



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>

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



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DEGLI STUDI
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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>



Be smart in a SNAP!



SMARTCITY
EXPO WORLD CONGRESS

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Ingestion and Interoperability

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

<https://www.snap4city.org/944>

<https://www.snap4city.org/577>

LIVING LAB

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES



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INFORMATICA
E DELL'INFORMAZIONE

DISIT
DIPARTIMENTO DI
SISTEMI
DISTRIBUTI E
INFORMATICA



<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	IoT 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

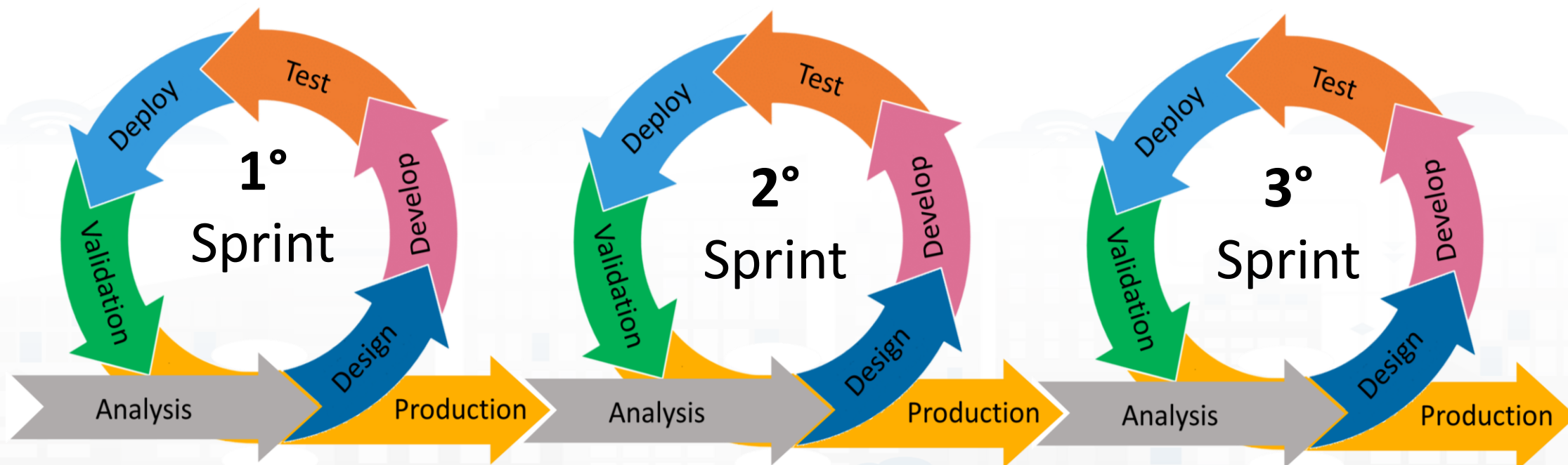
- **Snap4City for Dummies** <https://www.snap4city.org/1046>
- **Course:** <https://www.snap4city.org/944>
 - Introductionary course to Snap4City technology
 - Italian version CN MOST: <https://www.snap4city.org/1068>
- **Older version Course** <https://www.snap4city.org/577>
 - Full training course 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

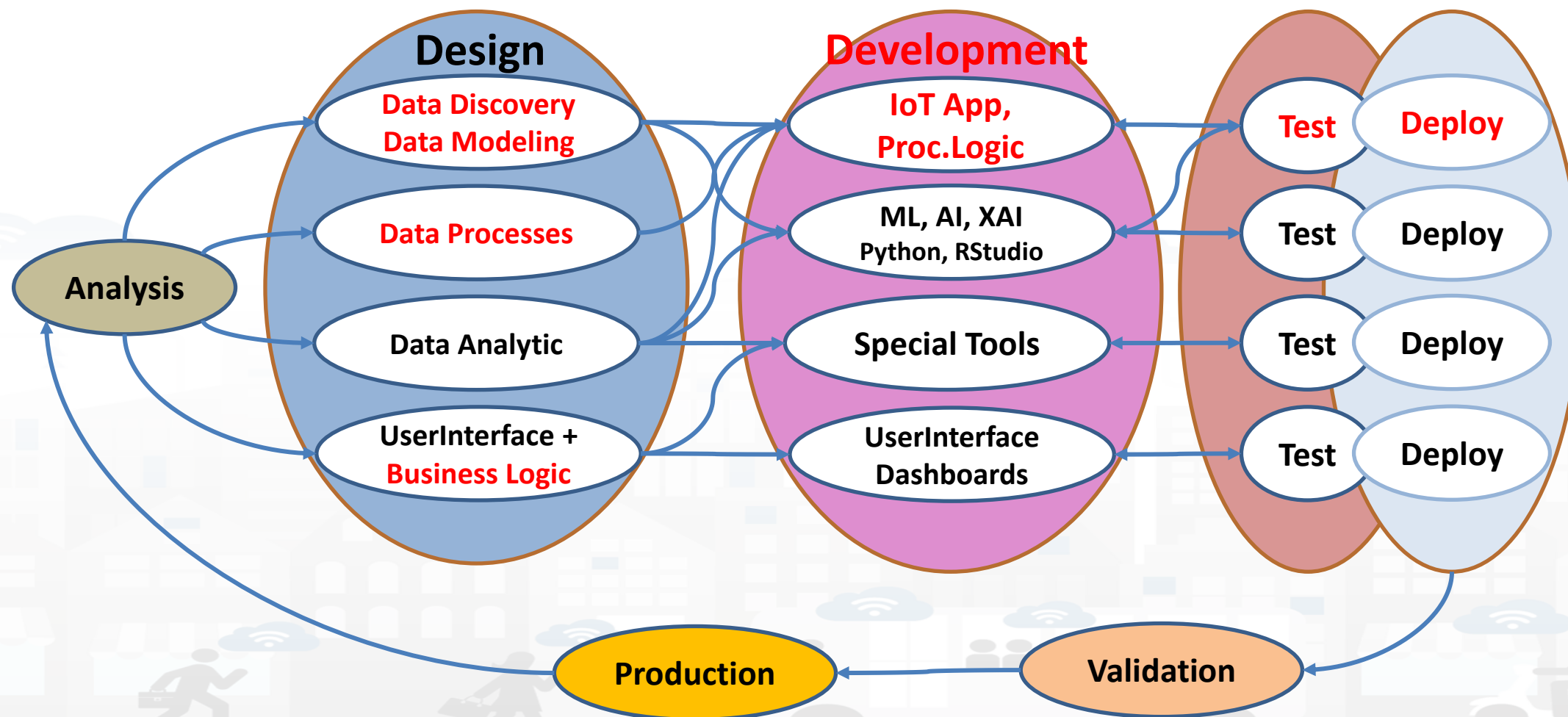
- Recall of Snap4City Architecture
- Data Ingestion Strategy and Orientation
 - Basic entity elements
 - Knowledge Base: Modelling and ServiceURI as Entity Identifier
 - Models vs Devices/Entities and Registration
- Develop: Data Processes Proc.Logic / IoT App
 - Proc.Logic = Node-RED + Snap4City
 - 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



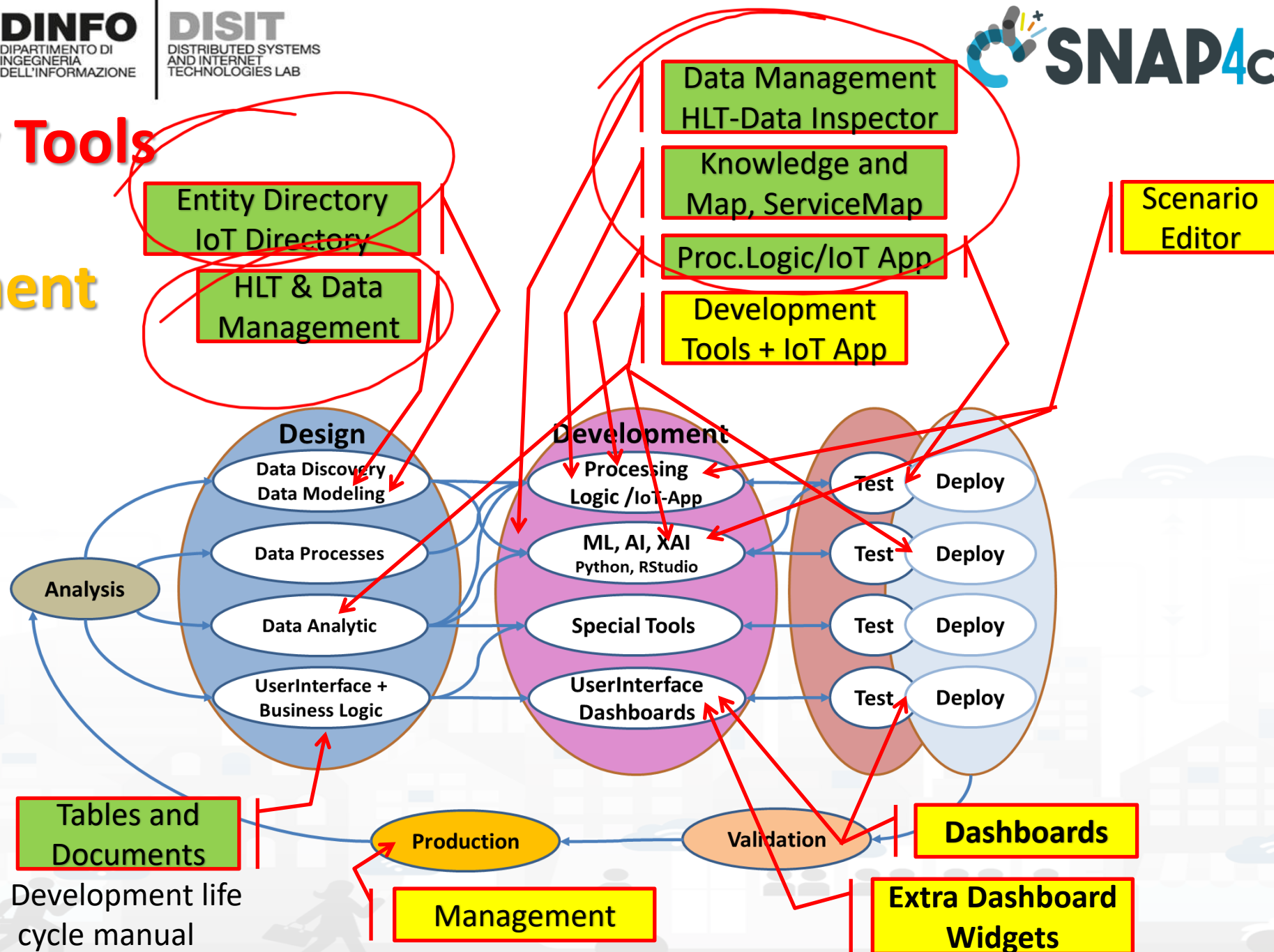
Development Life Cycle Smart Solutions



Snap4City Tools

vs

Development Life Cycle



Development

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



Development Life-Cycle

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

From Snap4City:

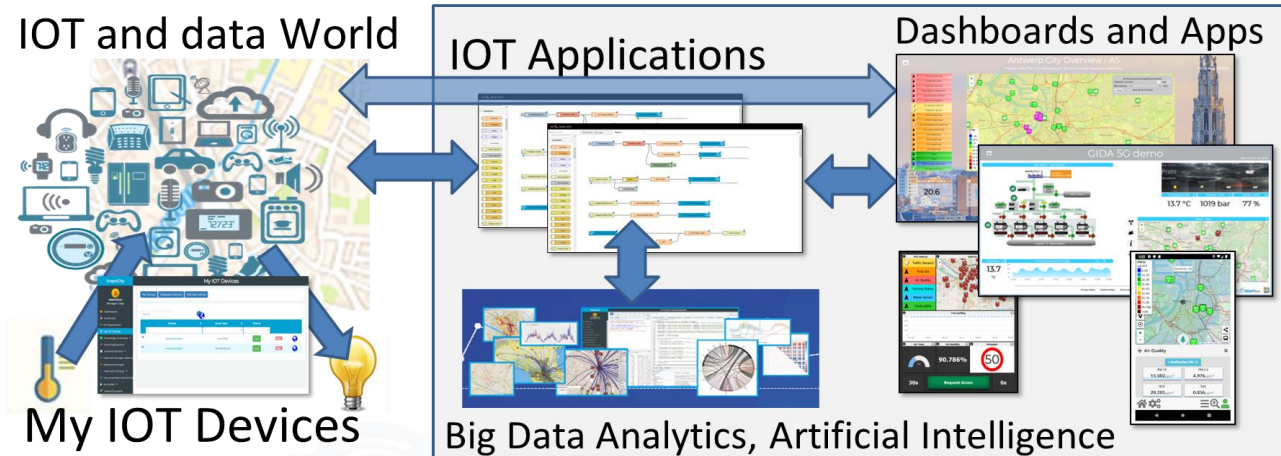
- We suggest you to read the **TECHNICAL OVERVIEW**:
 - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>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

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

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT/IOE DEVICES AND NETWORKS

APPLICATION THE LOGIC AND THE SMARTNESS

LIVING LAB

SNAP4CITY FOR BEGINNERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY AND KM4CITY PROJECTS

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



Digital Twin Solutions for Sustainability

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



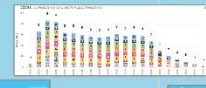
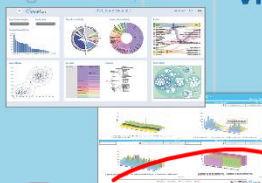
CITY USER'S SERVICES AND TOURISM MANAGEMENT



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



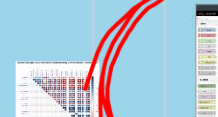
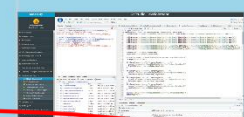
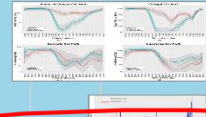
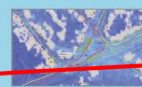
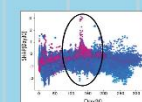
VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS - BUSINESS INTELLIGENCE - SIMULATIONS



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 ...

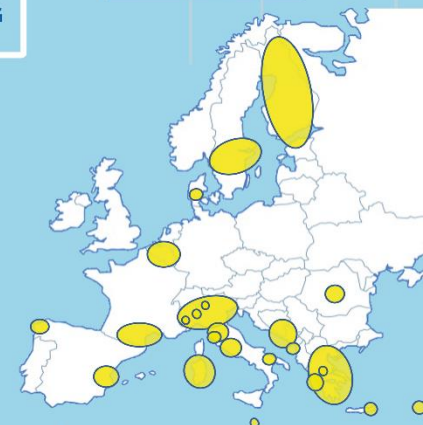


EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE

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



Powered by
FIWARE

FREE
TRIAL

PEN Test
Passed

EU GDPR
COMPLIANT

SNAP4
Appliances and Dockers
Installations

EUROPEAN OPEN
SCIENCE CLOUD

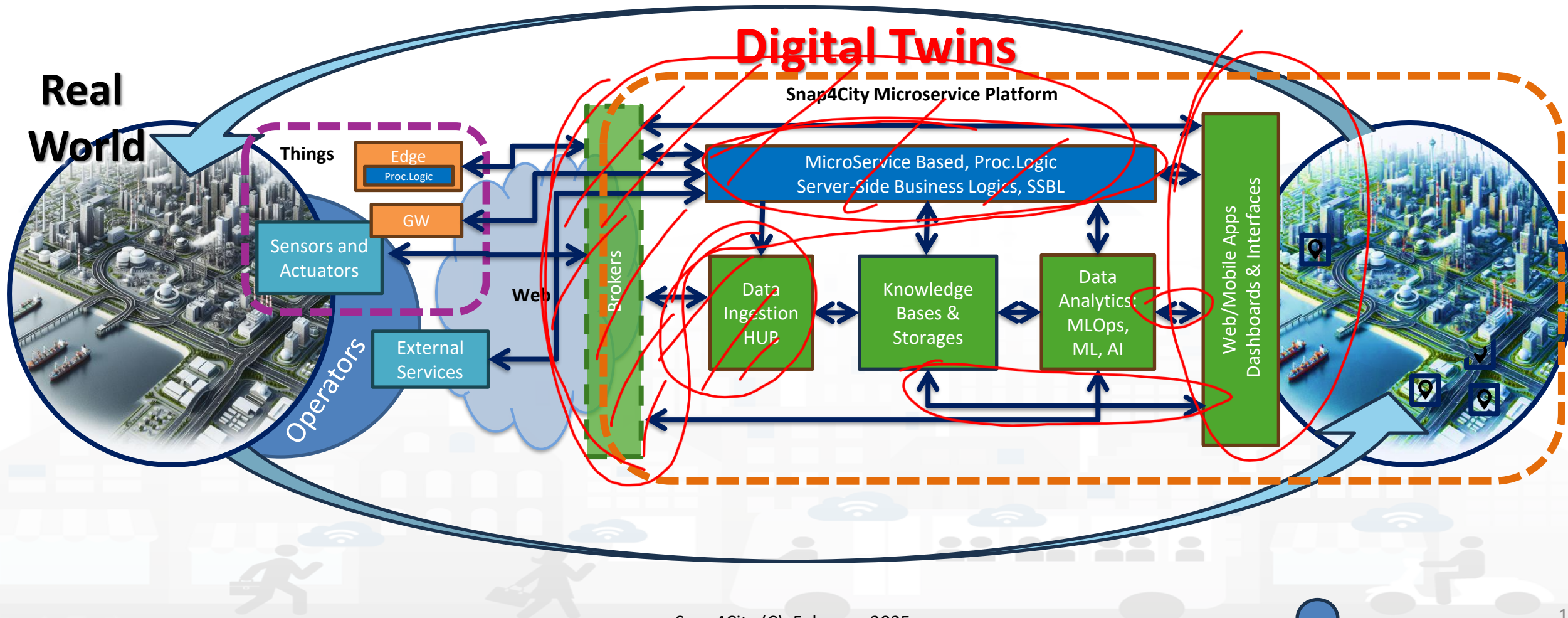
Node-RED

JS Foundation

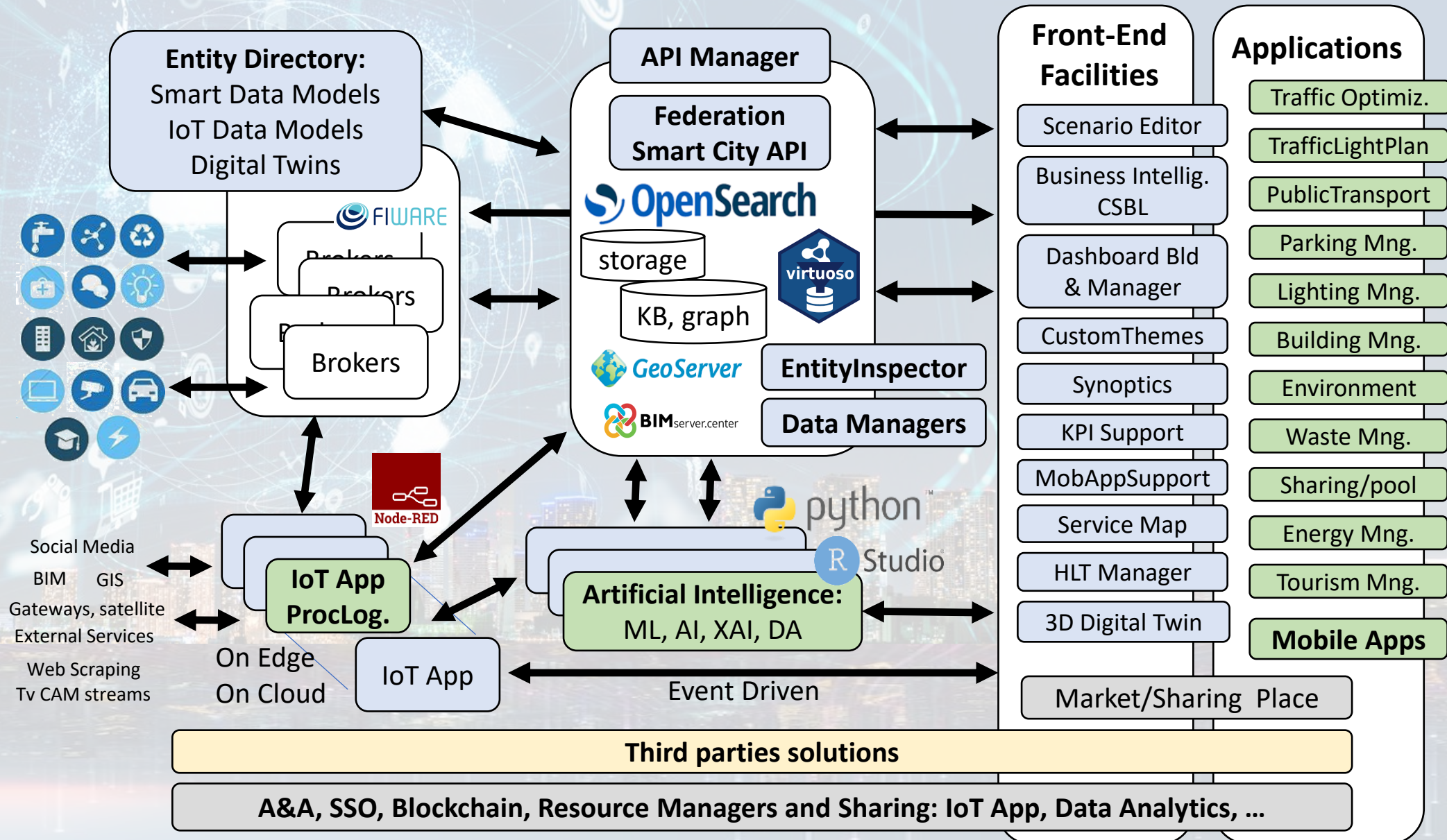
E015
digital ecosystem

NVIDIA

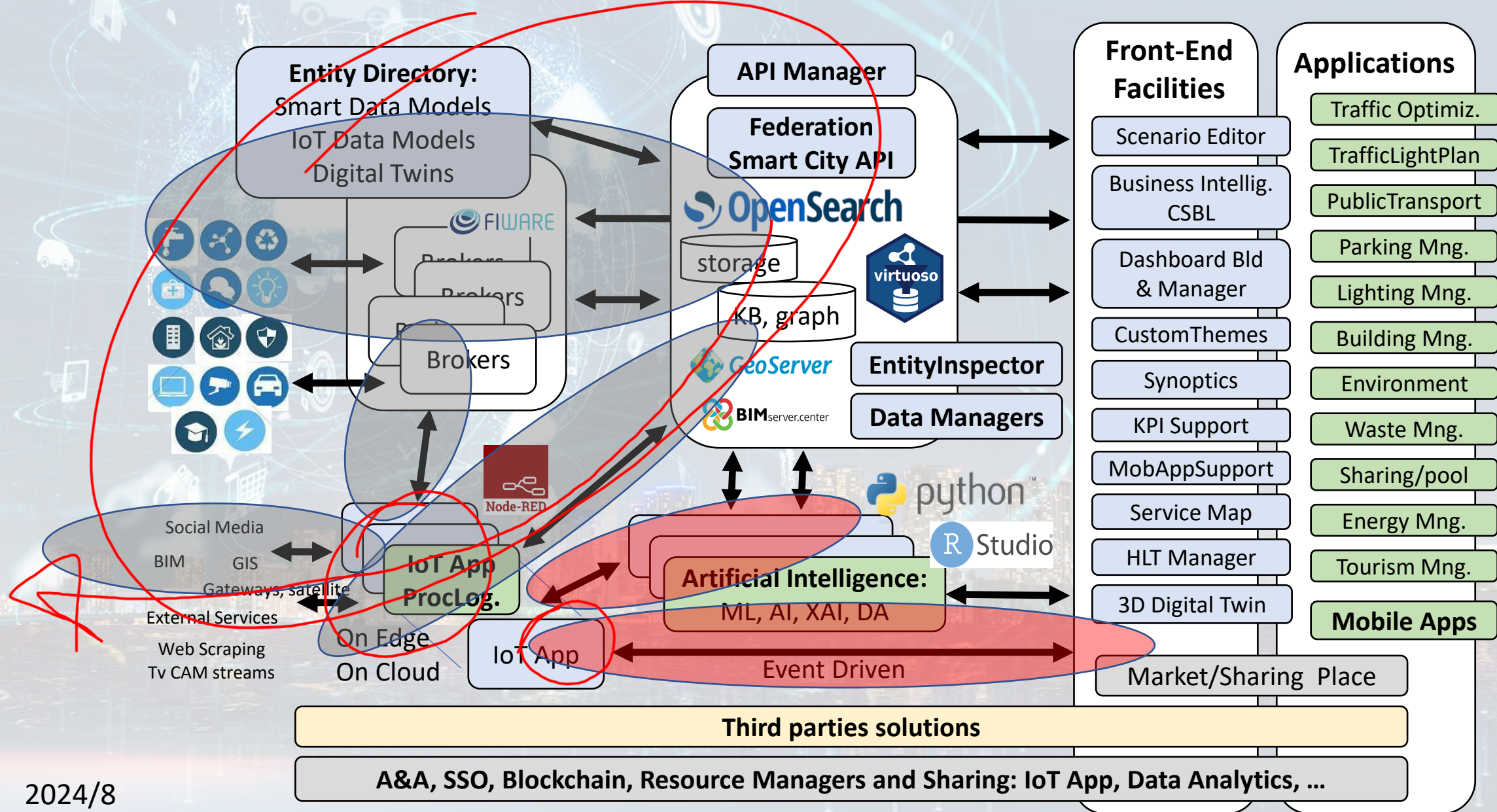
Digital Twin Development Platform



Technical Architecture



Technical Architecture



Data Ingestion Strategy and Orientation

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT/IOE DEVICES AND NETWORKS

IoT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

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SNAP4CITY ARCHITECTURE AND SCOPE OF DEVELOPMENT AND USER

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- Acknowledgements

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.

