



www.snap4city.org
www.snap4solutions.org



www.km4city.org

IoT App. / Proc.Logic Server Side Business Logic

Sept. 2024, Course, Part 3

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

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

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



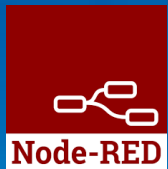
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DISTRIBUTED SYSTEMS
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TECHNOLOGIES LAB



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



Be smart in a SNAP!



IoT App. / Proc.Logic
Server Side Business Logic

Sept. 2024, Course, Part 3
<https://www.snap4city.org/944>
<https://www.snap4city.org/577>

LIVING LAB

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES



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DISTRIBUTED DATA INTELLIGENCE
AND TECHNOLOGIES LAB

SNAP4CITY

SNAP4CITY





Digital Twin Solutions for Sustainability

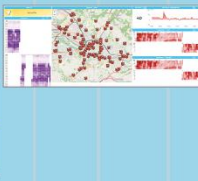
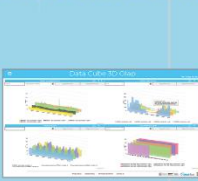
OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS



- 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



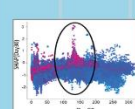
DASHBOARDS, WIDGETS TEMPLATES

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

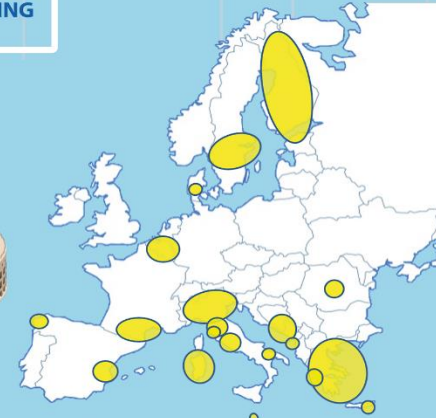


BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING, GENERATIVE AI
OPERATIVE RESEARCH, STATISTICS



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

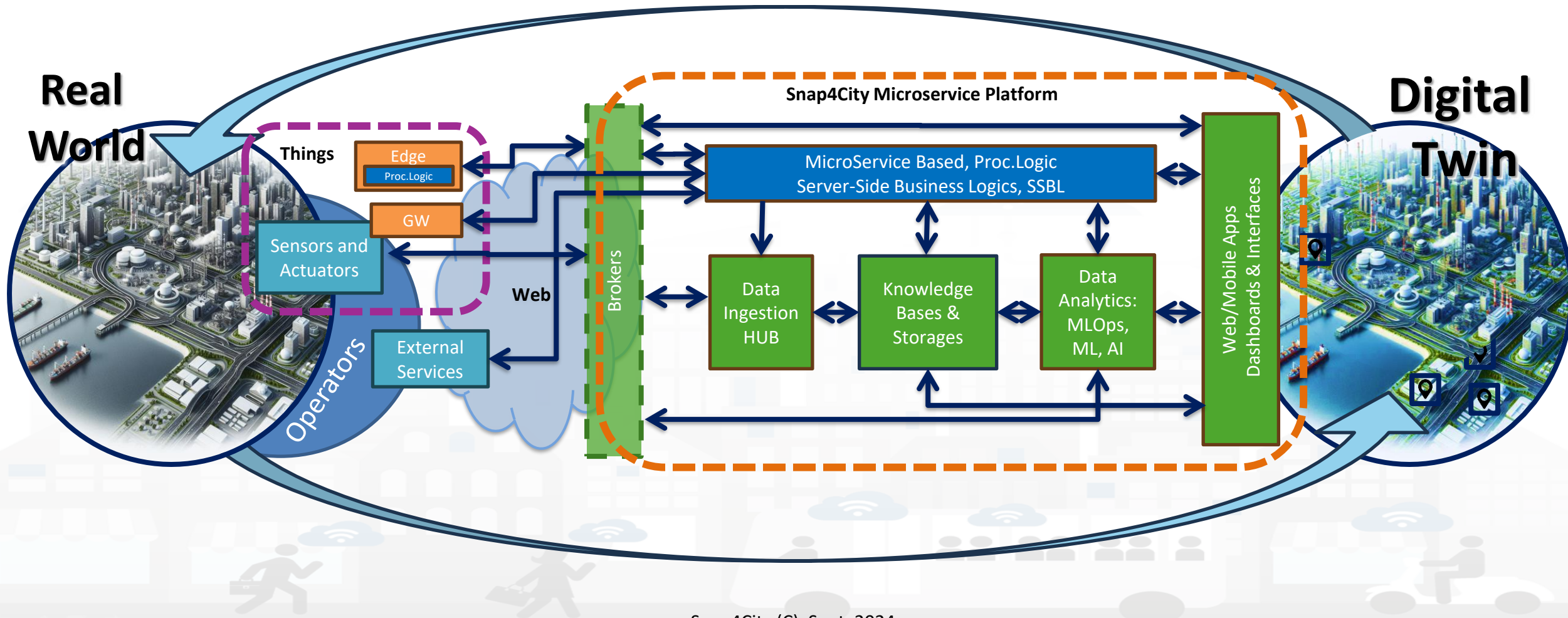
Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

Digital Twin Development Platform



<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

- **Course 2023:** <https://www.snap4city.org/944>
 - Introductionary course to Snap4City technology
- **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>

Tech Overview

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



Technical Overview

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

Snap4City:

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

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

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

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:

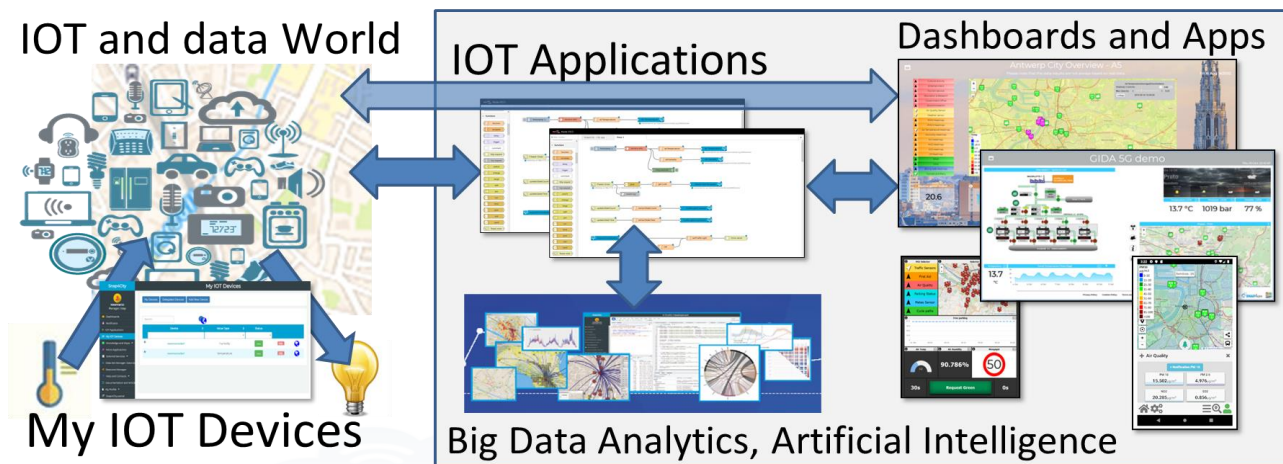
- We suggest you to read the **TECHNICAL OVERVIEW**:
 - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandq>

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

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

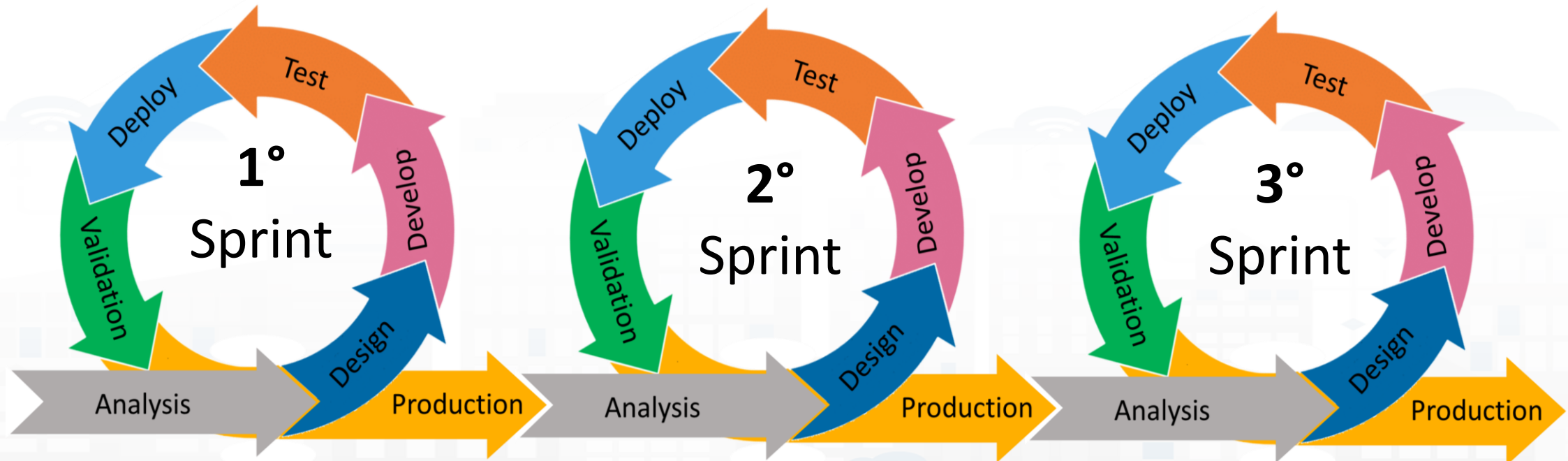


IF you need to go more in deep you can ask us to pass at the next Role becoming full AreaManager with full rights of development, also for Data Analytics, machine learning, etc.

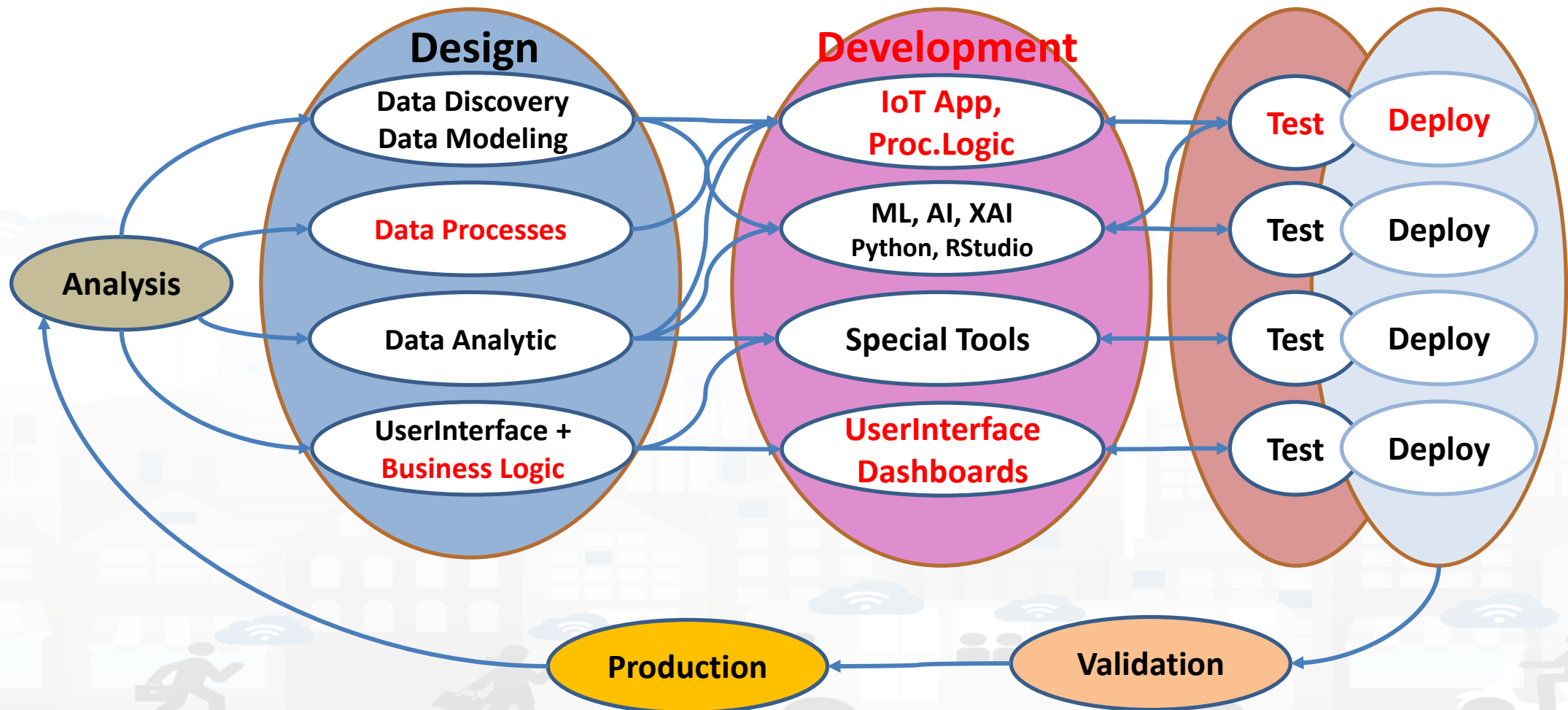
Agenda of third part

- Recall on Snap4City Architecture
- Node-RED
- IOT App = Node-RED + Snap4City
 - IoT App === Proc.Logic
- Examples of IOT App for Smartening Solutions
- Exploiting/Generating data by using: IoT App/Proc.Logic
- External Service \leftrightarrow IoT App/Proc.Logic
- Dashboards \leftrightarrow IoT App/Proc.Logic
 - Server Side Business Logic

Development Life Cycle Smart Solutions

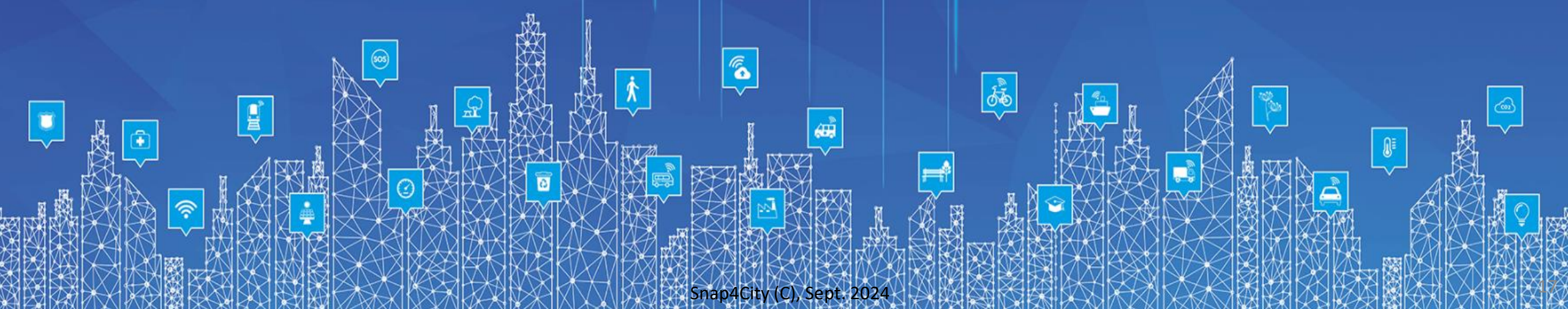
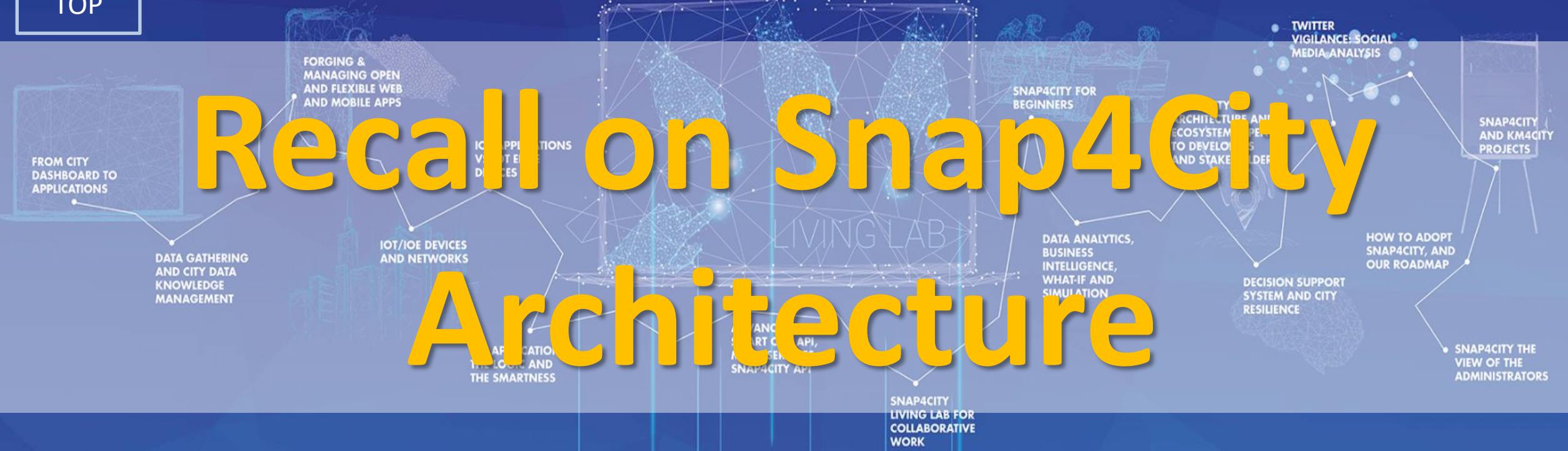


Development Life Cycle Smart Solutions



TOP

Recall on Snap4City Architecture

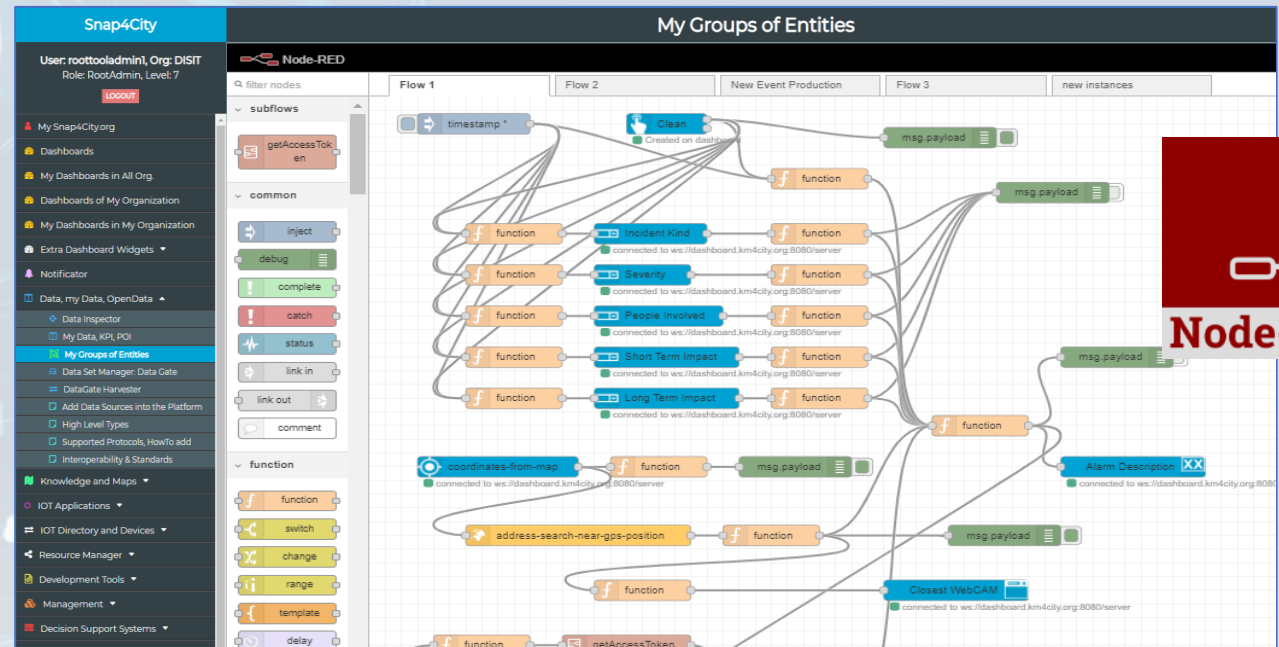


Ingestion, aggreg. → exploitation



IoT App Visual Programming, no coding

- Data transformation
- Integration, Interoperab.
- Scripting Data Analytics
- Data ingestion
- Business logic



Edge and Cloud

MicroServices data driven develop via visual language Node-RED

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

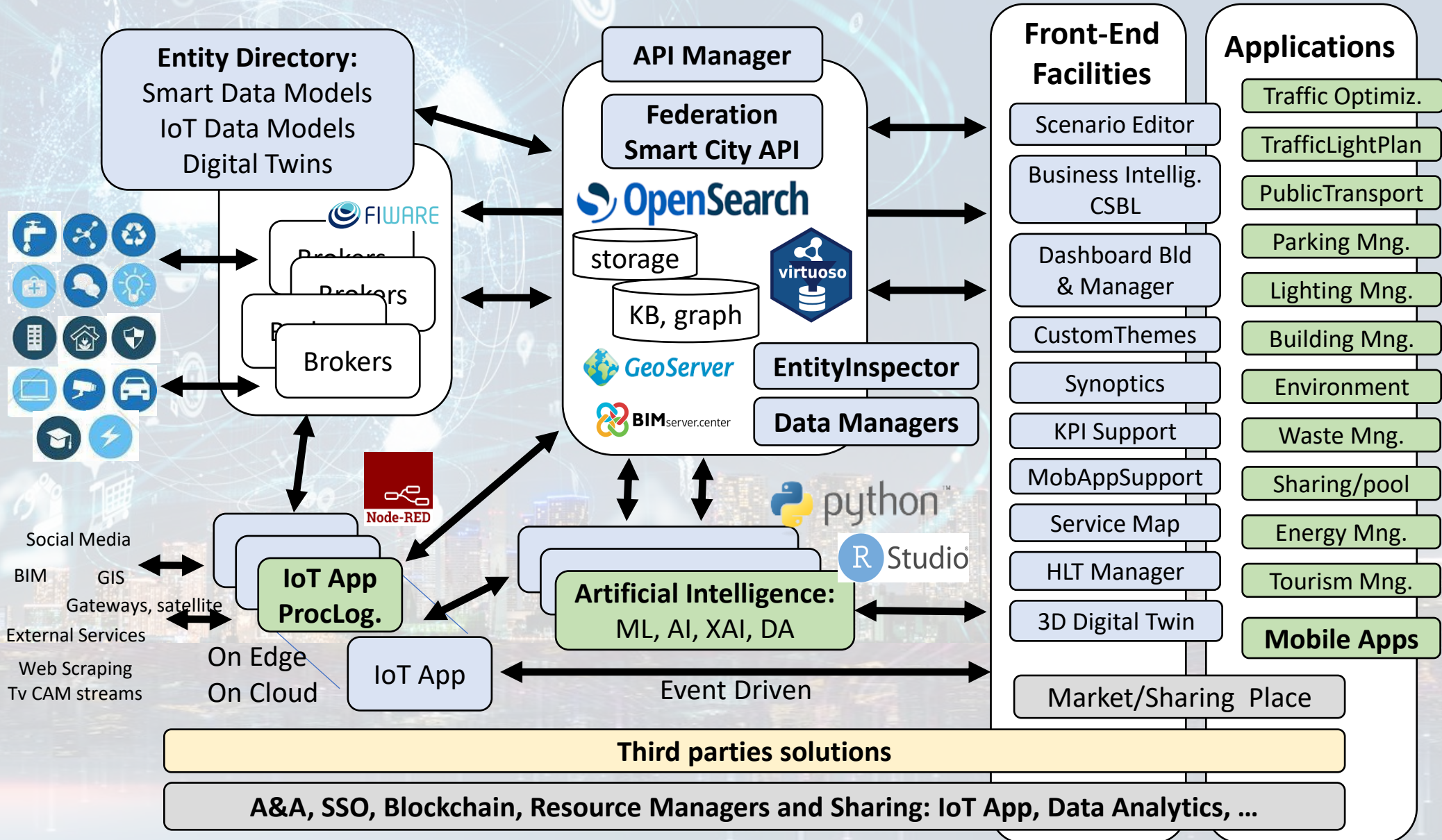
AND: From Resource Manager

We suggest also to install:

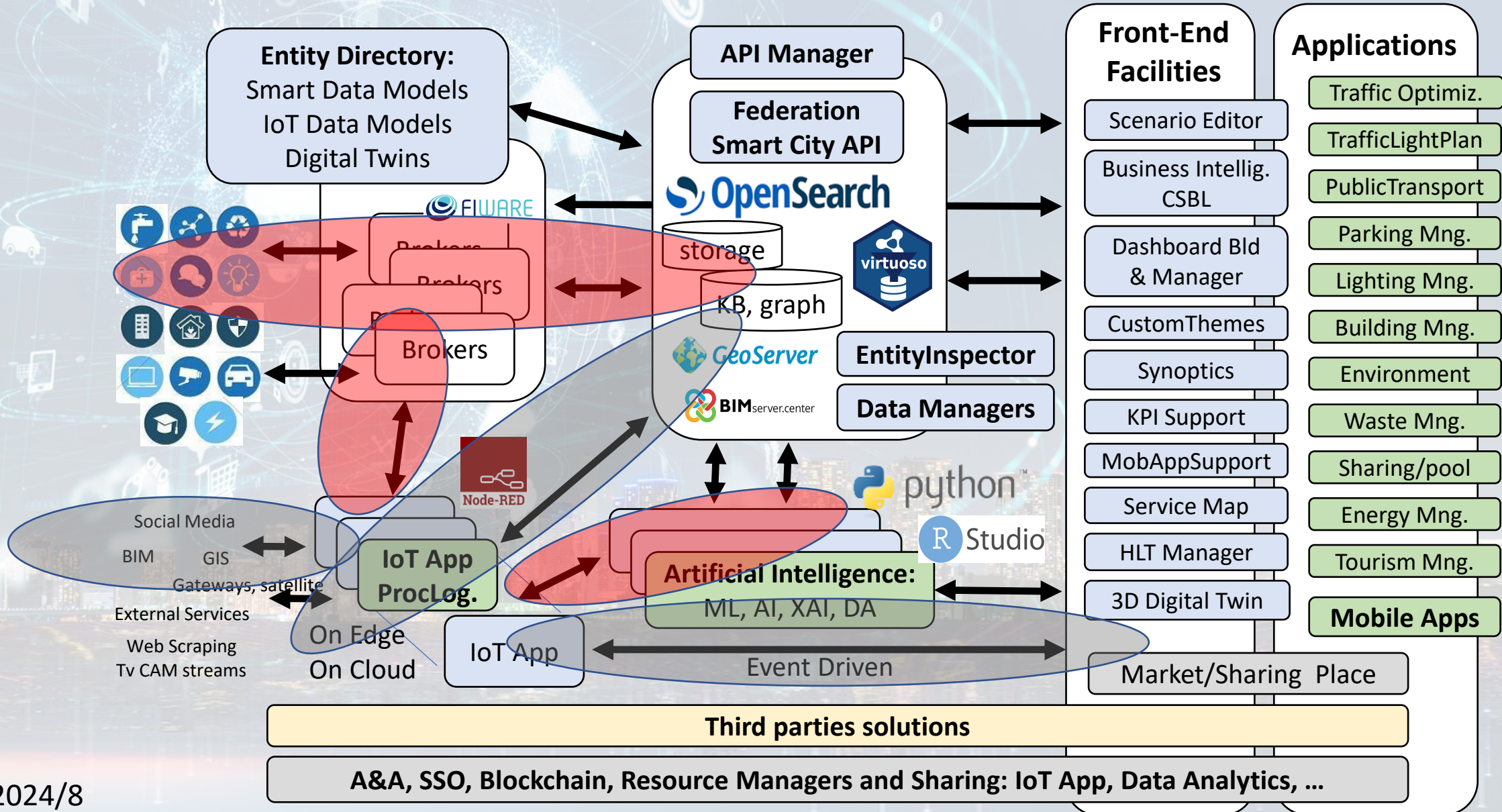
- NGSI
- social
- subflows
- location

Snap4City(C), May 2021

Technical Architecture



Technical Architecture



IoT App / Proc.Logic

- Storage → IoT App / Proc.Logic
- External Service ↔ IoT App / Proc.Logic
- Dashboards ↔ IoT App / Proc.Logic

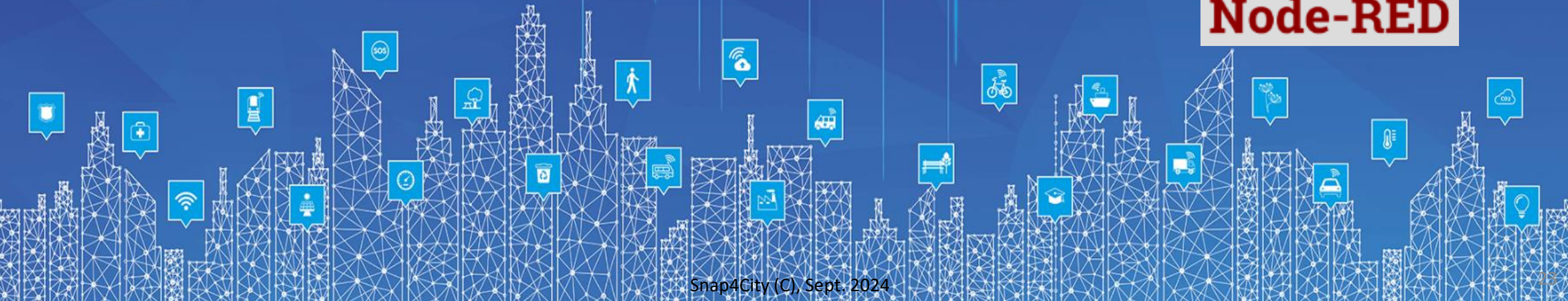
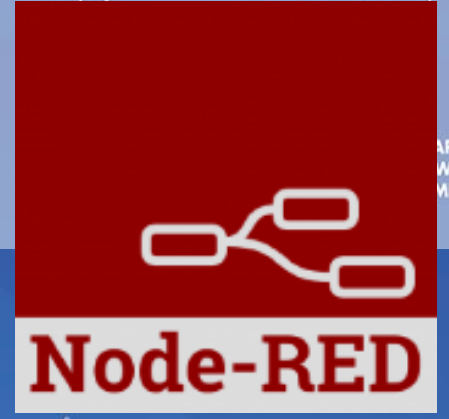
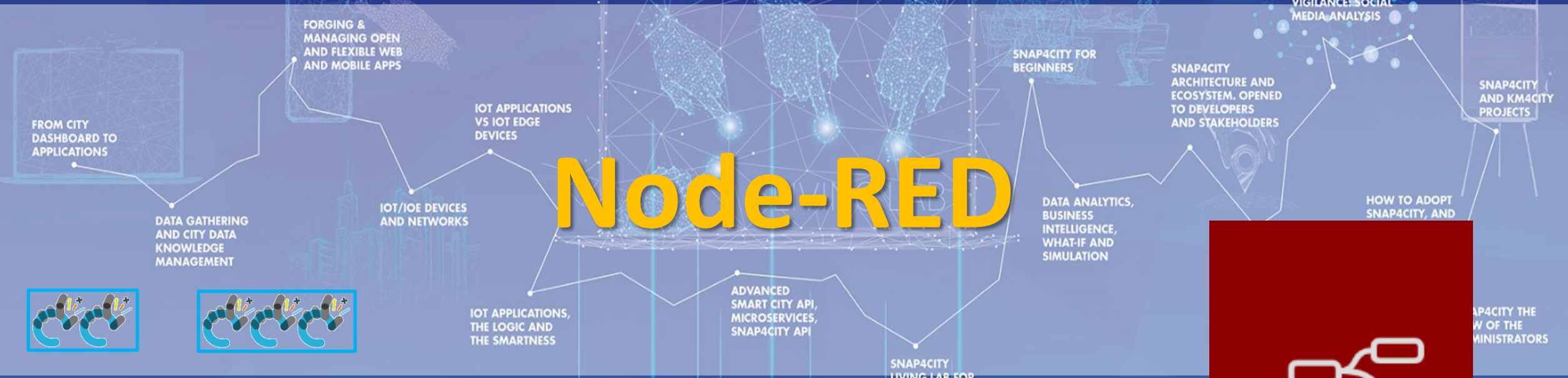


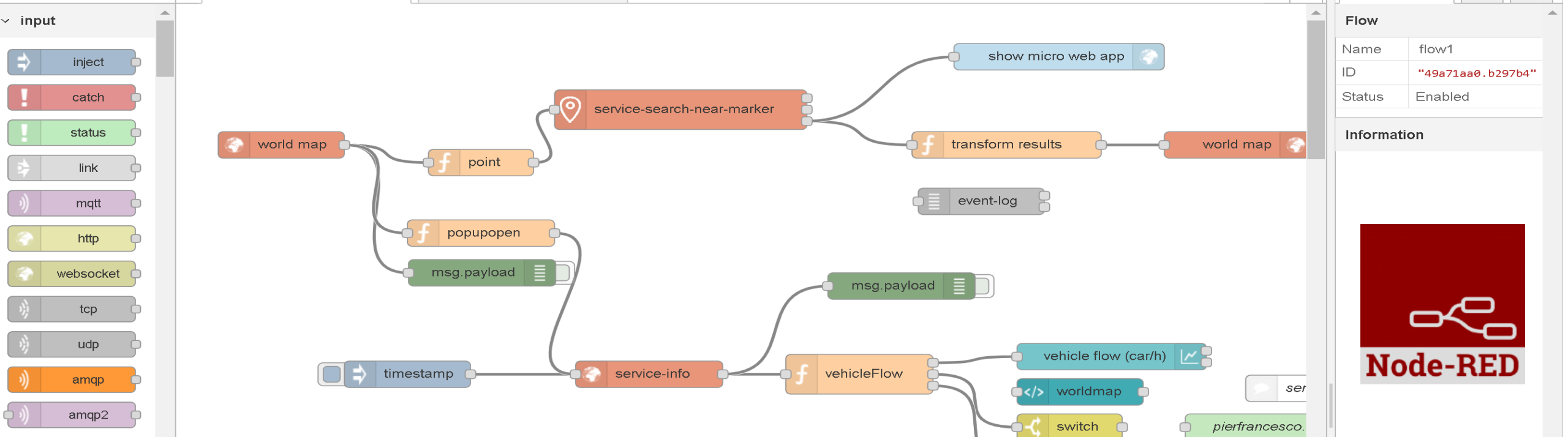
- Data Analytics ↔ IoT App / Proc.Logic **Part 4**
- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic
- IoT App / Proc.Logic → Storage

Part 5

TOP

Node-RED





input

- inject
- catch
- status
- link
- mqtt
- http
- websocket
- tcp
- udp
- amqp
- amqp2

output

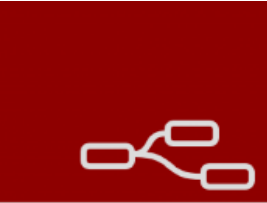
- debug
- link
- mqtt
- http response
- websocket
- tcp
- udp
- amqp
- amqp2

info debug dashb

Flow

Name	flow1
ID	"49a71aa0.b297b4"
Status	Enabled

Information



Node-RED

Search for nodes using

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



The screenshot shows the Node-RED block palette with the following categories and blocks:

- common**: inject, debug, complete, catch, status, link in, link out, comment
- function**: function, switch, change, range, template, delay, trigger, exec, zip, md5, soap request, string, xml converter, random, rbe
- network**: 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
- sequence**: split, join, sort, batch, parser (csv, html, json, xml, yaml, base64, msgpack), storage (file, file in, watch, ftp in, mysql, tail)
- social**: email, twitter in, email, twitter out, advanced (feedparser), NGSi (NGSI Entity, NGSI v2ToLD), lwm2m (lwm2m client in, lwm2m client out), location (turf, worldmap, worldmap in, tracks, convex hull), time (sunrise)
- dashboard**: button, dropdown, switch, slider, numeric, text input, date picker, colour picker, form, text, gauge, chart, audio out, notification, ui control, template

+ on IOT Edge Raspberry

The screenshot shows the Node-RED block palette with the following categories and blocks:

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

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

Categories shown in the screenshot:

- common:** inject, debug, complete, catch, status, link in, link out, comment
- function:** function, switch, change, range, template, delay, trigger, exec, zip, md5, soap request, string, xml converter, random, rbe
- network:** mqtt in, mqtt out, http in, http response, http request, websocket in, websocket out, tcp in, tcp out, tcp request, udp in, udp out
- input:** amqp in, amqp2 in, stomp in
- output:** amqp out, amqp2 out, stomp out
- sequence:** split, join, sort, batch
- parser:** csv, html, json, xml, yaml, base64, msgpack
- storage:** file, file in, file out, watch, ftp in, ftp out, mysql, tail
- social:** email, twitter in, twitter out, advanced, feedparser, NGSI, NGSI Entity, NGSI v2toLD, Iwm2m, Iwm2m client in, Iwm2m client out, location, turf, worldmap, worldmap in, tracks, convex hull, time, sunrise
- dashboard:** button, dropdown, switch, slider, numeric, text input, date picker, colour picker, form, text, gauge, chart, audio out, notification, ui control, template
- social (on IOT Edge Raspberry):** e mail, twitter, irc, google plus, google places, google calendar
- Raspberry Pi:** rpi gpio, rpi mouse, rpi keyboard, camerapi takephoto, rpi dht22, imagecapture, ledborg, Sense HAT, Sense HAT
- storage:** tail, file, mongodb, file, mongodb
- network:** ping

99

Hello World of Node-RED

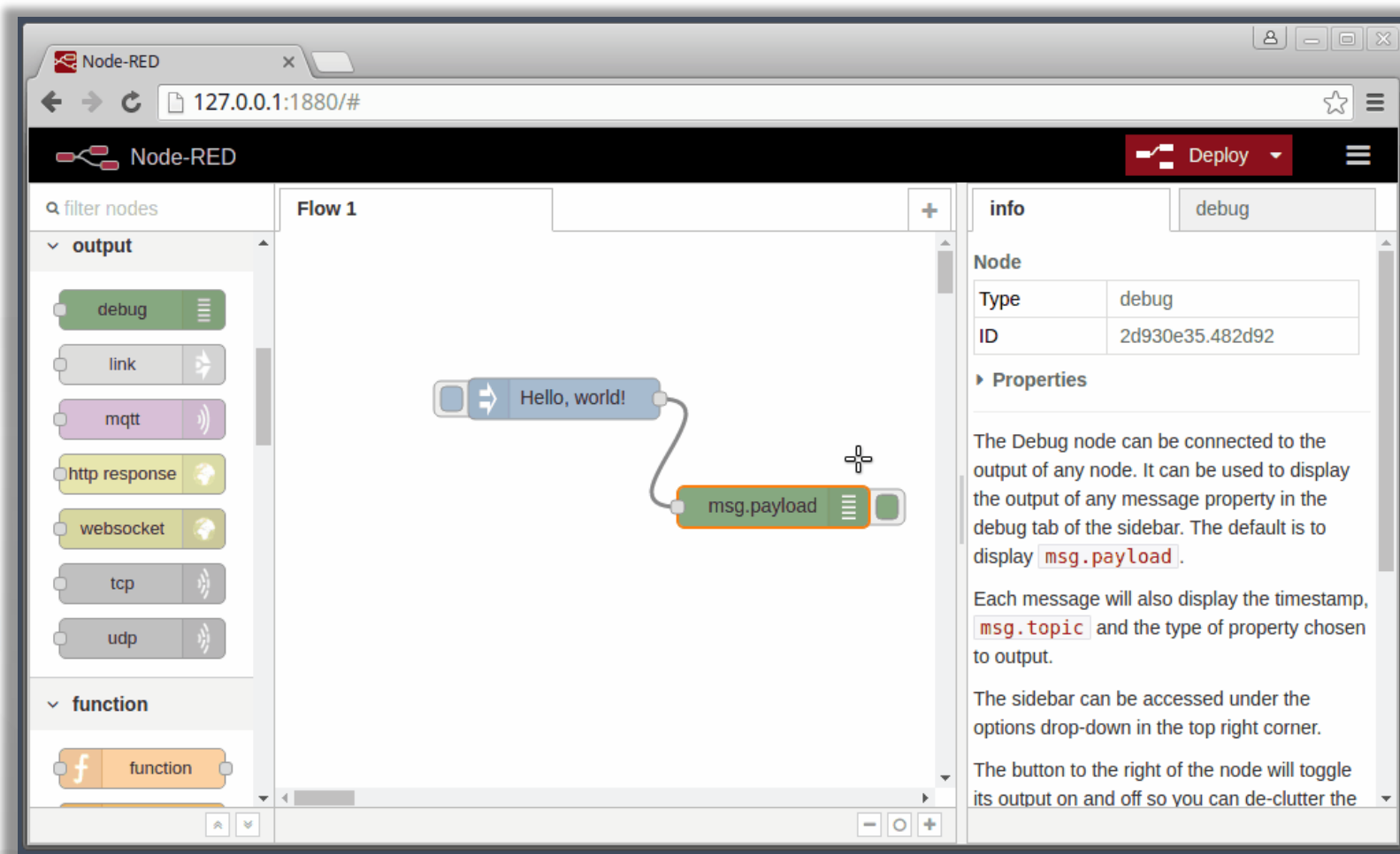
- <http://developer.opto22.com/nodered/general/getting-started/node-red-hello-world/>

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 sidebar on the left with a 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 flow with two nodes: a 'Hello, world!' node (a blue box with a right-pointing arrow) and a 'msg.payload' node (a green box with a right-pointing arrow). A line connects the output of the 'Hello, world!' node to the input of the 'msg.payload' node. The 'msg.payload' node has a small green button on its right side. On the right side of the interface, there is a sidebar with two tabs: 'info' and 'debug'. The 'info' tab is active, displaying a table with the following content:

Node	
Type	debug
ID	2d930e35.482d92

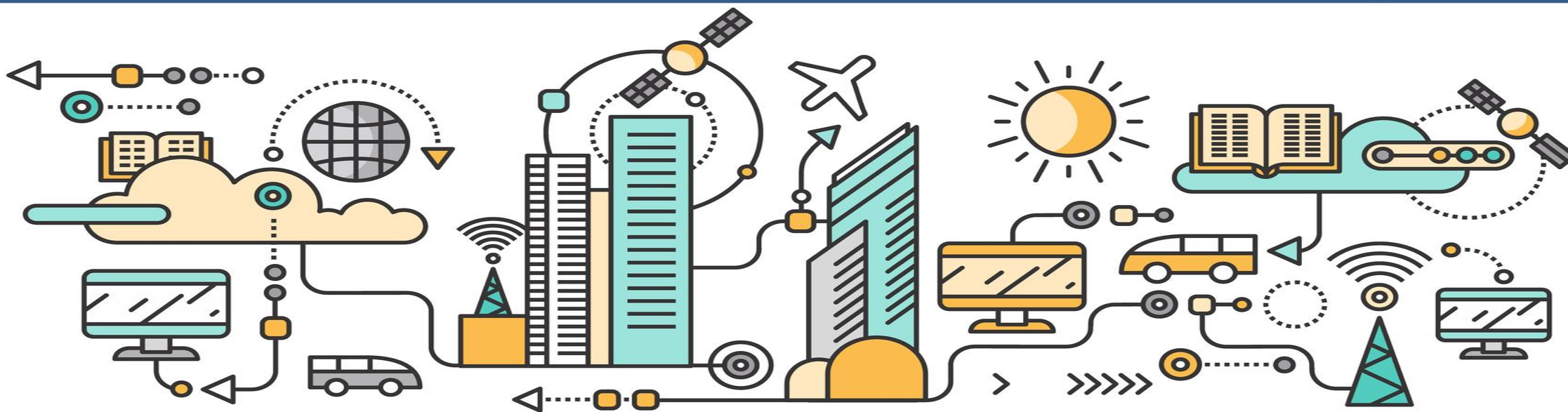
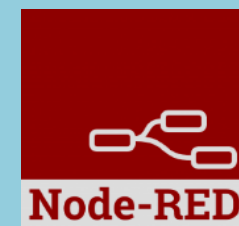
Below the table, there is a section titled 'Properties' with a plus sign icon. The text in this section reads: 'The Debug node can be connected to the output of any node. It can be used to display the output of any message property in the debug tab of the sidebar. The default is to display `msg.payload`. 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 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**



TOP

Node-RED Demo 0

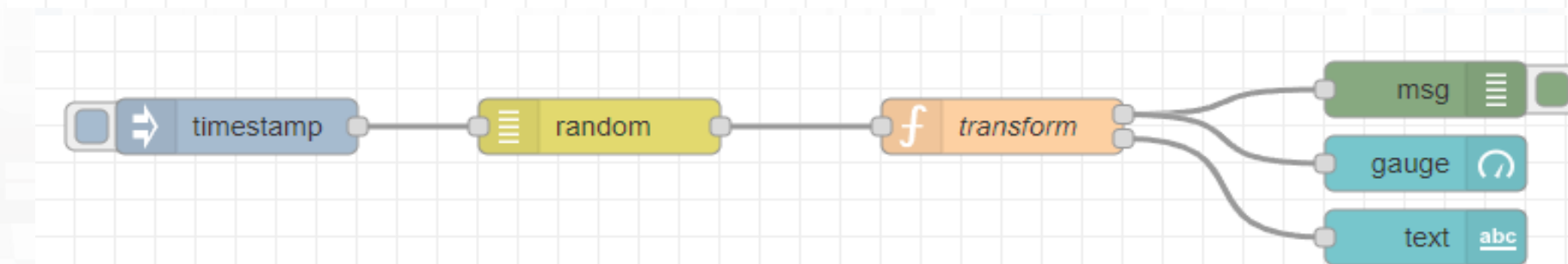
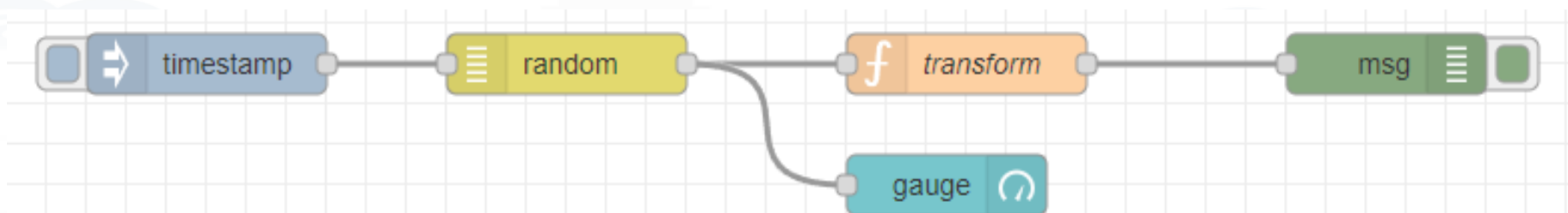


Course 2023 IoT App / Proc.Logic

- Pattern:



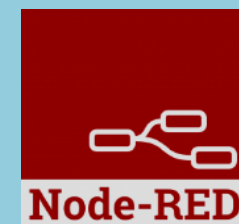
- Pattern:



recap

- Inject messages
 - Structure of messages, msg.payload
- Function for coding
 - Function with two outputs
- Connection on Dashboard element
 - Tab of dashboard, setting for color, position, etc.
- Real time update on gauge and trends
- Debug tab, timestamp, copy value, copy path, etc.
- Etc.

