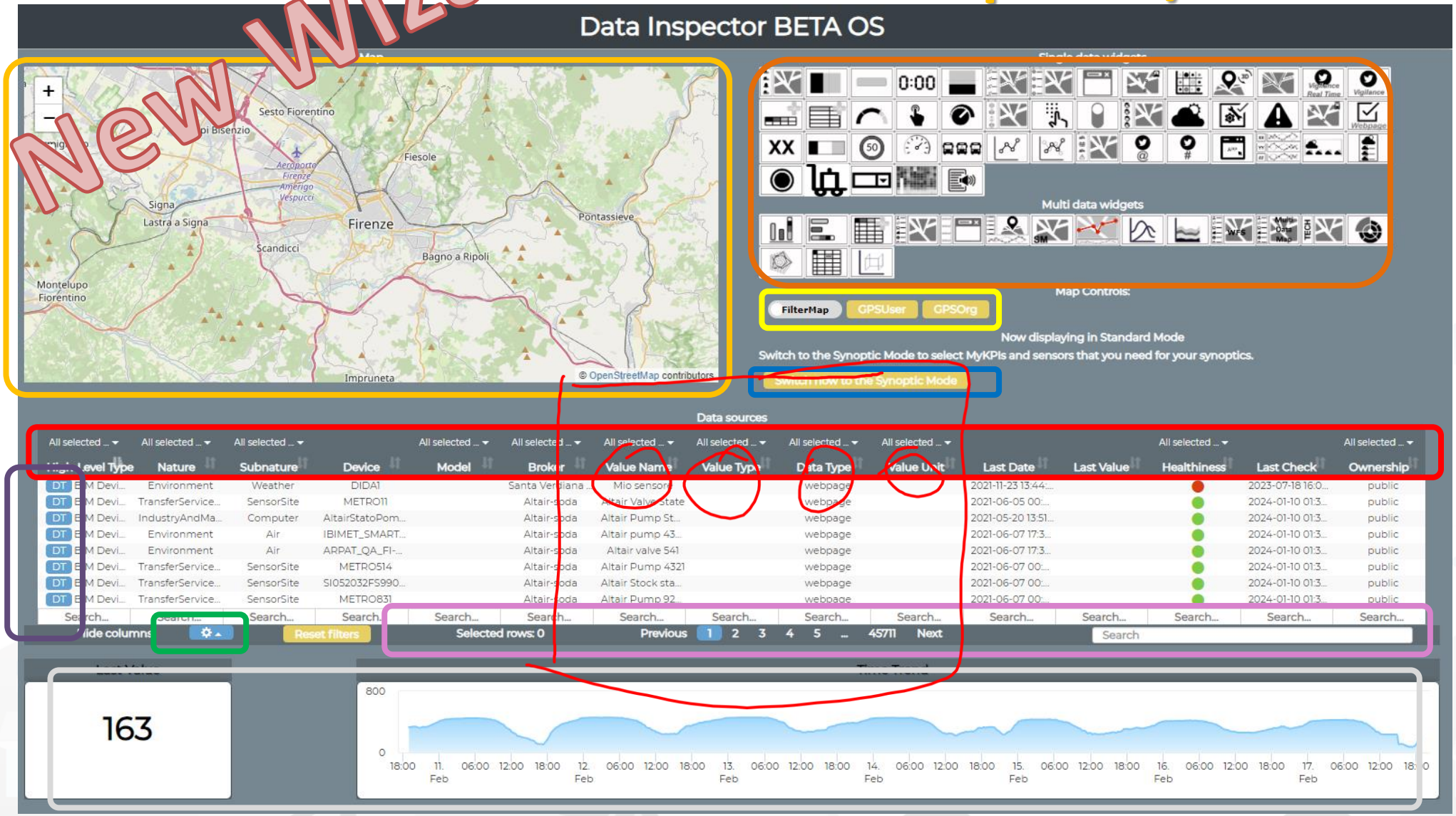
Classification of Variables of Devices, Entities, Sensors, etc. Data Dictionary



Data Inspector



New Data Inspector/Wizard



Filtering/Searching for individual fields (even for some fields not displayed as geographic coordinates)

Geographic Filtering

Text Search on all fields

Menu for choosing the fields to display in the table

View on Map(via PREVIEW)

Data and Trend visualization

Opening Digital Twin

Pass to Synoptic mode

Select the graph representation

HLT: Unified Classification for Data and Services

IoT Device Variable, Sensor Device	All selected (15)	All selected (48)	All selected (27)	All selected (1499)	All selected (159)	All selected (15)	All selected (63)		All selected (2)	All selected (2)
High-Level Type	Nature	Subnature	Device/Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date Last Value	Healthiness	Last Check	Ownership
IoT Device Variable	IoTDevice	IoTSensor	devicetest1	orionUNIFI	temperature	temperature	float	°C			2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	devicetest1	orionUNIFI	humidity	humidity	float	#			2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	temperature	temperature	float	°C			2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	humidity	humidity	float	#			2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	temperature	temperature	string	°C	2018-05-31 19:16:05		2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	humidity	humidity	string	%	2018-05-31 19:16:05		2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	temperature	temperature	float	%			2021-10-15 10:00:59	private
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	humidity	humidity	float	%			2021-10-15 10:00:59	private

Hide columns | Reset filters | Selected rows: 1 | Previous 1 2 3 4 5 ... 2466 Next | Search

High Level Types

Nature

SubNature

Dev/Model name

Broker name

Value Name

Value Type

Data Type

Value Unit

Last Date/Time

Last Value

Healthiness

Last Check

Ownership

Organization

Semantic Classific.

Technical Source

Variables, names

Real Time

Status

For Admin

Main HLT diff.

- HLT: MyKPI
- **Nature**: Industry and manufacturing
- **Subnature**: Chemical
- **Value Name**: CloroParaffine
- **Value Type**: Density percentage
- **Value Unit**: %
- **Data Type**: float mykpi
- **Last Date**: 2019-02-25 *«DateTime»*
- **Last Value**: 87.0
- **Healthiness**:
- **Last Check**: 2020-04-03 10:28:12
- **Ownership**: private for xyz…
- **Organization**: Firenze

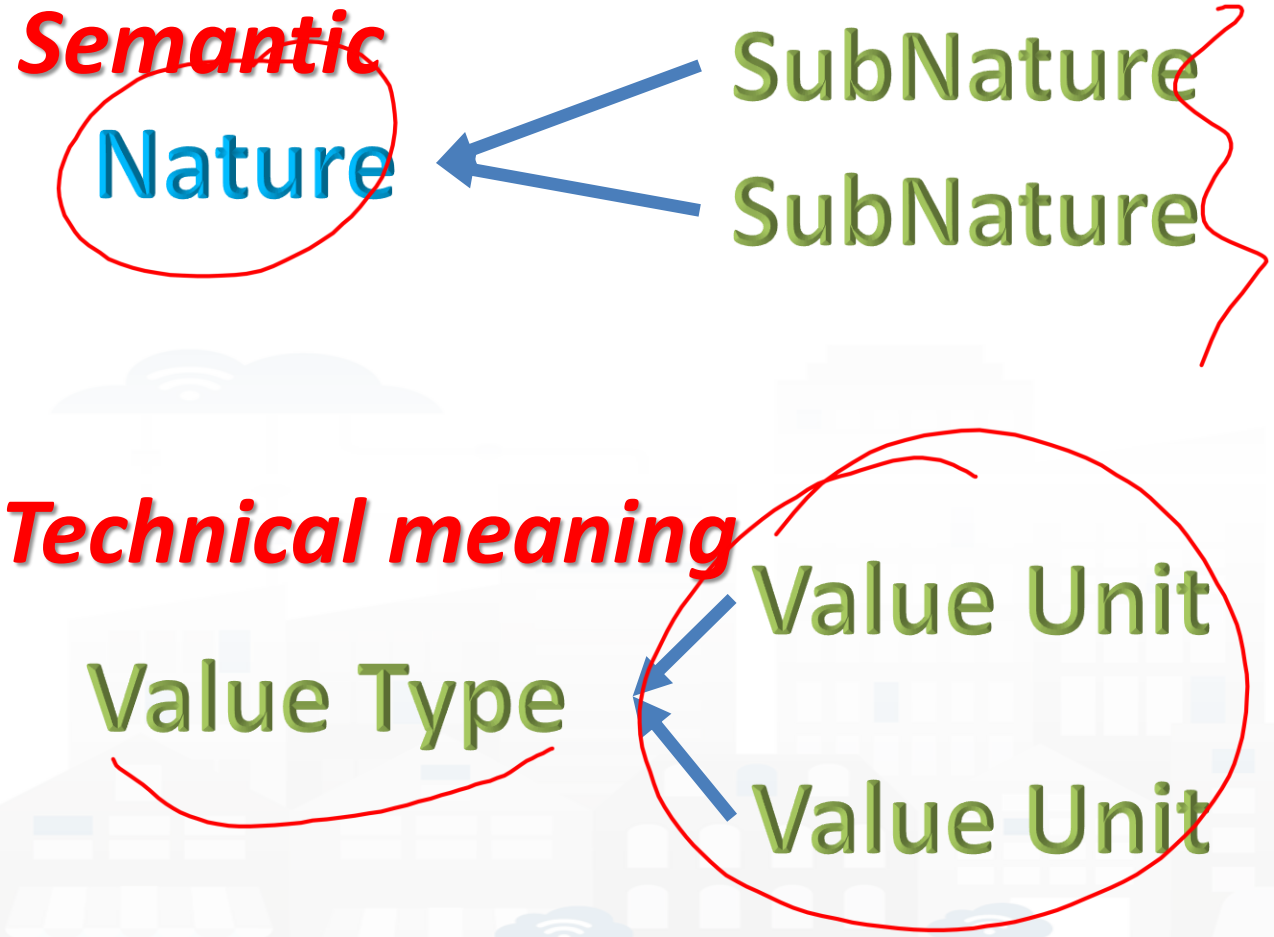
Single Variable for MyKPI

- HLT: IoT Device, Sensor Device, Data Tab Devic
- **Nature**: Industry and manufacturing
- **Subnature**: Chemical
- **Value Name**: Irrigator fioriera Gag
- **Value Type**: Battery Level
- **Value Unit**: V
- **Data Type**: float
- **Last Date**: 2020-04-01 12:59:00 *«dateObserved»*
- **Last Value**: 5.18
- **Healthiness**:
- **Last Check**: 2020-04-03 03:28:12
- **Ownership**: public/private
- **Organization**: Firenze

This Section is repeated for each variable

an IoT Device may have multiple Sensors/variables

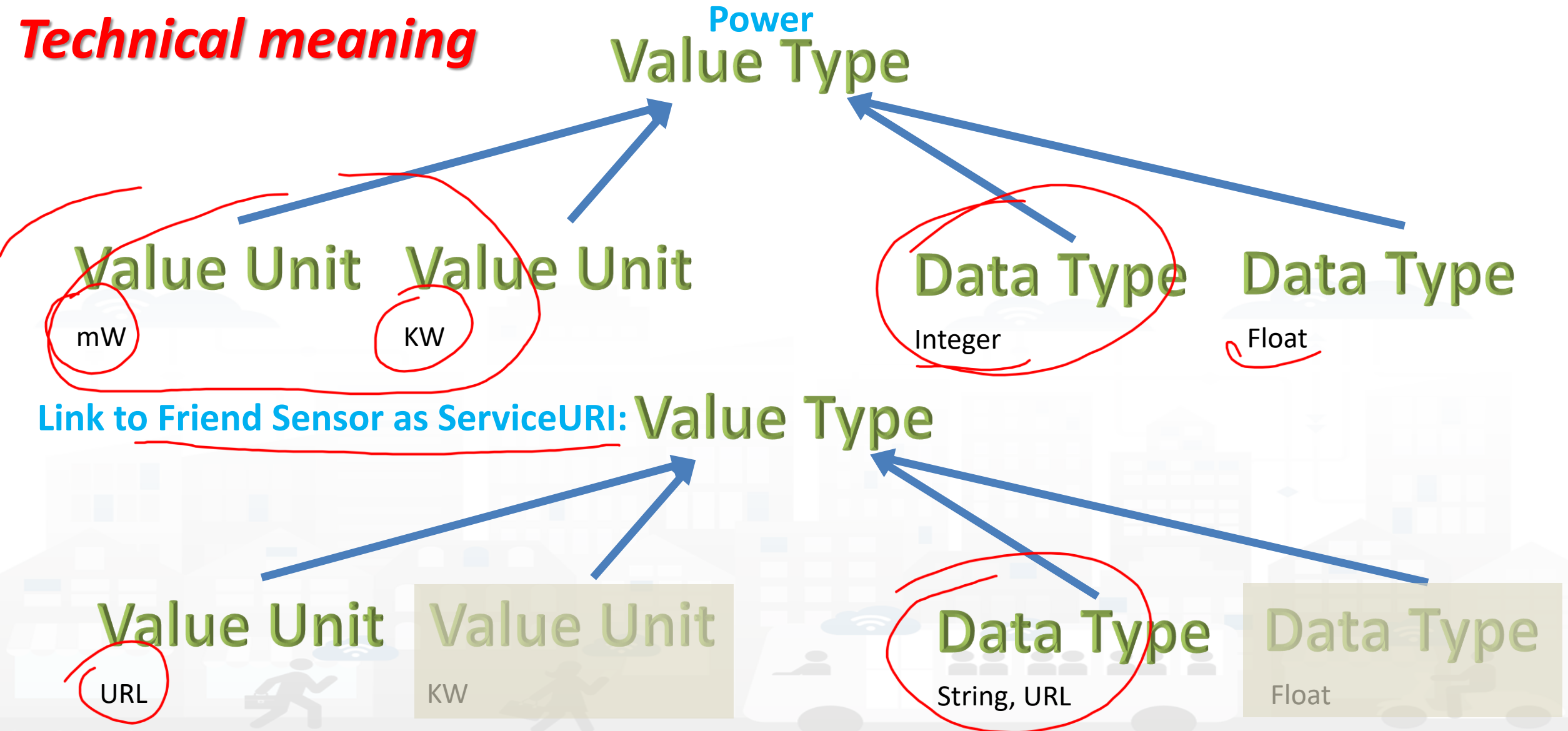
Unified Data and Services Model/Classification



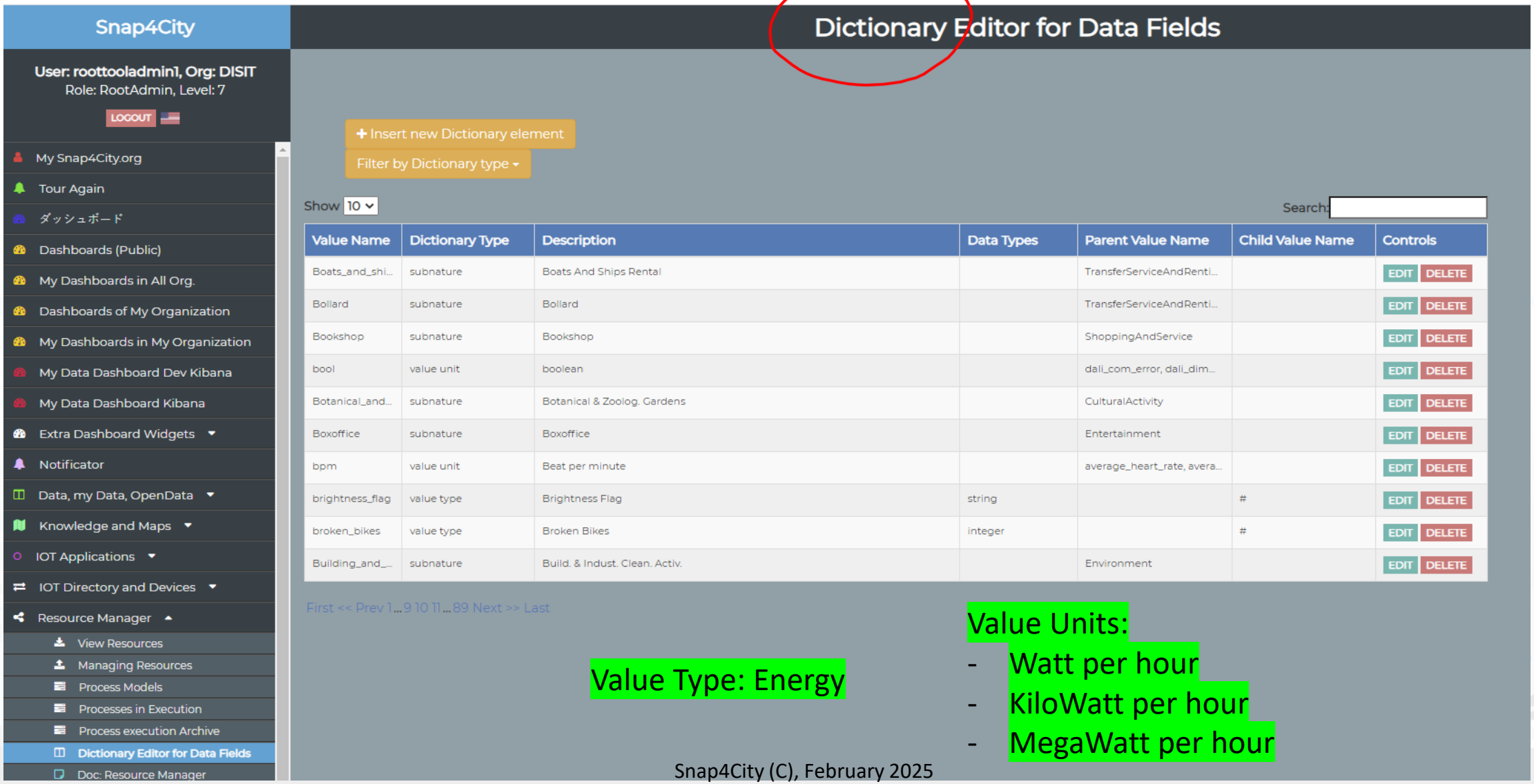
- Exists a Dictionary for the 4 categories
- They are related each other and not all values are possible
- **Right setting** leads to right rendering on graphs / dash
- **automated** combinations and processing
- The Dictionary is used by many tools

For example

Technical meaning



Example of Energy and its Value Units



Value Type: Energy

Value Units:
- Watt per hour
- KiloWatt per hour
- MegaWatt per hour

Please note on: Data Type

- Value Types have only a few number of **Data Types** because they represent how the data area treated into the system
- Therefore: main Data Types are:
  - **Float**: numbers with decimals large as you like, etc.
  - **Integer**: numbers, booleans (0/1), etc.
  - **String**: url, links, names, id, descriptions, status code, etc.
  - **Json**: structured data, vector, matrices, etc.
  - …..

IoT Device Model and Devices Data Dictionary: updated on web at 03/2023

UPDATED on Snap4City.org Tool every day

https://www.snap4city.org/818

IoT Device Model and Devices Data Dictionary: updated at 11/2022

View | Edit | Track | Access control | Convert

Any update and addtion to the dictionary of snap4city.org has to be requested to snap4city@disit.org

If you have your own instance of the platform you can define your own dictionary and request a copy of the snap4city.org dictionary

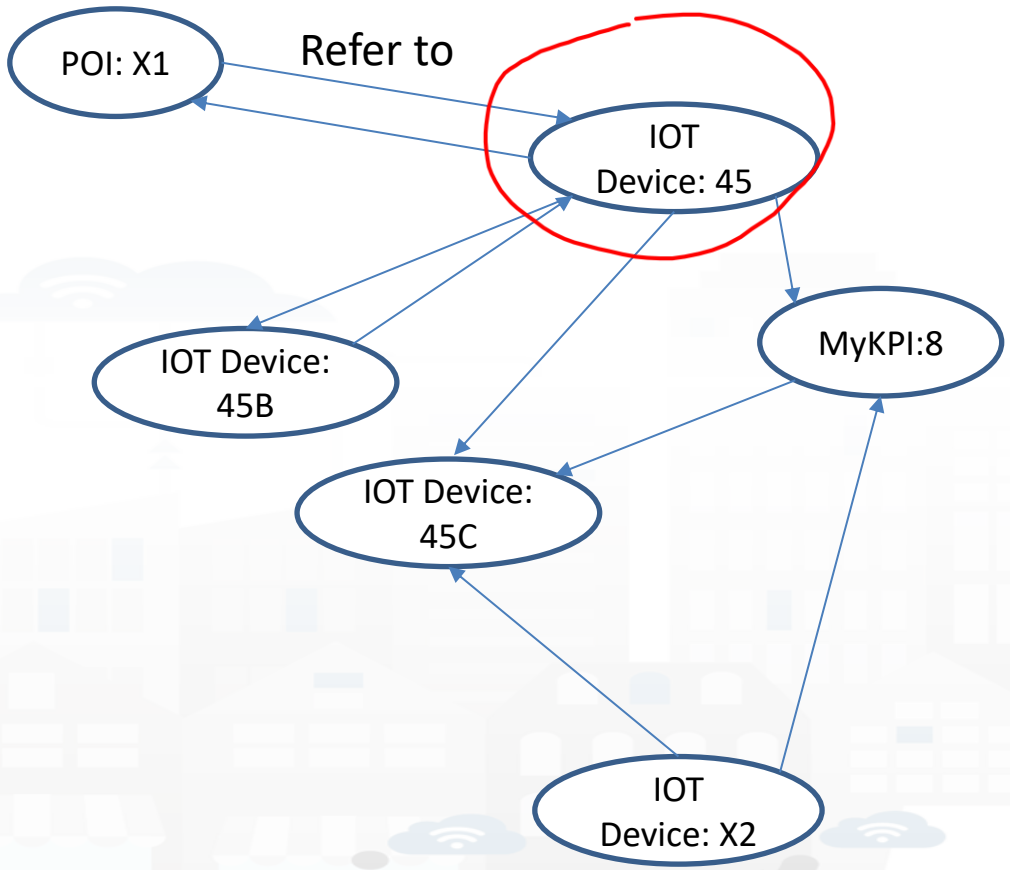
The dictionary is used into the IoT Device Model definition, in mapping smart data models, and in creating full custom devices.

https://www.snap4city.org/drupal/sites/default/files/image_from_word/fil...

value type	Description	possible value Units	Possible Data Types
actuator_canceller	Actuator Canceller		string
actuator_deleted	Actuator Deleted		integer
actuator_deletion_date	Actuator Deletion Date	timestamp	string
air_quality_index	Air quality index		float
altitude	Altitude	m	float,integer
angle	angle	deg	float
annual_C6H6_average	annual_C6H6_average	ppm, mg/m3, µg/m³	float
annual_C6H6_exceedance_count	annual_C6H6_exceedance_count	#	integer,float
annual_CO_average	annual_CO_average	ppm, mg/m3, µg/m³	float
annual_CO_exceedance_count	annual_CO_exceedance_count	#	integer,float
annual_NO2_average	annual_NO2_average	ppm, mg/m3, µg/m³	float
annual_NO2_exceedance_count	annual_NO2_exceedance_count	#	integer,float
annual_O3_average	annual_O3_average	ppm, mg/m3, µg/m³	float

References/Links to Entities Instances / IoT Devices

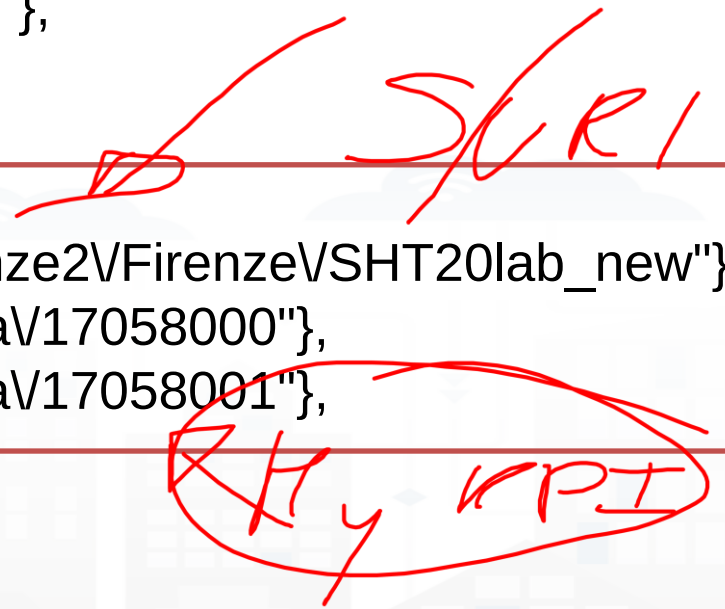
Relationships among Devices/Entities, POI and MyKPI



- **Devices and POI** may refer to:
  - IoT Devices/Entities, POI, MyKPI, Heatmaps, etc.
  - The Links may change over time
- **MultiDataMap** can be used for navigation:
  - Among: IoT Devices, POI, MyKPI
  - Automated focus
  - Accessing Time Trends

IoT device with References to other and MyKPI


```
{
"id":"ThermalBOX1",
"type":"thermalbox",
"dateObserved":{"type":"string","value":"2022-02-24T17:15:34.609Z"},
"latitude":{"type":"float","value":"43.76965"},
"longitude":{"type":"float","value":"11.25570"},
"SHTdevice":{"type":"string",
      "value":"http:\/\/www.disit.org\/km4city\/resource\/iot\/orionFirenze2\/Firenze\/SHT20lab_new"},
"cam51count":{"type":"string","value":"datamanager\/api\/v1\/poidata\/17058000"},
"cam52count":{"type":"string","value":"datamanager\/api\/v1\/poidata\/17058001"},
…
}
```

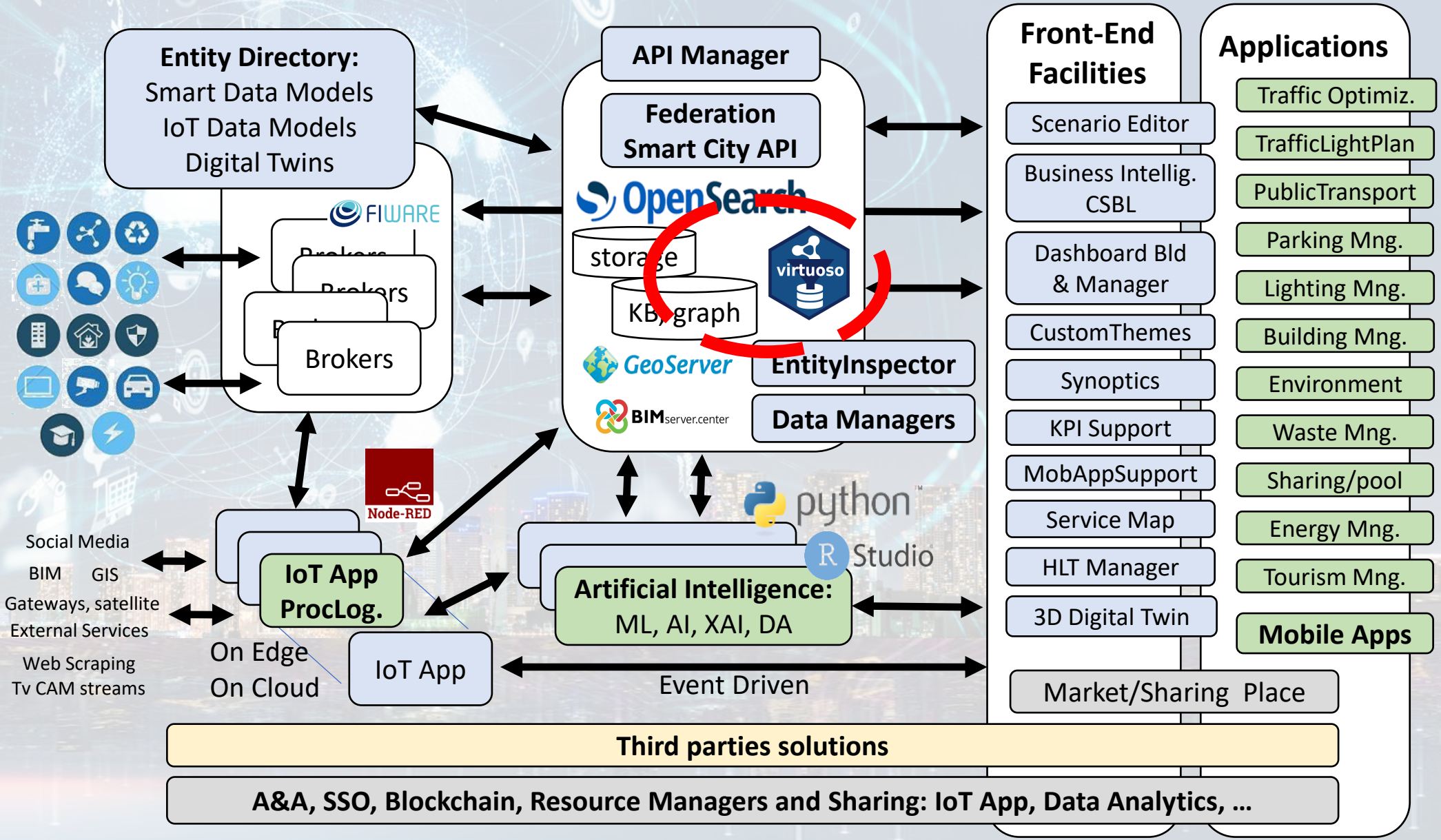
Value Type: Identifier

Value Unit: ServiceURI *//any query: such as those of the Selector*

Data Type: String

Knowledge Base: Modelling and ServiceURI as Entity Identifier

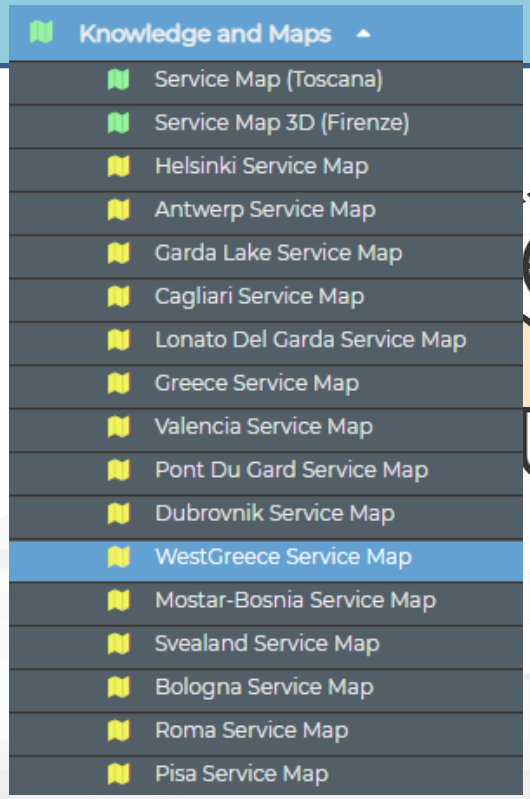
Technical Architecture



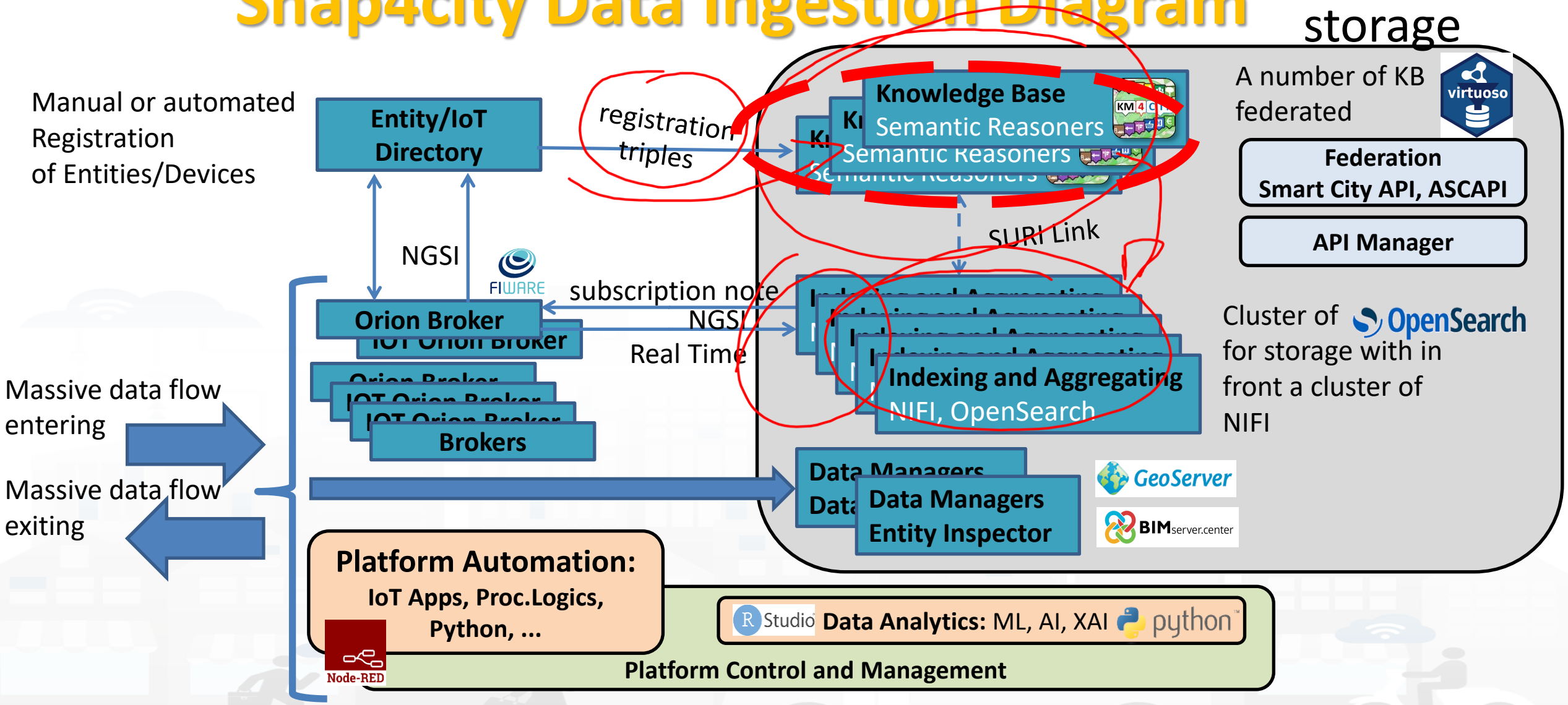
Knowledge Base city structure

- Needs of the KB city Structure:
  - For many trivial applications of Smart City the KB does not need to be initialized with some road graph, for example taken from OSM
  - For example, if you need only to position devices on map to some GPS coordinates you do now need to set up the KB
- The KB Set up is needed only when is needed to have:
  - Geoserver functionality
  - Routing based on KB
  - Some spatial reasoning queries
  - Etc.