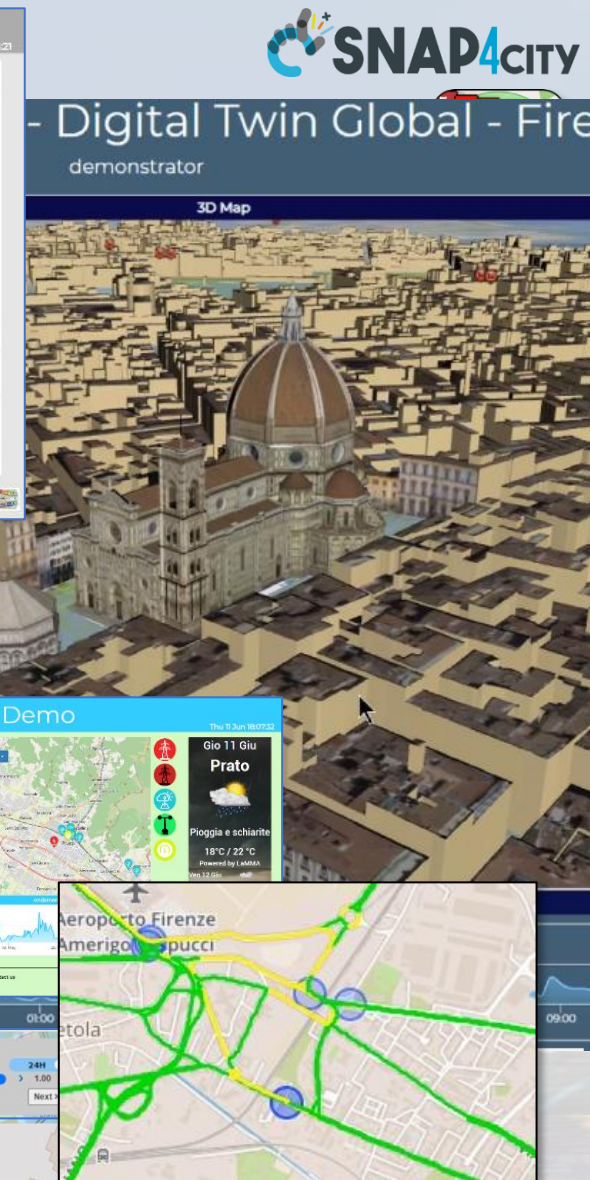
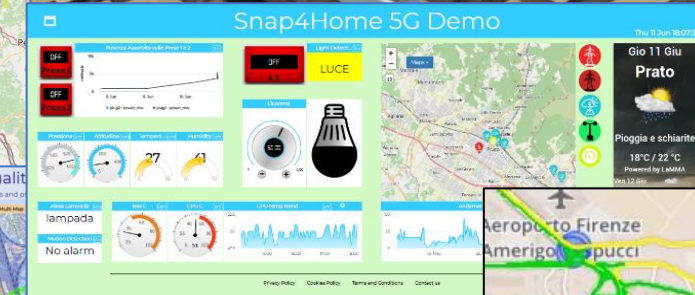
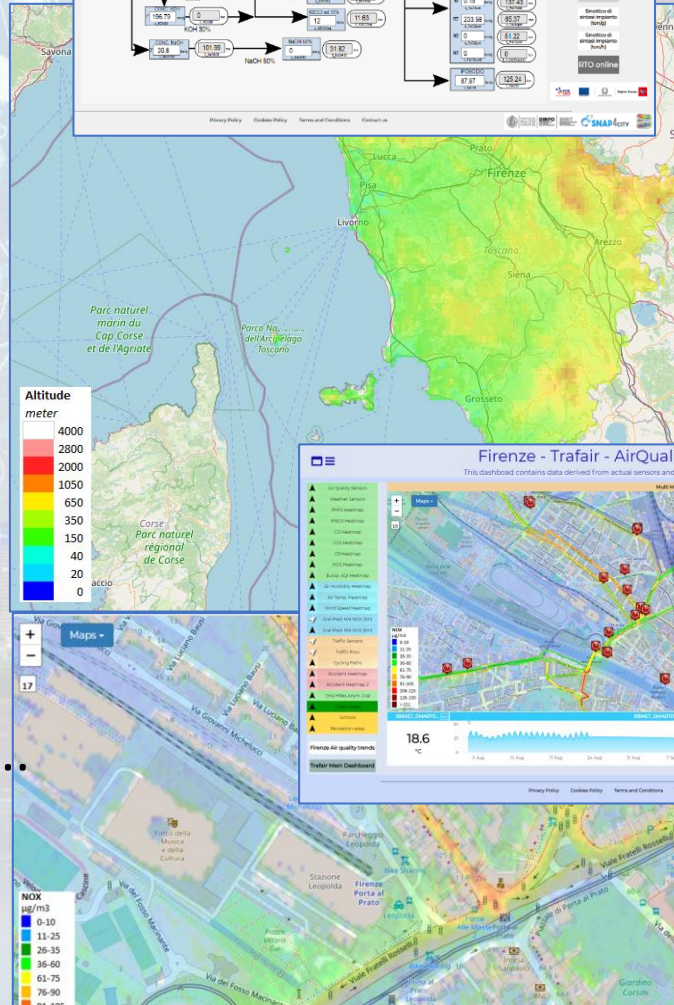
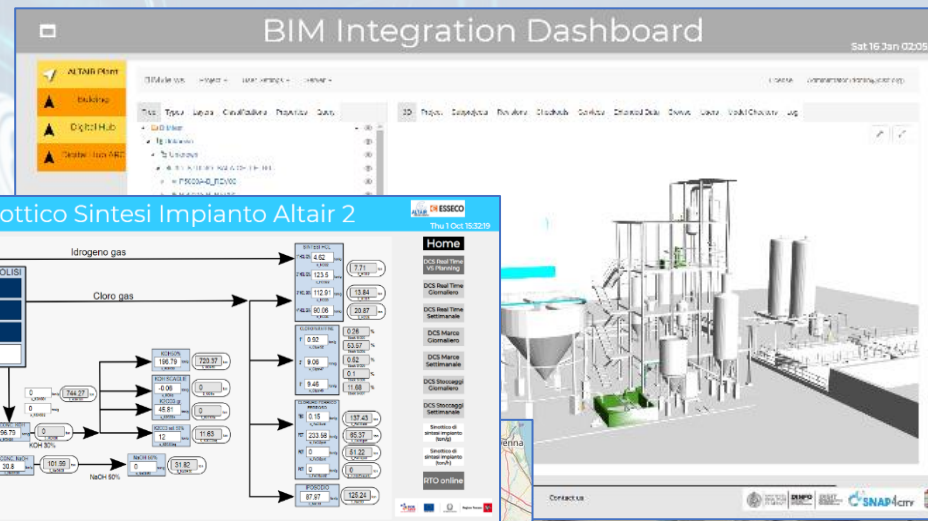


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Snap4City (C), February 2025



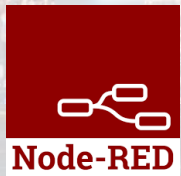
Standards and Interoperability (10/2024)



Compliant with:

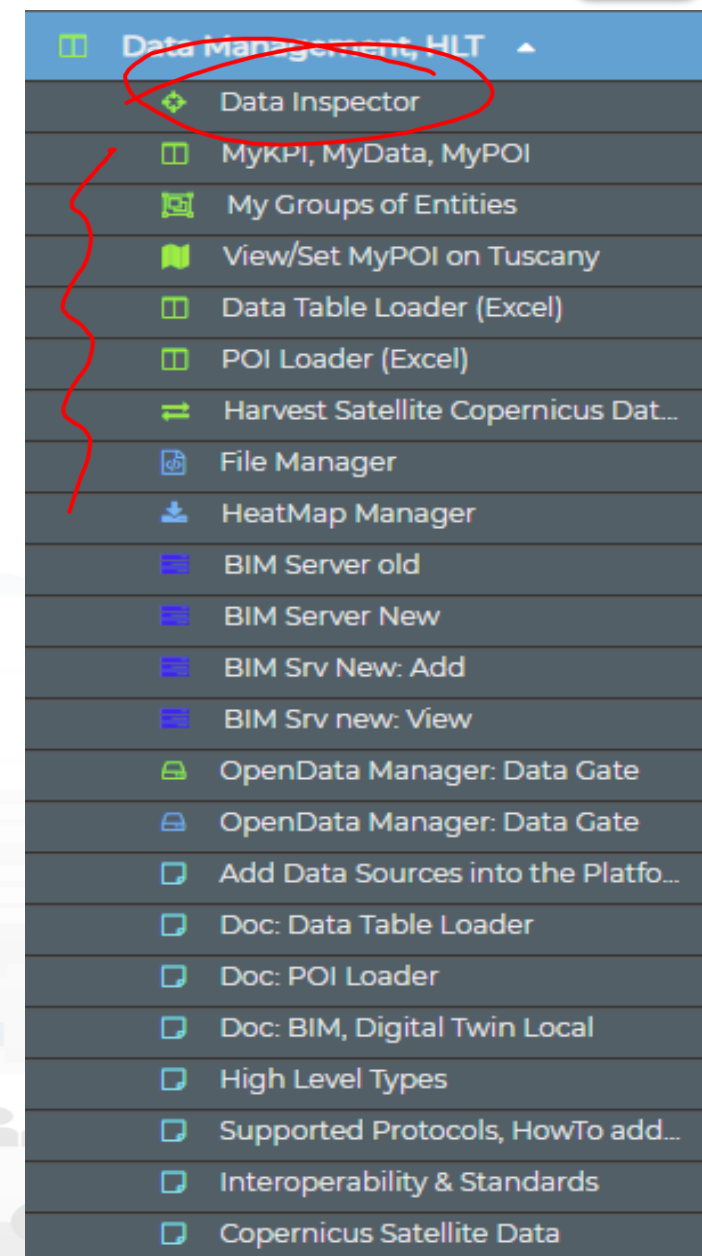
- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, EnOcean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **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 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](#)

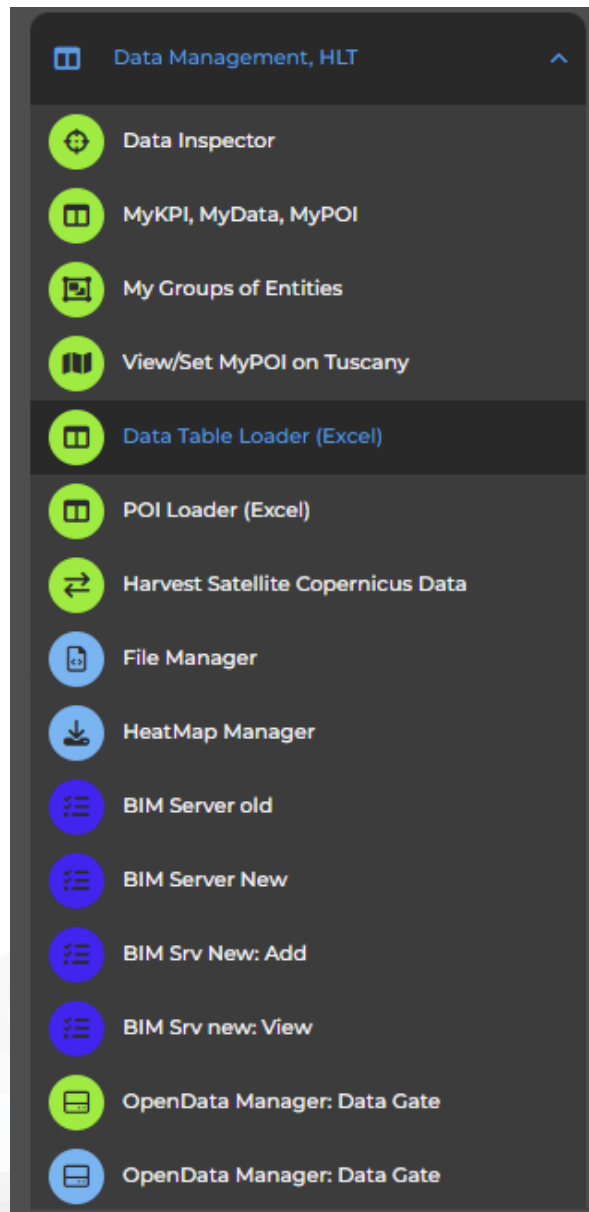


The main High Level Types

- **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
<i>Messages exchanged with Dashboards</i>	<i>A set of values for each time instant of observation (dateObserved)</i>	No/No
<i>Messages exchanged with Synoptics</i>	<i>A set of values for each time instant of observation (dateObserved)</i>	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 ▾

Notifier

Data Management, HLT ▴

Data Inspector

MyKPI, MyData, MyPOI

My Groups of Entities

View/Set MyPOI on Tuscany

Data Table Loader (Excel)

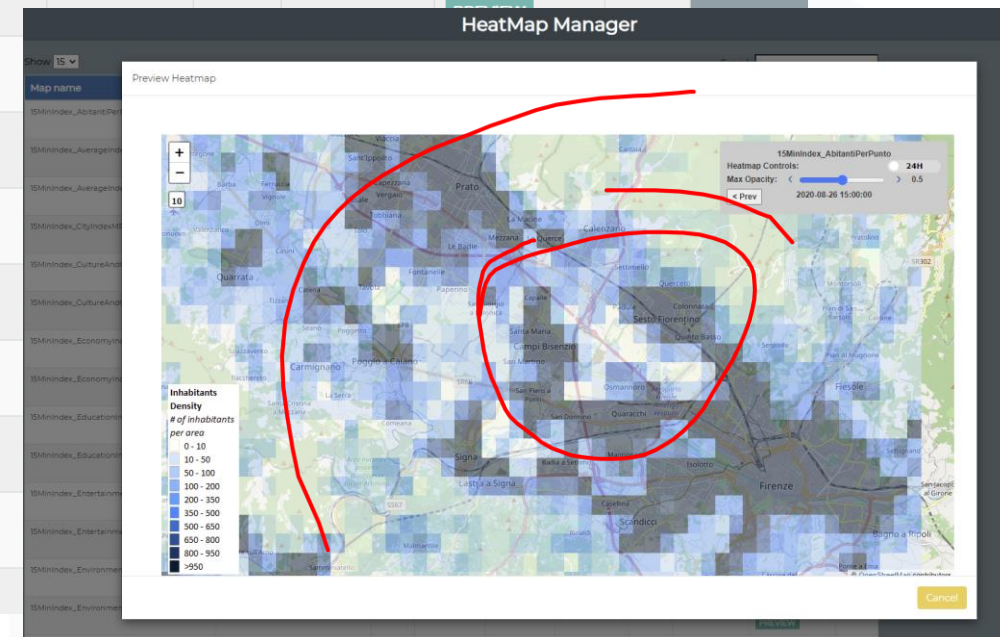
POI Loader (Excel)

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	CulturaI_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							
15MinIndex_EntertainmentSocialIndex	VIEW EDIT 15minsubindex	VIEW							
15MinIndex_EntertainmentSocialIndexBologna	VIEW EDIT 15minsubindex	VIEW							



TrafficFlow Manager

Snap4City

Switch To New Layout (Beta)

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

LOGOUT

- Data Management, HLT
- Data Inspector
- MyKPI, MyData, MyPOI
- My Groups of Entities
- View/Set MyPOI on Tuscany
- Data Table Loader (Excel)
- POI Loader (Excel)
- Harvest Satellite Copernicus Data
- Data Inspector OpenSearch
- File Manager
- HeatMap Manager
- ColorMap Manager
- TypicalTimeTrend Manager
- TrafficFlow Manager**
- TVCam Manager
- OD Manager
- BIM Manager
- BIM Server old
- BIM Server New
- BIM Srv New: Add
- BIM Srv new: View
- OpenData Manager: Data Gate
- OpenData Manager: Data Gate
- OpenData Harvester: Data Gate
- Add Data Sources into the Platform
- Doc: Data Table Loader

TrafficFlow Manager

Show 15

Search

Flux Name	Locality	Organization	Scenario	Instances	View Data	Metric	ColorMap	Delete	Preview	Unit of Measure
+ cinque	nomedelloscenario	Toscana	cinque	3	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle per 20m
+ FirenzeFIPILITrafficRealtime	FirenzeFIPILI	Toscana	TrafficRealtime	11241	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle per 20m
+ FirenzeFIPILITrafficScenarioScenario1before	FirenzeFIPILI	Toscana	Scenario1before	1	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle per 20m
+ FirenzeFIPILITrafficScenarioScenarioAFeb2020	FirenzeFIPILI	Toscana	ScenarioAFeb2020	14	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenarioAFeb2020TTT	FirenzeFIPILI	Toscana	ScenarioAFeb2020TTT	14	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenarioANov2019	FirenzeFIPILI	Toscana	ScenarioANov2019	14	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenarioANov2019TTT	FirenzeFIPILI	Toscana	ScenarioANov2019TTT	14	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario2	FirenzeFIPILI	Toscana	stefano2	4	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario2TTT	FirenzeFIPILI	Toscana	stefano2TTT	4	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario3	FirenzeFIPILI	Toscana	stefano3	7	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario3TTT	FirenzeFIPILI	Toscana	stefano3TTT	7	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario5	FirenzeFIPILI	Toscana	stefano5	8	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario5TTT	FirenzeFIPILI	Toscana	stefano5TTT	8	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle
+ FirenzeFIPILITrafficScenarioScenario6	FirenzeFIPILI	Toscana	stefano6	5	VIEW	TrafficDensity	VIEW EDIT densityTrafficMap	DEL	PREVIEW	vehicle

TrafficFlow Manager

Preview Traffic flow

Free street

Fluid traffic

Heavy traffic

Very heavy

Sensor position

FirenzeFIPILITrafficRealtime

Traffic Heatmap Controls:

Max Opacity: 1

24H

2024-10-01 23:00:00

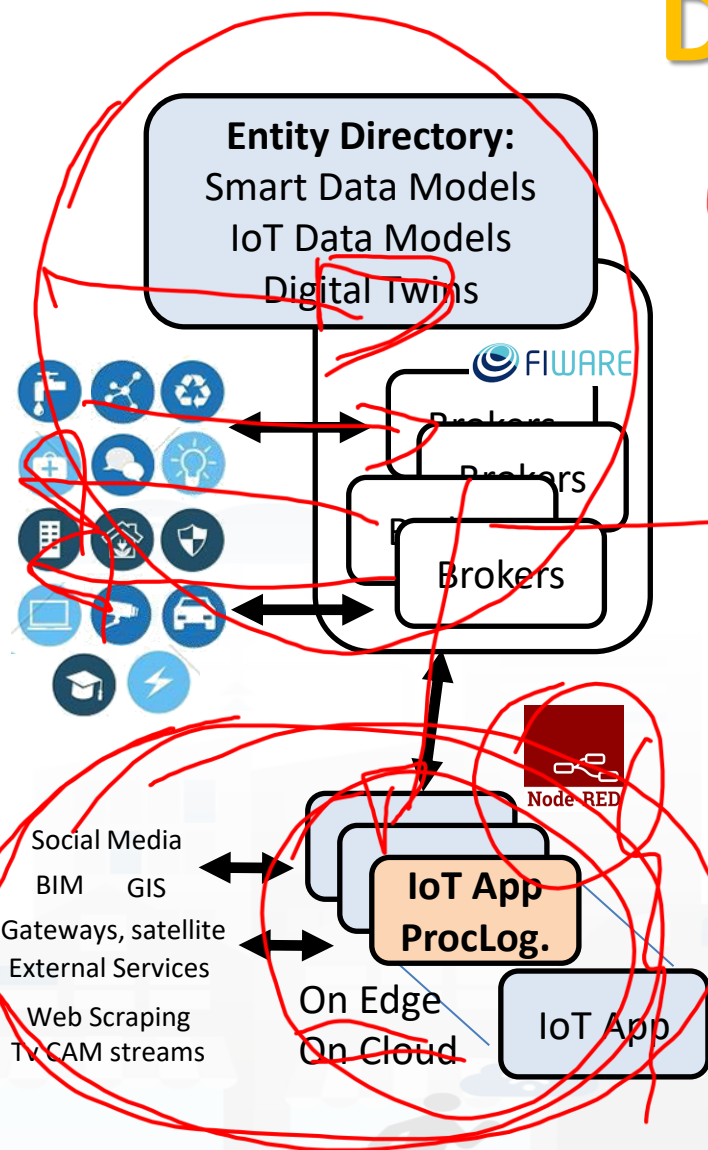
Prev

Cancel

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

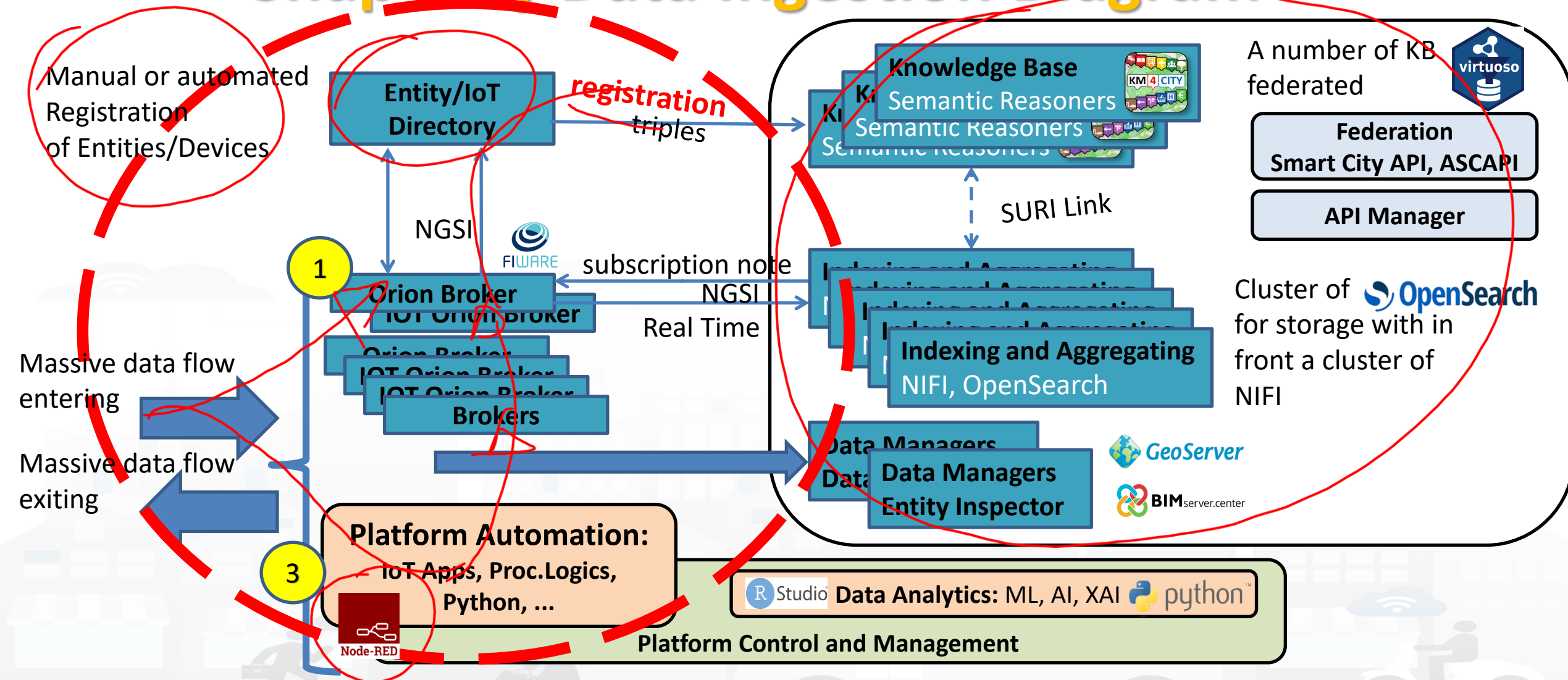
- the data messages arriving in **PUSH** on the external broker,
 - Have to be **mapped** to a known Model **and** referring to a known Device/Entity
 - To be AUTOMATICALLY: *stored, indexed*, and ready to be used by Wizard, Dashboards, Views and Applications

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

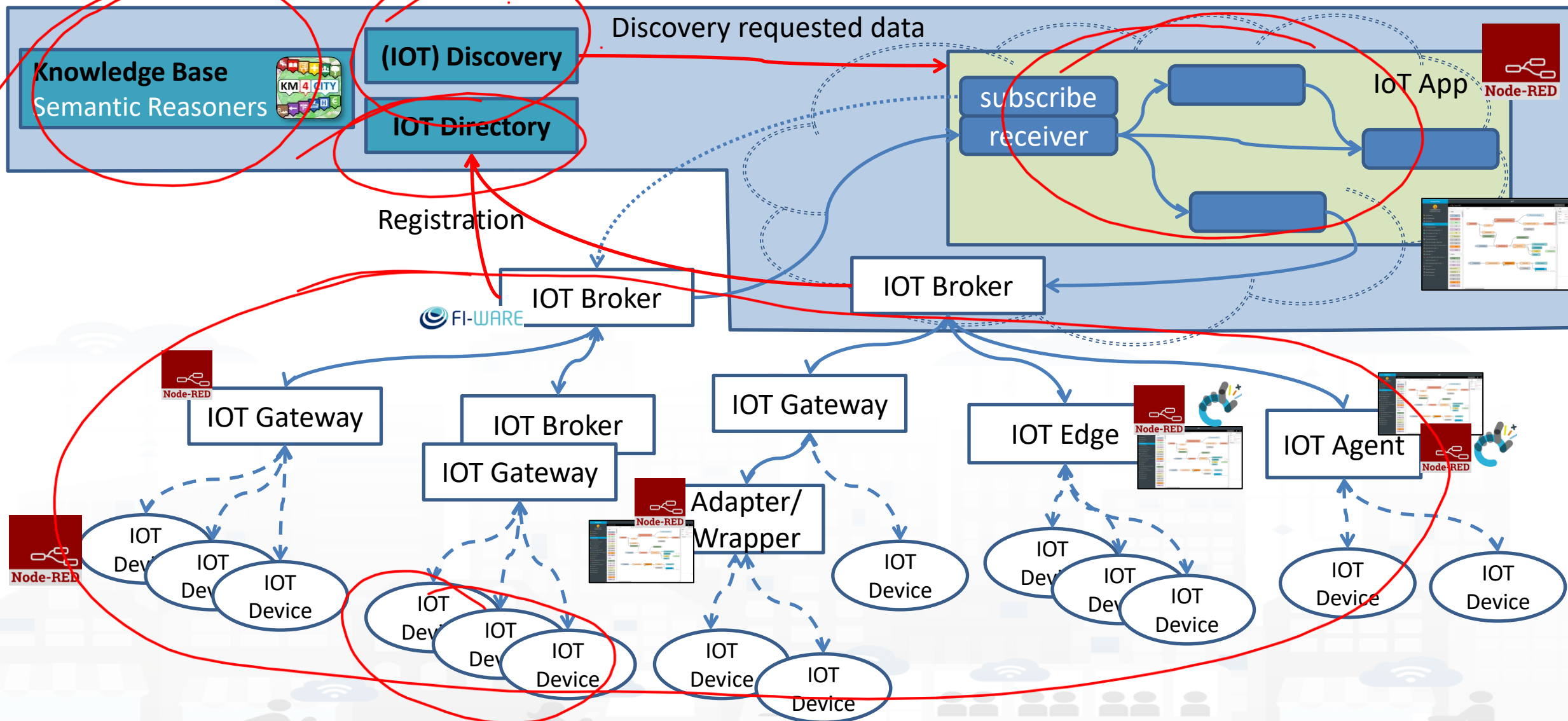
- **mapped** on an Snap4City IoT/Entity Model and Entity/Device Instance
- **ingested in real time or batch**, by a process implemented as
 - an **IoT App/Proc.Logic**, on container, on cloud or Edge
 - a **Python** or other language, on container, on cloud or Edge

Snap4city Data Ingestion Diagram

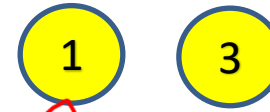


30

IoT Network



Basic Concepts of Data Ingestion for



- **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

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

IOT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADVANCED
SMART CITY API,
MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

DATA ANALYTICS
USING
INTELLIGENCE
WHAT-IF AND
SIMULATION

SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM. OPENED
TO DEVELOPERS
AND STAKEHOLDERS

DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

Snap4City

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

LOGOUT

- My Snap4City.org
- Dashboards
- 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, my Data, OpenData
- Knowledge and Maps
- Service Map (Toscana)**
- Service Map 3D (Firenze)
- Helsinki Service Map
- Antwerp Service Map
- Garda Lake Service Map
- Cagliari Service Map
- Lonato Del Garda Service Map
- Valencia Service Map
- Pont Du Gard Service Map
- Dubrovnik Service Map
- WestGreece Service Map
- Mostar-Bosnia Service Map
- Svealand Service Map
- Roma Service Map
- Pisa Service Map
- Creating WKT
- Service Map 3D (Antwerp)
- Service Map 3D (Helsinki)
- Producing POI triples for KB
- Load WKT on ServiceMap (Helsinki)
- Load WKT on ServiceMap (Toscana)
- Load WKT on ServiceMap (Antwerp)

Service Map (Toscana)

Public transport | Municipalities | Text Search | Address Search | Events

Select an agency:
- Select an Agency -

Select a line:
- Select a Line -

Select a route:
- Select a Route -

Select a bus stop:
- Select a Bus Stop -

Position of selected Busses

Actual Selection
Service: METRO758

Serviceuri: <http://www.disit.org/km4city/resource/METRO758>

Name: METRO758
Nature: TransferServiceAndRenting
Subnature: SensorSite
Address: Lavagnini dir. Viale Strozzi (38)
DBpedia: "Spartaco_Lavagnini"

Property/Value Type	Value
avgDistance	Not Available
avgTime	14.291604
occupancy	Not Available
concentration	8.25
vehicleFlow	1344.0
averageSpeed	29.613344
thresholdPerc	Not Available
speedPercentile	Not Available
congestionLevel	119.0967
anomalyLevel	101.56058

Latest Update: 2021-01-16T13:57:00+01:00

Regular Services | Transversal Services

De/Select All

- ☒ Accommodation +
- ☒ Advertising +
- ☒ AgricultureAndLivestock +
- ☒ CivilAndEdilEngineering +
- ☒ CulturalActivity +
- ☒ EducationAndResearch +
- ☒ Emergency -
- ☒ Carabinieri
- ☒ Civil_protection
- ☒ Coast_guard
- ☒ Corps_of_forest_rangers
- ☒ Emergency_medical_care
- ☒ Emergency_services
- ☒ Fire_brigade
- ☒ First_aid
- ☒ Italian_finance_police
- ☒ Entertainment +
- ☒ Environment +
- ☒ Fire_service +
- ☒ GovernmentOffice +
- ☒ HealthCare +
- ☒ IndustryAndManufacturing +
- ☒ IoTDevice +
- ☒ MiningAndQuarrying +
- ☒ ShoppingAndService +
- ☒ TourismService +
- ☒ TransportServiceAndRenting +
- ☒ UtilitiesAndSupply +
- ☒ Wholesale +
- ☒ WineAndFood +

Filter:
search text into service

Select value type
N. results: 500

Search Range: 2 km
Search Area: select...

Weather Forecast for Municipality of: FIRENZE

Saturday	Sunday	Monday	Tuesday	Wednesday
bit cloudy -2°C / 7°C	overcast -2°C / 6°C	cloudless -3°C / 7°C	cloudy -3°C / 6°C	overcast 5°C / 10°C

Latest Update: 2021-01-16T07:57:00+01:00
<http://www.disit.org/km4city/resource/Firenze1610780220000>

Dev, Entity

Geometry of a POI or Dev

POI

Dev, Entity

Map: Struct. Information

Data Inspector

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
- Data Inspector**
- MyKPI, MyData, MyPOI
- My Groups of Entities
- View/Set MyPOI on Tuscany
- Data Table Loader (Excel)
- POI Loader (Excel)
- Harvest Satellite Copernicus Data
- File Manager
- HeatMap Manager
- BIM Server old
- BIM Server New
- BIM Srv New: Add
- BIM Srv new: View
- OpenData Manager: Data Gate
- OpenData Manager: Data Gate

Data Inspector

Map

METRO729

VALUE NAME: METRO729

DESCRIPTION	DESCRIPTION	RT DATA
congestionLevel	109.37501	Last value Last 4 hours Last 24 hours Last 7 days
dateObserved	2023-07-08T17:15:00.000Z	Last value Last 4 hours Last 24 hours Last 7 days
vehicleFlow	1138.9792	Last value Last 4 hours Last 24 hours Last 7 days

Keep data on target widget(s) after popup close: ☐

Single data widgets
Multi data widgets

Map Controls:

FilterMap GPSUser GPSOrg

Now displaying in Standard Mode

Switch to the Synoptic Mode to select MyKPIs and sensors that you need for your synoptics.

Switch now to the Synoptic Mode

Data sources

High-Level Type	Nature	Subnature	Device/Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO792	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO791	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO793	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO713	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO729	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO7	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO760	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO799	orionUNIFI			sensor_map		2023-07-08 13:55:00		●	2023-07-08 13:55:00

Hide column Reset filters Selected rows: 1 Previous 1 2 3 4 5 ... 262 Next

vehicleFlow

1139

vehicleFlow - Day

New Data Inspector/Wizard

Single data widgets

Multi data widgets

Map Controls:

FilterMap GPSUser GPSOrg

Now displaying in Standard Mode

Switch to the Synoptic Mode to select MyKPIs and sensors that you need for your synoptics.