Node-RED Demo 1



Example of simple IoT Application

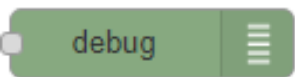
In this demo let's create an IoT Application that:

- generate a random value,
- the value is switched on the correct path
- the value is showed in the local dashboard of NodeRed

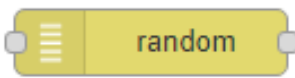
Nodes for flow



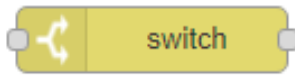
Generates an input for the other nodes. It can be repeated at predefined intervals, entered manually and of various types (timestamp, string, number, boolean, JSONetc)



Each message that enters the debug node is shown in the "debug" tab on the right of node-red (you can choose which part of the message to show)



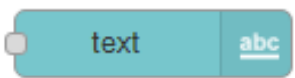
Generates a random number. You can configure the number generation interval and the type (integer or float).



Evaluates the input message and routes it to the correct output according to the desired configuration



Shows a number inside a gauge counter.



Shows a text inside the local dashboard



Step 1

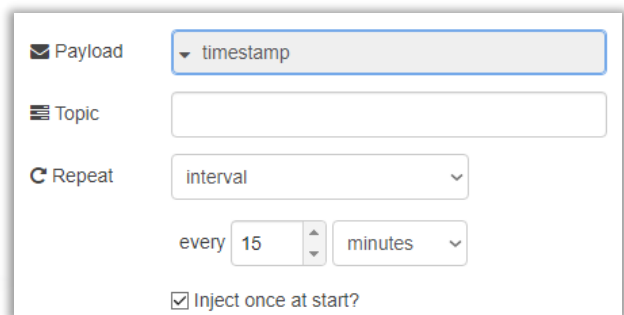


- Inject and Debug

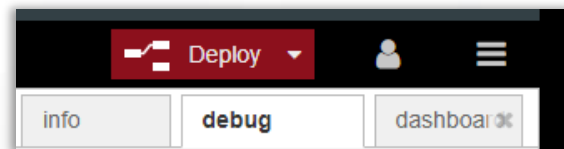


- Connect

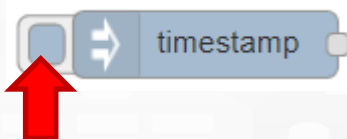
- Configure



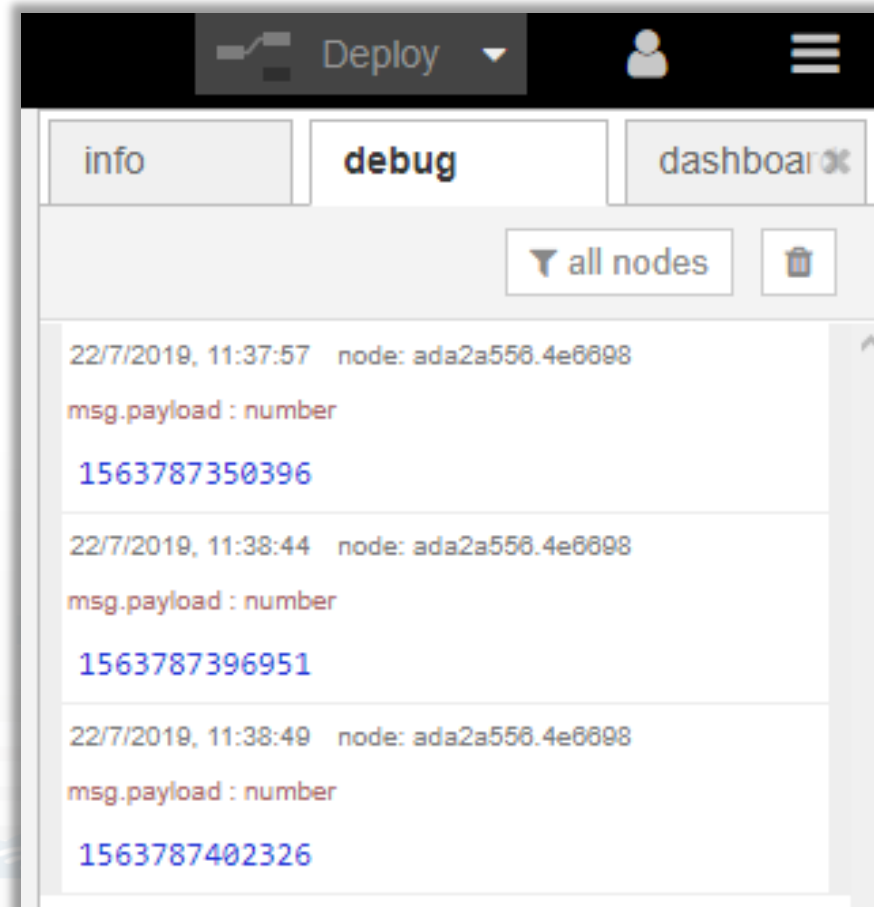
- Deploy



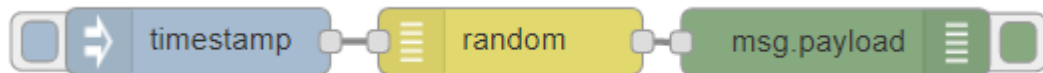
- Click



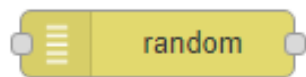
- Observe



Step 2

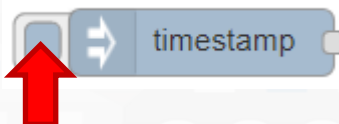
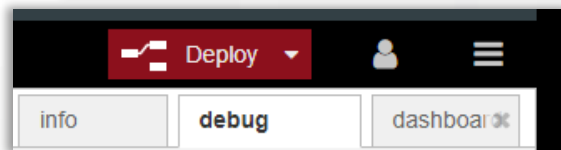


- Random
- Connect
- Configure
- Deploy
- Click
- Observe



random node configuration:

- msg_payload
- Generate: a whole number - integer
- From: 1
- To: 100
- Name: Name



```
8/4/2020, 14:19:16 node: 54db7d04.3fa264
msg.payload : number
6

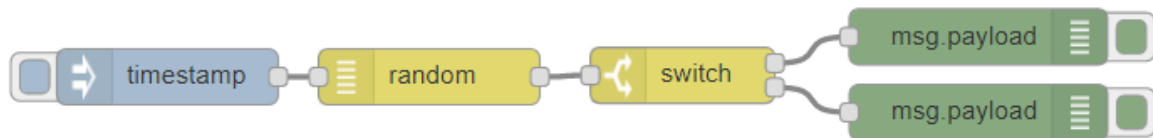
8/4/2020, 14:19:18 node: 54db7d04.3fa264
msg.payload : number
20

8/4/2020, 14:19:20 node: 54db7d04.3fa264
msg.payload : number
42

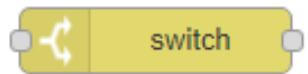
8/4/2020, 14:19:21 node: 54db7d04.3fa264
msg.payload : number
78
```



Step 3



- Switch
- Connect
- Configure



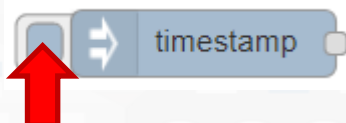
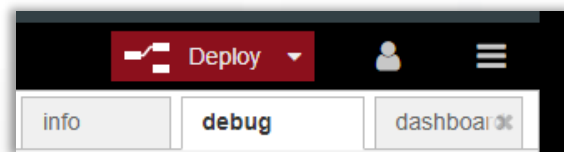
Name:

Property:

Condition: → 1

Otherwise: → 2

- Deploy
- Click
- Observe



```

    8/4/2020, 14:19:16 node: 54db7d04.3fa264
    msg.payload : number
    6

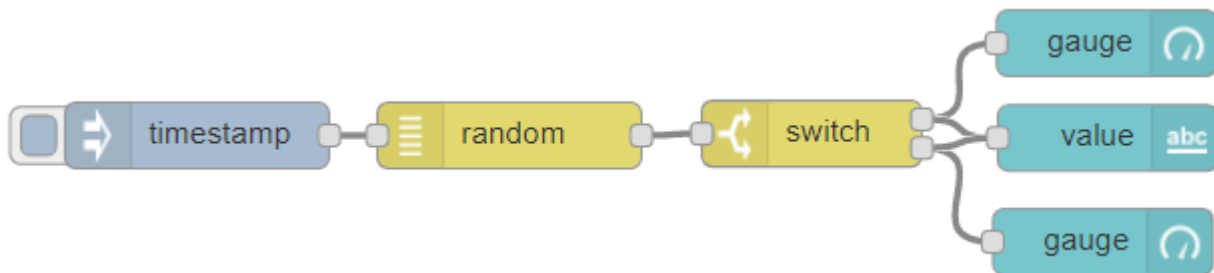
    8/4/2020, 14:19:18 node: 54db7d04.3fa264
    msg.payload : number
    20

    8/4/2020, 14:19:20 node: 54db7d04.3fa264
    msg.payload : number
    42

    8/4/2020, 14:19:21 node: 54db7d04.3fa264
    msg.payload : number
    78
  
```



Step 4



- Gauge and text  

- Connect

- Configure gauge

Group: [Home] Default

Size: auto

Type: Gauge

Label: gauge

Value format: {{value}}

Units: units

Range: min 0 max 100

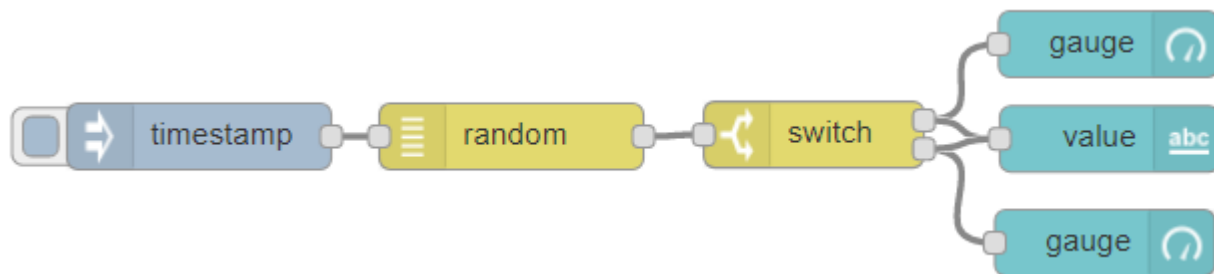
Colour gradient:

Sectors: 0 ... optional ... optional ... 100

Name:



Step 4 Bis



- Gauge and text  

- Connect

- Configure text

Group: [Home] Default

Size: auto

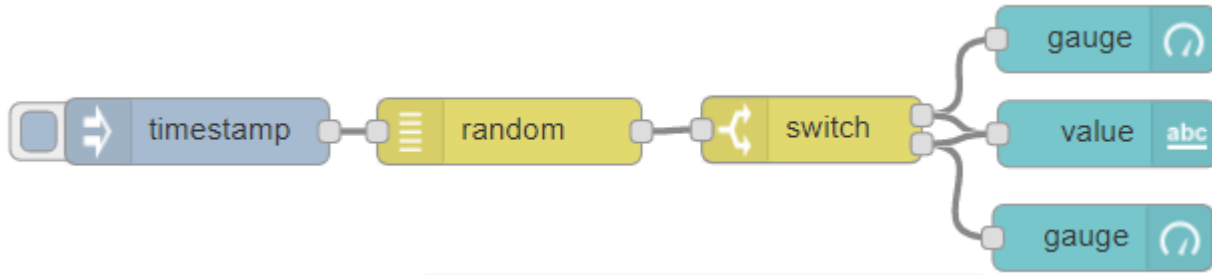
Label: value

Value format: {{msg.payload}}

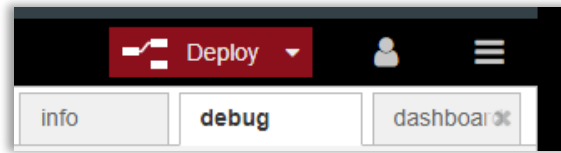
Layout:

Name:

Step 5



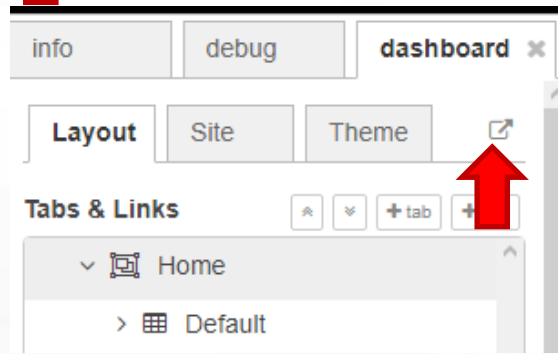
- Deploy



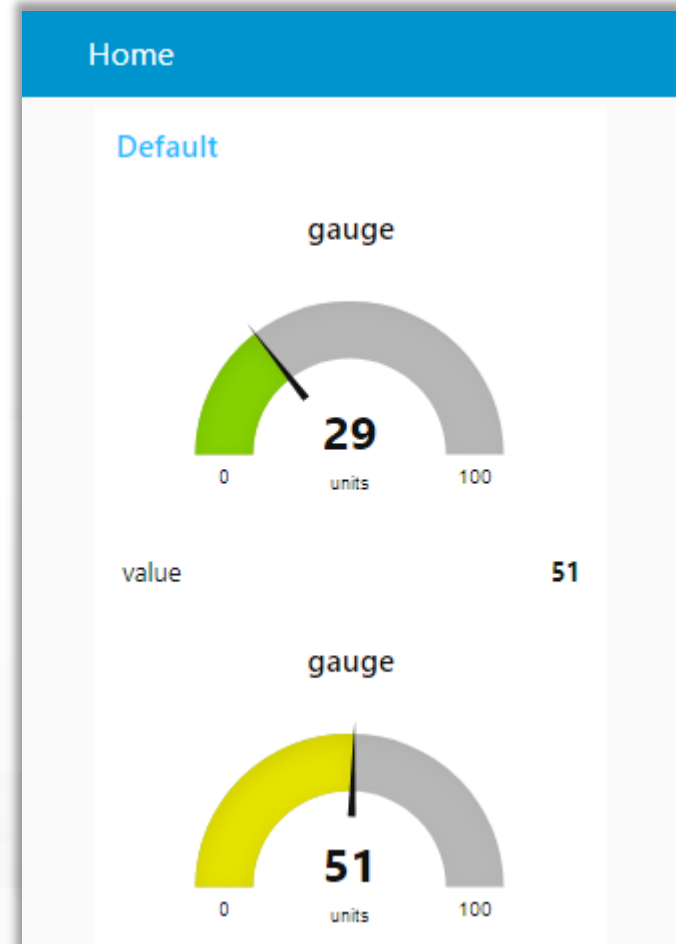
- Click



- Click



- Observe



Nodes configuration 1/2

inject

Payload timestamp

Topic

Repeat interval

every 15 minutes

Inject once at start?

debug

Output msg.payload

to debug tab

Name Name

switch

Name Name

Property msg.payload

Rules

- \geq 50 → 1
- otherwise → 2

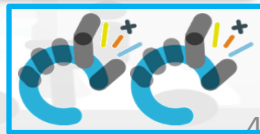
random

Generate a whole number - integer

From 1

To 100

Name Name



Nodes configuration 2/2

gauge

Group: [Home] Default

Size: auto

Type: Gauge

Label: gauge

Value format: {{value}}

Units: units

Range: min 0 max 100

Colour gradient:

Sectors: 0 ... optional ... optional ... 100

Name:

text abc

Group: [Home] Default

Size: auto

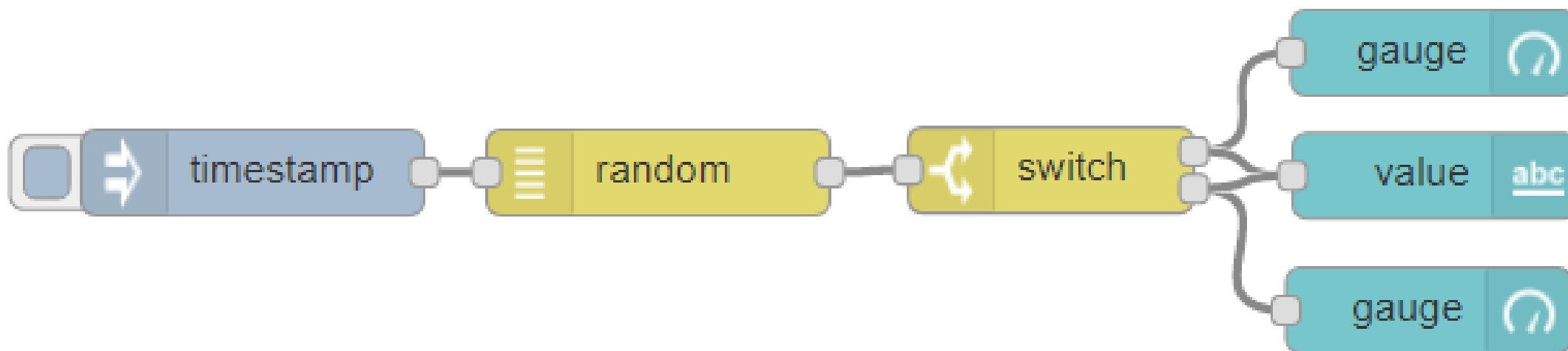
Label: value

Value format: {{msg.payload}}

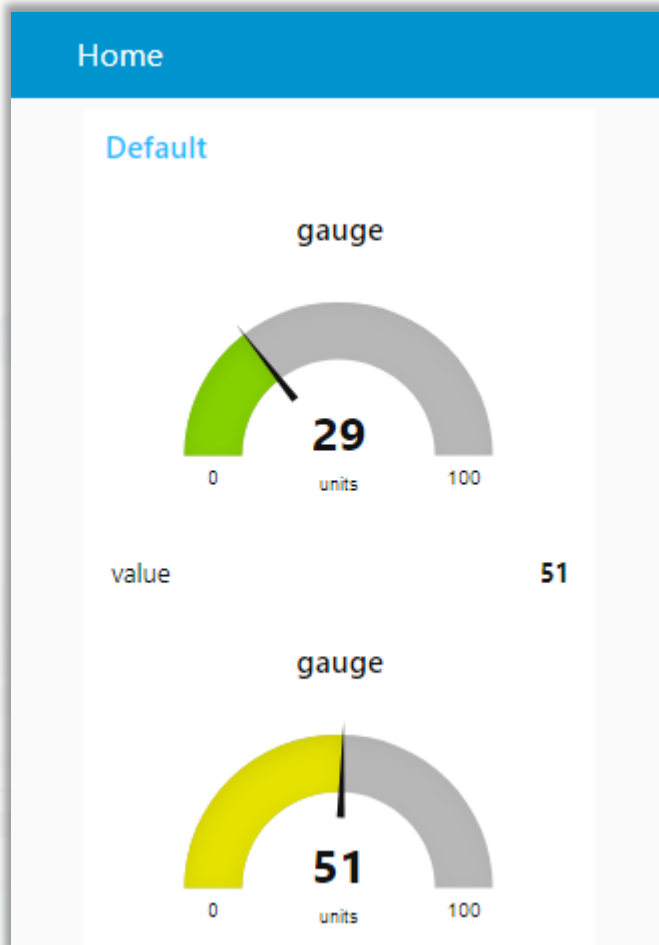
Layout:

Name:

Nodes connections



Resulting Dashboard



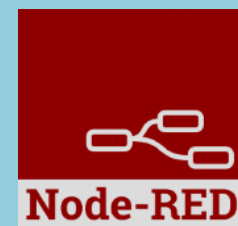
This is a local Node-RED dashboard.
Simple to be created, very limited for many
aspects.

Snap4city dashboards are more :

- Powerful
- Flexible
- Secure
- nicer

TOP

Node-RED Libraries



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

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

Search library [+](#) [Sign in with GitHub](#)

[nodes](#) **[flows](#)** [collections](#) [recent](#) [downloads](#) [rating](#)

node-red-contrib-websocket-header Custom Websocket with Header v0.5.2 144 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-cx-alarm-log A Node-RED industrial alarm parser for simple HMI applications. v1.1.0 16 5.0 node
node-red-contrib-websocket-header-acknowledge Custom Websocket with Header v0.0.1 0 node	node-red-contrib-websocket-header-subscriber Custom Websocket with Header v0.0.1 0 node	node-red-contrib-message-queue Message queuing for Node-RED v1.1.4 11 node
node-red-contrib-zigbee2mqtt Zigbee2mqtt connectivity nodes for node-red v2.0.9 1326 4.6 node	@mschaeffler/node-red-asterisk-ami-manager Transfer Asterisk AMI events to json object string representation v1.1.2 6 node	node-red-contrib-sendmail send emails with help of a local sendmail command. v1.0.5 16 node
node-red-contrib-nooperation just do nothing. v1.0.6 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-websocket-header-test Custom Websocket with Header v0.0.1 0 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-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-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/>

Two views of the same 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. At the top, there is a navigation bar with links for home, about, blog, documentation, forum, flows, and github. A search bar contains the text 'snap4city'. Below the search bar, there are tabs for 'nodes', 'flows', and 'collections', with 'nodes' selected. To the right of these tabs are filters for 'recent', 'downloads', and 'rating'. The search results are displayed in a grid of six cards. Each card contains 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			NaN	collection

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

Load an IOT application of example



aaa

The screenshot shows the Node-RED interface with a dark theme. A 'msg.payload' node is connected to an 'Import s4c' dialog box. The dialog box contains a list of public flows and a JSON payload. A red arrow points from the 'Import S4C' menu item in the top right to the 'Import s4c' dialog box. The 'Import S4C' menu item is circled in red, and the 'Import' menu item in the top right is also circled in red.

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

TOP

Snap4City Node-RED



Node-RED

Debug extending Cauldron



Snap4City

Switch To New Layout (Beta)

User: rootooladmin1, 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

Node-RED

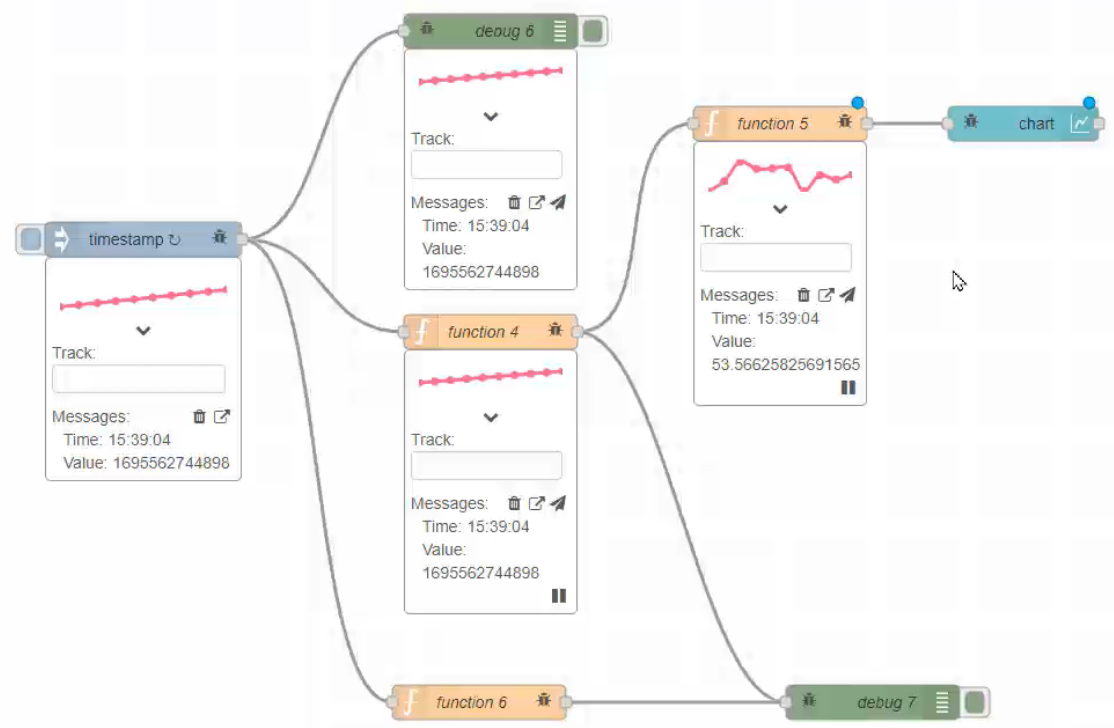
advanced3debug

Deploy

filter nodes

Flow 4 Flow 3 Flow 1 R - Python

- subflows
 - getAccessToken
 - getAccessToken (2)
 - getAccessToken (3)
 - getAccessToken (2) (2)
- common
 - inject
 - debug
 - complete
 - catch
 - status
 - link in
 - link call
 - link out
 - comment
- function
 - function
 - switch
 - change



- 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

TOP

IOT App = Node-RED + Snap4City

IoT App === Proc.Logic

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

FROM CITY DATA TO APPLICATIONS

IOT APPLICATIONS IOT DEVICES

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS

TWITTER VIGILANCE SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IOT/IOE DEVICES AND NETWORKS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT AND SIMULATION

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

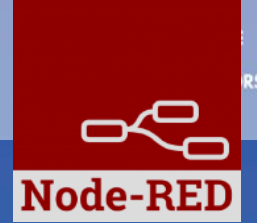
DECISION SUPPORT SYSTEM AND CITY RESILIENCE



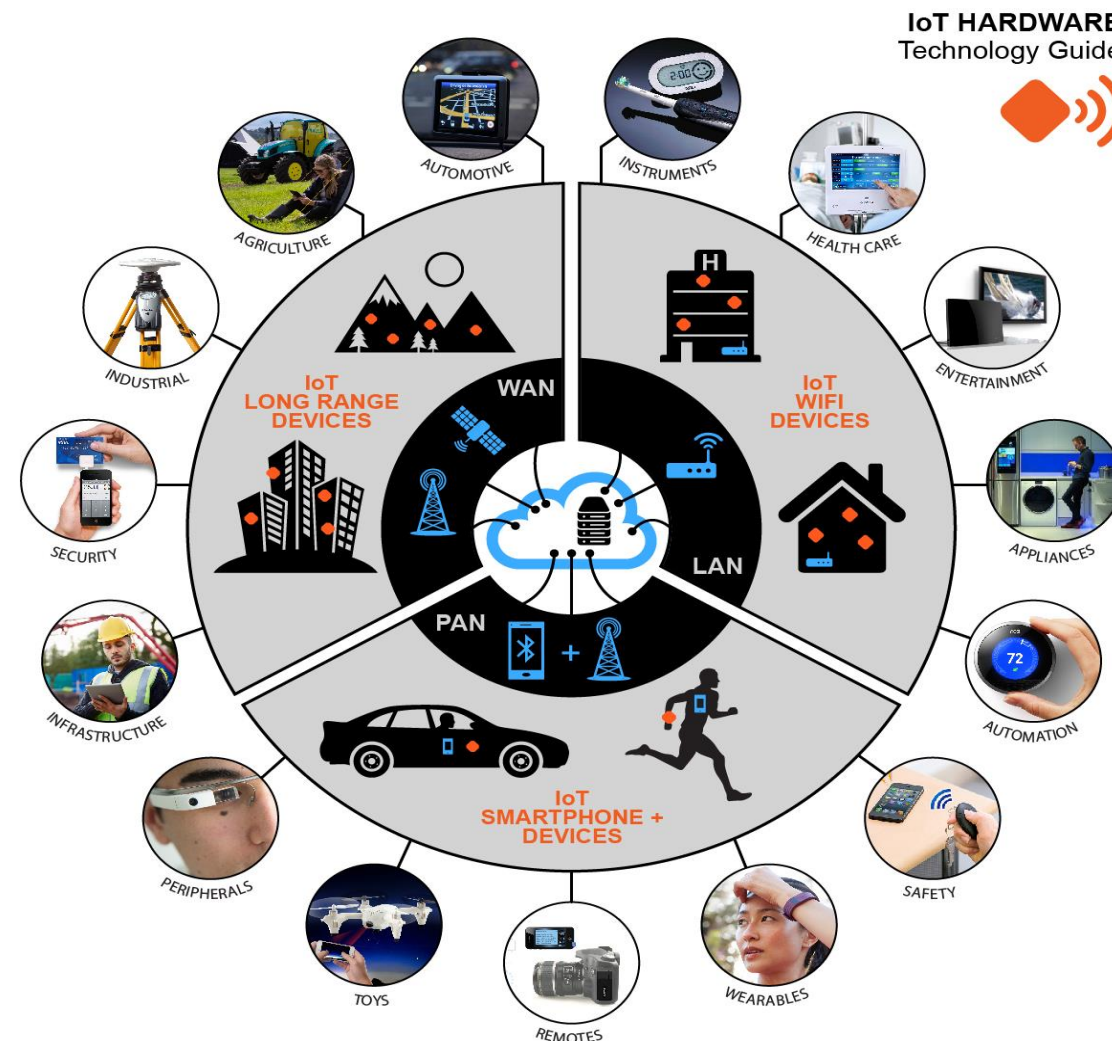
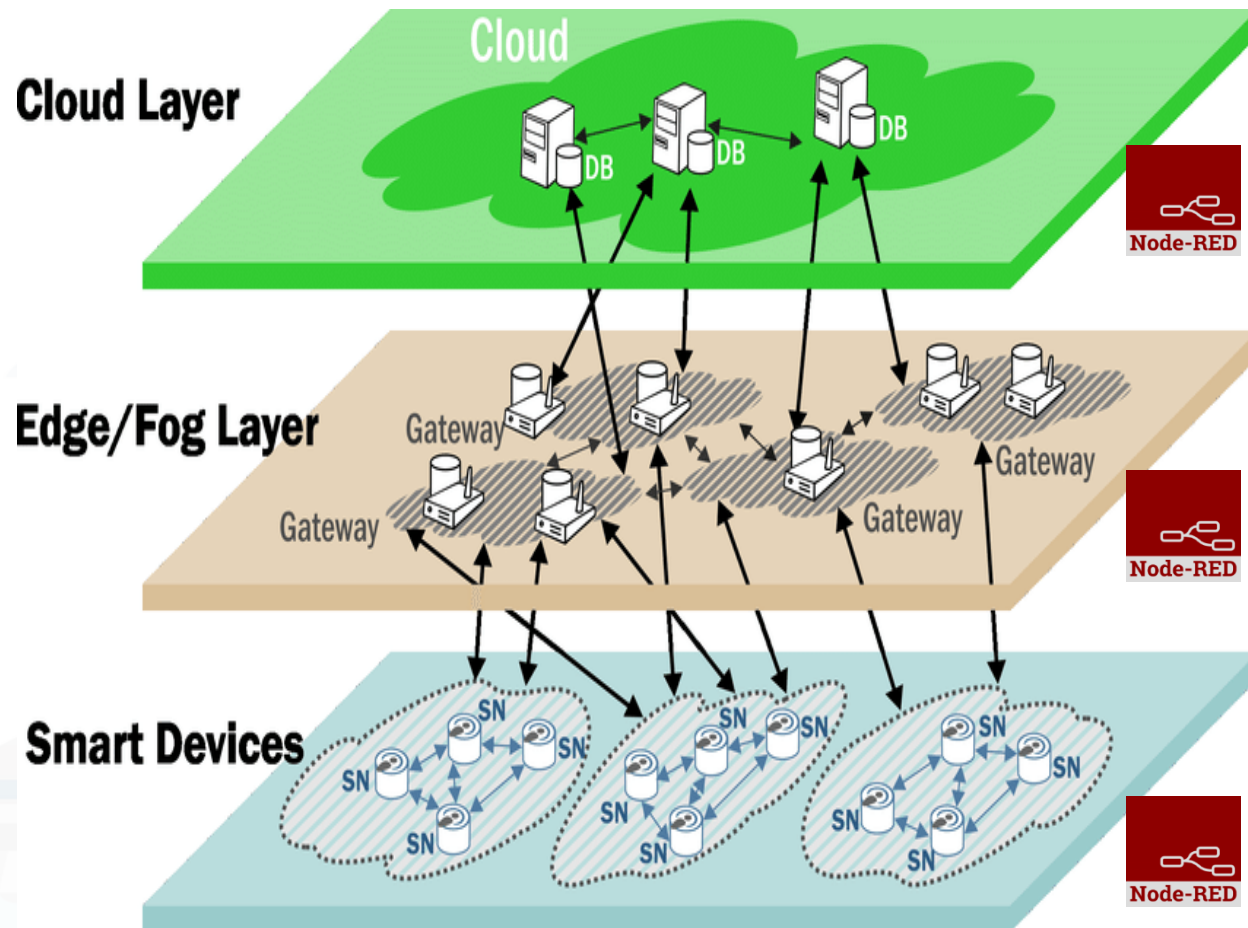
IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



WoT: Cloud vs Fog/Edge Computing

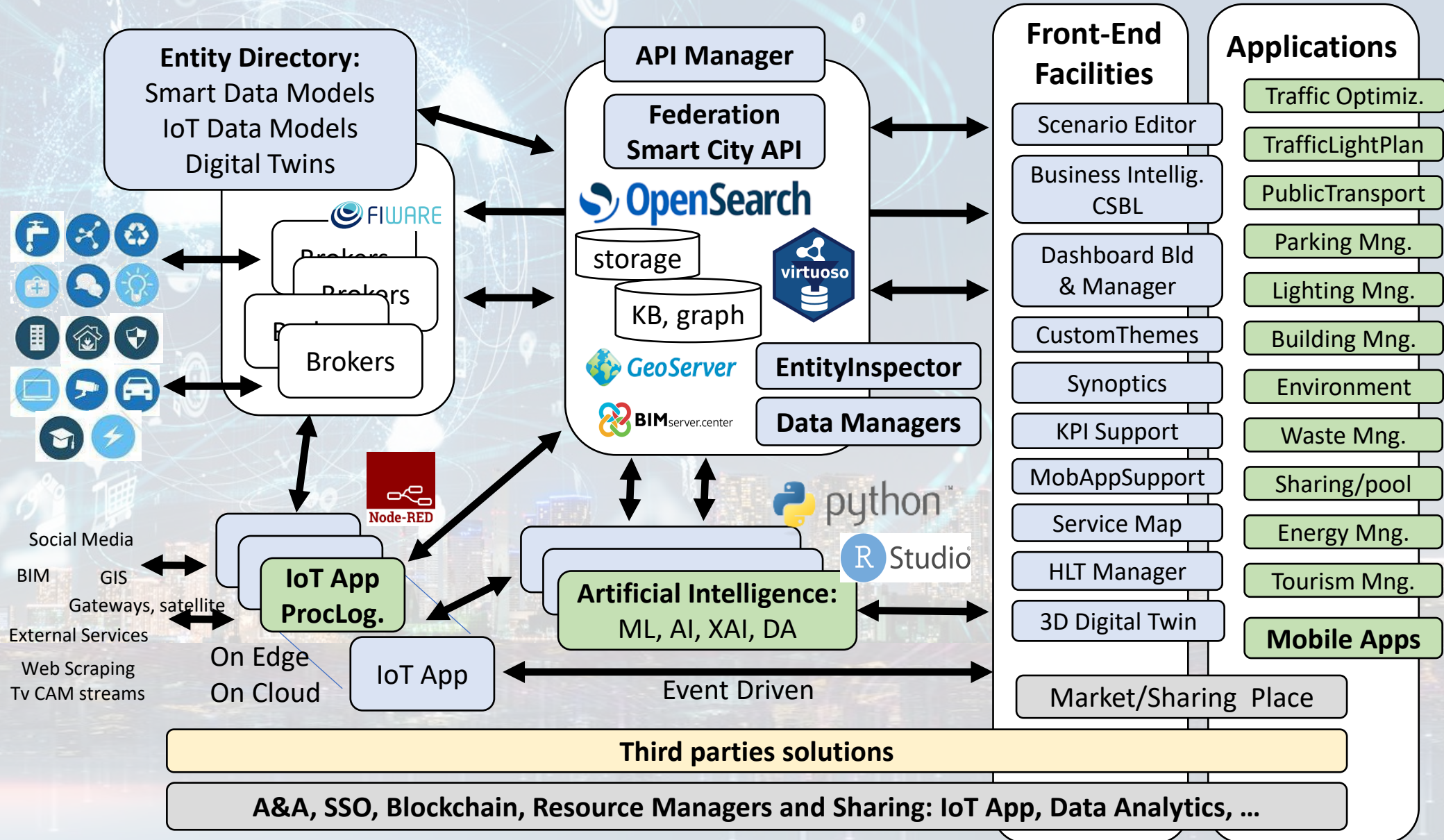


Brokers

	AMQP	STOMP	JMS	COAP	NGSI	MQTT OASIS
RabbitMQ	X	X	X	X		X
Mosquitto						X
ActiveMQ	X	X	X			X
StormMQ	X					
HIVEMQ			X			X
ORION BROKER				X	X	X