Usage of the ServiceMap and Knowledge Base Browsing



Snap4city Data Ingestion Diagram



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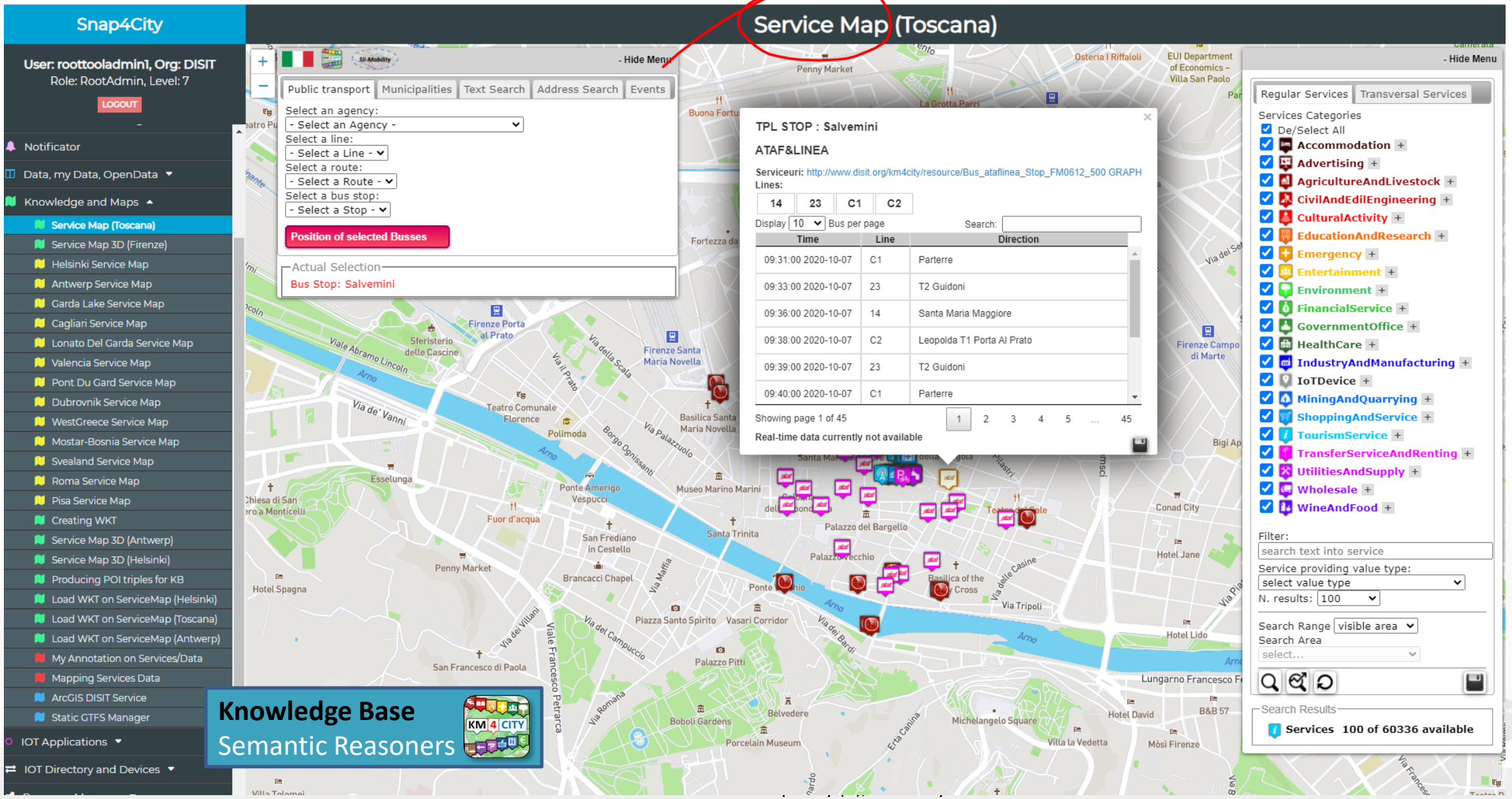
ServiceMaps

SNAP4CITY | KM4CITY

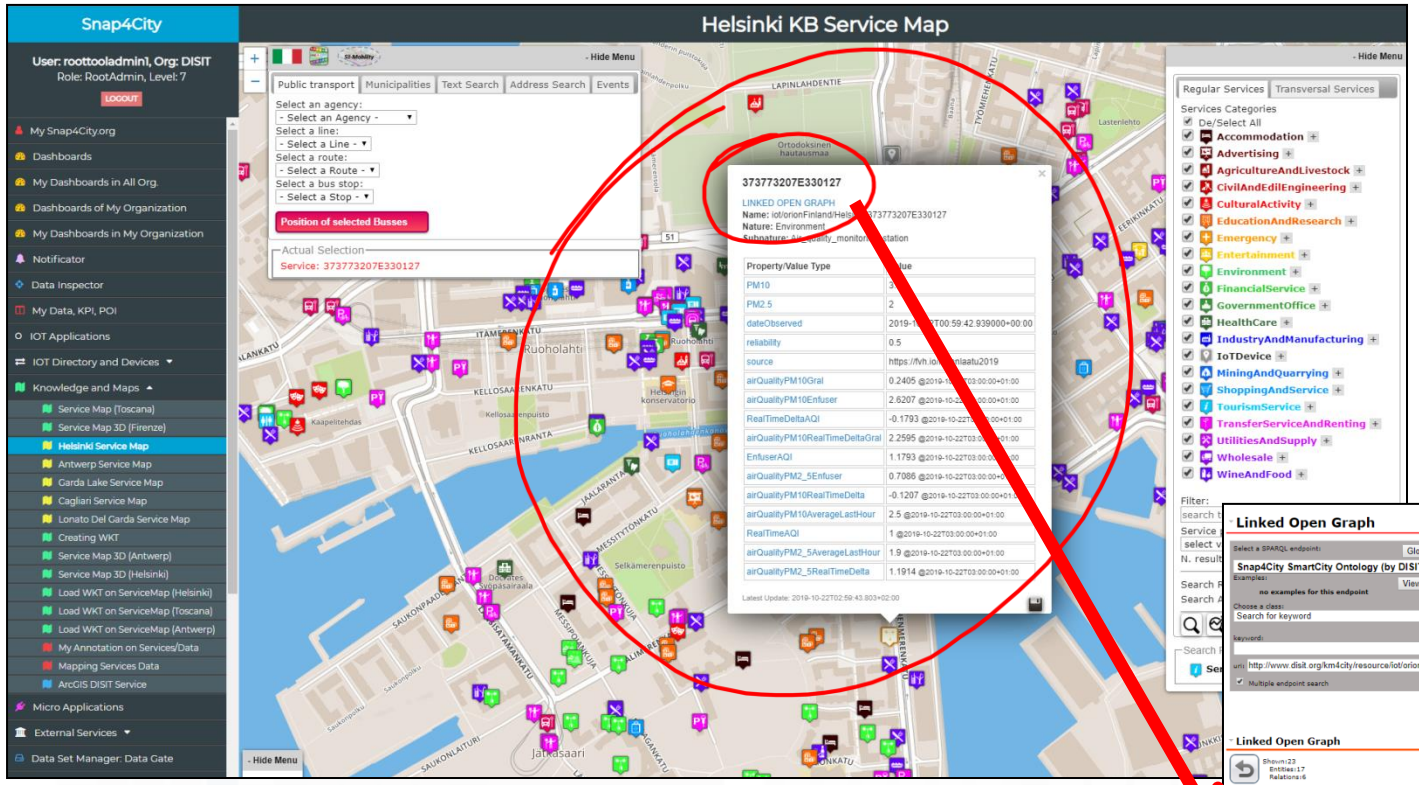


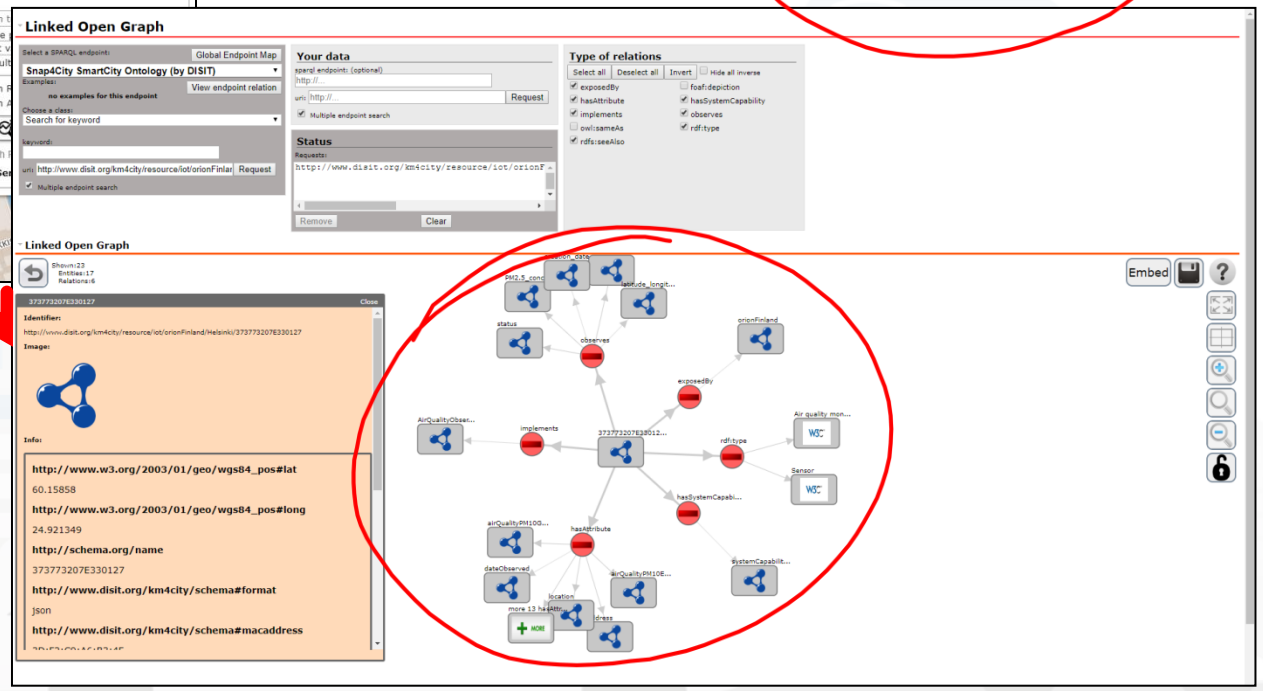
Semantic modeling

- **KB is based on the Km4City ontology,** It allows to:
  - keep connected city entities each other:
    - Semantic Index, reticular
    - Perform spatial, geo graphic, and temporal reasoning
  - Discover city entities and their relationships via Proc.Logic / IoT App and Smart City API:
    - Entities / devices, sensors, city elements, roads, services, Brokers, etc. etc.
  - Provide access via Advanced Smart City API
  - Federate other Smart Cities / Knowledge Bases, the approach allows to scale geographically and create redundancies, improving performances

Views of the Knowledge Base

Knowledge Base
Semantic Reasoners





- How pass from ServiceMap to Linked Open Graph, Linked Data view tool


- Nascondi Menu
Fermate Firenze
Comuni in Toscana
Ricerca Testuale
Seleziona una provincia:
FIRENZE
Seleziona un comune:
FIRENZE
Actual Selection
COMUNE di FIRENZE
Tuscany
Florence,
Pisa....
Road Graph (Tuscany region)
132,923 Roads , 389,711 Road Elements
318,160 Road Nodes, 1,508,207 Street Numbers
Info on: points, paths, areas, etc.
Services (20 cat, 512 cat.)
16 Public Transport Operators
21.280 Bus stops & 1081 bus lines
Dynamic/real-time as in Tuscany Region
• Real time bus lines: 144 updates X day X line
• 1081 Transport Pub Lines: 1-2 up per day, time-path
• >210 parking lots status: 76 updates X day X sensor
• >796 traffic Sensors: 288 updates X day X sensor
• 285 weather area: 2 updates X day X area
• >12 hospital Triage status: 96 updates X day X FA
• 600 Environmental data: 20 updates X day X sensor
• 39 Bike Sharing racks data: Pisa and Siena
• 12 Pollination data, 37 air quality data
• 177 recharging stations
• Smart benches, waste mng, irrigators, lighting, …
• Florence ent.events: about 60 new events X day
• Different kinds of Florence traffic events,
• [1600 Fuel stations: 1 update X day X station]
• [Wi-Fi: > 400.000 measures X day]
• App mobiles: >50.000 measures X day
• more than 40.000 distinct users X day
• From 600.000 to 4.5 M Tweets X day
• + many IOT sensors personal and industrial …
- Nascondi Menu
Previsioni Meteo per il comune di FIRENZE:
Martedi
poco nuvoloso
23°C / 27°C
Mercoledi
pioggia debole e schiarite
20°C / 30°C
Giovedi
poco nuvoloso
20°C / 33°C
Venerdi
poco nuvoloso
/
Sabato
velato
/
Ultimo Aggiornamento: 2015-09-15T09:07:00+02:00
LINKED OPEN GRAPH
- Nascondi Menu
Servizi Regolari
Servizi Trasversali
search text into service
Categorie Servizi
De/Select All
Accommodation
Advertising
AgricultureAndLivestock
CivilAndEdilEngineering
CulturalActivity
EducationAndResearch
Emergency
Entertainment
Environment
FinancialService
GovernmentOffice
HealthCare
IndustryAndManufacturing
MiningAndQuarrying
ShoppingAndService
TourismService
TransferServiceAndRenting
UtilitiesAndSupply
Wholesale
WineAndFood
N. risultati: Nessun Limite
Raggio ricerca 100 metri
Risultati della ricerca
più di 4000 risultati, attivato clustering
Services 16858
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

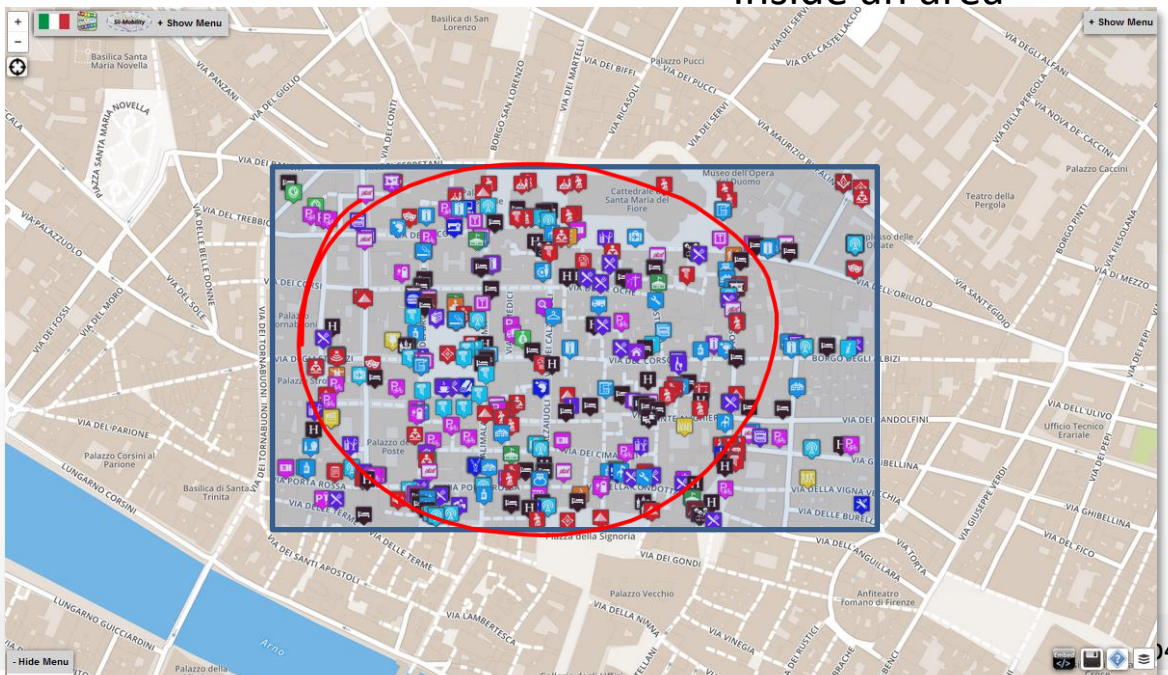
Discovery

Search by Shape and Distance

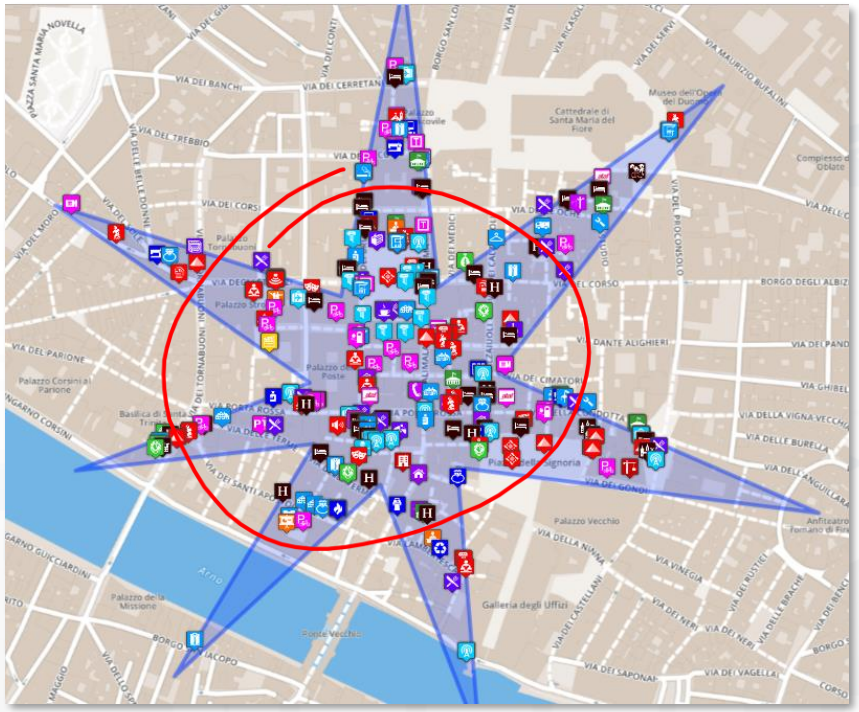
Around a point or POI

Each request or search in the Km4City model can be referred to a point and a ray, to an area, to a polyline

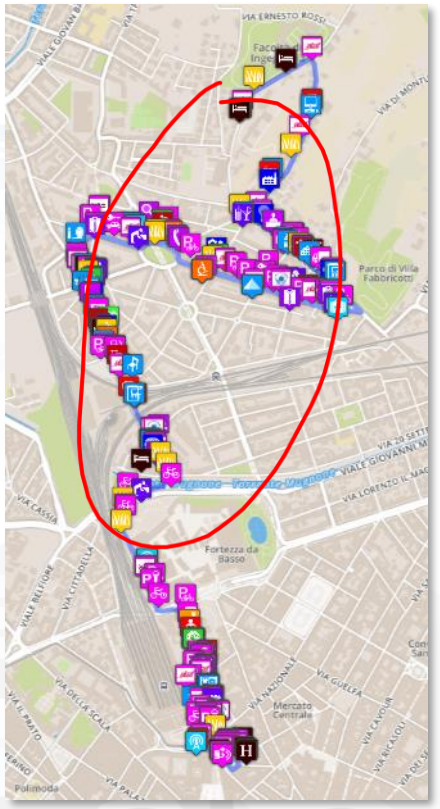
Inside an area



Inside a closed polyline

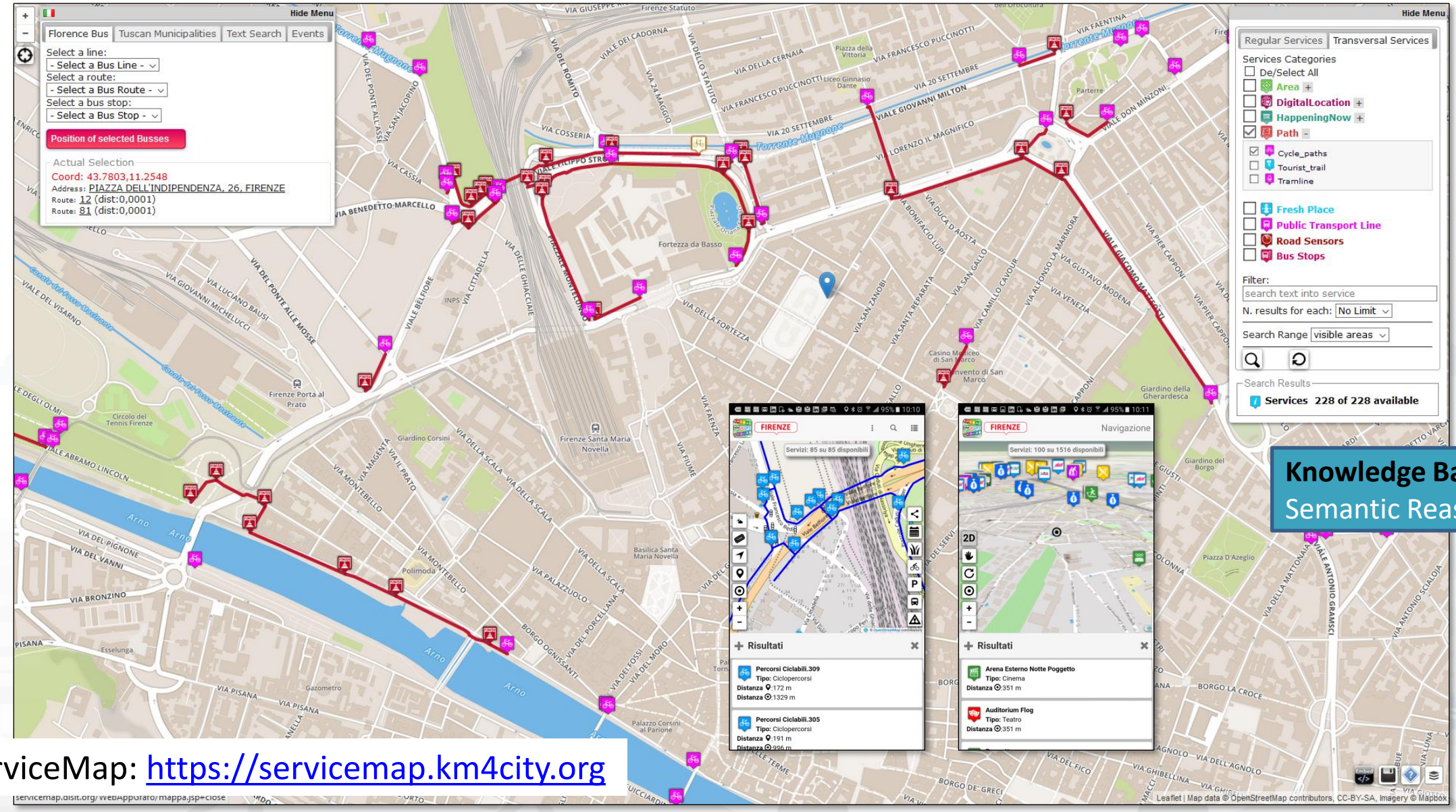


Along a polyline



Knowledge Base
Semantic Reasoners

Cycling Paths

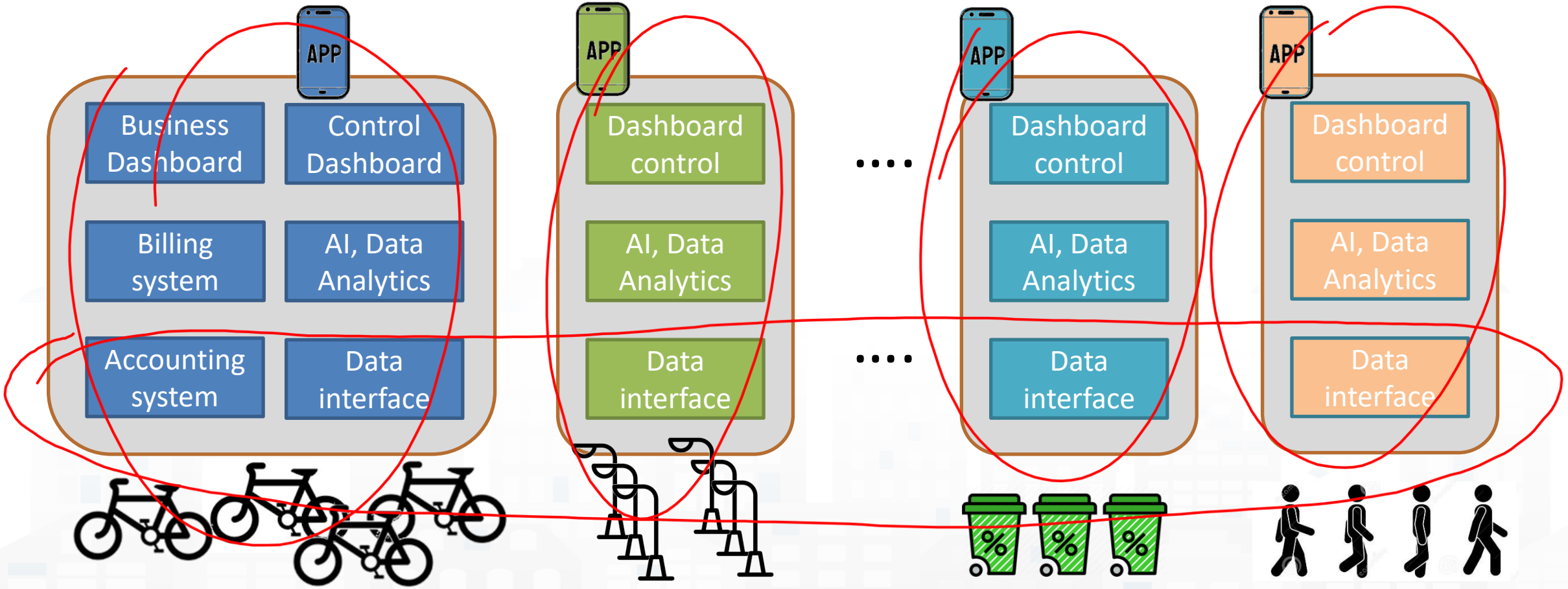


Knowledge Base
Semantic Reasoners

ServiceMap: https://servicemap.km4city.org

Set up of the Knowledge Base performed with an open source tool

Avoiding to have a collection of verticals

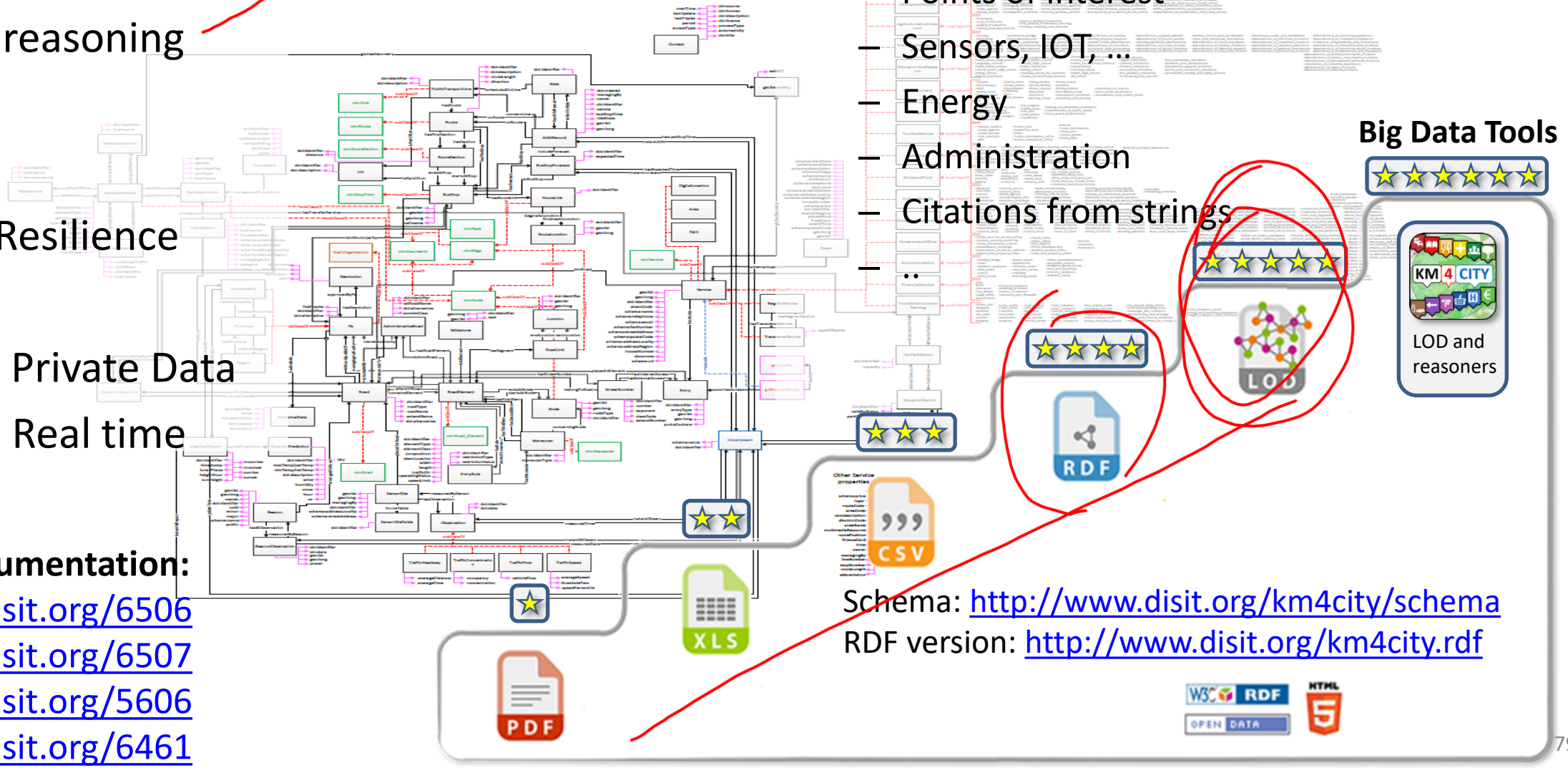


Simplifying the development and integration of verticals

Km4City: Knowledge Base

- **Multiple DOMAINS**
- Geospatial reasoning
- Temporal reasoning
- Metadata
- Statistics
- Risk and Resilience
- Licensing
- Open and Private Data
- Static and Real time
- IOT/IOE

- Street-Guide
- Mobility and transport
- Points of interest
- Sensors, IOT, …
- Energy
- Administration
- Citations from strings
- ..

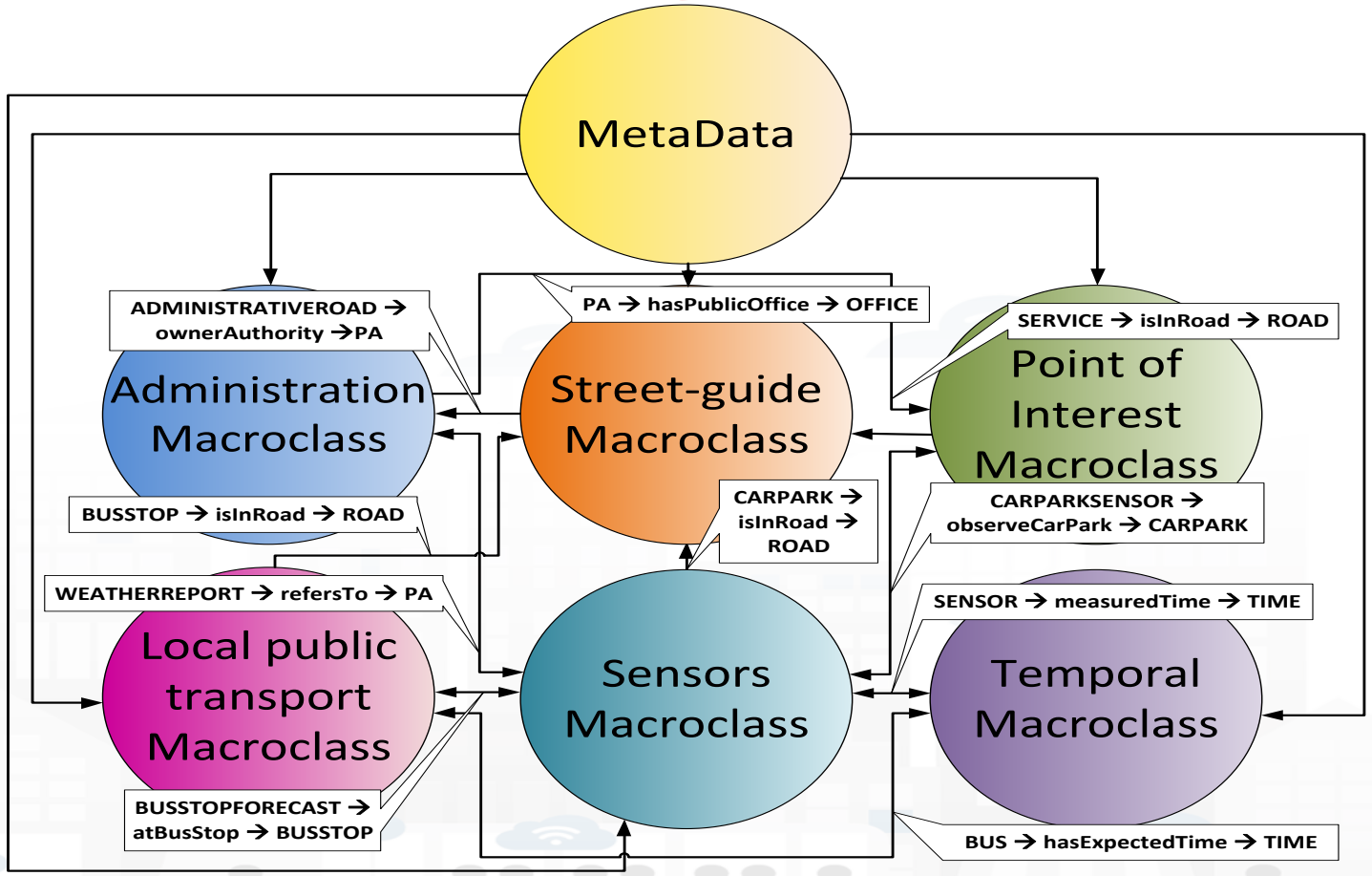


Ontology Documentation:
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

Schema: http://www.disit.org/km4city/schema
RDF version: http://www.disit.org/km4city.rdf

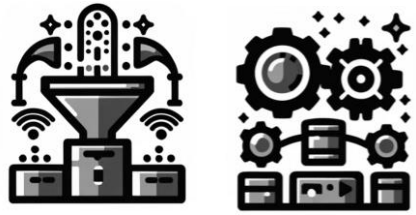
Smart-city Ontology: 1.6.8

- covers different aspects:
  - Administration
  - Street-guide
  - Points of interest
  - Local public transport
  - Sensors
  - Temporal aspects
  - Metadata on the data
  - Industry 4.0 structures
  - Digital Twin models
  - High Level Types



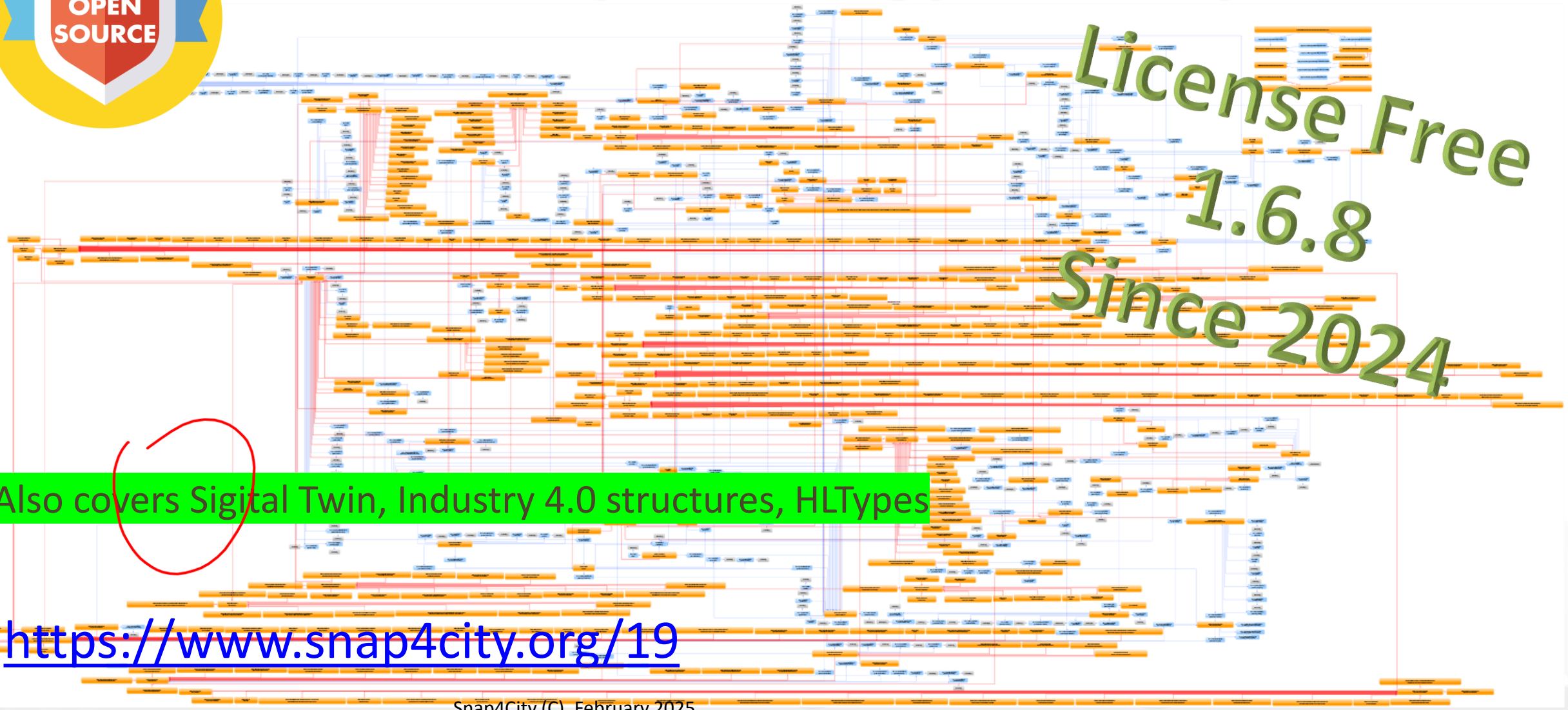
Km4City Ontology elements 1.6.8

- **Km4C**: Km4City 1.6.8
- Using
  - **DCTERMS**: for metadata Dublin Core Metadata Initiative
  - **FOAF**: friends of a friends
  - **Good Relation**: entities relationships
  - **iot-lite**: IOT Vocabuary
  - **OTN**: Ontology of Transportation Networks
  - **OWL-Time**: time reasoning
  - **SAREF** Smart Appliances REFerence extension for building devices available at https://saref.etsi.org/saref4bldg/
  - **Schema.org** for people and organizations
  - **SSN**: Semantic Sensor Network Ontology (see https://www.w3.org/TR/vocab-ssn/
  - **WGS84** Datum of Geo-Objects
  - **GTFS**, General Transit Feed Specification, and **Transmodel**, for public transport infrastructures: lines/rides time schedules, real-time records, paths, etc.;
  - **BOT**: Building Topology Ontology. https://w3c-lbd-cg.github.io/bot/
  - **S4CITY**: SAREF extension for Smart City. https://saref.etsi.org/saref4city/v1.1.2/



Smart-city Ontology km4city

100% OPEN SOURCE



License Free
1.6.8
Since 2024

Also covers Sigital Twin, Industry 4.0 structures, HLTypes

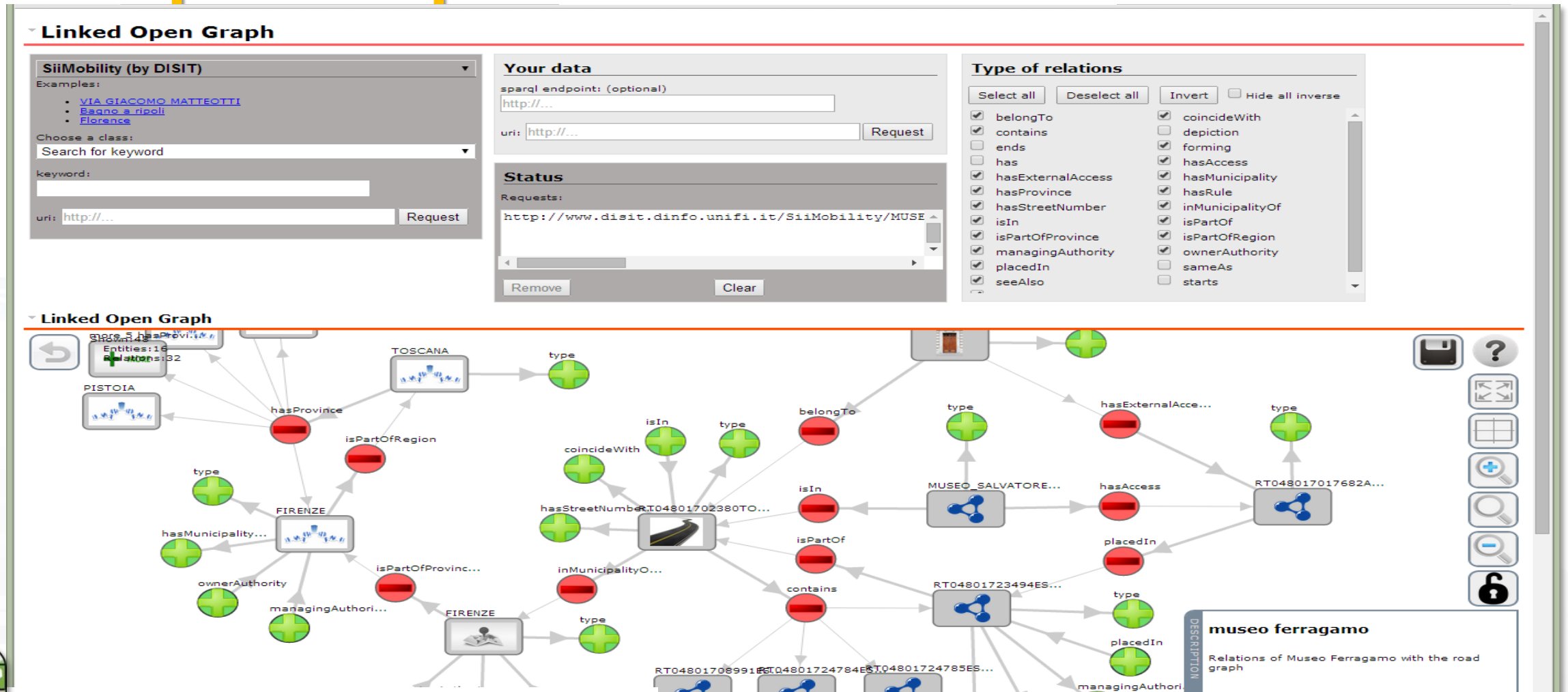
https://www.snap4city.org/19

Set up of the Knowledge Base, KB

- The **KB starts with the ontology and empty in terms of instances**, it should to be **initialized** with the Road Graph(s) of interest, but may be not needed in some cases.
- **Road Graphs** can be obtained from:
  - GIS of the municipalities, regional govern, etc.
  - Open Street Map, OSM
  - Etc.
  - See this note on KM vs OSM: https://www.snap4city.org/397
- Snap4City provides a tool to **feed the KB with OSM, or edited OSM**
  - TC5.10- Open Street Map ingestion process
  - From the Open Street Map to the Km4City street graph
    - https://www.snap4city.org/download/video/From%20the%20Open%20Street%20Map%20to%20the%20Km4City%20street%20graph.pdf
  - **OSM2KM4C** tool is included into KBSM, VM and Docker https://www.snap4city.org/471
  - Tool: https://github.com/disit/osm2km4c
- The load of a city of 1 Million of inhabitants can be done in few hours.