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Data sources

DT	SM Devl...	Nature	Subnature	Device	Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last Check	Ownership
DT	SM Devl...	Environment	Weather	DIDA1		Santa Verdiana ...	Mio sensore		webpage		2021-11-23 13:44...			2023-07-18 16:0...	public
DT	SM Devl...	TransferService...	SensorSite	METRO11		Altair-soda	Altair Valve State		webpage		2021-06-05 00:00...			2024-01-10 01:3...	public
DT	SM Devl...	IndustryAndMa...	Computer	AltairStatoPom...		Altair-soda	Altair Pump St...		webpage		2021-05-20 13:51...			2024-01-10 01:3...	public
DT	SM Devl...	Environment	Air	IBIMET_SMART...		Altair-soda	Altair Pump 43...		webpage		2021-06-07 17:3...			2024-01-10 01:3...	public
DT	SM Devl...	Environment	Air	ARPAT_QA_FI...		Altair-soda	Altair valve 541		webpage		2021-06-07 17:3...			2024-01-10 01:3...	public
DT	SM Devl...	TransferService...	SensorSite	METRO514		Altair-soda	Altair Pump 4321		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public
DT	SM Devl...	TransferService...	SensorSite	SI052032FS990...		Altair-soda	Altair Stock sta...		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public
DT	SM Devl...	TransferService...	SensorSite	METRO831		Altair-soda	Altair Pump 92...		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public

Search... Search... Search... Search... Search... Search... Search... Search... Search... Search... Search... Search... Search... Search...

Selected rows: 0 Previous 1 2 3 4 5 ... 45711 Next

Search

163

- 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

Snap4City
Data Inspector

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Role: AreaManager, Level: 3

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- MyKPI, MyData, MyPOI
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- File Manager
- HeatMap Manager
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- BIM Server New
- BIM Srv New: Add
- BIM Srv new: View
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- OpenData Manager: Data Gate

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IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO760	orionUNIFI			sensor_map		2023-07-08 14:05:00		●	2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO799	orionUNIFI			sensor_map		2023-07-08 13:55:00		●	2023-07-08 13:55:00

Hide columns Reset filters Selected rows: 1 Previous 1 2 3 4 5 ... 262 Next metro7

vehicleFlow

1139

vehicleFlow - Day

Any Entity has a Semantic Classification

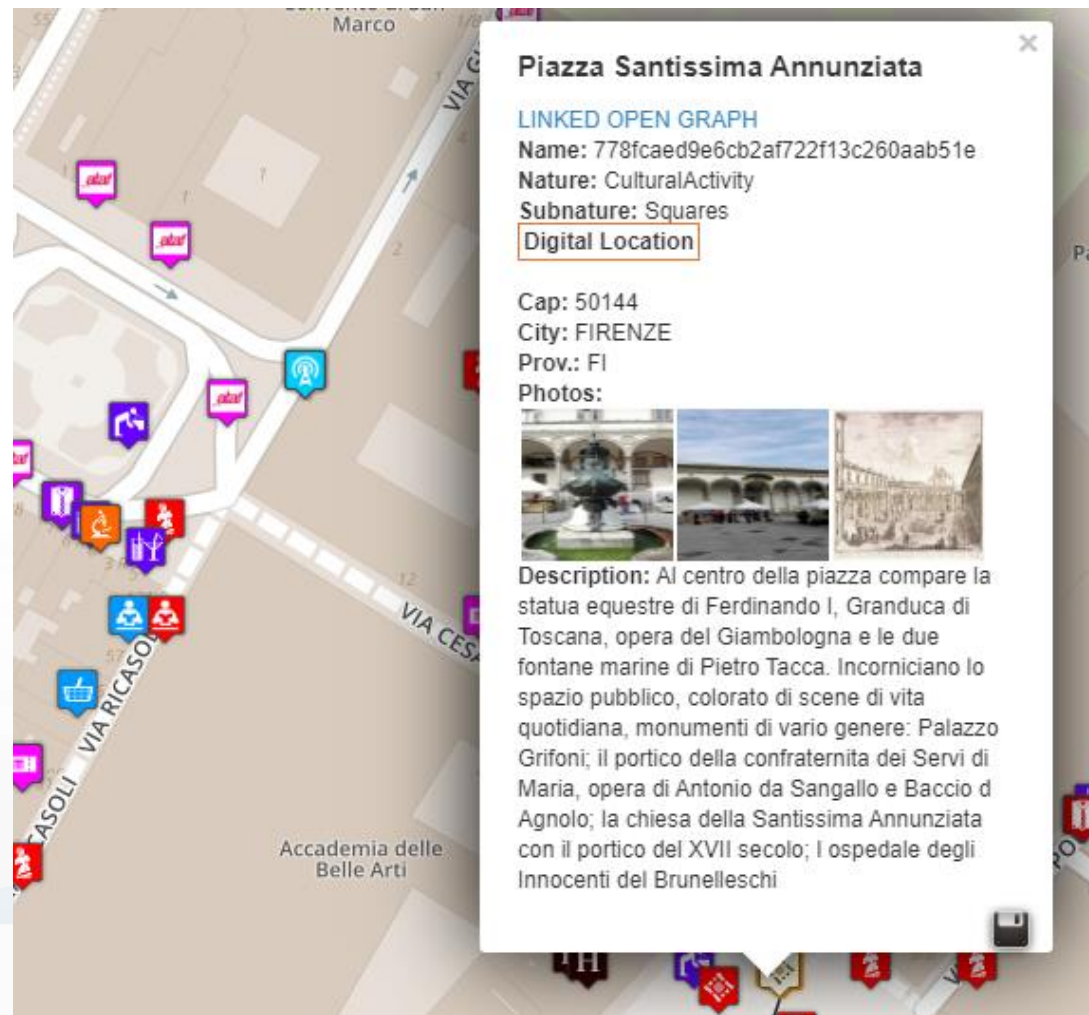
Nature

- 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

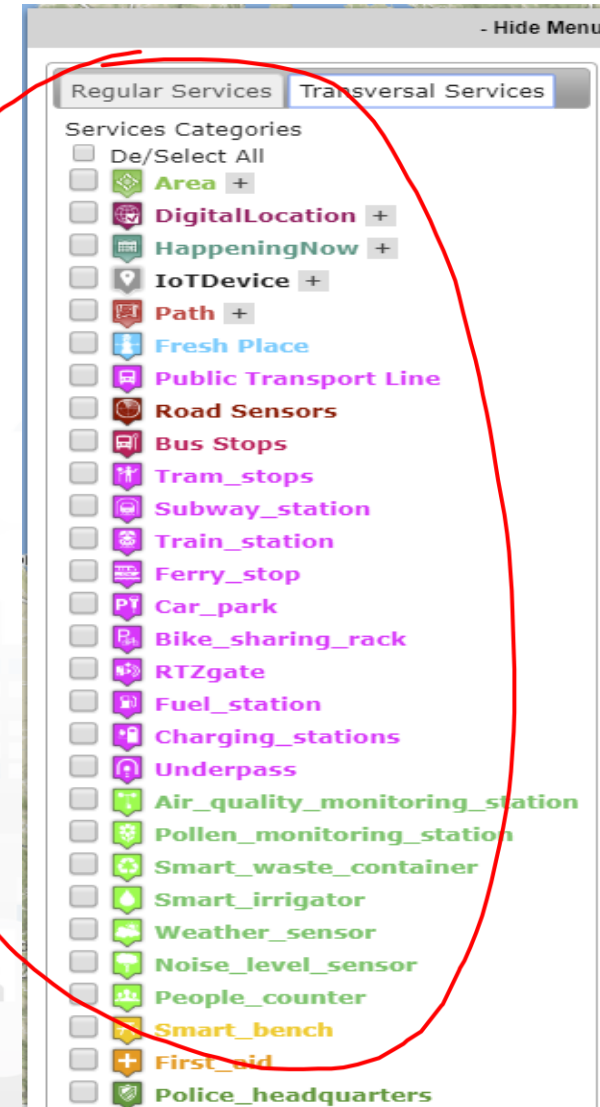


Point of Interests, POI *mainly static data*



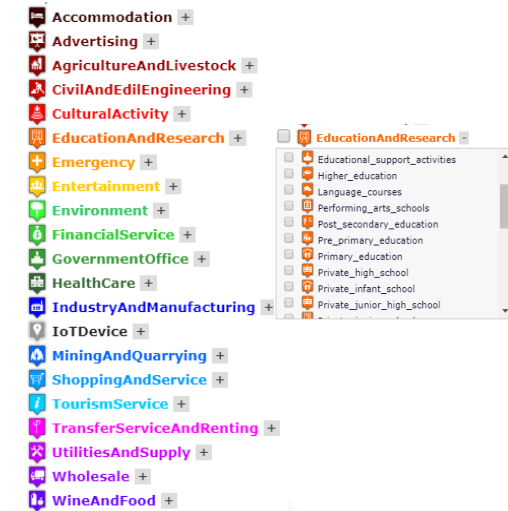
Access to Point of Interest information, POI

- **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.



IOT Device



Entity: IOT
Device

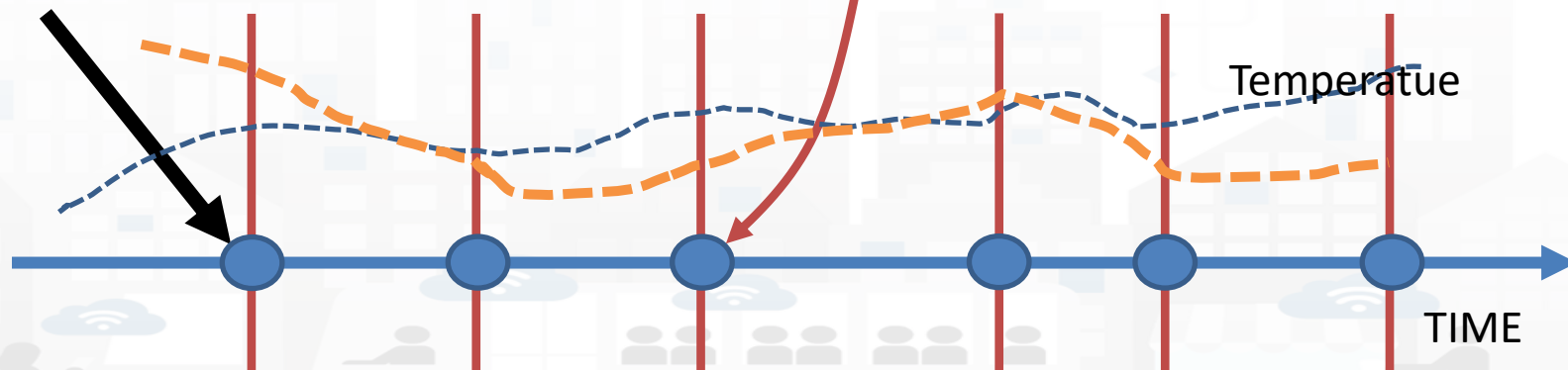
Sends a
message

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

What About a Time Series

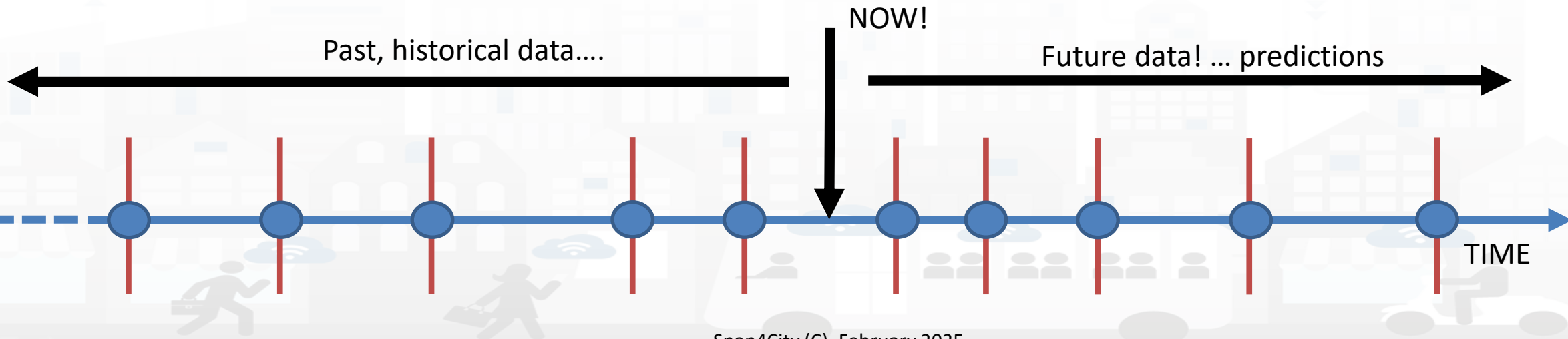
- A set of data coming from an IoT Device with multiple sensor become a time series of values for devices.
 - For example: taking a new measure every 10 minutes (**Red Lines**)
 - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «**dateObserved**»,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

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



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:

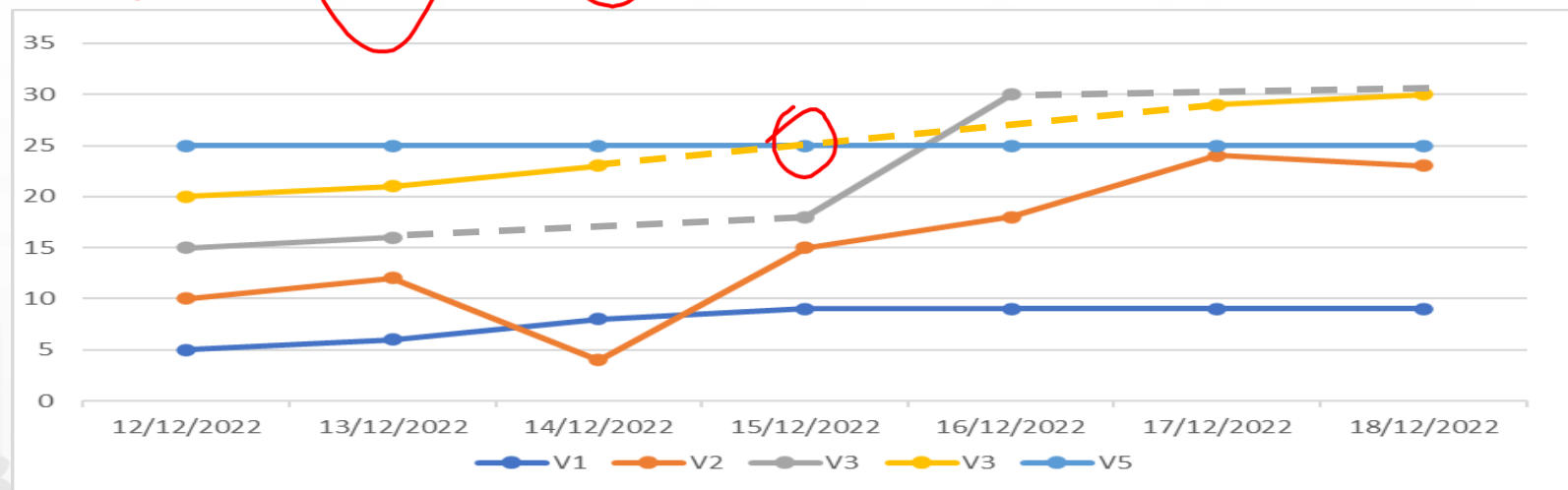
- interpolate line on graphs: dashed are actually continuous lines in Dashboards
- Empty values in the tables

device42

Entity Messages over time

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

Color for missed



IoT Devices, Entities Instances, WoT



- 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

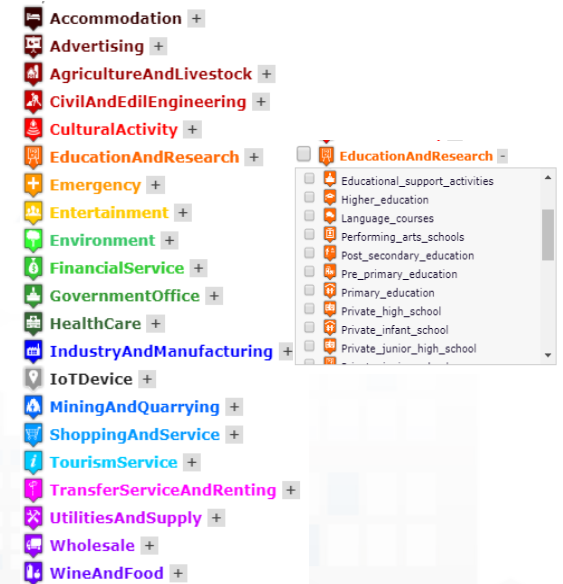


IoT Device

- 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

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

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

Snap4City
Data Inspector

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
- Data Inspector**
- MyKPI, MyData, MyPOI
- My Groups of Entities
- View/Set MyPOI on Tuscany
- Data Table Loader (Excel)
- POI Loader (Excel)
- Harvest Satellite Copernicus Data
- File Manager
- HeatMap Manager
- BIM Server old
- BIM Server New
- BIM Srv New: Add
- BIM Srv new: View
- OpenData Manager: Data Gate
- OpenData Manager: Data Gate

METRO729

VALUE NAME: METRO729

DESCRIPTION	DESCRIPTION	RT DATA
congestionLevel	109.37501	Last value Last 4 hours Last 24 hours Last 7 days
dateObserved	2023-07-08T17:15:00.000Z	Last value Last 4 hours Last 24 hours Last 7 days
vehicleFlow	1138.9792	Last value Last 4 hours Last 24 hours Last 7 days

Keep data on target widget(s) after popup close: ☐

Single data widgets

Multi data widgets

Map Controls:

FilterMap GPSUser GPSOrg

Now displaying in Standard Mode

Switch to the Synoptic Mode to select MyKPIs and sensors that you need for your synoptics.

Switch now to the Synoptic Mode

High-Level Type	Nature	Subnature	Device/Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO792	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO791	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO793	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO713	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO729	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO7	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
IoT Device	TransferServiceAndRenting	Traffic_sensor	METRO760	orionUNIFI			sensor_map		2023-07-08 14:05:00			2023-07-08 14:05:00
Device	TransferServiceAndRenting	Traffic_sensor	METRO799	orionUNIFI			sensor_map		2023-07-08 13:55:00			2023-07-08 13:55:00

vehicleFlow: 1139

vehicleFlow - Day

New Data Inspector/Wizard

New Wizard

Data Inspector BETA OS

Single data widgets

Multi data widgets

Map Controls:

FilterMap GPSUser GPSOrg

Now displaying in Standard Mode

Switch to the Synoptic Mode to select MyKPIs and sensors that you need for your synoptics.

Switch now to the Synoptic Mode

Level Type	Nature	Subnature	Device	Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last Check	Ownership
DT	EM Devi...	Environment	Weather	DIDA1	Santa Ver...	Mio sensor		webpage		2021-11-23 13:44...			2023-07-18 16:0...	public
DT	EM Devi...	TransferService...	SensorSite	METRO11	Altair-soda	Altair Valve state		webpage		2021-06-05 00:00...			2024-01-10 01:3...	public
DT	EM Devi...	IndustryAndMa...	Computer	AltairStatoPom...	Altair-soda	Altair Pump St...		webpage		2021-05-20 13:51...			2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	IBIMET_SMART...	Altair-soda	Altair Pump 43...		webpage		2021-06-07 17:3...			2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	ARPAT_QA_FI...	Altair-soda	Altair valve 541		webpage		2021-06-07 17:3...			2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO514	Altair-soda	Altair Pump 4321		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	SI052032FS990...	Altair-soda	Altair Stock sta...		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO831	Altair-soda	Altair Pump 92		webpage		2021-06-07 00:00...			2024-01-10 01:3...	public

163

- 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	2018-05-31 19:16:05		<div></div>	2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	devicetest1	orionUNIFI	humidity	humidity	float	#			<div></div>	2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	temperature	temperature	float	°C			<div></div>	2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	humidity	humidity	float	#			<div></div>	2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	temperature	temperature	string	°C			<div></div>	2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	humidity	humidity	string	%			<div></div>	2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	temperature	temperature	float	°C			<div></div>	2021-10-15 10:00:59	private
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	humidity	humidity	float	%			<div></div>	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

Semantic
Classific.

Dev/Model name

Broker name

Technical
Source

Value Name

Value Type

Data Type

Value Unit

Variables, names

Last Date/Time

Last Value

Real
Time

Healthiness


Last Check

Status

Ownership
Organization


For
Admin

- **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 Device**

- **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

Semantic
Nature

SubNature

SubNature

Technical meaning

Value Type

Value Unit

Value Unit

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

Technical meaning

^{Power}
Value Type

Value Unit

mW

Value Unit

KW

Data Type

Integer

Data Type

Float

Link to Friend Sensor as ServiceURI: Value Type

Value Unit

URL

Value Unit

KW

Data Type

String, URL

Data Type

Float

Example of Energy and its Value Units

Snap4City

User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7
[LOGOUT](#)

My Snap4City.org

Tour Again

ダッシュボード

Dashboards (Public)

My Dashboards in All Org.

Dashboards of My Organization

My Dashboards in My Organization

My Data Dashboard Dev Kibana

My Data Dashboard Kibana

Extra Dashboard Widgets

Notificator

Data, my Data, OpenData

Knowledge and Maps

IOT Applications

IOT Directory and Devices

Resource Manager

View Resources

Managing Resources

Process Models

Processes in Execution

Process execution Archive

Dictionary Editor for Data Fields

Doc: Resource Manager

+ Insert new Dictionary element

Filter by Dictionary type

Show 10

Search:

Value Name	Dictionary Type	Description	Data Types	Parent Value Name	Child Value Name	Controls
Boats_and_shi...	subnature	Boats And Ships Rental		TransferServiceAndRenti...		EDIT DELETE
Bollard	subnature	Bollard		TransferServiceAndRenti...		EDIT DELETE
Bookshop	subnature	Bookshop		ShoppingAndService		EDIT DELETE
bool	value unit	boolean		dali_com_error, dali_dim...		EDIT DELETE
Botanical_Land...	subnature	Botanical & Zoolog. Gardens		CulturalActivity		EDIT DELETE
Boxoffice	subnature	Boxoffice		Entertainment		EDIT DELETE
bpm	value unit	Beat per minute		average_heart_rate, avera...		EDIT DELETE
brightness_flag	value type	Brightness Flag	string		#	EDIT DELETE
broken_bikes	value type	Broken Bikes	integer		#	EDIT DELETE
Building_and_...	subnature	Build. & Indust. Clean. Activ.		Environment		EDIT DELETE

First << Prev 1 ... 9 10 11 ... 89 Next >> Last

Value Type: Energy

Value Units:

- Watt per hour
- KiloWatt per hour
- MegaWatt per hour

Snap4City (C), February 2025

60

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

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

View Edit Track Access control Convert

Any update and addition 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...