Technical Architecture



IOT Device

What About IoT Devices, Time Series



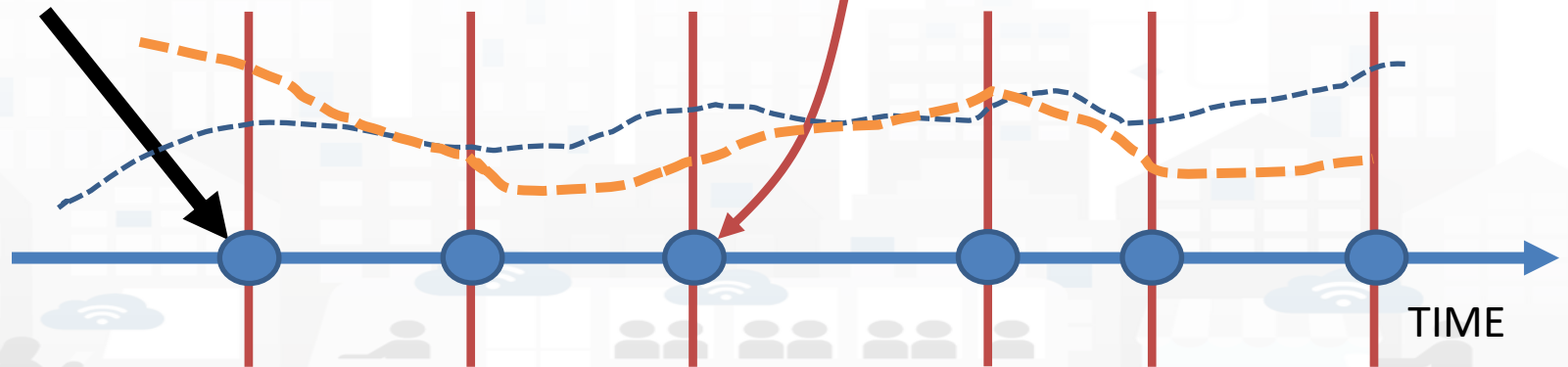
Entity: IOT
Device

Sends a
message

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

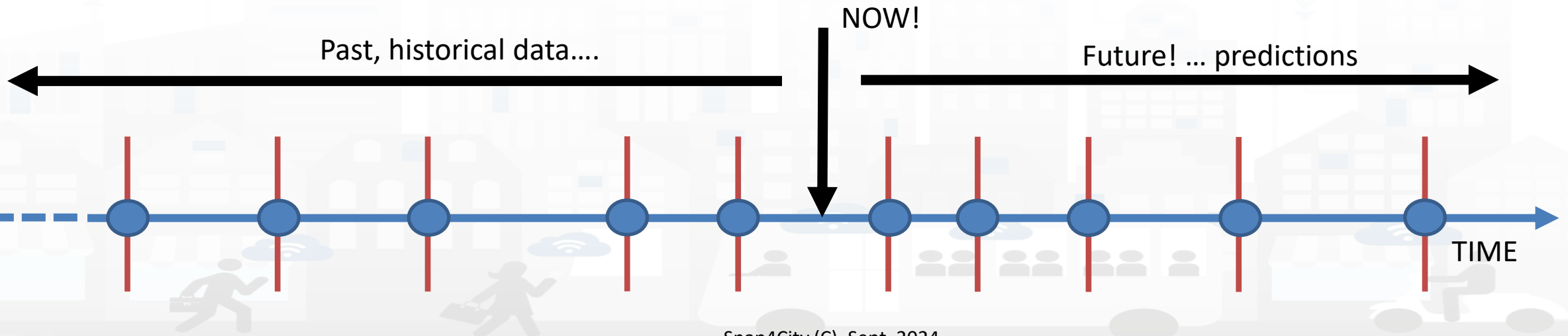
- A set of data coming from an IoT Device with multiple sensor become a time series of values for devices.
 - For example: taking a new measure every 10 minutes (**Red Lines**)
 - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «**dateObserved**»,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

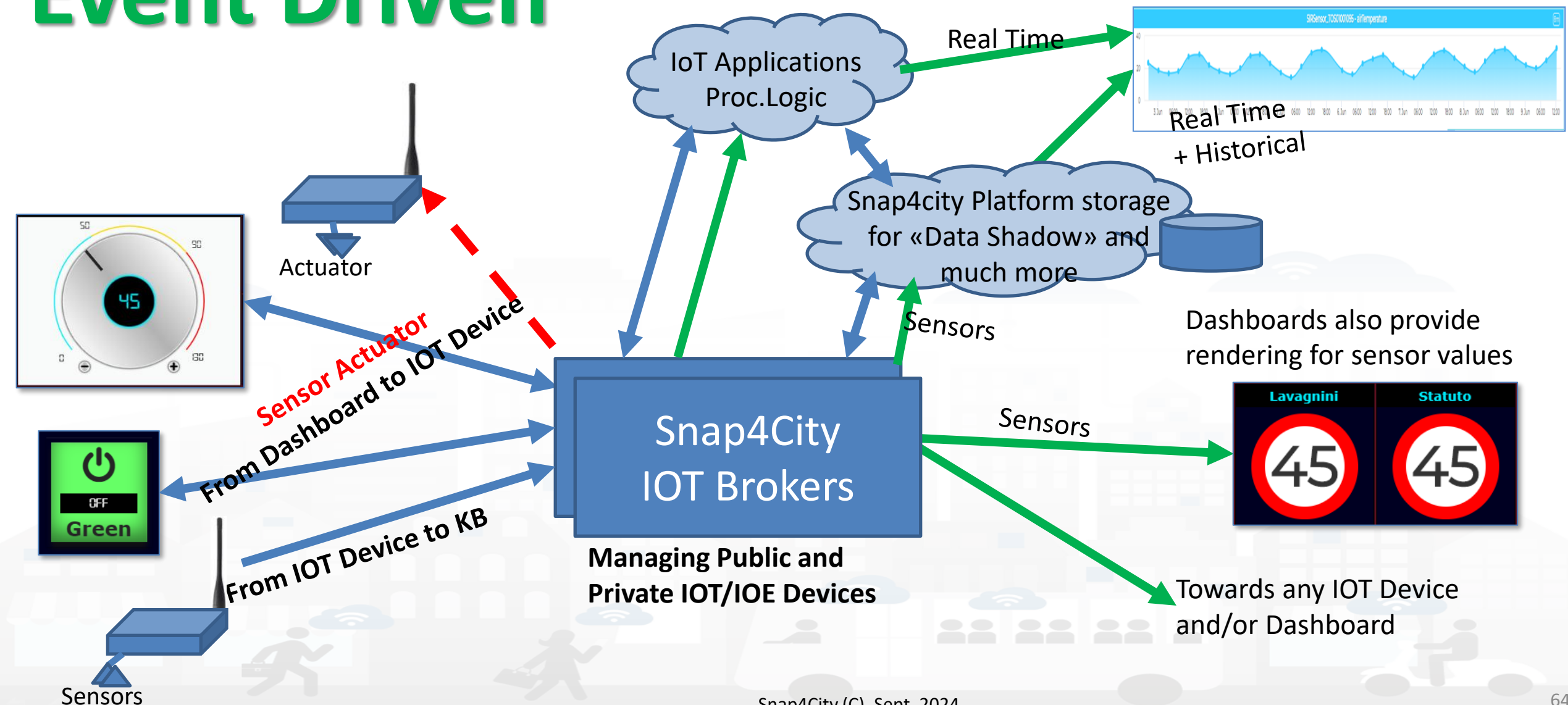


Time Series: they are data streams

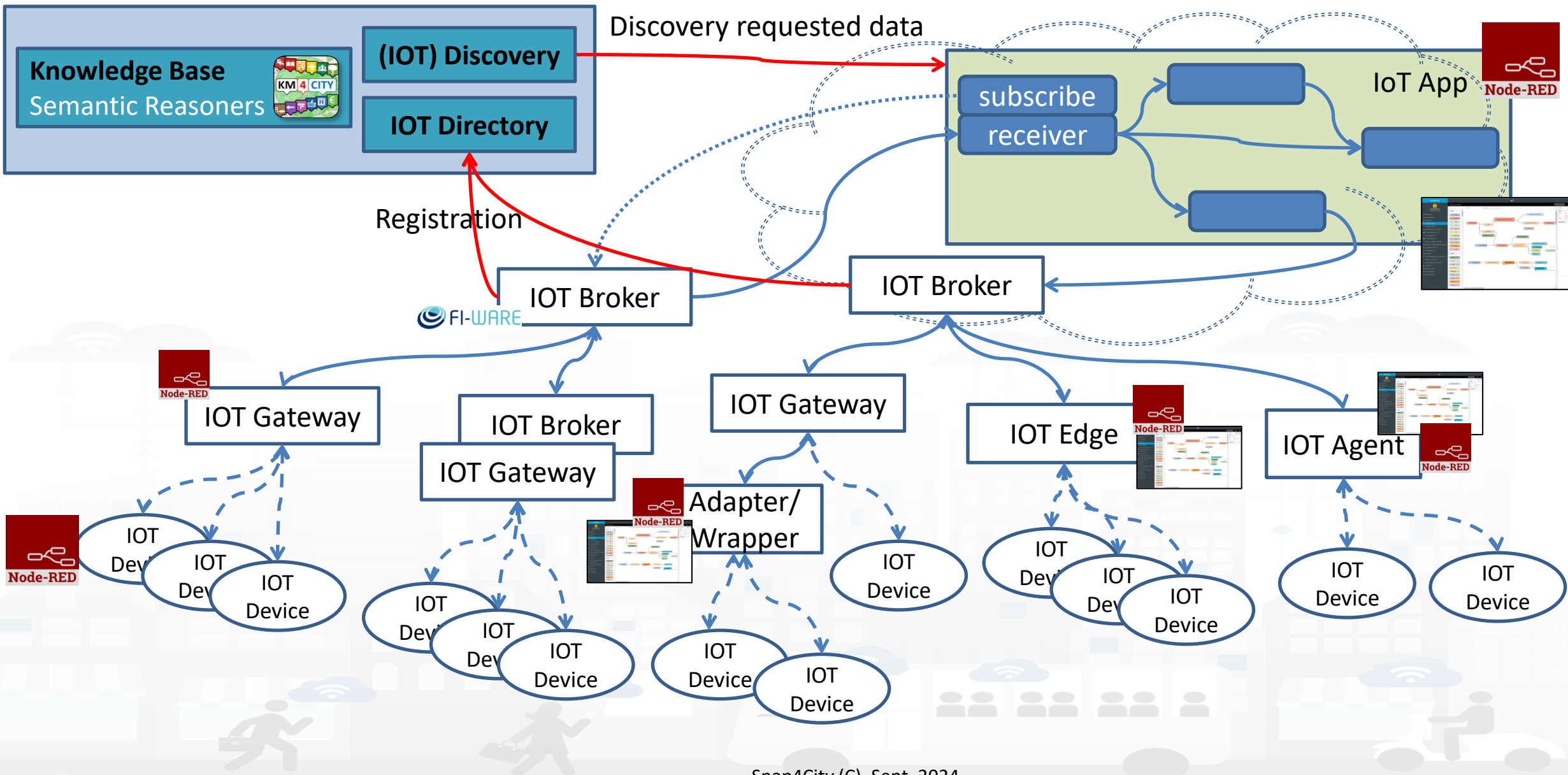
- As soon as you have registered an Entity Instance / IoT Device
 - You are ready to get Future data, may be arriving in PUSH
 - Recall and store historical data as well, but they have to be
 - recalled in PULL with some IoT App.
 - Loaded in PULL with some File or Data Table Loader



Event Driven



IoT Network



IoT/IIoE Protocols



Communication Patterns



Discovery
Discover, register and "thrust" new devices on the network

Registration



Telemetry
Information Flows From device to another system for conveying status changes in the device

Push



Inquiries
Requests from devices looking to gather required information or asking to initiate activities



Commands
Commands from other systems to a device or a group of devices to perform specific activities

Bulk action

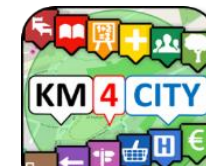


Notifications
Information flows from other systems to a device or a group for conveying status changes in the world

- MQTT
- HTTP(s)
- AMQP
- COAP
- NGSI
- OneM2M
- WebSocket
- S
-
- Etc.

Note on Communication patterns

- Not all Communication Patterns are supported by all Protocols
- Not all Communication Patterns are supported by all Platforms
- Protocols implement Patterns, + formats, + sequences, etc.
- They are referred at level of communications
 - IoT Device $\leftarrow \rightarrow$ IoT Gateway $\leftarrow \rightarrow$ IoT Broker
- IoT Protocols mostly used at level of IP are:
 - NGSI V1/2, MQTT, COAP, AMQP, OneM2M, WS, ModBUS,
- Radio protocols are: Lora, ZigBee, 3G, Wi-Fi, etc.
- Formats: JSON, Geo-JSON, Linked Data, XML, CSV,



Proc.Logic / IoT App



User: paolo.disit, Org: DISIT
Role: AreaManager, Level: 3
[LOGOUT](#)



[Switch to Legacy Layout](#)

[CREATE NEW](#)

Dashboards (Public)



My Snap4City.org



Tour Again

Sort icons: ↕, ↕, Prev 1 2 3 Next, Filter, Search, Close

- www.snap4solutions.org
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- Extra Dashboard Widgets
- Data Management, HLT
- Knowledge and Maps
- Processing Logics / IOT App
 - Processing Logics / IOT App
 - MicroServices for Proc.Logic/IOT Apps
 - MicroServices from DataAnalytic
 - IOT MicroServices for Final Users
 - IOT MicroServices for Developers
 - DOC: Processing Logic/IOT App

<p>● 2020-07-28T10:20</p> <p>My own</p> <p>Management</p>	<p>● 2020-07-28T12:32</p> <p>My own</p> <p>Management</p>	<p>● 2020-08-18T08:38</p> <p>My own</p> <p>Management</p>	<p>● 2021-01-19T16:25</p> <p>My own</p> <p>Management</p>	<p>● 2021-08-21T13:26</p> <p>My own</p> <p>Management</p>
<p>● 2022-05-28T14:50</p> <p>My own</p> <p>Management</p>	<p>● actionurltest</p> <p>My own</p> <p>Management</p>	<p>● Alarm Management</p> <p>My own</p> <p>Management</p>	<p>● corona1</p> <p>My own</p> <p>Management</p>	<p>● coronaR</p> <p>My own</p> <p>Management</p>

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



Prev 1 2 3 ... 9 Next

Filter

Create new

- Dashboards
- My Dashboards
- Notificator
- IOT Applications**
- My Personal Data
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal
- Km4City portal
- DISIT Lab portal

● 2018-09-14T04:44

IOT Edge App

owner: badii

Management

● 2018-09-21T03:19

IOT Edge App

owner: panesi

Management

● 2018-10-19T16:07

IOT Edge App

owner: pb3

Management

● 2018-10-19T17:17

IOT Edge App

owner: pb3

Management

● 2018-10-22T11:57

IOT Edge App

owner: semolarudy

Management

● application

IOT Application

owner: tester5

Management

● Bib APP

IOT Application

owner: semolarudy

Management

● ChargingStations

IOT Application

owner: comunedashres

Management

● Deprecated - SiIMobilityControlRoom

IOT Application

owner: badii

Management

● SamsungGalaxyS4Barcode

IOT Edge App

owner: badii

Management

● esercitazione

IOT Application

owner: tester2

Management

● Iot-App

IOT Application

owner: tester14

Management

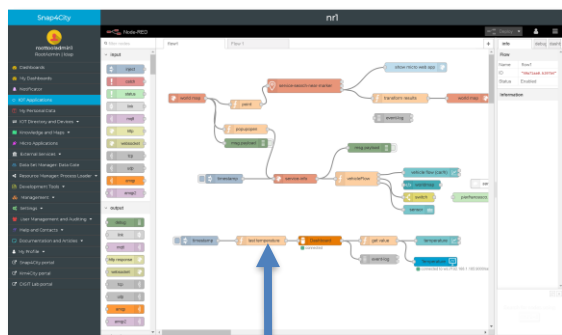
IOT Application Listing, they can be

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

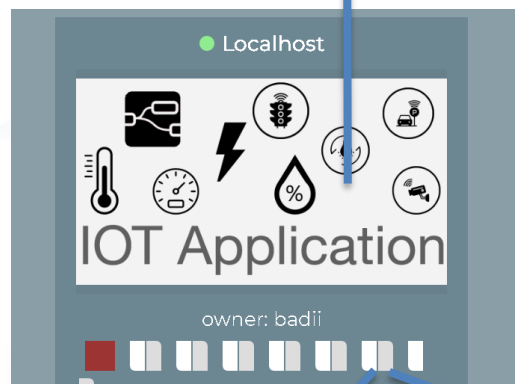
The screenshot shows the Snap4City IOT Applications dashboard. On the left is a navigation sidebar with a menu including: Dashboards, My Dashboards, Notificator, IOT Applications (highlighted), My Personal Data, IOT Directory and Devices, Knowledge and Maps, Micro Applications, External Services, Data Set Manager: Data Gate, Resource Manager: Process Loader, Development Tools, Management, Settings, User Management and Auditing, Help and Contacts, Documentation and Articles, My Profile, Snap4City portal, Km4City portal, and DISIT Lab portal. The main content area is titled 'IOT Applications' and features a grid of application cards. Each card displays an icon, a title, a date, and an owner. The applications shown 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 'Create new' button is visible in the top right corner of the main area.

IOT Applications Listing

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

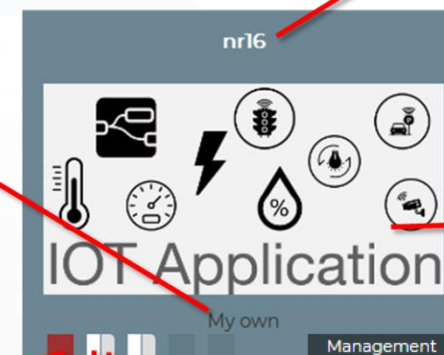
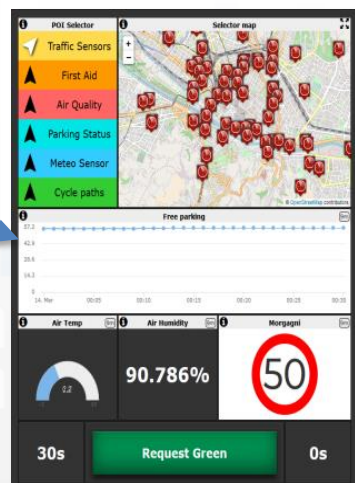


EDIT IOT APP



VIEW

EDIT



IOT App title

Click the icon to edit the IOT App

Ownership of the IOT App

Click to open the Node-RED IOT App dashboard

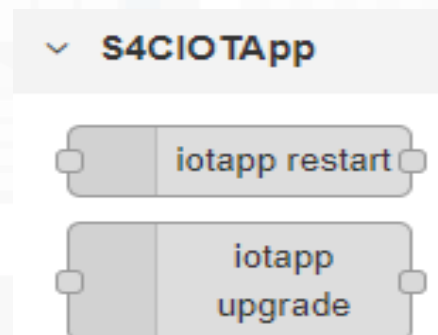
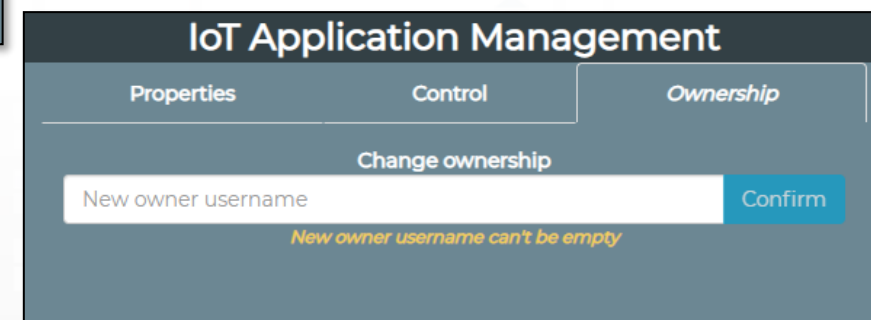
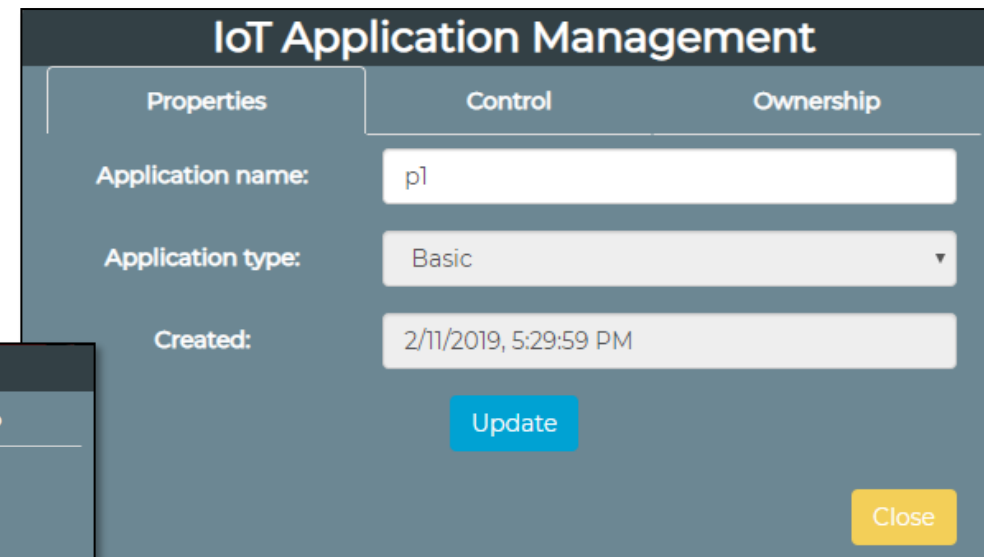
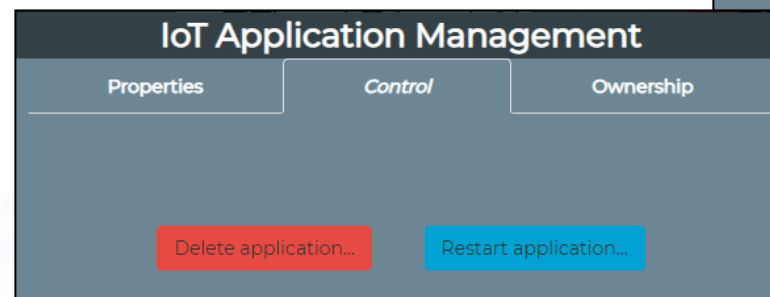
Click to edit IOT App properties

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

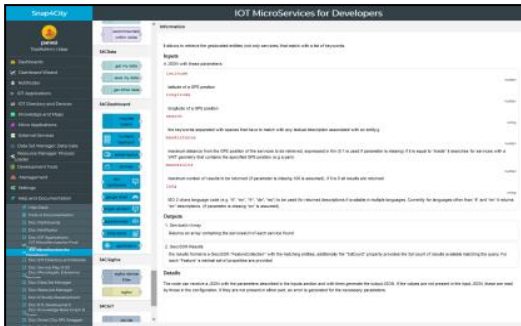


Automating restart
and update

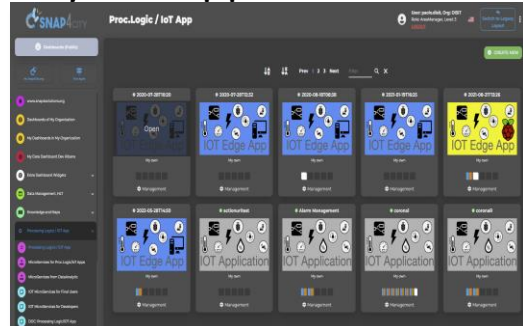
IOT Applications Development

IOT Discovering

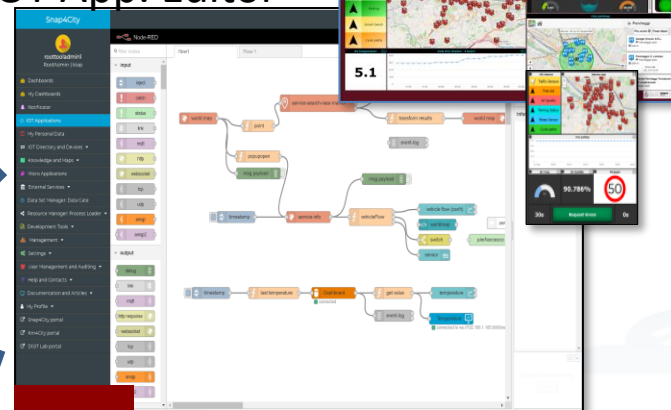
MicroServices collections



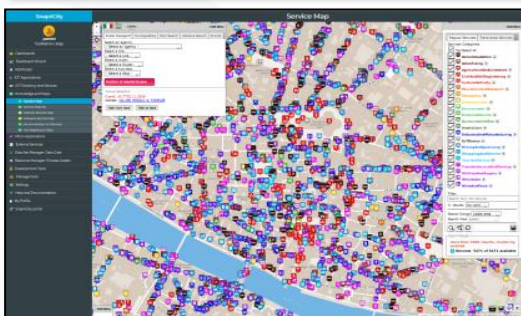
My IOT Applications



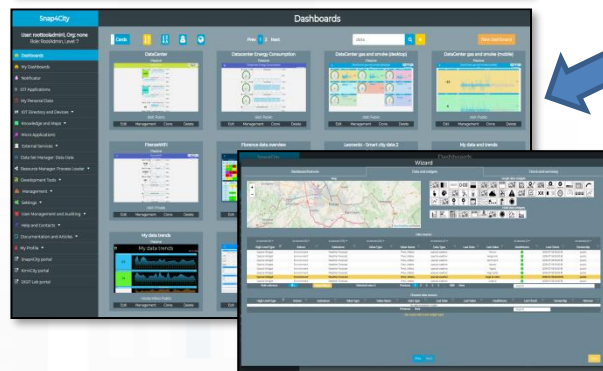
IOT App. Editor



Generating IOT App With Dashboard



ServiceMap Discovery
Knowledge Base, Km4City



Dashboard Collection,
Editor and Wizard

Sharing/saving
reusing IOT App



Resource Manager



nr1

Node-RED

filter nodes

flow1

Flow 1

Deploy

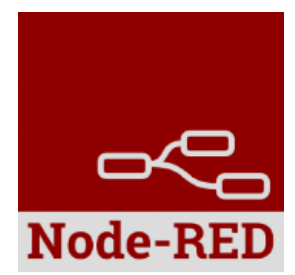
info debug dashb

Flow

Name	flow1
ID	"49a71aa0_b297b4"
Status	Enabled

Information

Search for nodes using



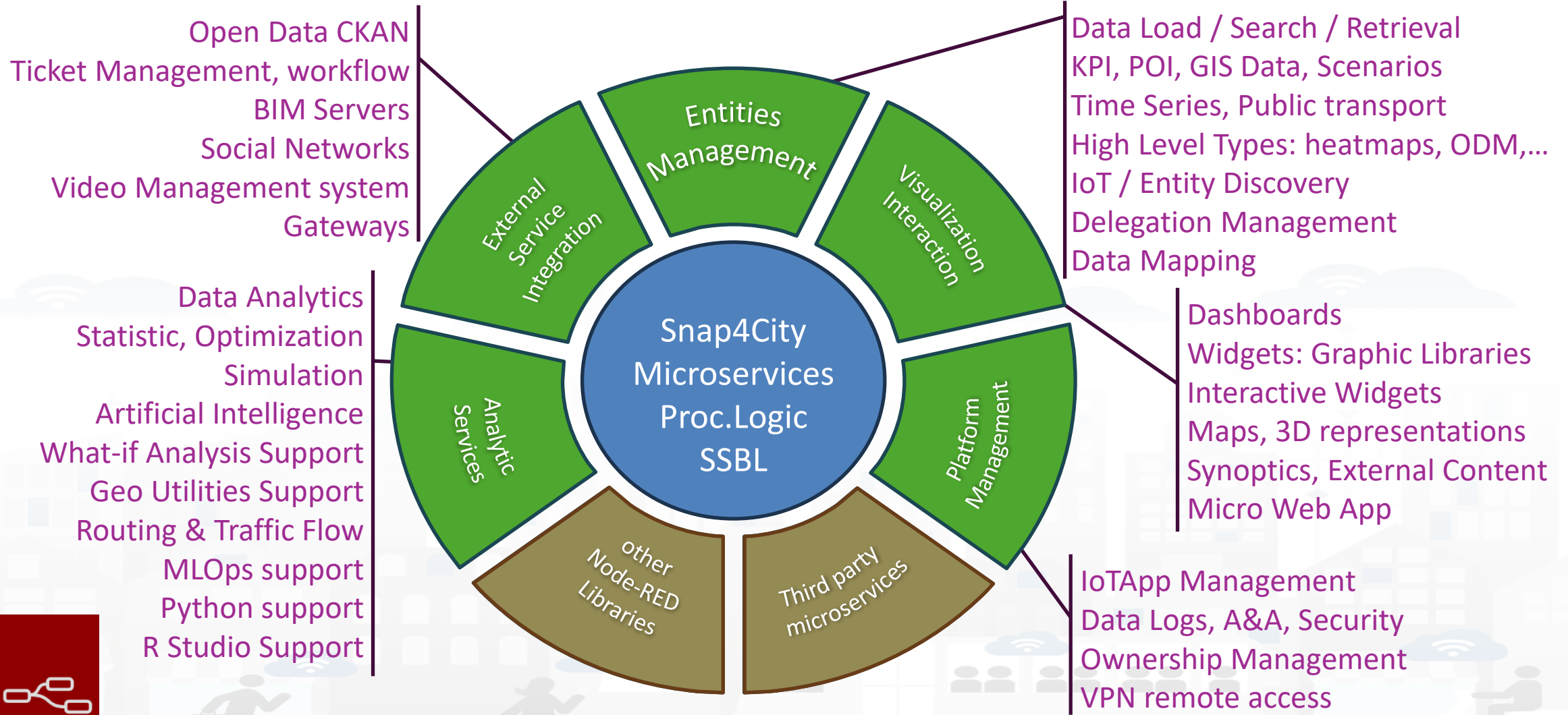
Data Adaption
 Transformation, Conversion
 Integration
 Business Logic vs Dashboards

Editing IOT Applications

Data Analytics control

Everywhere: Cloud, on IoT Edge Devices

Areas



The Processing Logic (IoT App) microservices

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

- **Data ingestion:** more than 100 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.
- **Data access:** save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, call to Smart City API, etc.
- **Data Transformation/transcoding:** binary, hexadecimal, XML, JSON, String, any format
- **Integration:** CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIM Server, any external service REST Call, etc.
- **Manipulation of complex data:** heatmaps, scenarios, typical time trend, multi series, calendar, maps, etc.
- **Access to Smart City Entities and exploitation of Smart City Services:** transport, parking, POI, KPI, personal data, scenarios, etc.
- **Data Analytic:** managing Python native, calling and scheduling Python/Rstudio containers as snap4city microservices (predictions, anomaly detection, statistics, etc.)
- **User interaction on Dashboard:** get data and message from the user interface, providing messages to the user (form, buttons, switches, animations, selector, maps, etc.), send data to special graphical widgets: D3, Highcharts, etc.
- **Custom Widgets:** SVG, synoptics, animations, dynamic pins on maps, etc
- **Event management:** Telegram, Twitter, Facebook, SMS, WhatsApp, CAP, etc.
- **Special tools as:** routing, georeverse, Twitter Vigilance and sentiment analysis, etc.
- **Hardware Specific Devices:** Raspberry Pi, Android, Philips, video wall management, etc.
- **Etc. etc.**



Sept 2024 collection

Two Snap4City Libraries



Navigation menu on the left:

- > common
- > function
- > network
- > input
- > output
- > sequence
- > parser
- > storage
- > social
- > advanced
- > Advanced FTP
- > location
- > NGSi
- > Iwm2m
- > S4C SearchDev
- > S4C Utility
- > S4C Mapping
- > S4C Management
- > S4C Data Analytic
- > S4C Big Data
- > S4C IoT App
- > S4C Open Maint
- > S4C IoT
- > S4C Whatif
- > S4C Search
- > S4C Data
- > S4C KPi Data
- > S4C Dashboard
- > S4C Sigfox
- > S4C LogDev
- > S4C View
- > S4C Social
- > dashboard
- > time

Library categories and their contents:

- S4C SearchDev**
 - service search
 - service search near gps position
 - service search near service
 - service search within gps area
 - service search within wkt area
 - service search within stored wkt area
 - service search by municipality
 - service search by queryid
 - full text search dev
 - full text search within wkt area
- S4C Utility**
 - full text search within gps area
 - full text search near gps position
 - full text search exp
 - event search dev
 - event search exp
 - event search within wkt area
 - event search within gps area
 - event search near gps position
 - address search near gps position
 - geometry search near gps position
 - address poi search by text
- S4C Mapping**
 - address poi search by text exp
 - address poi search by text near gps position
 - bus routes search
 - bus routes search near gps position
 - bus routes search within gps area
 - bus routes search within wkt area
 - bus routes
- S4C Data Analytic**
 - point within polygon
 - routing
 - heatmap picker
 - coordinates to address
 - service info
 - edge-tunnel-to-cloud
 - service info mapped
 - mapping
 - set mapping
- S4C Management**
 - get job detail
 - get triggers of job
 - get job group names
 - get trigger group names
 - get paused trigger groups
 - get job fire times
 - get system status
 - trigger job
 - pause all
 - pause trigger
 - pause triggers
 - resume all
 - resume job
 - resume jobs
 - resume trigger
 - resume triggers
- S4C IoT App**
 - notifier history events
 - descriptive statistics
 - trend plot
 - time series predictions
 - machine learning predictions
 - anomaly detection
 - plumber data analytic
 - python data analytic
 - datagate search
 - datagate create
 - portia crawler
 - iotapp restart
 - iotapp upgrade
 - ownership
- S4C Search**
 - service search near marker
 - service search within circle
 - service search within polygon
 - service search along path
 - full text search within circle
 - full text search within polygon
 - full text search along path
 - full text search usr
 - event search near marker
 - geometry search near marker
 - address poi search by text usr
 - address poi search by text near marker
 - address poi search by text within circle
 - bus routes search near marker
 - bus routes search within circle
 - bus routes search within polygon
 - tpl agencies
 - tpl lines
- S4C Data**
 - event search within polygon
 - event search along path
 - event search usr
 - address search near marker
 - geometry search near marker
 - address poi search by text usr
 - address poi search by text near marker
 - address poi search by text within circle
 - address poi search by text within polygon
 - value type search along path
 - get my data
 - get my delegator
 - get my delegated
 - get my activity
- S4C Social**
 - tpl routes by agency
 - tpl routes by line
 - tpl stops by route
 - tpl stop timeline
 - recommendatio within circle
 - value type search near marker
 - value type search within circle
 - value type search within polygon
 - value type search along path

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

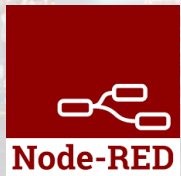
Standards and Interoperability (6/2023)



Compliant with:

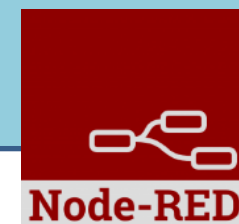
- **IoT:** NGSII V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **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,
- **Formats:** JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, Lidar, gITF, 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>

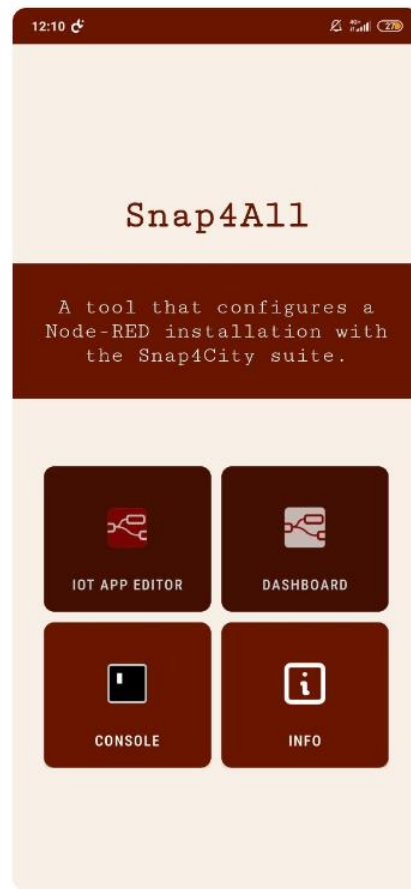


Snap4All Mobile App

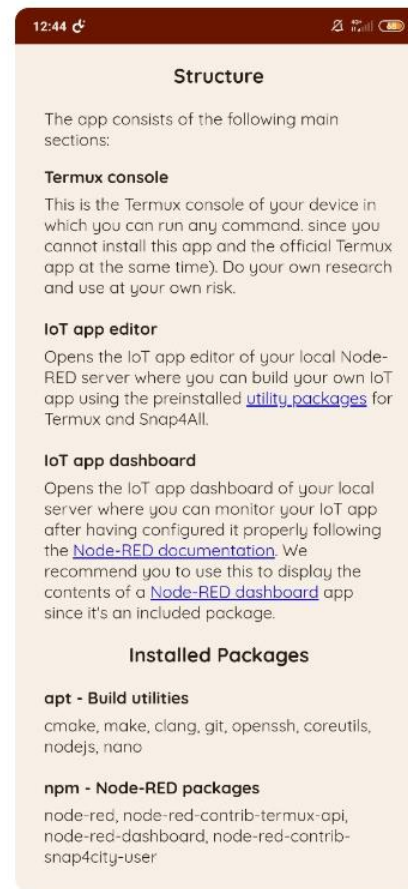
Node-RED on Android



Snap4All mobile app for Android



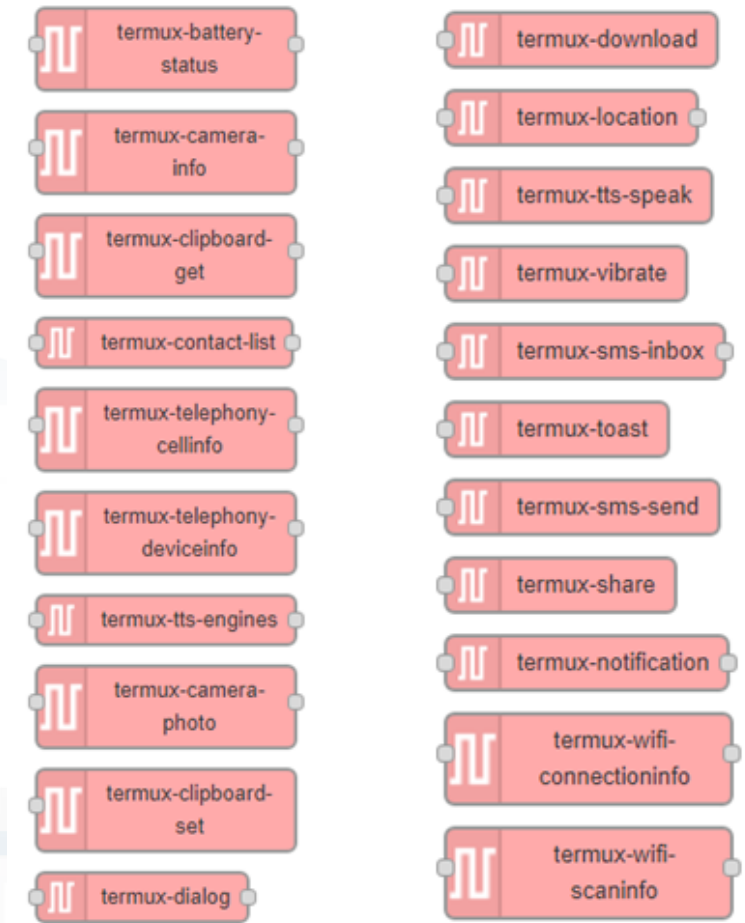
(a) Home



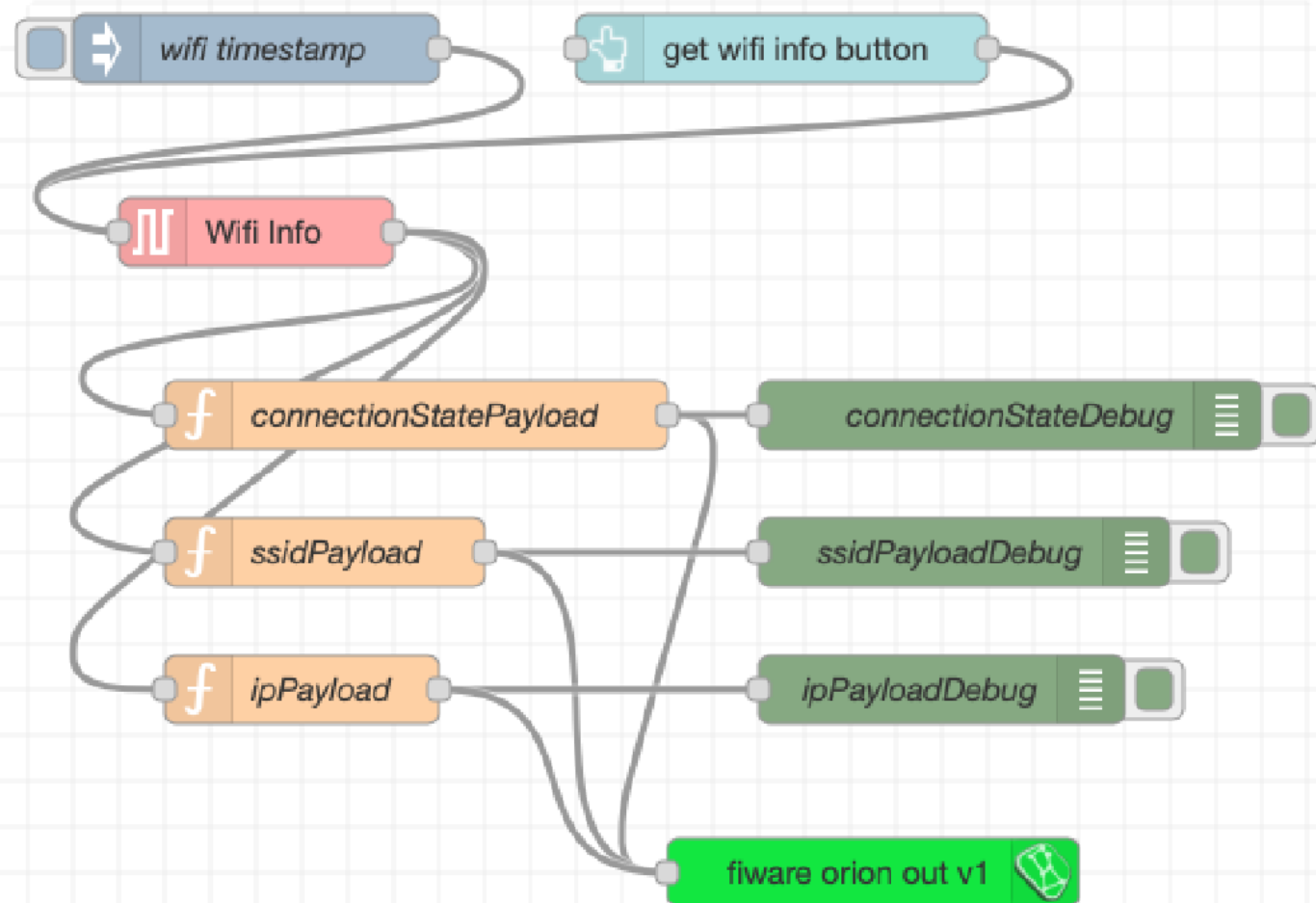
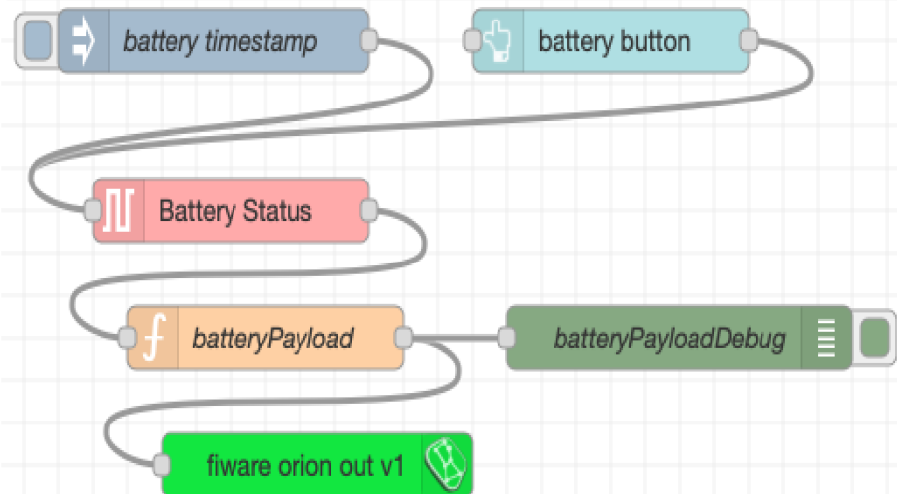
(b) Info