Linked Open Graph

LOG: https://log.disit.org



Schema: http://www.disit.org/km4city/schema

RDF version: http://www.disit.org/km4city.rdf

The role of Knowledge base and ServiceMaps

Accessing to Snap4City Services

storage

Other federated Smart City

Knowledge Base
Semantic Reasoners

SURI Link

Indexing and Aggregating
NIFI, OpenSearch

Data Managers
Entity Inspector

A number of KB federated

virtuoso

Federation Smart City API, ASCAPI

SCAPI

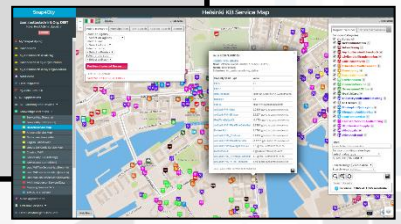
Super SCAPI

API Manager (Optional)

Cluster of OpenSearch for storage with in front a cluster of NIFI

GeoServer

BIMserver.center



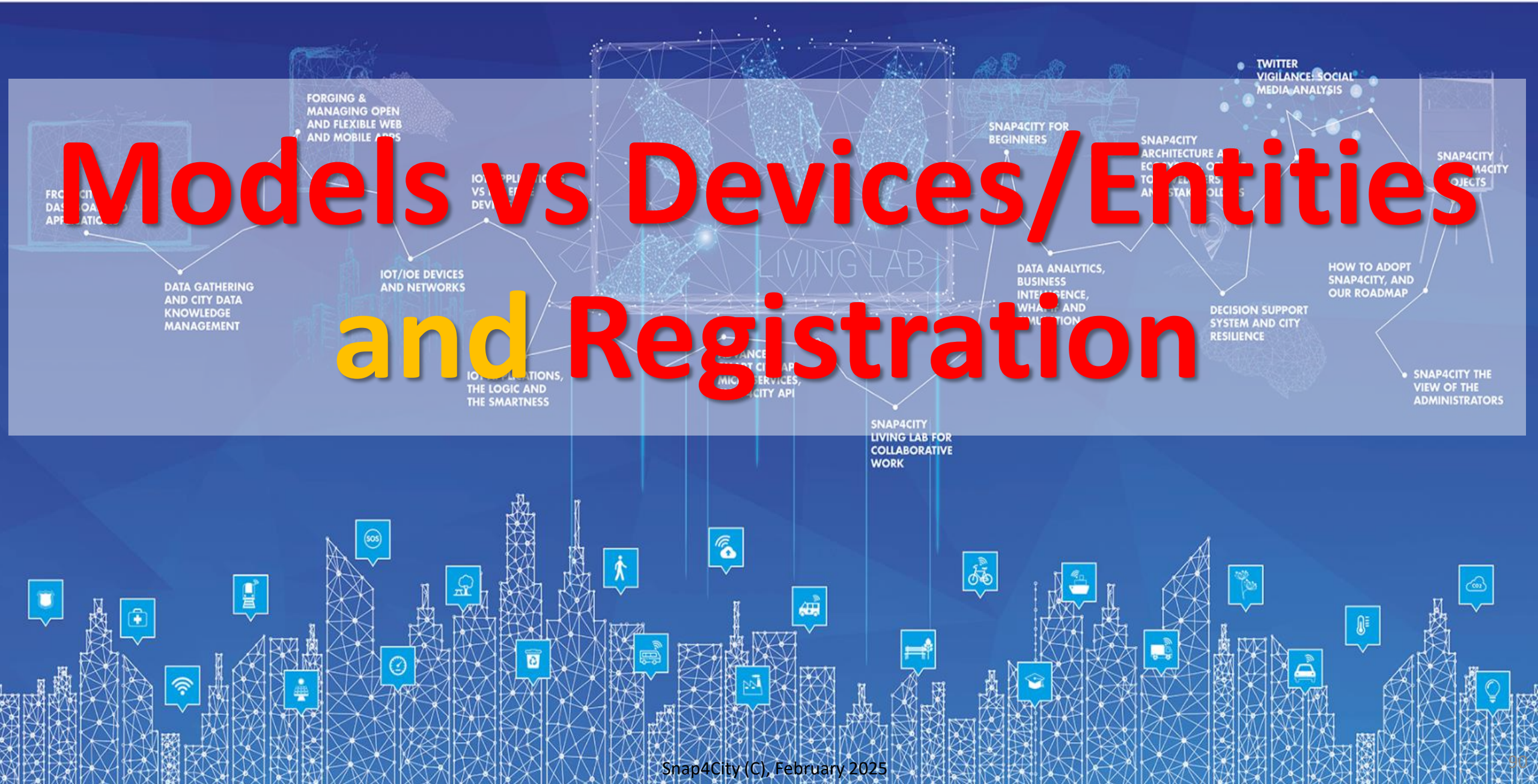
ServiceMap

Multi/Super ServiceMap

ServiceMaps

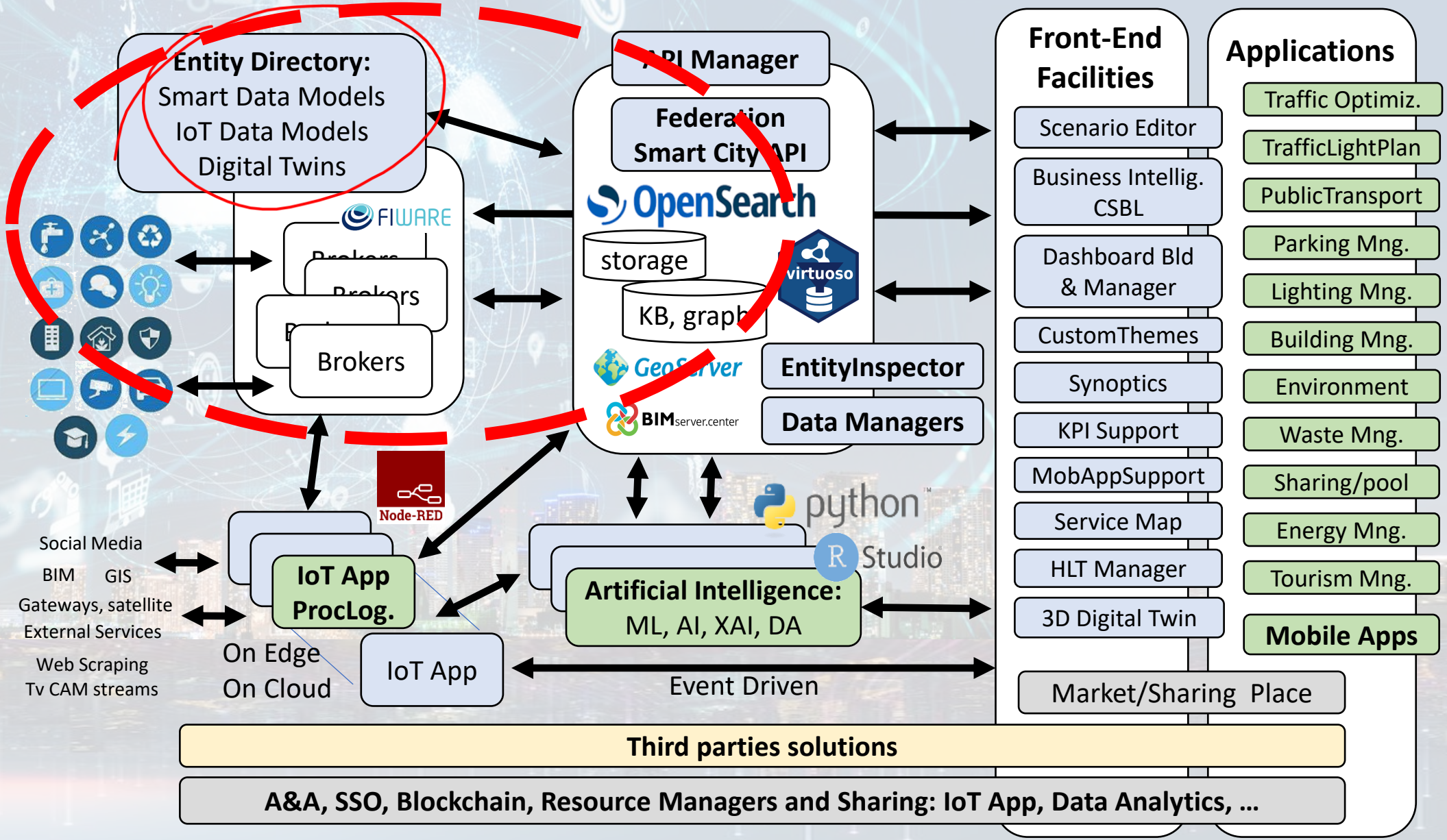
Knowledge Base
Semantic Reasoners

- ServiceMap is the **main Tool** to:
  - monitor the status of the Knowledge Base
  - test queries and produce query and SmartCity API testing calls for developers
    - Any kind of search (semantic, full text, etc.), routing,
  - Access at the specific Graph Data base via LOG.disit.org
- **ServiceMap is showing**:
  - only **public data**. Private data are not shown via ServiceMap but can be accessed via DataInspector, Wizard, Dashboards
  - data regarding **a single Knowledge Base** of the federated network of KBs. Each KB may contain multiple Organizations.
  - technical views for developers
- **Super ServiceMap** shows to you your private data and data which have been delegated in Access to you.
- In most cases we refer as ServiceMap to intend both Super and basic
- In the installations on Cloud, the Super is the Default used by Dashboards, on premise the basic ASCAPI are the default



Models vs Devices/Entities and Registration

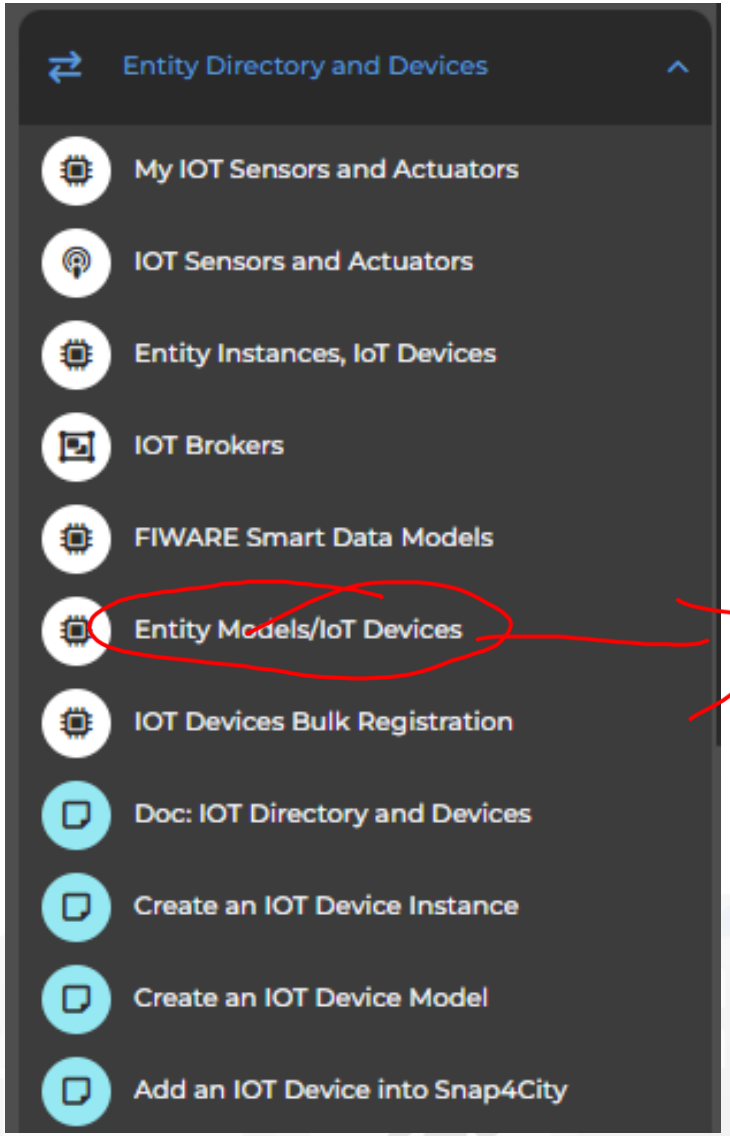
Technical Architecture

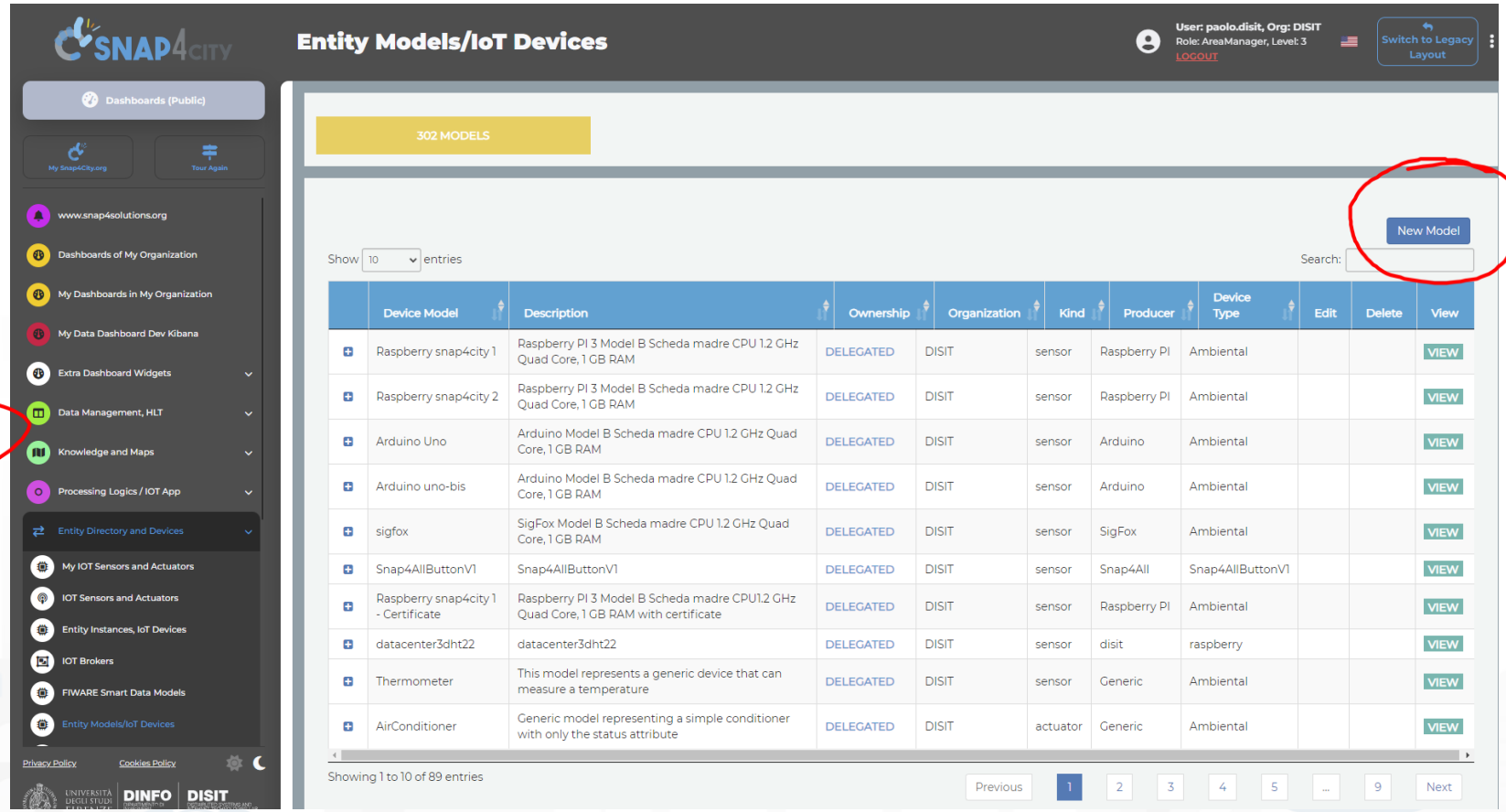


Directory Features vs Users Roles (01/25)

Entities	what	By using IoT/Entity Directory and:	Manager	AreaManager	ToolAdmin/ RootAdmin	Proc.Logic/IOT App microservices
Sensor/Actuator	Browse, use	Several Tools	X	X	X	Yes
	Delegate	API, ..	X	X	X	
	Discovery	KB, API, ..	X	X	X	Yes
Devices/Entities	Browse, use	Several Tools	X	X	X	Yes (use)
	Create, change, delete	API, ..	X	X	X	Yes
	Register in Bulk	API, ..		X	X	Yes
	Delegate, Change Owner	API, ..	X	X	X	Yes
	Discovery	KB, API, ..	X	X	X	Yes
Models (S4C, Fiware)	Browse, Use		X	X	X	(Yes)
	Create, change, delete		X	X	X	(Yes)
	delegate, change ownership		X	X	X	Yes
Brokers	Browse, use		use	Browse, use	X	Yes (use)
	Register/change/Delete				X	
	Deploy Orion Broker				ToolAdmin	
	Delegate				X	
	Periodic Update				X	

Entity / Iot Directory: User Role





Entity Directory for Beginners

- Browse and see models and entities/devices of other users, that publiched them
- Create your Entity / Device Models
  - User the dictionary approach: value type, data type, value unit
  - Manage delegation of the models and ownership
- Create your Entities / Devices from scratch and/or from models
  - Several models are ready to be used…..
- Send a Message to a Device, thus to the broker
- Read a Message from the Broker, see the message forma expected to be sent at the Broker in NGSI format

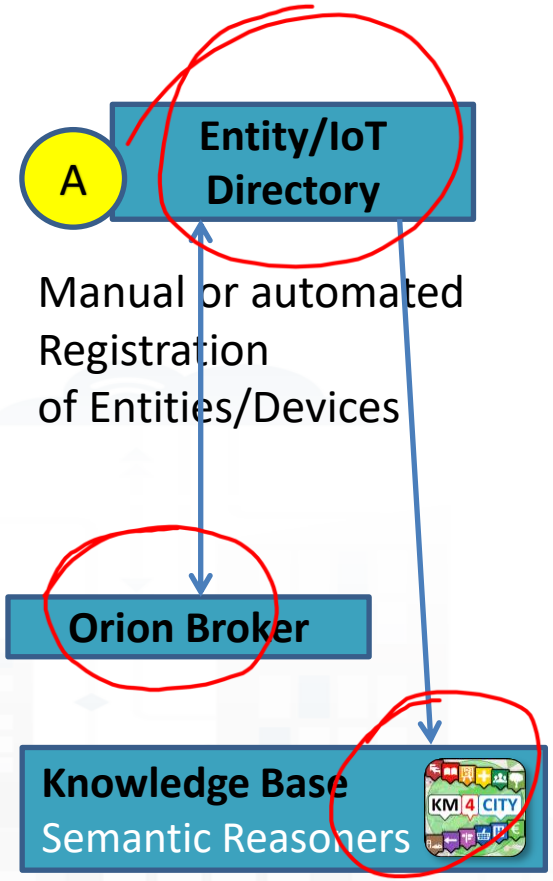
Entity/Device Registration

many possibilities

- IOT Directory and Devices
  - My IOT Sensors and Actuators
  - IOT Sensors and Actuators
  - IOT Devices
  - IOT Devices Management
  - IOT Device Discovery
  - IOT Brokers
  - IOT Device Models
  - IOT Devices Bulk Registration
  - IOT Broker Periodic Update setti...
  - IOT Orion Broker Mapping Rules...
  - Doc: IOT Directory and Devices
  - Create an IOT Device Instance
  - Create an IOT Device Model
  - Add an IOT Device into Snap4Cit...

Benefits of Registration on Directory

- **The registration implies the automated production of the Digital Twin Device into the Knowledge Base**
  - Registration of the Entity on Brokers and KB
  - Activation of the Storage “DataShadow” for historical data access
  - Activation of all the relationships
  - Activation of Discovery mechanisms via Entity Directory, KB and SCAPI, etc.
  - Activation of Dashboard Wizard (after a few minutes), and Data Inspector



Activities for Registration on Directory

- **Manual Registration**
  - From scratch Single Device / Entity Registration → **Entity Directory / IoT Directory**
  - From a template (the templates are called Models)
- **Automated Registration for bulk/massive registration: N** Entities / Devices
  - From IoT App/Proc.Logic on the basis of some **Models** from IoT App
  - From IoT App/Proc.Logic **loading a CSV** (with or without a reference IoT/Entity Model)
  - Programming from scratch or from a **Model**
  - On the basis of some EXCEL file with data by using the **Data Table Loader, which create model, devices and data**
  - Etc.

Manual or automated Registration of Entities/Devices

Entity Instances, IoT Devices

Snap4City

Switch To New Layout (Beta)

User: paolo.disit, Org: DISIT
Role: AreaManager, Level: 3

LOGOUT

- My Snap4City.org
- Tour Again
- www.snap4solutions.org
- Dashboards (Public)
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- Extra Dashboard Widgets
- Data Management, HLT
- Knowledge and Maps
- Processing Logics / IOT App
- Entity Directory and Devices
  - My IOT Sensors and Actuators
  - IOT Sensors and Actuators
  - Entity Instances, IoT Devices
  - IOT Brokers
  - FIWARE Smart Data Models
  - Entity Models/IoT Devices
  - IOT Devices Bulk Registration
  - Doc: IOT Directory and Devices
  - Create an IOT Device Instance
  - Create an IOT Device Model

Show delegated dev. | Show public dev. | Show my dev. | Show all dev | Add new device

Show entries | Search:

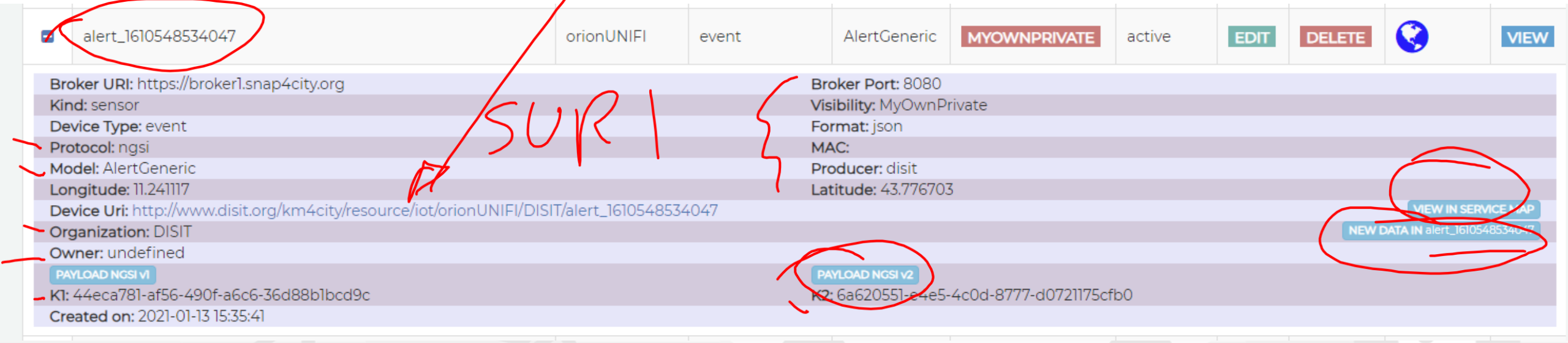
	Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Edit	Delete	Location	View
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	orionUNIFI	File	fileModel	MYOWNPUBLIC	active	EDIT	DELETE		VIEW
+	alert_1610543238306	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610548534047	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610613189703	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610629197473	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
		orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
		orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
		orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
		orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
		orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW

Previous 1 2 3 4 5 ... 12 Next

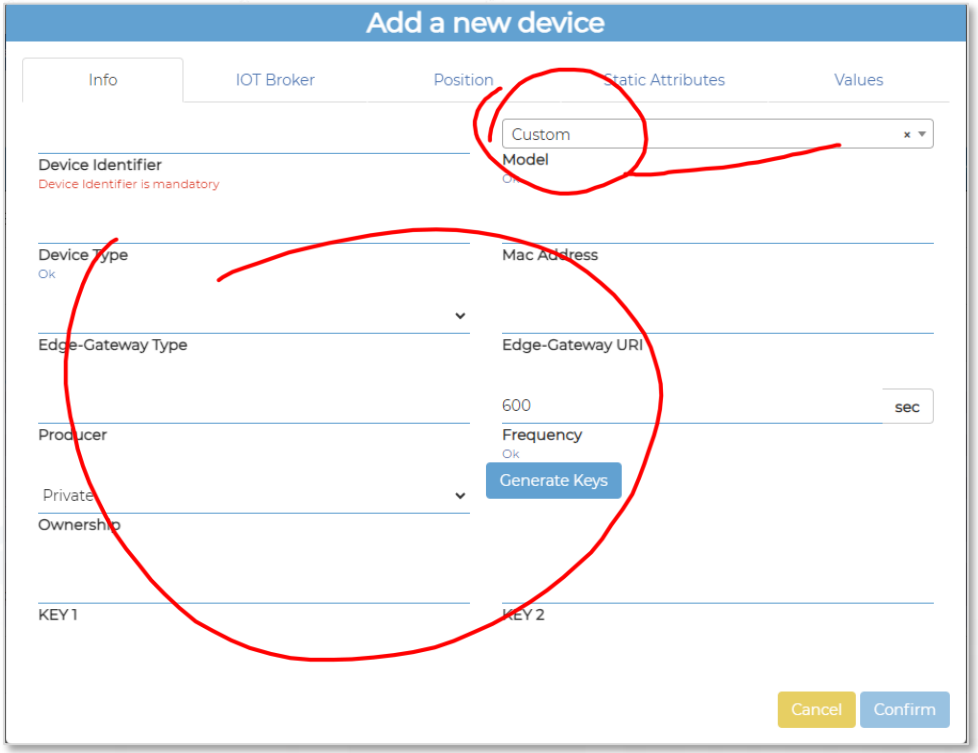
What you can do ?

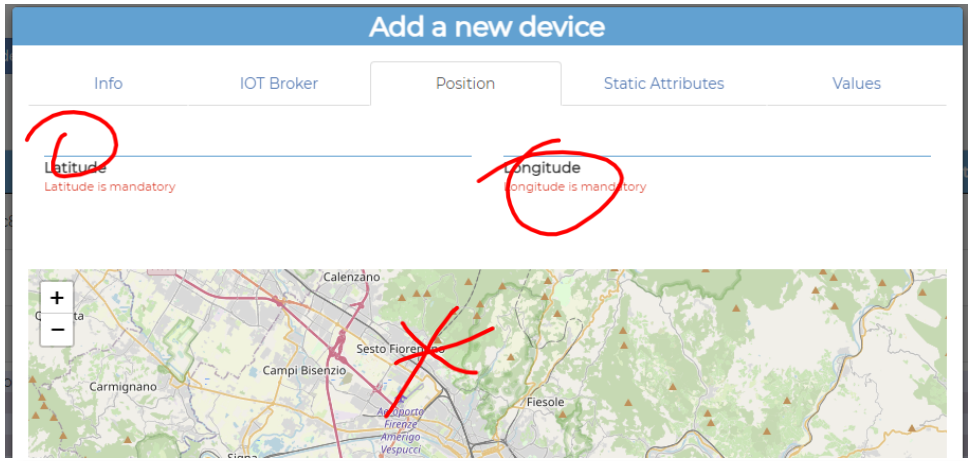
- List and browse your devices and those received in delegation
- Change ownership, control the delegation
- Edit, Change, delete all paramerters
- View on map and view all data
- See details

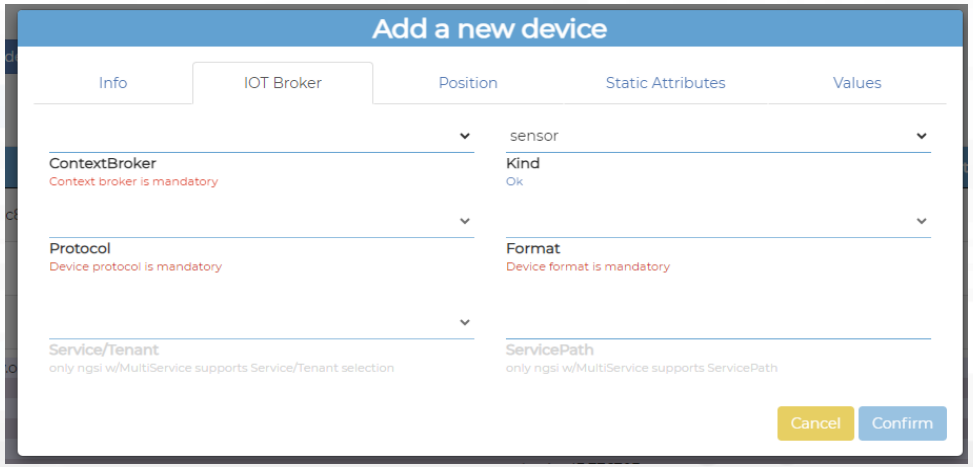
Entity/IoT Directory

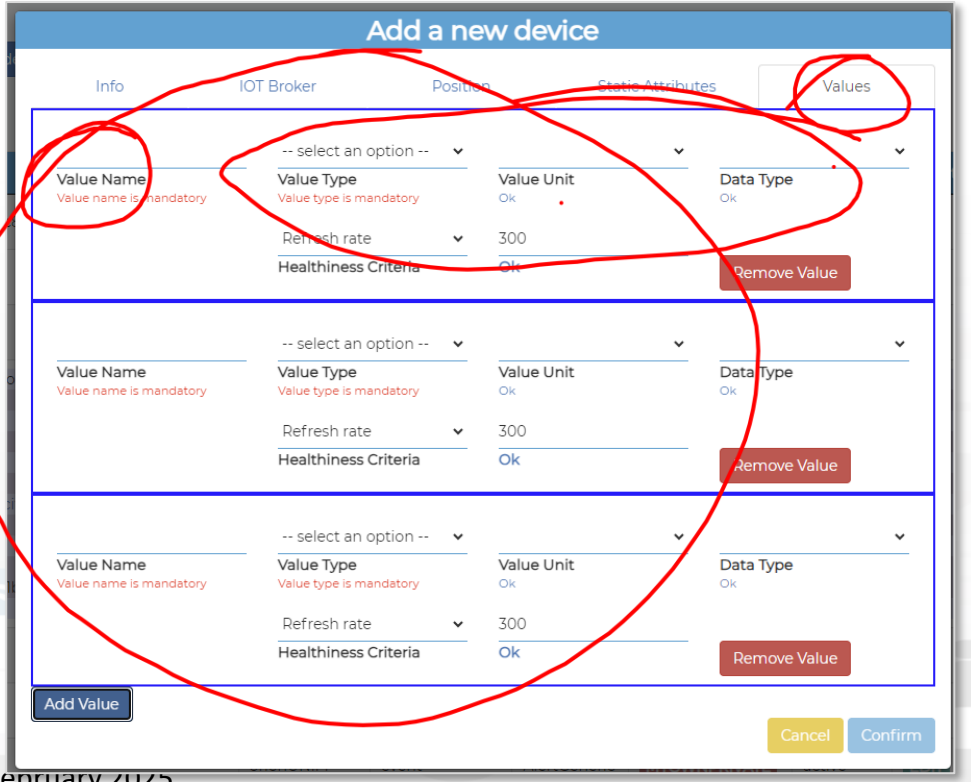


Add New Device





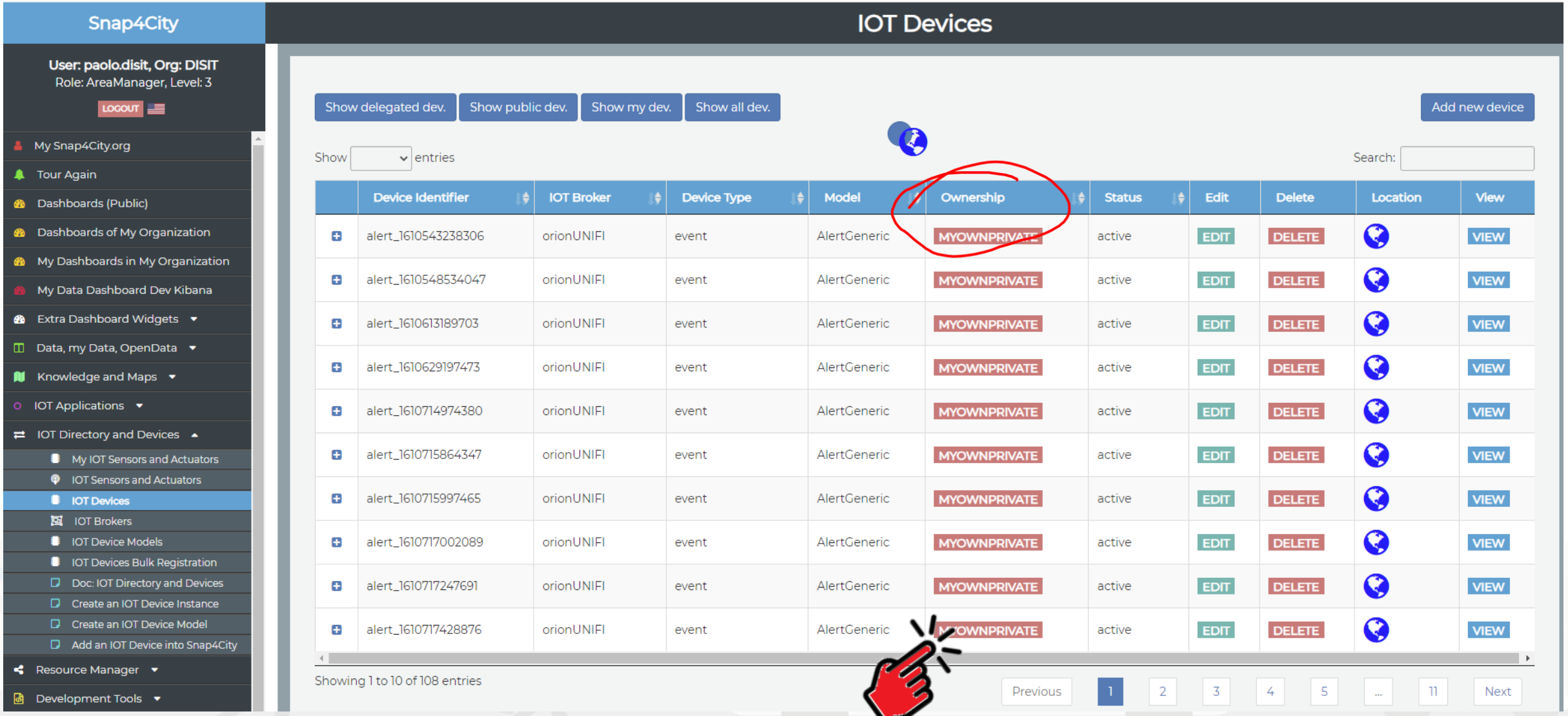




Entity/ Device: Attributes

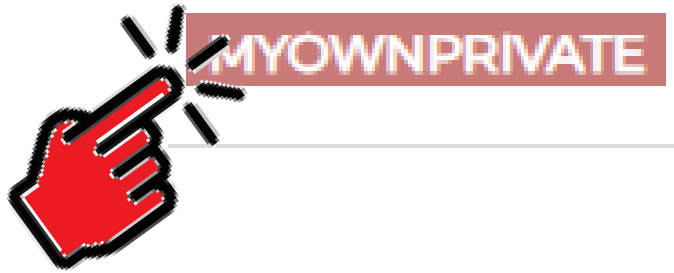
Where	IOT Device	AT 23-12-2019T20:13:12…	AT 23-12-2019T22:13:12…
IOT Broker	**Broker: OrionUNIFI**	--	
IOT Broker	**Protocol: NGSI**	--	
Info	ID: "park45"	**park45**	**park45**
Position	GSP Position: 43.12, 11.34	GSP Position: 44.12, 11.12	GSP Position: 44.14, 11.13
Static attribute	Description: "parking massaia"	--	
Static attribute	Location: "Via Massaia"	--	
Static attribute	Civic Number: 3	--	
Static attribute	MaxCapacity: 456	--	
Values	**dateObserved: Timestamp**	23-12-2019T20:13:12…	23-12-2019T22:13:12…
Values	**FreeSlots: Integer, #**	345	356
Values	**Humidity: float, %**	25,5	25,5
Values	**Temperature: float, celsius**	34	