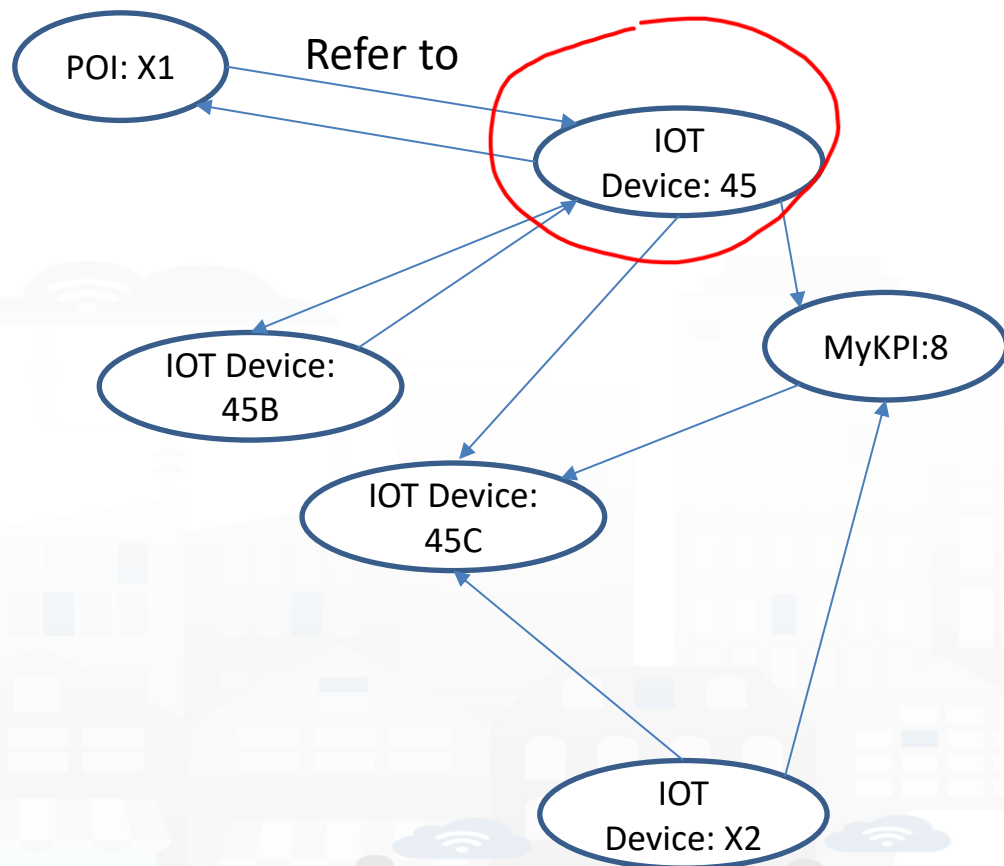
<https://www.snap4city.org/818>

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/m ³ , µg/m ³	float
annual_C6H6_exceedance_count	annual_C6H6_exceedance_count	#	integer, float
annual_CO_average	annual_CO_average	ppm, mg/m ³ , µg/m ³	float
annual_CO_exceedance_count	annual_CO_exceedance_count	#	integer, float
annual_NO2_average	annual_NO2_average	ppm, mg/m ³ , µg/m ³	float
annual_NO2_exceedance_count	annual_NO2_exceedance_count	#	integer, float
annual_O3_average	annual_O3_average	ppm, mg/m ³ , µg/m ³	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/Viot/Vorion/Firenze2/Firenze/SHT20lab_new"},  
  "cam51count": {"type": "string", "value": "datamanager/Vapi/Vv1/Vpoidata/V17058000"},  
  "cam52count": {"type": "string", "value": "datamanager/Vapi/Vv1/Vpoidata/V17058001"},  
  ...  
}
```

Handwritten red notes:
- A red box highlights the "SHTdevice" and "cam51count"/"cam52count" fields.
- "SHTdevice" is crossed out with a red line and "SURI" is written next to it.
- "cam51count" and "cam52count" are circled in red with "My KPI" written inside the circle.

Value Type: Identifier

Value Unit: ServiceURI

Data Type: String

//any query: such as those of the Selector

Knowledge Base: Modelling and ServiceURI as Entity Identifier

FROM CITY
DASHBOARD TO
APPLICATIONS

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

DATA INTEGRATION
AND CITY DATA
KNOWLEDGE
MANAGEMENT

IOT/KNOWLEDGE
DEVICES AND NETWORKS

IOT/KNOWLEDGE
DEVICES AND NETWORKS

ADVANCED SMART CITY
API, MICROSERVICES
AND CLOUD PLATFORMS

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

DATA ANALYTICS
BUSINESS
INTELLIGENCE,
WHAT-IF AND
SIMULATION

SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM. OPENED
TO DEVELOPERS
AND STAKEHOLDERS

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

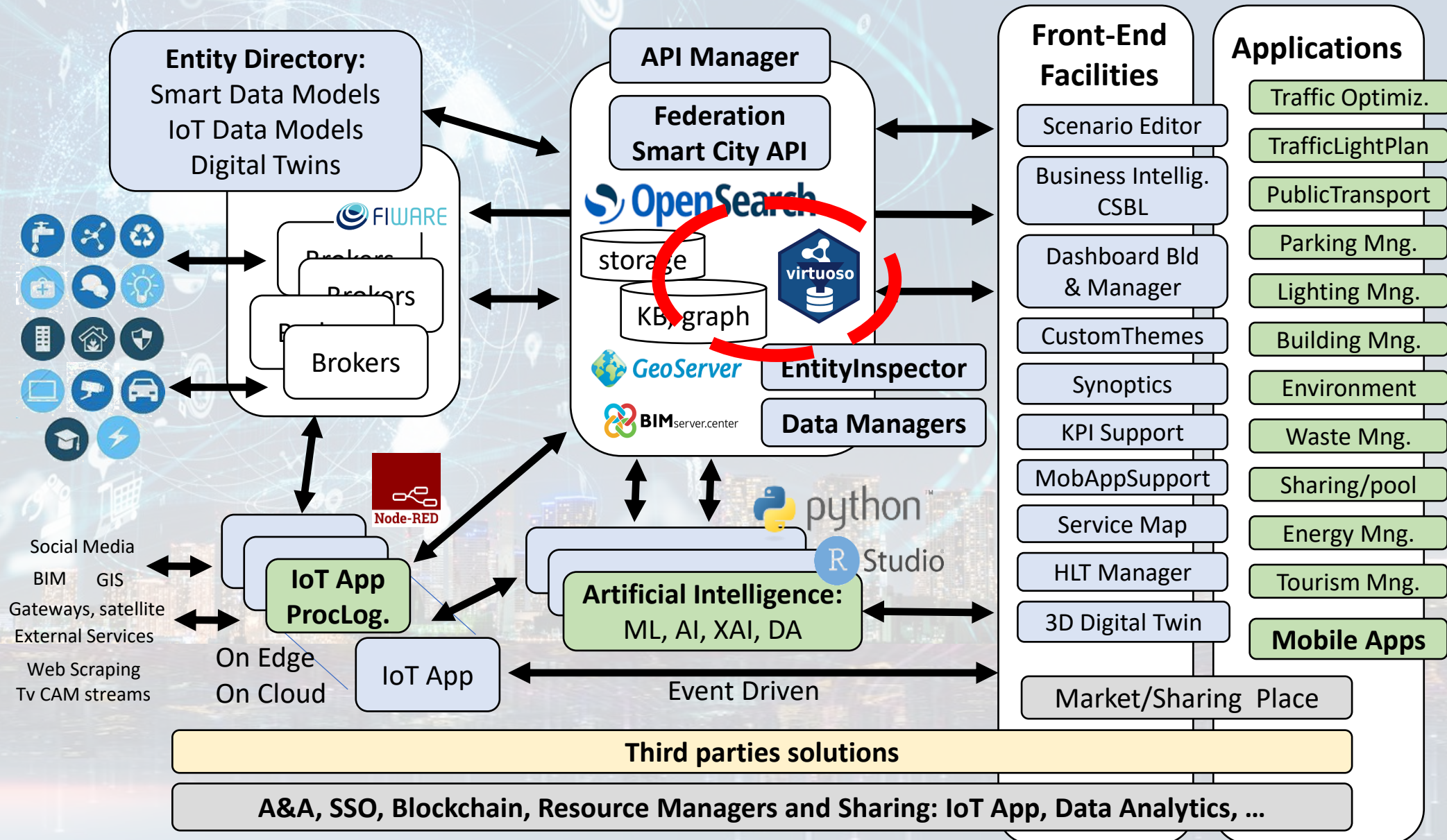
DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

SNAP4CITY
AND KM4CITY
PROJECTS

HOW TO ADOPT
SNAP4CITY AND
OUR ROADMAP

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

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 not 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

Knowledge and Maps
Service Map (Toscana)
Service Map 3D (Firenze)
Helsinki Service Map
Antwerp Service Map
Garda Lake Service Map
Cagliari Service Map
Lonato Del Garda Service Map
Greece Service Map
Valencia Service Map
Pont Du Gard Service Map
Dubrovnik Service Map
WestGreece Service Map
Mostar-Bosnia Service Map
Svealand Service Map
Bologna Service Map
Roma Service Map
Pisa Service Map



Snap4city Data Ingestion Diagram

Manual or automated
Registration
of Entities/Devices

**Entity/IoT
Directory**

NGSI

Orion Broker

IoT Orion Broker

Orion Broker

IoT Orion Broker

IoT Orion Broker

Brokers

registration
triples

subscription note
NGSI
Real Time

Knowledge Base

Semantic Reasoners

Semantic Reasoners

Semantic Reasoners

SURI Link

Indexing and Aggregating
NIFI, OpenSearch

Data Managers

Data Managers

Entity Inspector

Platform Automation:
IoT Apps, Proc.Logics,
Python, ...



Data Analytics: ML, AI, XAI



Platform Control and Management

storage

A number of KB
federated



Federation
Smart City API, ASCAPI

API Manager

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



Snap4City

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

LOGOUT

Notificator

Data, my Data, OpenData

Knowledge and Maps

- Service Map (Toscana)**
- Service Map 3D (Firenze)
- Helsinki Service Map
- Antwerp Service Map
- Garda Lake Service Map
- Cagliari Service Map
- Lonato Del Garda Service Map
- Valencia Service Map
- Pont Du Gard Service Map
- Dubrovnik Service Map
- WestGreece Service Map
- Mostar-Bosnia Service Map
- Svealand Service Map
- Roma Service Map
- Pisa Service Map
- Creating WKT
- Service Map 3D (Antwerp)
- Service Map 3D (Helsinki)
- Producing POI triples for KB
- Load WKT on ServiceMap (Helsinki)
- Load WKT on ServiceMap (Toscana)
- Load WKT on ServiceMap (Antwerp)
- My Annotation on Services/Data
- Mapping Services Data
- ArcGIS DISIT Service
- Static GTFS Manager
- IOT Applications
- IOT Directory and Devices

Service Map (Toscana)

Public transport | Municipalities | Text Search | Address Search | Events

Select an agency:
- Select an Agency -

Select a line:
- Select a Line -

Select a route:
- Select a Route -

Select a bus stop:
- Select a Stop -

Position of selected Busses

Actual Selection:
Bus Stop: Salvemini

TPL STOP : Salvemini

ATAF&LINEA

Serviceuri: http://www.disit.org/km4city/resource/Bus_ataflinea_Stop_FM0612_500 GRAPH

Lines:

14

23

C1

C2

Display 10 Bus per page Search:

Time	Line	Direction
09:31:00 2020-10-07	C1	Parterre
09:33:00 2020-10-07	23	T2 Guidoni
09:36:00 2020-10-07	14	Santa Maria Maggiore
09:38:00 2020-10-07	C2	Leopolda T1 Porta Al Prato
09:39:00 2020-10-07	23	T2 Guidoni
09:40:00 2020-10-07	C1	Parterre

Showing page 1 of 45

Real-time data currently not available

Regular Services | Transversal Services

Services Categories

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

Filter:

search text into service

Service providing value type:
select value type

N. results: 100

Search Range: visible area

Search Area: select...

Search Results

Services 100 of 60336 available

Knowledge Base

Semantic Reasoners



- **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

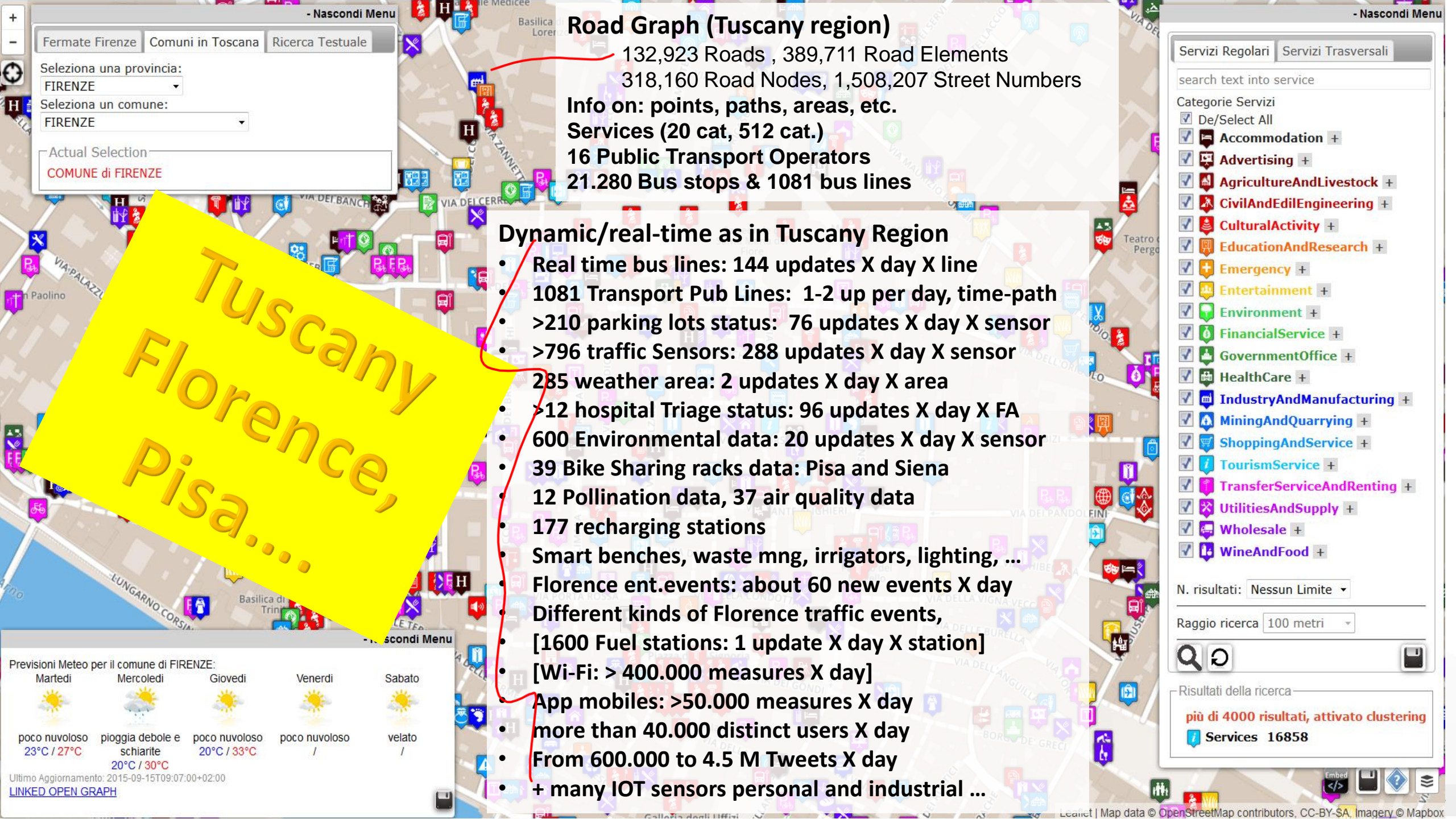
ASCAPI

Views of the Knowledge Base

Knowledge Base
Semantic Reasoners

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

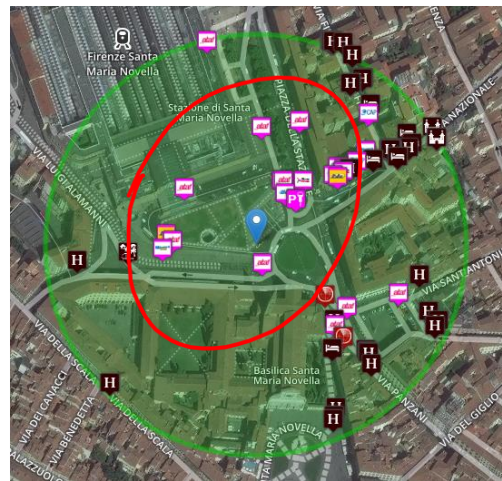
The screenshot displays the Snap4City interface. On the left is a sidebar with navigation options like 'My Snap4City.org', 'Dashboards', and 'Knowledge and Maps'. The main area shows the 'Helsinki KB Service Map' with a map of Helsinki and various service icons. A red circle highlights a specific service icon, which is then shown in a detailed 'Linked Open Graph' view. This view includes a table of properties and values, a 'Your data' section with a search bar, and a 'Type of relations' section with checkboxes for different relationship types. A red arrow points from the highlighted service icon on the map to the 'Linked Open Graph' view.



Around a point or POI

Search by Shape and Distance

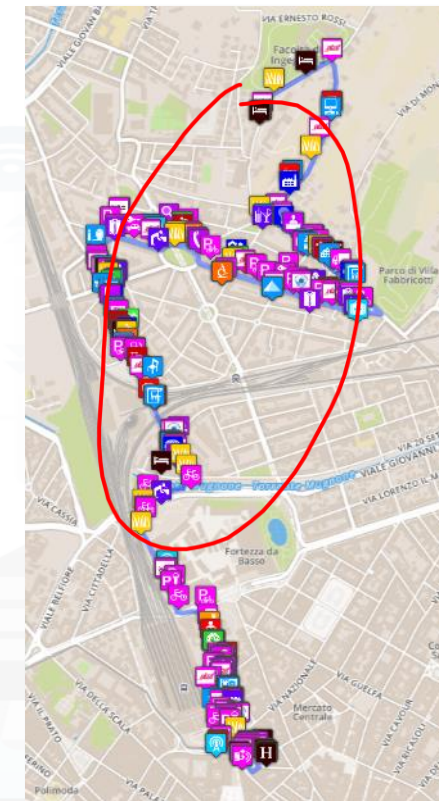
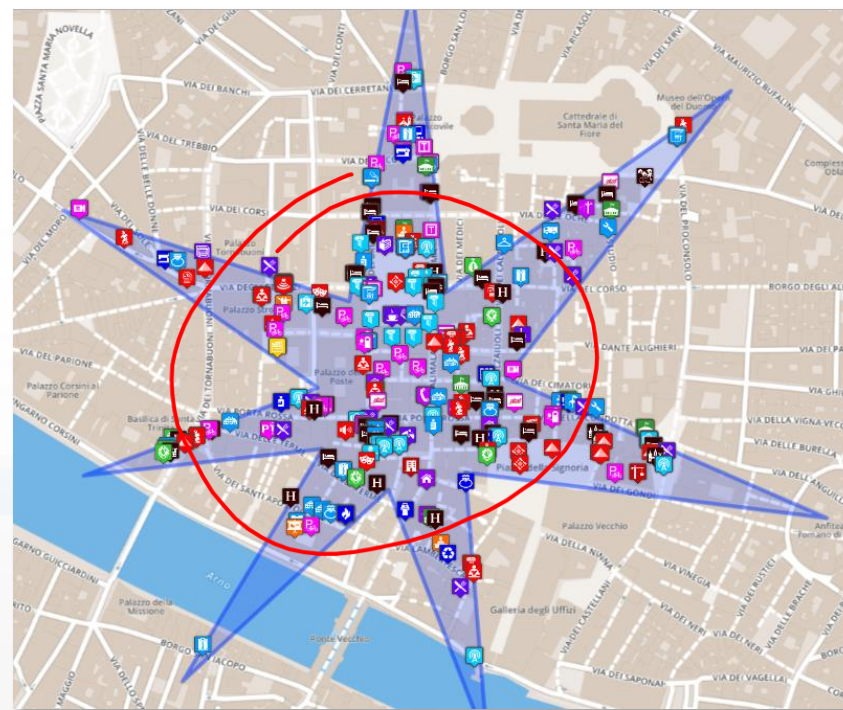
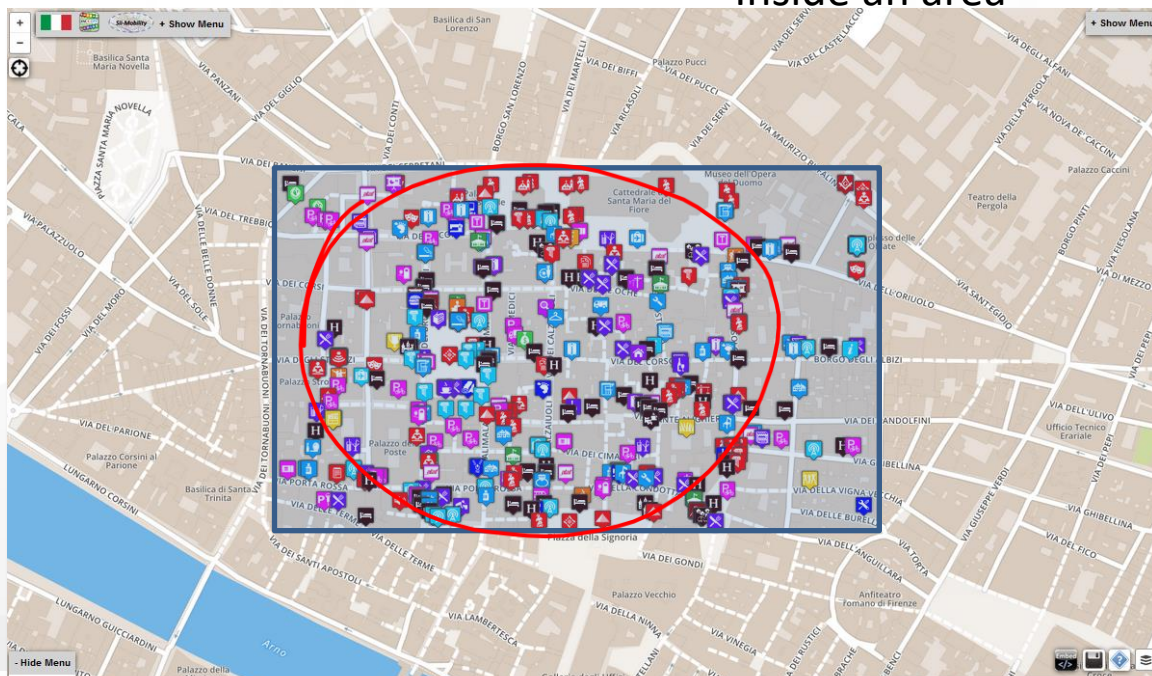
Each request or search in the Km4City model can be referred to a point and a ray, to an area, to a polyline



Inside a closed polyline

Along a polyline

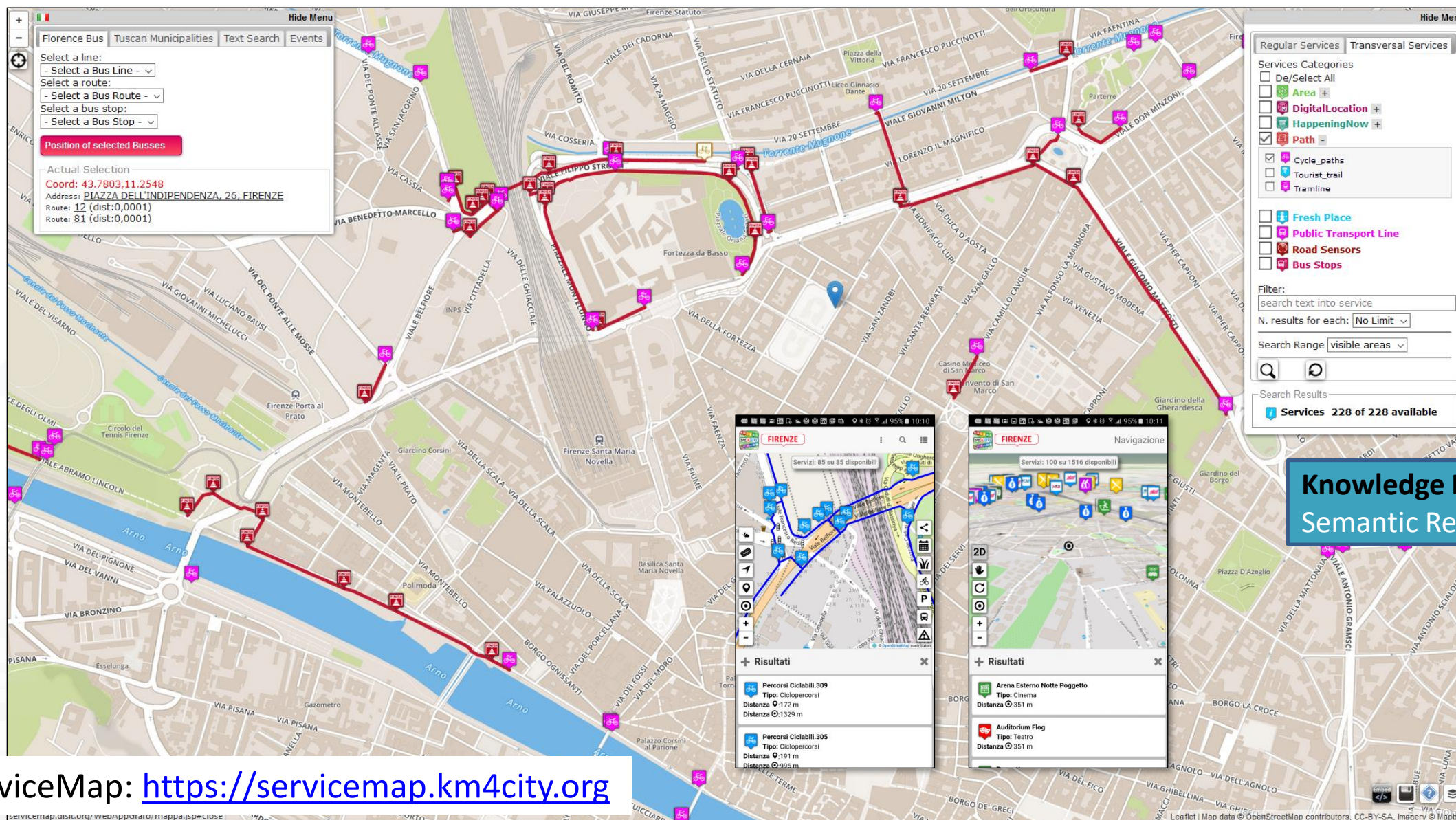
Inside an area



Knowledge Base
Semantic Reasoners



Cycling Paths

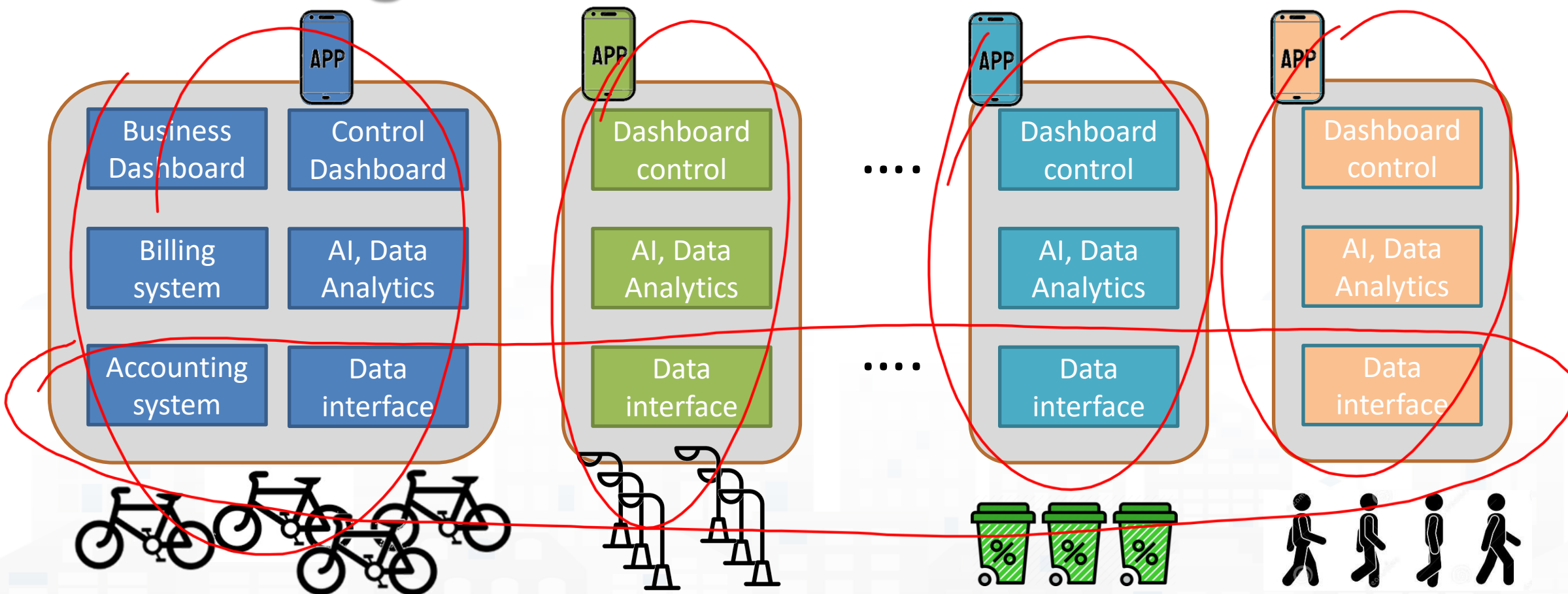


ServiceMap: <https://servicemap.km4city.org>

*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
- ..

Big Data Tools



LOD and reasoners



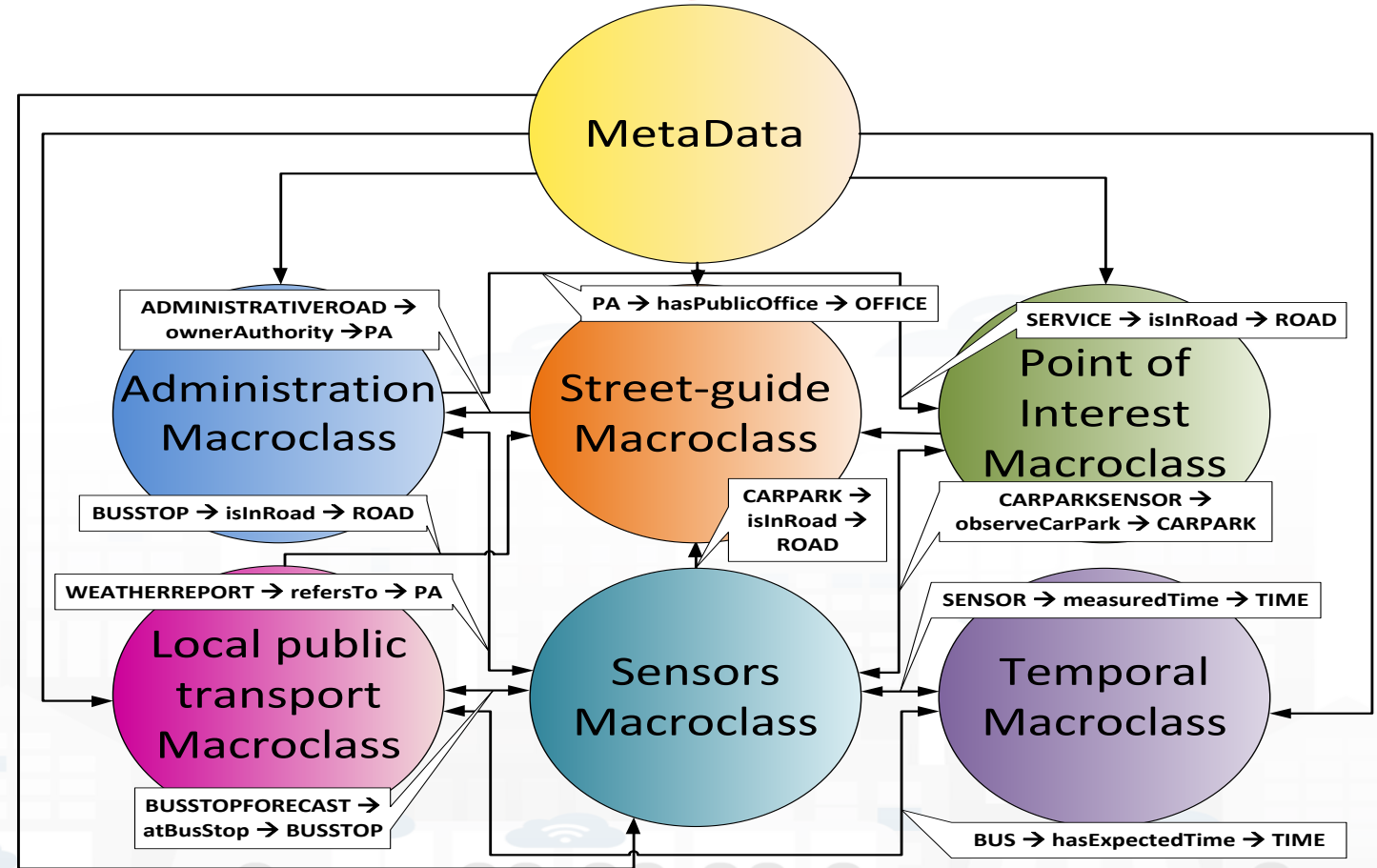
Schema: <http://www.disit.org/km4city/schema>
RDF version: <http://www.disit.org/km4city.rdf>



Smart-city Ontology: 1.6.8

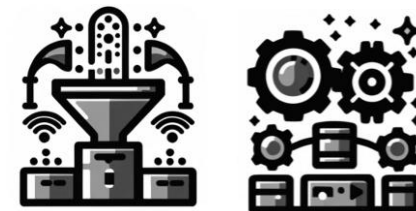
- covers different aspects:

- 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 Vocabulary
 - **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

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.

Knowledge Base
Semantic Reasoners



Linked Open Graph

LOG: <https://log.disit.org>

Linked Open Graph

SiiMobility (by DISIT)

Examples:

- [VIA GIACOMO MATTEOTTI](#)
- [Bagno a ripoli](#)
- [Florence](#)

Choose a class:

Search for keyword

keyword:

uri: Request

Your data

sparql endpoint: (optional)

uri: Request

Status

Requests:

<http://www.disit.dinfo.unifi.it/SiiMobility/MUSE>

Remove Clear

Type of relations

Select all Deselect all Invert Hide all inverse

<input checked="" type="checkbox"/> belongTo	<input checked="" type="checkbox"/> coincideWith
<input checked="" type="checkbox"/> contains	<input type="checkbox"/> depiction
<input type="checkbox"/> ends	<input checked="" type="checkbox"/> forming
<input type="checkbox"/> has	<input checked="" type="checkbox"/> hasAccess
<input checked="" type="checkbox"/> hasExternalAccess	<input checked="" type="checkbox"/> hasMunicipality
<input checked="" type="checkbox"/> hasProvince	<input checked="" type="checkbox"/> hasRule
<input checked="" type="checkbox"/> hasStreetNumber	<input checked="" type="checkbox"/> inMunicipalityOf
<input checked="" type="checkbox"/> isIn	<input checked="" type="checkbox"/> isPartOf
<input checked="" type="checkbox"/> isPartOfProvince	<input checked="" type="checkbox"/> isPartOfRegion
<input checked="" type="checkbox"/> managingAuthority	<input checked="" type="checkbox"/> ownerAuthority
<input checked="" type="checkbox"/> placedIn	<input type="checkbox"/> sameAs
<input checked="" type="checkbox"/> seeAlso	<input type="checkbox"/> starts

Linked Open Graph

museo ferragamo

DESCRIPTION

Relations of Museo Ferragamo with the road graph

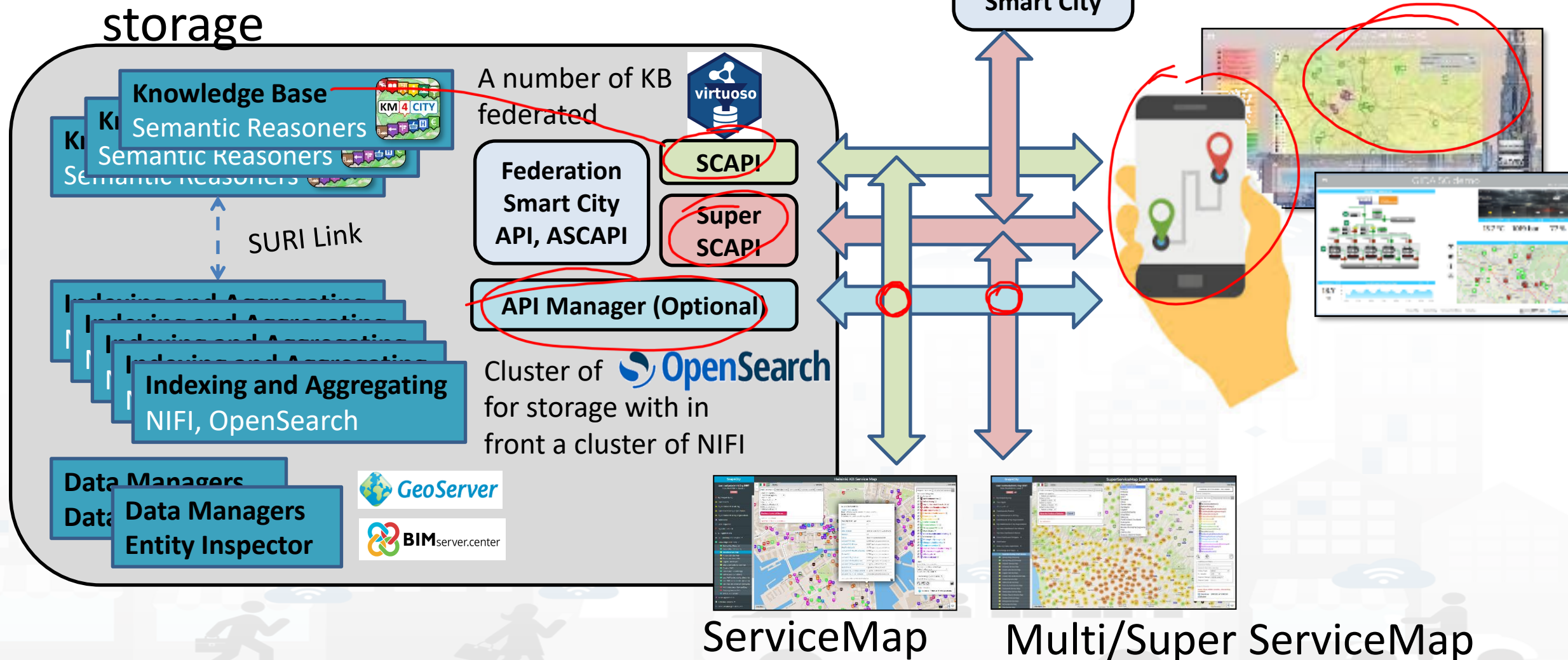
Schema: <http://www.disit.org/km4city/schema>

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

The role of Knowledge base and ServiceMaps

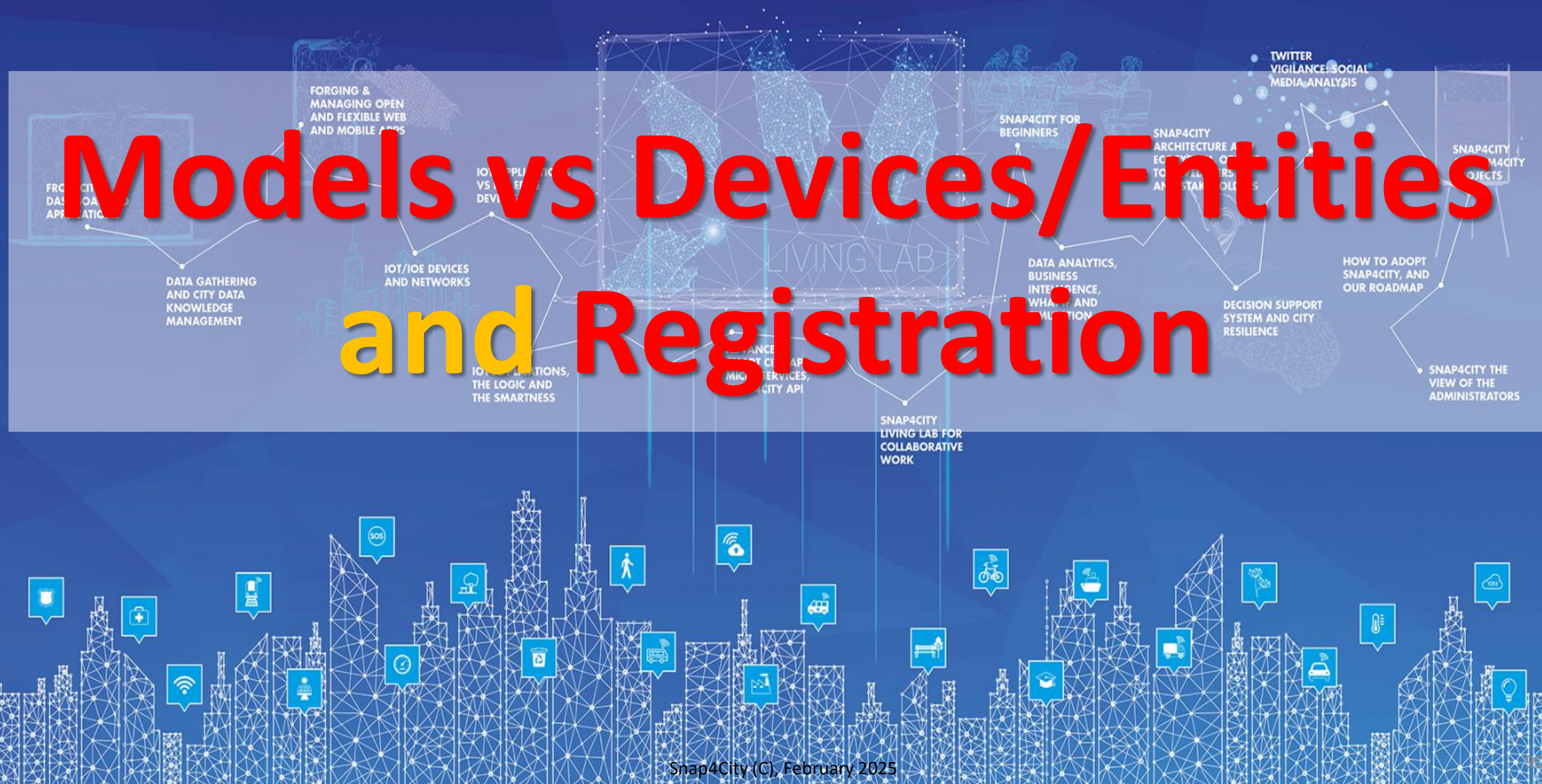


Accessing to Snap4City Services

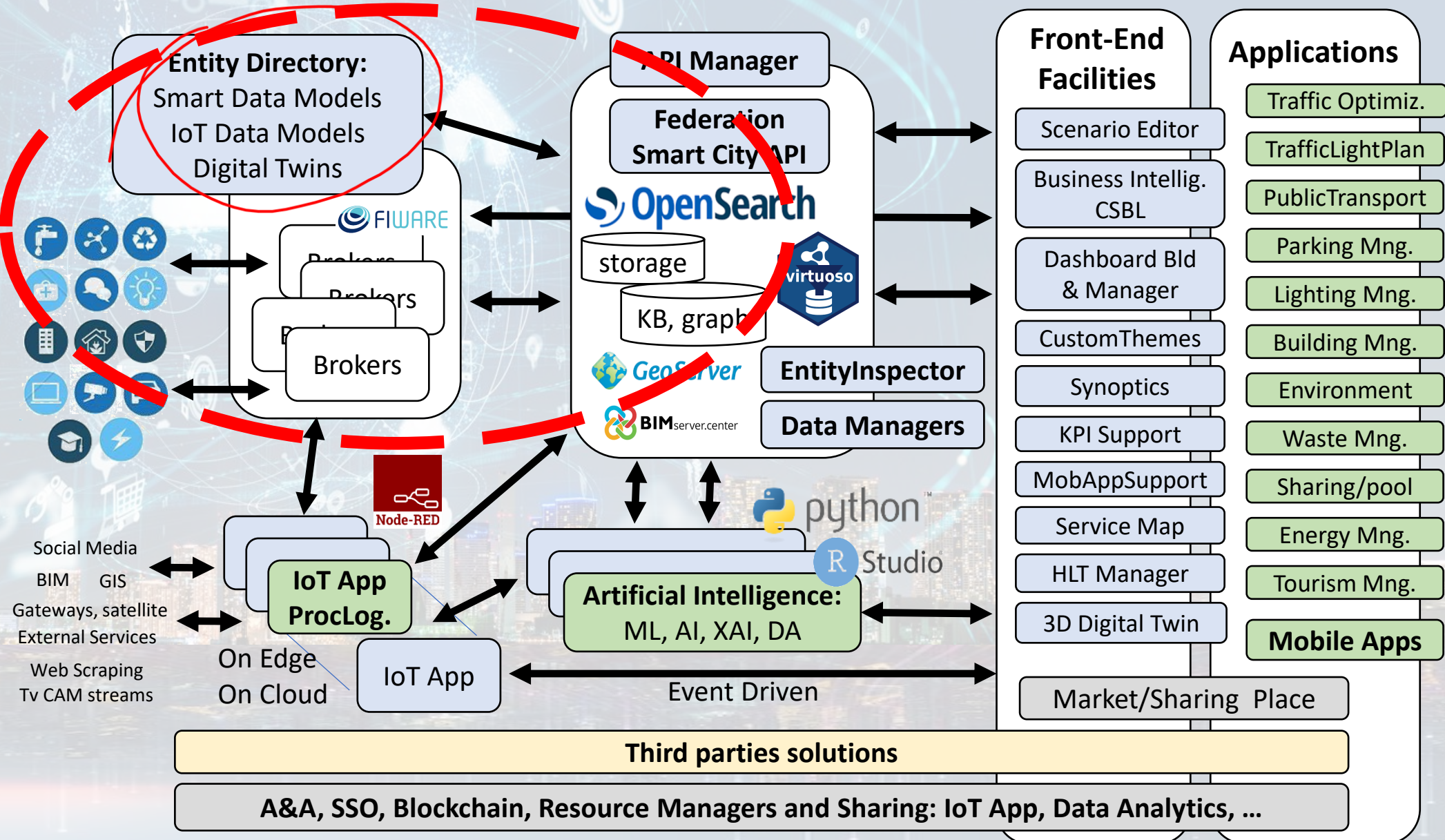


- ServiceMap is the **main Tool** to:
 - monitor the status of the Knowledge Base
 - test queries and produce query and SmartCity API testing calls for developers
 - Any kind of search (semantic, full text, etc.), routing,
 - Access at the specific Graph Data base via LOG.disit.org
- **ServiceMap is 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



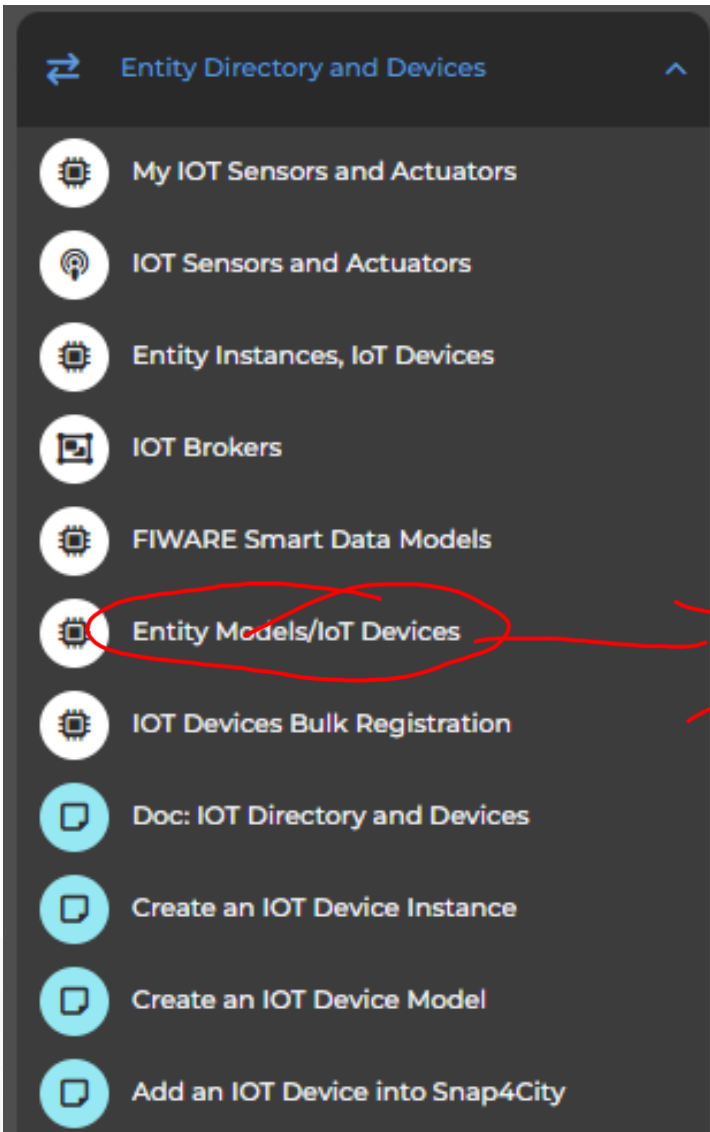
Technical Architecture



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 Models/IoT Devices

Dashboards (Public)

My Snap4City.org

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

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

302 MODELS

Show 10 entries

Search:

New Model

	Device Model	Description	Ownership	Organization	Kind	Producer	Device Type	Edit	Delete	View
+	Raspberry snap4city1	Raspberry PI 3 Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM	DELEGATED	DISIT	sensor	Raspberry PI	Ambiental			VIEW
+	Raspberry snap4city2	Raspberry PI 3 Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM	DELEGATED	DISIT	sensor	Raspberry PI	Ambiental			VIEW
+	Arduino Uno	Arduino Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM	DELEGATED	DISIT	sensor	Arduino	Ambiental			VIEW
+	Arduino uno-bis	Arduino Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM	DELEGATED	DISIT	sensor	Arduino	Ambiental			VIEW