(c) Console

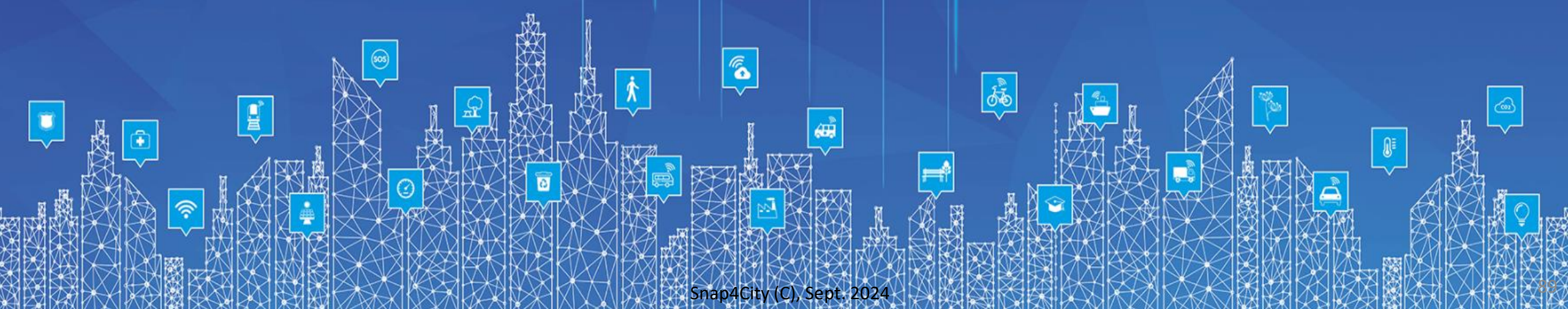
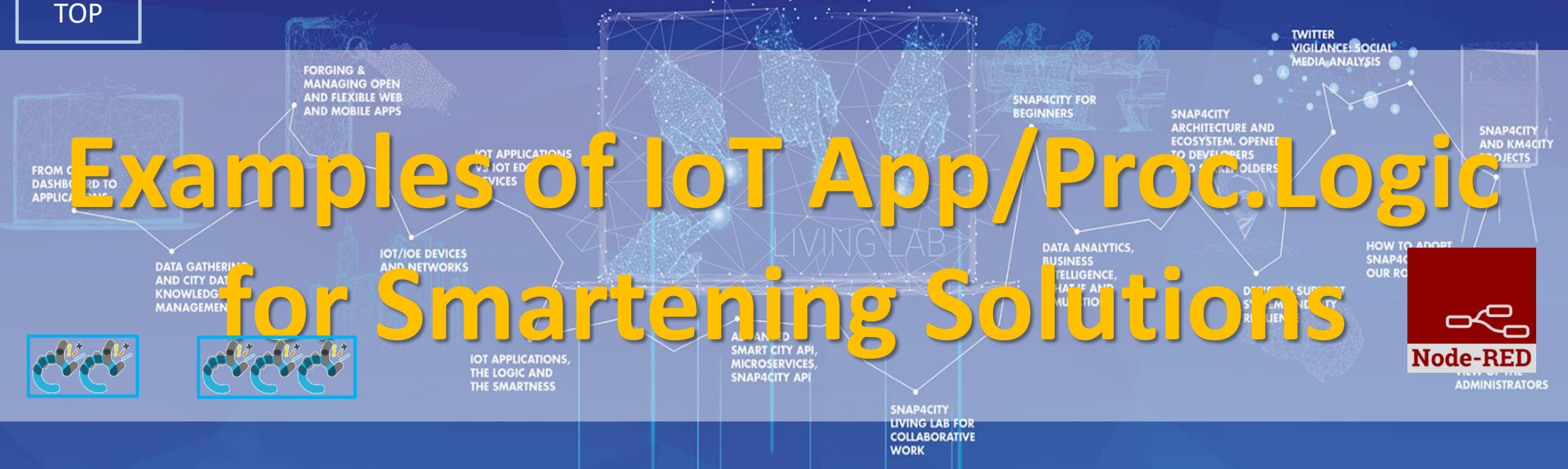


<https://www.snap4city.org/download/video/Snap4All-v1.0.5-large.apk>



TOP

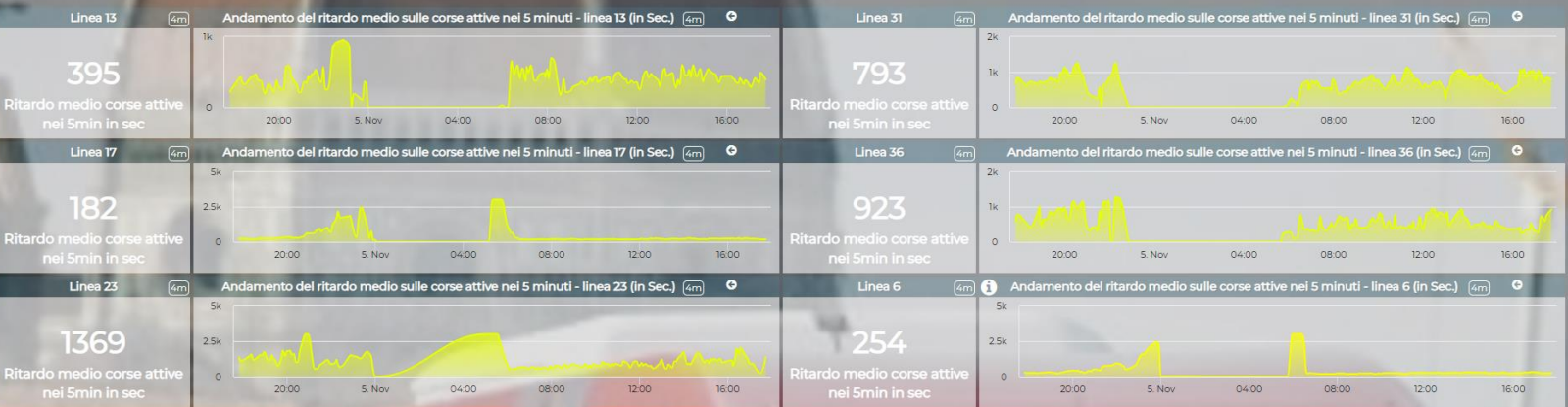
Examples of IoT App/Proc.Logic for Smartening Solutions



Valutazione Trasporto Pubblico

Firenze - 6 linee

Tue 5 Nov 17:49:00



The Snap4City user interface sidebar, showing the user's profile and navigation menu.

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
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications**
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management

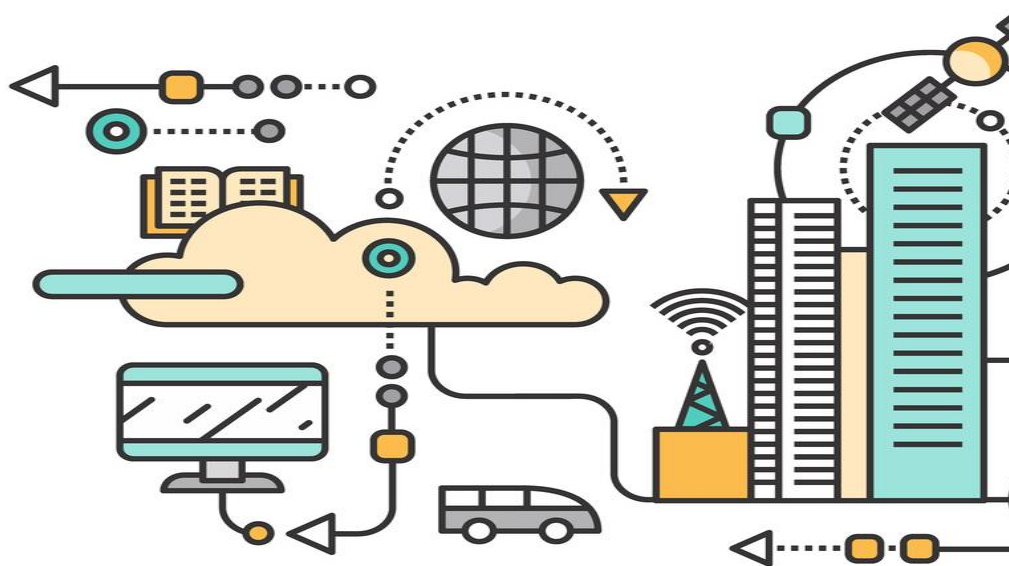
The Node-RED dashboard for "BusLinesWaitTimeToDash". It shows a flow with a "timestamp" input node, followed by six function nodes that process data for different bus lines (linea6, linea13, linea17, linea23, linea31, linea36). Each function node is connected to a "Save on Tempo_medioattesa_lineaX" output node, which then feeds into a "msg.payload" node.



Estimation of the mean waiting time at bus stops

TOP

IoT App Smartening Devices and Dashboards



PaxCounter devices



- **Fix PaxCounter LoraWan**

- sniffing on: Wi-Fi, Bluetooth
- Sending data via LoraWan

- **Mobile PaxCounter LoraWan**

- sniffing on: Wi-Fi, Bluetooth
- Sending data via LoraWan

- **Fix PaxCounter, multiple out**

- Sending data via LoraWan and Wi-Fi
- sniffing on: Wi-Fi, Bluetooth



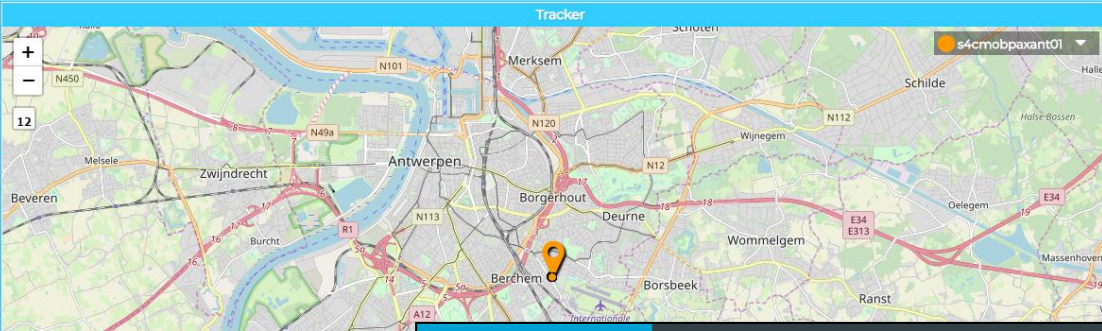
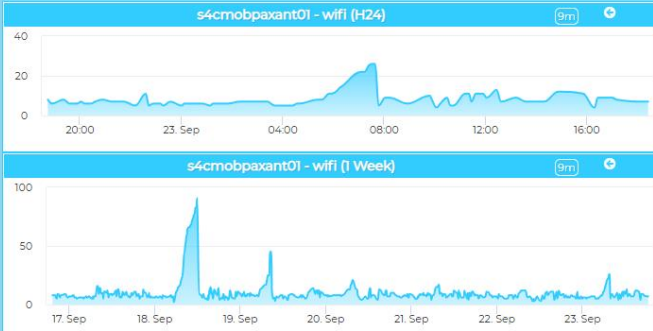
<https://www.snap4city.org/456>

Programmable PAX counting



Mobile PAXCounter 01 in Antwerp

Mon 23 Sep 18:39:46



Begin 3:00 + -

Finish 5:30 + -

Activate

Status 9m

Status 9m

Pax Counter Status 9m

CUMULATIVE MODE OFF

Cumulative Mode Active from 2019-09-23T03:00:00.000Z and 2019-09-23T05:30:00.000Z

Device in Cumulative Mode OFF



Snap4City

User: rootoadmini, 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
- Notifier
- Data Inspector
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- KM4CITY portal
- DISIT Lab portal

Node-RED

Input: inject, catch, status, link, mqtt, http, websocket, top, udp, amqp, stomp

Output: mqtt, link, mqtt, http response, websocket, top, udp, amqp2, stomp

PAXCounter Antwerp Control

Flow: timestamp → OFF ADR for mobile PAX → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03down → request config from server → msg.payload

Flow: timestamp → Display OFF → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → Display ON → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → Short range → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → MID range → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → Long range → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → WIFI Scan for 500m → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → WIFI Scan for 100m → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → start Cumulative counter → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → activate cyclic counter → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → payload every 5 min → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → payload every 8.5 min → msg.payload → digipolisnap4citypaxdevices/s4cmobpaxant03up → json → msg.payload

Flow: timestamp → request config from server → msg.payload

Antwerp

TOP

IoT App Smart Parking



Smart Lonato del Garda

Sat 9 Nov 17:20:59

Slot 1 to Slot 22 list on the left. A map shows the location of Lonato del Garda. A data table for 'TEST1_AIRSENSEUR_RVB01' is displayed:

DETAILS	DESCRIPTION	RT DATA
dateObserved	4:18:33 PM	Last value 4 hours, Last 24 hours, Last 7 days, Last 30 day
humidity	66.347755	Last value 4 hours, Last 24 hours, Last 7 days, Last 30 day
pressure	987.0833	Last value 4 hours, Last 24 hours, Last 7 days, Last 30 day
temperature	14.078355	Last value 4 hours, Last 24 hours, Last 7 days, Last 30 day

Visualizations include a bar chart for 'NumFreeSlots - Slots' showing 2 free slots and a line graph for 'temperature - Day'.

Smart Parking Monitoring (SVG, statistic, overparking)

SmartParkingLonato_1 dashboard showing:

- 0 status
- pressure: 987.1 mm
- humidity %: 66.3
- temperature: 14.1 C
- Slot ID: 14
- Max Present Duration: 19 ore e 11 minuti

Footer: Privacy Policy, Cookies Policy, Terms and Conditions, Contact us

Snap4City user interface showing navigation menu:

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications**
 - IOT Directory and Devices
 - Knowledge and Maps
 - Micro Applications
 - External Services
 - Data Set Manager: Data Gate
 - Resource Manager: Process Loader
 - Development Tools
 - Management
 - Settings

Node-RED interface for SmartParking LonatoDelGarda. Flow 1 includes:

- timestamp
- http request
- split
- Parcheggi
- fware-orion-out
- Parcheggi - statico
- estimations
- delay 5s
- Busy
- Save on NumFreeSlots
- Save on MaxDuration
- Save on MaxDurationSlotID
- Max Present Duration
- AVG time of free slot
- Median of Busy Slots



Lonato del Garda

TOP

IoT App Smart Industry 4.0

Snap4Industry



External
Services

Fleet
management



IoT Devices/Edge

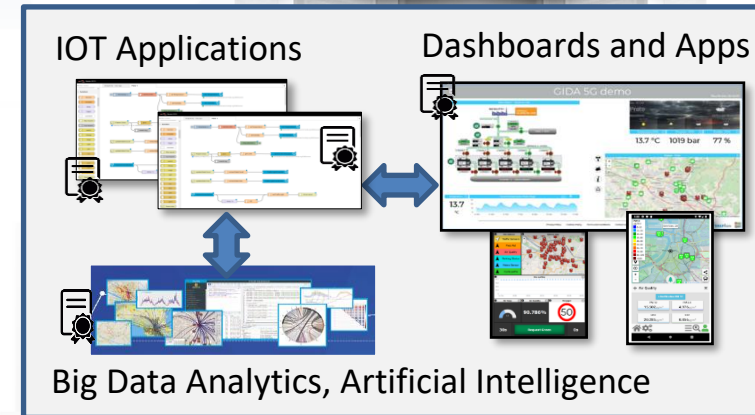
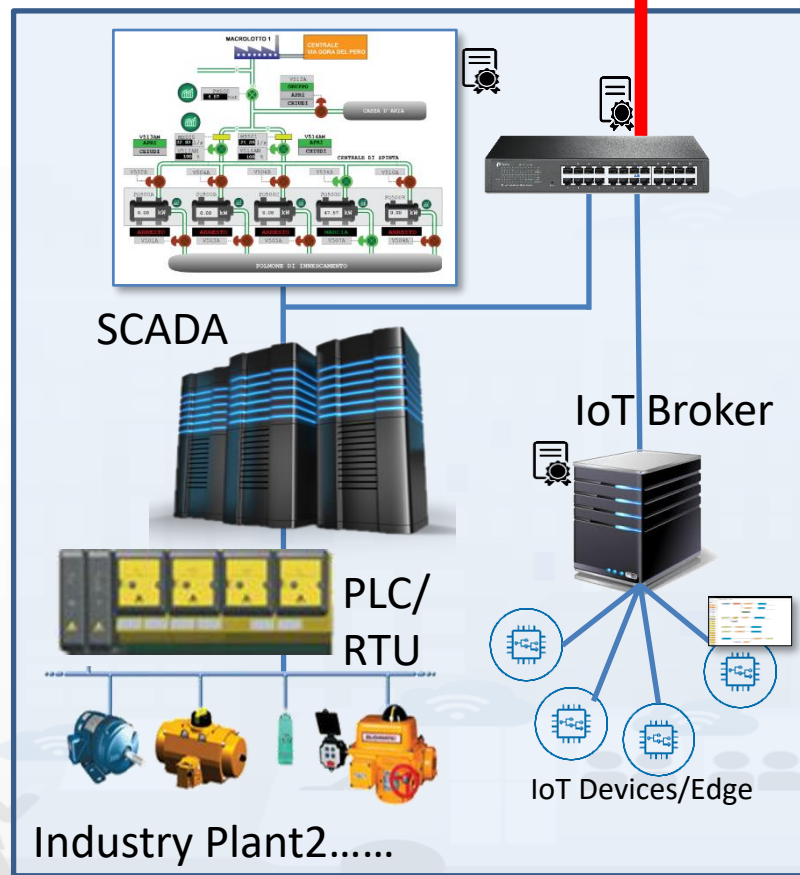
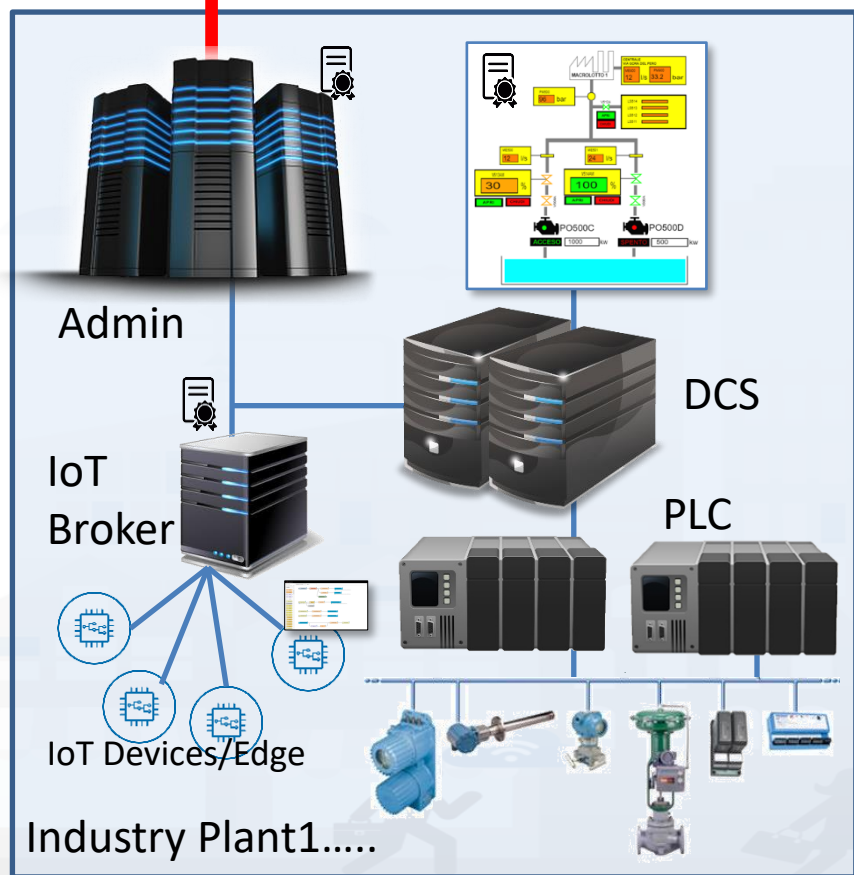
IoT Broker



SECURE



Internet



Control and Supervision on
Multiple Supply Chains
Industry 4.0 as a Service



Prato

<https://www.snap4city.org/758>

Smart City vs Industry 4.0



UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB



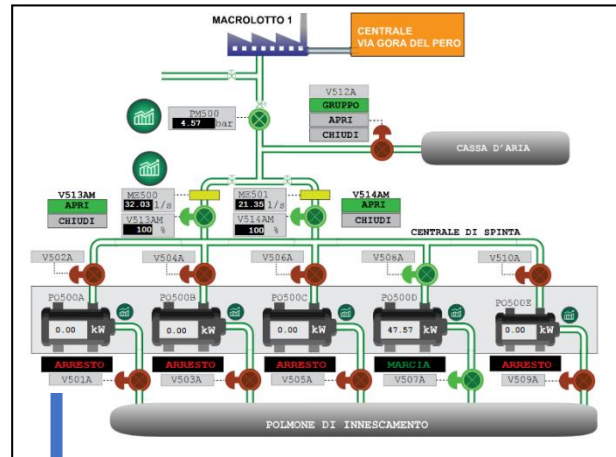
GIDA set up



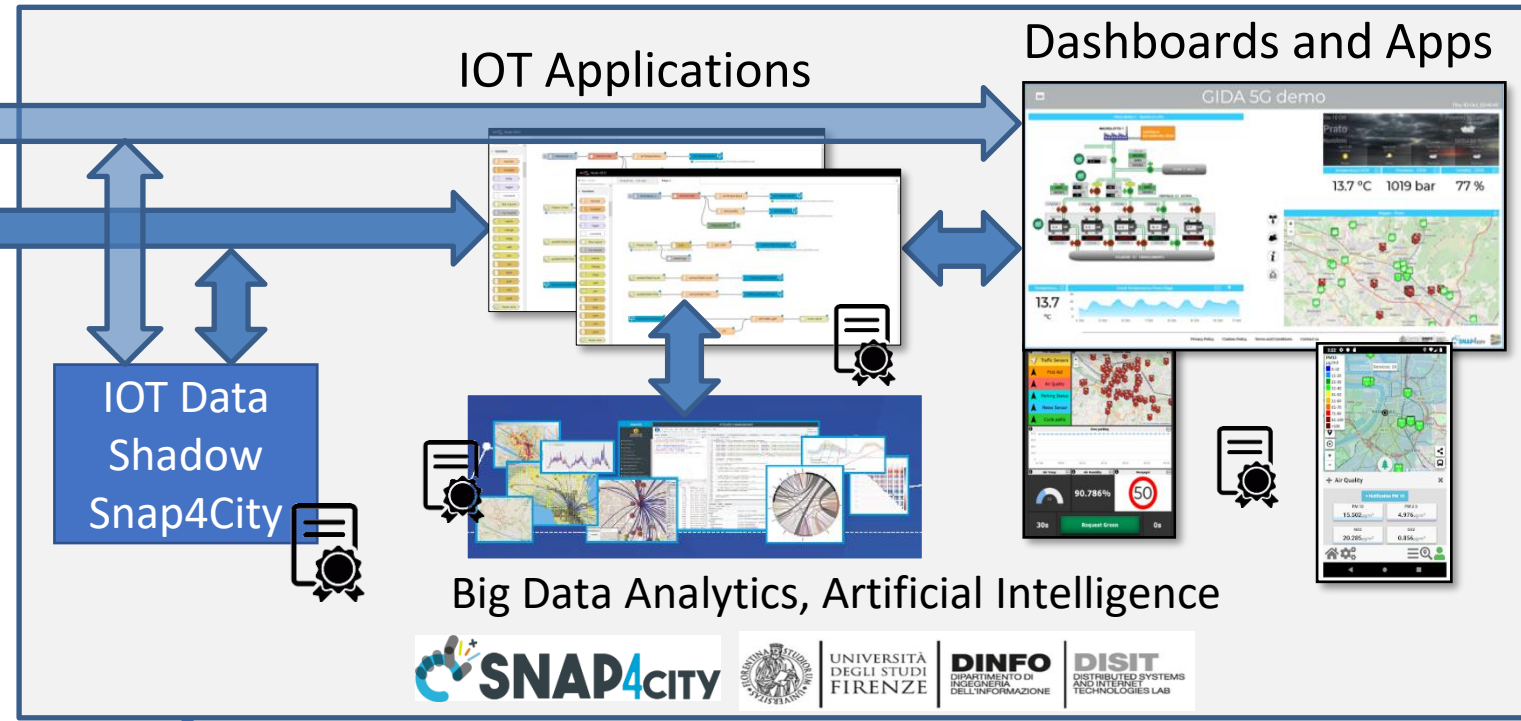
GESTIONE IMPIANTI DEPURAZIONE ACQUE S.p.A.



Smart City data from many sources



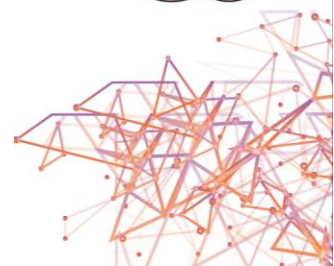
GESTIONE IMPIANTI DEPURAZIONE ACQUE S.p.A.



Telemonitoring Telecontrol

<https://www.snap4city.org/369>

5G



ModBus to Snap4City Gateway Edge

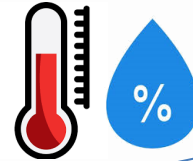
5G network devices



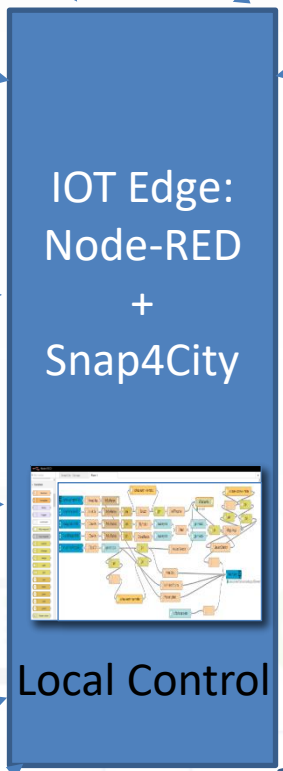
Measuring any kind of sensors values

Controlling Energy Power

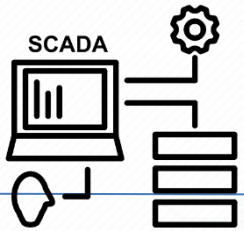
Measuring
Energy Consumption



Any kind of notification channel

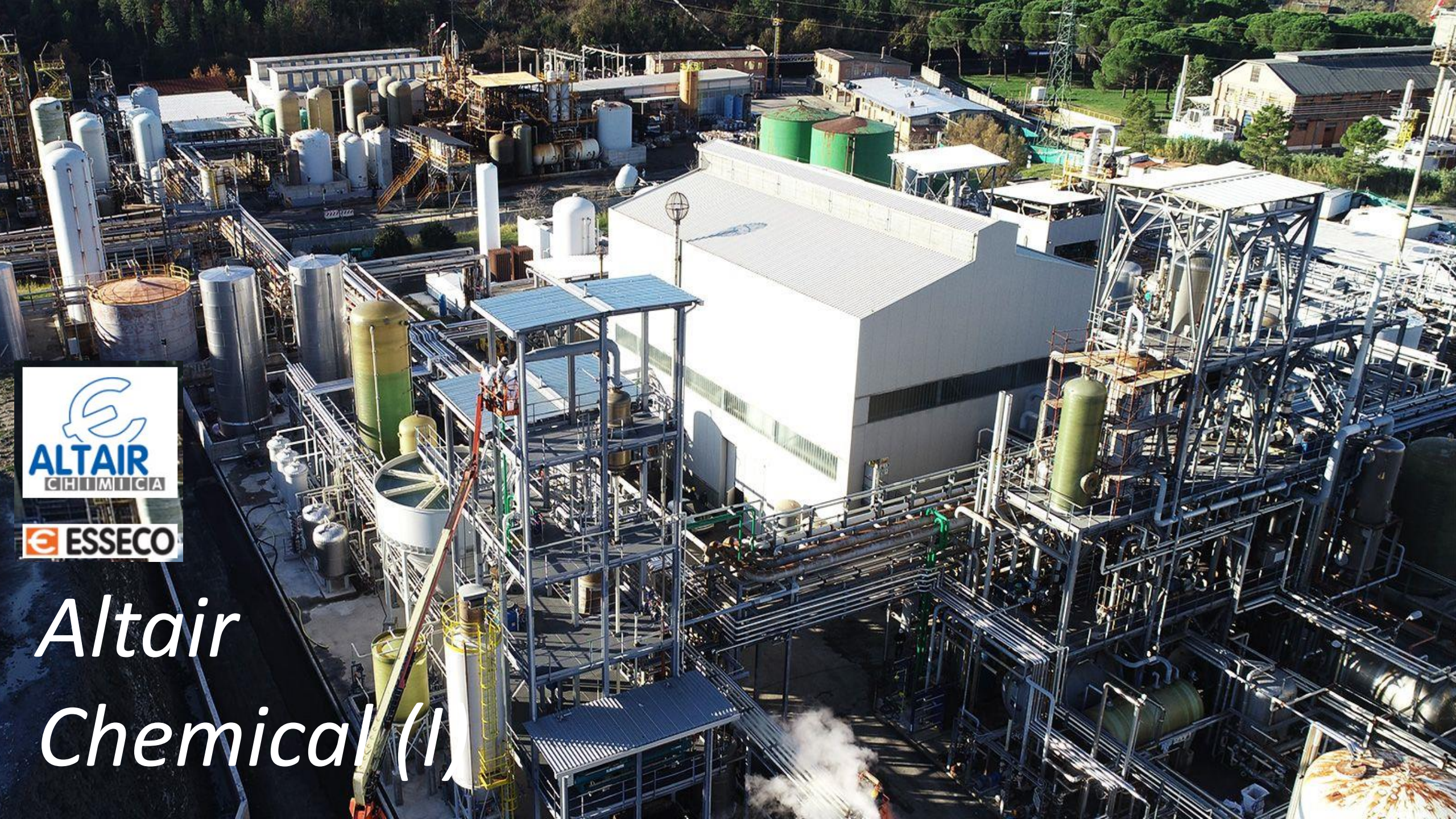


Contextual (smart city/home) data, Data Analytics
Historical Data, Remote Control, Mobile App



Alexa: Voice Commands

Administrative Servers



*Altair
Chemical (I)*

Snap4Altair Decision Support supervision and control, Industry 4.0



reference

- **Multiple Domain Data**

- Distributed Control System: energy, flows, storage, chemical data, settings, ..
- Cost of energy, Orders, Production Parameters
- Maintenance data

- **Multiple Levels & Decision Makers**

- Optimized planning on chemical model
- Business Intelligence on Maintenance data

- **Historical and Real Time data**

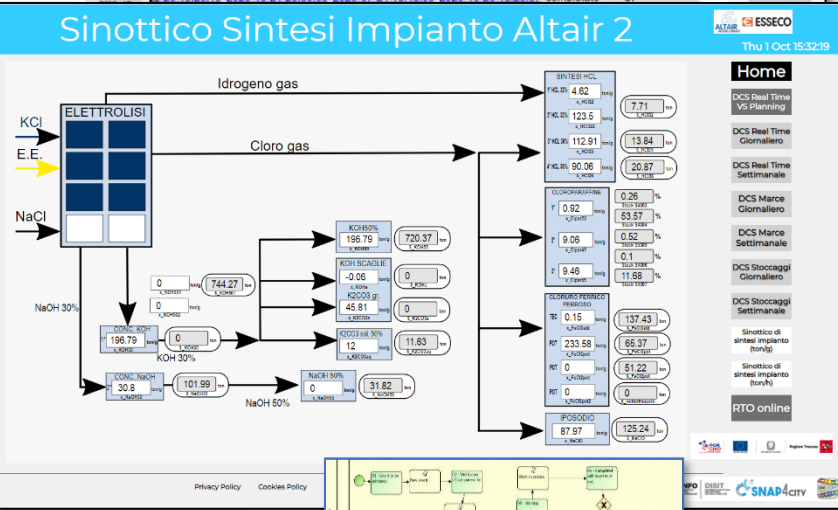
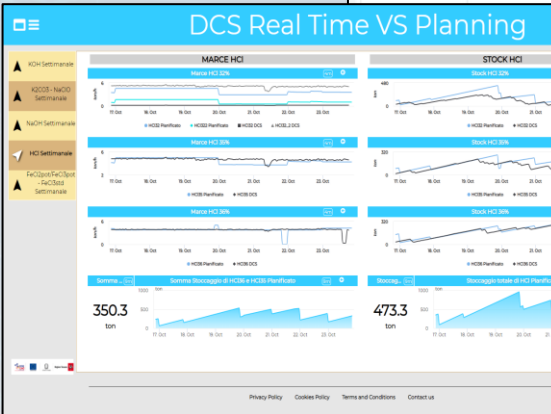
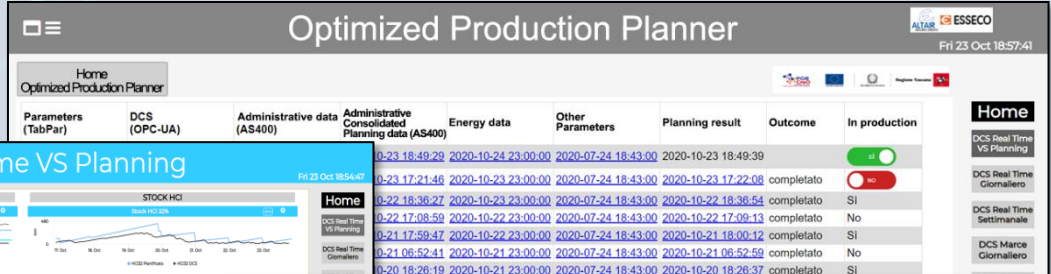
- Billions of Data

- **Services Exploited on:**

- Multiple Levels, Mobile Apps, API

- **Since 2020**

Snap4City (C), Sept. 2024





Industry Plant Supervision and Maintenance

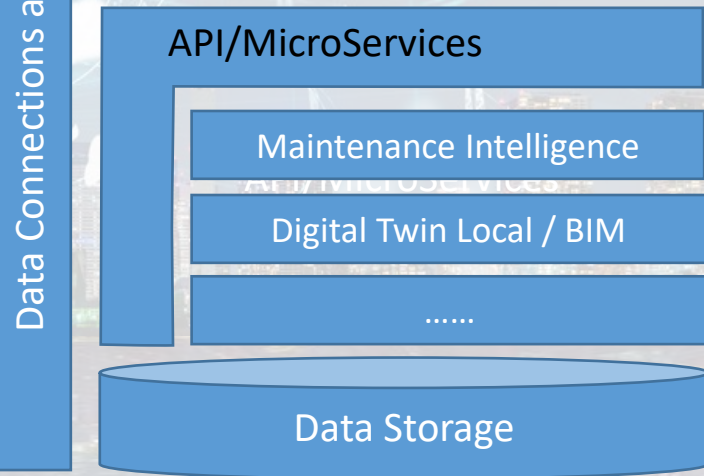
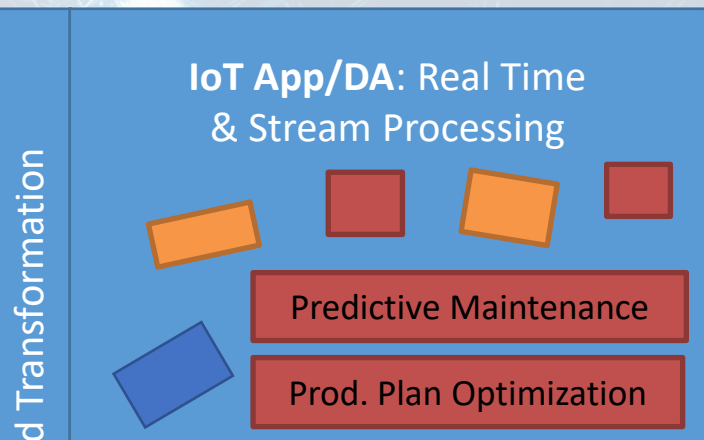


Aims

- **Control Room: Higher level supervision and monitoring (since 2020)**
 - Management of Production Plan *Optimization*
 - Control of Perimeter with drone and sensors
- **Maintenance ticketing (since 2017)**
 - *predictive* (in development)
 - 3D Digital Twin (in development)



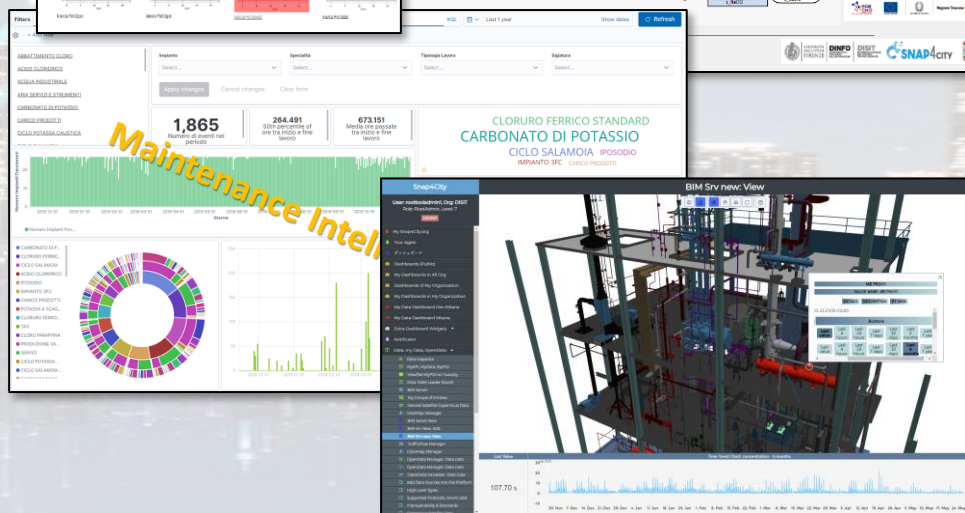
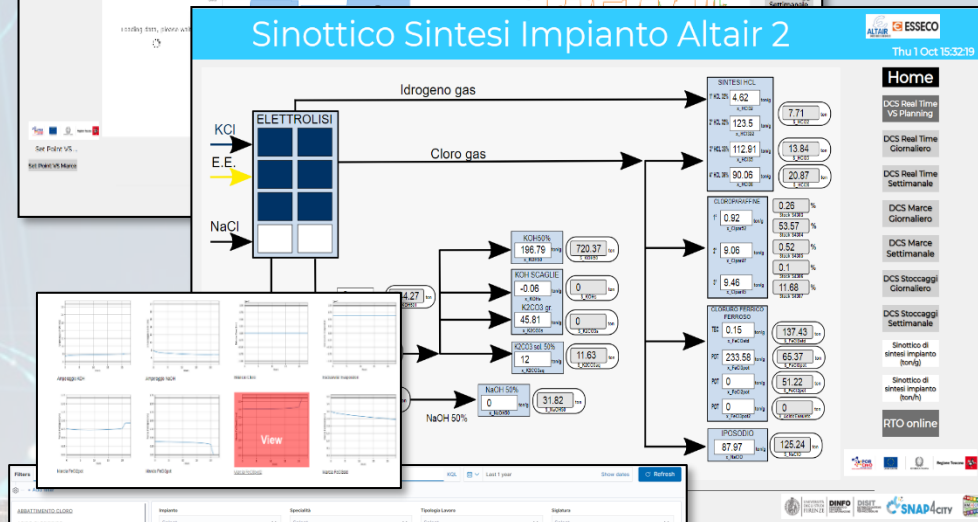
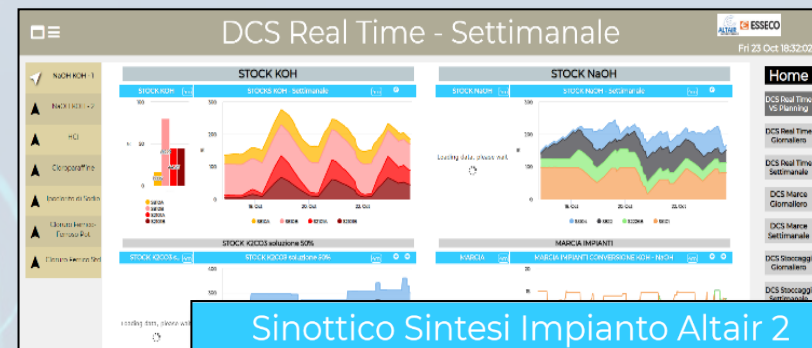
MicroService Architecture



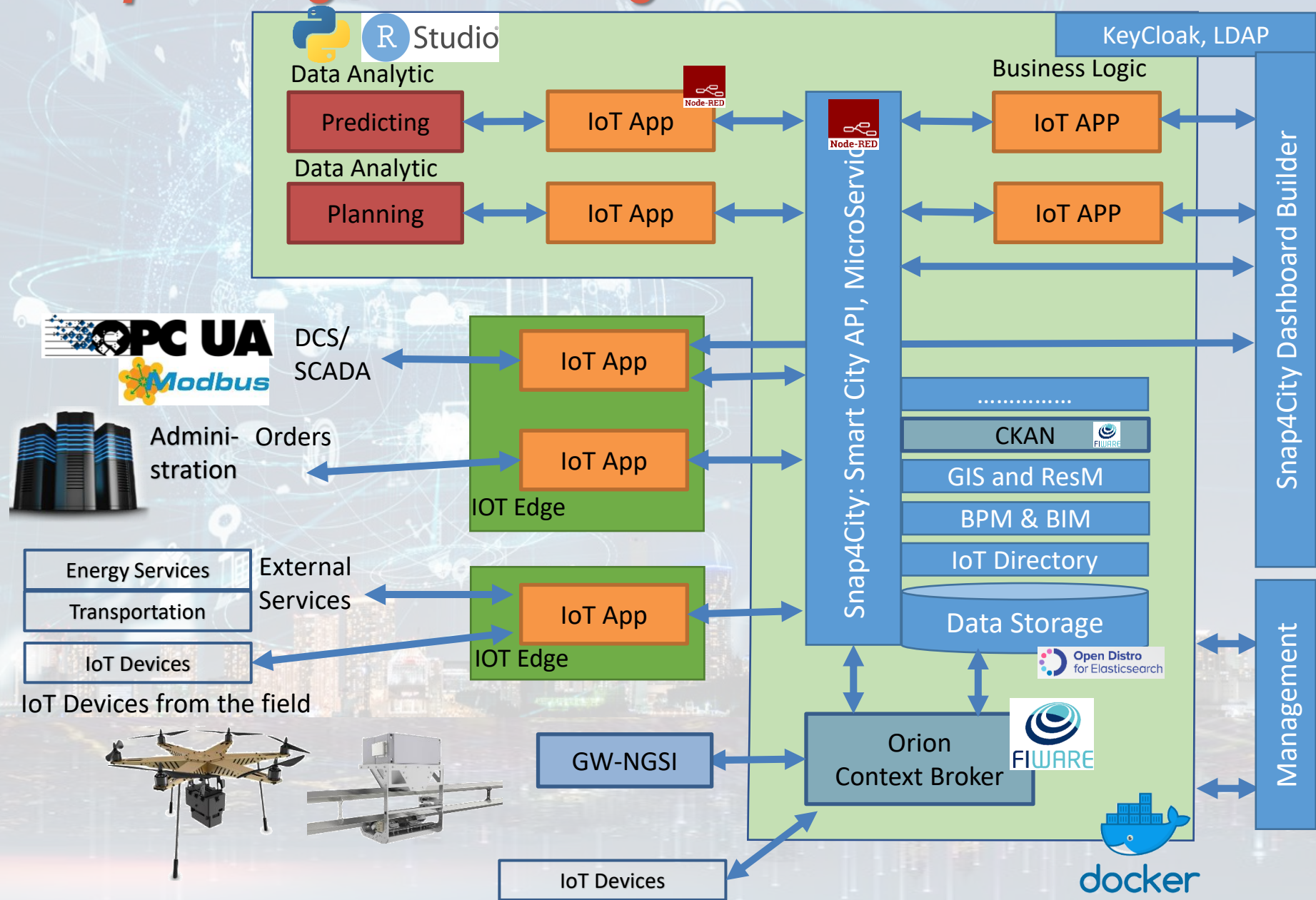
Management, Auth./Autoriz.