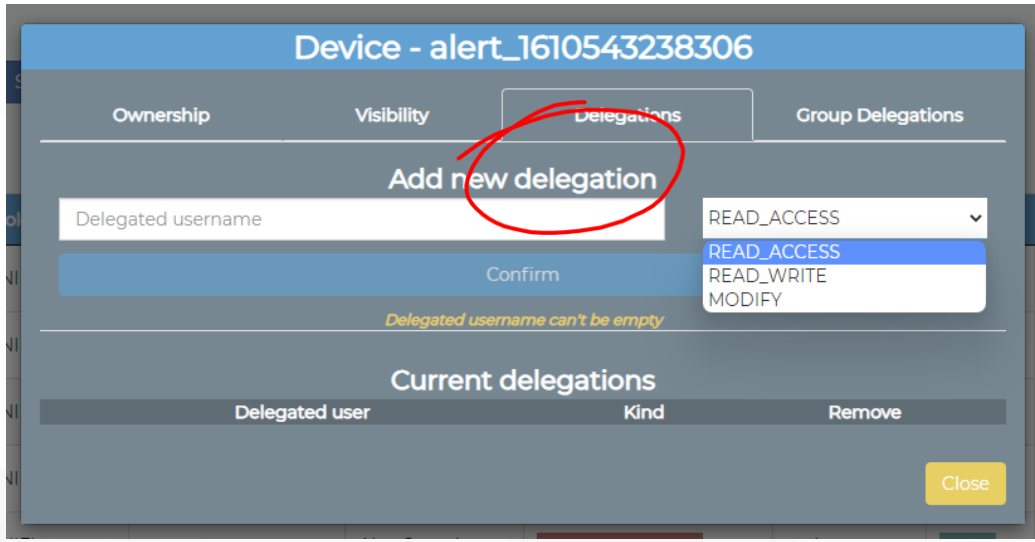
IoT Device Management for All, Developers



Developers can

- Manage their own Devices
  - Edit/Modify, Delete, view, send messages, etc.
  - Pass the ownership of a Device to another user
  - Delegate to other users/groups in
    - READ_ACCESS the IoT Device
    - READ_WRITE the IoT Device
    - MODIFY the IoT Device
    - WRITE_ONLY the IoT Device (is coming)
  - See and change the Delegations
- See Delegated IoT Devices/Entities, …
- See Public IoT Devices/Entities, …





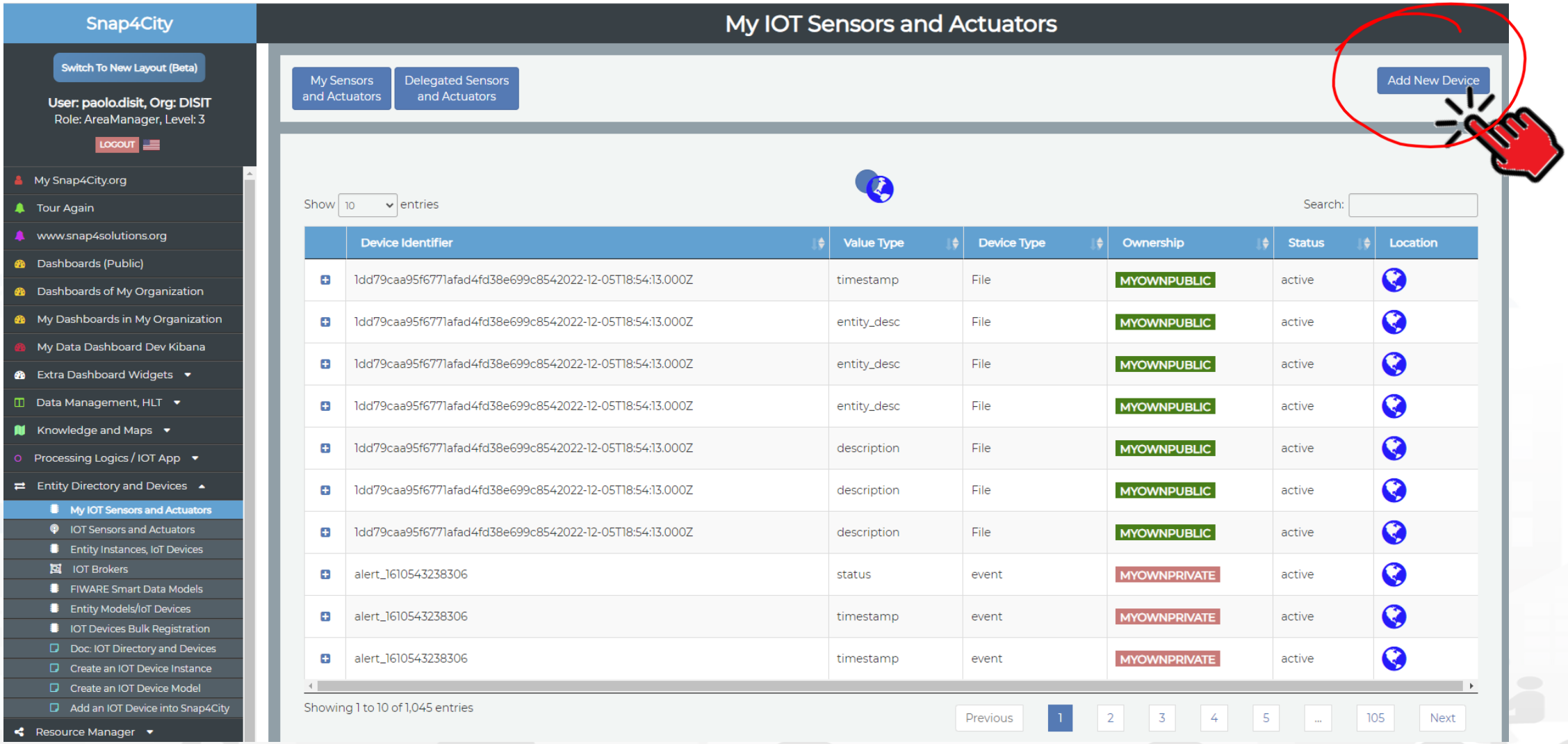
What they mean ?

Supposing that User User45 has the Device D34 !

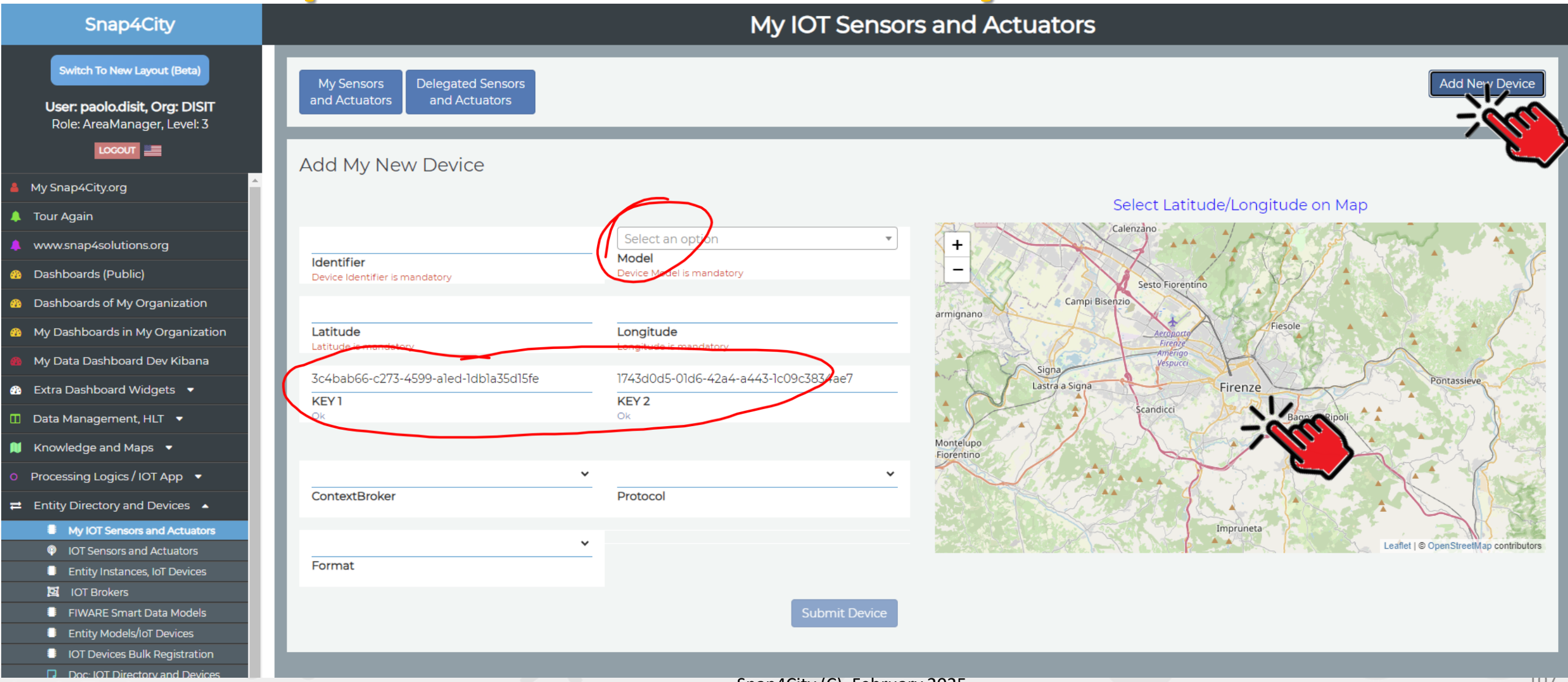
THUS: User45 can delegate Device D34 at Users DD12, DD13 for

- **READ_ACCESS**. This means that User DD12 can read the values/data of Device D34, real time and historical
- **READ_WRITE**. This means that User DD12 can
  - read the values/data of Device D34, real time and historical
  - Send messages to the broker to add them for device DD12
- **WRITE_ONLY.** This means that User DD12, DD13 can send data to the Device D34, while they cannot read back the messages sent
- **MODIFY**. This means that User DD12 can Modify structure of Device D34, for example: changing the name of variables, etc.

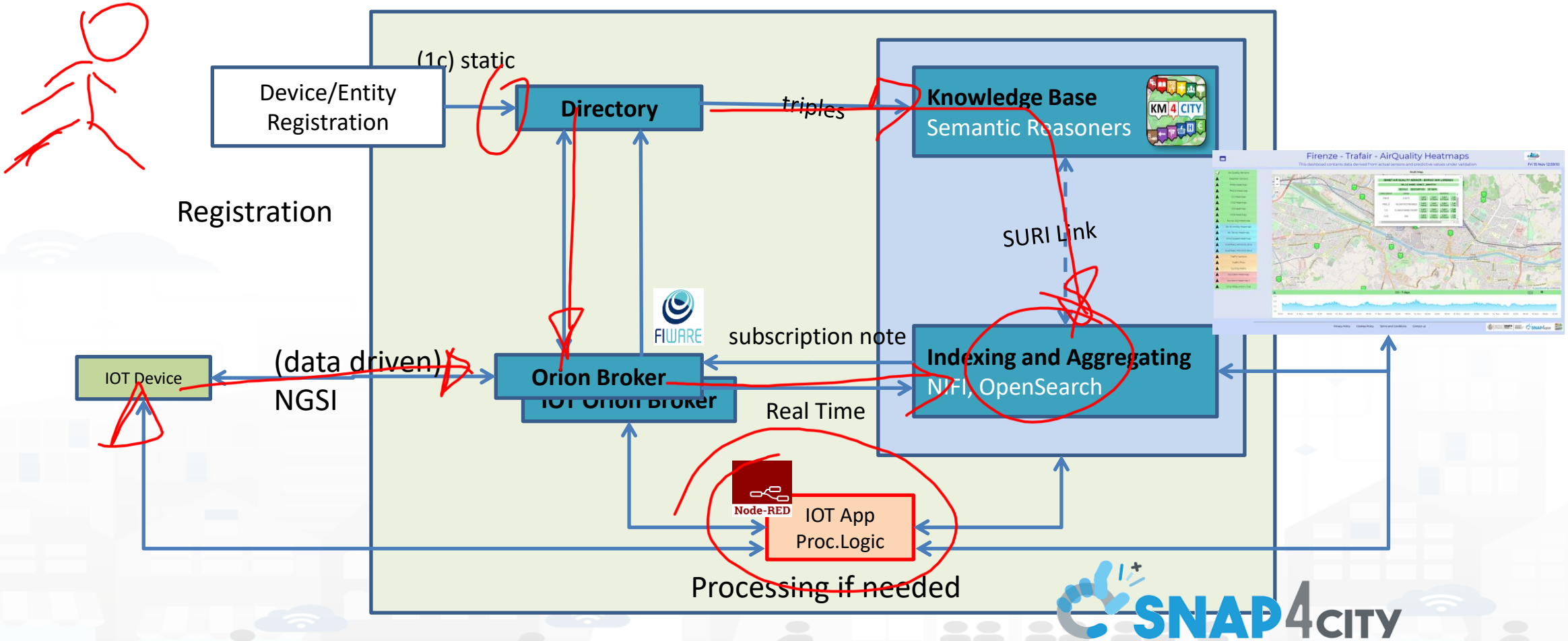
Simplified Device Management



Simplified Add Device: only from Model



- NGSI devices can be directly connected to Snap4City (data driven)



Design: from Data Modelling to Data Ingestion

Using the Entity/Device Model notes!!!

- Once performed the Entity/Device Model, a number of Entities/Devices can be produce **using the model as a Template**
  - **NOTE:** the produced Entities/Devices are not going to change if the Entity/Device Model is modified.
  - *Your biscuit is not changing if the template is modified after the printout*

The Data Models can be simply instantiated from

a) **Entity Model / IoT Device Model** which are accessible into the Snap4City environment

b) Creating a **custom Entity Model / IoT Device Model** in standard Snap4City format via **Entity Directory** / **IoT Directory**

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

Connections among Entities

Where	Entity Model (IOT Device Model)	Entity Instance (IOT Device)	Entity Message at 23-12-2019T20:15:00	Entity Message at 23-12-2019T20:30:12
Broker	**Broker: OrionUNIFI**			
Broker	**Protocol: NGSI**			
Info	**ID: string**	ID: "park45"	**park45**	**park45**
Position	**GPS: lat, long**	GSP: 43.12, 11.34	GSP: 44.1256, 11.1234	GSP: 44.1259, 11.1233
Static attribute	**Description: string**	Description: "parking massaia"		
Static attribute	**MyAddInfoSURI: string**	**MyAddInfoSURI**: "http://...../InfoPersonal"		
Values	**dateObserved: Timestamp**		23-12-2019T20:15:00	23-12-2019T20:30:12
Values	**FreeSlots: Integer, #**		**FreeSlots:** 345	**FreeSlots:** 234
Values	**TodayCarSURI: string**		**TodayCarSURI:** "http://...../CarNF126GD"	**TodayCarSURI:** "http://...../CarGF789KK"
Values	**Temperature: float, celsius**		34	34

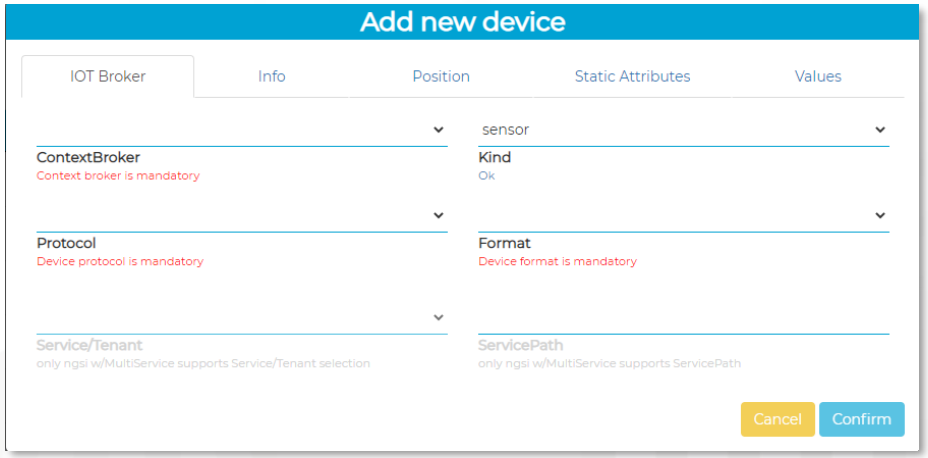
Model meaning

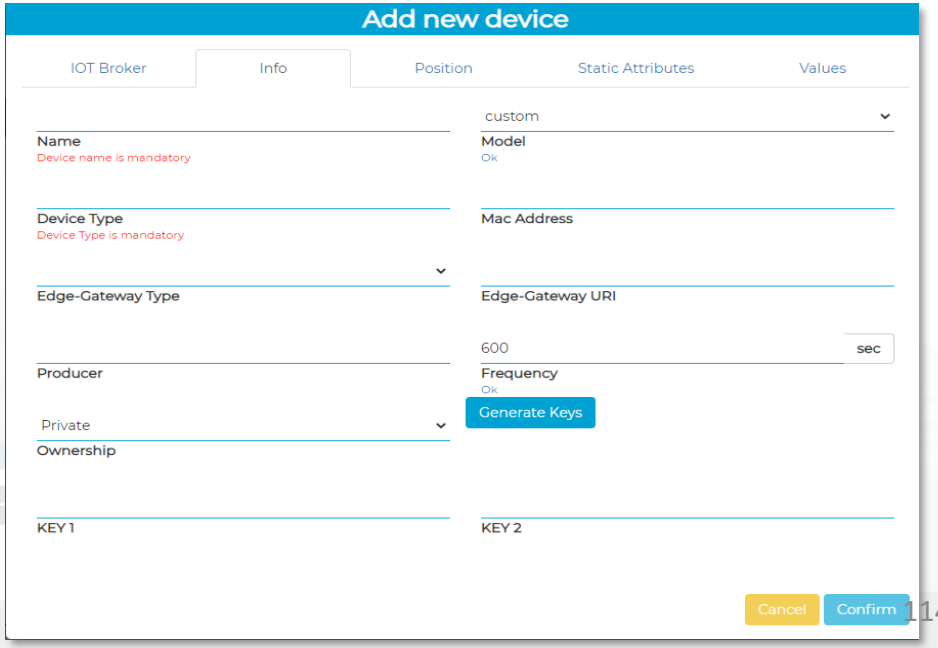
- **ID:** is the unique identifier for reconnecting Temporal Instances with registered Entity / Devices
- **Static Attributes:**
  - Are typically associated with instances of the IOT Device.
    E.g.:, You have a set of parking areas, each of them is located in a specific street, and has its one name, 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

Entity / Device Model (1)

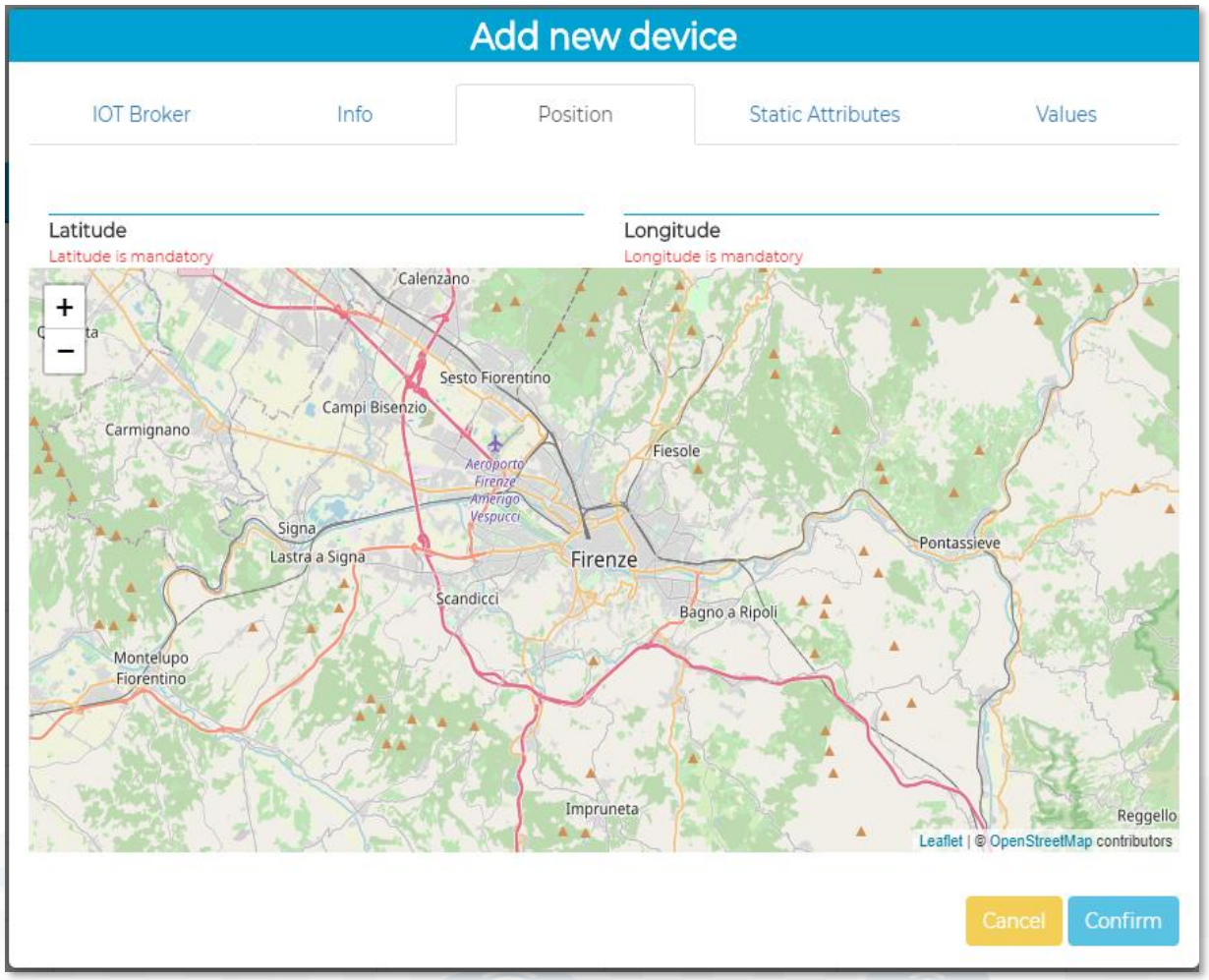
- IOT Broker
  - Name of the Brokers: among those registered
  - Protocol: NGSI, AMQP, MQTT, etc..
  - Format: CSV, JSON, XML.
  - Service/Tenant:…….
  - ServicePath:……

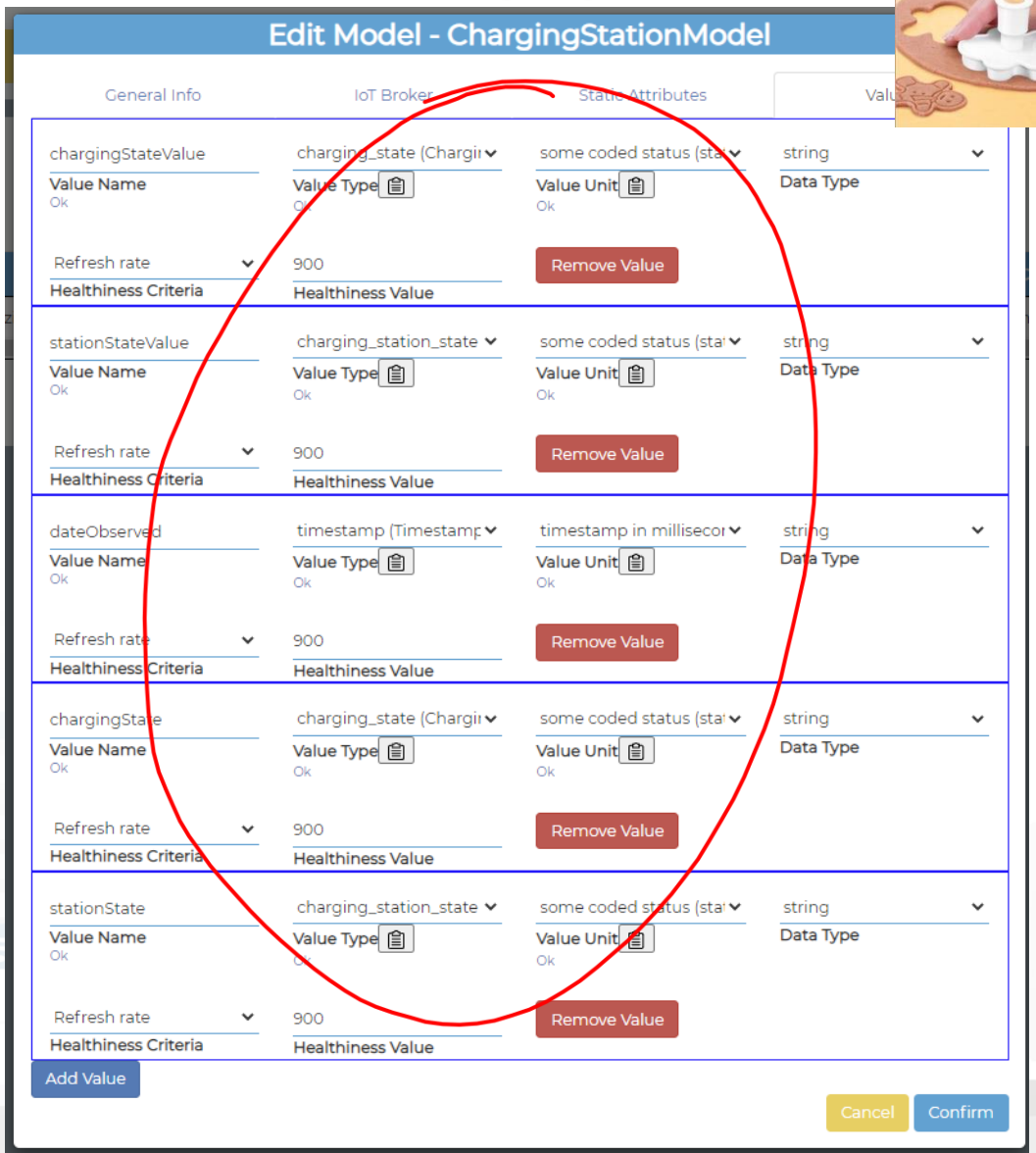
- Info
  - Name (Identifier)
  - Model: Custom or Model ID
  - DeviceType: ..a string..
  - MAC address: …optional…
  - Edge-GW: Raspberry, Android, …
  - Edge-GW: URI
  - Producer
  - Owner
  - Freq: ….. Sec
  - Keys: K1, K2





Entity / Device Data Model (2)





SURI Connections

From a

- *Static* Attribute of an Entity Instance to another Entity Instance, as highlighted in green in previous table.
- *Dynamic* Value/Variable of an Entity Message of an Entity Instance to another Entity Instance, as highlighted in green in previous table.

- *the example reports a*
  - *static connection and*
  - *dynamic connection to change the car at a given timestamp, note also change of position and other parameters, if needed*

Non sicuro | disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759

App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCe

p	o
http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/ns/sosa/Sensor
http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.disit.org/km4city/schema#Traffic_sensor
http://www.w3.org/ns/ssn/implements	http://www.disit.org/km4city/resource/iot/traffic
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/avgDistance
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/occupancy
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/thresholdPerc
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/speedPercentile
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/dateObserved
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/avgTime
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/concentration
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/vehicleFlow
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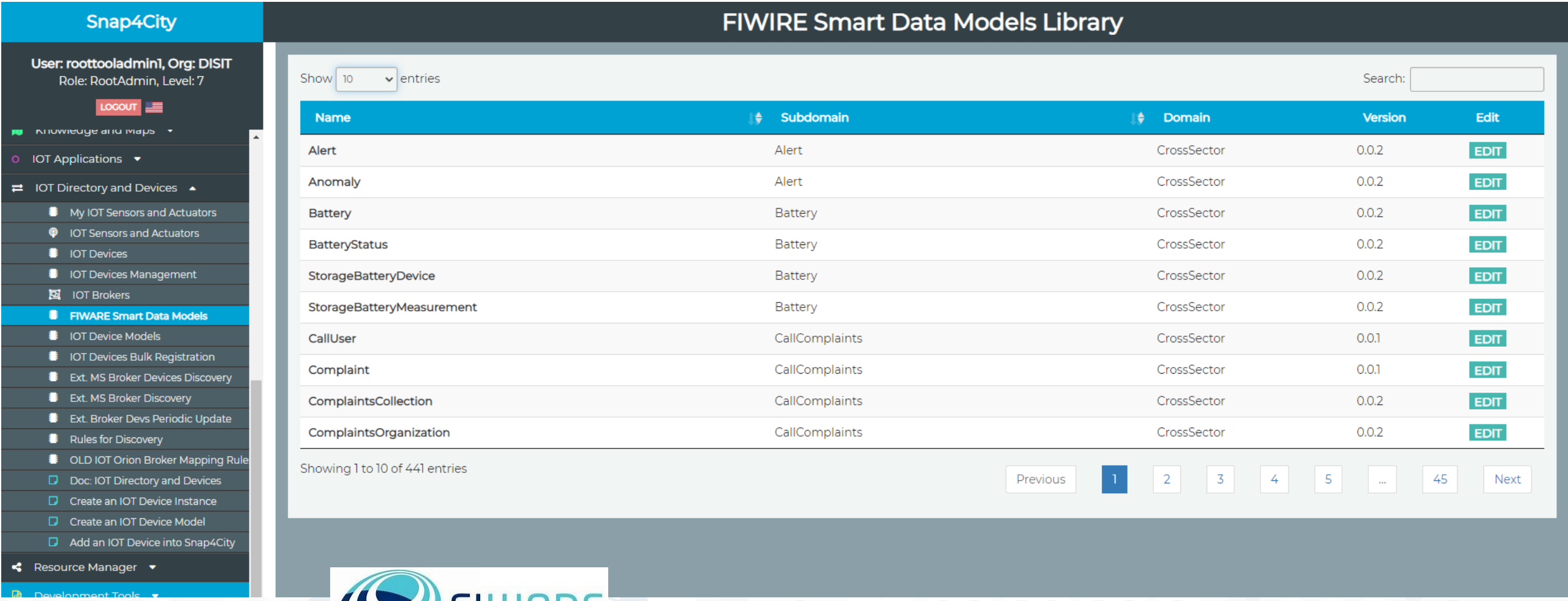
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/anomalyLevel
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/average_vehicle_distance
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/average_vehicle_speed
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/average_vehicle_time
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/vehicle_concentration
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/vehicle_speed_percentile
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/vehicle_threshold_perc
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/vehicle_flow
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/timestamp
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/anomaly_level
http://www.w3.org/ns/sosa/observes	http://www.disit.org/km4city/resource/value_type/traffic_congestion
http://www.w3.org/ns/ssn/hasSystemCapability	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/systemCapability
http://purl.oclc.org/NET/UNIS/fiware/iot-lite#exposedBy	http://www.disit.org/km4city/resource/iot/orionUNIFI
http://www.disit.org/km4city/schema#protocol	"ngsi"
http://www.disit.org/km4city/schema#format	"json"
http://www.w3.org/2003/01/geo/wgs84_pos#long	11.25673
http://schema.org/addressLocality	"FIRENZE"
http://schema.org/name	"METRO759"
http://schema.org/streetAddress	"Lavagnini P.zza Della Liberta' (38)"
http://www.w3.org/2003/01/geo/wgs84_pos#lat	43.78278
http://www.disit.org/km4city/schema#isInRoad	http://www.disit.org/km4city/resource/RT04801703772TO
http://www.w3.org/2003/01/geo/wgs84_pos#geometry	"POINT(11.256730079651 43.782779693604)"^^<http://www.openlinksw.com/schemas/virtrdf#Geometry>
http://www.disit.org/km4city/schema#model	"metrotrafficsensor"
http://www.disit.org/km4city/schema#producer	"metro"
ma#organization	"DISIT"

www.disit.org/km4city/resource/iot/traffic

FIWARE Smart Data Models -- Library



- Snap4City - Powered by FIWARE Solution & Platform:
  - https://www.fiware.org/marketplace/product-details/?category=powered&id=snap4city-snap4city
  - NGSI V1, V2 The IOT Orion Broker
  - IOT Orion Broker can connect JSON, MQTT, Lightweight M2M, LoraWAN, OPC, SigFOX, etc. see FiWare Https://www.fiware.org
- Snap4City - FIWARE Training Services:
  - https://marketplace.fiware.org/pages/solutions/03bccd83a0e1b0398ba7a0bf
- Snap4City - FIWARE Consultancy Services:
  - https://marketplace.fiware.org/pages/solutions/907f5ecc63927f643dd8421b
- **Snap4City is compatible** with all the above protocols
  - via IOT Orion Broker,
  - via IOT Applications.
  - via direct connection on ETL processes on their corresponding IOT brokers, and/or
- **Snap4City is also compatible** with many other protocols, see the table reported in page: https://www.snap4city.org/65

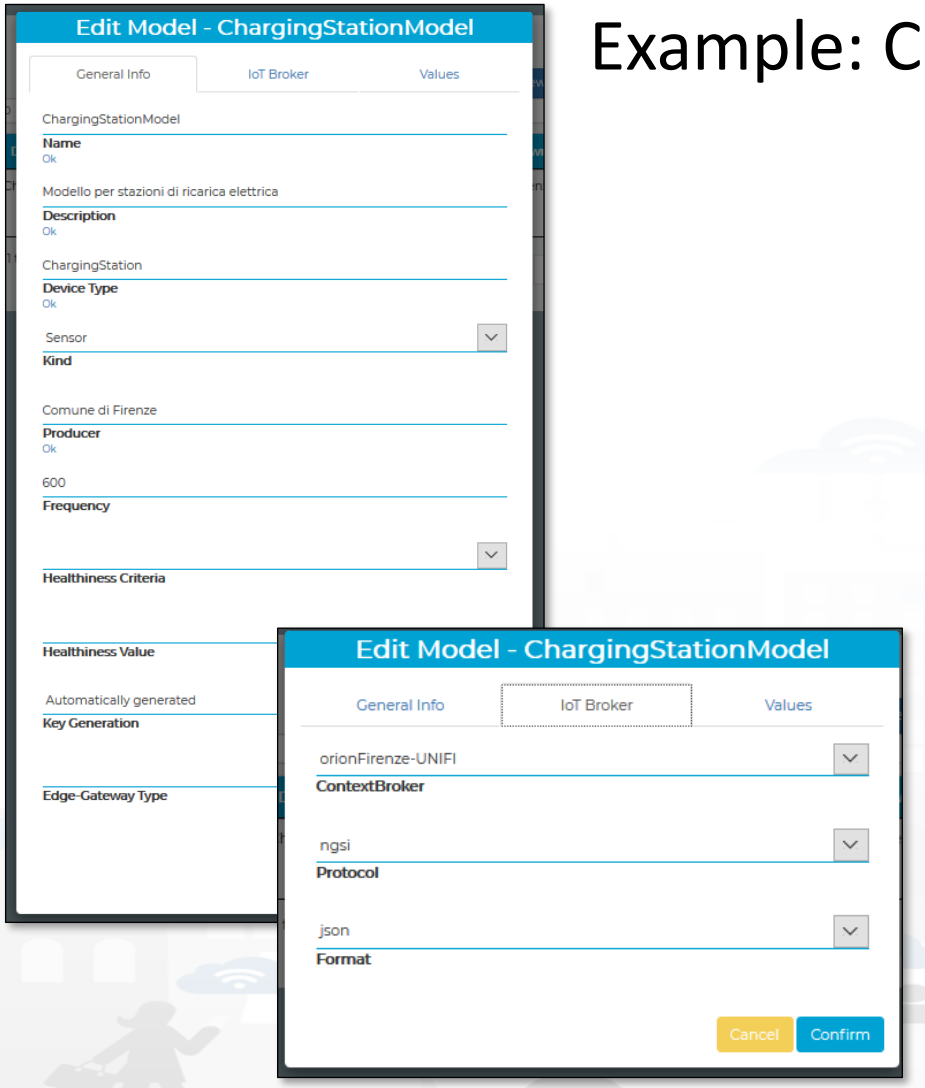
Powered by FIWARE

Entity / Device Registration from Model

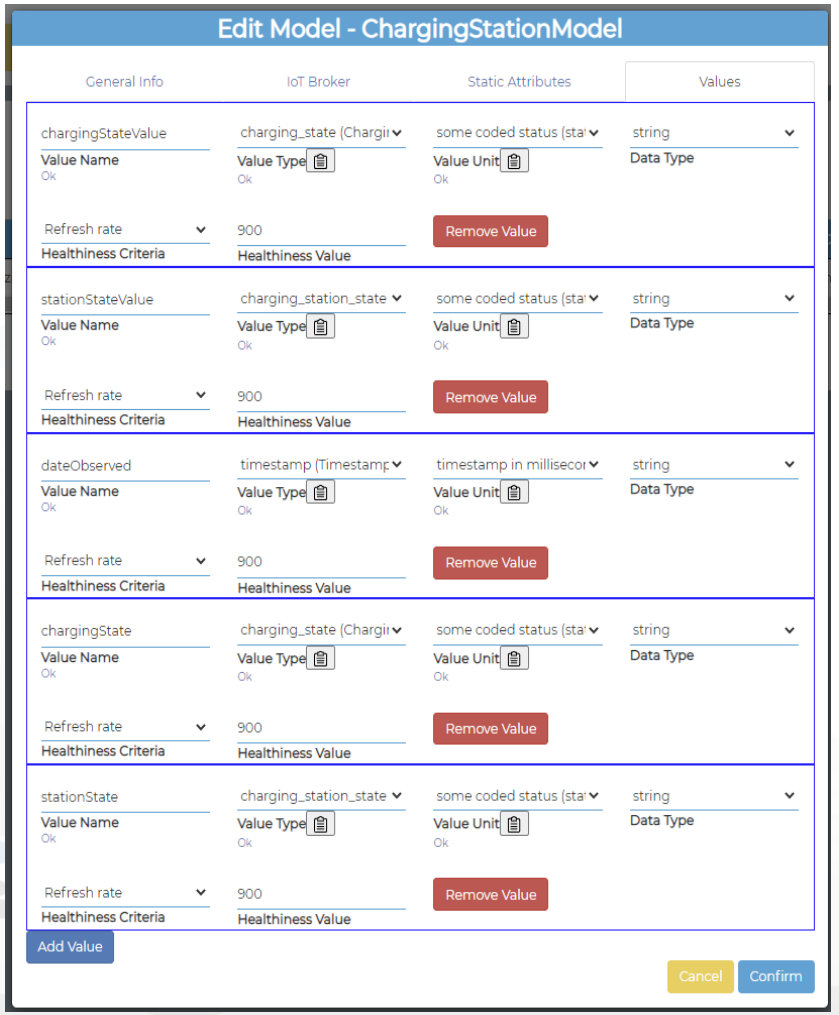
- IOT Directory and Devices
  - My IOT Sensors and Actuators
  - IOT Sensors and Actuators
  - IOT Devices
  - IOT Devices Management
  - IOT Device Discovery
  - IOT Brokers
  - IOT Device Models
  - IOT Devices Bulk Registration
  - IOT Broker Periodic Update setti...
  - IOT Orion Broker Mapping Rules...
  - Doc: IOT Directory and Devices
  - Create an IOT Device Instance
  - Create an IOT Device Model
  - Add an IOT Device into Snap4Cit...