+	sigfox	SigFox Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM	DELEGATED	DISIT	sensor	SigFox	Ambiental			VIEW
+	Snap4AllButtonV1	Snap4AllButtonV1	DELEGATED	DISIT	sensor	Snap4All	Snap4AllButtonV1			VIEW
+	Raspberry snap4city1 - Certificate	Raspberry PI 3 Model B Scheda madre CPU 1.2 GHz Quad Core, 1 GB RAM with certificate	DELEGATED	DISIT	sensor	Raspberry PI	Ambiental			VIEW
+	datacenter3dht22	datacenter3dht22	DELEGATED	DISIT	sensor	disit	raspberry			VIEW
+	Thermometer	This model represents a generic device that can measure a temperature	DELEGATED	DISIT	sensor	Generic	Ambiental			VIEW
+	AirConditioner	Generic model representing a simple conditioner with only the status attribute	DELEGATED	DISIT	actuator	Generic	Ambiental			VIEW

Showing 1 to 10 of 89 entries

Previous 1 2 3 4 5 ... 9 Next

Entity Directory for Beginners

- Browse and see models and entities/devices of other users, that published 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

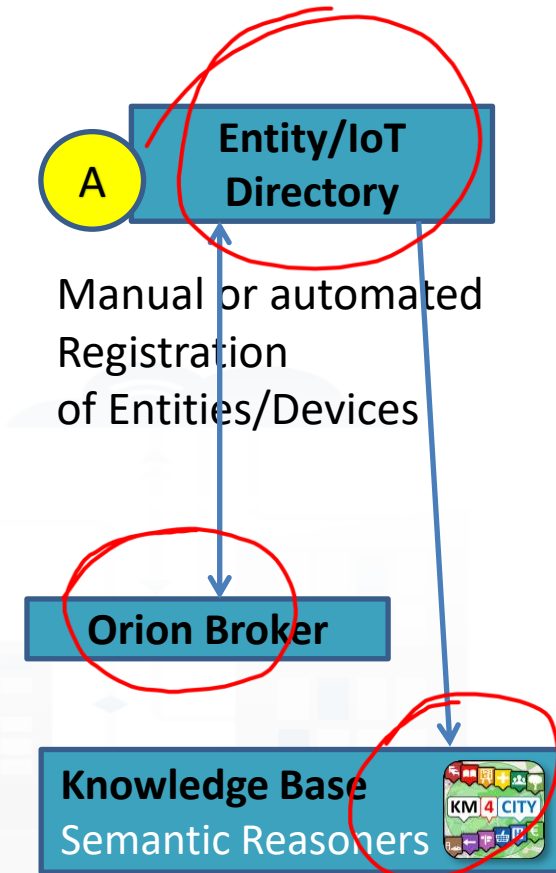
many possibilities

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.

A Entity/IoT
Directory

Manual or automated
Registration
of Entities/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

Entity Instances, IoT Devices

Show delegated dev.
Show public dev.
Show my dev.
Show all dev.

Show entries

Add new device

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

Search Device Location on Map

Cancel

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 parameters
- View on map and view all data
- See details

Entity/IoT
Directory

<input checked="" type="checkbox"/>	alert_1610548534047	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
-------------------------------------	---------------------	------------	-------	--------------	--------------	--------	------	--------	--	------

Broker URI: <https://broker1.snap4city.org>

Kind: sensor

Device Type: event

Protocol: ngsi

Model: AlertGeneric

Longitude: 11.241117

Device Uri: http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/alert_1610548534047

Organization: DISIT

Owner: undefined

PAYLOAD NGSI v1

K1: 44eca781-af56-490f-a6c6-36d88b1bcd9c

Created on: 2021-01-13 15:35:41

Broker Port: 8080

Visibility: MyOwnPrivate

Format: json

MAC:

Producer: disit

Latitude: 43.776703

PAYLOAD NGSI v2

K2: 6a620551-e4e5-4c0d-8777-d0721175cfb0

SURI

VIEW IN SERVICE MAP

NEW DATA IN alert_1610548534047

Add New Device

Add a new device

Info IOT Broker Position Static Attributes Values

Device Identifier Device Identifier is mandatory

Model Model is mandatory

Device Type Ok

Mac Address

Edge-Gateway Type

Edge-Gateway URI

600 sec

Producer

Frequency Ok

Private

Ownership

Generate Keys

KEY1 KEY2

Cancel Confirm

Add a new device

Info IOT Broker Position Static Attributes Values

Latitude Latitude is mandatory

Longitude Longitude is mandatory

Add a new device

Info IOT Broker Position Static Attributes Values

ContextBroker Context broker is mandatory

Kind Ok

Protocol Device protocol is mandatory

Format Device format is mandatory

Service/Tenant only ngsi w/MultiService supports Service/Tenant selection

ServicePath only ngsi w/MultiService supports ServicePath

Cancel Confirm

Add a new device

Info IOT Broker Position Static Attributes Values

Value Name Value name is mandatory

Value Type Value type is mandatory

Value Unit Ok

Data Type Ok

Refresh rate

Healthiness Criteria Ok

Remove Value

Add Value

Cancel Confirm

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

Snap4City

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

LOGOUT

- My Snap4City.org
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- My Data Dashboard Dev Kibana
- Extra Dashboard Widgets ▾
- Data, my Data, OpenData ▾
- Knowledge and Maps ▾
- IOT Applications ▾
- IOT Directory and Devices ▴
 - My IOT Sensors and Actuators
 - IOT Sensors and Actuators
 - IOT Devices**
 - IOT Brokers
 - IOT Device Models
 - IOT Devices Bulk Registration
 - Doc: IOT Directory and Devices
 - Create an IOT Device Instance
 - Create an IOT Device Model
 - Add an IOT Device into Snap4City
- Resource Manager ▾
- Development Tools ▾

IOT Devices

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
+	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
+	alert_1610714974380	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610715864347	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610715997465	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610717002089	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610717247691	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+	alert_1610717428876	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE		VIEW

Showing 1 to 10 of 108 entries

Previous 1 2 3 4 5 ... 11 Next

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, ...



MYOWNPRIVATE

Device - alert_1610543238306

Ownership Visibility **Delegations** Group Delegations

Add new delegation

Delegated username

Confirm

Delegated username can't be empty

Current delegations

Delegated user	Kind	Remove
	READ_ACCESS	
	READ_ACCESS	
	READ_WRITE	
	MODIFY	

Close

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

Snap4City

Switch To New Layout (Beta)

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

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 - Add an IOT Device into Snap4City
- Resource Manager

My IOT Sensors and Actuators

My Sensors and Actuators | Delegated Sensors and Actuators

Add New Device

Show 10 entries

	Device Identifier	Value Type	Device Type	Ownership	Status	Location
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	timestamp	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
+	1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
+	alert_1610543238306	status	event	MYOWNPRIVATE	active	
+	alert_1610543238306	timestamp	event	MYOWNPRIVATE	active	
+	alert_1610543238306	timestamp	event	MYOWNPRIVATE	active	

Showing 1 to 10 of 1,045 entries

Previous 1 2 3 4 5 ... 105 Next

Simplified Add Device: only from Model

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

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Doc: IOT Directory and Devices

My IOT Sensors and Actuators

My Sensors and Actuators

Delegated Sensors and Actuators

Add New Device

Identifier

Select an option

Model

Device Identifier is mandatory

Device Model is mandatory

Latitude

3c4bab66-c273-4599-a1ed-1db1a35d15fe

Longitude

1743d0d5-01d6-42a4-a443-1c09c3834ae7

KEY1

KEY2

ContextBroker

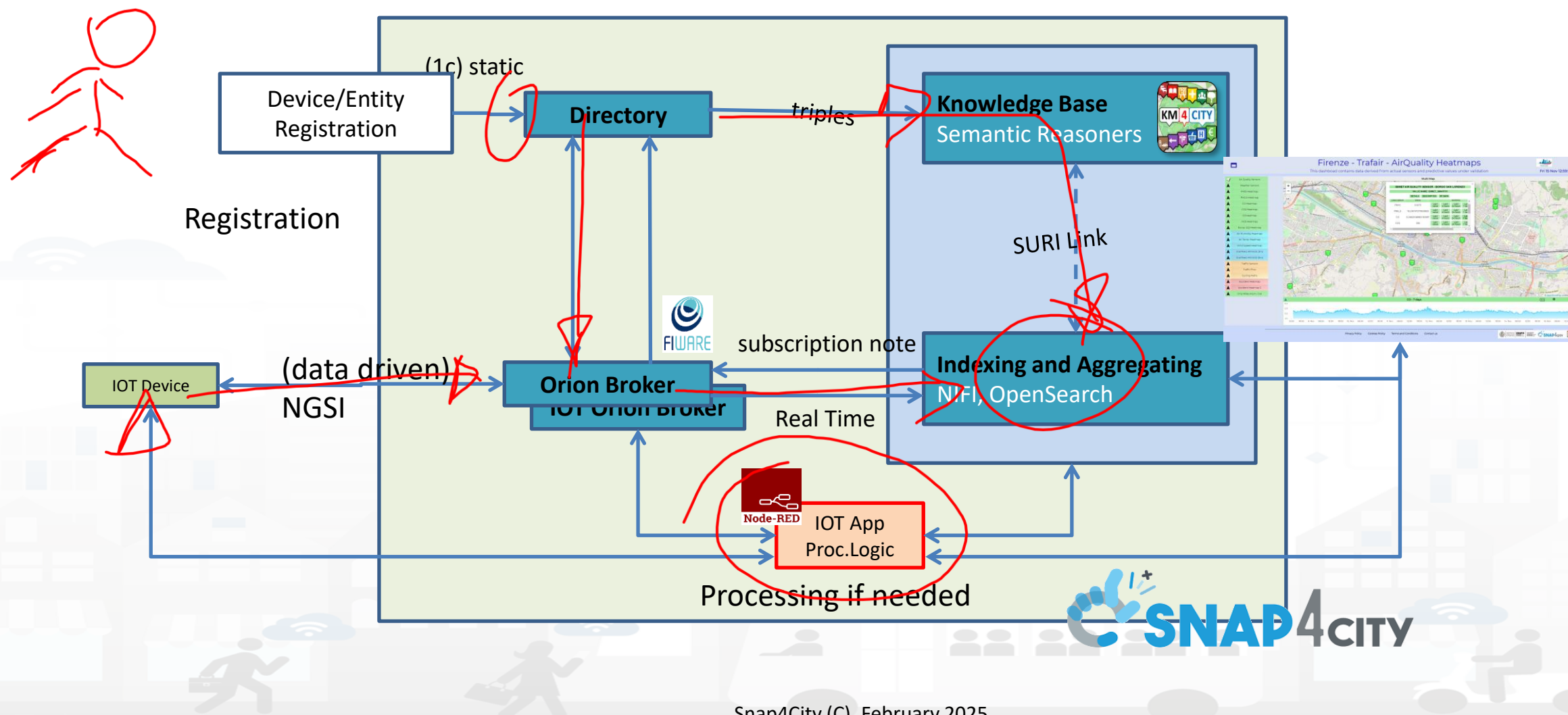
Protocol

Format

Submit Device

Select Latitude/Longitude on Map

- 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://...../CarN7126GD"	TodayCarSURI: "http://...../CarG789KK"
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 alphanumeric 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

Add new device

IOT Broker	Info	Position	Static Attributes	Values
ContextBroker <small>Context broker is mandatory</small>		sensor	Kind Ok	
Protocol <small>Device protocol is mandatory</small>			Format <small>Device format is mandatory</small>	
Service/Tenant <small>only ngsi w/MultiService supports Service/Tenant selection</small>			ServicePath <small>only ngsi w/MultiService supports ServicePath</small>	

Cancel Confirm

Add new device

IOT Broker	Info	Position	Static Attributes	Values
Name <small>Device name is mandatory</small>		custom	Model Ok	
Device Type <small>Device Type is mandatory</small>			Mac Address	
Edge-Gateway Type			Edge-Gateway URI	
Producer			600 Frequency Ok	sec
Private Ownership			Generate Keys	
KEY1			KEY 2	

Cancel Confirm

Entity / Device Data Model (2)

Add new device

IOT Broker
Info
Position
Static Attributes
Values

Latitude

Longitude

Latitude is mandatory
Longitude is mandatory

Cancel
Confirm

Edit Model - ChargingStationModel

General Info
IoT Broker
Status Attributes
Values

chargingStateValue	charging_state (Chargin	some coded status (sta	string
Value Name	Value Type	Value Unit	Data Type
Ok	Ok	Ok	
Refresh rate	900	Remove Value	
Healthiness Criteria	Healthiness Value		
stationStateValue	charging_station_state	some coded status (sta	string
Value Name	Value Type	Value Unit	Data Type
Ok	Ok	Ok	
Refresh rate	900	Remove Value	
Healthiness Criteria	Healthiness Value		
dateObserved	timestamp (Timestamp	timestamp in millisecond	string
Value Name	Value Type	Value Unit	Data Type
Ok	Ok	Ok	
Refresh rate	900	Remove Value	
Healthiness Criteria	Healthiness Value		
chargingState	charging_state (Chargin	some coded status (sta	string
Value Name	Value Type	Value Unit	Data Type
Ok	Ok	Ok	
Refresh rate	900	Remove Value	
Healthiness Criteria	Healthiness Value		
stationState	charging_station_state	some coded status (sta	string
Value Name	Value Type	Value Unit	Data Type
Ok	Ok	Ok	
Refresh rate	900	Remove Value	
Healthiness Criteria	Healthiness Value		

Add Value
Cancel
Confirm

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*

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
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/averageSpeed
http://www.disit.org/km4city/schema#hasAttribute	http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO759/congestionLevel
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://www.disit.org/addressLocality	"FIRENZE"
http://www.disit.org/name	"METRO759"
http://www.disit.org/streetAddress	"Lavagnini P.zza Della Libertà' (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/virttrdf#Geometry >
http://www.disit.org/km4city/schema#model	"metrotrafficsensor"
http://www.disit.org/km4city/schema#producer	"metro"
http://www.disit.org/km4city/resource/iot/traffic	http://www.disit.org/km4city/resource/iot/traffic
http://www.disit.org/km4city/resource/iot/traffic	http://www.disit.org/km4city/resource/iot/traffic

FIWARE Smart Data Models -- Library

Snap4City

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

LOGOUT

- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
 - My IOT Sensors and Actuators
 - IOT Sensors and Actuators
 - IOT Devices
 - IOT Devices Management
 - IOT Brokers
 - FIWARE Smart Data Models**
 - IOT Device Models
 - IOT Devices Bulk Registration
 - Ext. MS Broker Devices Discovery
 - Ext. MS Broker Discovery
 - Ext. Broker Devs Periodic Update
 - Rules for Discovery
 - OLD IOT Orion Broker Mapping Rule
 - Doc: IOT Directory and Devices
 - Create an IOT Device Instance
 - Create an IOT Device Model
 - Add an IOT Device into Snap4City
- Resource Manager
- Development Tools