Snap4City Dashboard Builder

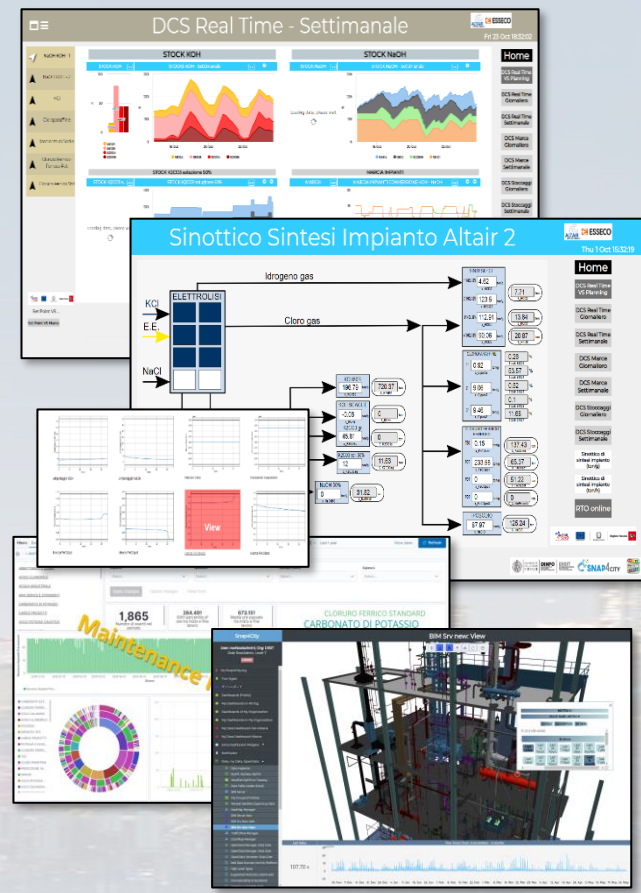


Snap4City/Industry Detailed Architecture

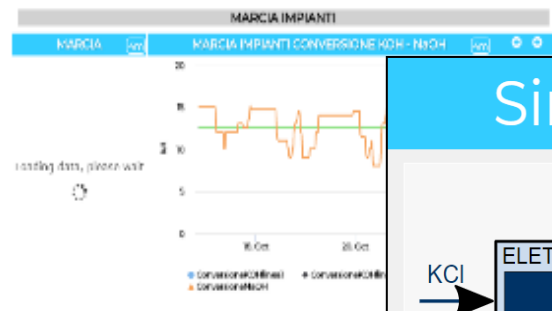
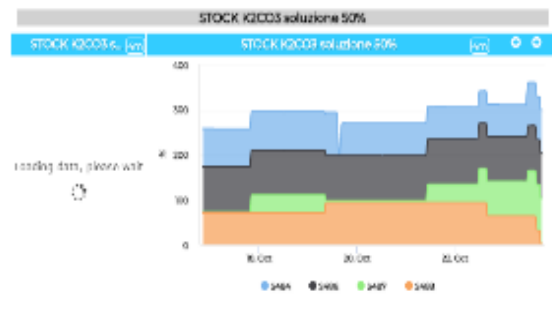
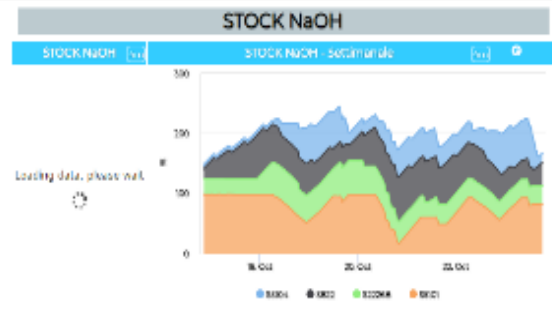
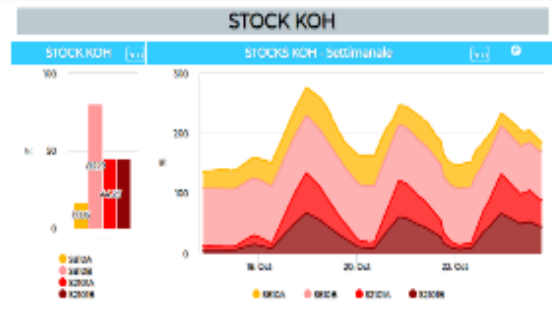


Production Parameters

Dashboards, Visual Analytics, Synoptics, 3D, Maps



- ▲ NaOH KOH -1
- ▲ NaOH KOH -2
- ▲ HCl
- ▲ Cloroparaffine
- ▲ Cloruro di Ferro
- ▲ Cloruro Ferrico Ferroso Pot
- ▲ Cloruro Ferrico Ferroso Pot



- Home
- DCS Real Time VS Planning
- DCS Real Time Giornaliero
- DCS Real Time Settimanale
- DCS Marce Giornaliero
- DCS Marce Settimanale
- DCS Stocaggi



RTO online

Operazione (data)	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
0-01 09:32:54	2020-10-01 23:00:00	2020-07-24 18:43:00	2020-10-01 09:33:27	completato	<input type="checkbox"/>
0-30 17:20:50	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 17:21:00	completato	<input checked="" type="checkbox"/>
0-30 16:24:57	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 16:27:23	completato	<input type="checkbox"/>
0-30 14:54:11	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 14:56:22	completato	<input type="checkbox"/>
0-30 13:43:47	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 13:43:57	completato	<input type="checkbox"/>
0-29 19:03:27	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-29 19:03:43	completato	<input type="checkbox"/>
0-28 18:30:13	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 18:30:23	completato	<input type="checkbox"/>
0-28 17:57:14	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 17:57:23	completato	<input type="checkbox"/>
0-28 15:50:21	2020-09-28 23:00:00	2020-07-24 18:43:00	2020-09-28 15:50:45	completato	<input type="checkbox"/>
0-25 18:46:02	2020-09-26 23:00:00	2020-07-24 18:43:00	2020-09-25 18:47:46	completato	<input checked="" type="checkbox"/>

- Home
- DCS Real Time VS Planning
- DCS Real Time Giornaliero
- DCS Real Time Settimanale
- DCS Marce Giornaliero
- DCS Marce Settimanale
- DCS Stocaggi Giornaliero
- DCS Stocaggi Settimanale

Sinottico di sintesi impianto

Sinottico Sintesi Impianto Altair 2

Thu 1 Oct 15:32:19

- Home
- DCS Real Time VS Planning
- DCS Real Time Giornaliero
- DCS Real Time Settimanale
- DCS Marce Giornaliero
- DCS Marce Settimanale
- DCS Stocaggi Giornaliero
- DCS Stocaggi Settimanale
- Sinottico di sintesi impianto (ton/g)
- Sinottico di sintesi impianto (ton/h)
- RTO online

Some Flows

Snap4Altair

User: userrootadmin, Org: Organization
Role: RootAdmin, Level: **Logout**

IoT Application nodered2

Snap4Altair

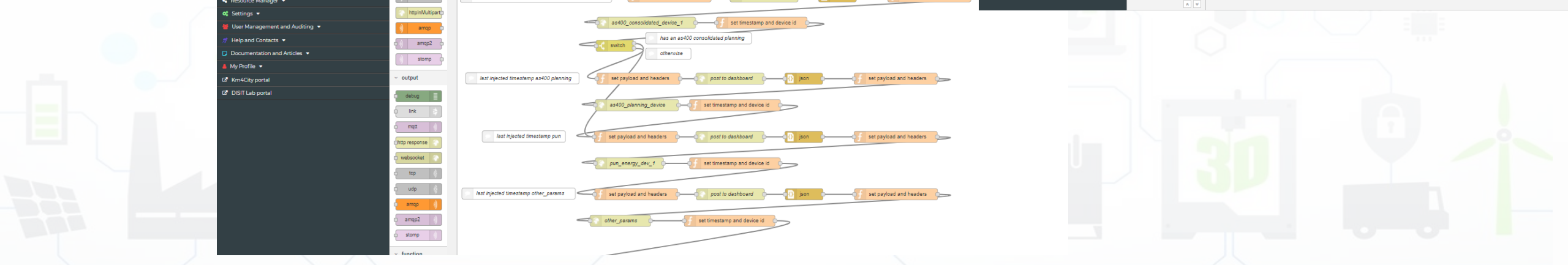
User: userrootadmin, Org: Organization
Role: RootAdmin, Level: **Logout**

IoT Application nodered2

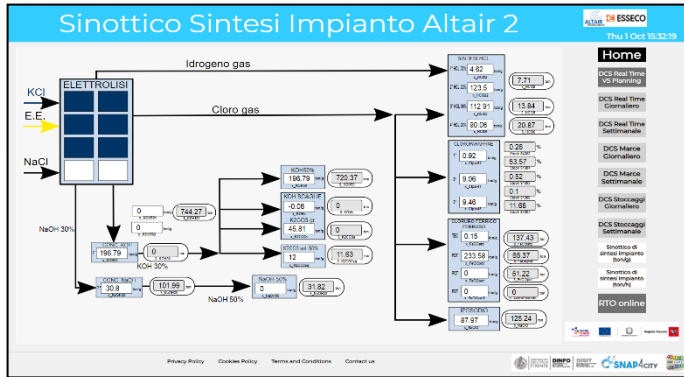
Snap4Altair

User: userareamanager, Org: Organization
Role: AreaManager, Level: **Logout**

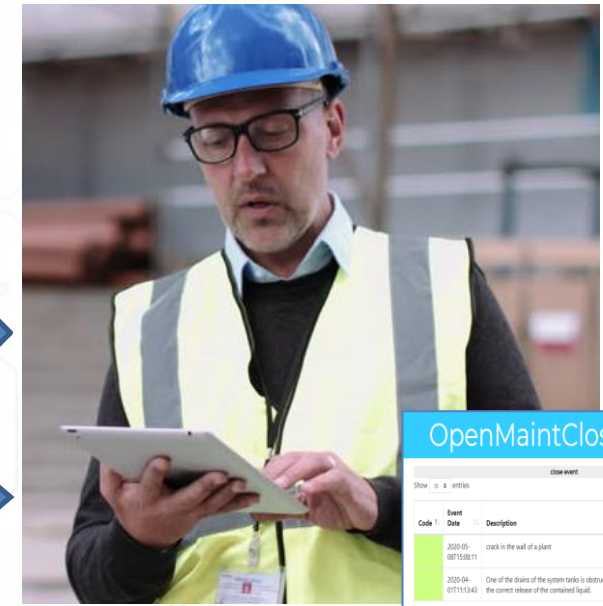
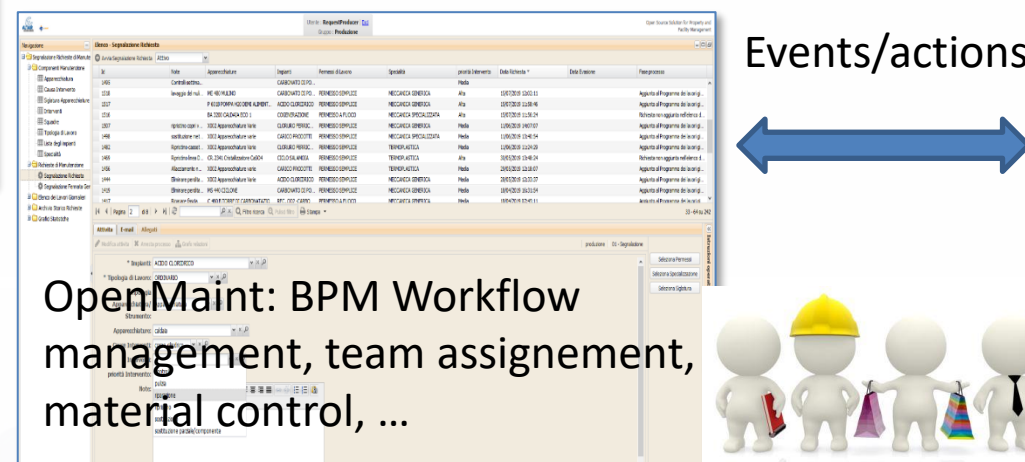
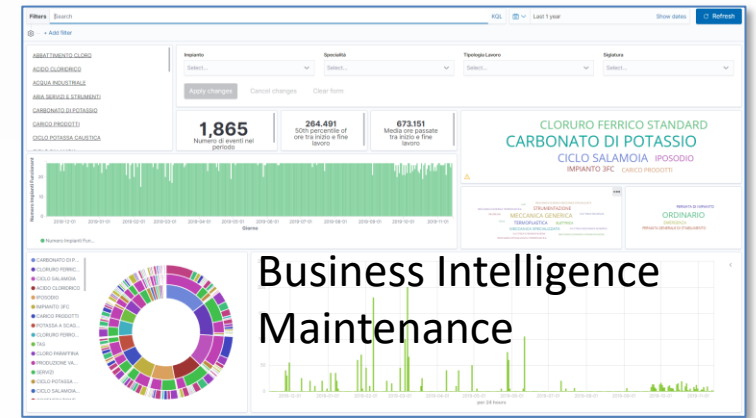
IoT Application nodered2



Workflow for Ticket management

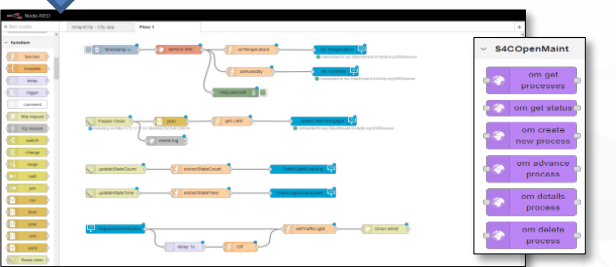


Consumptions/productions



Code	Date	Description	Controls
2020-05-08T15:08:11		crack in the wall of a plant	Adesso
2020-04-07T11:54:40		One of the drains of the system tanks is obstructed and does not allow the correct release of the contained liquid.	Adesso

Dashboards and actions



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



CAPELON

Västerås, Sweden



reference

Smart Light Control of **CAPELON**

• Energy Domain

- Smart Light, MQTT,
- IoT Orion Broker FIWARE

• Dashboards

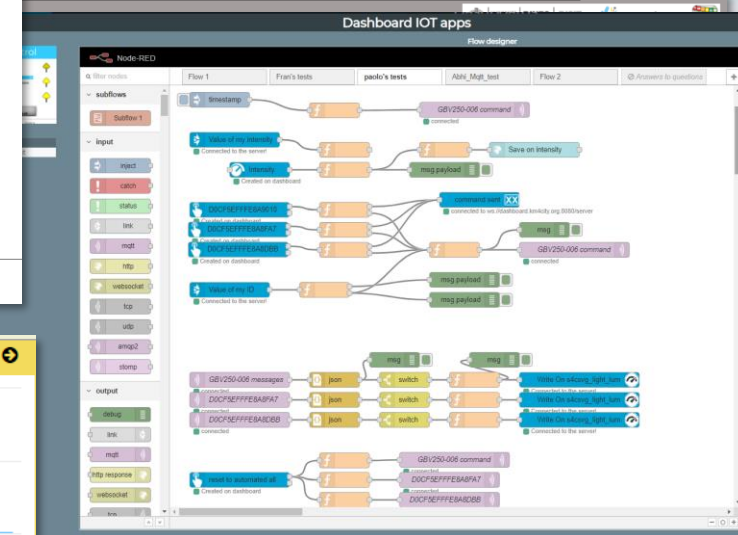
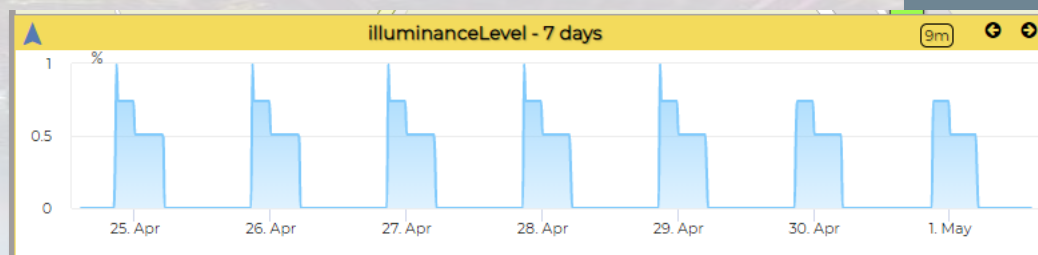
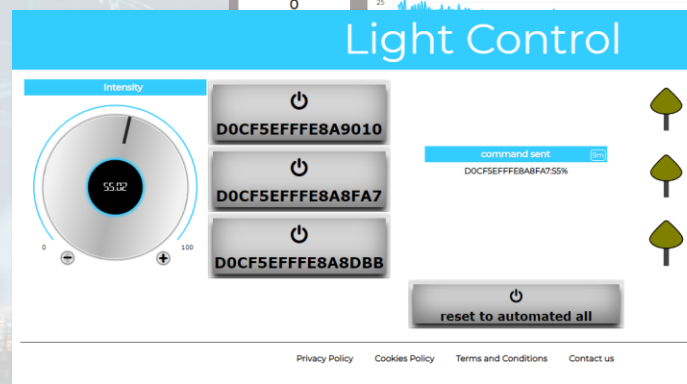
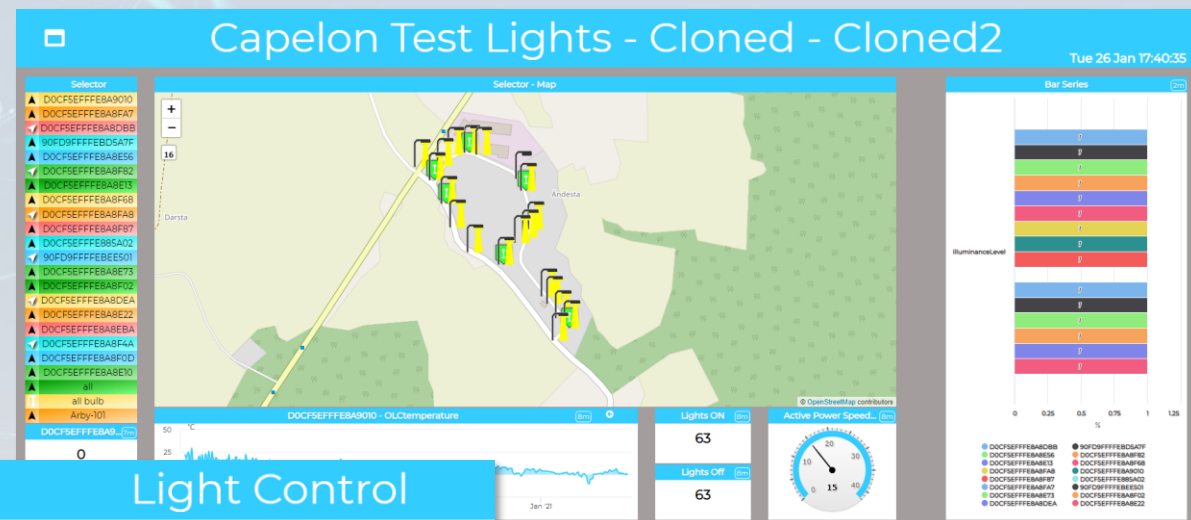
- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control

• Historical and Real Time data

• Services Exploited on:

- Multiple Levels, API
- Dashboards

• Since 2020

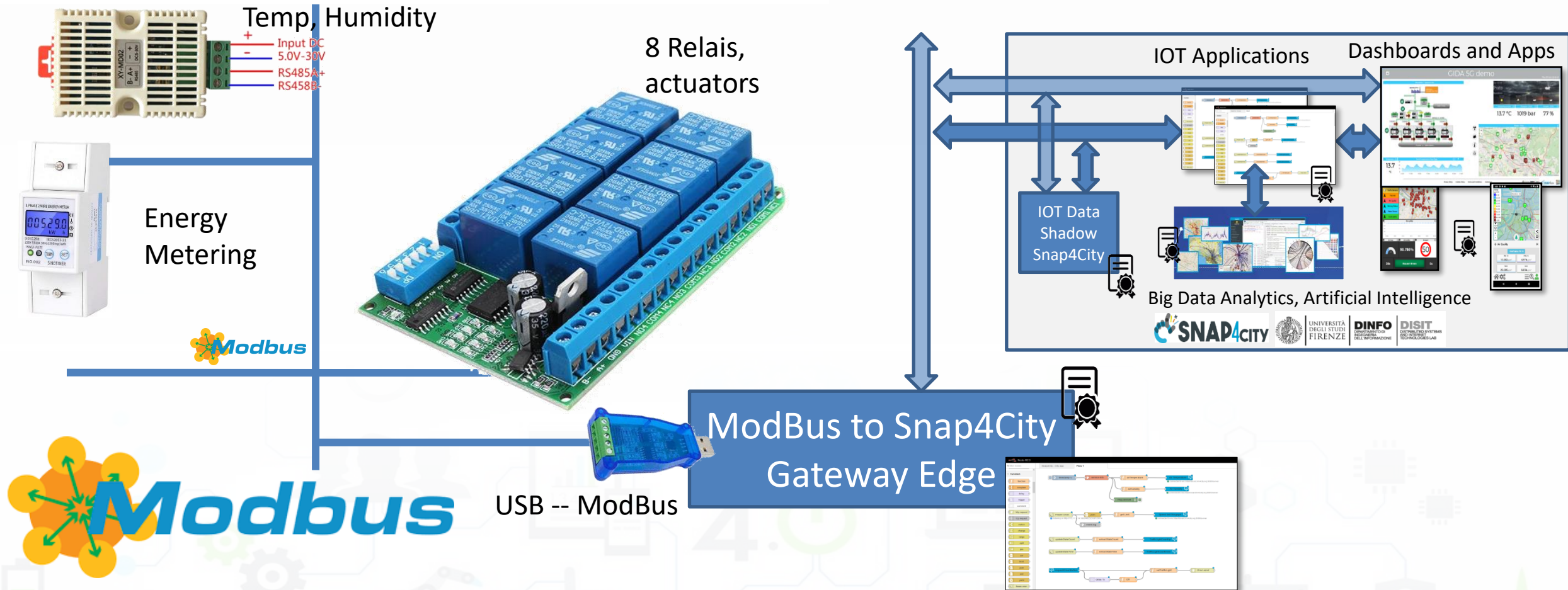


TOP

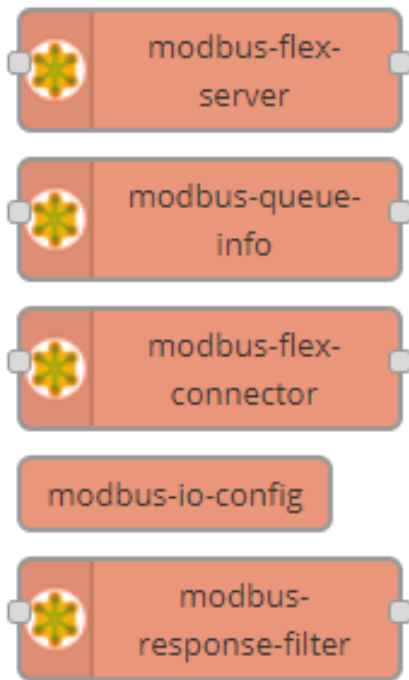
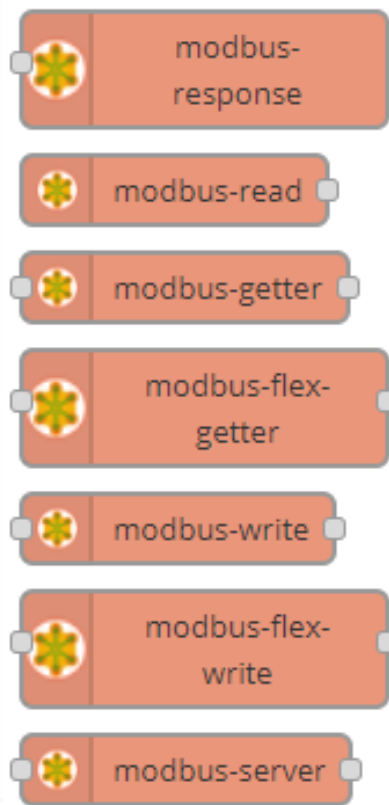
IoT App Smart Industry 4.0 ModBus Integration



Devices



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

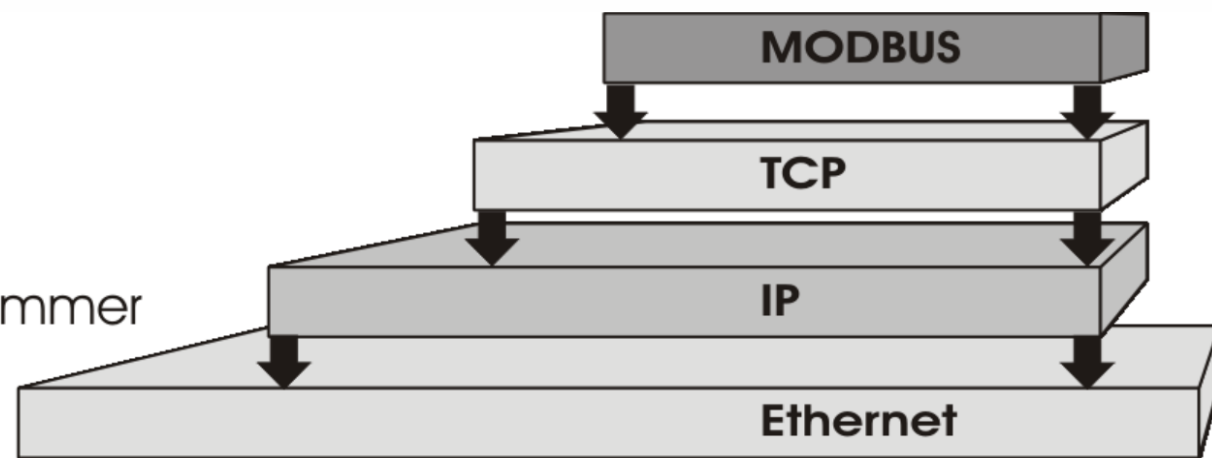


UNIT

PORT

TCP/IP Nummer

MAC ID

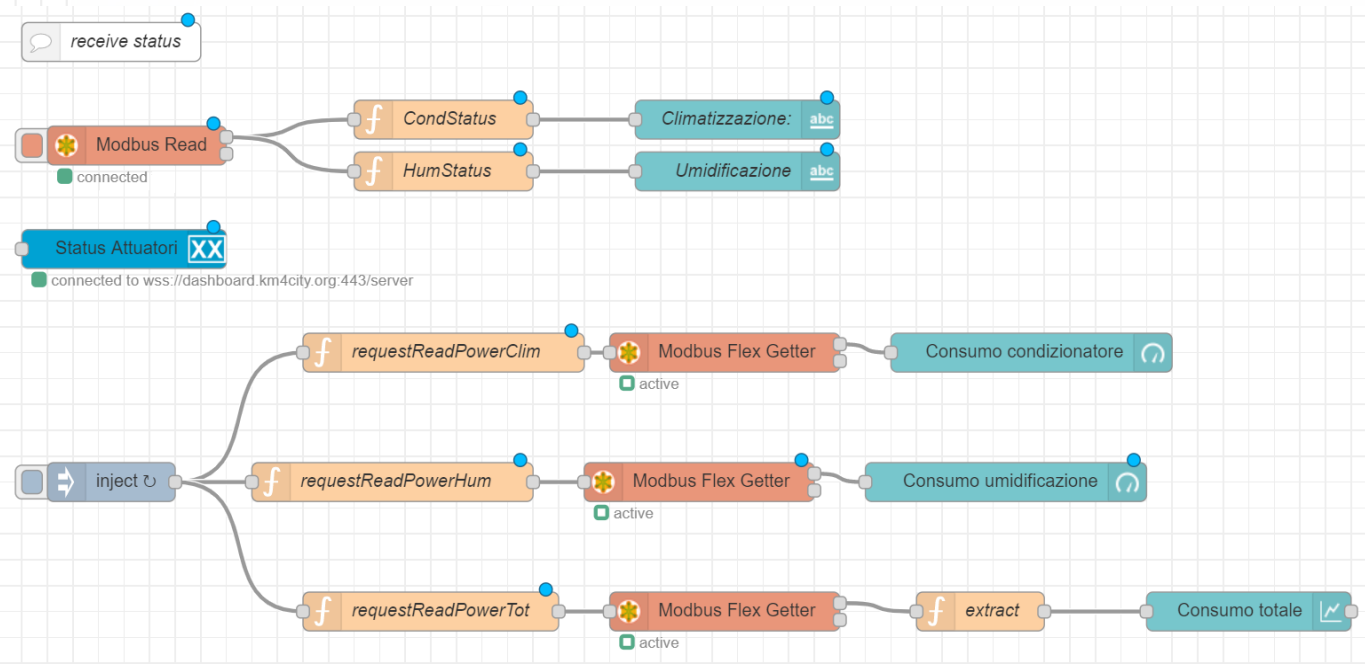
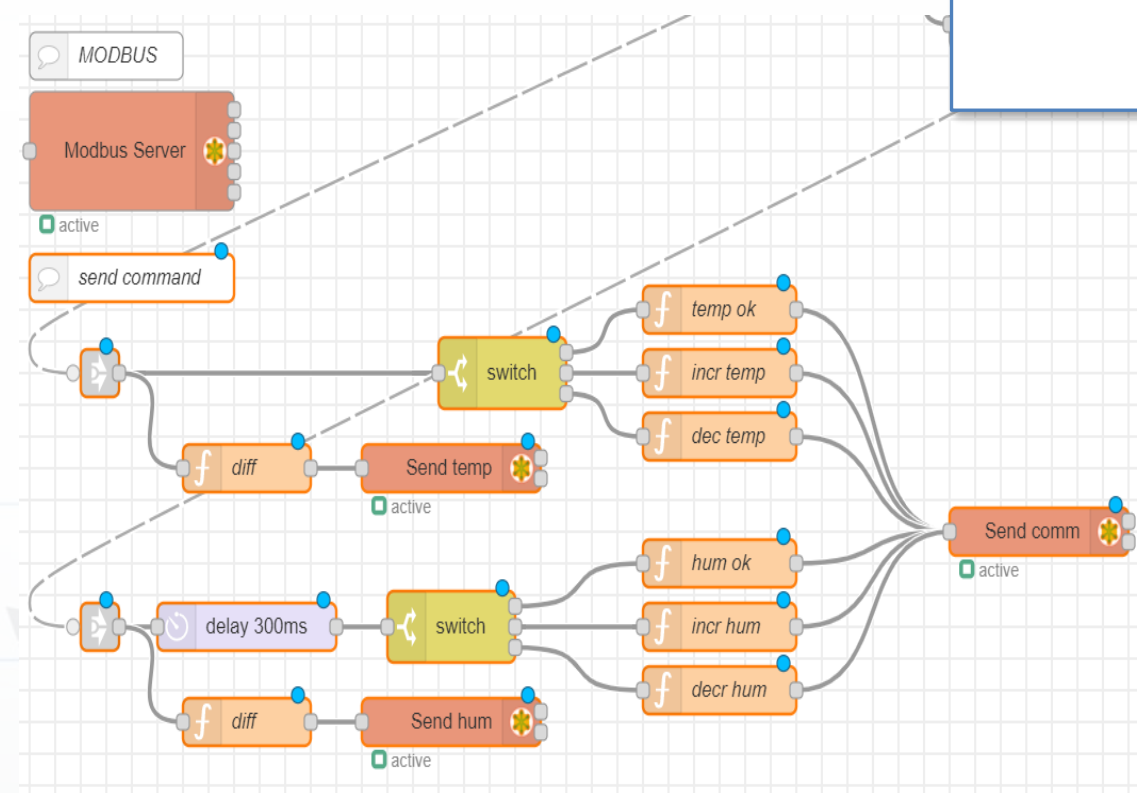
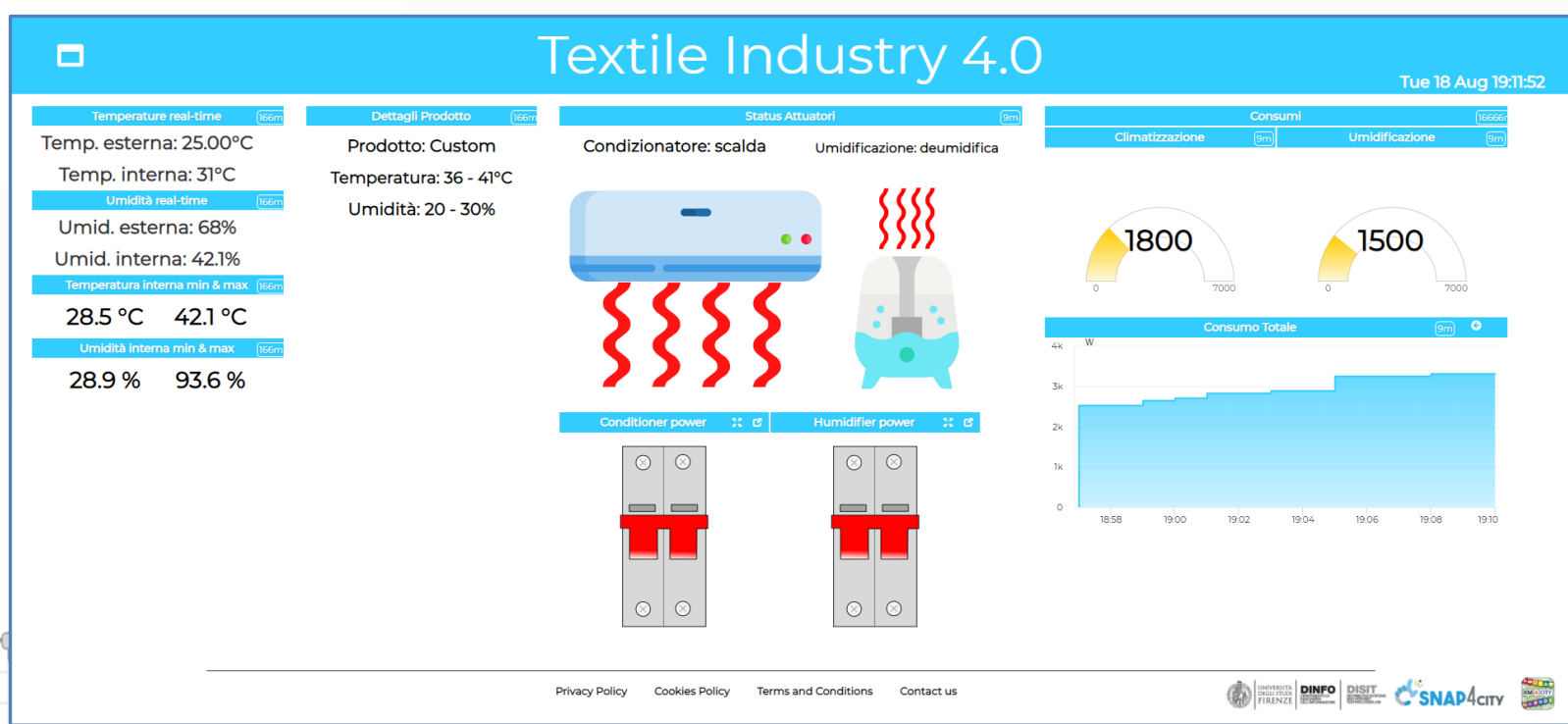




UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB



TOP

IoT App vs Smart Home Snap4Home





Snap4Home



Sonoff: Controlling Energy Power



Philips Hue: Controlling Lights



Hue: Motion Control / Alarm



Measuring
Energy Consumption



TP Link: Controlling / Measuring Energy Plugs



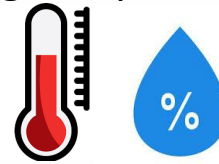
Alexa: Voice Control



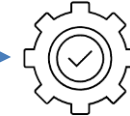
IOT Edge:
Raspberry
pi: Node-
RED +
Snap4City

Local Control

Measuring Temperature and Humidity



Controlling Motors



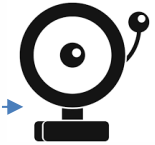
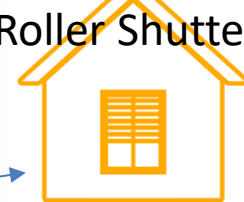
Controlling Irrigators



Garage Door



Window
Roller Shutters



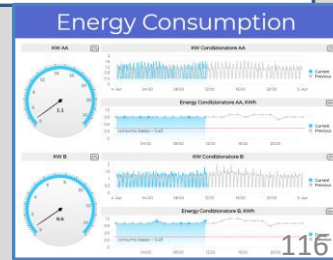
Alarm sound
and light

My house

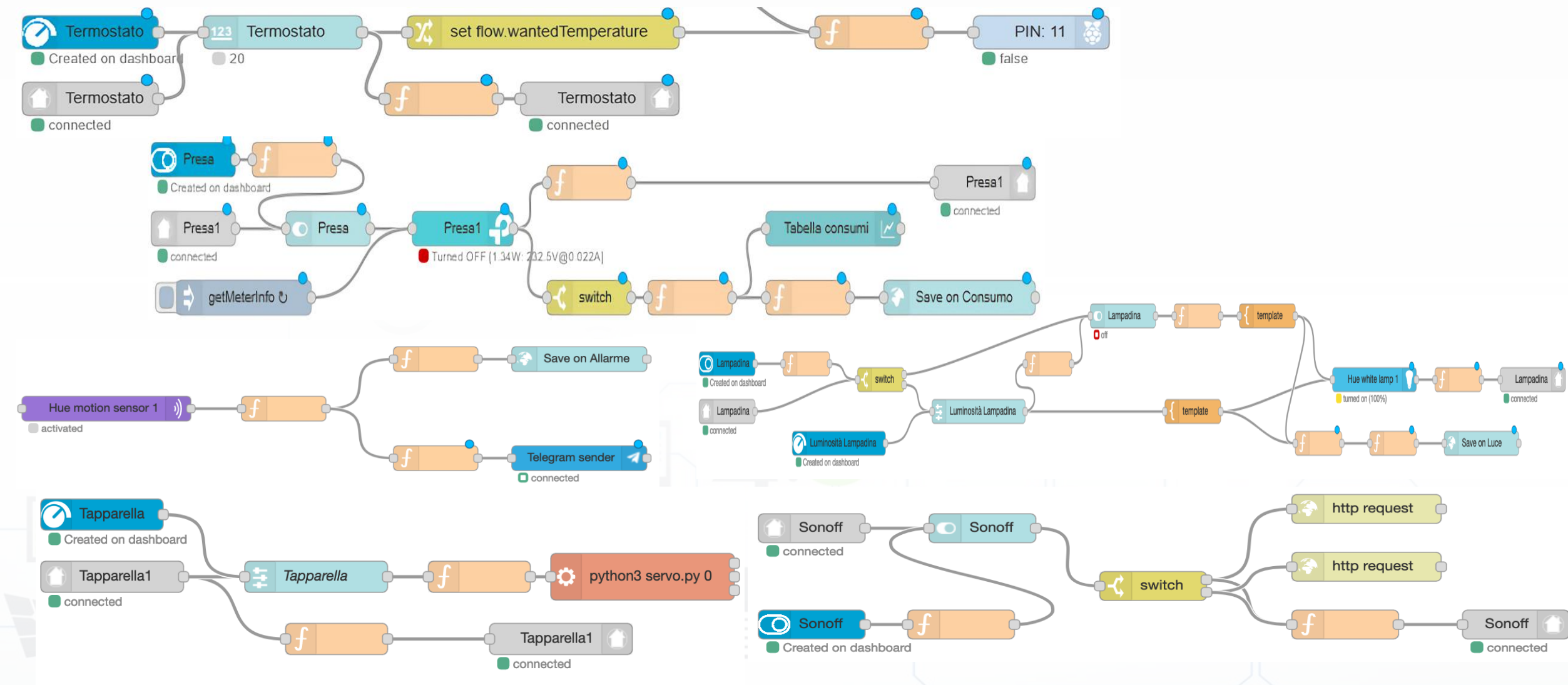
Living	Room1	Room2	Garden	Alexa	Garage	Windows
Plug1	Plug2	Plug3	Plug4			

SNAP4CITY

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



Example: IOT App on Snap4Home



Hue Hub



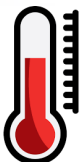
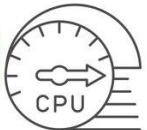
Motion Control / Alarm