Many IoT Devices? IOT Device Model!!!

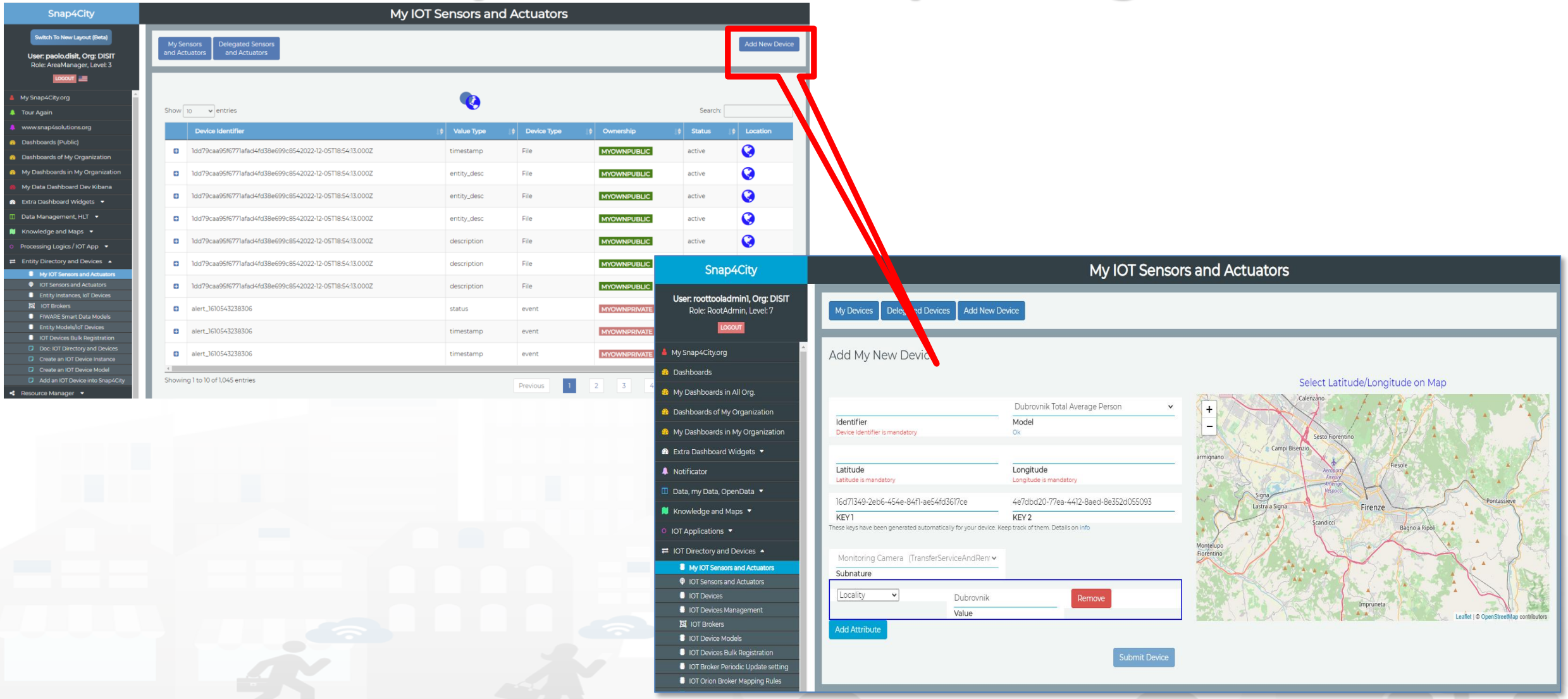
- **Prerequirements**: only for AreaManager users
- If you have a set of sensors with the same features,
  - you can create a model and then a set of instances (IoT Devices) in compliance with the model (not time consuming and avoiding errors)
- IoT Directory and Devices > IoT Device Models > ‘New Model’ button



Example: ChargingStationModel



Add Entity / Devices, exploiting a Model



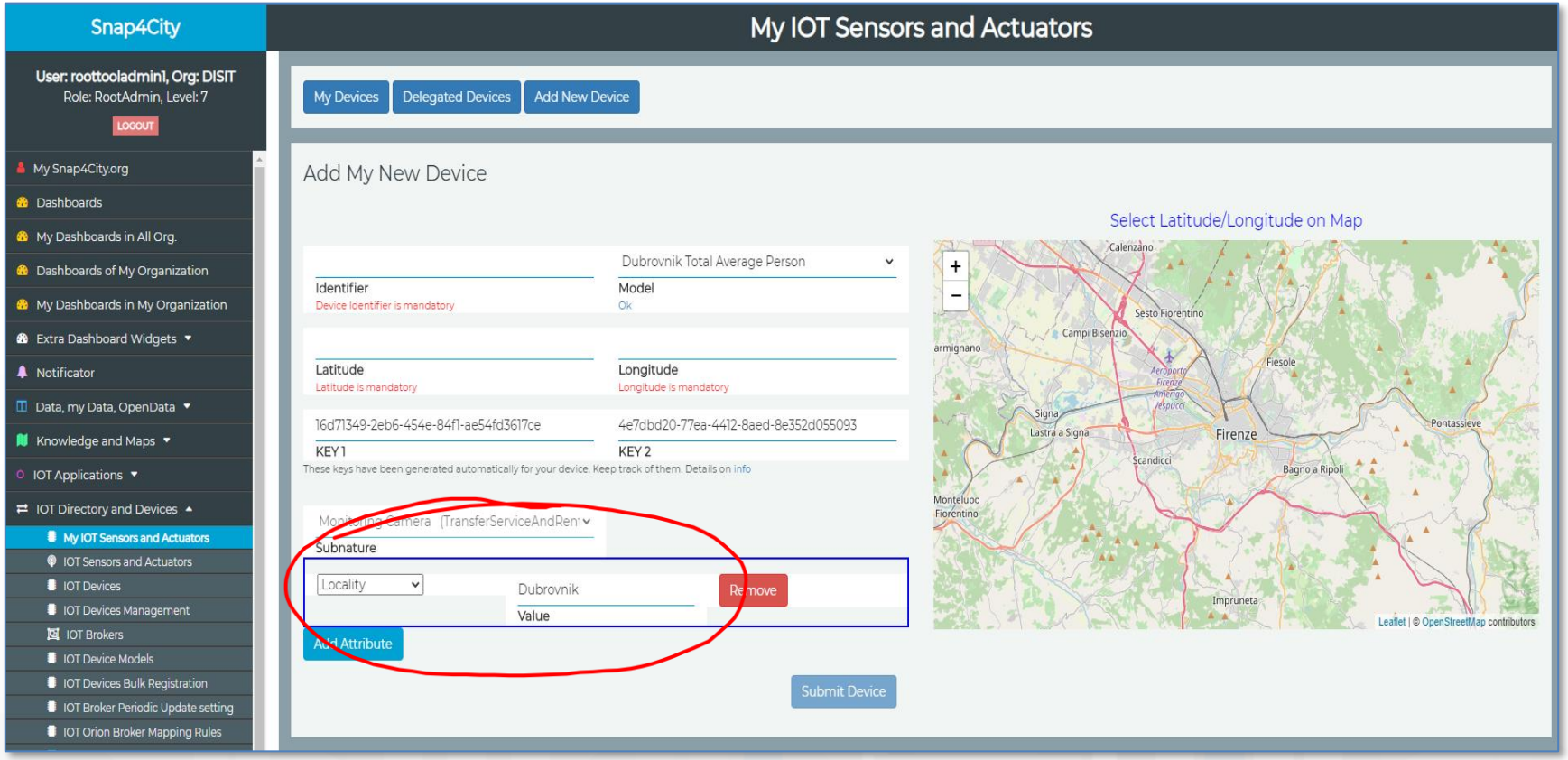
Add Entity / Devices, exploiting a Model

Just Buy an IOT Device and register: SigFOX, MQTT, NGSI (FiWare), …

- Attach them by
  - Models
- A range of protocols, formats, approaches

Create your own devices:

- Arduino,
- Raspberry,
- Android,
- LoraWAN + Arduino,
- etc.

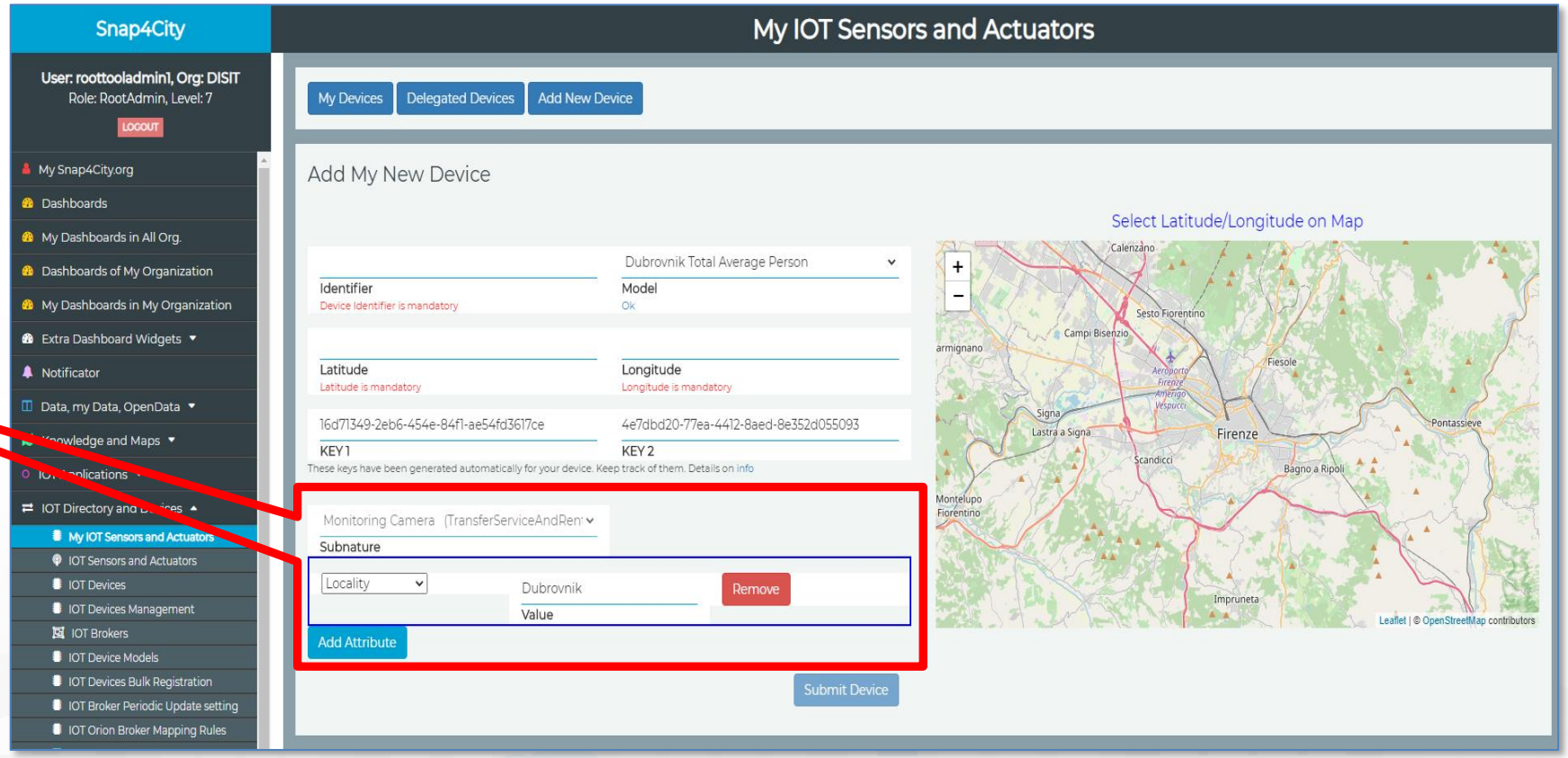


Secure Communication: HTTPS, TLS (K1, K2), Certificates

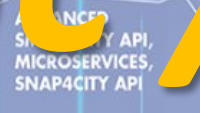
Add Entity / Devices, exploiting a Model

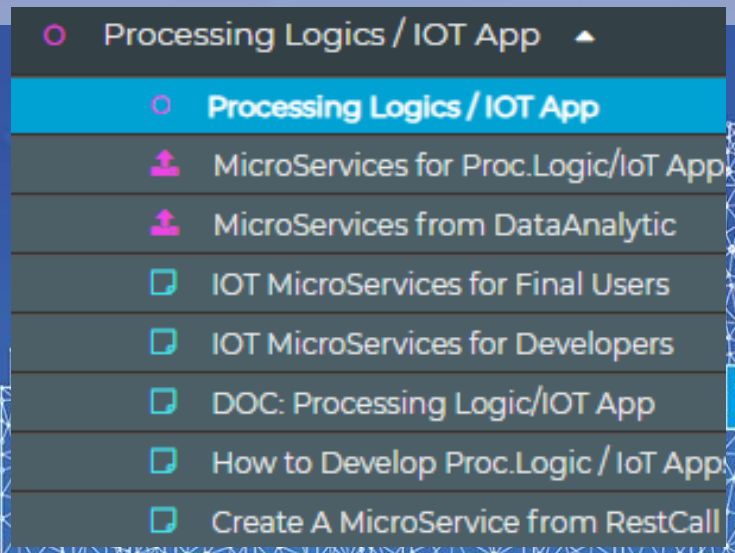
Addition of Static Attributes of the Entity Instance / IoT Device

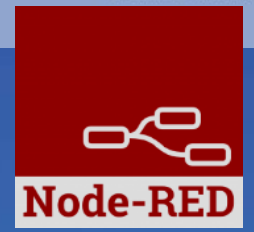
Only if you enabled from model



Develop: Data Processes
Proc.Logic / IoT App



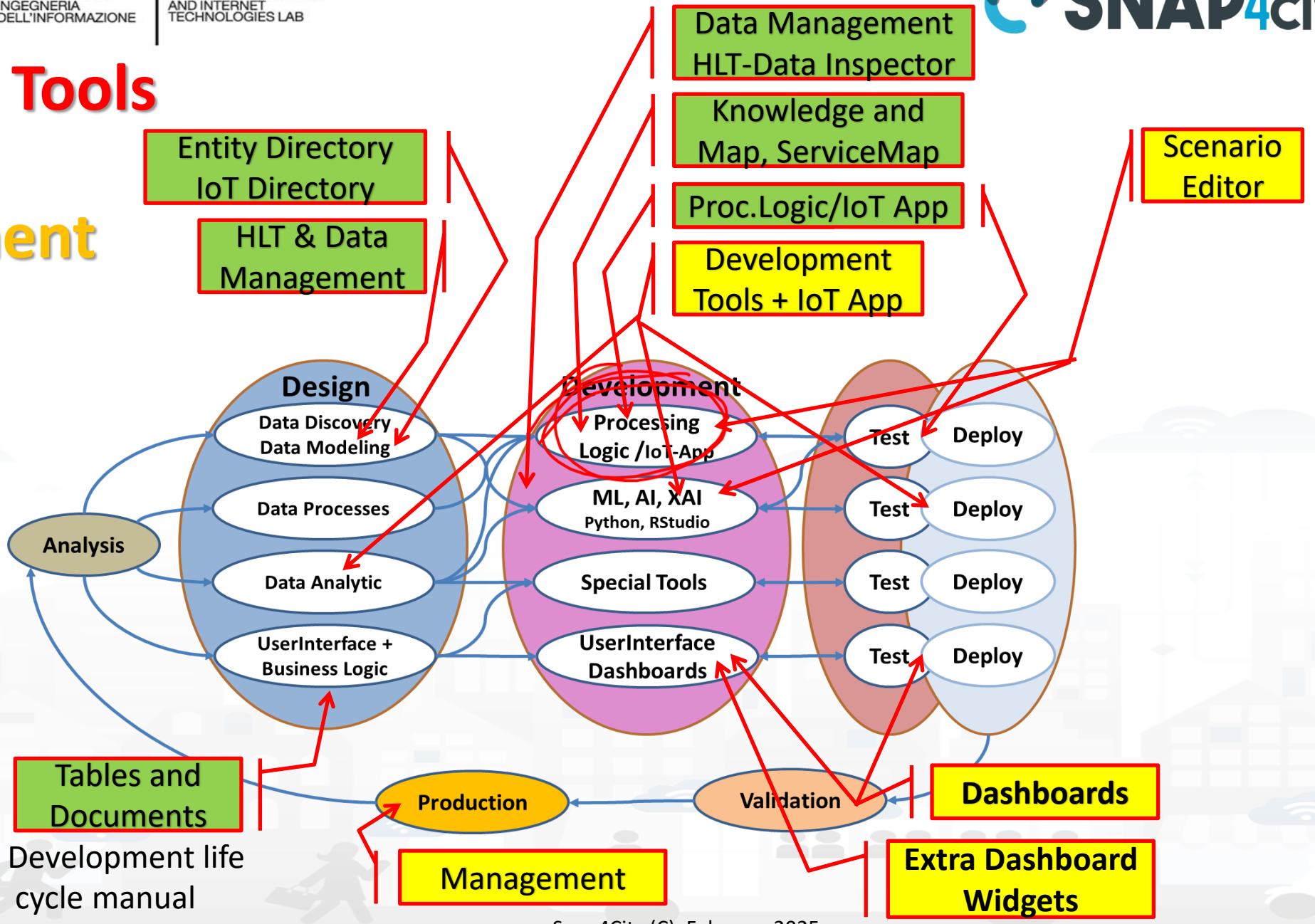




Agenda of this integrated overview part

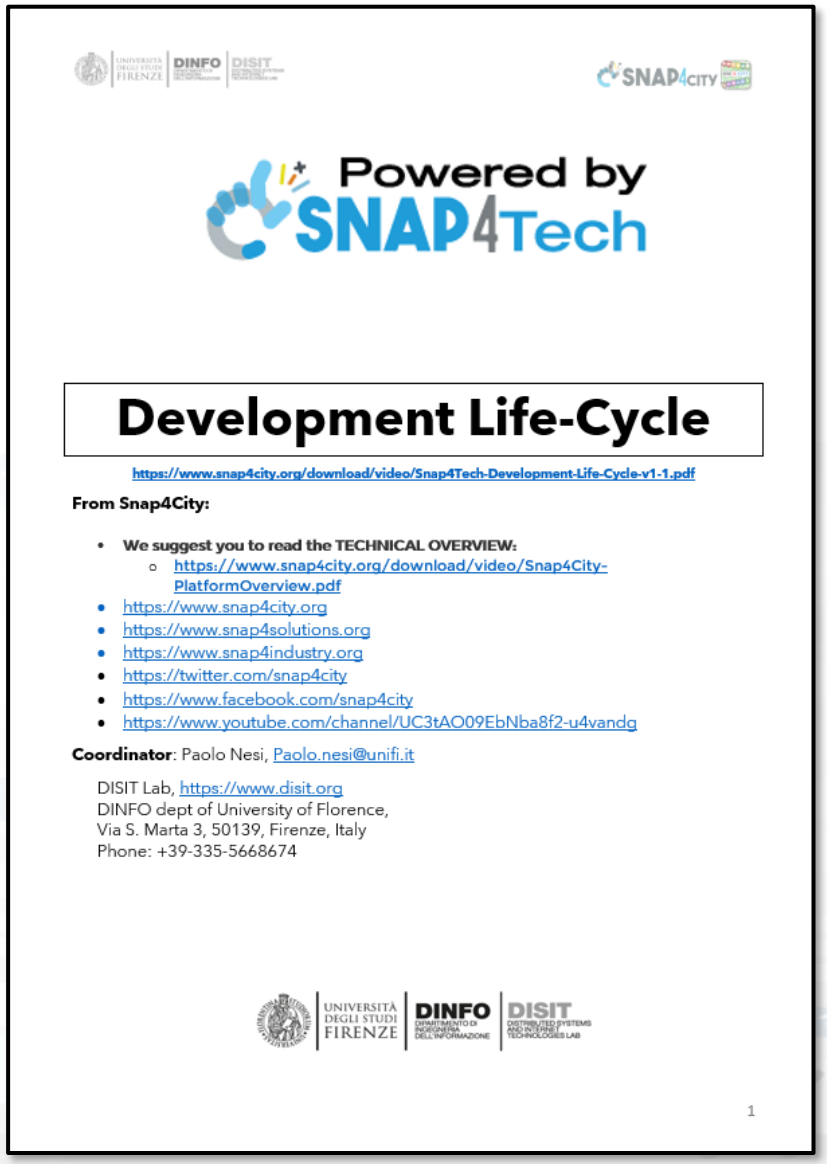
- Recall of Snap4City Architecture
- Data Ingestion Strategy and Orientation
  - Basic entity elements
  - Knowledge Base: Modelling and ServiceURI as Entity Identifier
  - Models vs Devices/Entities and Registration
- Develop: Data Processes Proc.Logic / IoT App
  - Proc.Logic = Node-RED + Snap4City
  - An Integrated Example for Time Series
  - Verification of Data Ingestion
  - Exploiting Storage data by using: IoT App / Proc. Logic
  - Interoperability with respect to Hardware staff
  - High Performance Ingestion
  - Interoperability of Snap4City Platform
- Some Applicative examples
- Training Material
- Acknowledgements

Snap4City Tools vs Development Life Cycle



Development

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



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

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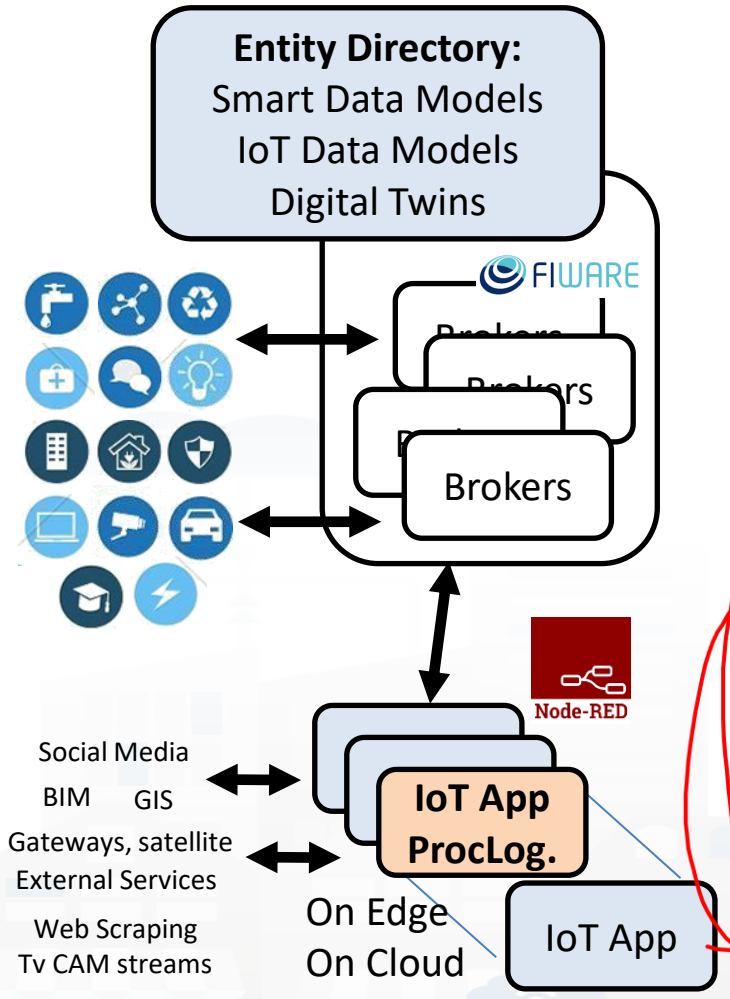
DINFO dept of University of Florence,
Via S. Marta 3, 50139, Firenze, Italy
Phone: +39-335-5668674

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT

1

Data Ingestions Strategy



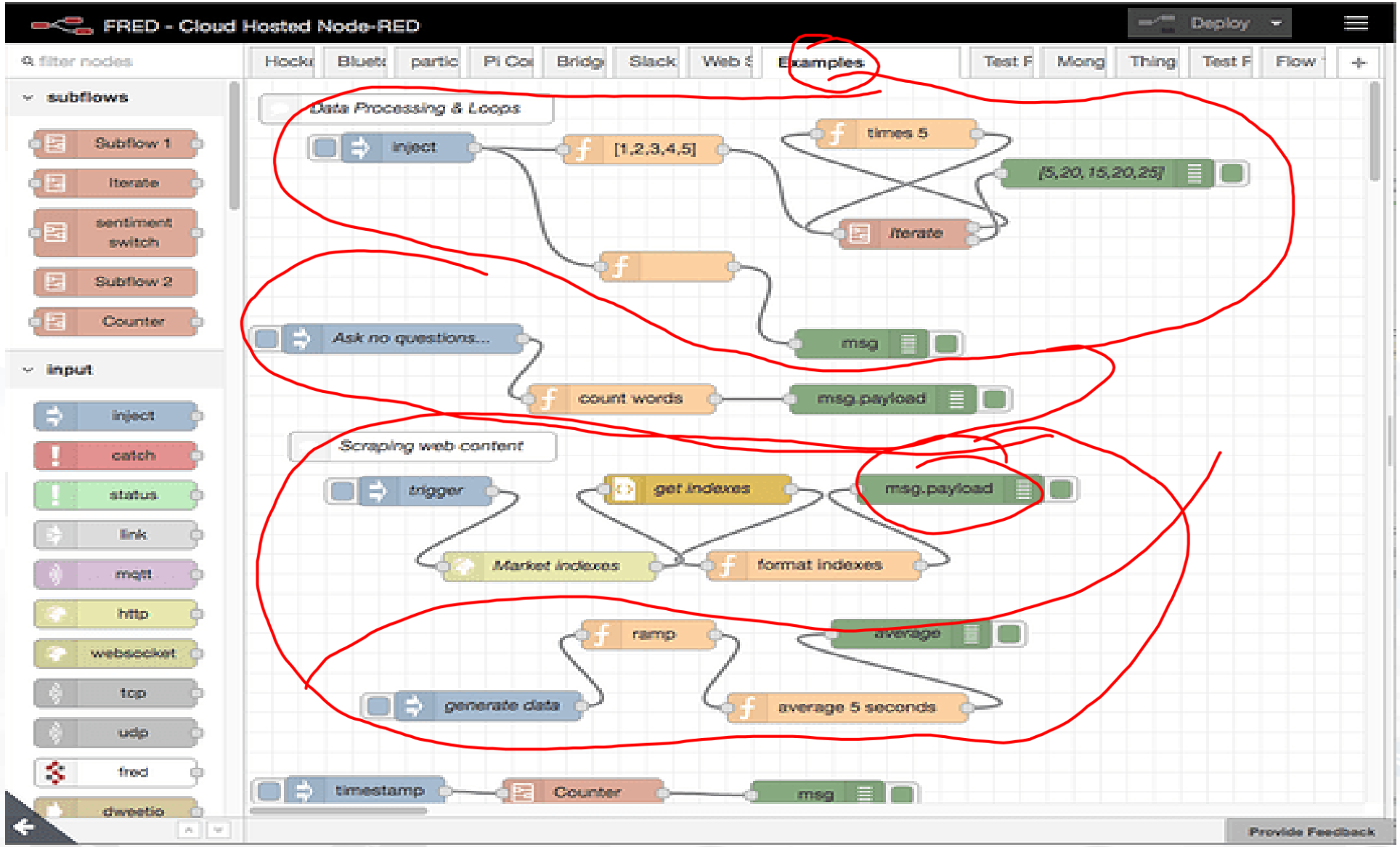
1

1) Via ***internal Brokers***: NGSI V1/V2, MQTT (beta), JSON
  - the data messages arriving in **PUSH** on the platform,
    - if compliant to a known Model **and** referring to a known Device/Entity
    - They are AUTOMATICALLY: *stored, indexed,* and ready to be used by Wizard, Dashboards, Views and Applications

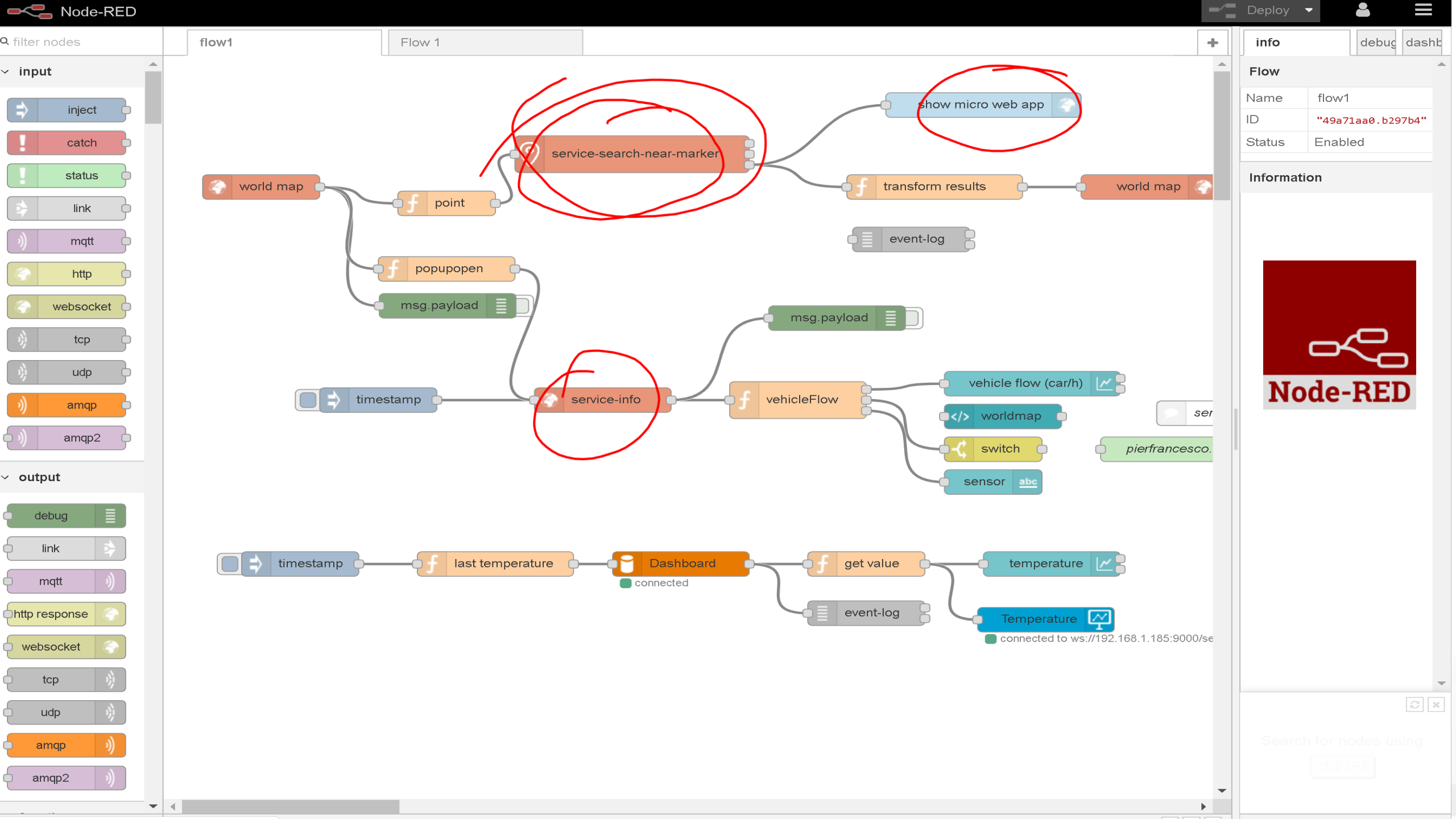
- 2) Via ***external Brokers***: NGSI V2, NGSI LD (beta), JSON
  - the data messages arriving in **PUSH** on the external broker,
    - Have to be **mapped** to a known Model **and** referring to a known Device/Entity
    - To be AUTOMATICALLY: *stored, indexed,* and ready to be used by Wizard, Dashboards, Views and Applications

3

3) Via any other broker, GateWay, API, server, WebService, database, protocol and/or format of the many available on Snap4City, in PUSH/PULL have to be
  - **mapped** on an Snap4City IoT/Entity Model and Entity/Device Instance
  - **ingested in real time or batch**, by a process implemented as
    - an **IoT App/Proc.Logic, on container, on cloud or Edge**
    - a **Python or other language, on container, on cloud or Edge**

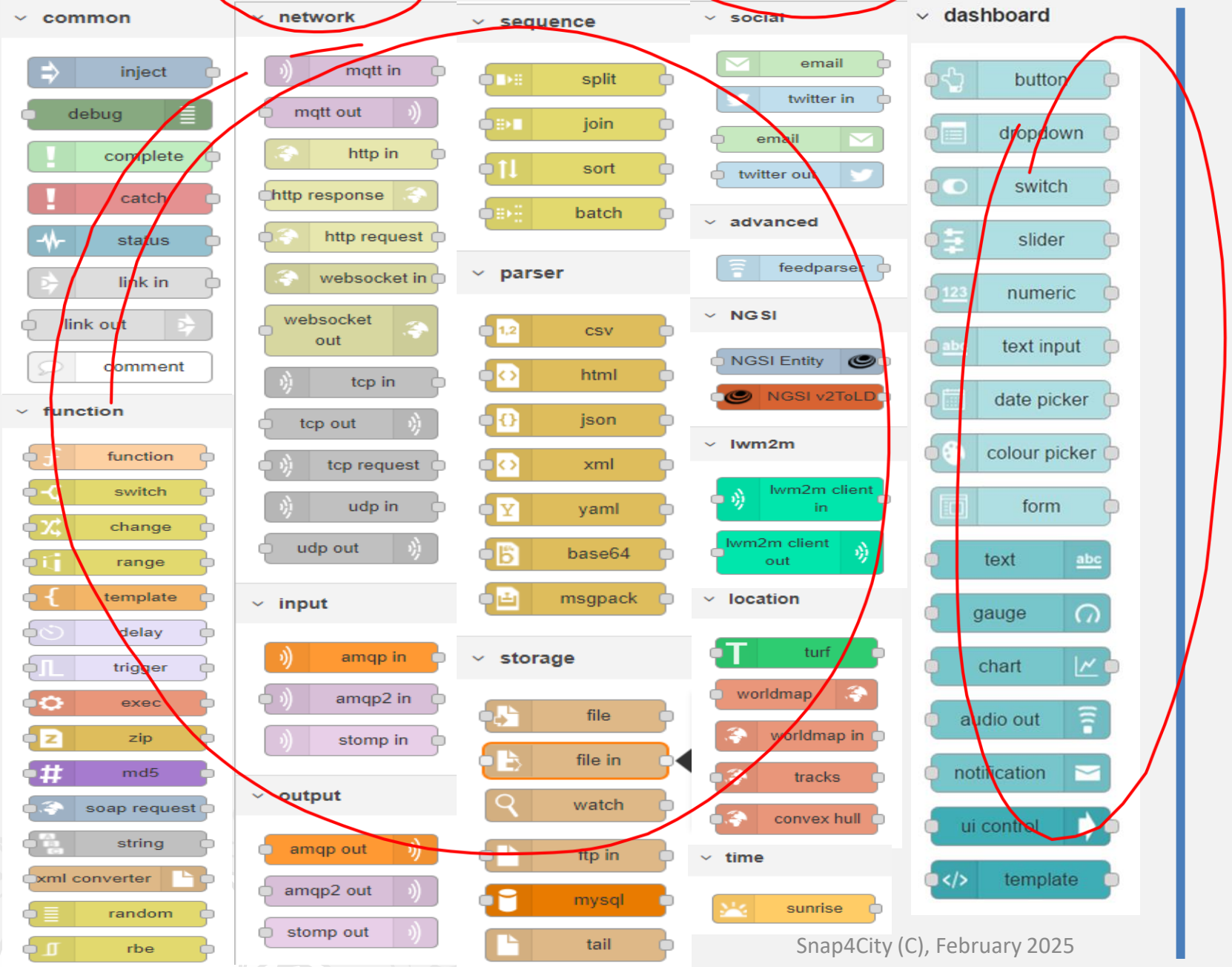

FRED - Cloud Hosted Node-RED
Deploy
filter nodes
Examples
subflows
Subflow 1
Iterate
sentiment switch
Subflow 2
Counter
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
fred
dweetio
Data Processing & Loops
inject
[1,2,3,4,5]
times 5
[5,20,15,20,25]
iterate
Ask no questions...
msg
count words
msg.payload
Scraping web content
trigger
get indexes
msg.payload
Market indexes
format indexes
ramp
average
generate data
average 5 seconds
timestamp
Counter
msg
Provide Feedback

Node-RED

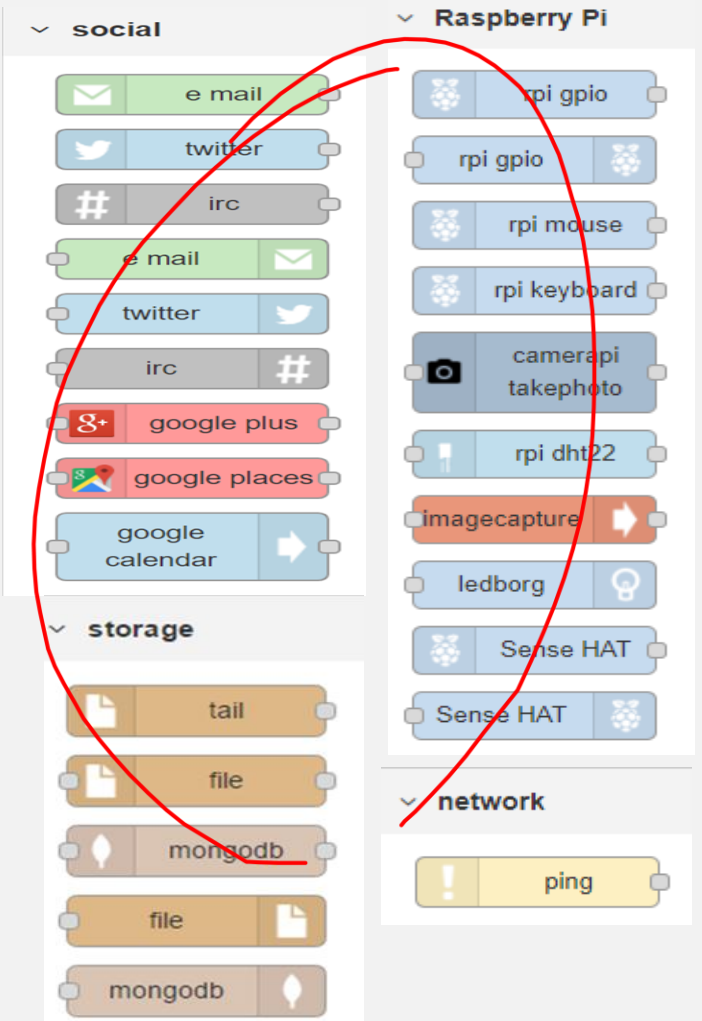

Node-RED
Deploy
filter nodes
flow1
Flow 1
info
debug
dashb
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
show micro web app
service-search-near-marker
world map
point
transform results
world map
event-log
popupopen
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
Flow
Name
flow1
ID
"49a71aa0.b297b4"
Status
Enabled
Information
Node-RED
Search for nodes using

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

DISIT Lab, Distributed Data Intelligence and
...ms and Internet
...formation Engin
http://www.di...