FIWARE Smart Data Models Library

Show 10 entries Search:

Name	Subdomain	Domain	Version	Edit
Alert	Alert	CrossSector	0.0.2	EDIT
Anomaly	Alert	CrossSector	0.0.2	EDIT
Battery	Battery	CrossSector	0.0.2	EDIT
BatteryStatus	Battery	CrossSector	0.0.2	EDIT
StorageBatteryDevice	Battery	CrossSector	0.0.2	EDIT
StorageBatteryMeasurement	Battery	CrossSector	0.0.2	EDIT
CallUser	CallComplaints	CrossSector	0.0.1	EDIT
Complaint	CallComplaints	CrossSector	0.0.1	EDIT
ComplaintsCollection	CallComplaints	CrossSector	0.0.2	EDIT
ComplaintsOrganization	CallComplaints	CrossSector	0.0.2	EDIT

Showing 1 to 10 of 441 entries

[Previous](#)
[1](#)
[2](#)
[3](#)
[4](#)
[5](#)
[...](#)
[45](#)
[Next](#)



- Snap4City - Powered by [FIWARE](https://www.fiware.org) 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](https://www.fiware.org) Training Services:
 - <https://marketplace.fiware.org/pages/solutions/03bccd83a0e1b0398ba7a0bf>
- Snap4City - [FIWARE](https://www.fiware.org) 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>

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!!!

- **Prerequisites:** 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

Value Name	Value Type	Value Unit	Data Type
chargingStateValue	charging_state (Chargi	some coded status (sta	string
stationStateValue	charging_station_state	some coded status (sta	string
dateObserved	timestamp (Timestamp	timestamp in millisecon	string
chargingState	charging_state (Chargi	some coded status (sta	string
stationState	charging_station_state	some coded status (sta	string

Add Entity / Devices, exploiting a Model

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
 - Add an IOT Device into Snap4City
- Resource Manager

My IOT Sensors and Actuators

My Sensors and Actuators | Delegated Sensors and Actuators | **Add New Device**

Show 10 entries

Device Identifier	Value Type	Device Type	Ownership	Status	Location
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	timestamp	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	entity_desc	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
1dd79caa95f6771afad4fd38e699c8542022-12-05T18:54:13.000Z	description	File	MYOWNPUBLIC	active	
alert_1610543238306	status	event	MYOWNPRIVATE		
alert_1610543238306	timestamp	event	MYOWNPRIVATE		
alert_1610543238306	timestamp	event	MYOWNPRIVATE		

Showing 1 to 10 of 1,045 entries

Previous 1 2 3 4

Snap4City

User: rootooladmin1, Org: DISIT
Role: RootAdmin, Level: 7

Logout

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Extra Dashboard Widgets
- Notifier
- Data, my Data, OpenData
- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
 - My IOT Sensors and Actuators
 - IOT Sensors and Actuators
 - IOT Devices
 - IOT Devices Management
 - IOT Brokers
 - IOT Device Models
 - IOT Devices Bulk Registration
 - IOT Broker Periodic Update setting
 - IOT Orion Broker Mapping Rules

My IOT Sensors and Actuators

My Devices | Delegated Devices | **Add New Device**

Add My New Device

Select Latitude/Longitude on Map

Identifier: Dubrovnik Total Average Person
Model: OK

Latitude: 16d71349-2eb6-454e-84f1-ae54fd3617ce
Longitude: 4e7dbd20-77ea-4412-8aed-8e352d055093

KEY1: These keys have been generated automatically for your device. Keep track of them. Details on info

KEY2:

Monitoring Camera: (TransferServiceAndRem)

Subnature: Locality Dubrovnik Value Remove

Add Attribute

Submit Device

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

Snap4City

User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7
[LOGOUT](#)

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Extra Dashboard Widgets
- Notifier
- Data, my Data, OpenData
- Knowledge and Maps
- IoT Applications
- IOT Directory and Devices
 - My IOT Sensors and Actuators**
 - IOT Sensors and Actuators
 - IOT Devices
 - IOT Devices Management
 - IOT Brokers
 - IOT Device Models
 - IOT Devices Bulk Registration
 - IOT Broker Periodic Update setting
 - IOT Orion Broker Mapping Rules

My IOT Sensors and Actuators

[My Devices](#) [Delegated Devices](#) [Add New Device](#)

Add My New Device

Identifier: Dubrovnik Total Average Person
Device Identifier is mandatory

Model: Ok

Latitude: 16d71349-2eb6-454e-84f1-ae54fd3617ce
Latitude is mandatory

Longitude: 4e7dbd20-77ea-4412-8aed-8e352d055093
Longitude is mandatory

KEY1: These keys have been generated automatically for your device. Keep track of them. Details on info

KEY2:

Monitoring Camera (TransferServiceAndRen...)

Subnature

Locality: Dubrovnik
Value:

[Remove](#)

[Add Attribute](#)

[Submit Device](#)

Select Latitude/Longitude on Map

Map showing the location of the device in the Dubrovnik area.

Develop: Data Processes

Proc.Logic / IoT App

Processing Logics / IoT App

Processing Logics / IoT App

MicroServices for Proc.Logic/IoT App

MicroServices from DataAnalytic

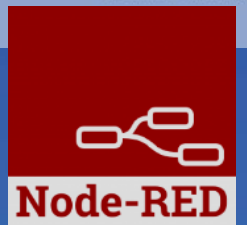
IOT MicroServices for Final Users

IOT MicroServices for Developers

DOC: Processing Logic/IoT App

How to Develop Proc.Logic / IoT App

Create A MicroService from RestCall



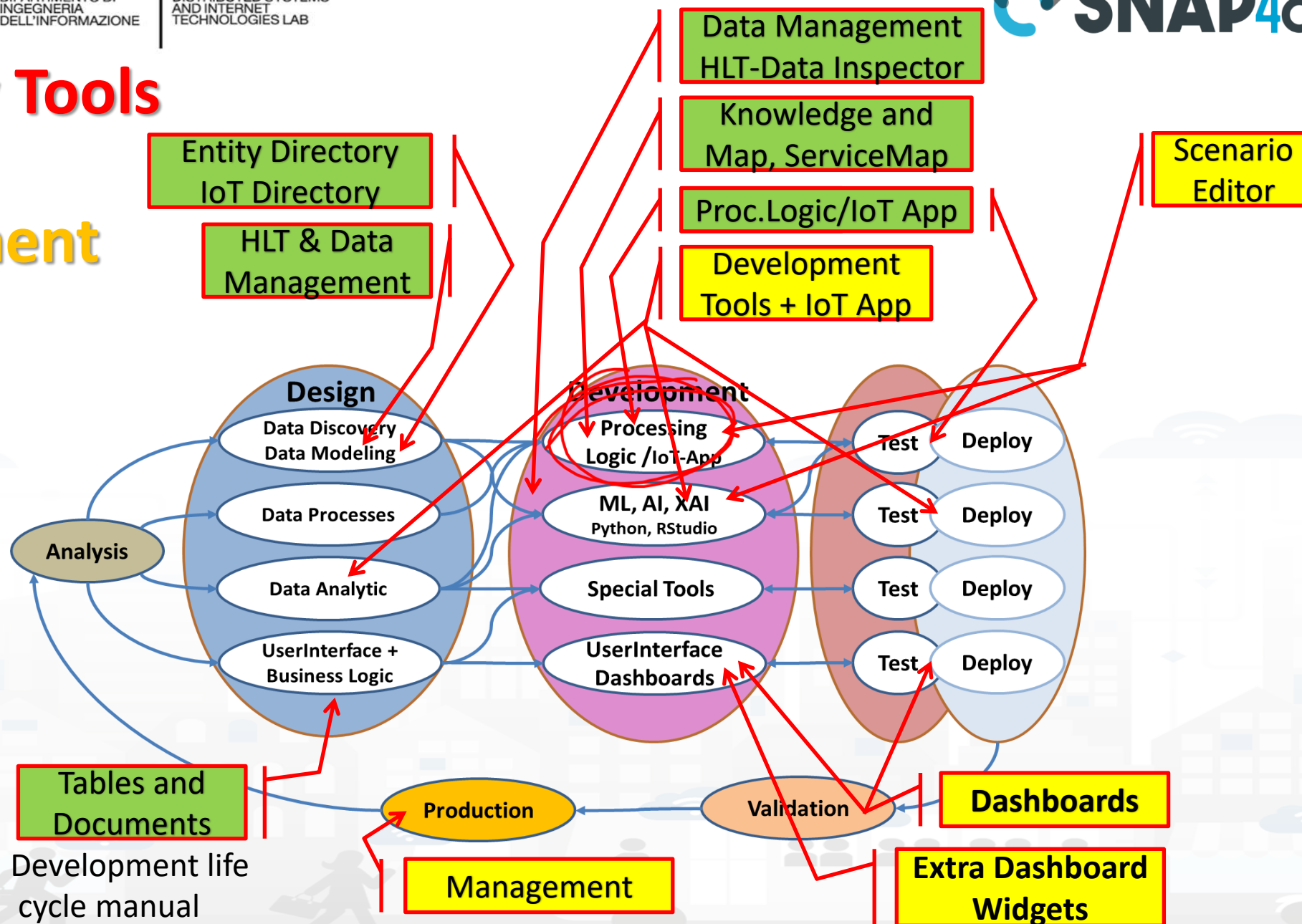
Agenda of this integrated overview part

- 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 life
cycle manual

Development

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



Development Life-Cycle

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

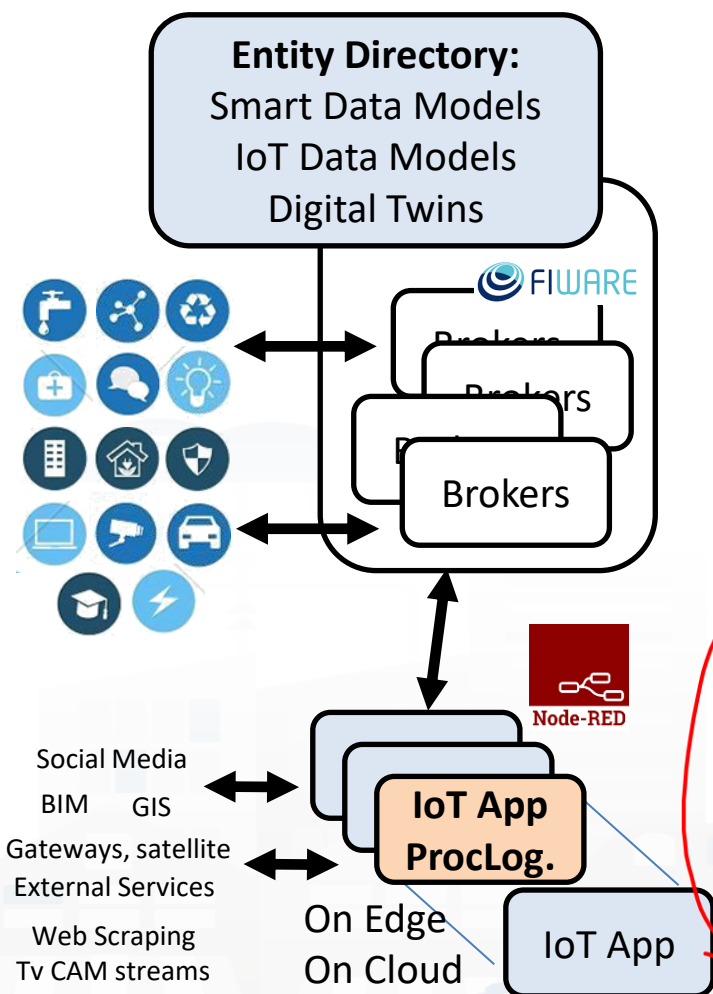
From Snap4City:

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

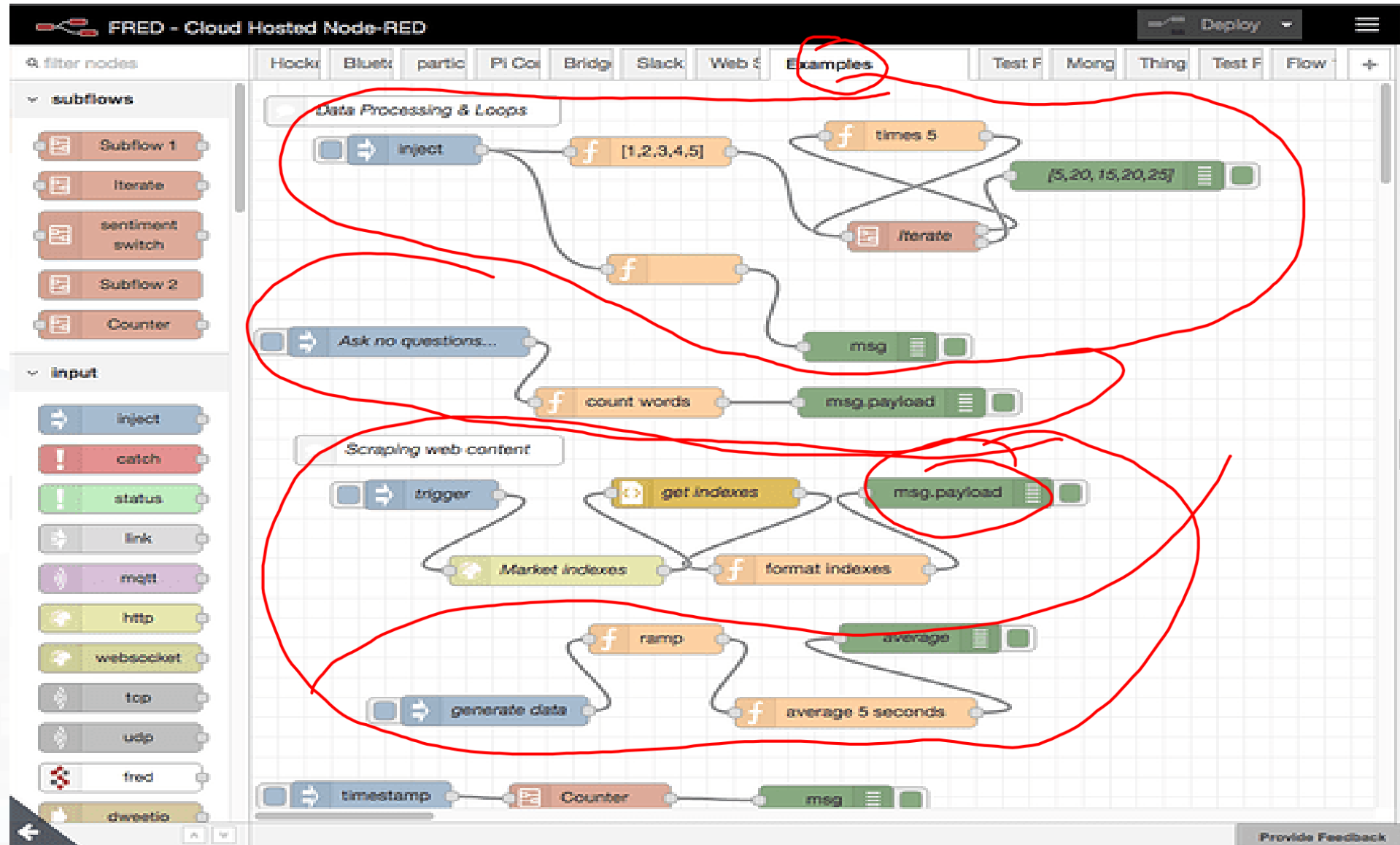
Coordinator: Paolo Nesi, Paolo.nesi@unifi.it

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

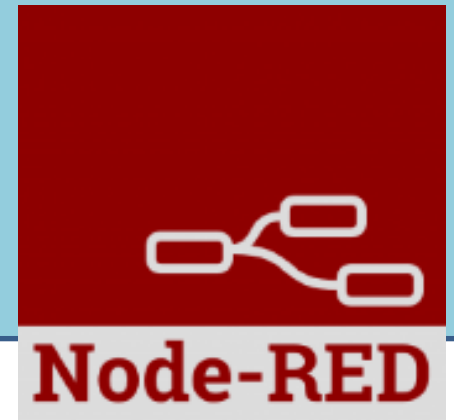
Data Ingestions Strategy

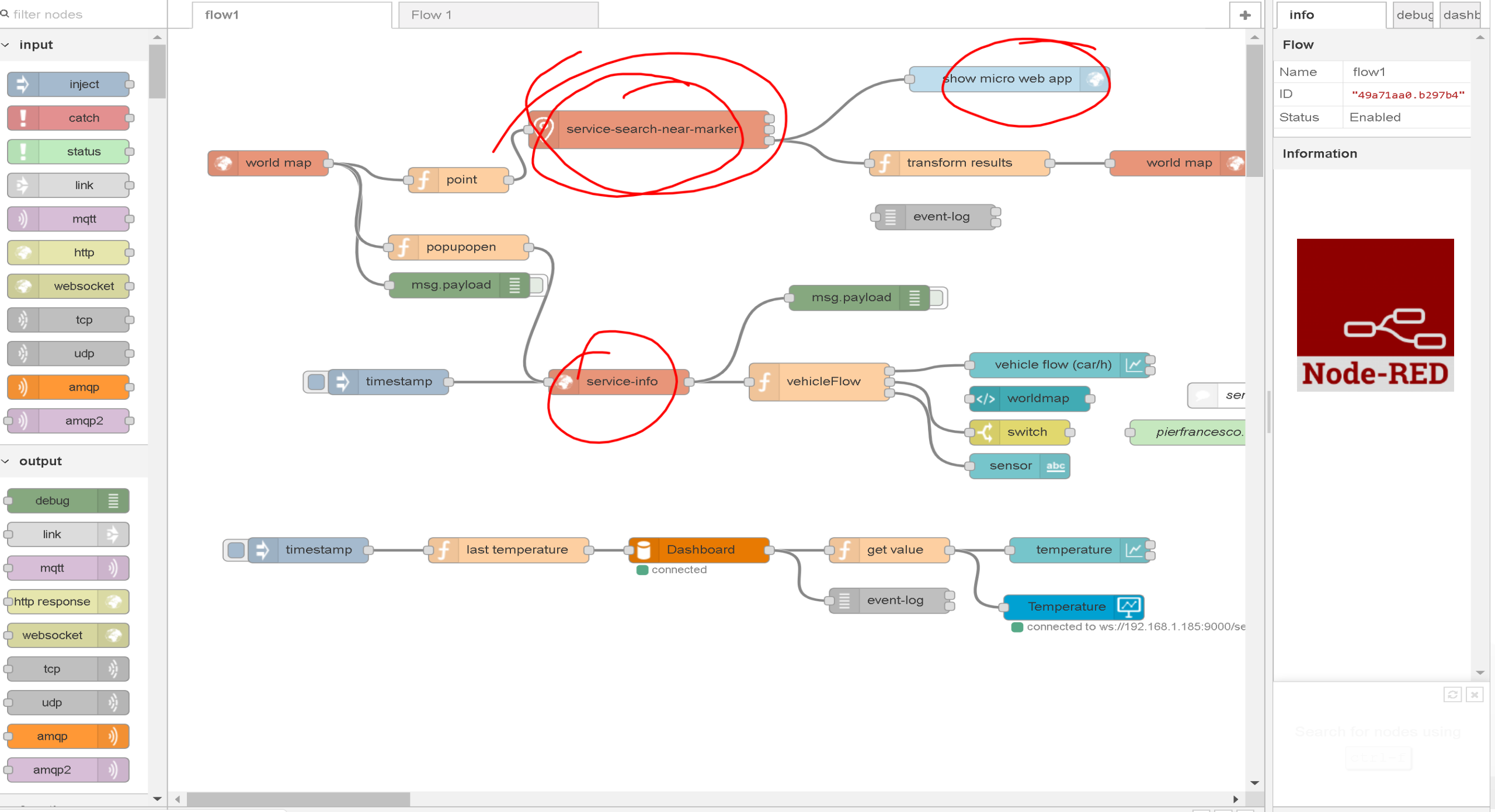


- 1) Via **internal Brokers**: NGSI V1/V2, MQTT (beta), JSON
 - the data messages arriving in **PUSH** on the platform,
 - if compliant to a known Model **and** referring to a known Device/Entity
 - They are AUTOMATICALLY: *stored, indexed*, and ready to be used by Wizard, Dashboards, Views and Applications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



Node-RED





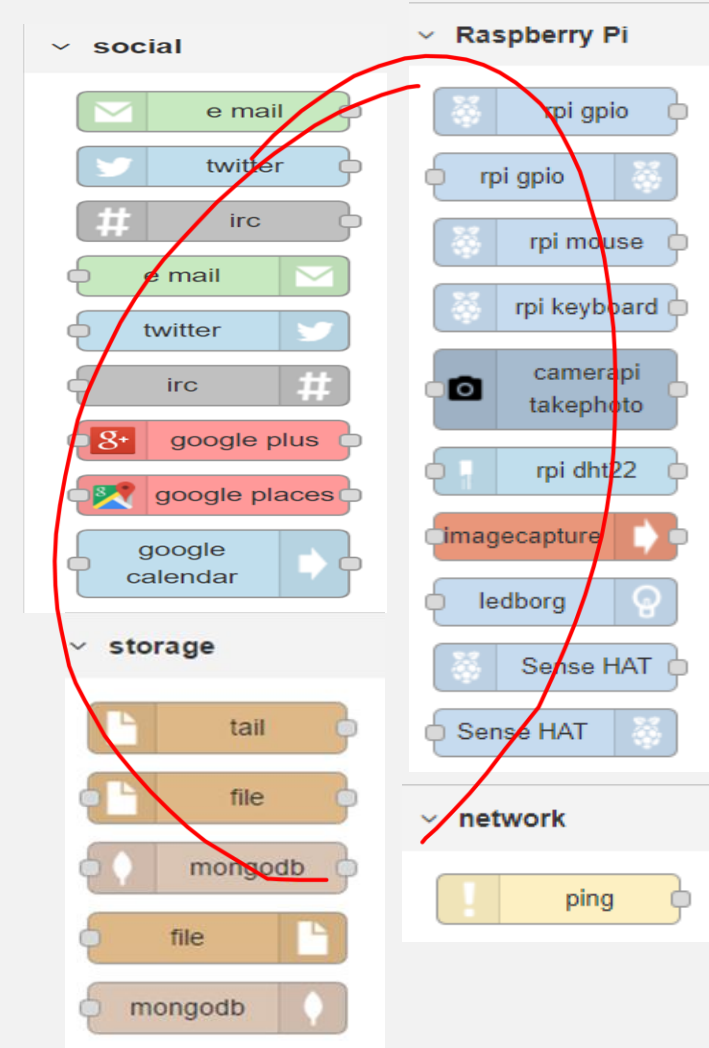
Basic Node.js Blocks on NodeRed on our Advanced IOT Apps



The screenshot shows the Node-RED block palette with several sections highlighted by red circles:

- common**: Includes blocks like inject, debug, complete, catch, status, link in, link out, and comment.
- network**: Includes MQTT, HTTP, WebSocket, TCP, and UDP blocks for both input and output.
- function**: Includes blocks for function, switch, change, range, template, delay, trigger, exec, zip, md5, soap request, string, xml converter, random, and rbe.

+ on IOT Edge Raspberry



The screenshot shows the Node-RED block palette with the following sections highlighted:

- social**: Includes e mail, twitter, irc, google plus, google places, and google calendar.
- storage**: Includes tail, file, and mongodb.
- Raspberry Pi**: Includes rpi gpio, rpi mouse, rpi keyboard, camerapi takephoto, rpi dht22, imagecapture, ledborg, Sense HAT, and network.

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.

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

+ on IOT Edge Raspberry

Categories shown: common, network, sequence, social, dashboard, function, input, output, storage, time, Raspberry Pi.

Nodes visible include: inject, debug, complete, catch, status, link in, link out, comment, mqtt in, mqtt out, http in, http response, http request, websocket in, websocket out, tcp in, tcp out, tcp request, udp in, udp out, amqp in, amqp2 in, stomp in, amqp out, amqp2 out, stomp out, split, join, sort, batch, csv, html, json, yaml, base64, msgpack, file, file in, file out, watch, ftp in, mysql, tail, email, twitter in, twitter out, feedparser, NGSI, NGSI v2toLD, Iwm2m, Iwm2m client in, Iwm2m client out, location, turf, worldmap, worldmap in, tracks, convex hull, time, sunrise, button, dropdown, switch, slider, numeric, text input, date picker, colour picker, form, text, gauge, chart, audio out, notification, ui control, template, e mail, twitter, irc, google plus, google places, google calendar, rpi gpio, rpi gpio, rpi mouse, rpi keyboard, camerapi takephoto, rpi dht22, imagecapture, ledborg, Sense HAT, Sense HAT, ping, tail, file, mongodb, file, mongodb.

Snap4City (C), November 2020

Hello World of Node-RED

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

The screenshot shows the Node-RED web interface in a browser window. The address bar displays '127.0.0.1:1880/#'. The interface includes a left sidebar with a 'filter nodes' search bar and two categories: 'output' and 'function'. The 'output' category is expanded, showing nodes like 'debug', 'link', 'mqtt', 'http response', 'websocket', 'tcp', and 'udp'. The 'function' category shows a 'function' node. The main workspace, titled 'Flow 1', contains a 'Hello, world!' node (a blue box with a right-pointing arrow) connected to a 'msg.payload' node (an orange box with a right-pointing arrow). A red circle highlights the 'Hello, world!' node, and a red arrow points from the 'debug' node in the left sidebar to it. The right sidebar has two tabs: 'info' and 'debug'. The 'info' tab is active, showing a table with the node's details:

Node	
Type	debug
ID	2d930e35.482d92

Below the table, the 'Properties' section is expanded, showing the following text:

The Debug node can be connected to the output of any node. It can be used to display the output of any message property in the debug tab of the sidebar. The default is to display `msg.payload`.

Each message will also display the timestamp, `msg.topic` and the type of property chosen to output.

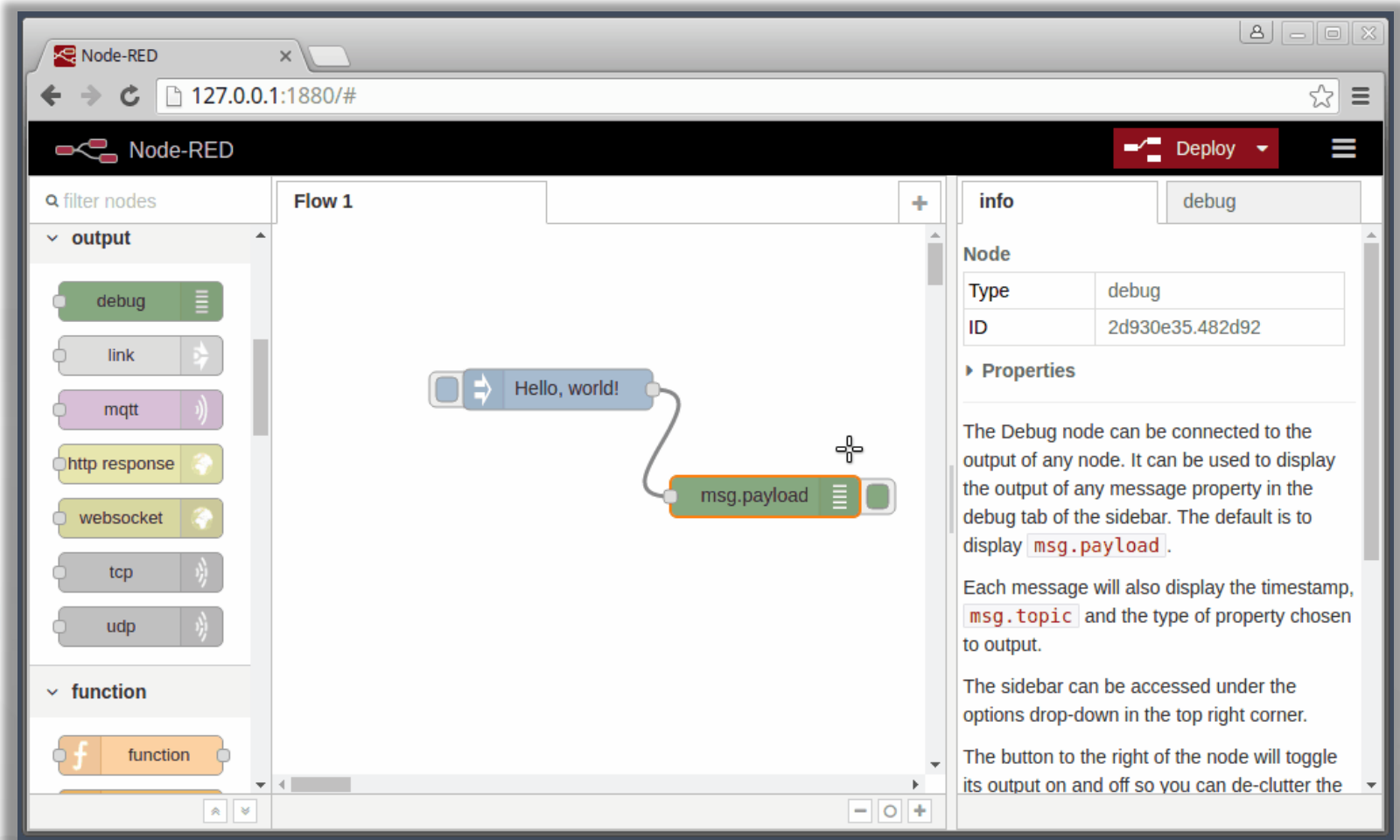
The sidebar can be accessed under the options drop-down in the top right corner.

The button to the right of the node will toggle its output on and off so you can de-clutter the

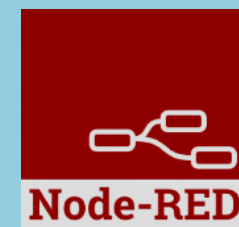


Node-RED

- 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=>



Node-RED[home](#)[about](#)[blog](#)[documentation](#)[forum](#)**[flows](#)**[github](#)

+[Sign in with GitHub](#)

nodes**flows**collections

recentdownloadsrating

node-red-contrib-websocket-header
Custom Websocket with Header
v0.5.2 144 node

node-red-contrib-websocket-header-acknowledge
Custom Websocket with Header
v0.0.1 0 node

node-red-contrib-zigbee2mqtt
Zigbee2mqtt connectivity nodes for node-red
v2.0.9 1326 4.6 node

node-red-contrib-nooperation
just do nothing.
v1.0.6 6 node

@nikolay_kuropatkin/node-red-contrib-dynamic-file-path