TP Link
plugs:
meter



Alexa: Voice Control

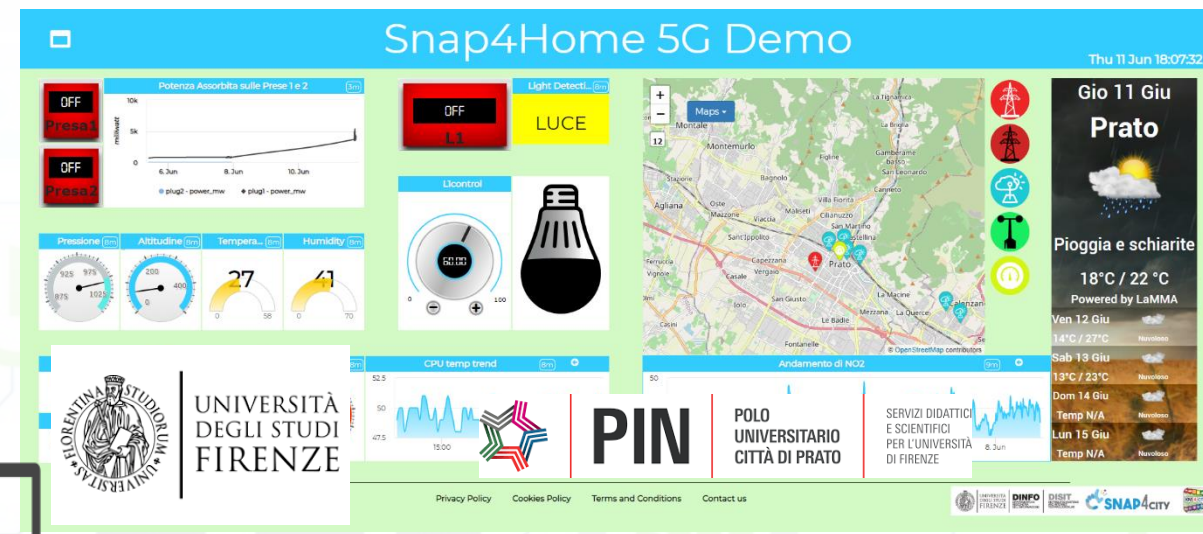
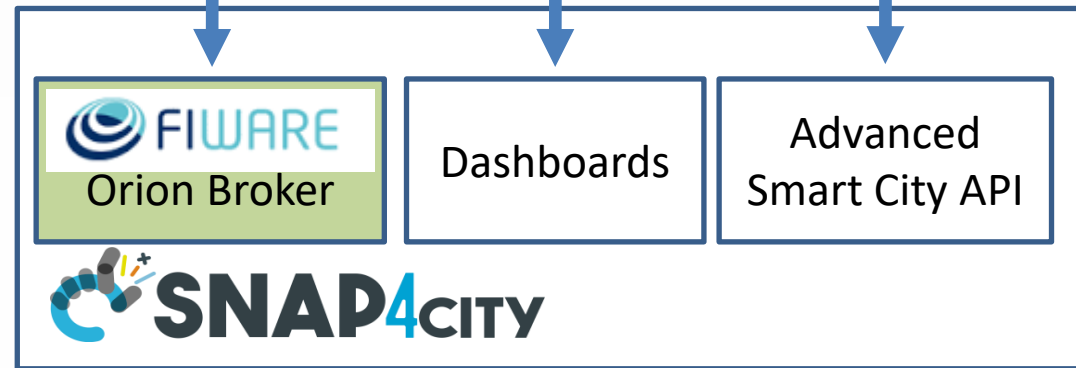


IOT Edge:

**Raspberry pi:
Node-RED
+
Snap4City
MicroService Library**

5G gateway

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



Philips Hue: Controlling Lights



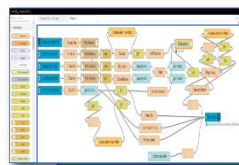
Hue: Motion Control / Alarm



TP Link: Controlling / Measuring Energy Plugs

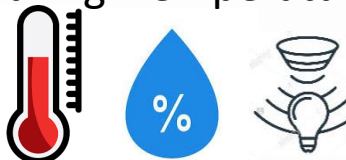


Alexa: Voice Control

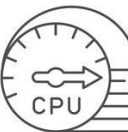


IOT Edge:
Raspberry
pi: Node-
RED +
Snap4City

Measuring: Temperature, Humidity, light in the room

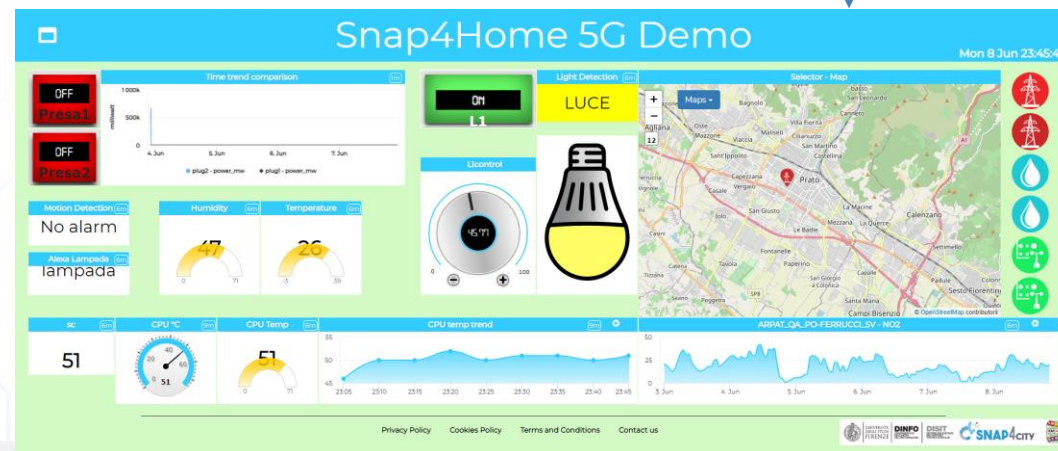


Monitoring: CPU clock, status



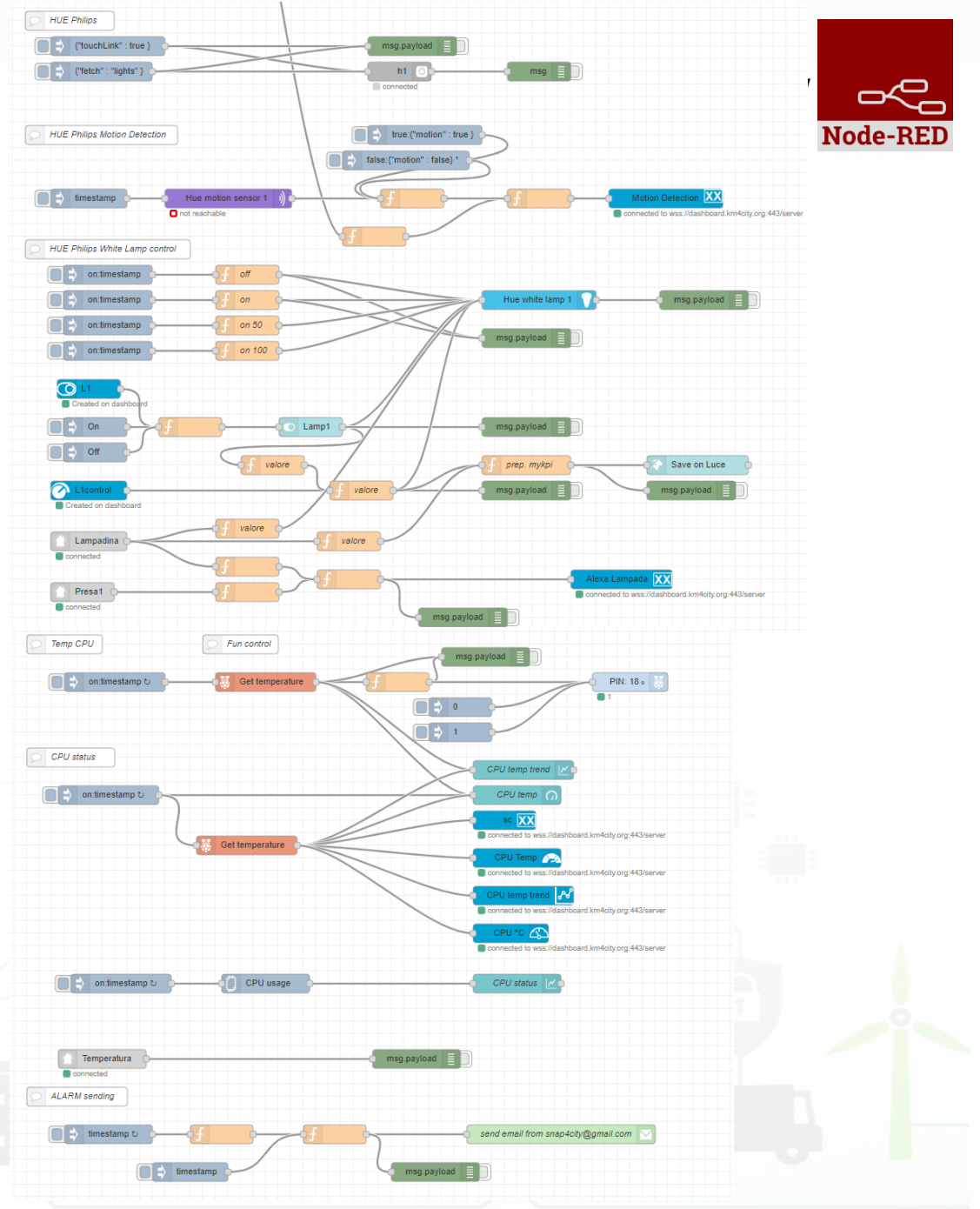
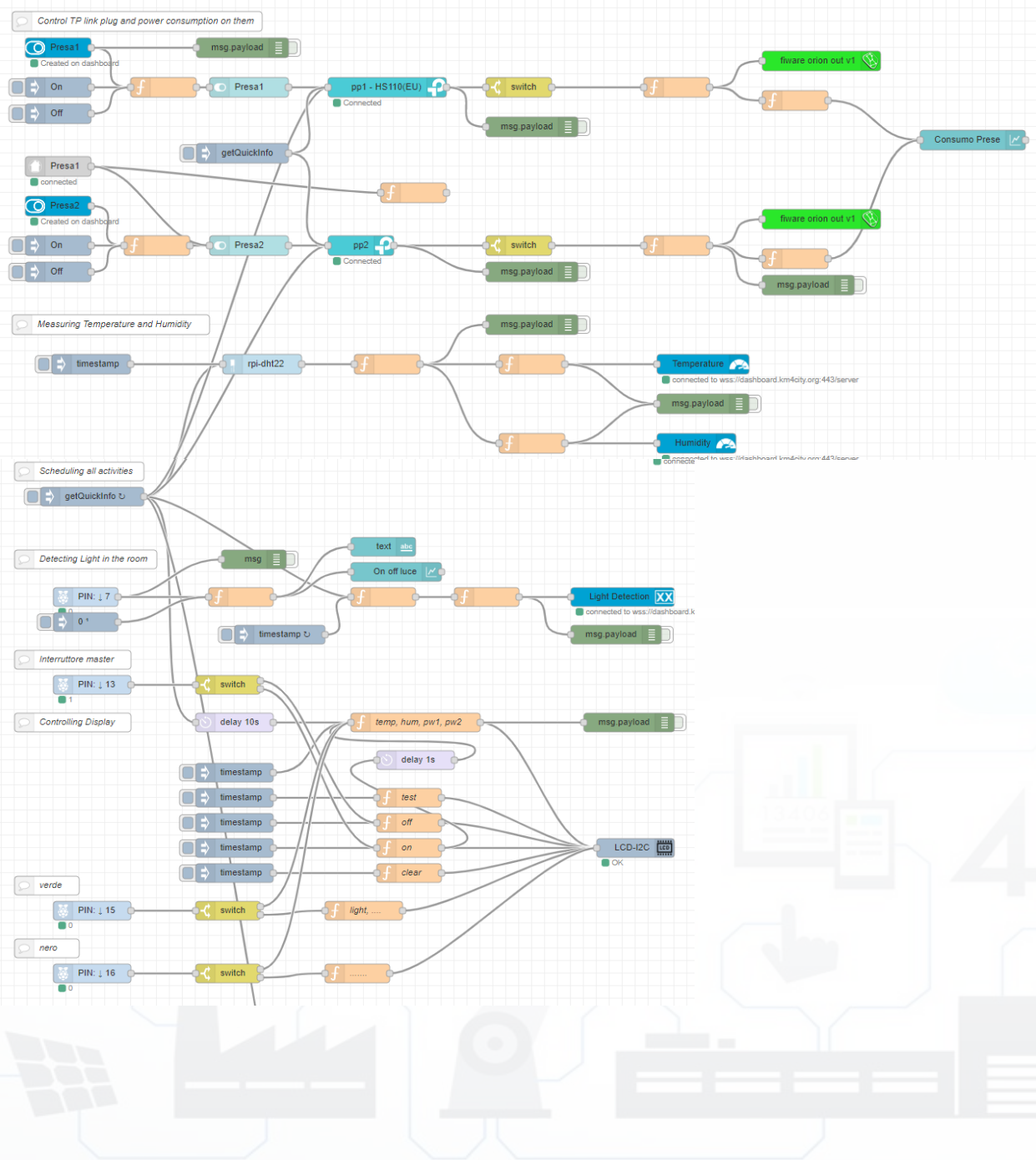
5G gateway

Internet



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





TOP

Moving IoT/WoT Entities, Tracking Devices



Working with Sensor Data from Moving Devices

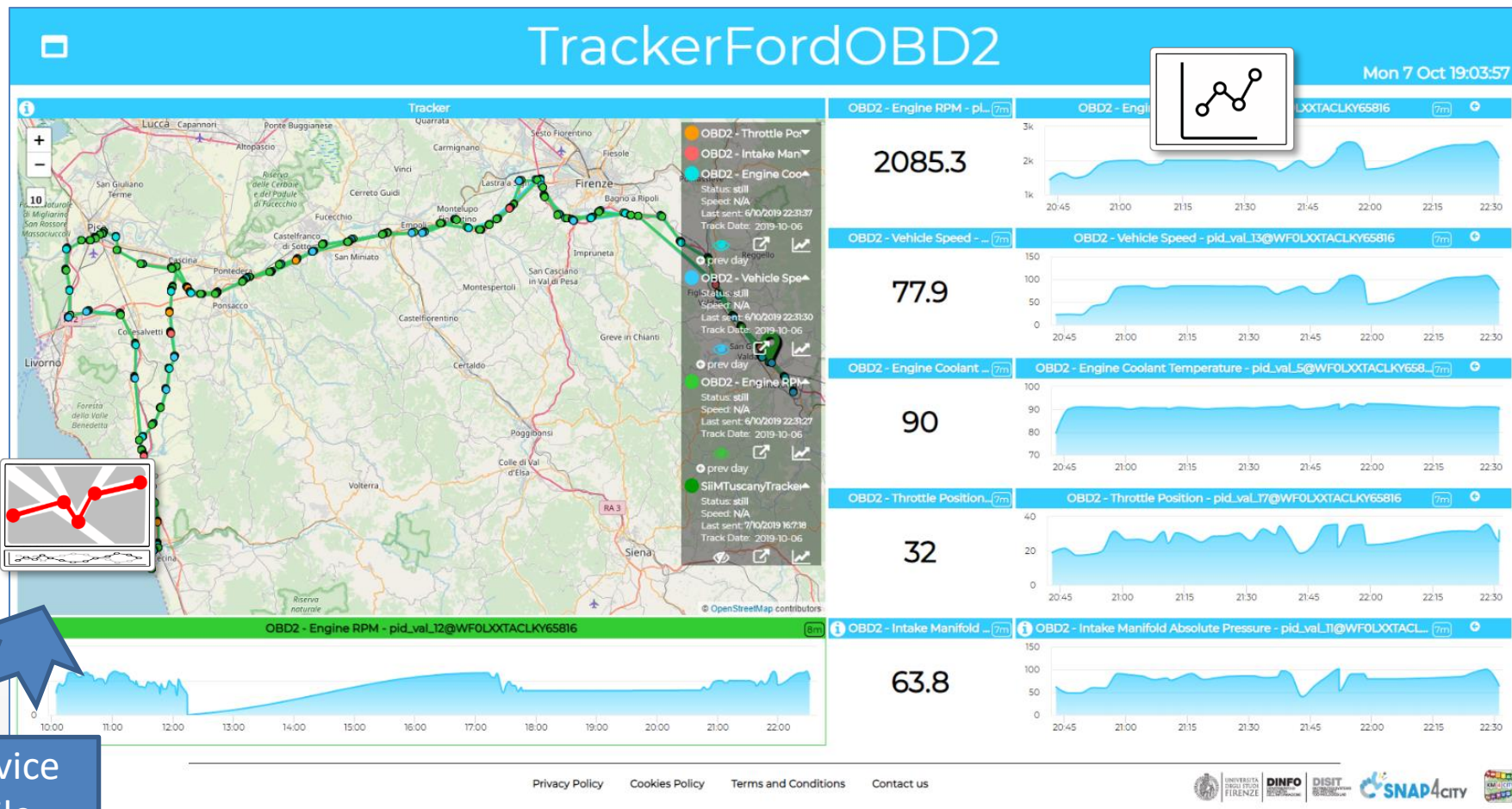
- Moving data can be collected by using:
 - **MyKPI:** in which each MyKPI has a ValueName, Unit, Type, etc.. And also GPS location
 - **IOT Device in Mobility:** which generates a new HLT SensorMobile

The screenshot shows the 'My Data, KPI, POI' interface. On the left is a navigation menu with 'My Data, KPI, POI' selected. The main area displays a table of KPIs with columns: No., High Level Type, Nature, Sub Nature, and Value Name. A modal window titled 'KPI Data Details' is open, showing fields like High Level Type (MyKPI), Nature (Environment), Sub Nature (Weather_sensor), Value Name (slider), Value Type (temperature), Value Unit (*C), Data Type (integer), Last Date (27/10/2020, 09:49:25), Last Value (43.18572617038263), Last Check, Username (paolo.disit), Organizations ([ou=DISIT,dc=ldap,dc=disit,dc=org]), Healthiness (false), Ownership (public), Description (Info), Latitude, Longitude, and Insert Time (27/10/2020, 09:49:25).

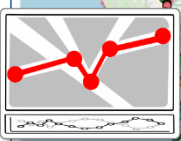
The screenshot shows the 'IOT Device Models' interface. On the left is a navigation menu with 'IOT Device Models' selected. The main area displays a table of device models with columns: Device Model, Device Type, Edit, and Delete. An 'Add New Model' modal window is open, showing tabs for General Info, IOT Broker, Static Attributes, and Values. The 'Device in Mobility' checkbox is checked, and the Subnature dropdown is set to 'Select an option'. The modal has 'Cancel' and 'Confirm' buttons.

MyKPI: Tracking of Devices and Mobiles

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



Apps



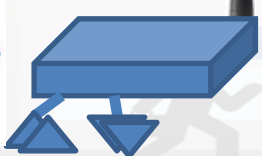
IOT Device
MOBILE



Mobile
PAX Counter



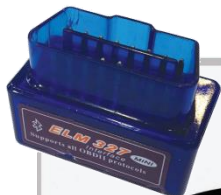
OBU



OBD2



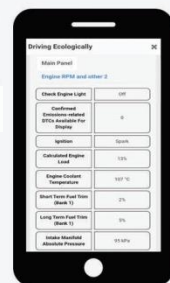
IOE – Vehicle Monitoring



CANBUS
sniffer

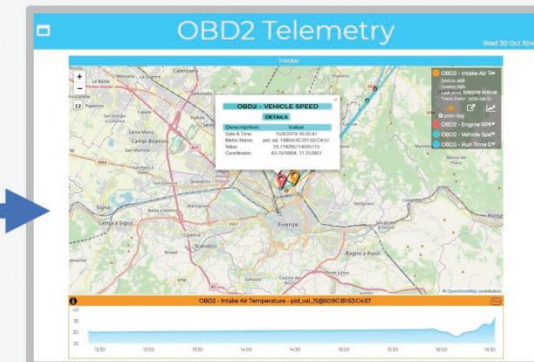


Bluetooth



My Data, KPI, POI

No.	High Level Type	Nature	Sub Nature	Value Name	Value Type	Data Type	Last Data	Last Value	Ownership	Username	Controls	Data	Visibility
17057177	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13@C13C544407252367	integer	2/10/2019, 15:26:00	0	private	badiantberg	YES	VALUES	DELEGATED
17057156	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13@C13C544407252367	integer	2/10/2019, 12:58:55	0	private	badihelinski	YES	VALUES	DELEGATED
17057137	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13@C13C544407252367	integer	23/10/2019, 15:49:04	126	private	badi toscana	YES	VALUES	DELEGATED
17055990	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_val_13@WBA3410001283814	integer	5/10/2019, 15:36:02	10,75	private	paolotot2	YES	VALUES	DELEGATED
17055958	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13@WFL0X0TACLXV65816	integer	19/10/2019, 19:17:31	100	public	badi toscana	YES	VALUES	DELEGATED



Tuscany in a Snap Mobile App on Android



Driving Ecologically

Main Panel

Engine RPM and other 2

Check Engine Light	Off
Confirmed Emissions-related DTCs Available For Display	0
Ignition	Spark
Calculated Engine Load	13%
Engine Coolant Temperature	107 °C
Short Term Fuel Trim (Bank 1)	2%
Long Term Fuel Trim (Bank 1)	5%
Intake Manifold Absolute Pressure	95 kPa

TrackerFordOBD2

Tue 29 Oct 18:34:02

Tracker - Trend

OBD2 - Throttle Pos. (%)	2353
OBD2 - Intake Manifold Absolute Pressure (kPa)	100
OBD2 - Engine Coolant Temperature (°C)	92
OBD2 - Throttle Position (%)	32
OBD2 - Intake Manifold Absolute Pressure (kPa)	63.8

Footer: Privacy Policy, Cookies Policy, Terms and Conditions, Contact us

TOP

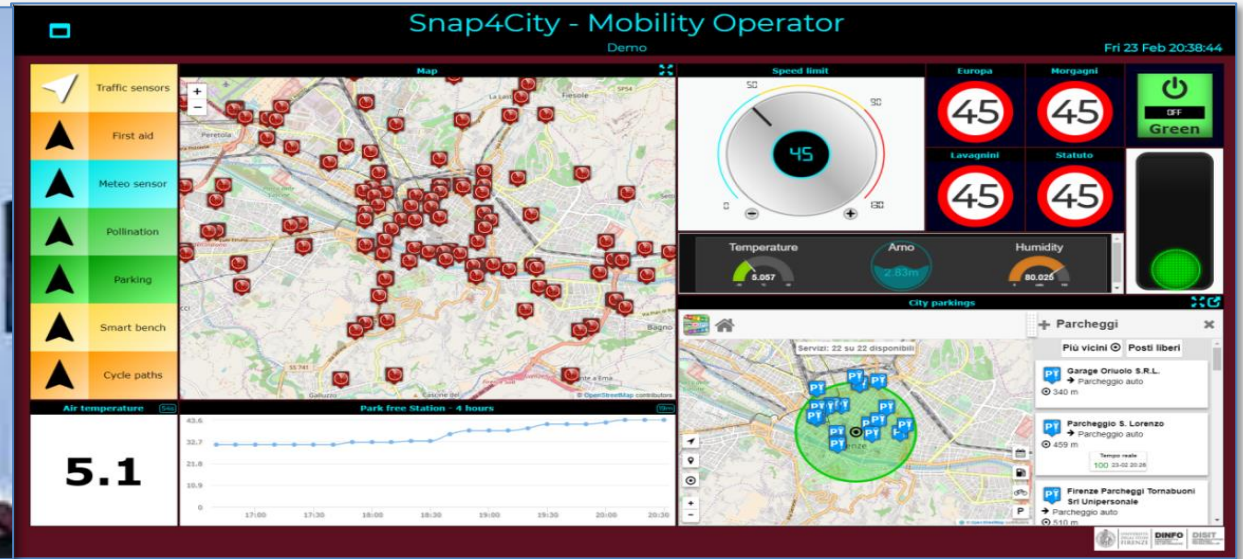
IOT App vs Smart City Solutions



Control Room Operator

Would like to:

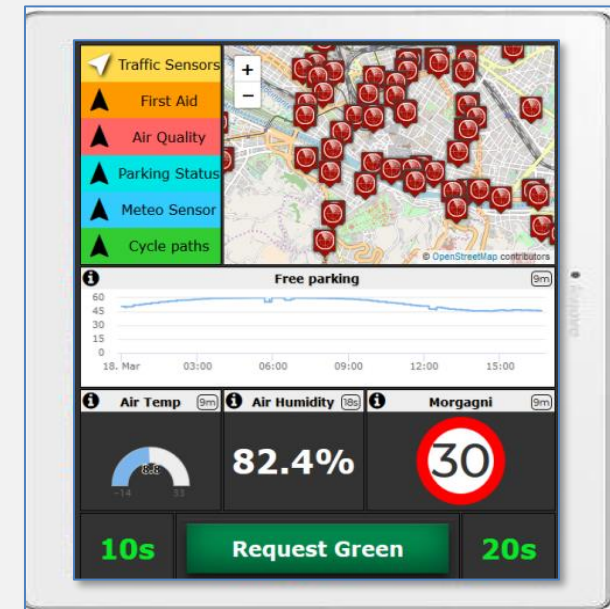
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., ..
- **Act and** monitor Dynamic Plates
- **Act and** monitor red lights



Driver, Policeman

Would like to:

- Monitor traffic, Parking, traffic events, speed limit, ...
- **Act and** monitor red lights



Traffic Sensors

- First Aid
- Air Quality
- Parking Status
- Meteo Sensor
- Cycle paths

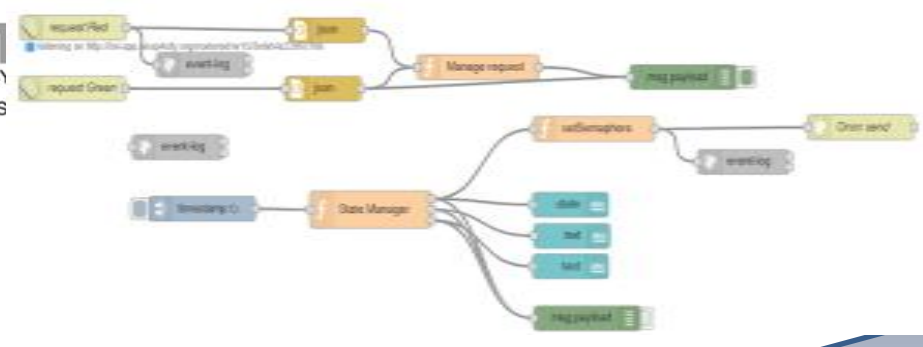
Free parking

Air Temp 8.8°C

Air Humidity 82.4%

Morgagni 30

10s **Request Green** **20s**



Snap4City - Mobility Operator

Map

Speed limit 45

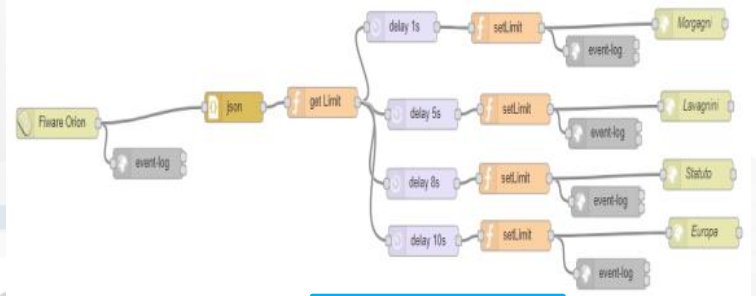
Temperature 5.057

Humidity 80.02%

City parkings

Parcheggi

5.1

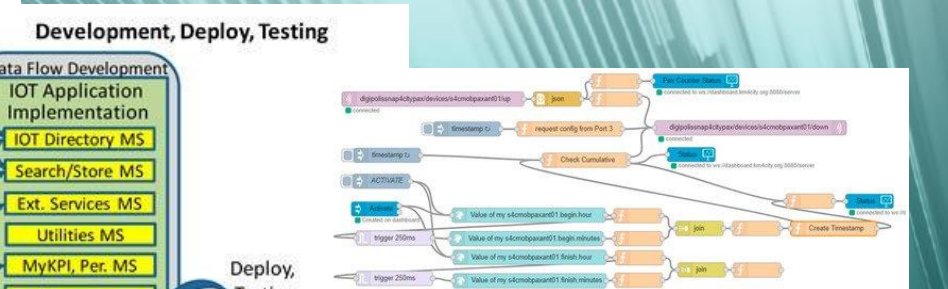
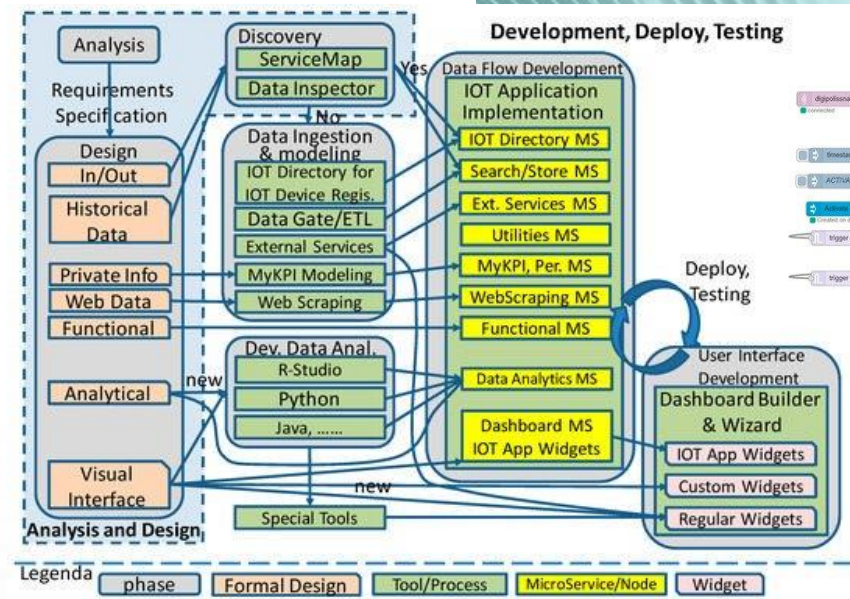


MicroServices Suite for Smart City

- Badii, C.; Bellini, P.; Difino, A.; Nesi, P.; Pantaleo, G.; Paolucci, M. MicroServices Suite for Smart City Applications.

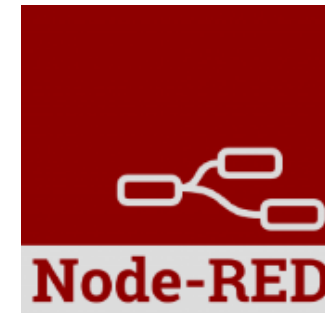
- *Sensors* **2019**, *19*, 4798.

- <https://www.mdpi.com/1424-8220/19/21/4798/pdf>



IoT App / Proc.Logic

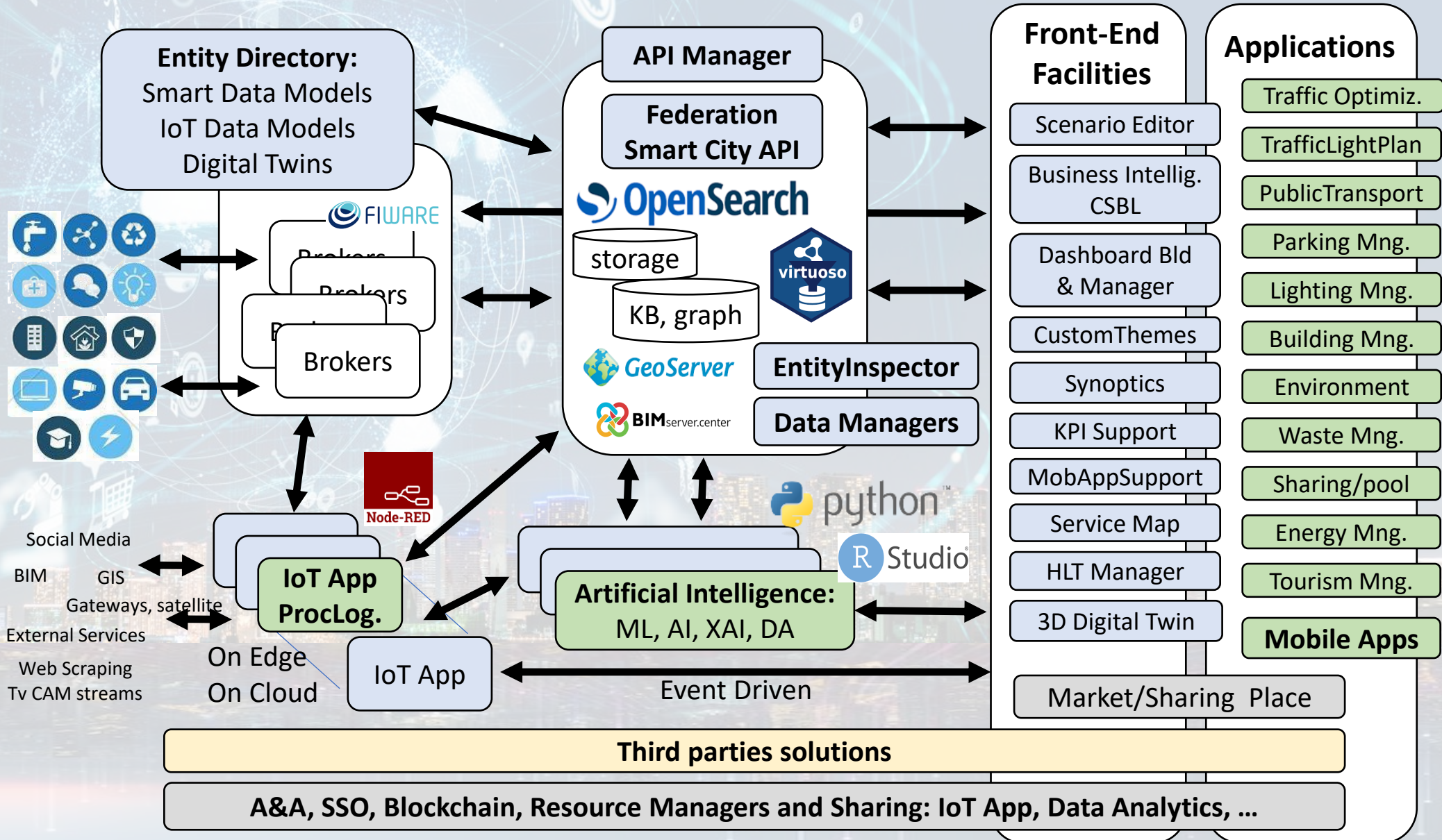
- Storage → IoT App / Proc.Logic
- External Service ↔ IoT App / Proc.Logic
- Dashboards ↔ IoT App / Proc.Logic



- Data Analytics ↔ IoT App / Proc.Logic **Part 4**
- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic
- IoT App / Proc.Logic → Storage

Part 5

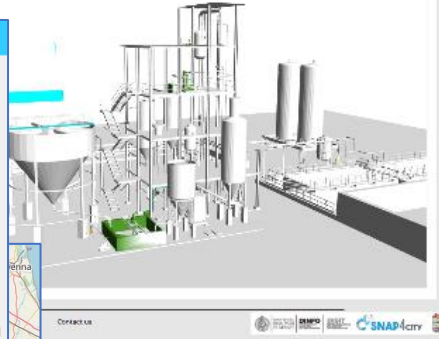
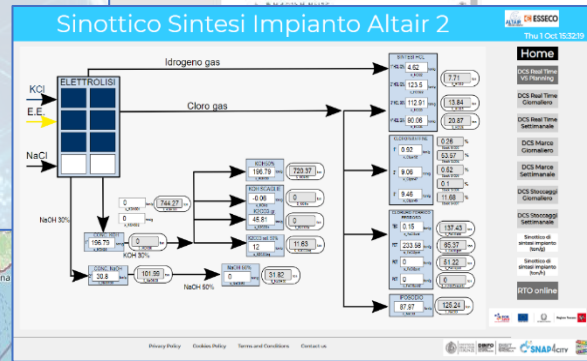
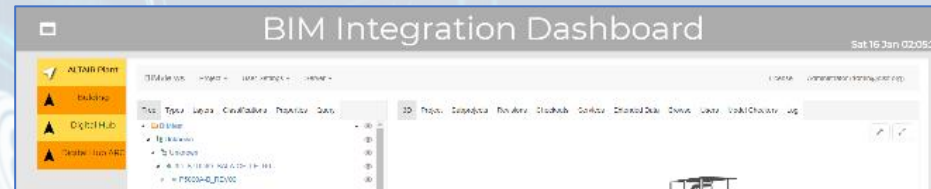
Technical Architecture



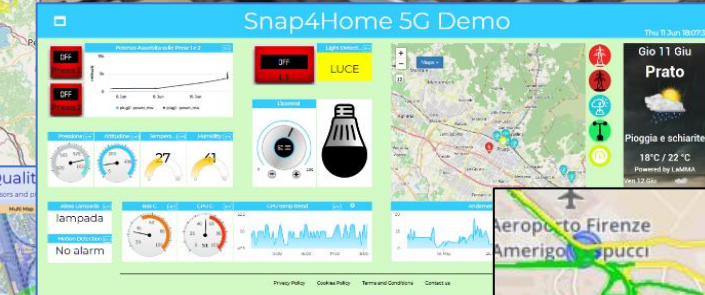
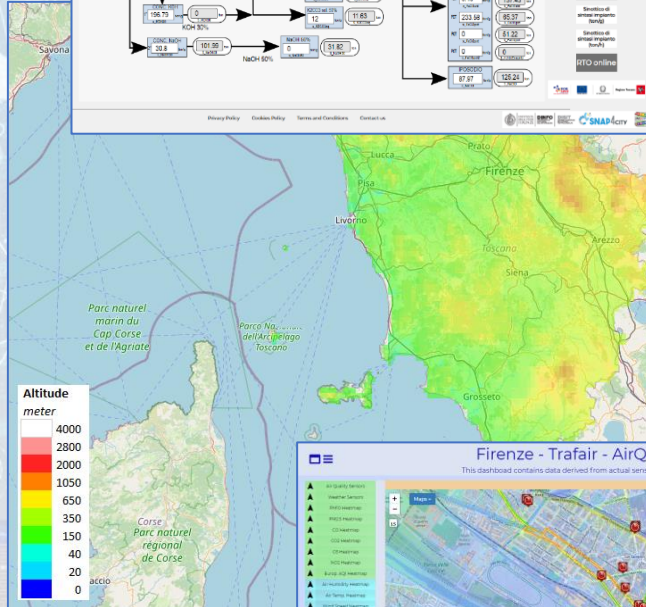
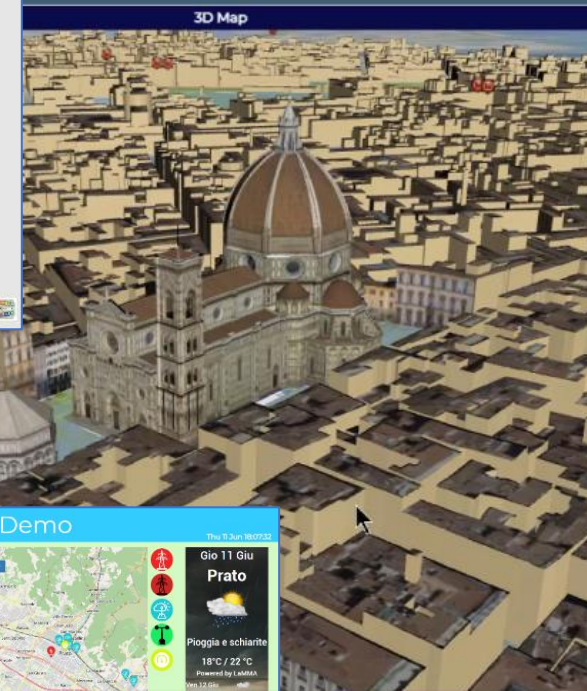
High Level Types

Snap4City (C), Sept. 2024

- 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.



SNAP4CITY
- Digital Twin Global - Fire
demonstrator



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

- **For PUBLIC:**
 - IOT Devices,
 - Sensors,
 - Sensor mobile,
 - Actuators,
 - Virtual Sensors,
 - POI, etc.
- See as
 - ServiceURI

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
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 Stop -

Position of selected Buses

Actual Selection
Service: IBIMET Air Quality Sensor - BORGIO SAN LORENZO

IBIMET Air Quality Sensor - BORGIO SAN LORENZO

Name: IBIMET_SMART01
Nature: Environment
Subnature: Air_quality_monitoring_station
Address: BORGIO SAN LORENZO
City: FIRENZE

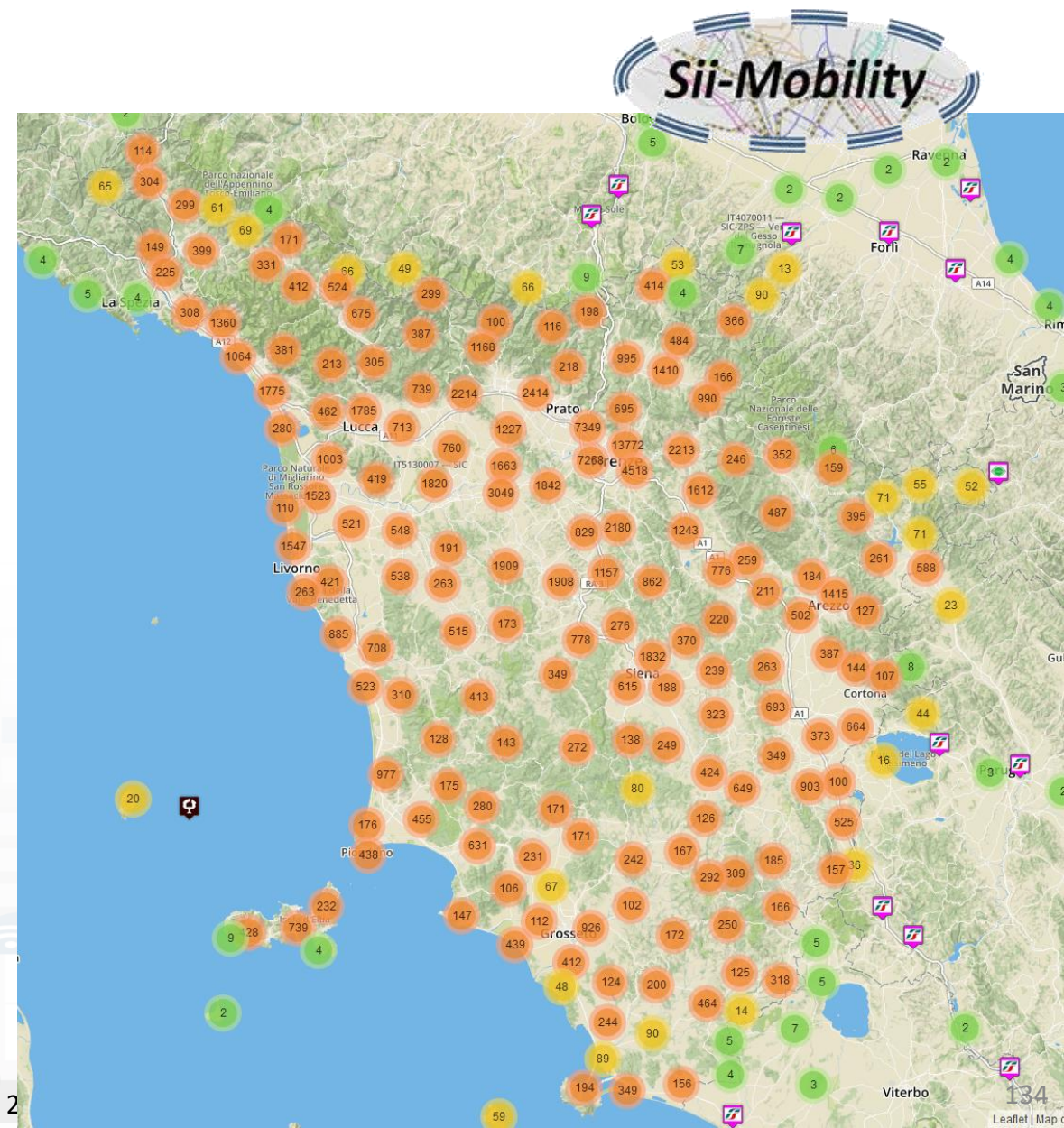
Property/Value Type	Value
PM10	2.4131048386898826
PM2_5	19.236197270630925
CO	0.22832953110492907
CO2	391.00
NO	
NO2	25.268744995957327
O3	128.39966613043157
airTemperature	18.60
airHumidity	73.60

Latest Update: 2020-10-26T17:46:50+0

ServiceURI: http://www.disit.org/km4city/resource/IBIMET_SMART01

ServiceURI: http://www.disit.org/km4city/resource/IBIMET_SMART01

- **Street and geoinformation of the territory and details for routing, navigation, ...**
- **GeoResolution, Environmental data**
- **Mobility and Transport:** public and private, public transport, parking status, fuel stations prices, traffic sensors, etc.
- **Culture and Tourism:** POI, churches, museum, schools, university, theatres, events in Florence
- **Environmental:** pollution real time, weather forecast, etc.
 - Environmental data geo resolution
- **Social Media:** twitter data
- **Health:** hospital, pharmacies, status of the first aid triage in major hospitals, ...
- **Alarms:** civil protection alerts, hot areas, ...