+ on IOT Edge Raspberry

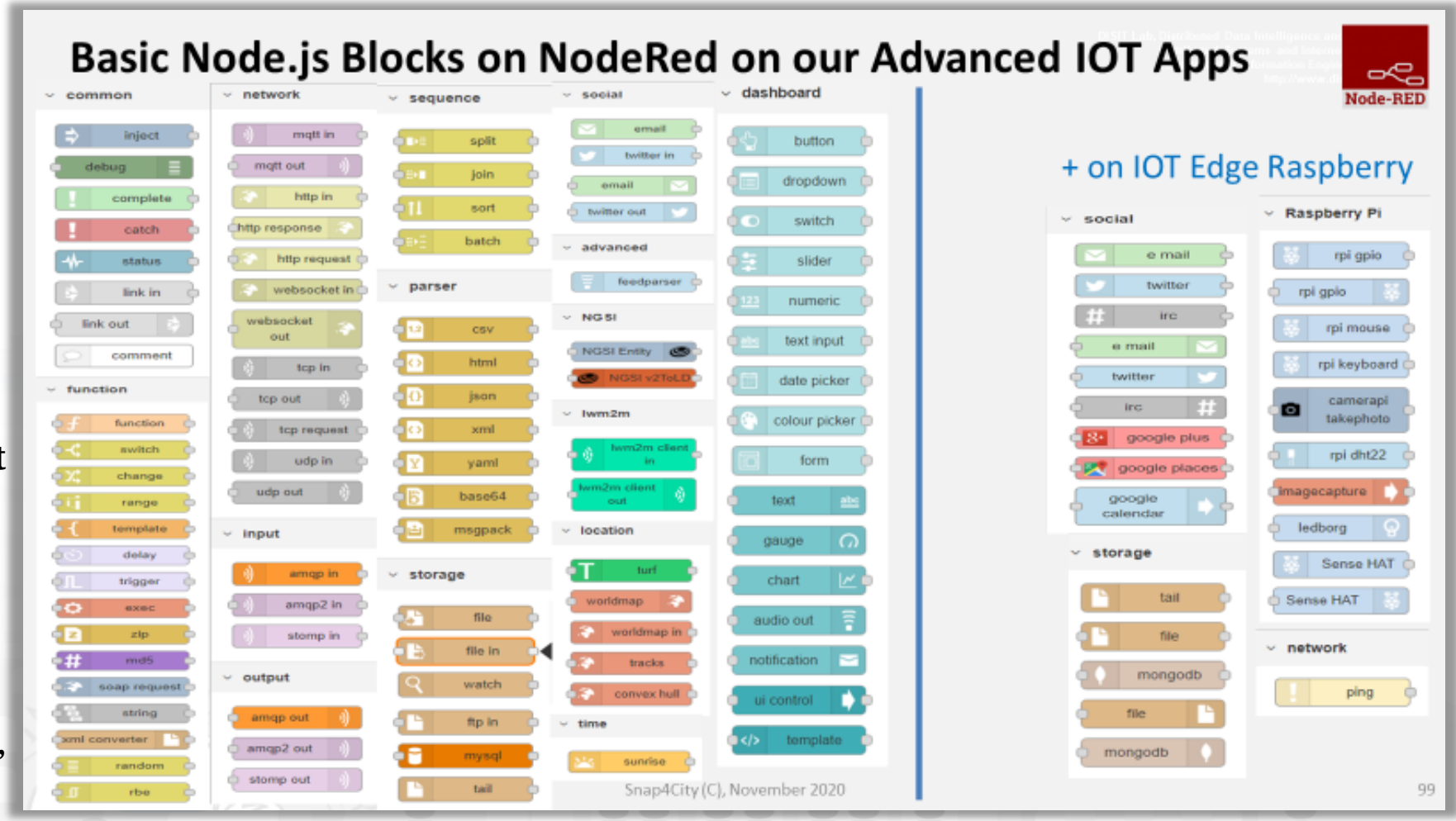


Node-RED Basic Blocks

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.

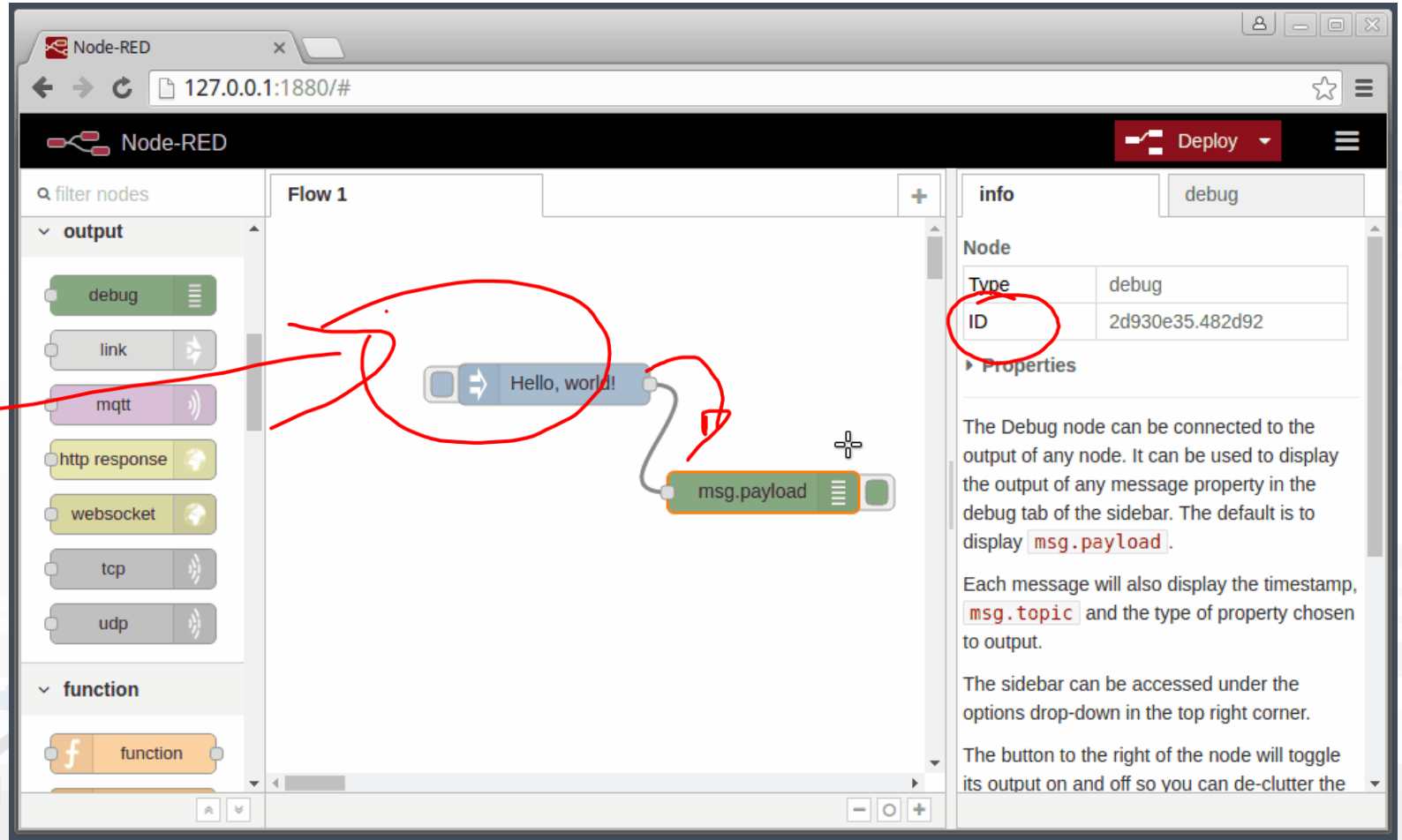
The classical nodes provided in the standard version can be classified as: input, output, function, social, storage, analysis, advanced, and dashboard.



Hello World of Node-RED

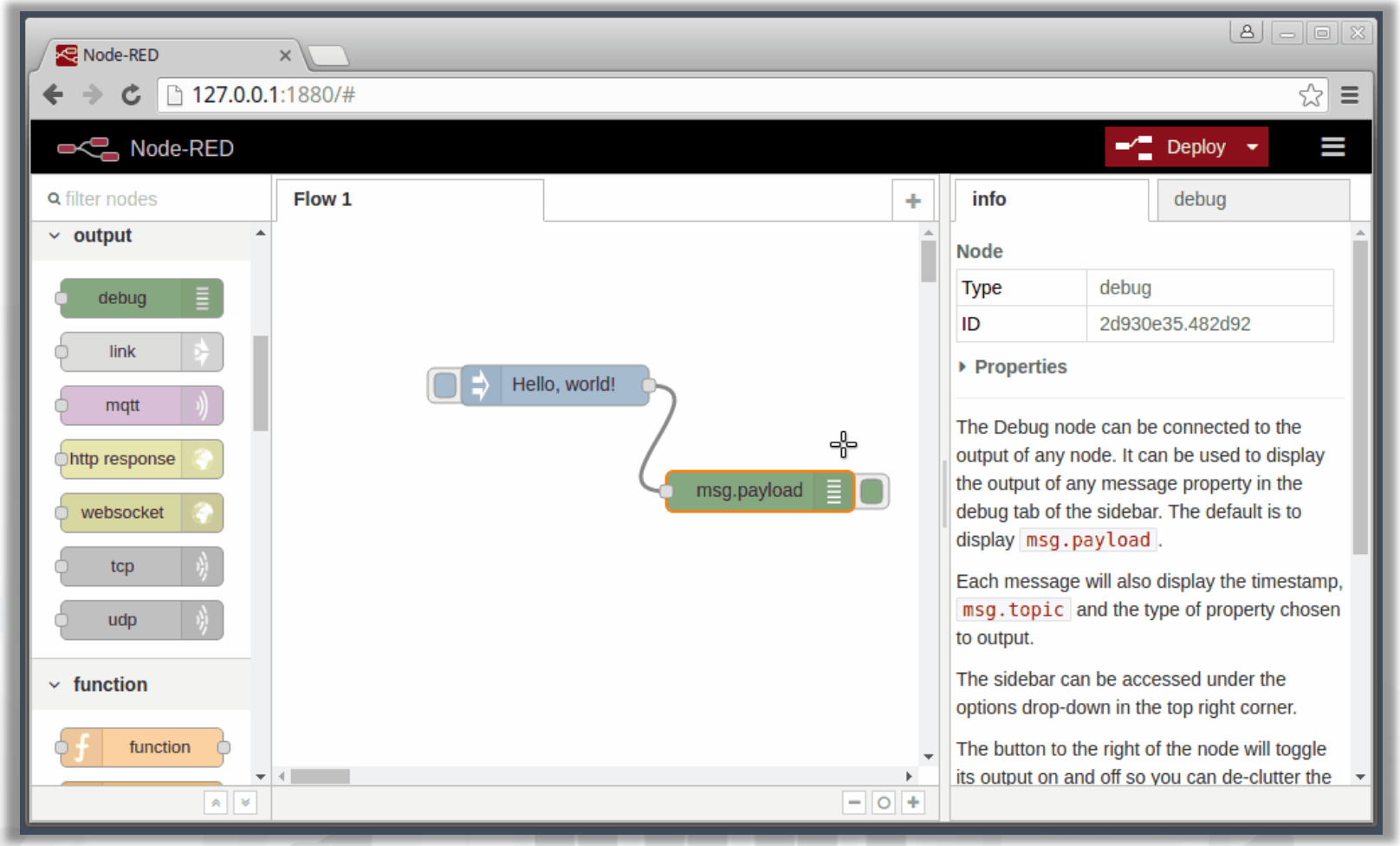
Node-RED

- http://developer.opto22.com/nodered/general/getting-started/node-red-hello-world/



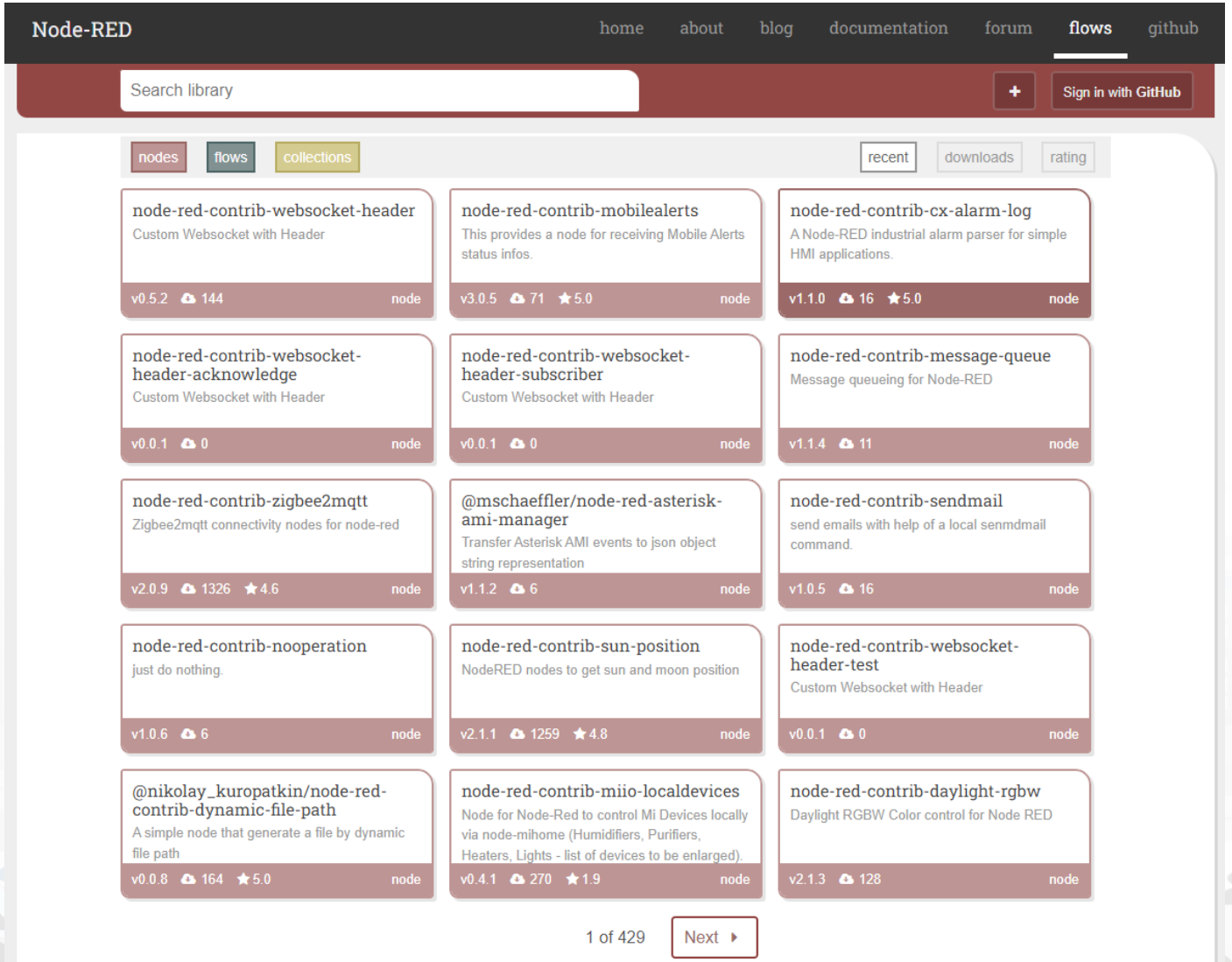
Node-RED

- Node-RED is a **flow-based** development tool for visual programming proposed by **JS Foundation**
- The Node-RED approach is a mix of **visual composition** of **nodes/blocks** to compose the so-called **flows** that are concurrently executed by an engine **Node.js**.
- It is quite diffuse being also directly provided into **official releases** of IOT devices as **Raspberry Pi** family
- Based on **Node.js**
- 100% **open source**



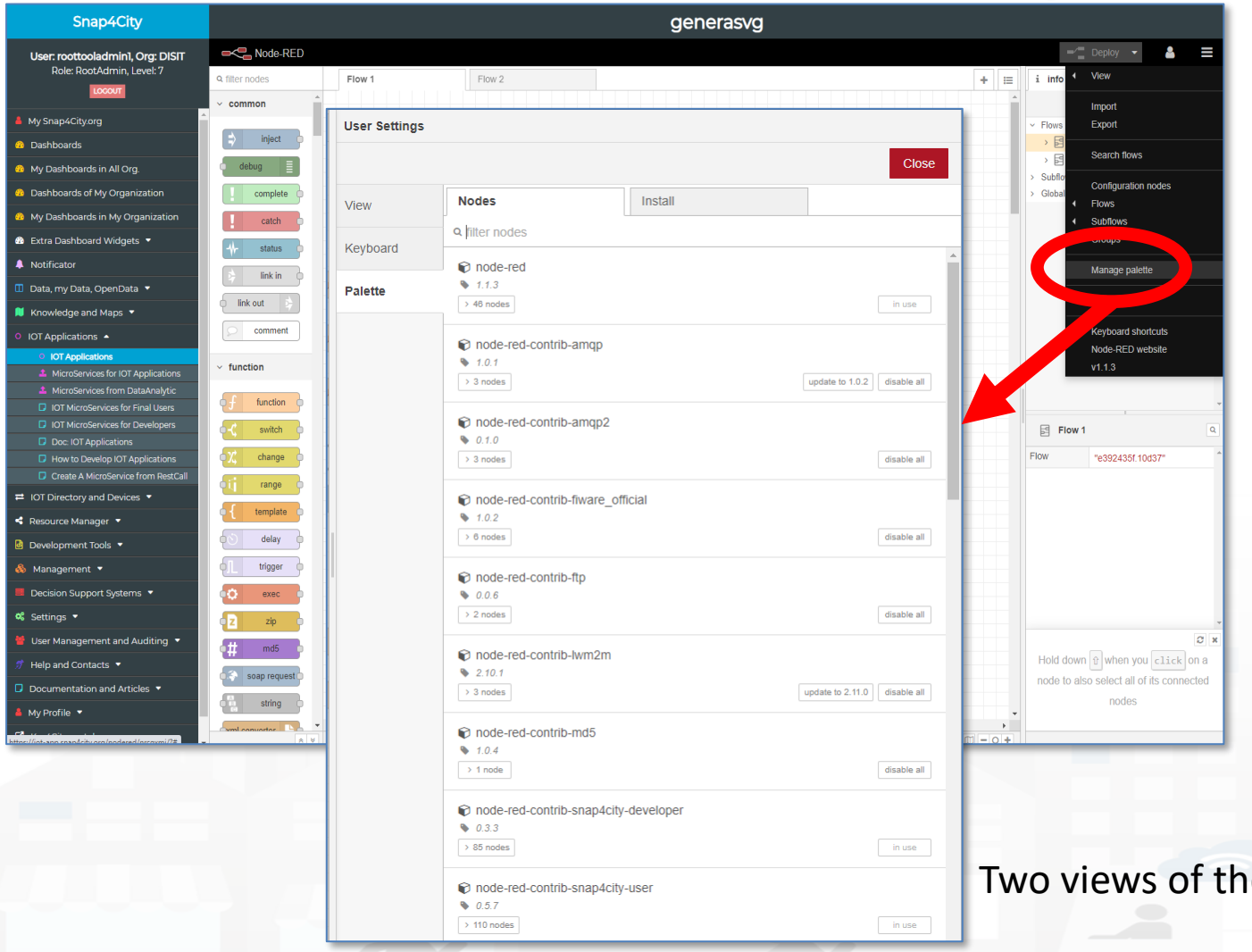
Node-RED Libraries

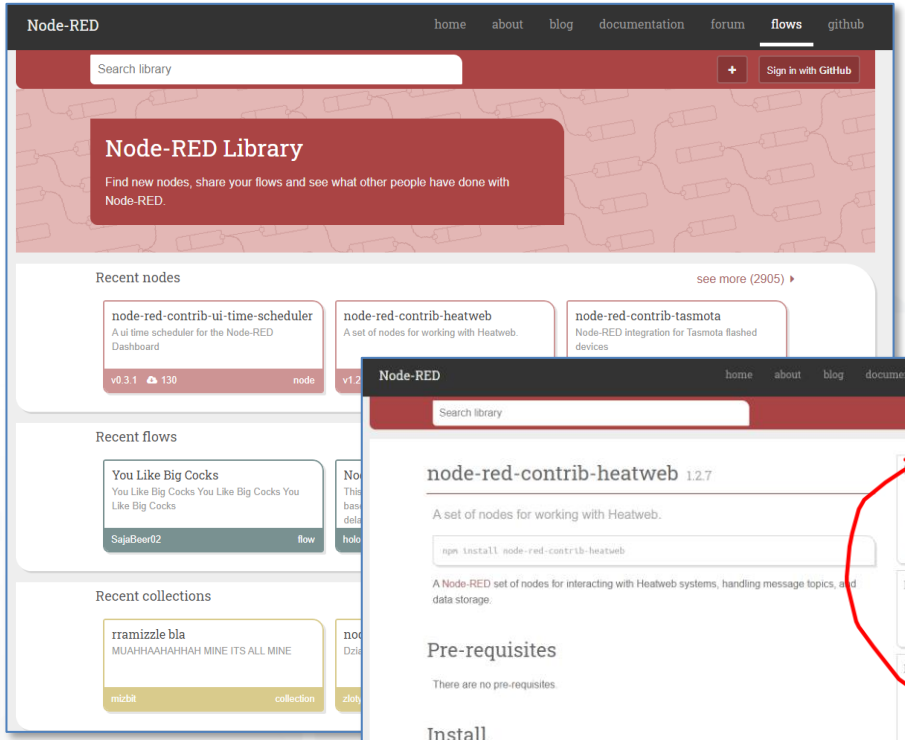
https://flows.nodered.org/search?term=

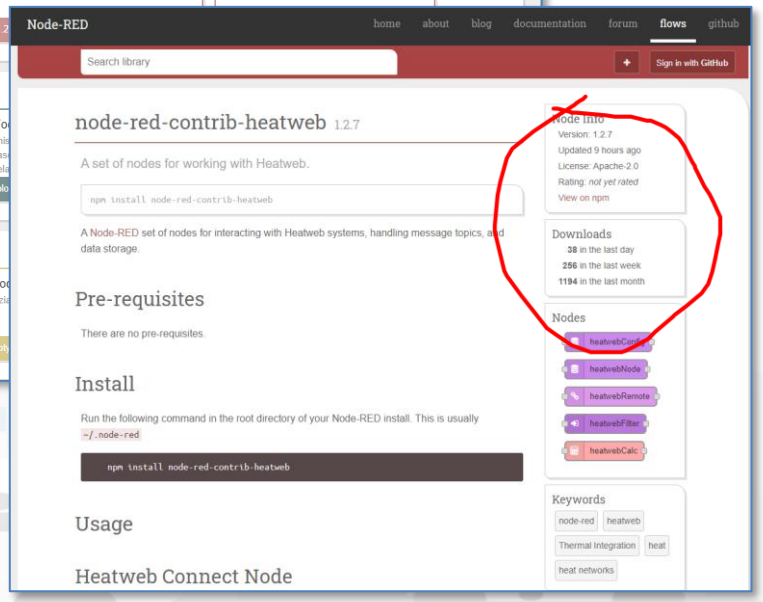


Load Library from Palette

https://flows.nodered.org/







Two views of the same libraries

Node-RED
SnaP4City Libraries

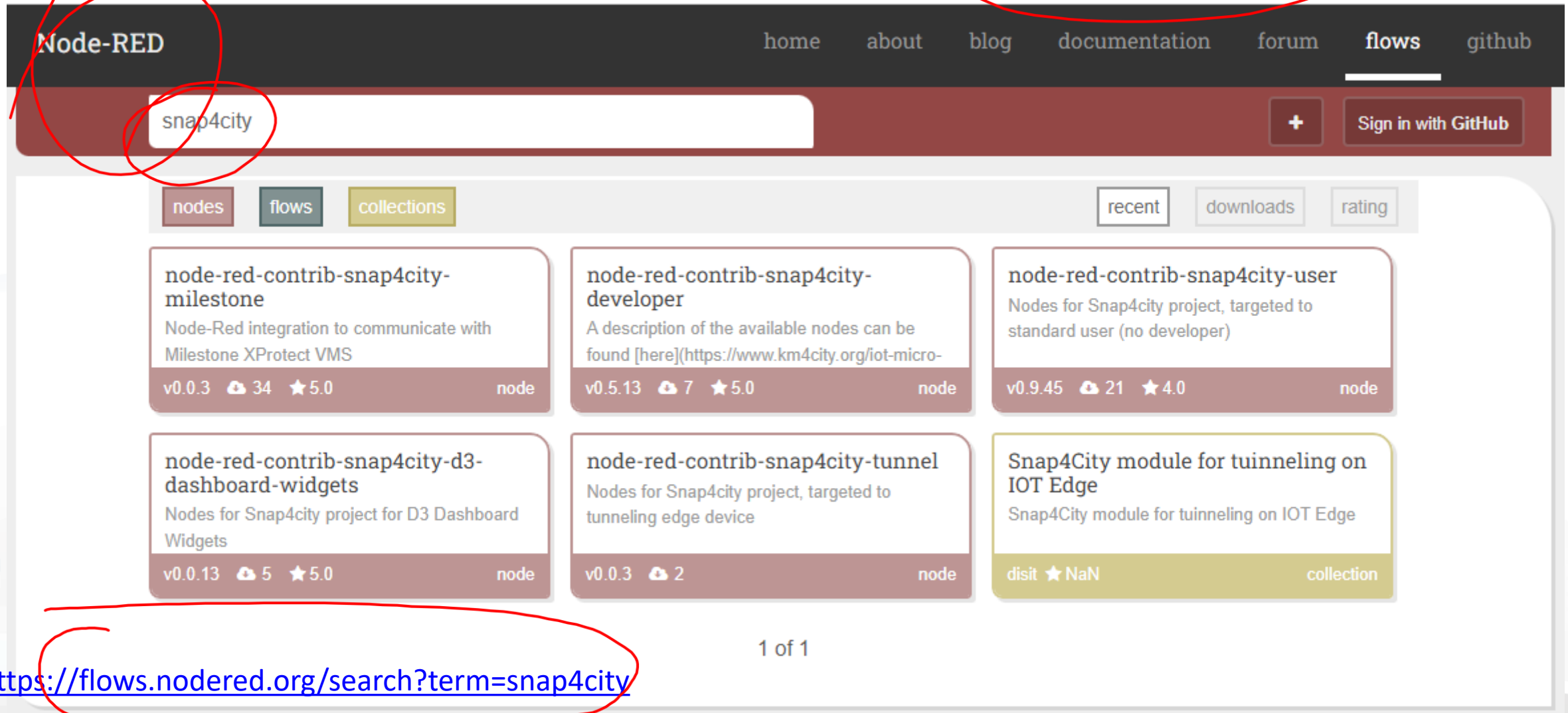
Proc.Logic / IoT App Editor: NODE-RED

- In the Proc.Logic / **IoT App of Snap4City**, it is possible to:
  - Execute flows that process data as: Event Driven, Batch (periodic or not)
  - Create multiple concurrent Flows for each IoT App / Proc. Logic
  - Create subflows as macros to be reused
  - Create Groups of nodes as macro
  - **Save/load**, **share**, of nodes, flows and applications with other users via
    - the Snap4City Resource Manager or
    - with JS Foundation or
    - via email, skype, file sharing in general
  - ..

IoT App / Proc.Logic Editor: NODE-RED

- In the **IoT Apps / Proc.Logic of Snap4City**, it is possible to Extend the Capabilities:
  - Load other Nodes, segments of flow and entire flows from several sources: email, libraries, S4C repository, etc.
  - Load other libraries of MicroServices/Nodes/Blocks from **Manage Palette**
    - A large set of Libraries of Node is available.
    - The loading may have some limitations for security reasons
  - **Get more IOT App / Proc.Logic** above the Limit that may depend on the organization and/or on personal authorizations, ask to Admin
  - ..

Snap4City Libraries on Node-RED

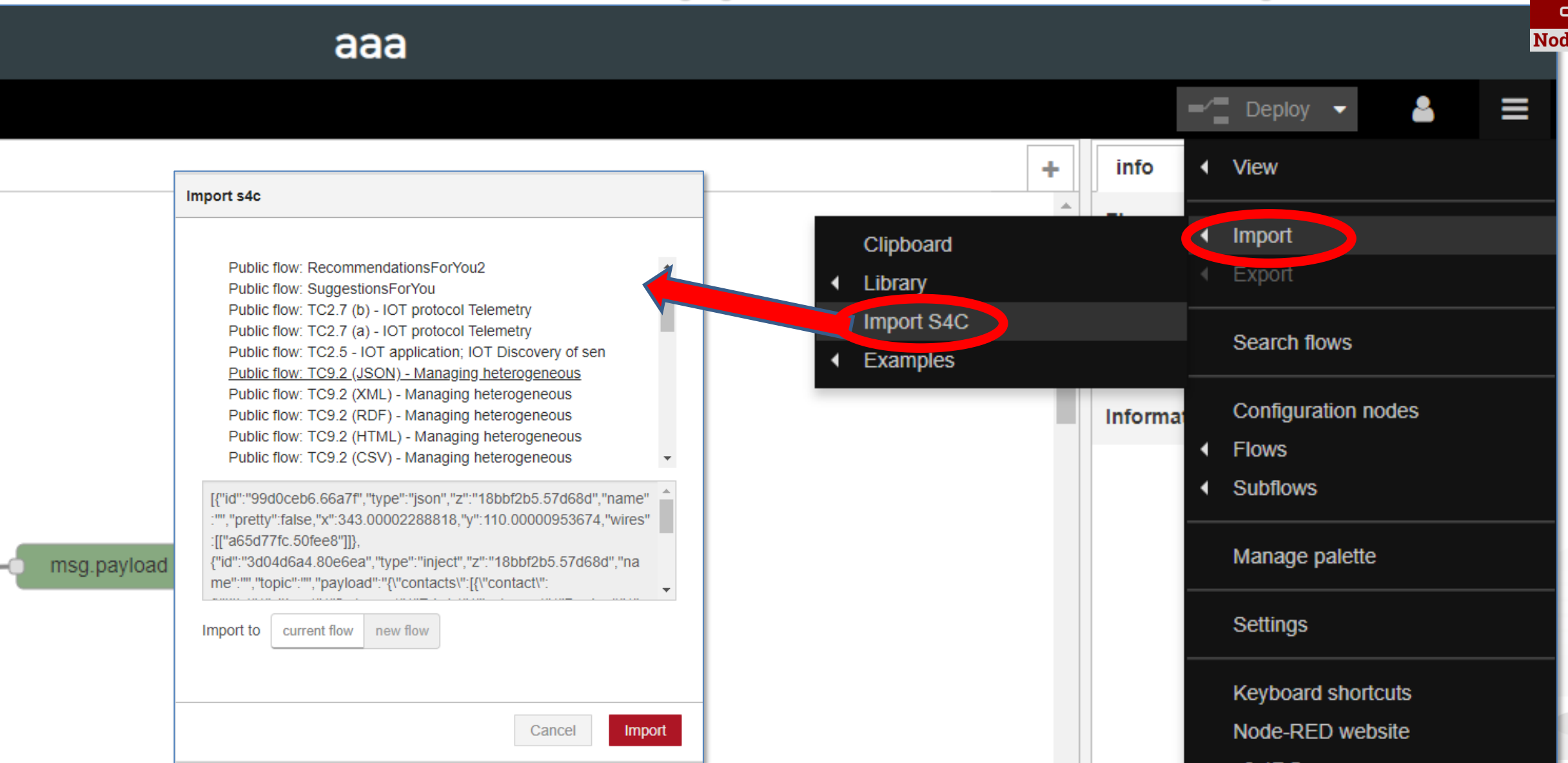


https://flows.nodered.org/search?term=snap4city

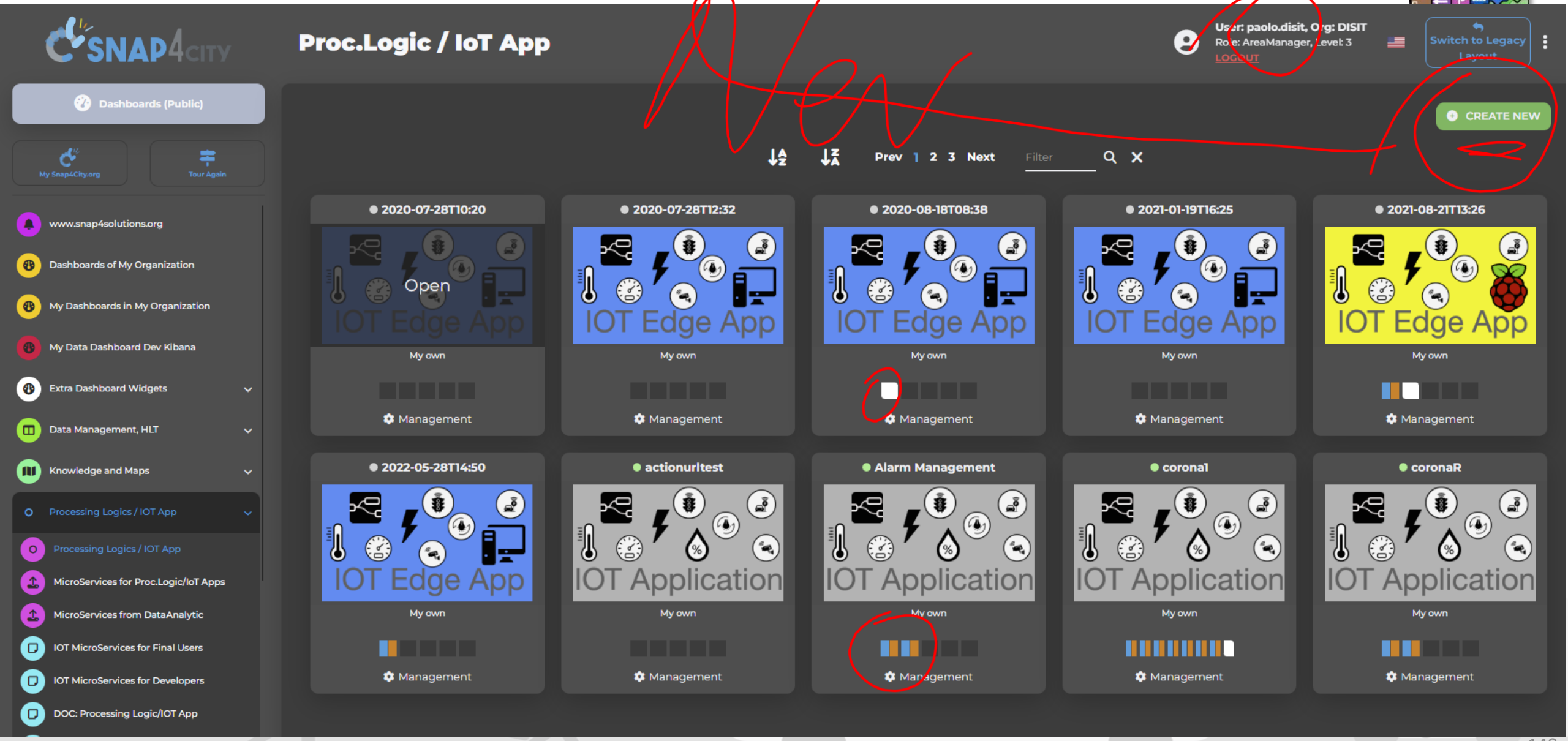
Snap4City Libraries on Node-RED

- https://flows.nodered.org/search?term=snap4city
  - https://flows.nodered.org/node/node-red-contrib-snap4city-user
  - https://flows.nodered.org/node/node-red-contrib-snap4city-developer
  - https://flows.nodered.org/node/node-red-contrib-snap4city-d3-dashboard-widgets
  - https://flows.nodered.org/node/node-red-contrib-snap4city-tunnel
  - https://flows.nodered.org/node/node-red-contrib-snap4city-milestone
  - https://flows.nodered.org/node/node-red-contrib-snap4city-clearml