A simple node that generate a file by dynamic file path
v0.0.8 164 5.0 node

node-red-contrib-mobilealerts
This provides a node for receiving Mobile Alerts status infos.
v3.0.5 71 5.0 node

node-red-contrib-websocket-header-subscriber
Custom Websocket with Header
v0.0.1 0 node

@mschaeffler/node-red-asterisk-ami-manager
Transfer Asterisk AMI events to json object string representation
v1.1.2 6 node

node-red-contrib-sun-position
NodeRED nodes to get sun and moon position
v2.1.1 1259 4.8 node

node-red-contrib-miio-localdevices
Node for Node-Red to control Mi Devices locally via node-mihome (Humidifiers, Purifiers, Heaters, Lights - list of devices to be enlarged).
v0.4.1 270 1.9 node

node-red-contrib-cx-alarm-log
A Node-RED industrial alarm parser for simple HMI applications.
v1.1.0 16 5.0 node

node-red-contrib-message-queue
Message queueing for Node-RED
v1.1.4 11 node

node-red-contrib-sendmail
send emails with help of a local sendmail command.
v1.0.5 16 node

node-red-contrib-websocket-header-test
Custom Websocket with Header
v0.0.1 0 node

node-red-contrib-daylight-rgbw
Daylight RGBW Color control for Node RED
v2.1.3 128 node

1 of 429 [Next](#)

Load Library from Palette

<https://flows.nodered.org/>

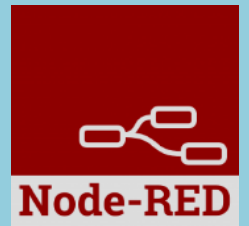
The screenshot shows the Snap4City interface with the Node-RED editor. The 'Manage palette' button is highlighted with a red circle and a red arrow pointing to it. The interface includes a sidebar with various tools and a main workspace for creating flows.

The top screenshot shows the 'Node-RED Library' page with a search bar and a list of recent nodes. The bottom screenshot shows the 'node-red-contrib-heatweb' node details page, with the 'Node Info' section highlighted by a red circle.

Two views of the same libraries

Node-RED

SnaP4City Libraries



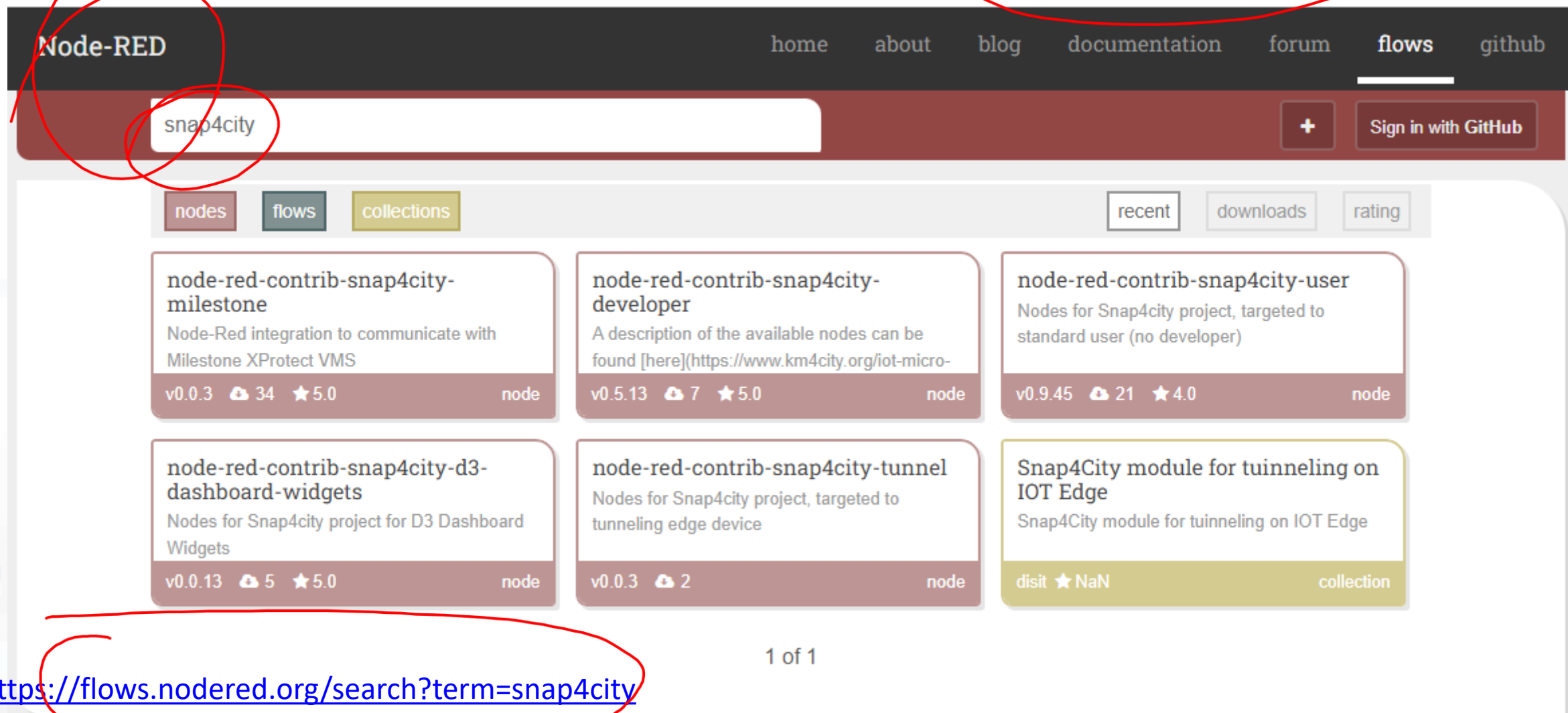
Proc.Logic / IoT App Editor: NODE-RED

- 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



The screenshot shows the Node-RED search interface. The search bar at the top contains the text 'snap4city'. Below the search bar, there are tabs for 'nodes', 'flows', and 'collections'. The 'nodes' tab is selected. The search results are displayed in a grid of six cards. Each card shows the name of the library, a brief description, the version number, the number of downloads, the star rating, and the type of library (node or collection). The first five cards are 'node' type, and the last one is a 'collection' type.

Library Name	Description	Version	Downloads	Rating	Type
node-red-contrib-snap4city-milestone	Node-Red integration to communicate with Milestone XProtect VMS	v0.0.3	34	5.0	node
node-red-contrib-snap4city-developer	A description of the available nodes can be found [here](https://www.km4city.org/iot-micro-)	v0.5.13	7	5.0	node
node-red-contrib-snap4city-user	Nodes for Snap4city project, targeted to standard user (no developer)	v0.9.45	21	4.0	node
node-red-contrib-snap4city-d3-dashboard-widgets	Nodes for Snap4city project for D3 Dashboard Widgets	v0.0.13	5	5.0	node
node-red-contrib-snap4city-tunnel	Nodes for Snap4city project, targeted to tunneling edge device	v0.0.3	2		node
Snap4City module for tunneling on IOT Edge	Snap4City module for tunneling on IOT Edge	disit		NaN	collection

1 of 1

<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



aaa

The screenshot shows the Node-RED web interface. On the left, a 'msg.payload' node is connected to a 'Import S4C' dialog box. The dialog box has a list of public flows and a text area containing JSON data. At the bottom of the dialog, there are buttons for 'current flow' and 'new flow', and 'Cancel' and 'Import' buttons. On the right, a sidebar menu is open, showing options like 'View', 'Import', 'Export', 'Search flows', 'Configuration nodes', 'Flows', 'Subflows', 'Manage palette', 'Settings', 'Keyboard shortcuts', and 'Node-RED website'. The 'Import' menu item is circled in red, and a red arrow points from it to the 'Import S4C' dialog box.

Import S4C

Public flow: RecommendationsForYou2
Public flow: SuggestionsForYou
Public flow: TC2.7 (b) - IOT protocol Telemetry
Public flow: TC2.7 (a) - IOT protocol Telemetry
Public flow: TC2.5 - IOT application; IOT Discovery of sen
Public flow: TC9.2 (JSON) - Managing heterogeneous
Public flow: TC9.2 (XML) - Managing heterogeneous
Public flow: TC9.2 (RDF) - Managing heterogeneous
Public flow: TC9.2 (HTML) - Managing heterogeneous
Public flow: TC9.2 (CSV) - Managing heterogeneous

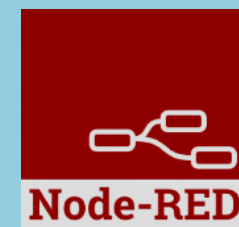
```
{["id":"99d0ceb6.66a7f","type":"json","z":"18bbf2b5.57d68d","name":"","pretty":false,"x":343.00002288818,"y":110.00000953674,"wires":[["a65d77fc.50fee8"]]},{"id":"3d04d6a4.80e6ea","type":"inject","z":"18bbf2b5.57d68d","name":"","topic":"","payload":{"contacts":[{"contact":
```

Import to

Clipboard
Library
Import S4C
Examples

View
Import
Export
Search flows
Configuration nodes
Flows
Subflows
Manage palette
Settings
Keyboard shortcuts
Node-RED website

Node-RED in Snap4City





Proc.Logic / IoT App



User: paolo.disit, Org: DISIT

Role: AreaManager, Level: 3

LOGOUT



Switch to Legacy
Layout

CREATE NEW

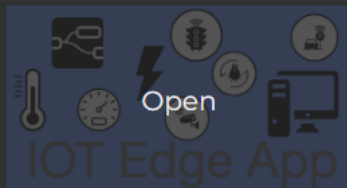


Prev 1 2 3 Next

Filter



2020-07-28T10:20

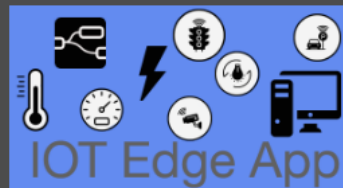


My own



Management

2020-07-28T12:32

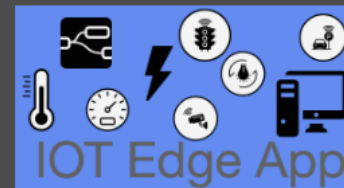


My own



Management

2020-08-18T08:38

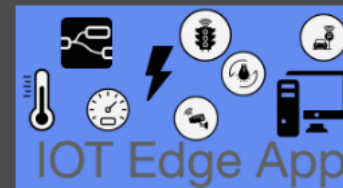


My own



Management

2021-01-19T16:25

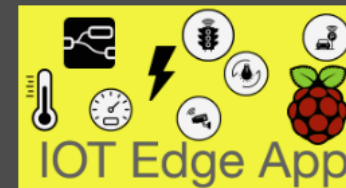


My own



Management

2021-08-21T13:26

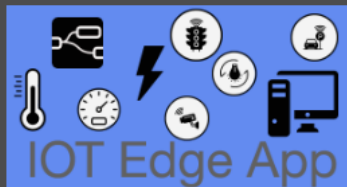


My own



Management

2022-05-28T14:50

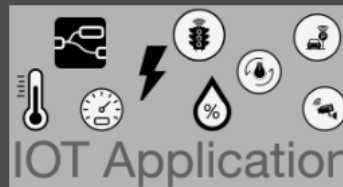


My own



Management

actionurltest



My own



Management

Alarm Management

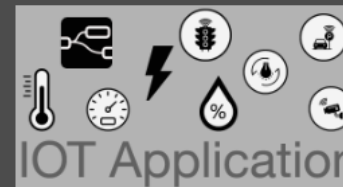


My own



Management

corona1

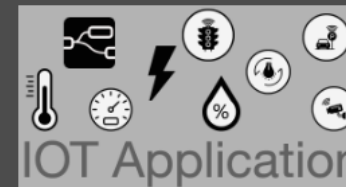


My own



Management

coronaR



My own



Management

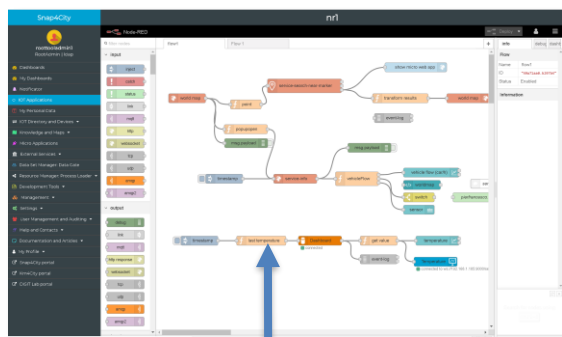
IOT Application Listing, they can be

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

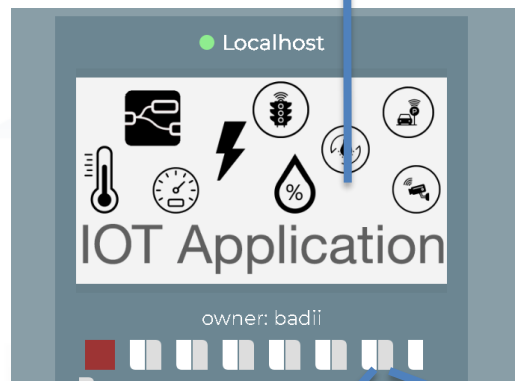
The screenshot shows the Snap4City web interface. On the left is a sidebar with a navigation menu. The main content area is titled 'IOT Applications' and displays a grid of application tiles. Each tile shows an icon, a title, a timestamp, and an owner. The tiles are: 'IOT Edge App' (owner: badii), 'IOT Edge App' (owner: panesi), 'IOT Edge App' (owner: pb3), 'Data Analytic' (owner: snap4city), 'IOT Edge App' (owner: semolarudy), 'IOT Application' (owner: tester5), 'IOT Application' (owner: semolarudy), 'ChargingStations' (owner: comunedashres), 'IOT Application' (owner: badii), 'IOT Edge App' (owner: badii), 'IOT Application' (owner: tester2), and 'Web Scraper Portia' (owner: My own). A red circle highlights the 'IOT Application' tile owned by semolarudy.

IOT Applications Listing

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

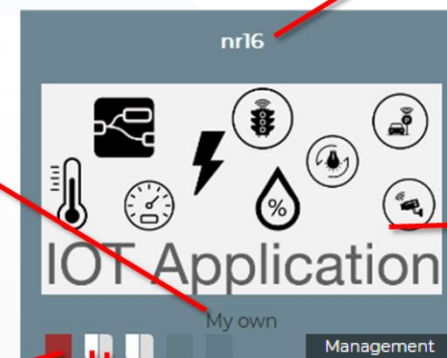
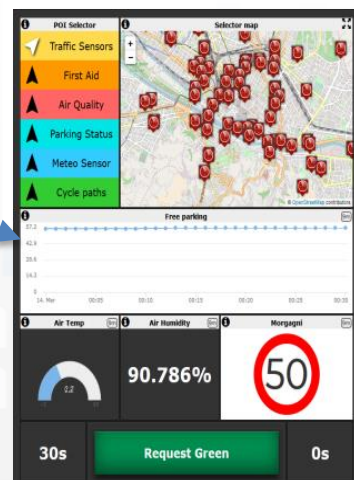


EDIT IOT APP



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

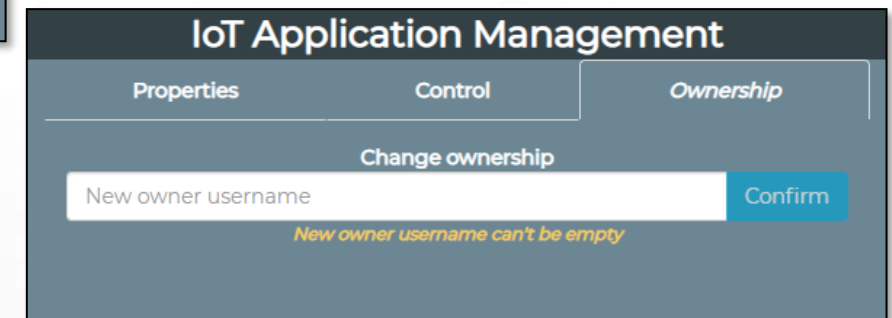
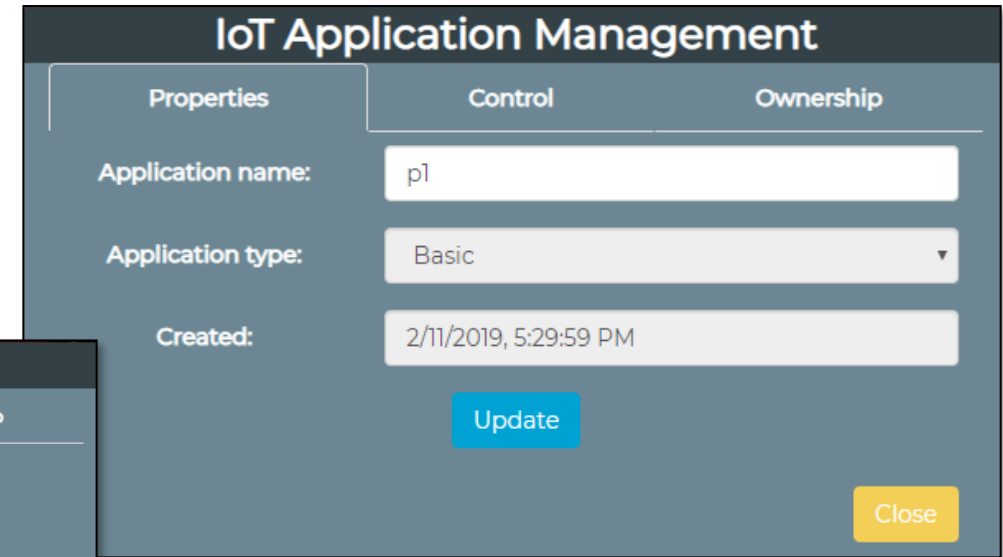
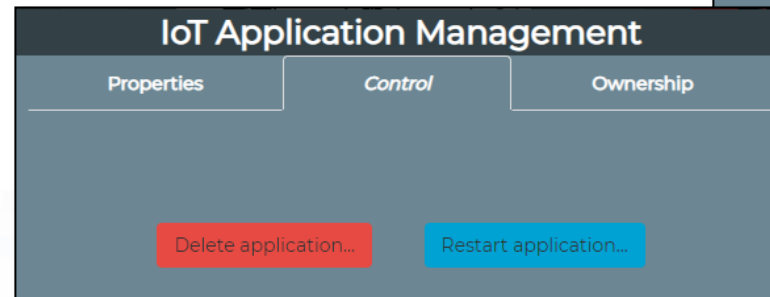
Click to edit IOT App properties

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

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

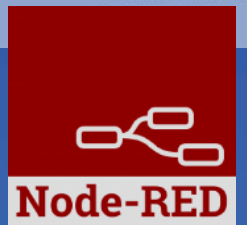
IOT MicroServices for Final Users

IOT MicroServices for Developers

DOC: Processing Logic/IoT App

How to Develop Proc.Logic / IoT App

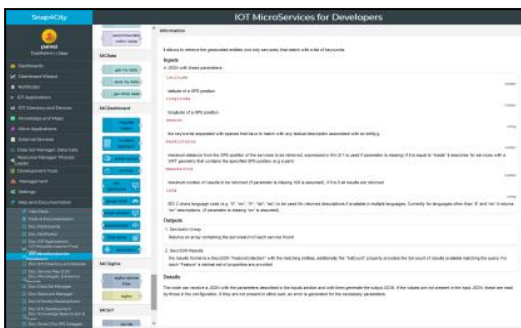
Create A MicroService from RestCall



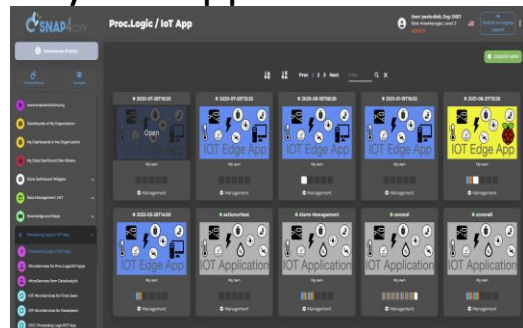
IOT Applications Development

IoT Discovering

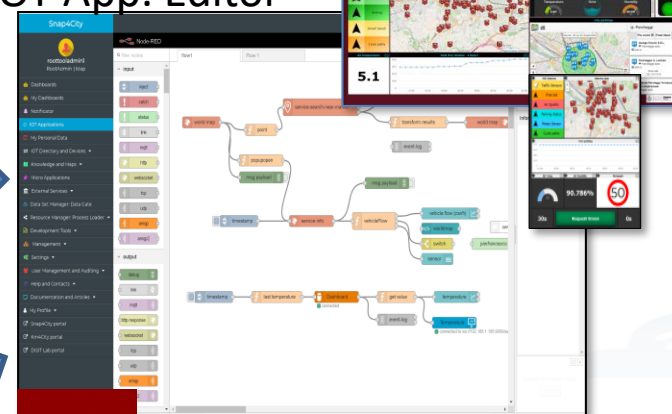
MicroServices collections



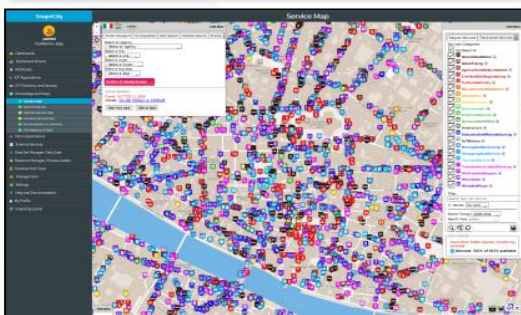
My IOT Applications



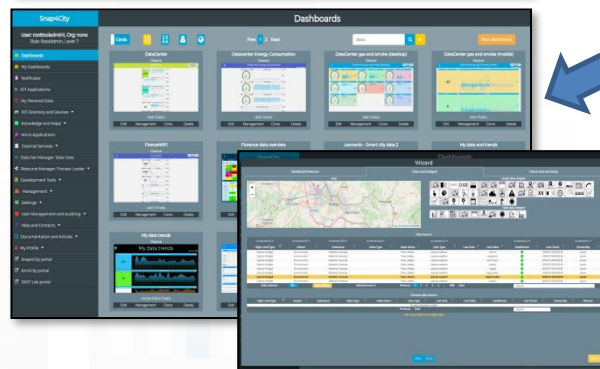
IOT App. Editor



Generating IOT App
With Dashboard



ServiceMap Discovery
Knowledge Base, Km4City



Dashboard Collection,
Editor and Wizard

Sharing/saving
reusing IOT App



Resource Manager



roottooladmin1

RootAdmin | Idap

Dashboards

My Dashboards

Notifier

IOT Applications

My Personal Data

IOT Directory and Devices

Knowledge and Maps

Micro Applications

External Services

Data Set Manager: Data Cate

Resource Manager: Process Loader

Development: Tools

Management

Settings

User Management and Auditing

Help and Contacts

Documentation and Articles

My Profile

Snap4City portal

Km4City portal

DISIT Lab portal

Node-RED

filter nodes

input

output

flow1

Flow 1

world map

point

service-search-near-marker

transform results

show micro web app

world map

event-log

popupopen

msg.payload

timestamp

service-info

vehicleFlow

vehicle flow (car/h)

worldmap

switch

sensor

last temperature

Dashboard

get v

event-log

Temperature

info

debug

dash

Flow

info

debug

dash

Information

SNAP4CITY

KM4CITY

Node-RED

Data Adapation

Transformation, Conversion

Integration

Business Logic vs Dashboards

Editing IOT Applications

Data Analytics control

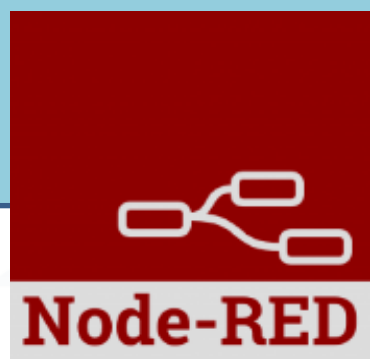
Everywhere: Cloud, on IoT Edge Devices

Snap4City (C), February 2025

154

Develop Snap4City IoTApp

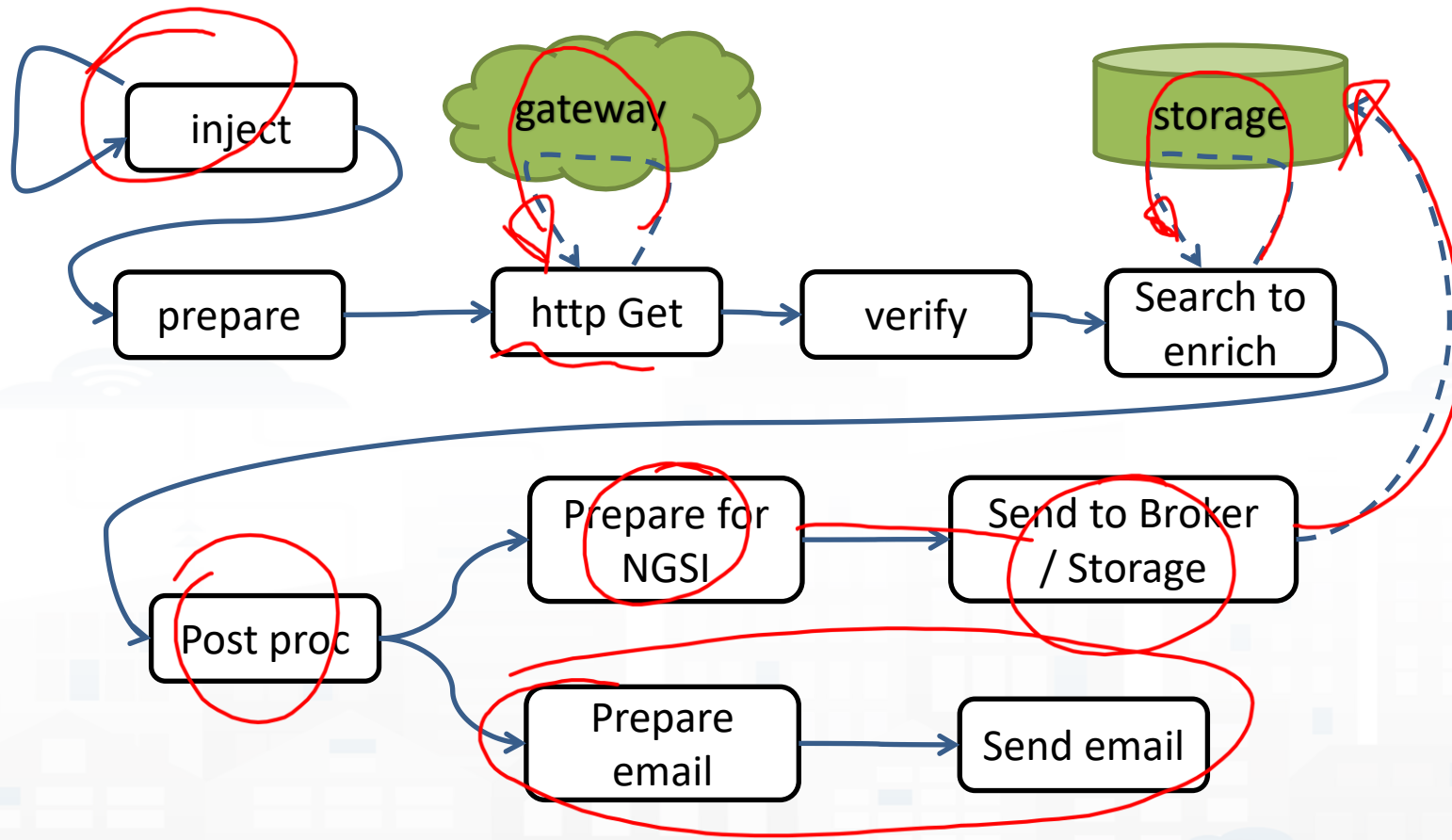
Processing Logic



How to Design

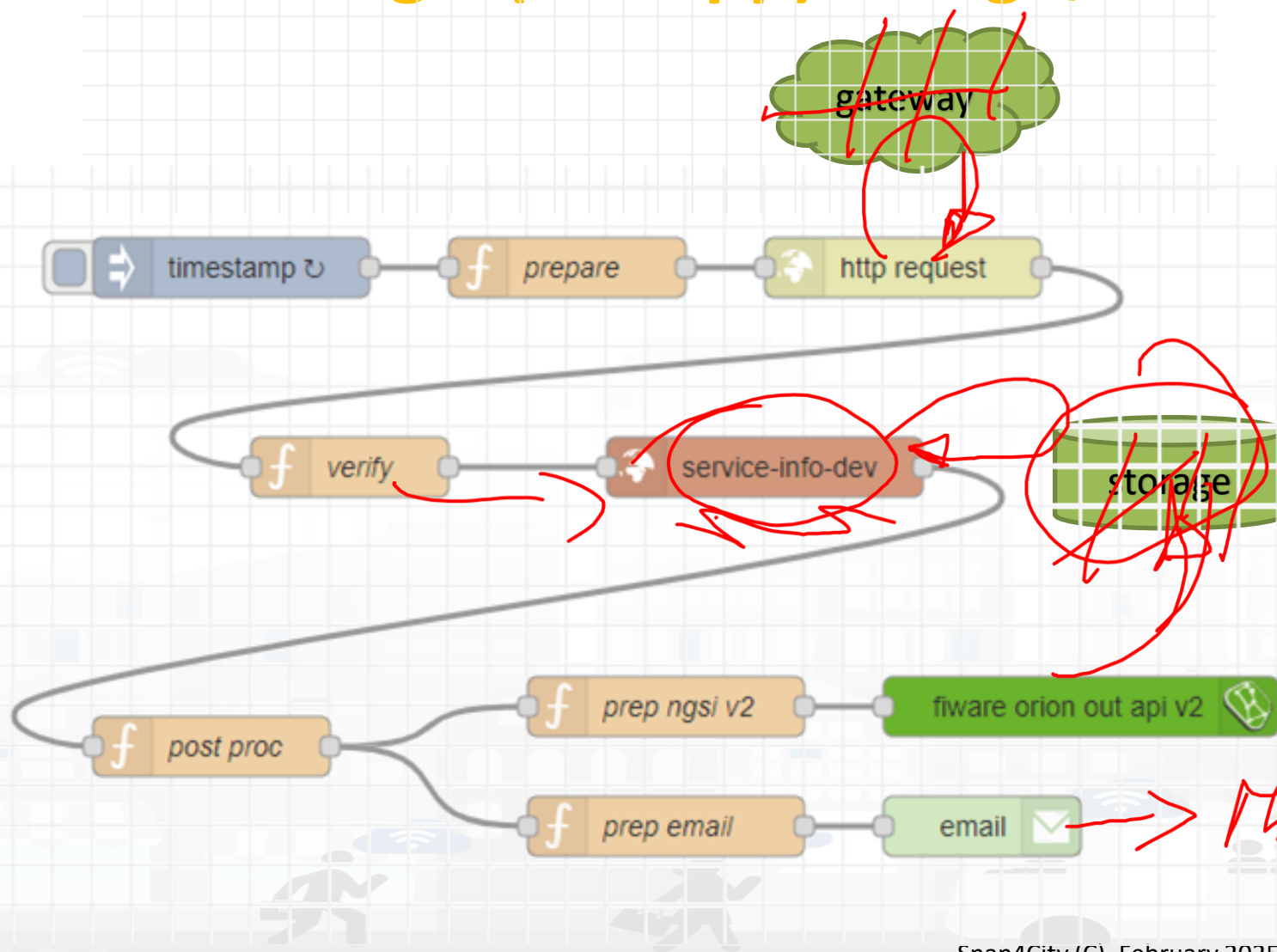
1. **Business Logic** is going to be implemented in Proc.Logic (IoT App), with a set of flows.
2. **Decompose your problem** and sequence diagram in single Data/event Flows, from client side and server side.
3. **Identify the single Data/Event Flow**, as those that start from a certain event (periodic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



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

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

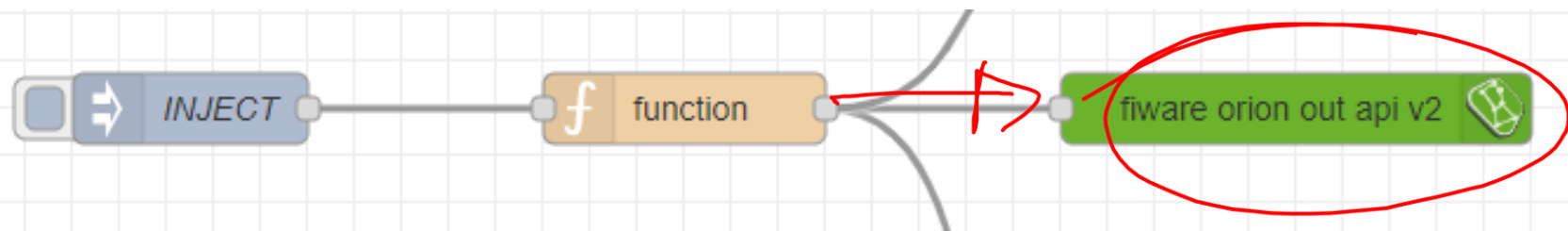


- Periodically activate the flow
- Call a gateway to get data
- Verify the correctness of data
- Enrich the data with other information coming from Cloud data into the storage
- Transform the data in the correct forma
- Send the data into the Broker, and thus send the data in the storage on a specific Entity Instance
- Send also a notification via email

Only Server

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},
     "latitude": {"type": "float", "value": "28.61810"},
     "longitude": {"type": "float", "value": "11.34300"},
     "status": {"type": "integer", "value": 34}
    }
  
```

```

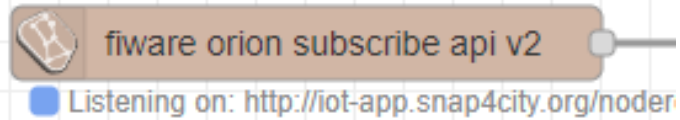
return msg;
  
```

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

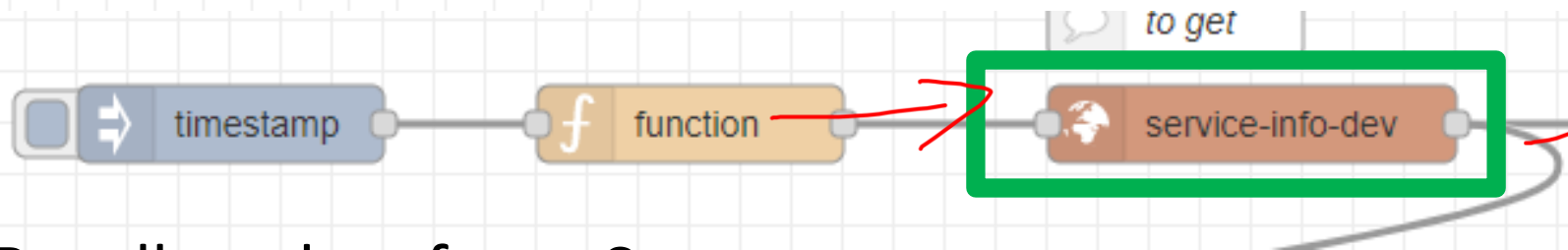
```

// it is a time serie
// it may move over time
// it may move over time
  
```

Read and share Data and Context Data



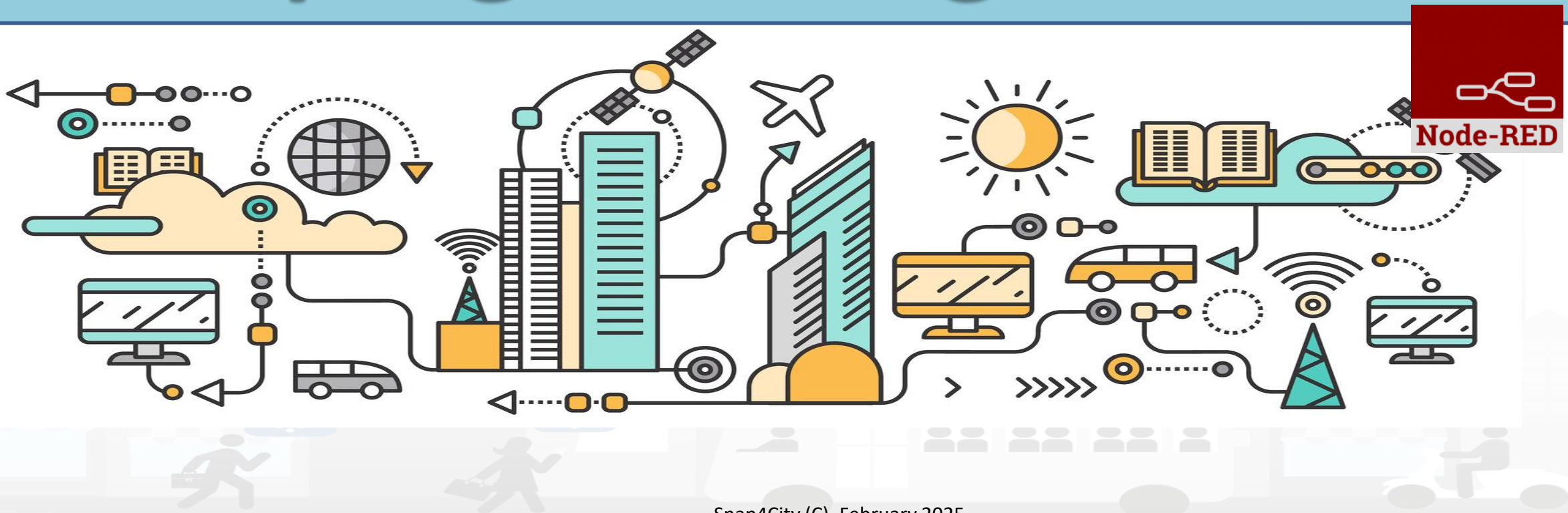
1) Event driven from Broker, read last context data. It is not sure that this change is on Storage



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





DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

Sept 2024 collection

Two Snap4City Libraries



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



Sept 2024 collection

Two Snap4City Libraries



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

We suggest also to install:

AND: From Resource Manager

Snap4City (C), February 2025

164

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:

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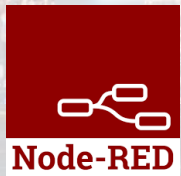
Standards and Interoperability (10/2024)



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, XPD, 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

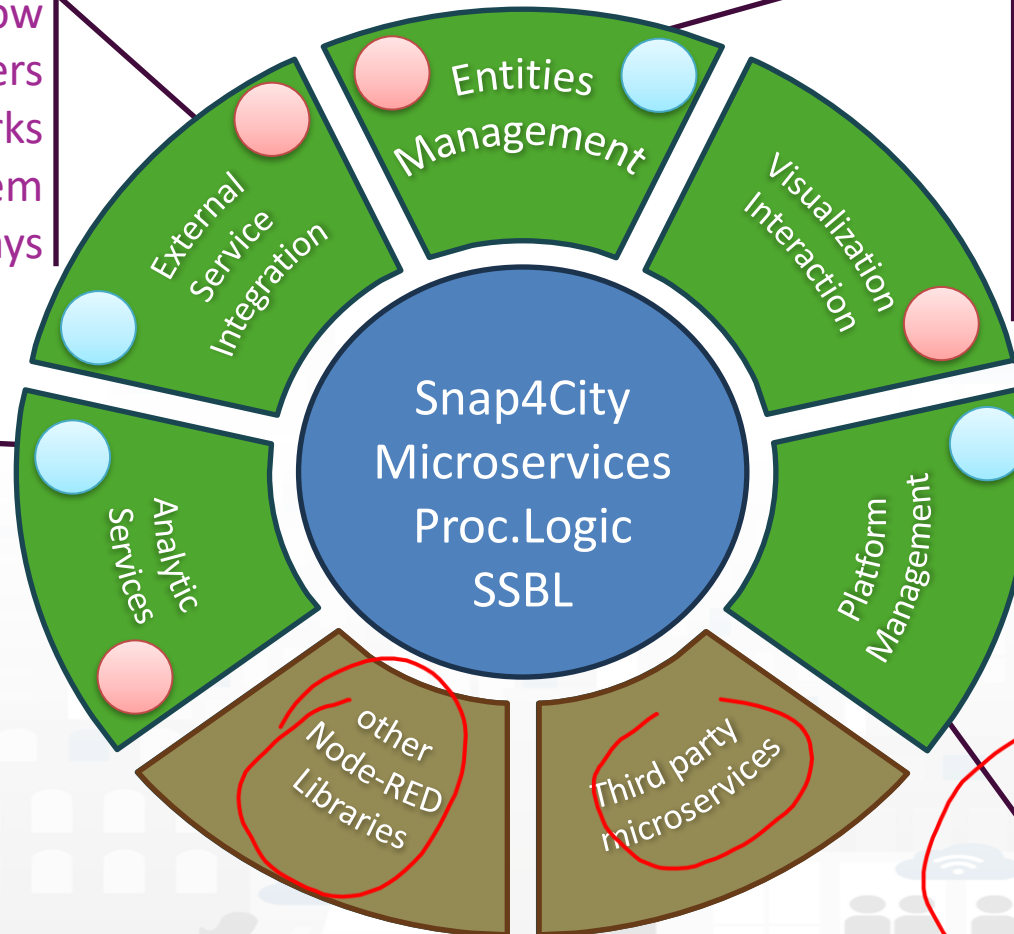
- <https://flows.nodered.org/search?term=snap4city>
- <https://flows.nodered.org/node/node-red-contrib-snap4city-user>
- <https://flows.nodered.org/node/node-red-contrib-snap4city-developer>
- <https://flows.nodered.org/node/node-red-contrib-snap4city-d3-dashboard-widgets>
- <https://flows.nodered.org/node/node-red-contrib-snap4city-tunnel>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

> 60.000 downloads

Areas

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

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



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

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

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

Saving Data on Storage

Even Driven

Get Data from Storage

Get Data from
Storage

Send email

Gen/access to
HTTP, HTML pages

Monitor messages

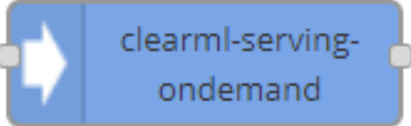
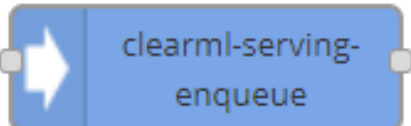
Stream Delay,
limiting rate

	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. With other nodes you can send Telegram, SMS, etc.	standard
	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
	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
 	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

	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 <u>msg.payload</u> 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: <u>Read access</u> , <u>Read write</u> , <u>Modify</u> (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.	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, <u>array</u> 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
		

The Proc.Logic (IoT App) microservices

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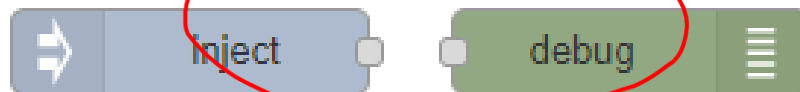
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Some patterns

Periodic or
Sporadic events to
data collection,
processing

Even Driven

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



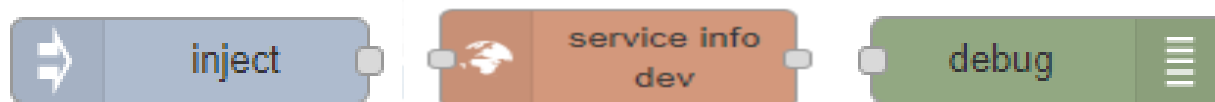
- 2) Hello world of node-red at two steps, the inject provides a push while a JSON is created into the function as `msg.payload = {.....}` and sent/shown to/by the debug.



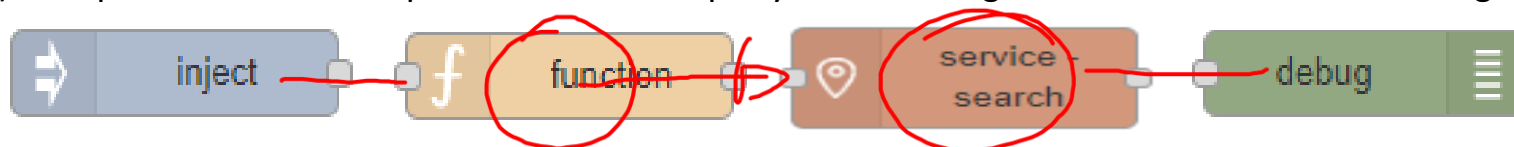
- 3) Event data reception from an MQTT broker, transformation and send it to the storage pushing data into the Orion Broker V2.



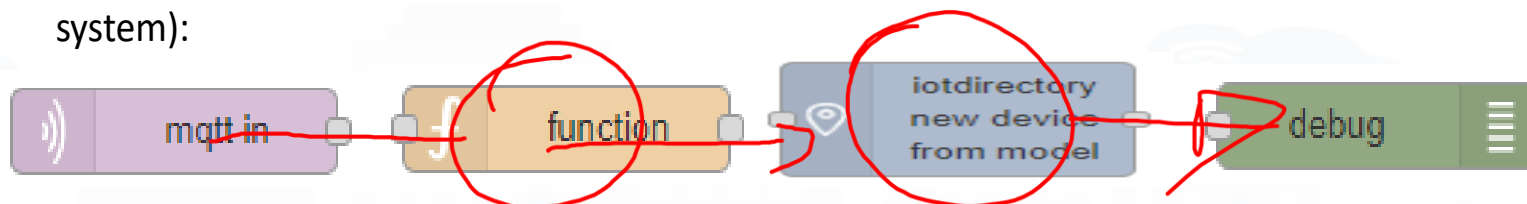
- 4) request on inject of a SURJ to the storage to see data on debug.



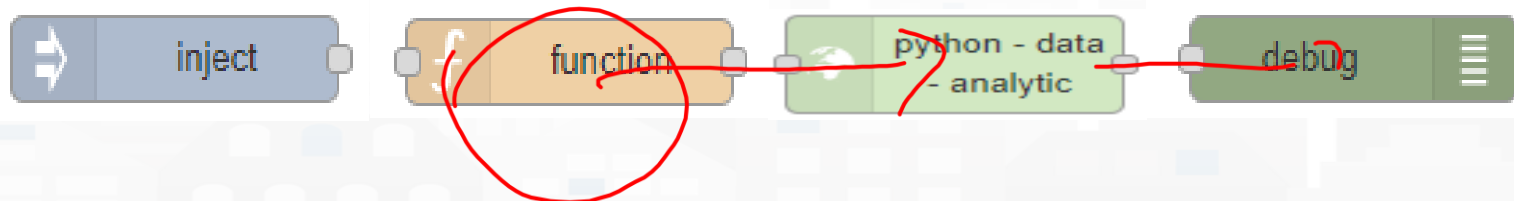
- 1) Preparation of data request on function, query to the storage and see data result on debug.



- 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):



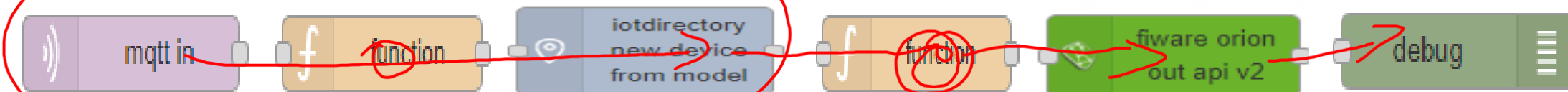
- 3) Preparation of data parameters on function, request computing Data Analytic, see data result on debug.



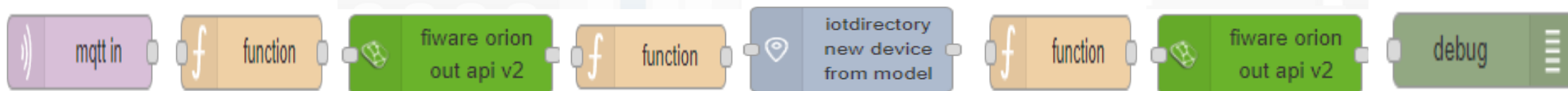
Even Driven

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).

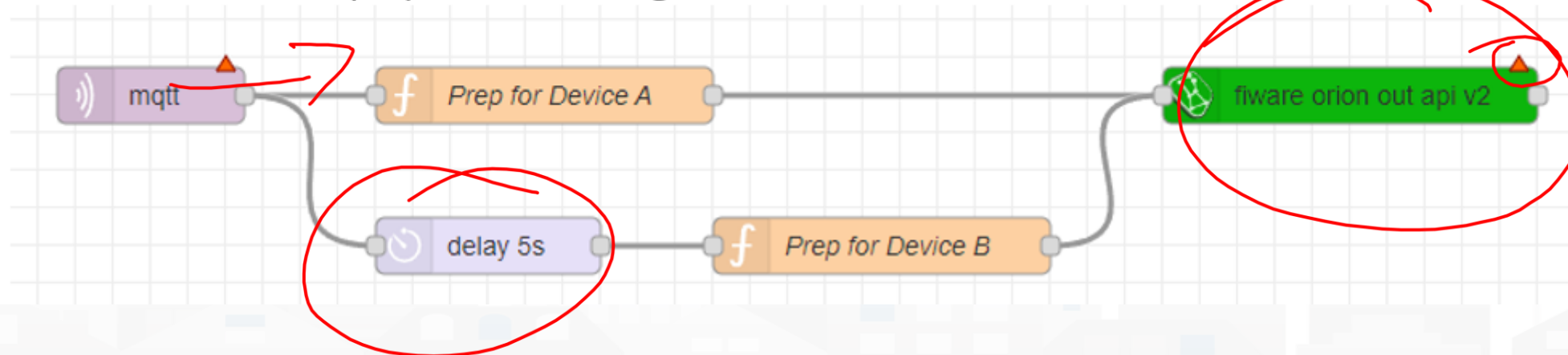


In most cases, it should be done the opposite: try to send the Entity Message, if it fails than create a new Entity Instance by known model, and if successful send again the Entity Message, or just wait for the new message to save it the first.



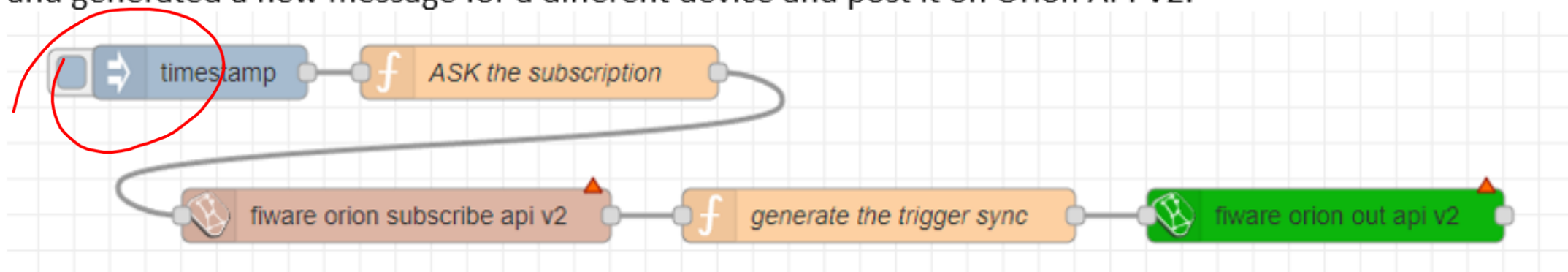
Sync data changes on Entities from an Event

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:

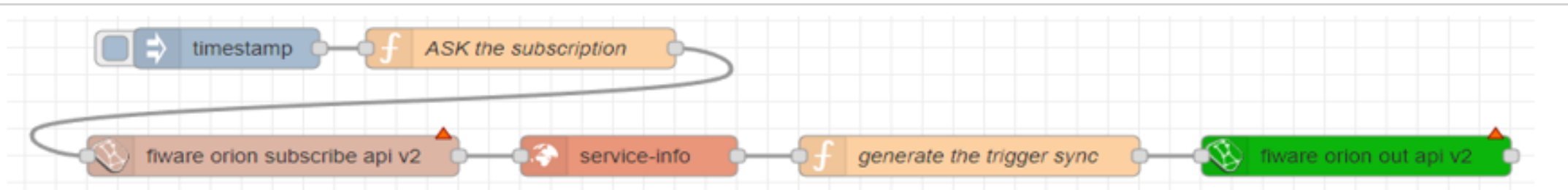


Subscribe on event from Broker, be carefull....

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:



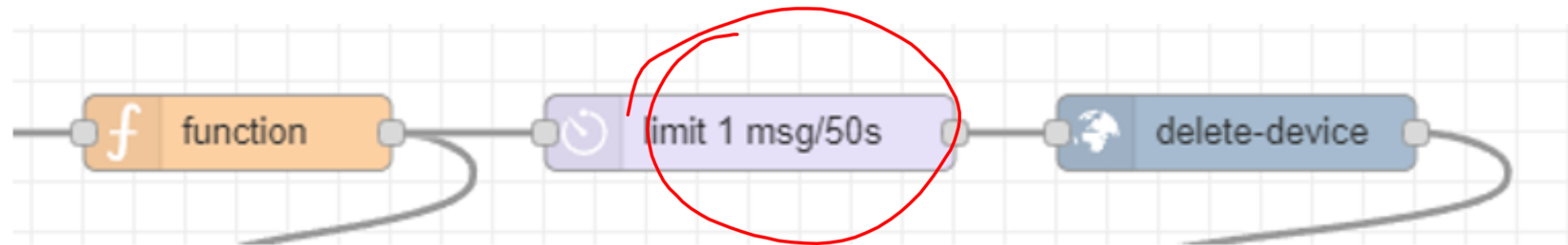
Delete Devices

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

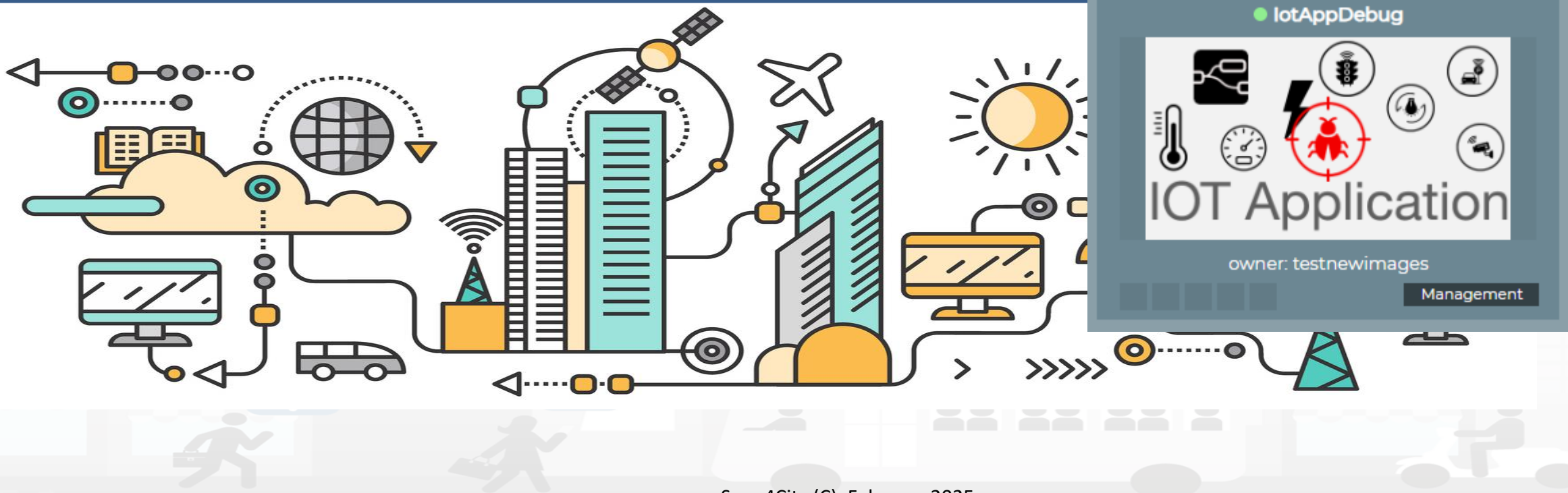
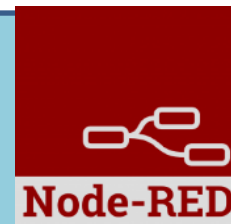
Execution Environment	JavaScript Runs in the browser (e.g., Chrome, Firefox, Edge)	NODE-RED + Snap4City
Programming Model	Procedural, asynchronous, and event-driven	Flow-based programming with visual node wiring, Event-driven, asynchronous, and non-blocking
Use Case	Enhancing web pages, UI interactivity, 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

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

Notifier

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 App

Create A MicroService from RestCall

Entity Directory and Devices

Resource Manager

Development Tools

advanced3debug

Node-RED

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

debug 6

function 4

function 5

chart

debug 7

info

Search flows

Flows

- Flow 4
- Flow 3
- Flow 1
- R - Python

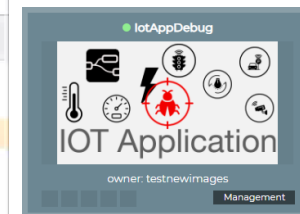
Subflows

Global Configuration Nodes

Flow 3

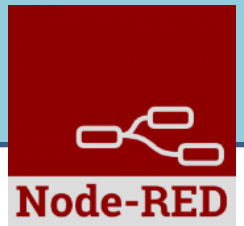
Flow "ff58664fe453ec66"

Import a flow by dragging its JSON into the editor, or with `ctrl-i`

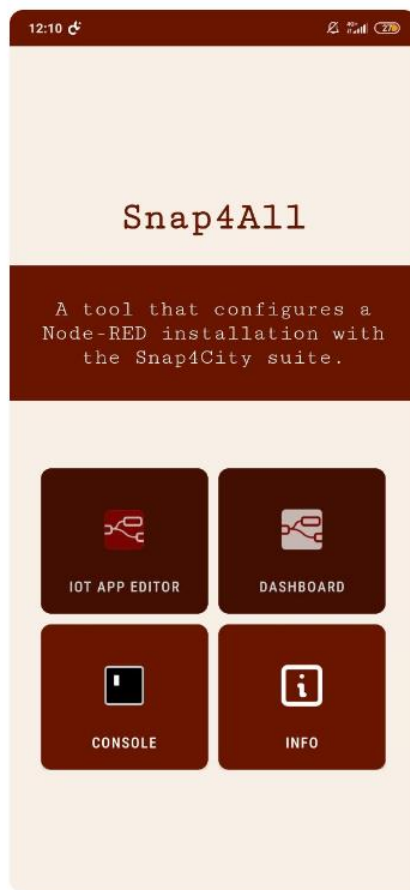


Snap4All Mobile App

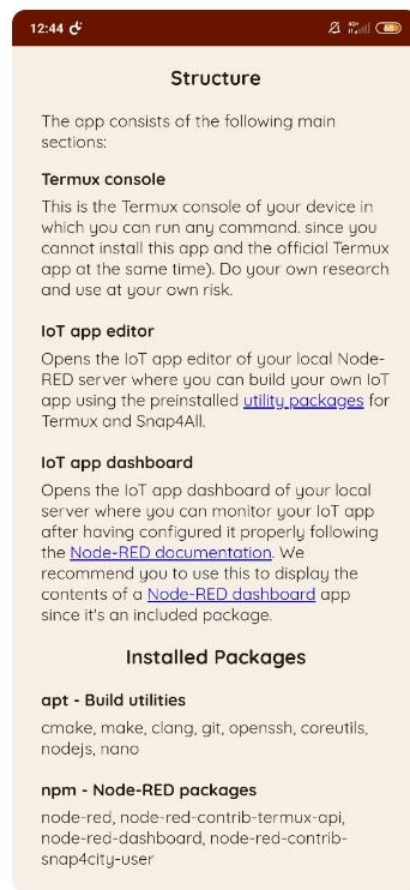
Node-RED on Android



Snap4All mobile app for Android



(a) Home



(b) Info



(c) Console



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