Load an IOT application of example

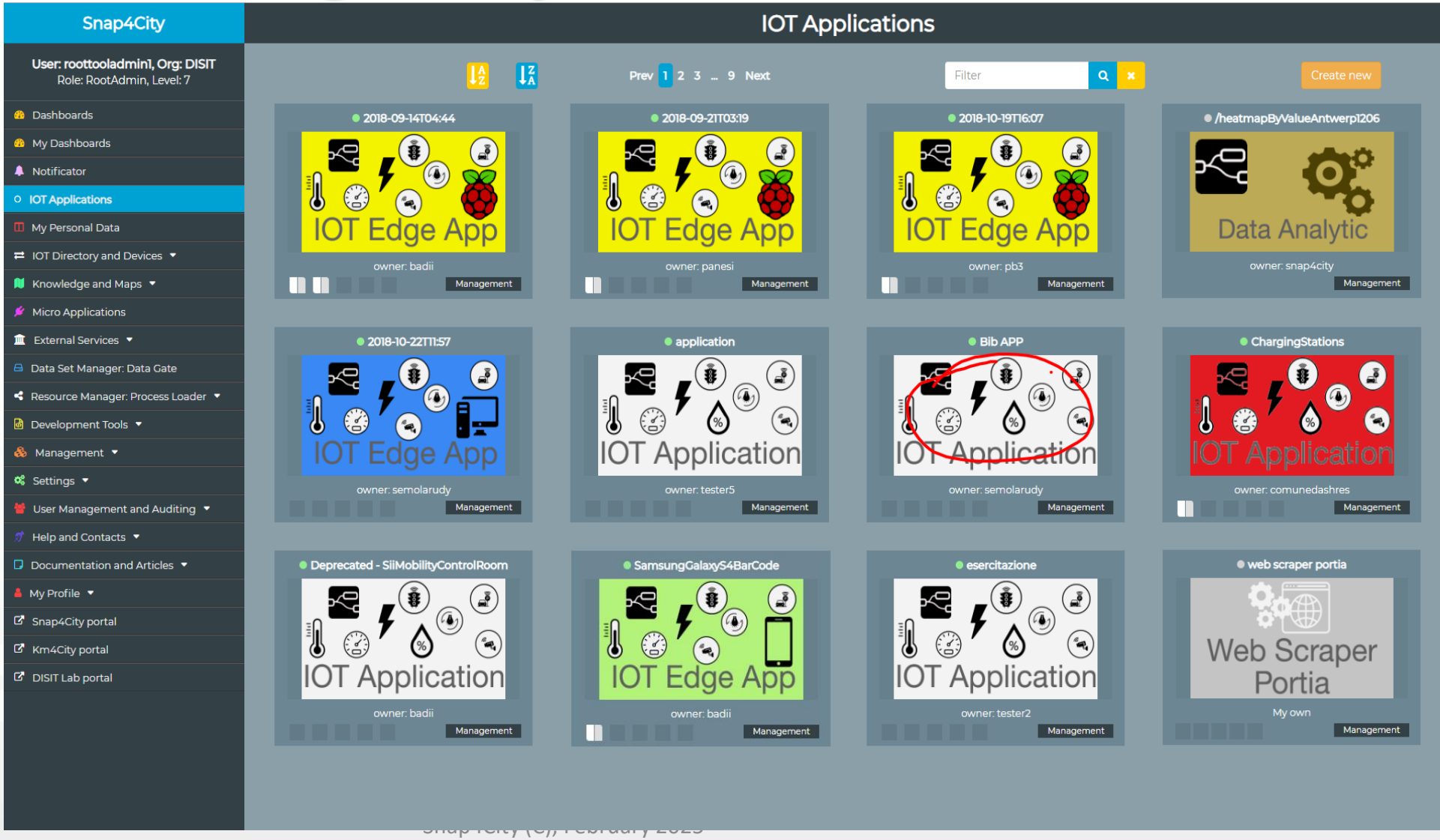


Node-RED in Snap4City


SNAP4CITY
Proc.Logic / IoT App
User: paolo.disit, Org: DISIT
Role: AreaManager, Level: 3
LOGOUT
Switch to Legacy Layout
Dashboards (Public)
My Snap4City.org
Tour Again
www.snap4solutions.org
Dashboards of My Organization
My Dashboards in My Organization
My Data Dashboard Dev Kibana
Extra Dashboard Widgets
Data Management, HLT
Knowledge and Maps
Processing Logics / IOT App
Processing Logics / IOT App
MicroServices for Proc.Logic/IoT Apps
MicroServices from DataAnalytic
IOT MicroServices for Final Users
IOT MicroServices for Developers
DOC: Processing Logic/IOT App
CREATE NEW
Prev 1 2 3 Next
Filter
2020-07-28T10:20
Open
IOT Edge App
My own
Management
2020-07-28T12:32
IOT Edge App
My own
Management
2020-08-18T08:38
IOT Edge App
My own
Management
2021-01-19T16:25
IOT Edge App
My own
Management
2021-08-21T13:26
IOT Edge App
My own
Management
2022-05-28T14:50
IOT Edge App
My own
Management
actionurltest
IOT Application
My own
Management
Alarm Management
IOT Application
My own
Management
coronal
IOT Application
My own
Management
coronaR
IOT Application
My own
Management

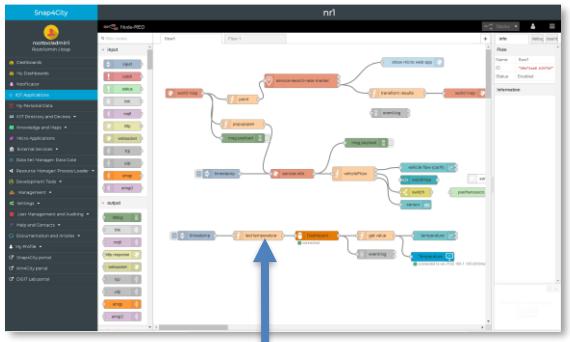
IOT Application Listing, they can be

- Basic (white)
- Advanced (red)
- IOT Edge
  - Raspberry Pi
  - Android
  - Win/Linux
- Data Analytic (Plumber)
- Web Scraper (Portia)

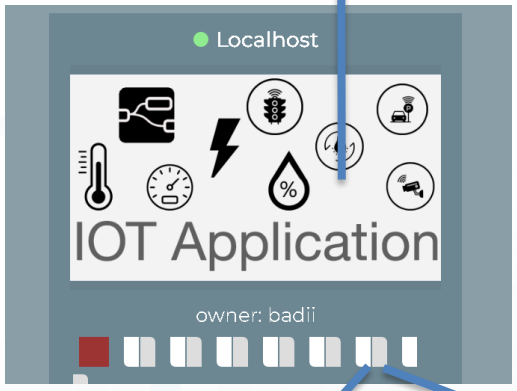


IOT Applications Listing

- Basic / Advanced
- On IOT Edge Raspberry Pi
- On IOT Edge Android
- On IOT Edge Win/Linux

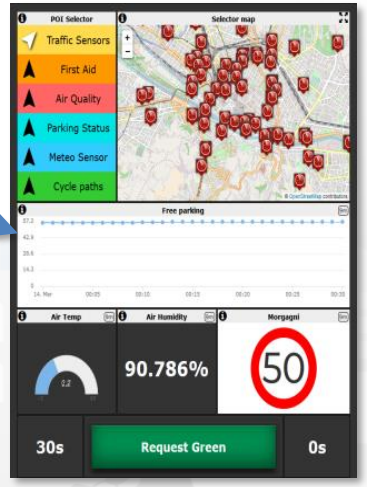


EDIT IOT APP



VIEW

EDIT



IOT App title

Ownership of the IOT App

Click the icon to edit the IOT App

Click to open the Node-RED IOT App dashboard

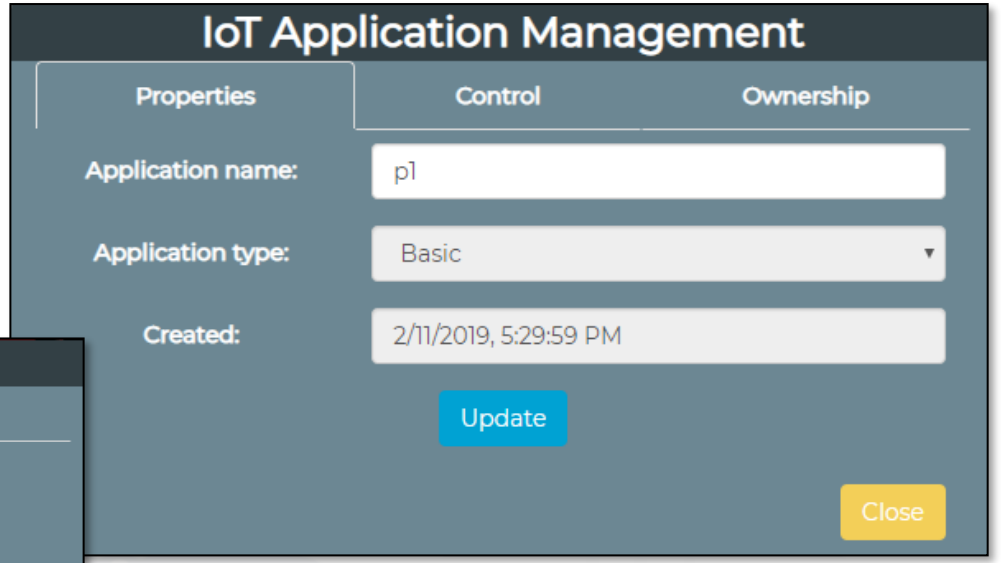
Click to edit IOT App properties

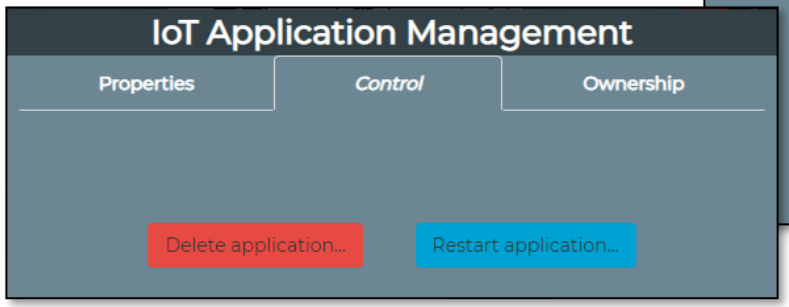
Click to view the Snap4City Dashboard

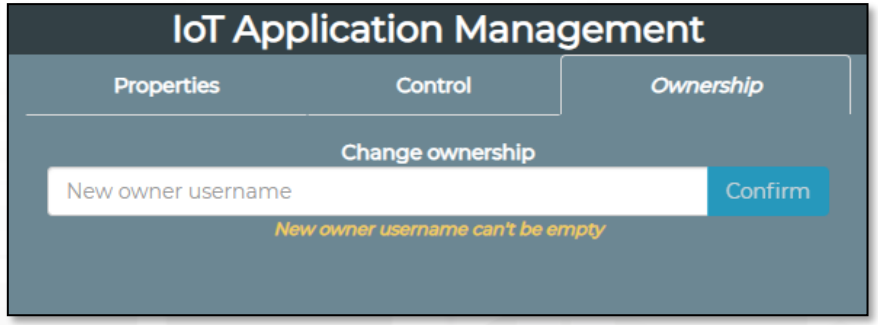
Click to edit the Snap4City Dashboard

IOT Application Self Control

- **Properties**
  - Name, Type, Creation date
- **Control**
  - Restart Container
  - Delete IOT App
- **Change of ownership**
  - Pass to another Snap4City User
- **From inside the IOT App**
  - Restart
  - Update Snap4City Library







Automating restart and update

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

SNAP4CITY

KM 4 CITY

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS

SNAP4CITY AND KM4CITY PROJECT

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IOT/IOE DEVICES AND NETWORKS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT AND SIMULATION

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

IOT App = Node-RED + Snap4City

IoT App === Proc.Logic

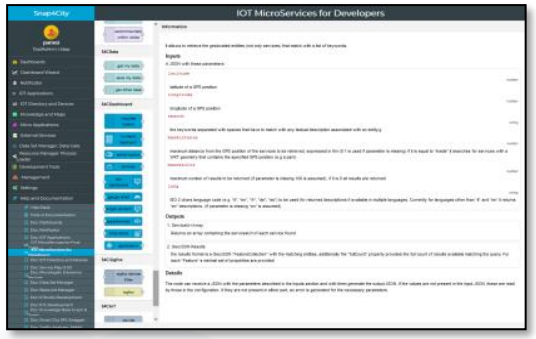
- Processing Logics / IOT App
  - Processing Logics / IOT App
  - MicroServices for Proc.Logic/IoT App
  - MicroServices from DataAnalytic
  - IOT MicroServices for Final Users
  - IOT MicroServices for Developers
  - DOC: Processing Logic/IOT App
  - How to Develop Proc.Logic / IoT App
  - Create A MicroService from RestCall

Node-RED

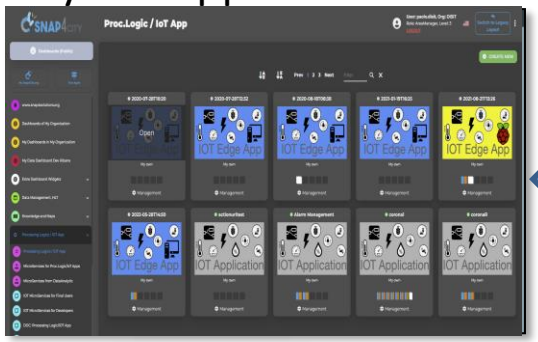
IOT Applications Development

IOT Discovering

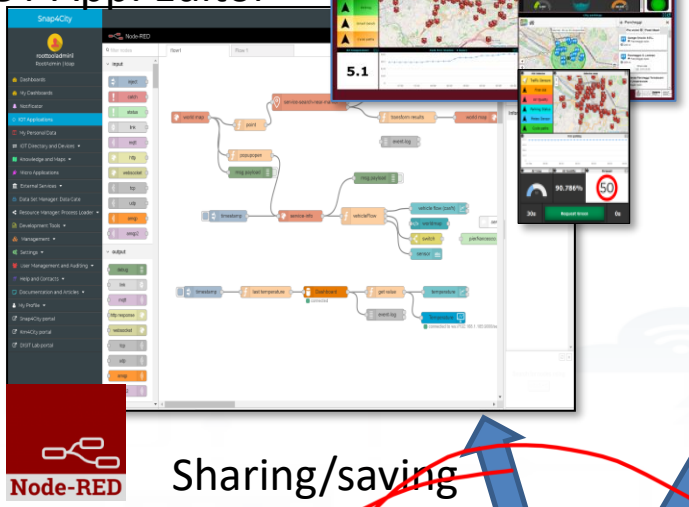
MicroServices collections



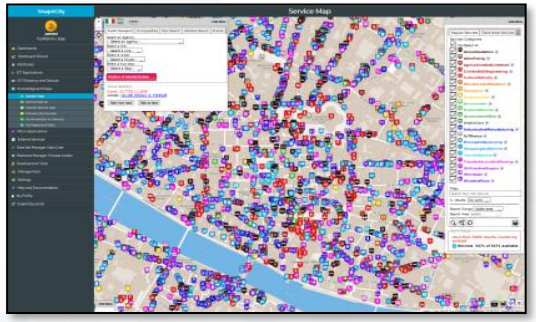
My IOT Applications

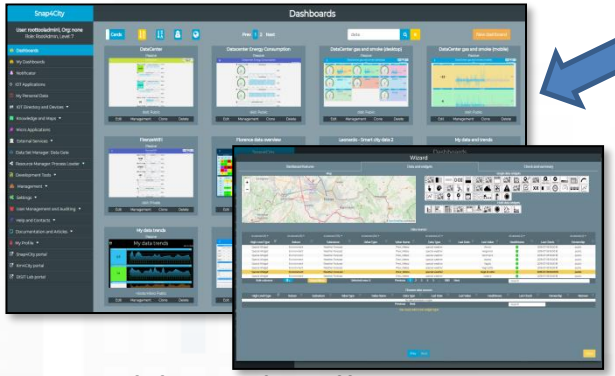


IOT App. Editor



Generating IOT App With Dashboard





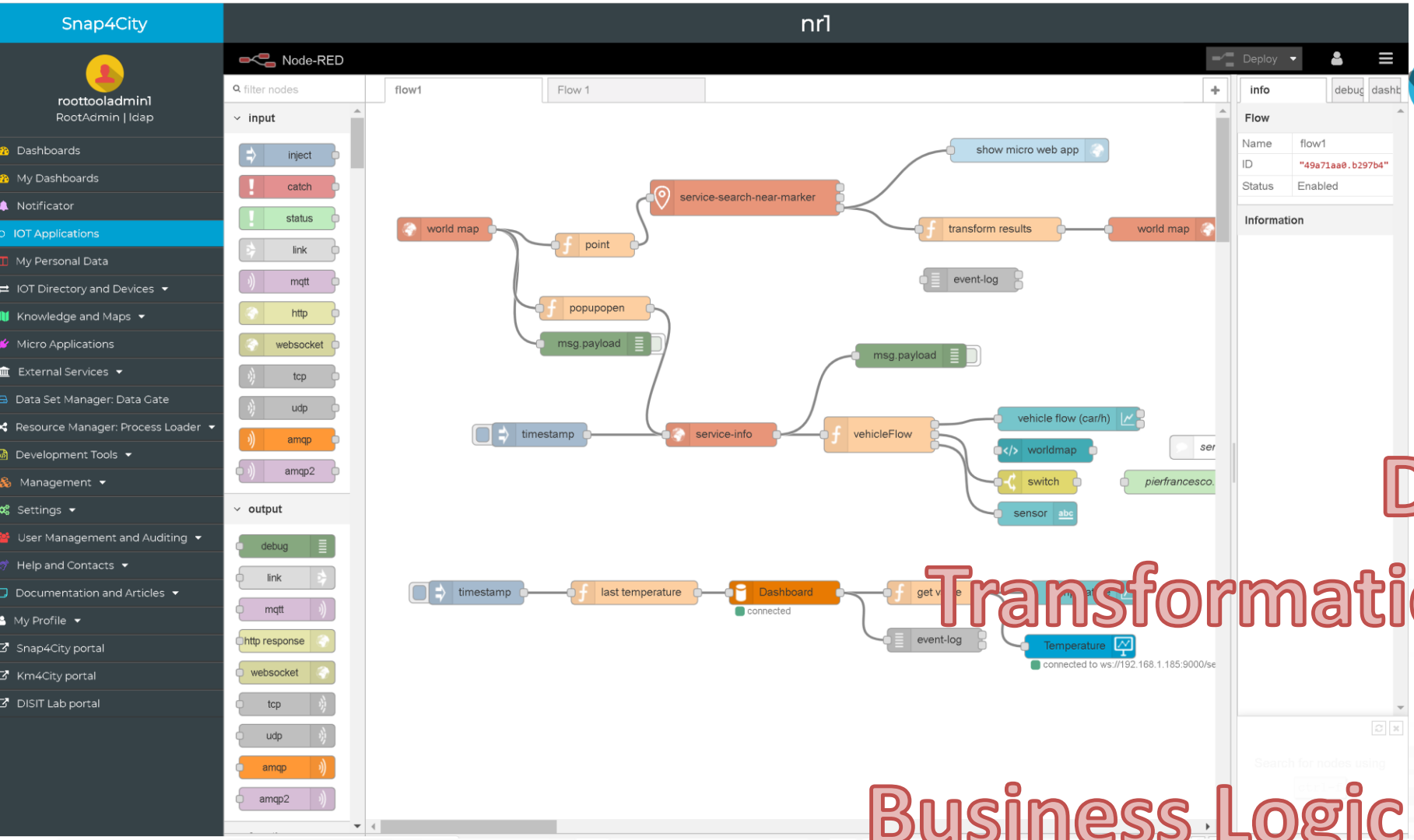
Sharing/saving reusing IOT App

Resource Manager

ServiceMap Discovery

Knowledge Base, Km4City

Dashboard Collection, Editor and Wizard



Editing IOT Applications

Data Adapation

Transformation, Conversion

Integration

Business Logic vs Dashboards

Data Analytics control

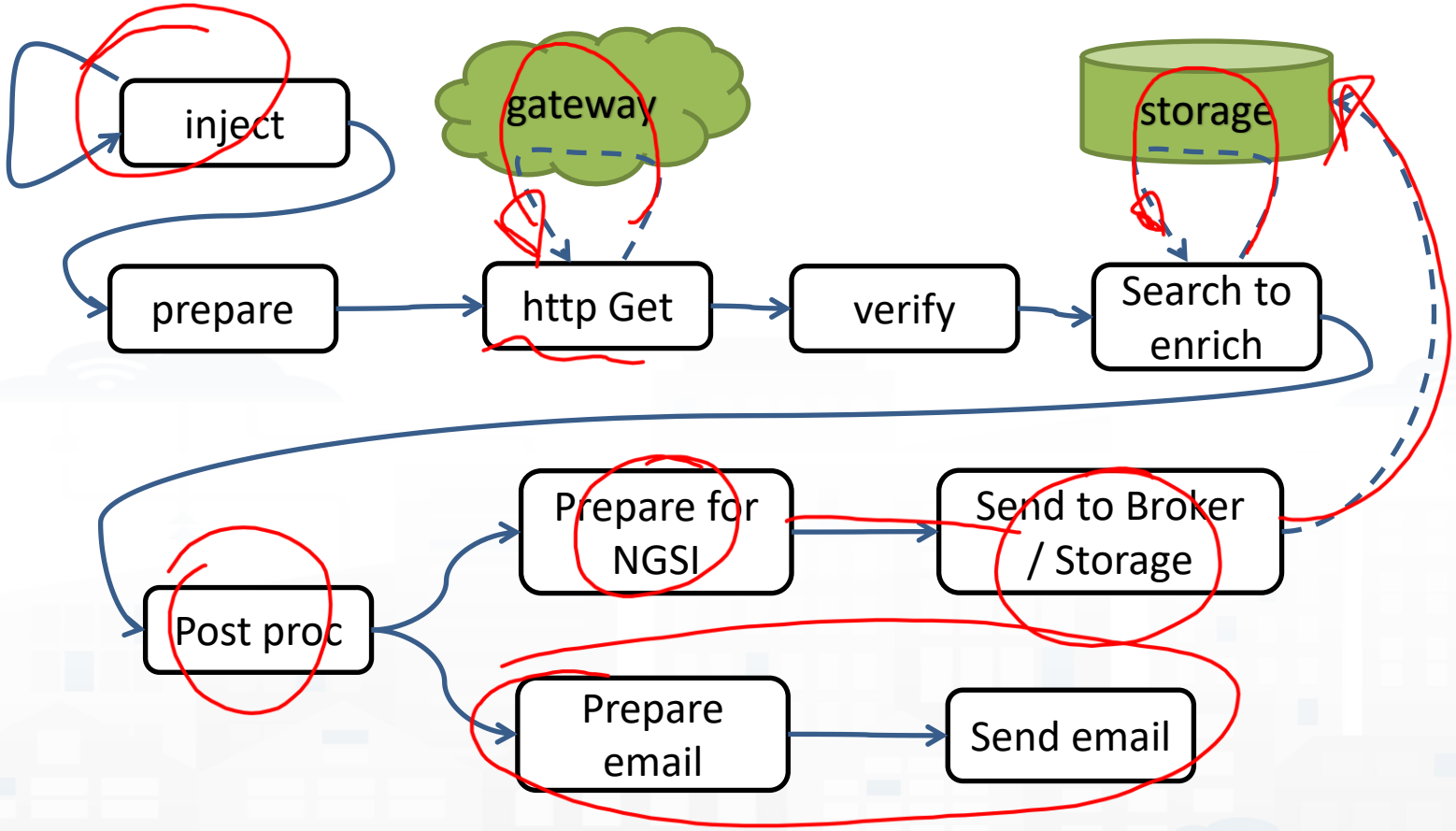
Everywhere: Cloud, on IoT Edge Devices

Develop Snap4City IoTApp Processing Logic

How to Design

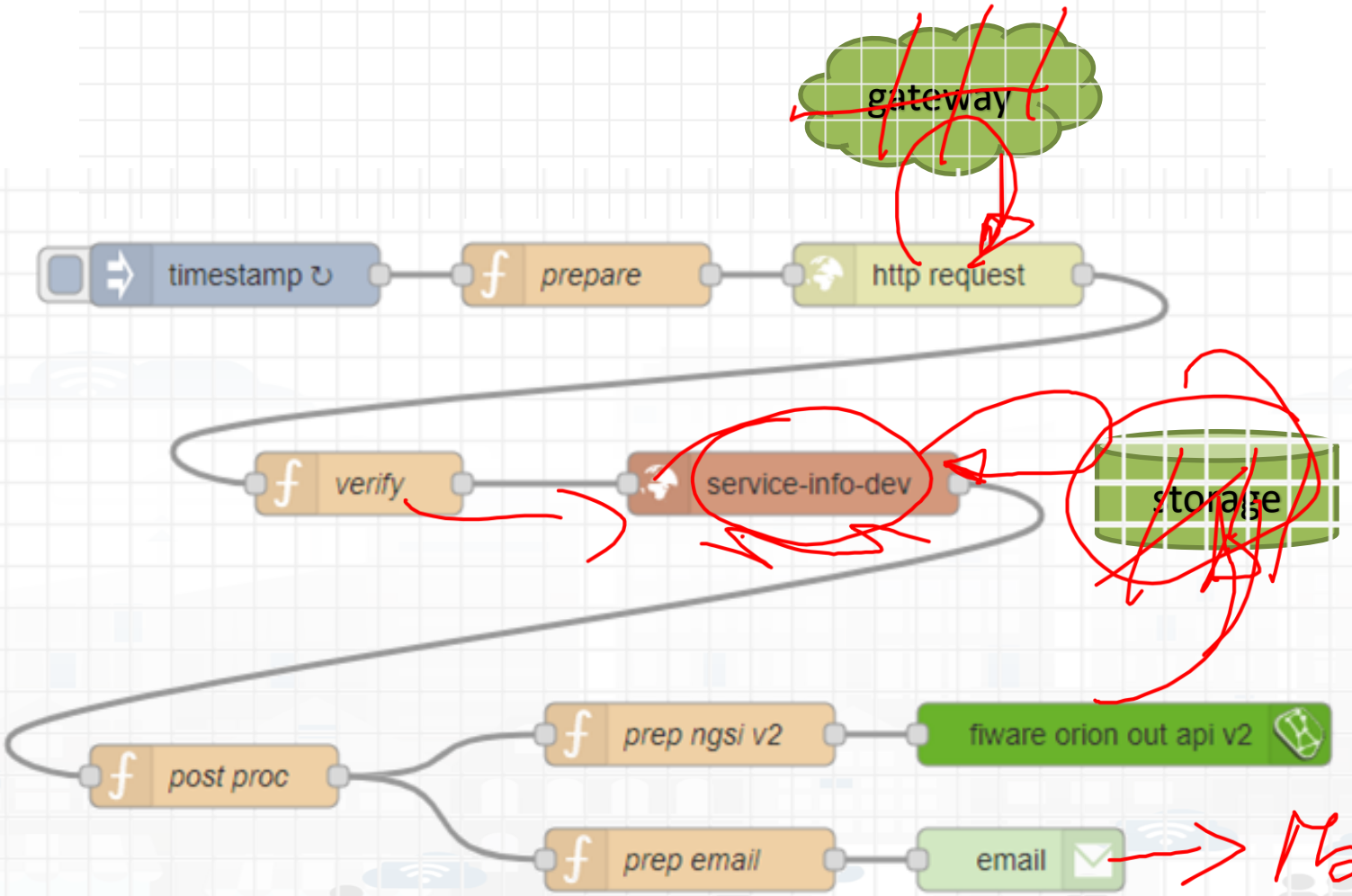
1. **Business Logic** is going to be implemented in Proc.Logic (IoT App), with a set of flows.
2. **Decompose your problem** and sequence diagram in single Data/event Flows, from client side and server side.
3. **Identify the single Data/Event Flow**, as those that start from a certain event (periodic 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 Proc.Logic** (IoT App) Node-RED flows by adding nodes needed
7. **Once obtained the Proc.Logic** (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 / Proc.Logic 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

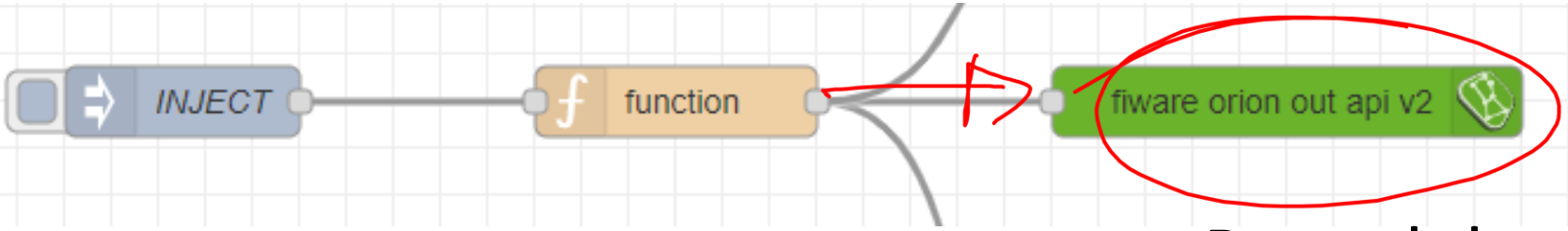
Proc.Logic (IoT App) Design, for each Data/Event Flow



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 Broker, and thus send the data in the storage on a specific Entity Instance
g. Send also a notification via email

Implicit services are not drawn

A sample of Data Ingestion



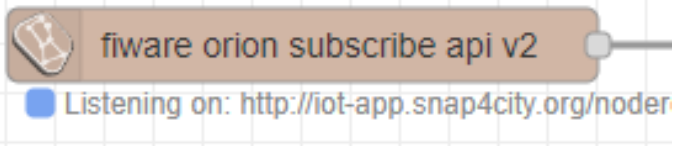
Function, example of NGSI V2 payload:

```
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;
```

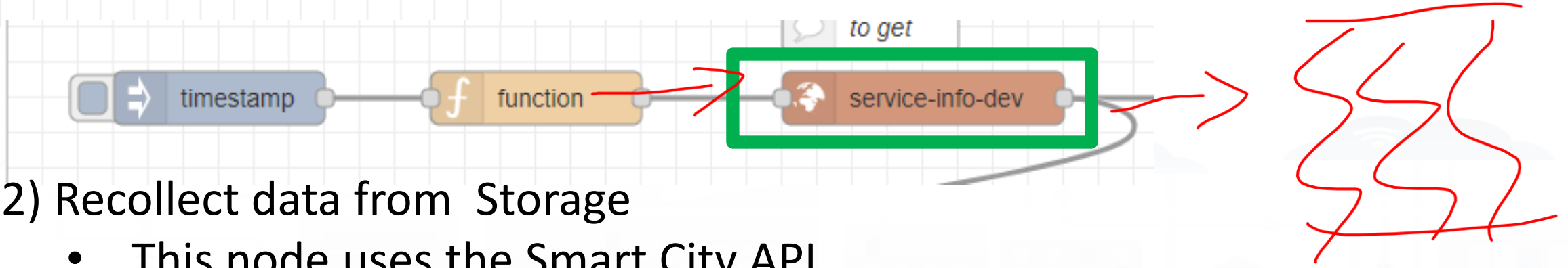
Posted data on IoT Brokers

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)

Snap4City MicroServices and programming Patterns

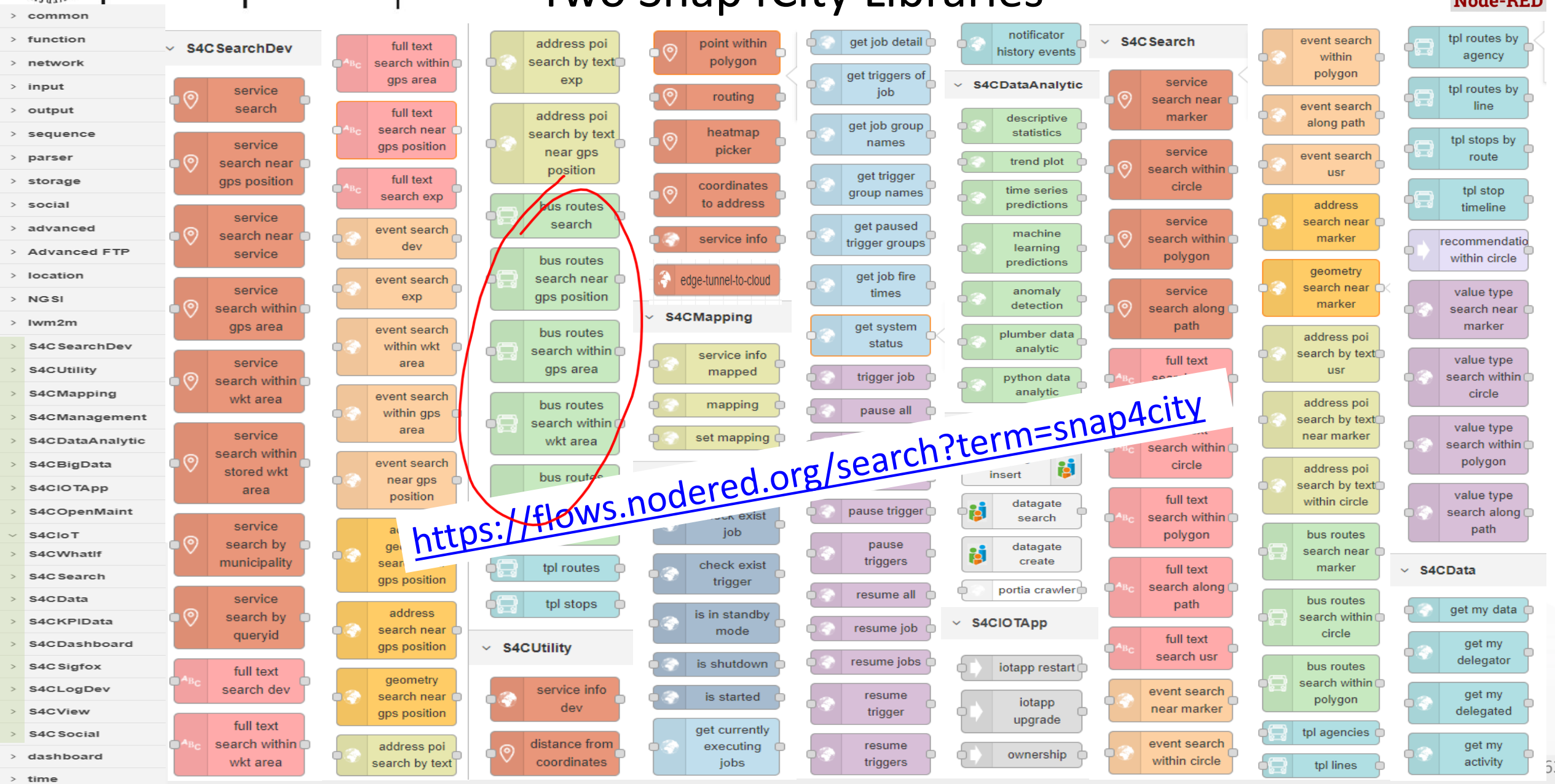
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Sept 2024 collection

Two Snap4City Libraries

SNAP4CITY Node-RED

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



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

Sept 2024 collection

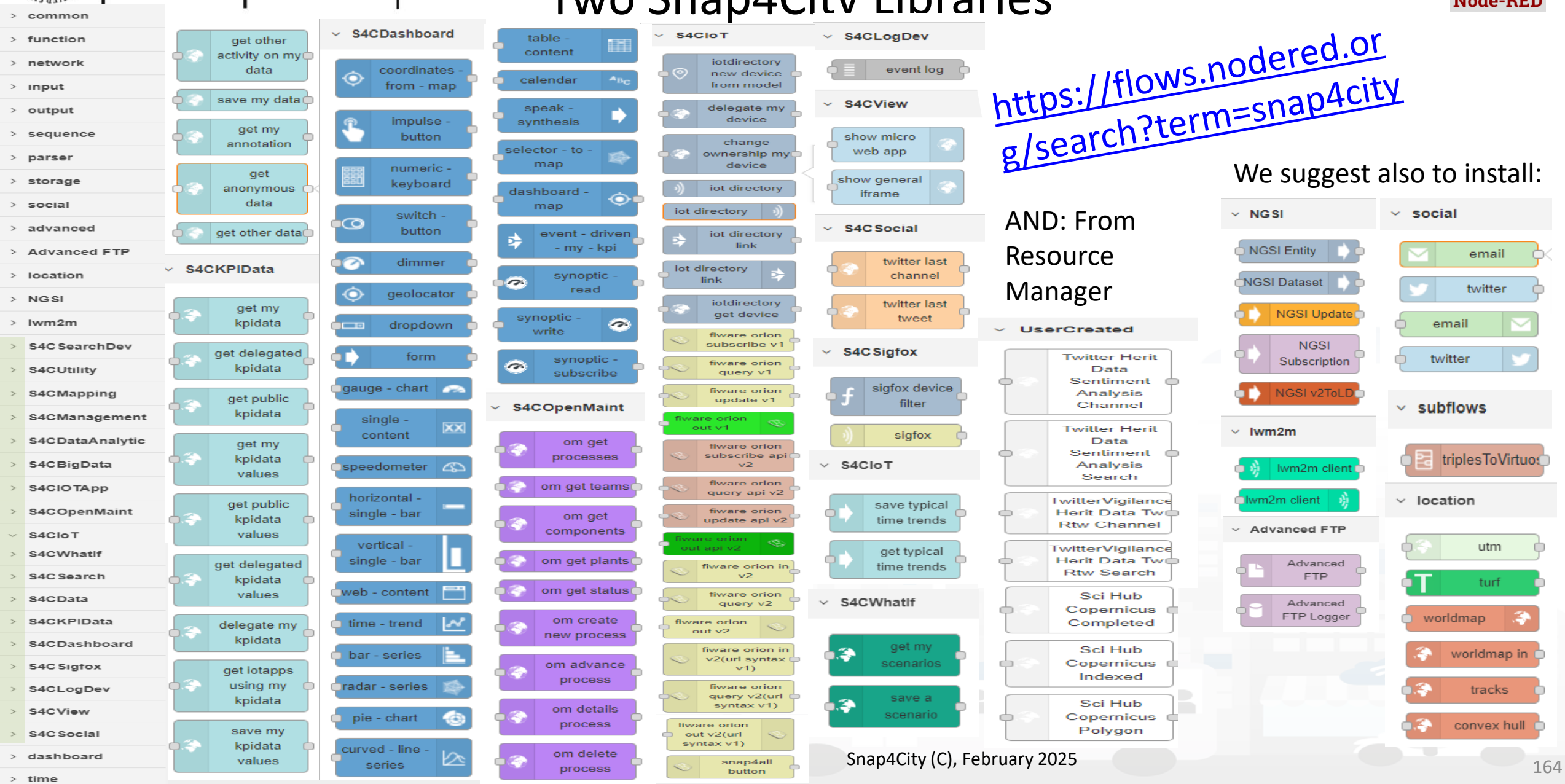
Two Snap4Citv Libraries

SNAP4CITY | Node-RED

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

We suggest also to install:

AND: From Resource Manager



The Processing Logic (IoT App) microservices

Actually, there are more than 180 nodes/blocks in the Snap4City libraries on Processing Logic (IoT App) which can really facilitate your life and save you time in producing Smart Applications for composition of the following microservices and using those that you can install from internet, thousands of functionalities:

- **Data ingestion**: more than 100 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, call to Smart City API, etc.
- **Data Transformation/transcoding:** binary, hexadecimal, XML, JSON, String, any format
- **Integration**: CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIM Server, 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.), send data to special graphical widgets: D3, Highcharts, etc.
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- **Special tools as**: routing, georeverse, Twitter Vigilance and sentiment analysis, etc.
- **Hardware Specific Devices**: Raspberry Pi, Android, Philips, video wall management, etc.
- **Etc**. etc.

Standards and Interoperability (10/2024)

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, SNMP, 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, VMS Milestone, TIM, HERE, ….
- **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, NeTEx, ..
- **Social**:Twitter, FaceBook, Telegram, ..
- **Events**: SMS, EMAIL, CAP, RSS Feed, ..
- **OS**: Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.

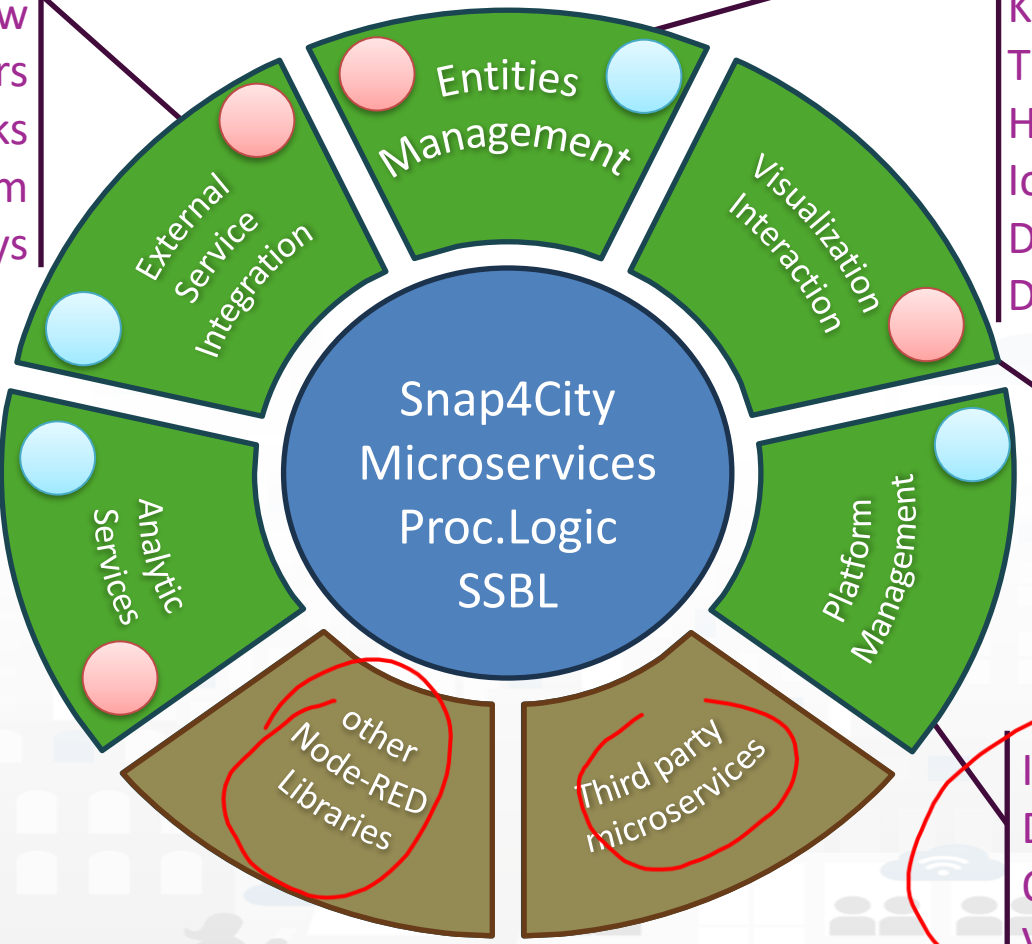
https://www.snap4city.org/65

Snap4City Libraries on Node-RED

- https://flows.nodered.org/search?term=snap4city
  - https://flows.nodered.org/node/node-red-contrib-snap4city-user
  - https://flows.nodered.org/node/node-red-contrib-snap4city-developer
    - https://flows.nodered.org/node/node-red-contrib-snap4city-d3-dashboard-widgets
    - https://flows.nodered.org/node/node-red-contrib-snap4city-tunnel
    - https://flows.nodered.org/node/node-red-contrib-snap4city-milestone
  - https://flows.nodered.org/node/node-red-contrib-snap4city-clearml

MicroServices Areas

> 60.000 downloads



Open Data CKAN
Ticket Management, workflow
BIM Servers
Social Networks
Video Management system
Gateways

Data Load / Search / Retrieval
KPI, POI, GIS Data, Scenarios
Time Series, Public transport
High Level Types: heatmaps, ODM,…
IoT / Entity Discovery
Delegation Management
Data Mapping

Data Analytics
Statistic, Optimization
Simulation
Artificial Intelligence
What-if Analysis Support
Geo Utilities Support
Routing & Traffic Flow
MLOps support
Python support
R Studio Support

Dashboards
Widgets: Graphic Libraries
Interactive Widgets
Maps, 3D representations
Synoptics, External Content
Micro Web App

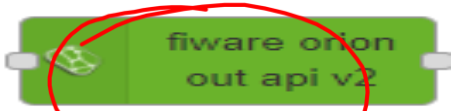
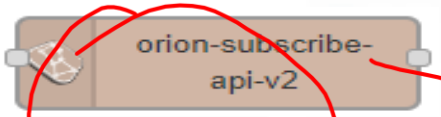
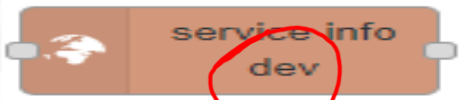
IoTApp Management
Data Logs, A&A, Security
Ownership Management
VPN remote access

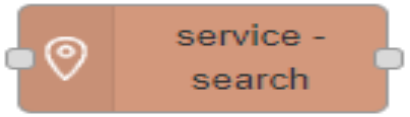
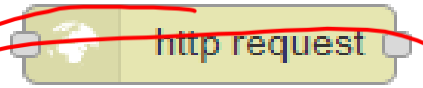
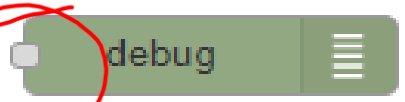
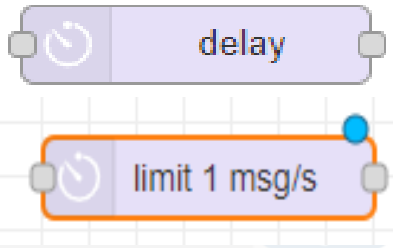
examples

Saving Data on Storage

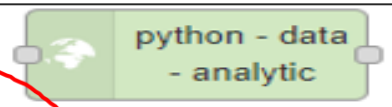
Even Driven

Get Data from Storage

Node shape	Description	Snap4City or standard
	To **generate injection messages** into a flow, scheduled/periodic or on manual demand by click it on left.	standard
	**DATA TRANSFORM** A **JavaScript function**, from a JSON input to one or more JSON outputs, which can be produced by setting it.	standard
	**SAVE to STORAGE via internal BROKER** To send an Entity Message of an Entity Instance into the storage. The Entity Instance has to be registered on Entity Directory (IoT Directory) and you have to be the owner or to be delegated in READ-WRITE to send messages to it. The node represents the broker, so that the same node can be used to send any Entity Message you need. Please manage the error in output.	Snap4city
	**SUBSCRIBE** to an Entity change on BROKER To subscribe the Processing Logic (IoT App) to receive event-driven notifications related to Entity Instances changes. The node is substantially a listener connected to an Orion Broker. You can subscribe to many Entities and then to get all of them from the output of the listener. The new version will go to provide an input port to send at this listener multiple subscriptions. **PLEASE NOTE THAT ALL THAT YOU CAN DO IN MQTT CAN BE DONE IN ORION BROKER NGSI. Moreover, Orion broker is authenticated, in SSO, provides JSON, etc. This node-red block allows you to subscribe to a topic / device and get event driven actions on IoT App directly.** Please manage the error in output.	Snap4city
	**READ from STORAGE** Query call to Smart City API to get any information about a SURI, ServiceURI. There are many other Nodes which can be used to pose Smart City API queries in very simple manner and recover vectors of ServiceURIs. Please manage the error in output.	Snap4city

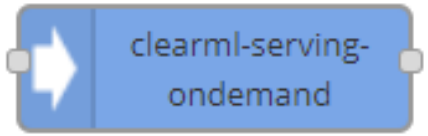
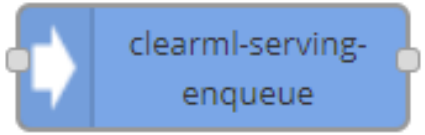
Get Data from Storage		**SEARCH on STORAGE** To perform queries on the storage to obtain a list of ServiceURI. The nodes of this family can allow you to perform searching queries by filtering for distance, area, subnature/category, values of attributes, time period, etc. Please manage the error in output.	Snap4city
Send email		Send email. With other nodes you can send Telegram, SMS, etc.	standard
Gen/access to HTTP, HTML pages		To send a **REST CALL** (get, post, etc.). Please USE THIS NODE ONLY for the access at external API and not to access at the Snap4City API for which a lot of MicroServices are accessible as NODEs/Blocks in the Processing Logic and they are simpler to be used and ready to use. Please manage the error in output.	standard
Monitor messages		A block which is printing on **debug** view the data JSON passed in its input. Please note that the node can be tuned to provide only msg.payload or the full JSON message, change configuration of the node.	standard
Stream Delay, limiting rate		A node to insert a delay to each message arriving, or to limit the rate of messages in output. In some cases, the node creates a buffer of messages regularizing the rate in output if the rate in input is greater in some moments.	standard

examples

	A block which is printing on **debug** view the data JSON passed in its input. Please note that the node can be tuned to provide only msg.payload or the full JSON message, change configuration of the node.	standard
	To **create an Entity Instance** (device instance) from a model prepared on Entity Directory (IoT Directory).	Snap4city
	To **change the ownership** of an Entity Instance (IoT Device).	Snap4city
	To **delegate a certain Entity Instance** (IoT Device) to some other user for which you have to know the Nickname. Delegations can be: Read access, Read write, Modify (to modify the Entity Instance structure)	Snap4city
	To **show something on Snap4City dashboard** with a single content widget (one of the simplest widgets). A large set of dashboard nodes/widgets to send and retrieve data to/from dashboards are provided. This specific Nodes allows to send on dashboard HTML formatted messages with some limitations. Full HTTP widget is also accessible. See in the following section for the Full list of Nodes for	Snap4city
	**MQTT broker listener**, to receive messages from the Broker. Another similar node can be used to send MQTT messages to the MQTT broker. This node allows to perform a subscription to a topic of the MQTT broker.	standard
	**DATA ANALYTICS** Request performed on a Container including a Python data analytics, which is loaded into the node and the container is created at the first Deploy of the Processing Logic. Similar Approach is performed for RStudio Data Analytics.	Snap4city
	**SPLIT:** This block takes in input a buffer, or an array, or an object and split it on a set of messages in output, for each line in the buffer, each element of the array, each element in the object, respectively.	standard
	**JOIN:** This block takes in input a set of messages and join/merge them into a single message (string, buffer, array or object, etc.), on the basis of specific criteria.	standard

DO NOT USE NOW

Integration with ClarML, MLOps, AI, HPC

 	**Exploit MLOps Clusters of CPUs/GPUs and HPC** The request of analytic execution is performed: (i) on demand, which implies the allocation of a process on container allocated on demand on some cluster and perform a single execution; (ii) on a stable analytic process which expose some API to respond in fast manner to request without any overhead of loading container and processes in memory.	Snap4City

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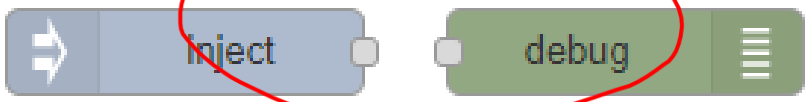
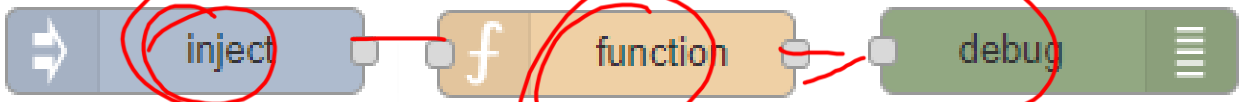
Some patterns

Periodic or Sporadic events to data collection, processing

1) Hello world of node-red, the inject may provide a string to the debug.



2) Hello world of node-red at two steps, the inject provides a push while a JSON is created into the function as *msg.payload = {……}* and sent/shown to/by the debug.



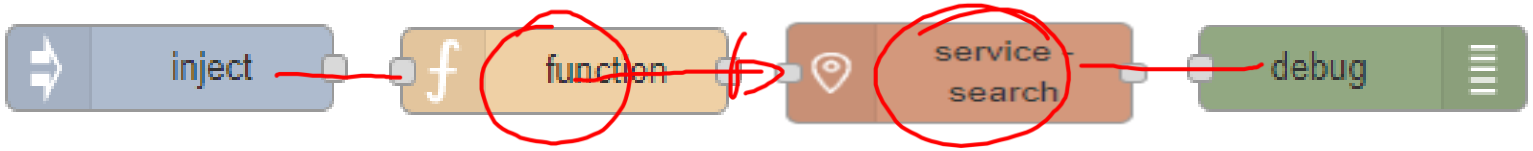
Even Driven

3) Event data reception from an MQTT broker, transformation and send it to the storage pushing data into the Orion Broker V2.

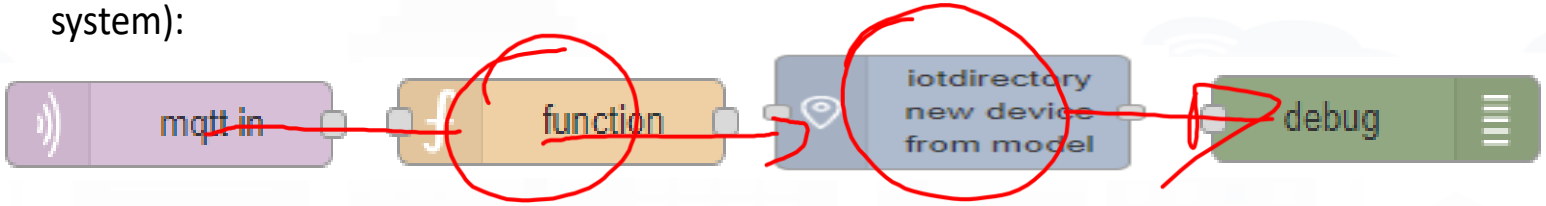
4) request on inject of a SURI to the storage to see data on debug.

Even Driven

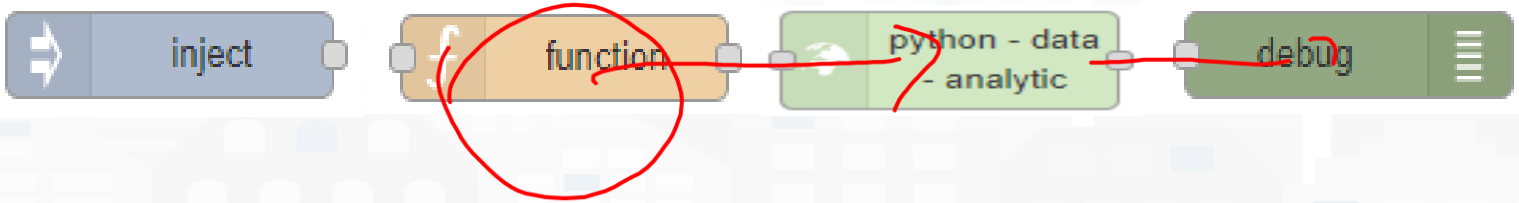
1) Preparation of data request on function, query to the storage and see data result on debug.



2) Event data reception from an MQTT broker, transformation to create an Entity Instance from a known Entity Model, debug to see eventual errors, for example if the device is already present (to avoid production of error, one may verify if the Entity Instance is already present by posing a query on the system):

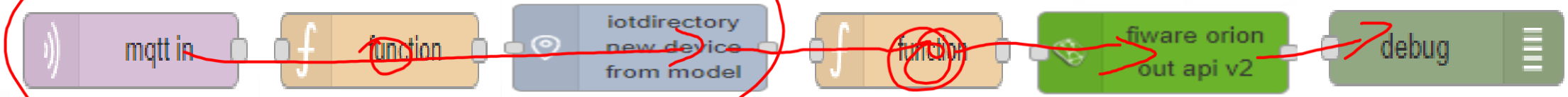


3) Preparation of data parameters on function, request computing Data Analytic, see data result on debug.



Typical strange patterns that may be not efficient in most cases:

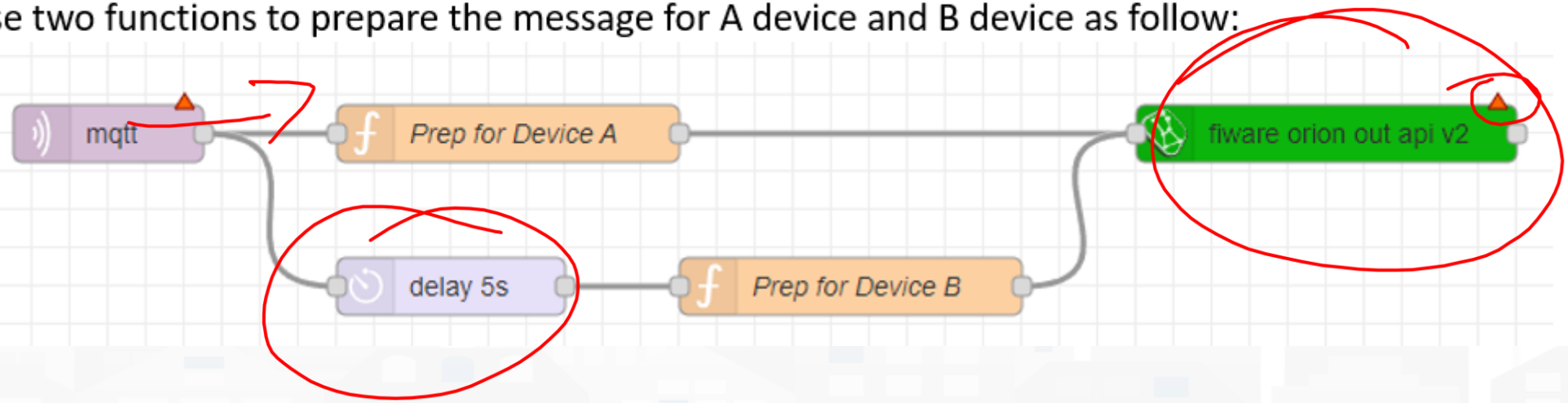
A. data reception from an MQTT broker, their transformation to create an Entity Instance from a known Entity Model, contextually to create and send an Entity Message into newly created Entity Instance, the debug to see eventual errors. This approach is typically strange since at each new message the Entity Directory is queried to see if the Entity is already be created and if not to create it and then pass the data to register the message. In most cases, it is much better to decouple the activity of creating with respect to that of sending message. In fact, this approach would largely reduce the ingestion rate and probably when the Entities are already created would create un-useful workload on Entity Directory (IoT Directory).



In most cases, it should be done the opposite: try to send the Entity Message, if it fails than create a new Entity Instance by known model, and if successful send again the Entity Message, or just wait for the new message to save it the first.

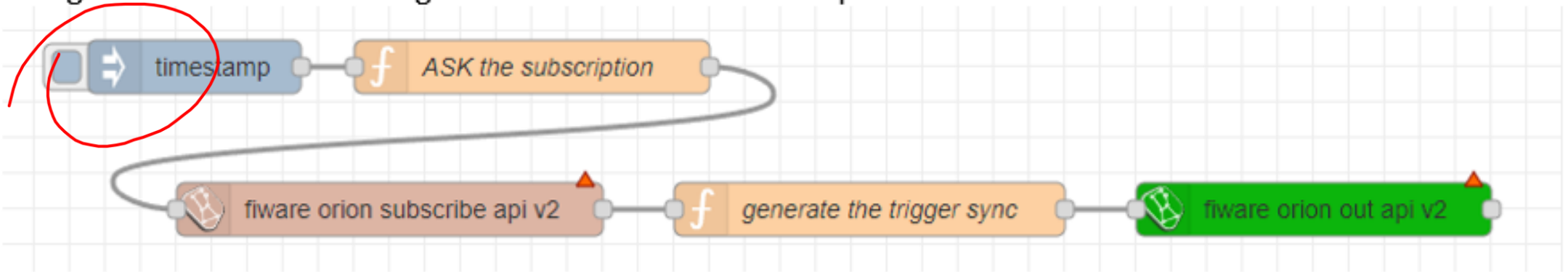
Sync data changes on Entities from an Event

If I would like to synchronize a device data A with another B by trigger event, I can do it in several manners. The first case would be the simplest. A triggering message arrives from MQTT event or from some NGSI ORION, or from some MyKPI, from dashboard event button, or email or anything, it does not matter. I can use two functions to prepare the message for A device and B device as follow:

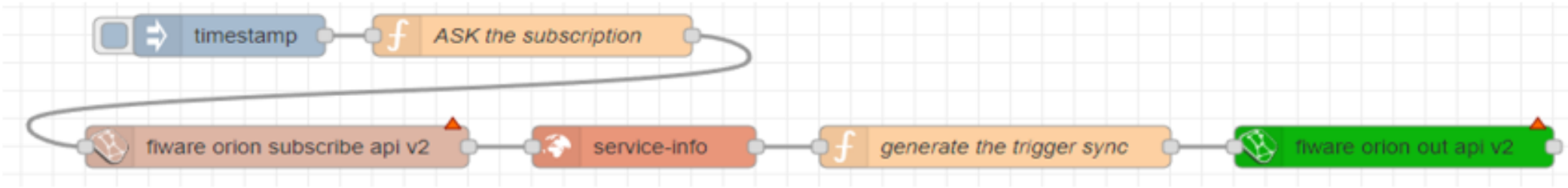


Subscribe on event from Broker, be carefull....

If the event for triggering is from another device/entity changed by some action performed posting a data on Orion Broker V2, you can subscribe with the event on the Orion broker by using a specific Node (do it once otherwise you risk receiving many events). Every time the device / entity receives a message you can take it and generated a new message for a different device and post it on Orion API V2.



If you need to verify if the new data has been changed, you can read the last value of recipient Device/entity to compare and decide to update or not:



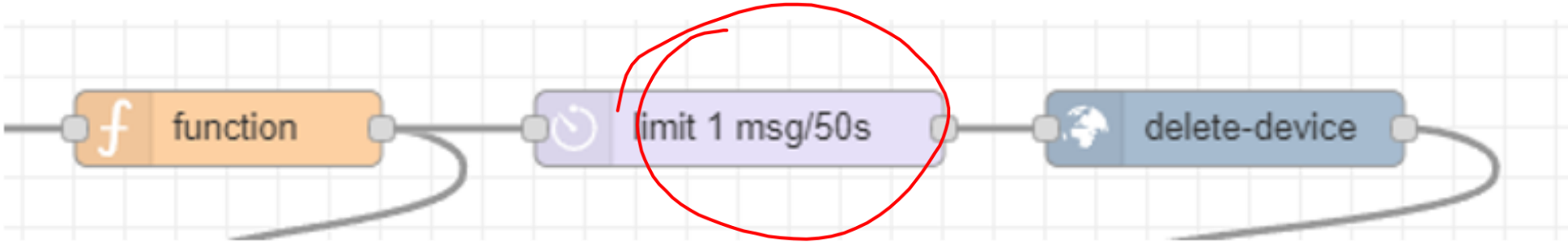
Delete Devices

IV.C.1.e- Delete Devices

Recently a node to delete devices has been added. It has to be used veery carefully since to delete data is always a terrible activity in a big data storage.

The delete of a device is allowed only for the Owner of the device and the root administrator of the platform. The device delete can be also performed from the Entity Directory and now with the Delete-Device node can be performed also from Proc. Logic / IoT App.

The classic pattern is as follows, including preparation, a RATE Limitation avoiding to provide more than one delete message every 50 seconds:



The delete device node needs in input Device ID and Broker ID. All data that you can recover from the Entity Directory.

- **Please note that**
  - the most important blocks nodes to interact with the platforms are reported in these tables to familiarize with the main concepts. ***They are actually families of blocks/nodes*** since many others are present that allow you to perform a very large number of other features.
  - You do not need to take care of Authentication and Authorization, all is performed via SSO, Access Tokens.
  - YOU DO NOT HAVE TO ACCESS AT THE API all is provided in terms of NODEs/BLOCKS into IoT APP. Everything can be parametrized via JSON passed in input to the nodes.
  - nodes input as JSON is primary mode for setting parameters
    - While they can be also configured from their user settings via user interface

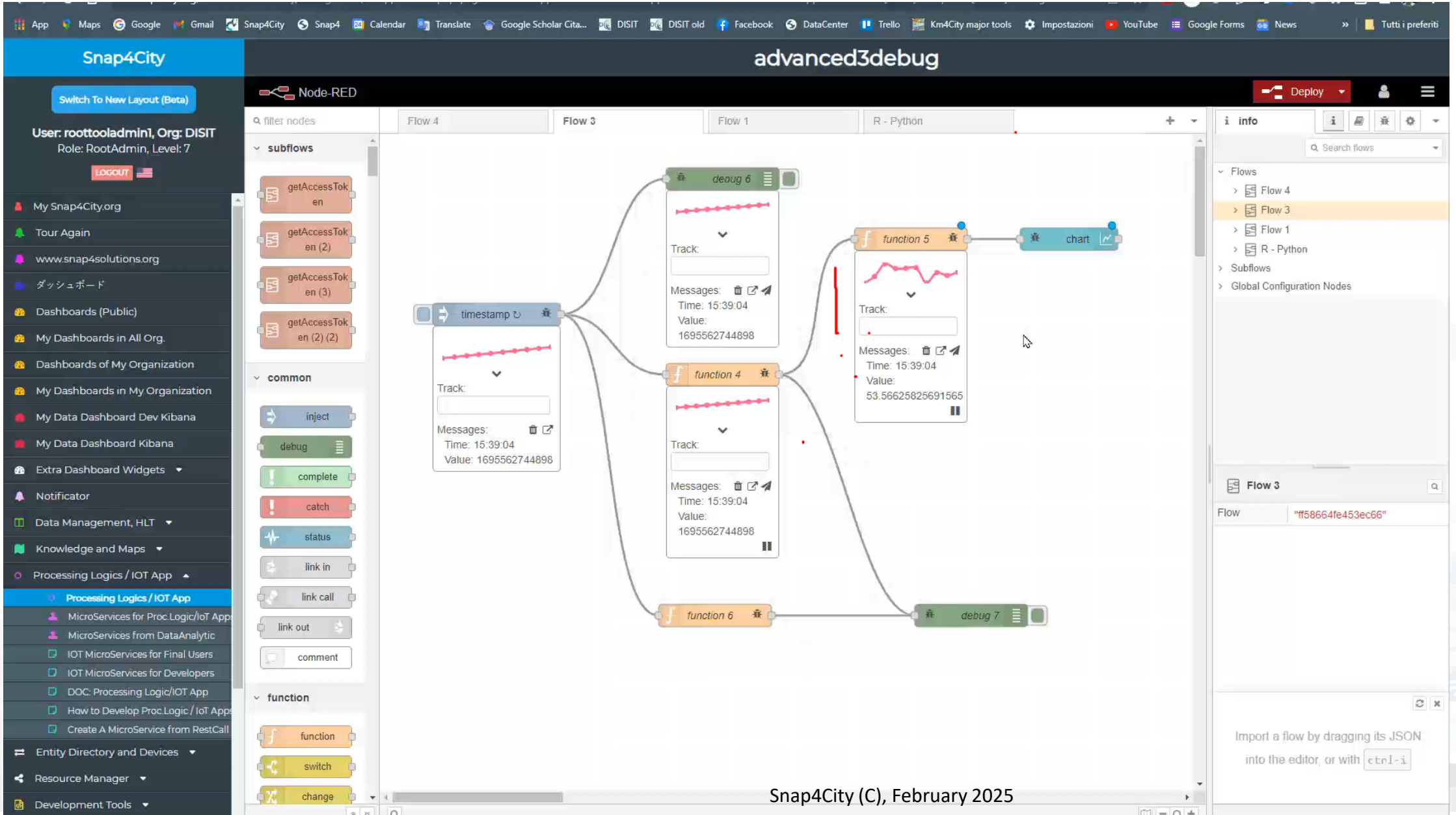
Programming Paradigm comparison

Execution Environment	JavaScript Runs in the browser (e.g., Chrome, Firefox, Edge)	NODE-RED + Snap4City
Programming Model	Procedural, asynchronous, and event-driven	Flow-based programming with visual node wiring, Event-driven, asynchronous, and non-blocking
Use Case	Enhancing web pages, UI interactivity, handling DOM events	IoT, automation, API orchestration, workflow management
Event Handling	Uses addEventListener, Promises, and Async/Await	Event-driven flows triggered by nodes (e.g., HTTP requests, MQTT, WebSockets)
Data Processing	Manipulates DOM, handles user inputs, and fetches API data	Processes messages between nodes (JSON-based) + HTTP, WS ….
Scalability	Limited to browser capabilities; depends on front-end frameworks (React, Angular, Vue)	Highly scalable, can integrate with databases, cloud services, and IoT devices, supports microservices and API-driven architecture
Integration	Primarily interacts with REST APIs, WebSockets, and browser storage	Easily integrates with MQTT, databases (MongoDB, MySQL), REST APIs, WebSockets, and hardware devices
Security Considerations	Runs in a sandboxed environment, limited file system access	Automated inplatform and Edge security handling, as it runs on a server and interacts with external systems. Additional security
Development Approach	Written manually in code editors (VS Code, etc.)	Low-code, flow-based, drag-and-drop UI
Debugging	Uses browser DevTools (console, breakpoints)	Uses built-in debug node and logs, additional Debugging capabilities
Deployment	Deployed in web browsers, hosted via CDNs or bundled	Runs on local, edge and on cloud servers, Docker, Kubernetes, or standalone Node.js environments

Comparison

paradigm	JavaScript traditional	NODE-RED + Snap4City
For on vector iteration	For on vector iteration	Split and single message processing
Variable on process	Local Variables	Status variable on **msg.xxxxx** to be passed ahead, custom made but temporary
Status Variable	Local variables	Local variable of flow and global node-RED
General Status interprocesses	On local database	On MyKPI, On Entities (open search), scalable, GDPR, etc.
User Interface in execution	HTML, not scalable, unsafe	Local Dashboards (to be avoided), Snap4City Dashboard SSBL WS (to be carefully used, Snap4City Dashboards from Storage !!!
storage	Local Databases, remote databases	Preferring Snap4City: (i) NGSI internal broker for internal database, and (ii) MyKPI, (iii) other facilities of Snap4City.., lastly other Databases
EventDriven	Some solutions, WS, MQTT, etc.	**Any NODE**, preferred: NGSI, MQTT, WS, etc.
API exposed	Local API, not scalable, unsafe	Do not create local API, use SCAPI
Forms from HTML	HTML, not scalable, unsafe	CSBL dashboards to be safe, secure and scalable
security	Hand made	OAuth all automated, GDPR, etc.
DA, ML, AI	Hand Made	All automated, ClearML, API, etc.

Snap4City Node-RED Debug extending Cauldron

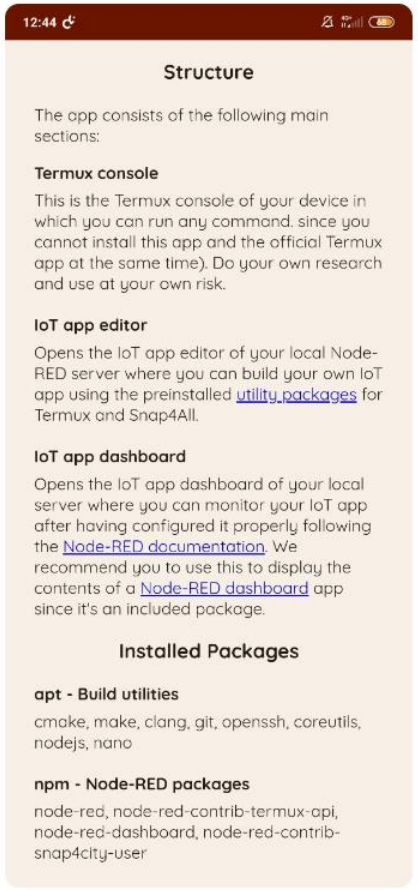

App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCenter Trello Km4City major tools Impostazioni YouTube Google Forms News Tutti i preferiti
Snap4City
advanced3debug
Switch To New Layout (Beta)
User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7
LOGOUT
My Snap4City.org
Tour Again
www.snap4solutions.org
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
Notificator
Data Management, HLT
Knowledge and Maps
Processing Logics / IOT App
Processing Logics / IOT App
MicroServices for Proc.Logic/IoT App
MicroServices from DataAnalytic
IOT MicroServices for Final Users
IOT MicroServices for Developers
DOC: Processing Logic/IOT App
How to Develop Proc.Logic / IoT Apps
Create A MicroService from RestCall
Entity Directory and Devices
Resource Manager
Development Tools
Node-RED
Deploy
filter nodes
Flow 4
Flow 3
Flow 1
R - Python
subflows
getAccessTok en
getAccessTok en (2)
getAccessTok en (3)
getAccessTok en (2) (2)
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
function
switch
change
timestamp
Track:
Messages:
Time: 15:39:04
Value: 1695562744898
debug 6
function 4
function 5
chart
53.56625825691565
function 6
debug 7
info
Search flows
Flows
Flow 4
Flow 3
Flow 1
R - Python
Subflows
Global Configuration Nodes
Flow
"ff58664fe453ec66"
Import a flow by dragging its JSON into the editor, or with ctrl-i
IotAppDebug
IOT Application
owner: testnewimages
Management

Snap4All Mobile App

Node-RED on Android

Snap4All mobile app for Android

(a) Home



(b) Info

(c) Console

https://www.snap4city.org/download/video/Snap4All-v1.0.5-large.apk