Concepts of Services: Macro and subcategory

A SKOS area into the Km4City Ontology and Knowledge base for modeling POI and any element on map

Regular Services | Transversal Services

Services Categories

- De/Select All
- Accommodation** +
- Advertising** +
- AgricultureAndLivestock** +
- CivilAndEditEngineering** -
- Architectural_consulting
- Building_construction
- Cartographers
- Civil_engineering
- Engineering_consulting
- Other_specialized_construction
- Specialized_construction
- Surveyor
- Technical_consultants
- CulturalActivity** +
- EducationAndResearch** +
- Emergency** +
- Entertainment** +
- Environment** +
- FinancialService** +
- GovernmentOffice** +
- HealthCare** +
- IndustryAndManufacturing** +
- MiningAndQuarrying** +
- ShoppingAndService** +
- TourismService** +
- TransferServiceAndRenting** +
- UtilitiesAndSupply** +
- Wholesale** +
- WineAndFood** +

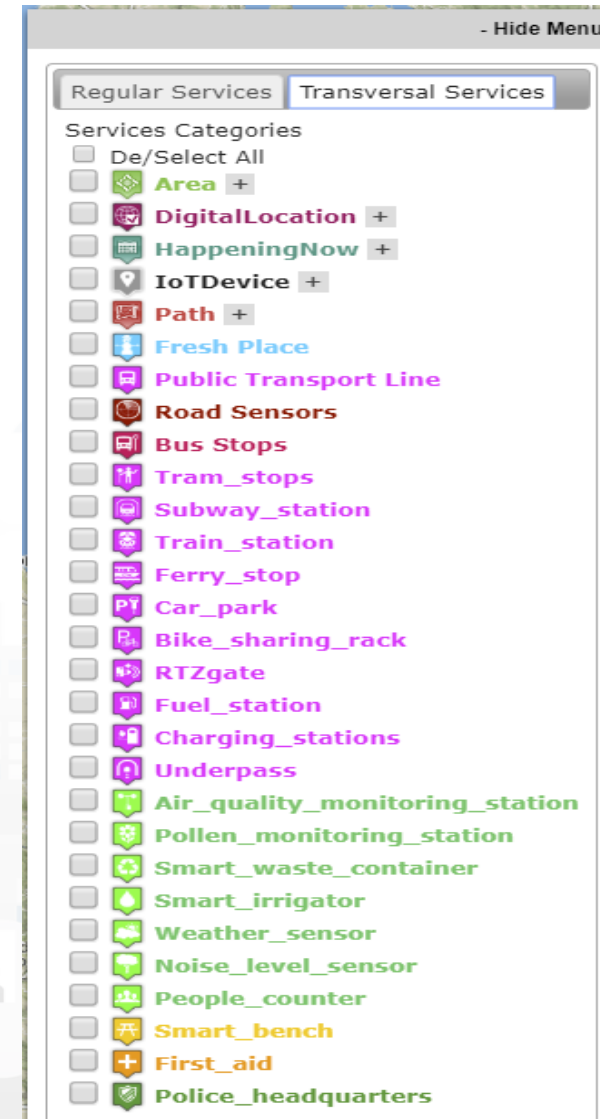
20 Service Macro Classes (The Nature)

Service subClasses (the SubNature)

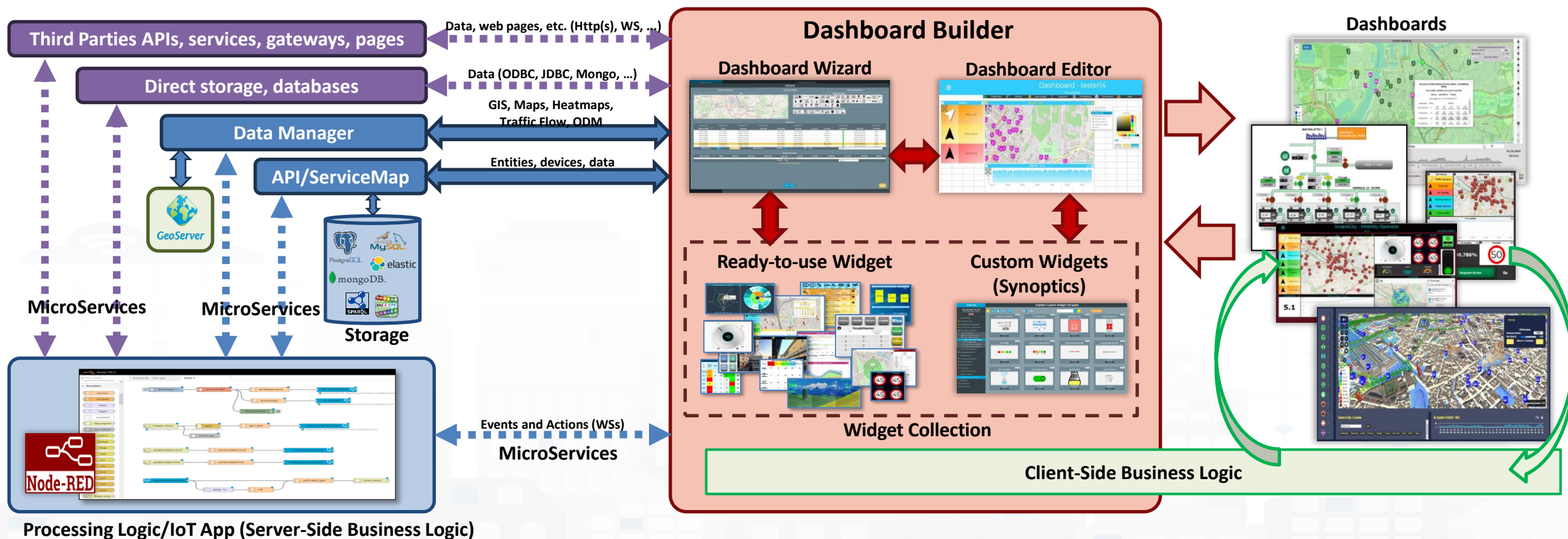
- Accommodation** -
- Agritourism
- Beach_resort
- Bed_and_breakfast
- Boarding_house
- Camping
- Day_care_centre
- Farm_house
- Historic_residence

Access to Entities

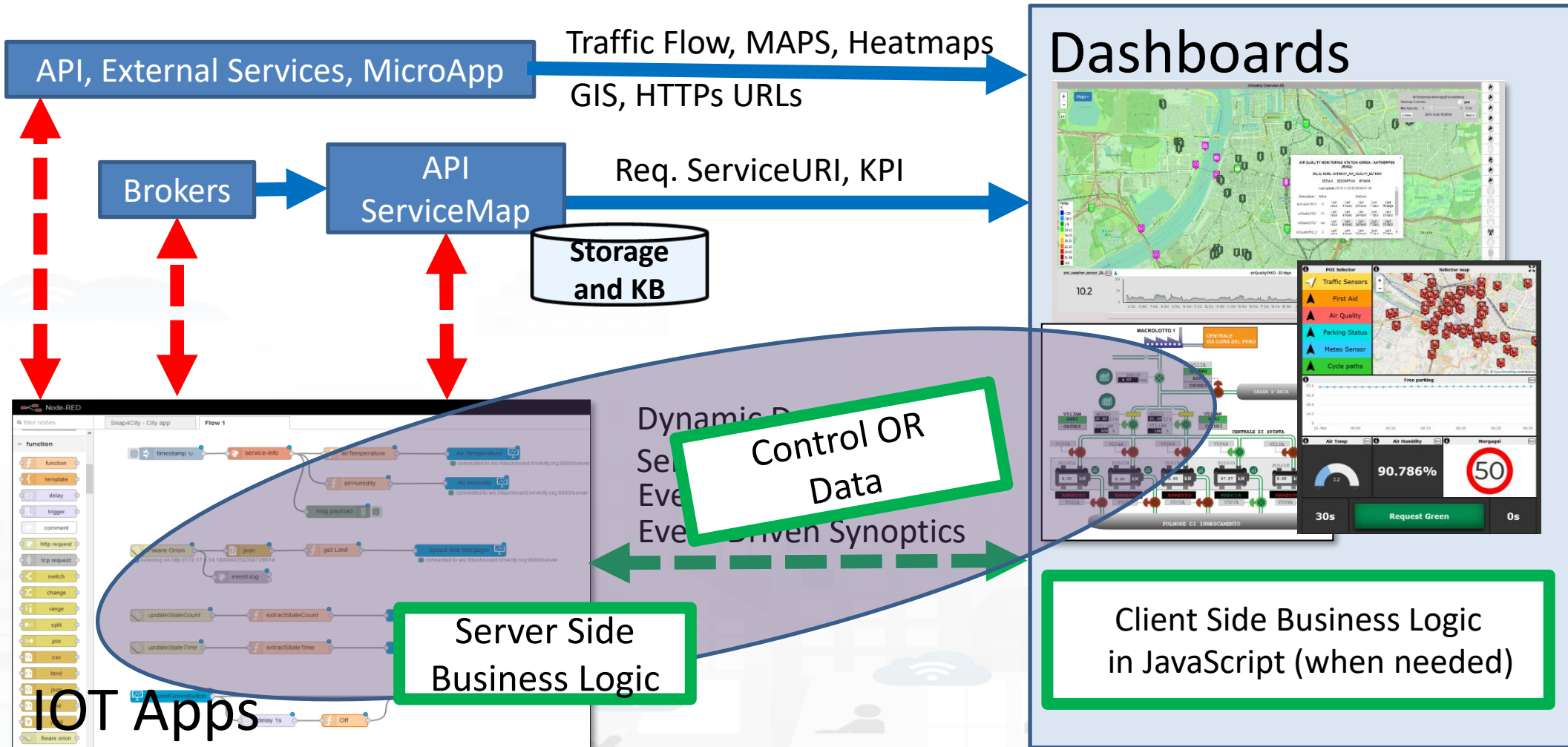
- IoT, POI, etc.
- **Classify**: macro (nature) and subcategories (subnature)
- **Position**: GPS, address, telephone, fax, email, URL, ...
- **Description**: textual, multilingual, with images, ...
- **Link** to dbPedia, Linked Open Data
- **Links to other services**
- **ActionURL**: links to actions on data (open, edit, show, etc.)
- **Real time data if any**: 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



How the Dashboards exchange data



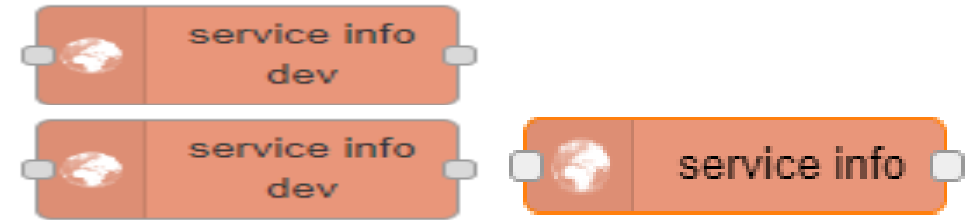
How the Dashboards exchange data



S4CUtility



- ANY kind of sensors
- To Get DATA of a Service / POI /sensor
 - Historical and real time
 - Real Time



Loggia San Paolo

LINKED OPEN GRAPH

Tipology: CulturalActivity - Monument_location

Digital Location

Address: VIA DELLA SCALA, 3

Cap: 50123

City: FIRENZE

Prov.: FI

Photos:

Description: The rounded arches, the stone skeleton and the glazed terracotta medallions recall the model of the Loggiato degli Innocenti. The medallions in glazed terracotta by Andrea della Robbia and his sons Marco and Luca contain seven polychrome figures of Santi Francescani and two works of mercy Cristo conforta un Giovane and Cristo conforta un Anziano. Beneath the portico can be admired the expressive embrace between San Domenico Guzman and San Francesco d Assisi by Andrea della Robbia

TPL STOP : Piazza Stazione (Fr. Cc)

Vaibus

LINKED OPEN GRAPH

Lines:

FI-LU FI-VG

No available routes

Display 50 Bus per page

Search:

Time	Line	Direction
08:46:00 2017-03-20	FI-LU	Piazzale Verdi
08:16:00 2017-03-20	FI-LU	Piazzale Verdi
10:09:00 2017-03-20	FI-LU	Piazzale Verdi
11:09:00 2017-03-20	FI-LU	Piazzale Verdi
12:16:00 2017-03-20	FI-LU	Piazzale Verdi
13:16:00 2017-03-20	FI-LU	Piazzale Verdi

Showing page 1 of 1

Real-time data currently not available

AURORA

LINKED OPEN GRAPH

Tipology: Accommodation - Hotel

Email: info@hotelaurora.info

Website: www.hotelaurora.info

Phone: 055210283

Address: VIA L. ALAMANNI, 5

Cap: 50100

City: FIRENZE

Prov.: FI

Giardino di piazza dell'Indipendenza

LINKED OPEN GRAPH

Tipology: Entertainment - Green_areas

Digital Location

Address: PIAZZA DELLA INDIPENDENZA, 15

Cap: 50129

City: FIRENZE

Prov.: FI

Note: areeeverdi238

Remove from map

ZCS_1_D

LINKED OPEN GRAPH

Tipology: TransferServiceAndRenting - Controlled_parking_zone

Digital Location

Address: VIA GUSCIANA

Cap: 50124

City: FIRENZE

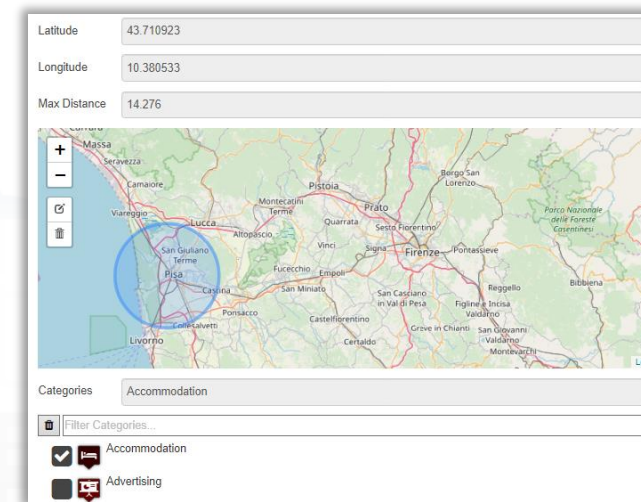
Prov.: FI

Remove from map

Smart City Entities Search

Simple and Fast

- **For example to search for:**
 - POIs:
 - near a GPS position, from text, along a path, in an area, etc..
 - Public Transport information / data
 - Suggestions
 - Public Transport Means Routes/Paths
 - Events in the area
 - Value Type (kind of data)
 - Etc.
- **To Get DATA of a Service / POI /sensor**
 - Real Time
 - ANY kind of sensors



▼ S4C Search

service search near marker	event search near marker	tpl agencies
service search within circle	event search within circle	tpl lines
service search within polygon	event search within polygon	tpl routes by agency
service search along path	event search along path	tpl routes by line
service info	event search usr	tpl stops by route
full text search near marker	address search near marker	tpl stop timeline
full text search within circle	geometry search near marker	recommendati within circle
full text search within polygon	address poi search by text near marker	value type search near marker
full text search along path	address poi search by text within circle	value type search within circle
full text search usr	bus routes search near marker	value type search within polygon
	bus routes search within circle	value type search along path
	bus routes search within polygon	



IOT Discovery on IOT Application Development

Node-RED interface showing a flow for processing temperature data. The flow includes nodes for timestamp, Celsius temperature, Fahrenheit temperature, JSON, http request, temp3010, Fiware Orion Query, aggregator, and convert temp. The debug console shows incoming MQTT messages with temperature values.

Device-based search interface showing a map of the Florence area with a blue location pin. Below the map is a table of aggregated device types.

Name	Type	Context-Broker
ARDUINO_ST_4203	Light	orionUNIMI
ARDUINO_ST_4204	Motion_Detection	orionUNIMI
ARDUINO_ST_4205	Sound_LV	orionUNIMI
ARDUINO_ST_4207	Presence_Detection_E	orionUNIMI
ARDUINO_ST_4212	Power_Meter_M	orionUNIMI
ARDUINO_ST_4213	Power_Meter_S	orionUNIMI

Node-RED interface showing the 'Edit device-registration node' dialog. It includes a map of the Florence area and fields for Device Name, Model, and two keys.

Device Name:

Model: Raspberry snap4city 1

Key 1*: 3568dcdf-3167-4ee7-ac05-91d3a9668cb8

Key 2*: 5e26b980-402e-4853-9edc-664e025254c8

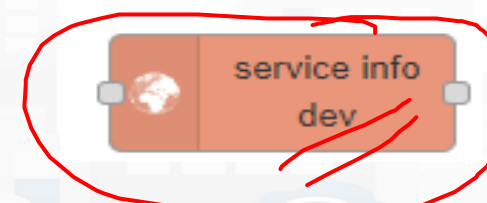
These keys have been generated automatically for your device. Keep track of them. Details on [info](#)

Smart City Entities Advanced Search

Flexibility

- Similar to basic Search functions but with more flexibility of the function for programming the search
- Adding Dynamic behavior:
 - Getting in input JSON with parameters
- **To Get DATA of a Service / POI /sensor**
 - Historical and real time
 - ANY kind of sensors

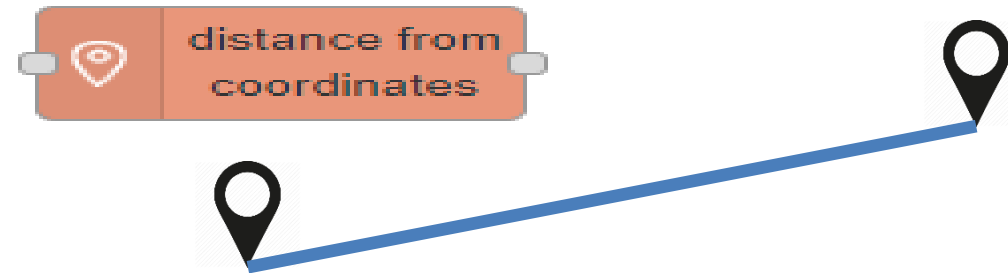
Latitude	<input type="text" value="0"/>
Longitude	<input type="text" value="0"/>
Categories	<input type="text" value="Categories"/>
Max Distance (in km)	<input type="text" value="1"/>
Max Results (0 for all Results)	<input type="text" value="100"/>
Geometry	<input type="checkbox"/>
Language	<input type="text" value=""/>



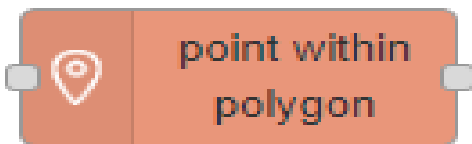
▼ S4CSearchDev

service search	full text search dev	address geometry search near gps position
service search near gps position	full text search within wkt area	address search near gps position
service search near service	full text search within gps area	geometry search near gps position
service search within gps area	full text search near gps position	address poi search by text
service search within wkt area	full text search exp	address poi search by text exp
service search within stored wkt area	event search dev	address poi search by text near gps position
service search by municipality	event search exp	bus routes search
service search by queryid	event search within wkt area	bus routes search near gps position
service info dev	event search within gps area	bus routes search within gps area
	event search near gps position	bus routes search within wkt area
		bus routes search within stored wkt area
	tpl routes	
	tpl stops	

- **Distance from GPS point**



- **Point  is in Polygon ?**
 - Polyline as WKT

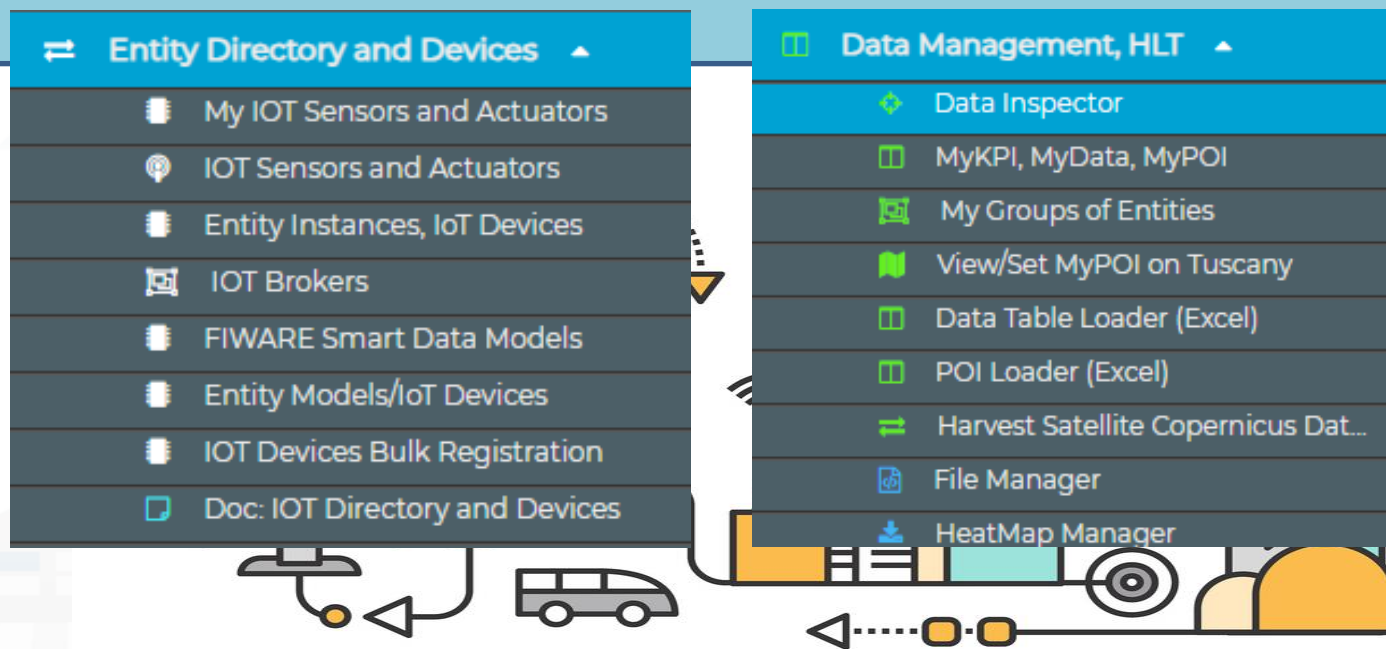


On video

- Example of searching of a IoT device on Service map
 - Identification of the service URI
 - Go on Super Service map, multi Org
- Example on Inspector the same device
 - See the Digital Twin view of the inspector
- Example on use Inject → function → service info dev → debug
 - Retrieve a data, retrieve a set of data in the last 24 hours

TOP

search vs services, the ServiceURI



Understanding / Testing an Entity/ IoT Device

	AdminDevice001	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW
Broker URI: https://broker1.snap4city.org		Kind: sensor		Broker Port: 8080		Visibility: MyOwnPrivate				
Device Type: Ambiental		Protocol: ngsi		Format: json		MAC:				
Model:		Longitude: 9.228193		Producer: Raspberry PI		Latitude: 45.499369				
Device Uri: http://www.disit.org/km4city/source/iot/orionUNIFI/AdminDevice001		Organization: DISIT						VIEW IN SERVICE MAP		
PAYLOAD NGSI v1								VIEW DATA IN AdminDevice001		
K1: b7c4115-f25c-4cb6-95eb-e4b363222bef										
Created: 2018-05-24 21:54:03										
						PAYLOAD NGSI v2				
						K2: 41ffb6c-dc8a-4fc9-a415-7f6564d656f5				



See Payload NGSI V1 in JSON directly from the Broker, Last message of the broker

The Broker

See Payload NGSI V2 in JSON directly from the Broker, Last message of the broker

See IoT Device on ServiceMap

Create a Message to be sent at the IoT broker regarding this device.



Snap4City

User: roottooladmini, 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
- Notificator
- Data Inspector**
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles

Data Inspector

Map

Single data widgets
Multi data widgets

Map Controls:
FilterMap GPSUser GPSOrg

Data sources

Sensor	High-Level Type	Nature
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment
Sensor	Sensor	Environment

Last Value: 14.9

Data sources Details

Device	Values	Healthiness	Process	Image	Licensing	User
GPS Coordinates:	42.642033, 18.1122					
High-Level Type:	Sensor					
Nature:	From IOT Device to KB					
Subnature:	IoTSensor					
Value Name:	Dubrovnik:orionDubrovnik-UNIFI/camera_Dubrovnik_1_Ploce					
Device ServiceURI or Data ID:	http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du					
Sensor ServiceURI or Data ID:	http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du					

Healthiness: 100%

Ownership: public

18:00 20:00 22:00

MAP4CITY

Click with the mouse on it

Data Inspector Wizard

Knowledge Base view

Device ServiceURI or Data ID: http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du

Sensor ServiceURI or Data ID: http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du

Datasource: iot

Ownership: private

Organizations: Dubrovnik

[Link to Service Map](#) [Link to IoT Device](#)

IOT Devices

IOT Device	IOT Broker	Device Type	Model	Ownership	Status	Soft	Delete	Location
AccessPoint1_FerniaSuperstore	orionLanatoDeCarde-UNIFI	AccessPointSensor	AccessPointLanato	DELEGATED	active	EDIT	DELETE	
AccessPoint2_ITIS	orionLanatoDeCarde-UNIFI	AccessPointSensor	AccessPointLanato	DELEGATED	active	EDIT	DELETE	
AccessPoint3_DataSport	orionLanatoDeCarde-UNIFI	AccessPointSensor	AccessPointLanato	DELEGATED	active	EDIT	DELETE	
adminDev1	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice001	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice002	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice004	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice006	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminTest005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	

Showing 1 to 10 of 370 entries

Some functionalities are limited to certain roles

Notation Terminology

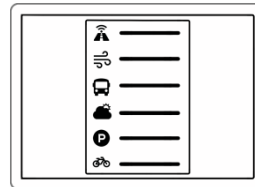
WHERE	Are synonymous at level of service which can be IoT device or entity with data and references to	Are synonymous at level of the single attribute of the entity , device, service, etc.
IoT Directory, Entity Directory	IoT Device, Entity Instance, Device URI	Sensor, Actuator, Attributes, Values (value name)
Knowledge Base, ServiceMap, SmartCity API, ASCAPI	Service, ServiceURI, SURI	Attribute, Metric
DataInspector, Wizard, Dashboard	Value Name	Sensor, Sensor Actuator, ValueType
IoT App., Proc.Logic, Node-RED	ServiceURI, SURI	SURI and its real time results of the objects into the data structure

ServiceURI, SURI of a sensor device:

- <http://www.disit.org/km4city/resource/METRO759>
- <http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/Streetlight%3A90FD9FFFFE5A7F>

ServiceURI, SURI extended with attribute/variable/value:

- <http://www.disit.org/km4city/resource/METRO759&metric=vehicleFlow>
- <http%3A%2F%2Fwww.disit.org%2Fkm4city%2Fresource%2FMETRO759&metric=vehicleFlow>
- In some cases
 - <http://www.disit.org/km4city/resource/METRO759/vehicleFlow>



Dashboard Usage and recipe: Event map target

- **Selector to Show on Map a**

- **category of Map positioned elements**

- https://servicemap.disit.org/WebAppGrafo/api/v1/?selection=43.08694333811321;8.791809082031252;44.93758500391093;14.065246582031252&categories=Traffic_sensor&maxResults=0&maxDists=0.1&text=&model=&value_type=&format=json
- <https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=e5f39066cd68ffe259ed8877bcee222b&format=json>

- **Entity by Model**

- <https://www.disit.org/superservicemap/api/v1?selection=59.36535064975547;13.457822799682619;59.39031474260852;13.566999435424806&model=SmartLightCapelon&format=json>

- **Single Entity**

- https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionFirenze2/Firenze/SHT20lab_new&format=json&fromTime=3-day

- **Heatmap among many**

- https://wmserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=Florence_PM10

- **Traffic flow**

- <https://wmserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=FirenzeFIPILITrafficRealtime&trafficflowmanager=true>
- <https://firenzetraffic.km4city.org/trafficRTDetails/roads/read.php>

- **Origin Destination Map**

- https://odmm.snap4city.org/api/get?precision=communes&from_date=&organization=Toscana&inflow=True&longitude=11.255751&latitude=43.769710&od_id=mobile_Toscana_1000&perc=True

- **Events which are also PIN on map**

- **Il Service URI as the unique identifier of the Entity**

- <http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO632>

- **For:**
IOT Devices,
Sensors, Sensor
mobile,
Actuators,
Virtual Sensors,
etc.
- Accessible as
 - ServiceURI
 - **Device URI**

The screenshot shows the Snap4City IoT Directory interface. The left sidebar contains a navigation menu with 'IOT Devices' selected. The main content area displays a table of IoT devices. The table has columns for Device Identifier, IOT Broker, Device Type, Model, Ownership, Status, Edit, Delete, Location, and View. The device 'AdminDevice001' is highlighted, and its details are shown below the table. A green arrow points from the 'Device URI' field in the details to the 'Device URI' field in the bottom banner.

Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Edit	Delete	Location	View
15EP22T2AA1S000022	orionFirenze-UNIFI	ChargingStation	ChargingStationModel	PUBLIC	active	EDIT	DELETE		VIEW
AccessPoint1_FamilaSuperstore	orionLonatoDelGarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE		VIEW
AccessPoint2_ITIS	orionLonatoDelGarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE		VIEW
AccessPoint3_Palaspport	orionLonatoDelGarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE		VIEW
adminDev1	orionUNIFI	Ambiental		MYOWNPUBLIC	active	EDIT	DELETE		VIEW
AdminDevice001	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW

Details for AdminDevice001:

- Broker URI: https://broker1.snap4city.org
- Kind: sensor
- Device Type: Ambiental
- Protocol: ngsi
- Model:
- Longitude: 9.228193
- Device Uri: http://www.disit.org/km4city/resource/iot/orionUNIFI/AdminDevice001
- Organization: DISIT
- PAYLOAD NGSi v1: K1: b7c4c115-f25c-4cb6-95eb-e4b363222bef
- PAYLOAD NGSi v2: K2: 441ffb6c-dc8a-4fc9-a415-7f6564d656f5
- Created on: 2018-05-24 21:54:03

Device Uri: <http://www.disit.org/km4city/resource/iot/orionUNIFI/AdminDevice001>

Data Registration Flow at a Glance

IOT Devices

Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Location
18EPZ27AR500002	orion@firenze-UNIFI	ChargingStation	ChargingStationModel	PUBLIC	active	
AccessPoint_FamiliadSupertore	orion@lonato@delCards-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	
AccessPoint_21S	orion@lonato@delCards-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	
AccessPoint_Palaesport	orion@lonato@delCards-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	
admin@delci	orion@UNIFI	Ambiental		MOWNPUBLIC	active	
Admin@Device001	orion@UNIFI	Ambiental		MOWNPUBLIC	active	

IOT Directory:
Devices...
Sensors...
Actuators...

Service Map (Toscana)

IBIMETAir Quality Sensor - BORGO SAN LORENZO

Service: IBIMETAir Quality Sensor - BORGO SAN LORENZO

Name: IBIMETAir Quality Sensor - BORGO SAN LORENZO

Address: BORGO SAN LORENZO

City: FIRENZE

Category: Air Quality

Manufacturer: Boreas

Model: BQ100

Latitude: 43.773191

Longitude: 11.251191

Altitude: 398.00

Temperature: 18.00

Humidity: 52.00

Pressure: 1013.25

PM10: 18.20

PM2.5: 12.41

CO: 16.20

NO: 1.20

NO2: 12.20

CO2: 128.30

SO2: 0.20

Amplitude: 73.50

Knowledge Base,
ServiceMap,
SuperServiceMap
SmartCity API,
ASCAP

IOT Apps

Data Inspector

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Value Unit	Last Date	Last Value	Health/Status	Last Check	Ownership
url	Environment	Natura	Natura	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public
url	Environment	Natura	Profil	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public
url	Environment	Natura	www_bioscote	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public
url	Environment	Natura	www_copernico	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public
url	Environment	Natura	Fauna	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public
url	Mobility and Transport	Traffic Sensors	Traffic Sensors	pollino	GWPTS		2020-04-03 09:58:16	0	●●●●●	2020-04-03 09:58:16	public

Last Value: 15.9

Time Trend: 3 Apr 01:00 to 10:00

DataInspector
Dashboard Wizard

TOP

MyKPI Nodes

- Data Management, HLT ▲
- Data Inspector
- MyKPI, MyData, MyPOI**
- My Groups of Entities
- View/Set MyPOI on Tuscany
- Data Table Loader (Excel)



- Save and retrieve MyKPI into the safe personal data storage

▼ S4CKPIData

get my kpdata

get my kpdata values

get public kpdata values

get delegated kpdata values

save my kpdata values

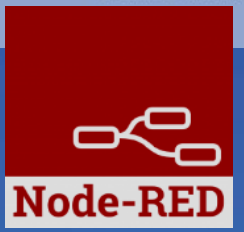
- Access to MyKPI and to those that other user have delegated to Me
- **MyKPI are:**
 - Time series of data with GPS coordinates that can change over time
 - Suitable for: moving sensors, trajectories, data from OBU, data from mobile, sensor data (if needed), etc. etc.
- **MyPOI are:**
 - POI with full metadata description and static coordinates

TOP

External Service ↔ IoT App / Proc.Logic

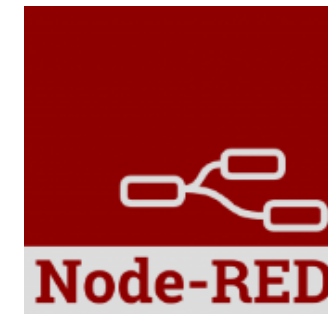


- Processing Logics / IOT App ▲
- Processing Logics / IOT App
- ↑ MicroServices for Proc.Logic/IoT App
- ↑ MicroServices from DataAnalytic
- ☐ IOT MicroServices for Final Users
- ☐ IOT MicroServices for Developers
- ☐ DOC: Processing Logic/IOT App
- ☐ How to Develop Proc.Logic / IoT App
- ☐ Create A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



IoT App / Proc.Logic

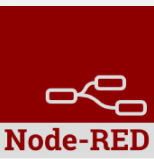
- Storage → IoT App / Proc.Logic
- External Service ↔ IoT App / Proc.Logic
- Dashboards ↔ IoT App / Proc.Logic



- Data Analytics ↔ IoT App / Proc.Logic **Part 4**
- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic
- IoT App / Proc.Logic → Storage

Part 5

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



The screenshot shows the Node-RED block palette with the following categories and blocks:

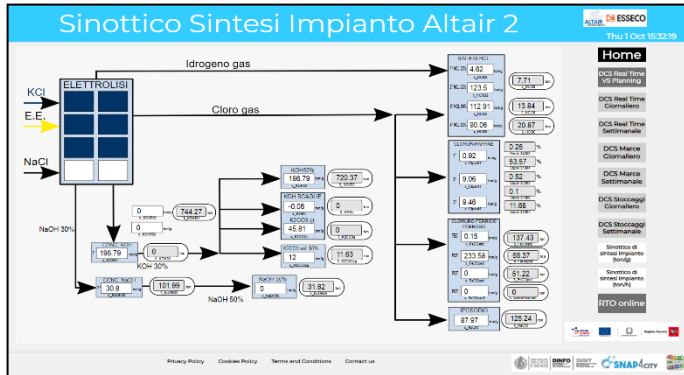
- common**: inject, debug, complete, catch, status, link in, link out, comment
- function**: function, switch, change, range, template, delay, trigger, exec, zip, md5, soap request, string, xml converter, random, rbe
- network**: mqtt in, mqtt out, http in, http response, http request, websocket in, websocket out, tcp in, tcp out, tcp request, udp in, udp out, amqp in, amqp2 in, stomp in, amqp out, amqp2 out, stomp out
- sequence**: split, join, sort, batch, parser (csv, html, json, xml, yaml, base64, msgpack), storage (file, file in, watch, ftp in, mysql, tail)
- social**: email, twitter in, email, twitter out, advanced (feedparser), NGSi (NGSI Entity, NGSI v2ToLD), lwm2m (lwm2m client in, lwm2m client out), location (turf, worldmap, worldmap in, tracks, convex hull), time (sunrise)
- dashboard**: button, dropdown, switch, slider, numeric, text input, date picker, colour picker, form, text, gauge, chart, audio out, notification, ui control, template

+ on IOT Edge Raspberry

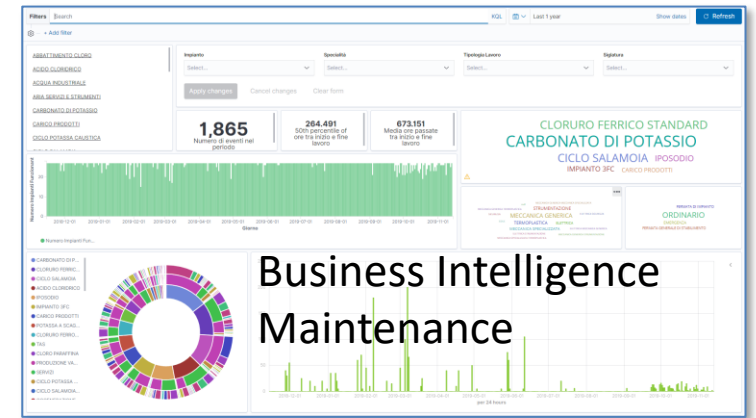
The screenshot shows the Node-RED block palette with the following categories and blocks:

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

Example of Integrated workflow



Consumptions/productions

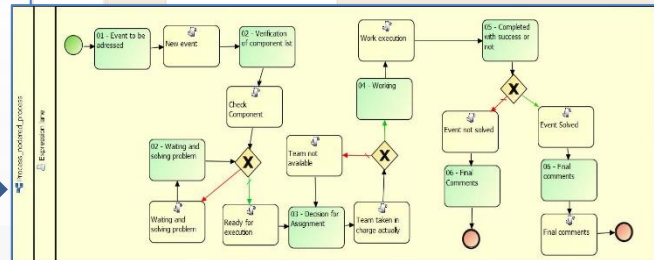


Events/actions

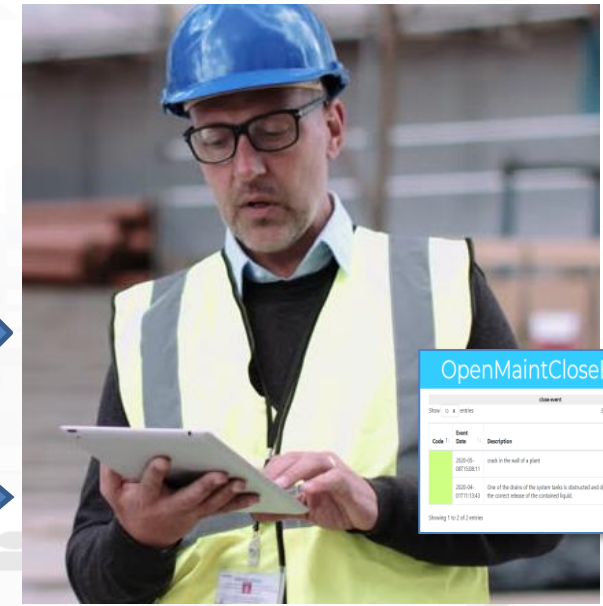
Business Intelligence
Maintenance

Dashboards and actions

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




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



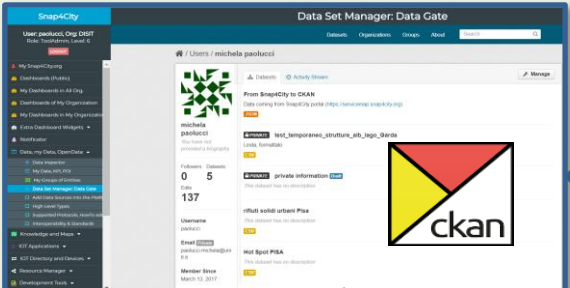
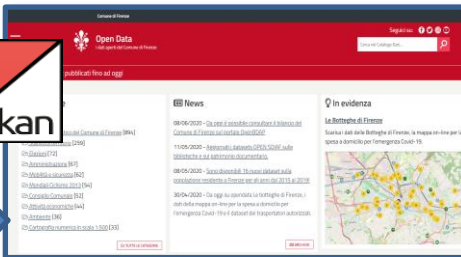
Snap4City vs CKAN

Snap4City Portal and Integrated tools



Advanced Snap4City APIs and Micro Services

Datagate

ckan

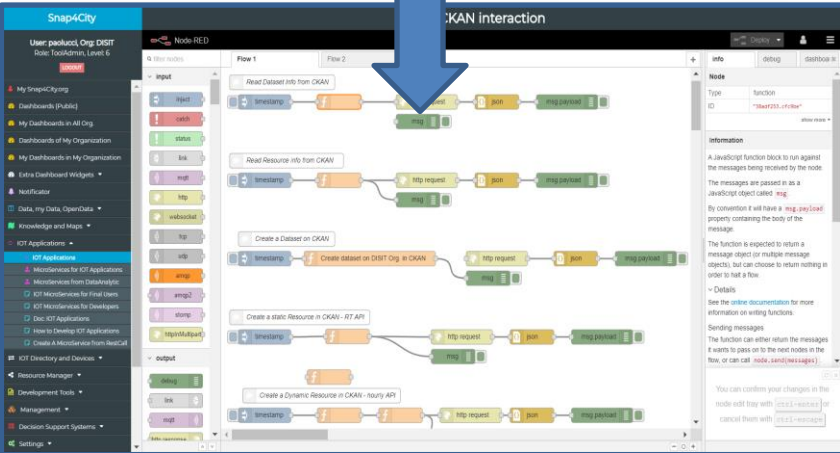


ckan

Harvesting and Publishing

Open or Private External CKAN Data Portals

CKAN interaction



Automatize:

- Import data from CKAN to Snap4City
- Upload Public Data from Snap4City to CKAN
- Data Harvesting
- Dashboards and Mobile/Web Apps creation

External REST Call API vs MicroServices

- Each Rest Call API can be automatically transformed into a MicroService for the IOT Applications

Snap4City

User: root@tooladmin | Org: DISIT
Role: RootAdmin, Level: 7

MicroServices for IOT Applications

File Name | Upload Date | Description | Control Status | View | Metadata | Published | Delete

Air quality.zip	2018-05-25 13:10:35	Air quality Microservice	OK - 2018-05-25 13:10:35	VIEW	EDIT	NO	DEL
Antwerp cameras location.zip	2019-01-13 17:22:06	Antwerp cameras location from A Open Data	OK - 2019-01-13 17:22:06	VIEW	EDIT	YES	DEL
Antwerp museum.zip	2019-01-13 17:22:08	Antwerp museum (data coming from A Open Data API)	OK - 2019-01-13 17:22:08	VIEW	EDIT	NO	DEL
Antwerp velo stations.zip	2019-01-13 17:32:17	Antwerp Velo stations ocation (data coming from A Open Data API)	OK - 2019-01-13 17:32:17	VIEW	EDIT	NO	DEL
Car Park Prediction.zip	2018-06-21 16:55:28	Free Parking Lots Prediction	OK - 2018-06-21 16:55:28	VIEW	EDIT	NO	DEL
Current UV in Antwerp.zip	2019-01-13 15:38:13	Current UV in Antwerp (data coming from the openweather API)	OK - 2019-01-13 15:38:13	VIEW	EDIT	YES	DEL
Current weather in Antwerp.zip	2019-01-13 15:25:55	Current weather in Antwerp (Openweather API)	OK - 2019-01-13 15:25:55	VIEW	EDIT	YES	DEL
Events in Finland.zip	2019-01-07 17:43:47	Cultural and educational events (Frequently updated events from multiple cultural event organizers including concerts, sports events, museum exhibitions and many more.), only in Finnish	OK - 2019-01-07 17:43:47	VIEW	EDIT	YES	DEL
Firenze Getico.zip	2019-02-13 12:33:31	Statistiche	OK - 2019-02-13 12:33:31	VIEW	EDIT	NO	DEL
Firenze_getico_interni.zip	2019-02-13 13:00:30	Ticket Getico interni	OK - 2019-02-13 13:00:30	VIEW	EDIT	NO	DEL

Edit MicroService: Antwerp cameras location.zip

Nature: Transfer service and renting
Sub Nature: Monitoring camera
Licence: Public
Description: Antwerp cameras location from A Open Data
Select Image: Nessun file selezionato
Method: GET
Do you want create a Microservice with Authentication?
Url: http://datasets.antwerpen.be/v4/public/gis/politie.json
Cancel Confirm

Edit Places in Finland node

Name:

node properties

Places in Finland

Node RED

Import External MicroService

- last-feedback
- Hotel_in_florence
- Events in Finland
- Places in Finland
- Tourism Activities in Finland
- Multilanguage Events search by location bbox
- Road Weather cameras in Finland
- Current weather in Antwerp
- Multilanguage Events search by date
- Current UV in Antwerp

Clipboard

- Library
- Import
- Import SAC
- Import External MicroService
- Import Data Analytic MicroService
- Examples

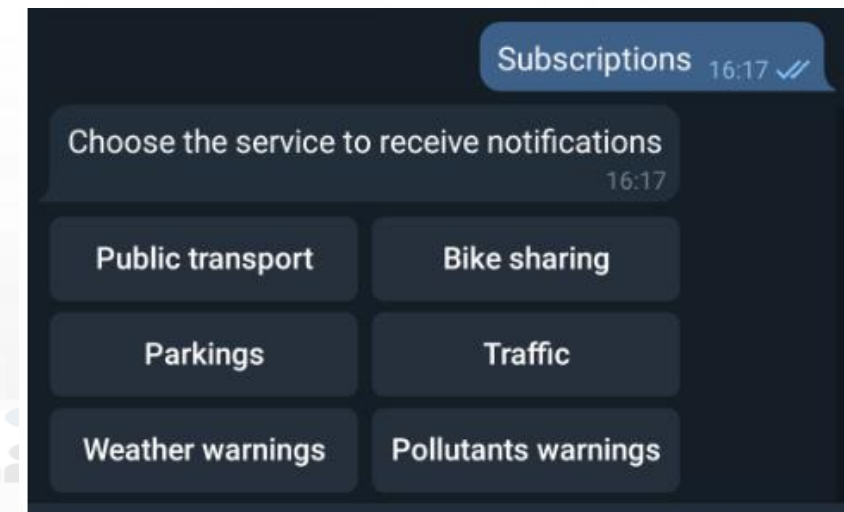
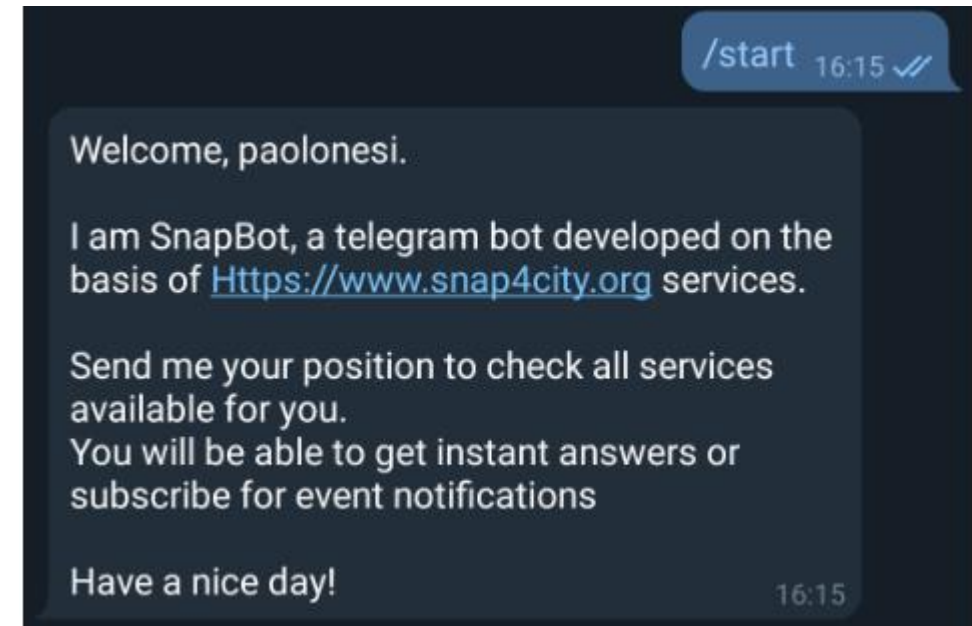
Places in Finland

Cancel Install

<https://www.snap4city.org/129>



- provides real time smart city services to Telegram users, geolocalized, when you like, what you like
- active on Tuscany in all provinces and cities according to the data accessible on <https://www.snap4city.org>
- Services on
 - Public Transport (more than 10 different operators),
 - bike sharing, parking lots,
 - traffic flow, weather warnings,
 - Air quality, pollutant,
 - find your location, etc.





Tap on the hour you prefer to receive 3 notification everyday for the Bike Sharing service 16:18

00:00	01:00	02:00	03:00	04:00	05:00
06:00	07:00	08:00	09:00	10:00	11:00
12:00	13:00	14:00	15:00	16:00	17:00
18:00	19:00	20:00	21:00	22:00	23:00

Qualità dell'aria 02:22 ✓✓

Qualità dell'aria rilevata dal sensore più vicino alla posizione:

- Temperatura: 8.10 °C
- Umidità: 97.50%
- CO: 0.3 µg/m3
- CO2: 499.0 µg/m3
- NO: NaN µg/m3
- NO2: 56.1 µg/m3
- O3: 20.9 µg/m3
- PM10: 13.8 µg/m3
- PM2.5: 12.2 µg/m3

Public transport 16:41 ✓✓

Choose a bus stop: 16:42

Giorgini	Giorgini
Vittorio Emanuele	Montelatici

Giorgini - FM0256

- 17:12 - [55] → Cappuccini
- 17:29 - [55] → Cappuccini
- 17:45 - [55] → Cappuccini
- 18:01 - [55] → Cappuccini
- 18:17 - [55] → Cappuccini
- 18:33 - [55] → Cappuccini 16:43

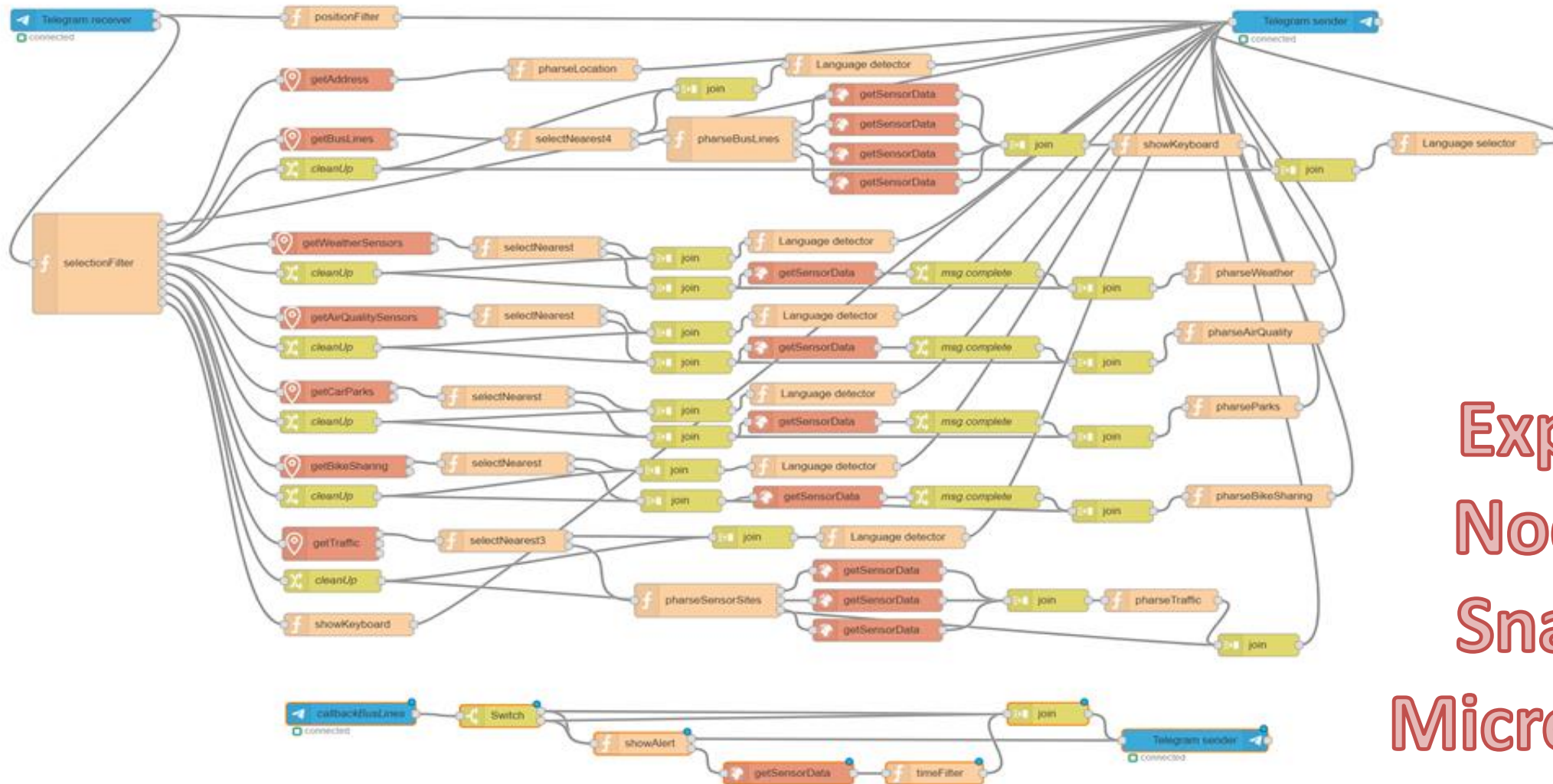
Trasporti pubblici 14:53 ✓✓

Ho trovato 6 linee vicino a te:

- 24 - ATAF&LINEA
Grassina → Bagno A Ripoli Robinson
- 49 - ATAF&LINEA
Grassina 02 → Bagno A Ripoli Robinson
- 48 - ATAF&LINEA
Il Roseto 01 → Bagno A Ripoli Robinson



IOT App of SnapBot: OneShot Services



Exploiting
Node-RED
Snap4City
MicroServices

TOP

Dashboards ↔ IoT App / Proc.Logic Server Side Business Logic

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND

TWITTER VIGILANCE SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

FROM CITY DASHBOARDS TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

TECHNICAL SUPPORT FOR DEVELOPERS AND CITY RESIDENTS

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

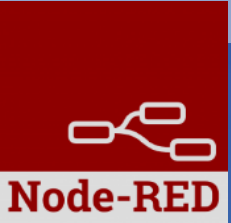


IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

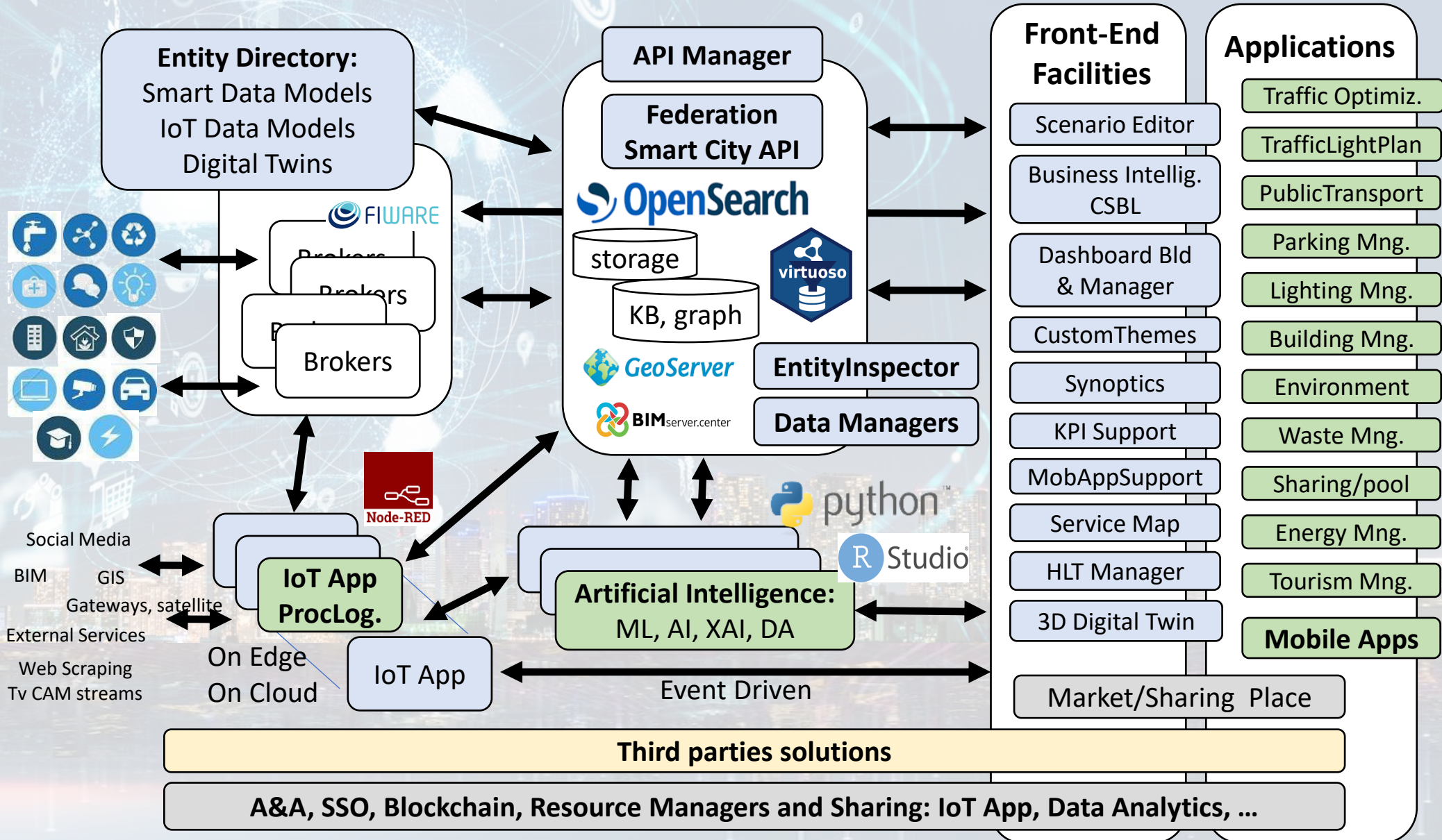
SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

- 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

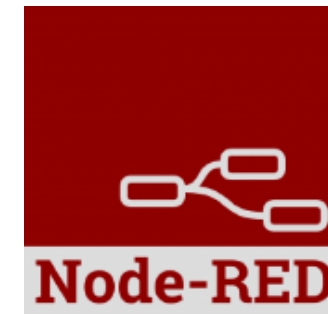


Technical Architecture



IoT App / Proc.Logic

- Storage → IoT App / Proc.Logic
- External Service ↔ IoT App / Proc.Logic
- **Dashboards ↔ IoT App / Proc.Logic**

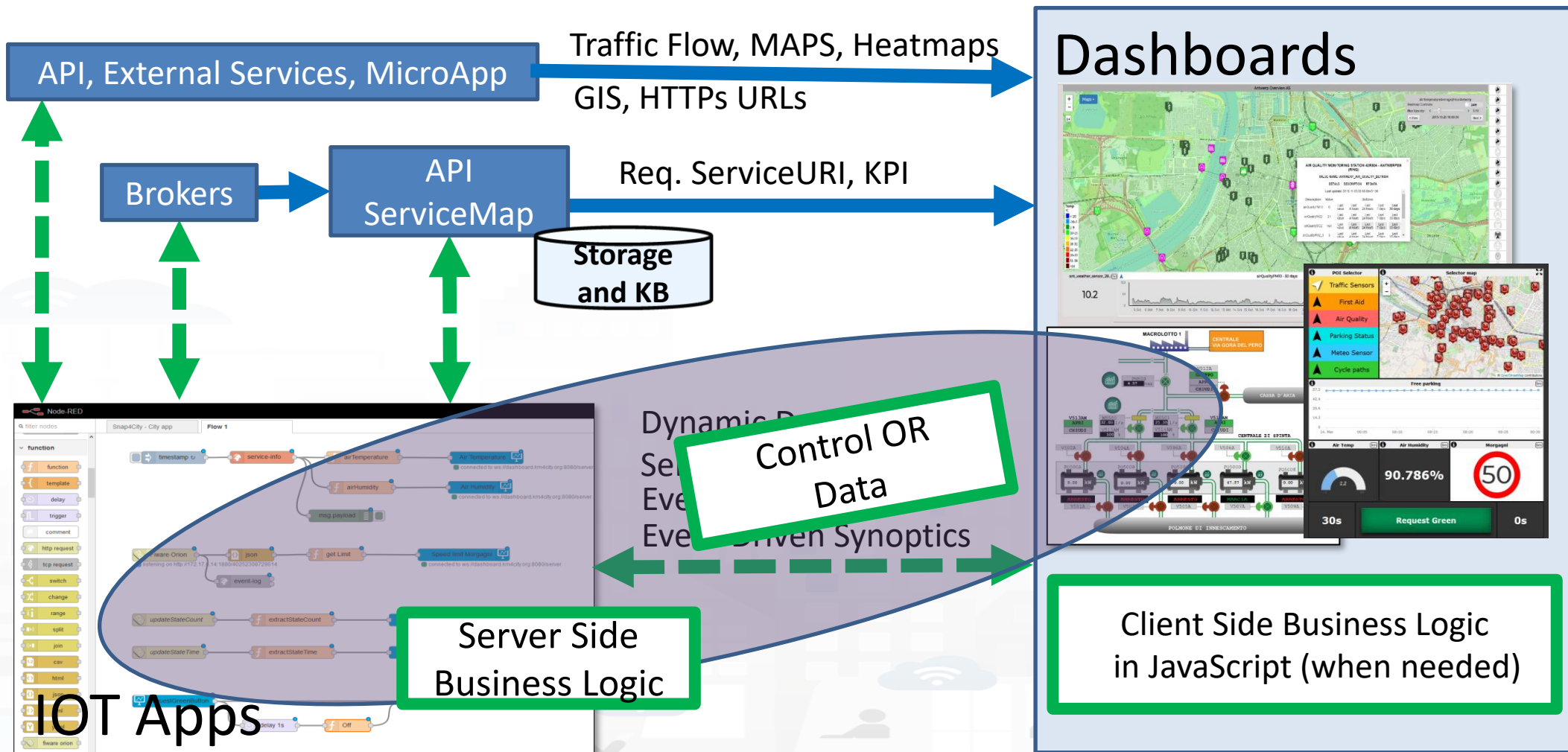


- Data Analytics ↔ IoT App / Proc.Logic
- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic
- IoT App / Proc.Logic → Storage

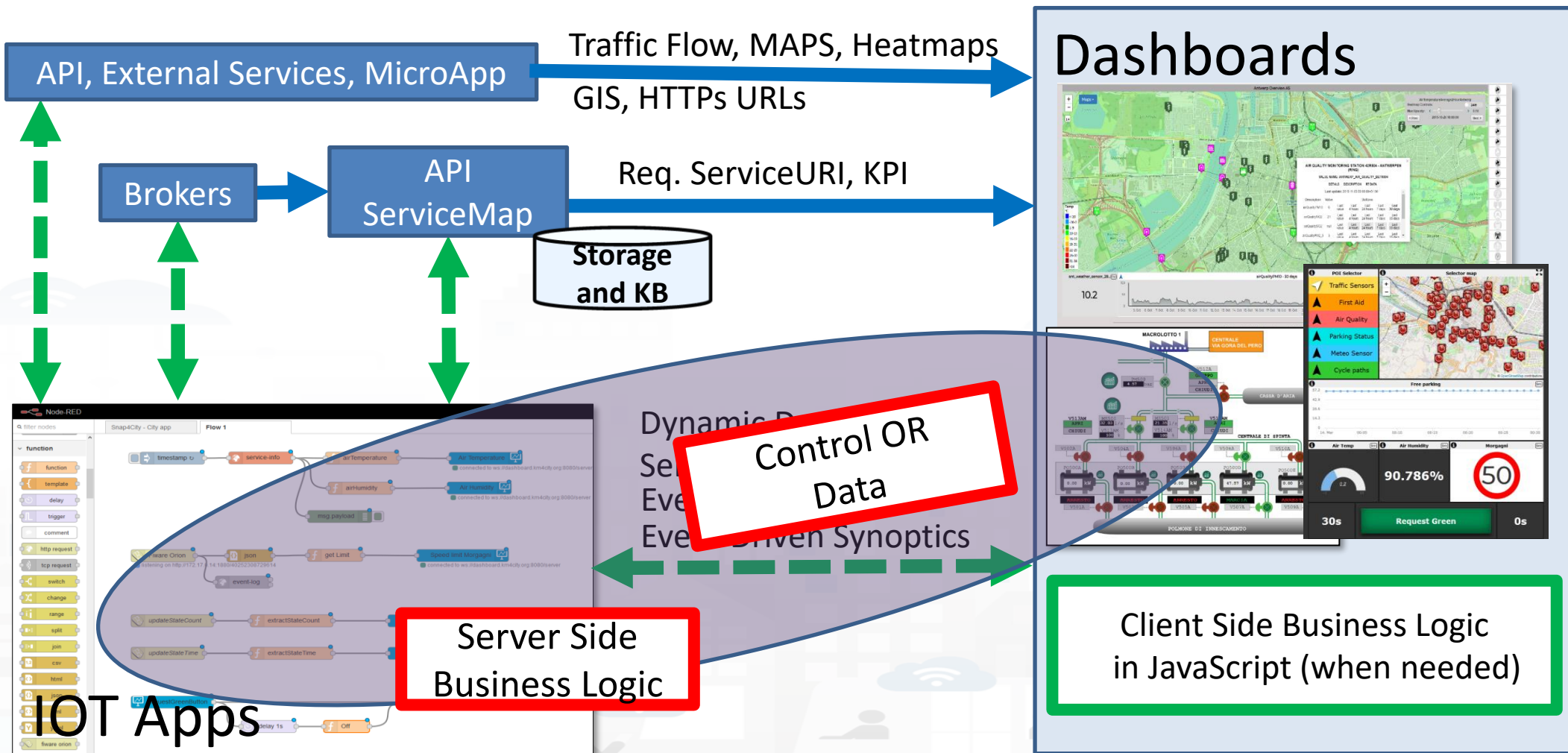
Part 4

Part 5

How the Dashboards exchange data



How the Dashboards exchange data



Snap4City Dashboards main concepts

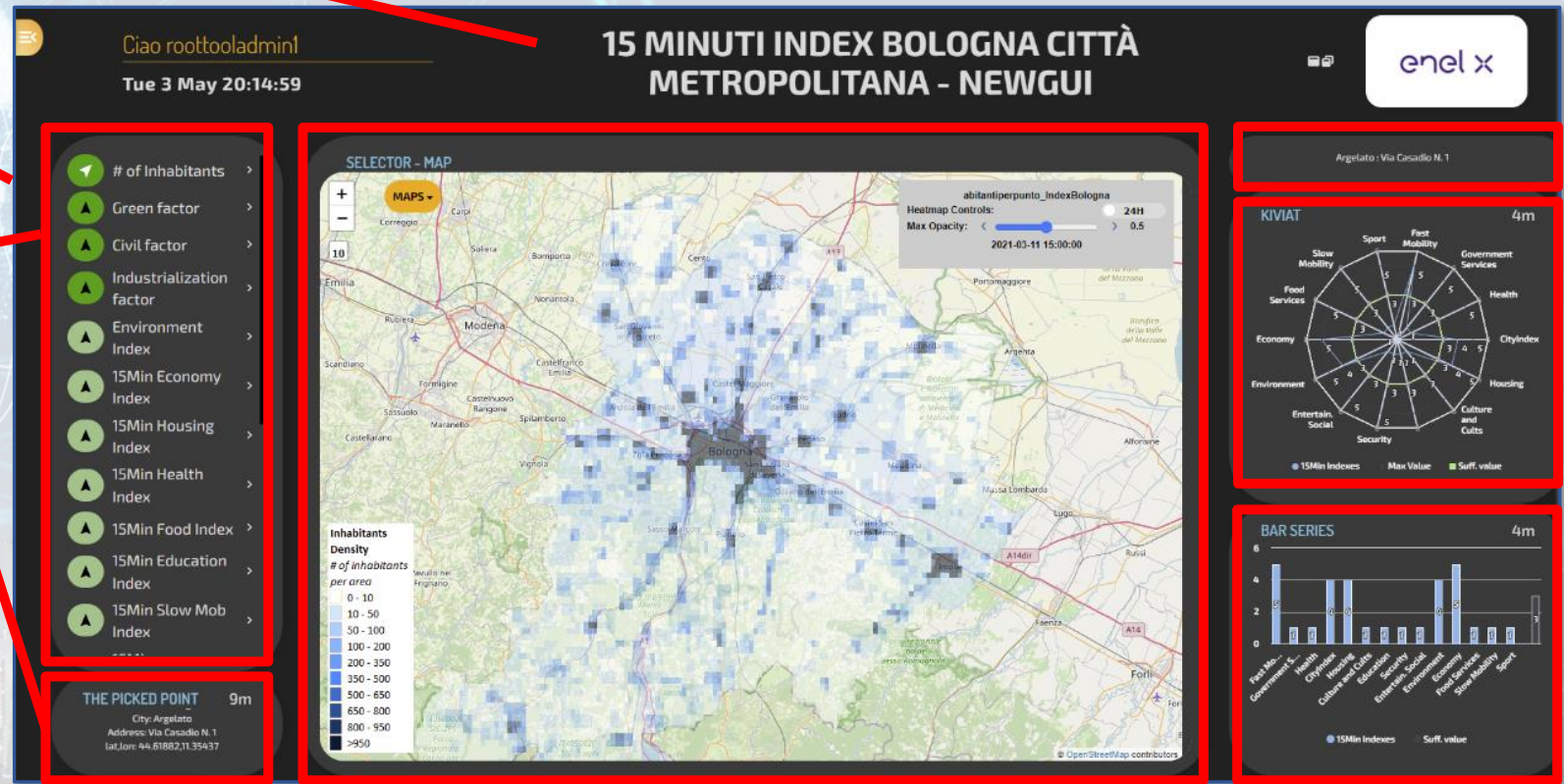
Header

Dashboard

Interactive Widgets

Server Communication

- Real Time data requests/send
- Event Driven
- **Server Side Business Logic**
 - **See Part 3 of the course**



Inter Widget Communication:
Client Side Business Logic
See part 8 of the Course

S4CDashboard

- coordinates from map
- impulse button
- numeric keyboard
- switch button
- dimmer
- geolocator
- dropdown
- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- event driven my kpi
- synoptic read
- synoptic write
- synoptic subscribe
- form

Native Local

- Input/output
- non secure
- Limited in graphics
- No authentication
- No HLT
- No integration
- No historical data
- No Synoptics
- Etc..

- Local on IOT Edge

or

Snap4City

- Input/output
- Secure
- Advanced in graphics
- Single Sign On
- Several HLT
- Fully integrated
- Historical data
- Full Synoptics
- Etc..
- Remote for IOT Edge via WebSocket Secure

dashboard

- button
- dropdown
- switch
- slider
- numeric
- text input
- date picker
- colour picker
- form
- text
- gauge
- chart
- audio out
- notification
- ui control
- template

From Dashboard to IoT App

- **Widgets:**

- Impulse Button
- Button
- Switch
- Dimer/Knowb
- KeyPad
- Geolocator
- Selection/Dropdown
- Form
- Map Picking

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

The collage features several distinct widgets:

- IOTDevice Data Form:** A form with fields for 'enter text', 'enter number', 'enter email' (value: rootooladmin1), 'enter password', 'enter check' (checked), 'enter check2', 'enter switch', 'enter switch2', 'enter date' (value: gg/mm/aaaa), and 'enter time'. A 'Submit' button is at the bottom.
- Impulse Button:** A square button with a hand icon pointing at a Wi-Fi symbol.
- Green Power Button:** A green square button with a power icon and the text 'OFF' and 'Green'.
- Gauge:** A circular gauge with a needle pointing to the number '45' on a scale from 0 to 100.
- Slider:** A horizontal slider control.
- Map Picking:** A map showing a location with a blue pin and labels like 'A DELLA CERNAIA', 'SANESCO CRISTO', 'Plaz Vi', and 'Liceo Gi Dar'.
- Geolocator:** A hand holding a smartphone displaying a map.
- Selection/Dropdown:** A dropdown menu showing 'BLINKING YELLOW' in red text.
- Form:** A simple form with a text input field and a dropdown arrow.
- Green Power Button (Large):** A large green square button with a power icon and the text 'OFF' and 'Green'.
- KeyPad:** A keypad with a grid of dots and a hand icon.
- PeopleNumber Table:** A table with the following data:

PeopleNumber		
New	Last confirmed	
	None	
7	8	9
4	5	6
1	2	3
		Canc
Confirm		
- Color Buttons:** A vertical stack of four colored buttons: Blue, Green, Yellow, and Red.

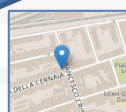
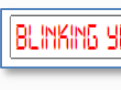
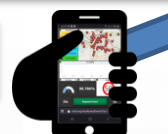
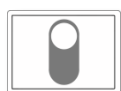
Acting on your systems

Dashboard-IoT App



PeopleNumber		
time	Last confirmed	
	None	
7	8	9
4	5	6
1	2	3
0	.	Cancel

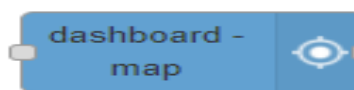
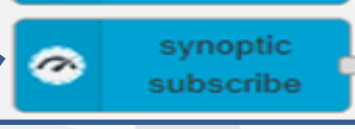
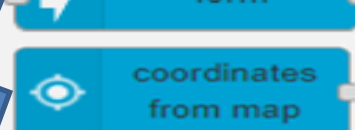
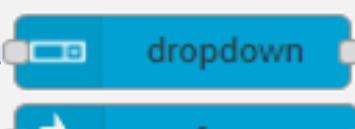
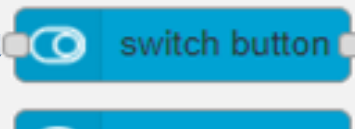
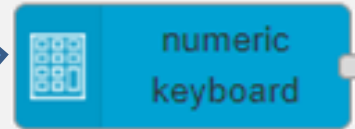
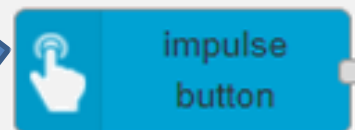
Confirm



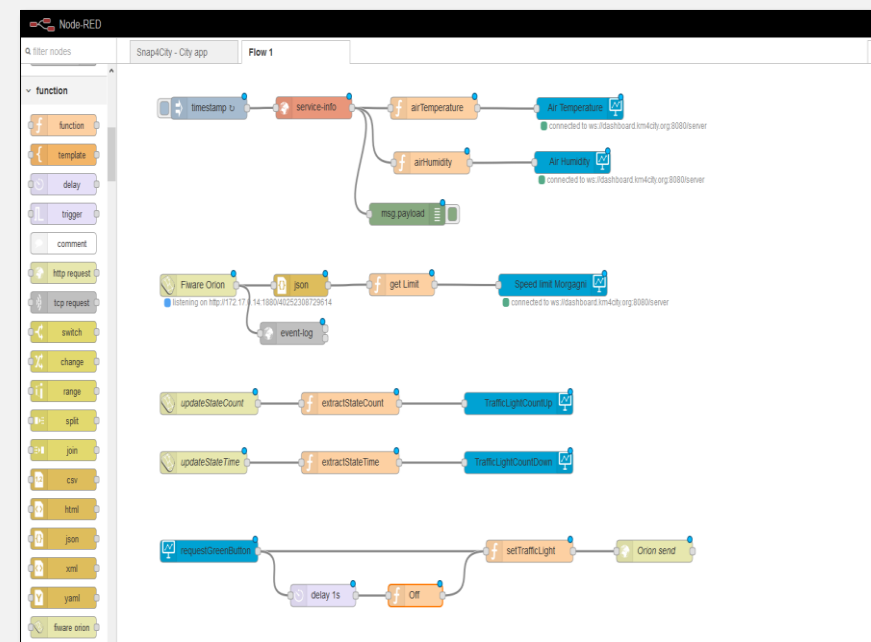
MapClick

MyKPI variable onchange

Synoptics



From Dashboard to IOT App

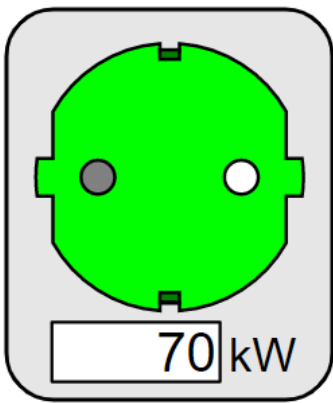


IOT Application

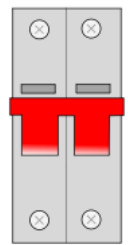
SVG Custom Widgets Examples 2

Tue 17 Nov 18:46:47

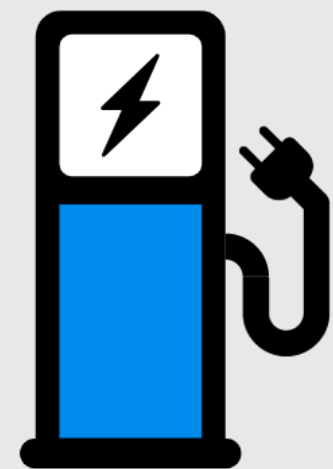
SVG shucko plug



Schuko switch



Charging Station Status



Legenda

Charging Station Status
Set on the keypad one of the following values

- 0 = ERROR (RED)
- 1 = AVAIBLE (GREEN)
- 2 = BOOKED (YELLOW)
- 3 = CHARGING
- 9999 = white icon

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

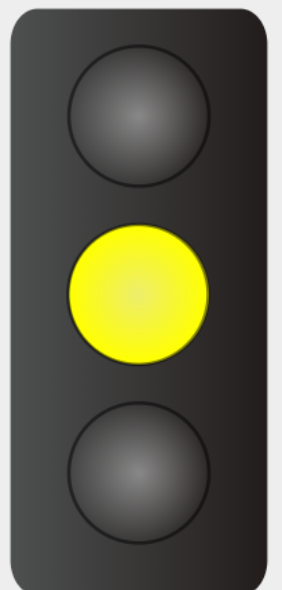
Underpass



Set tunnel st...



Traffic Light



Traffic Light status set

YELLOW LIGHT

Speed Limit Set

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

Dynamic Speed Limit Sign



Speed Limit Explanation

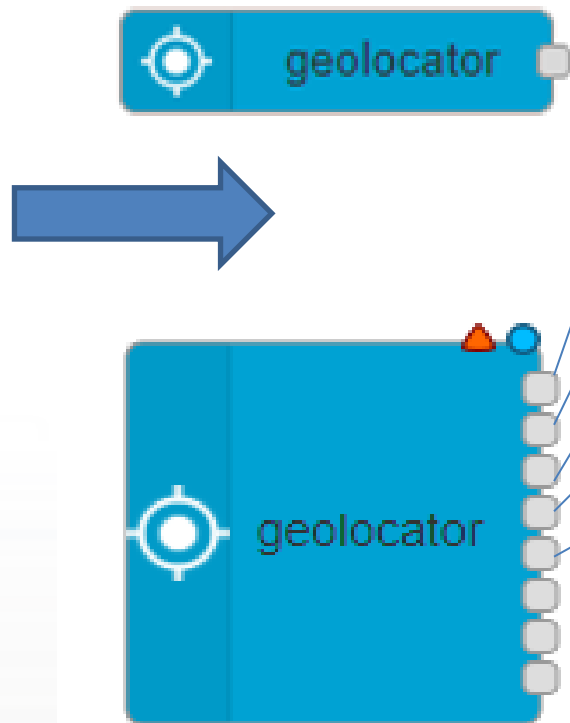
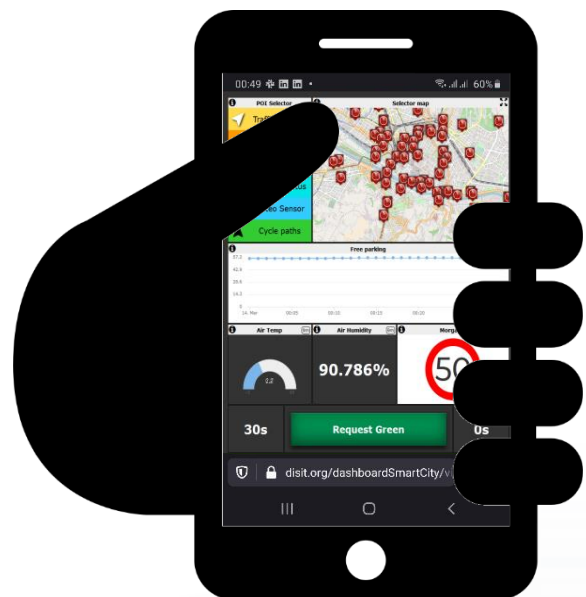
Speed Limit Custom Widget example

Write the speed limit by using the keypad and click CONFIRM.

9999 = white sign.

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=Mjk4Ng==>

Geolocation of Mobile Device



Web Browser GPS data rendering the Snap4City Dashboard can be passed to IOT Applications and saved 😊

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

Dashboard-IOT App

From IoT App to Dashboard

IOT Application

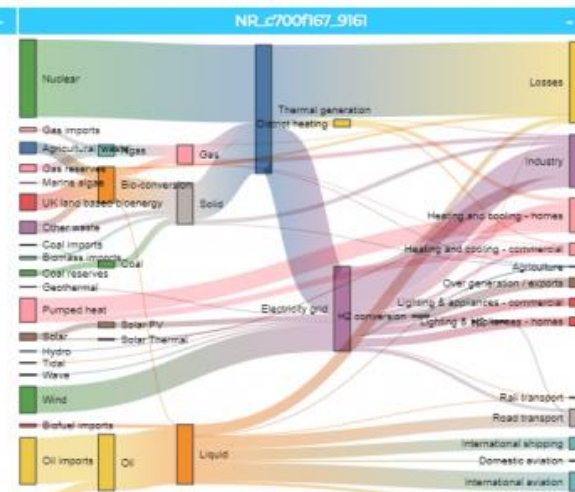
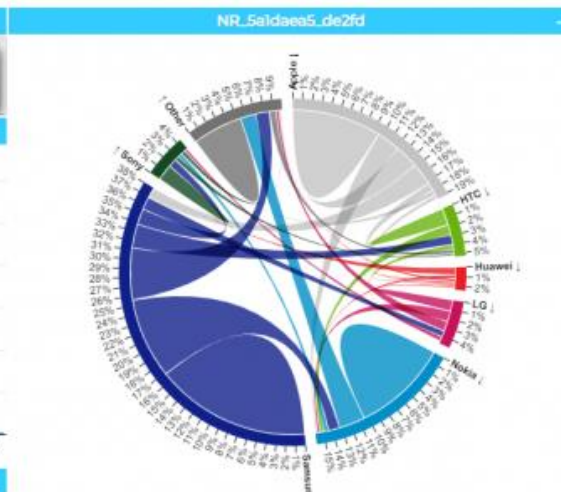
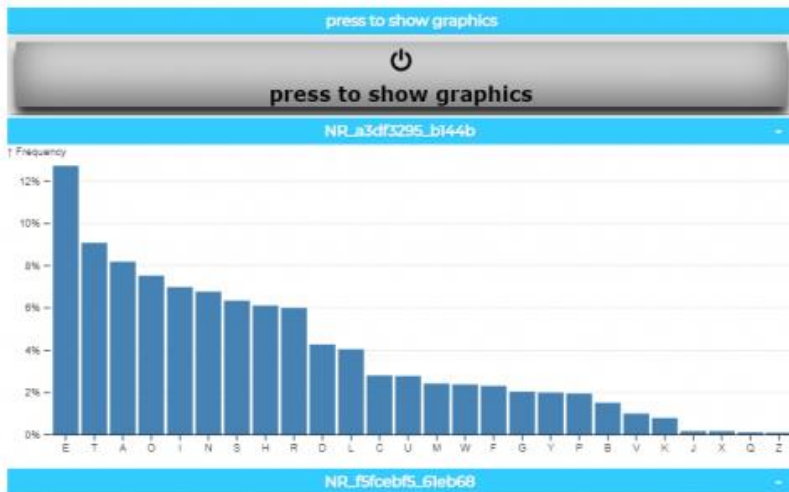
- Snap4D3
- dashboard - map
- event table
- device table
- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- calendar
- speak synthesis
- synoptic write
- Selector - Map

Dashboard Widgets:

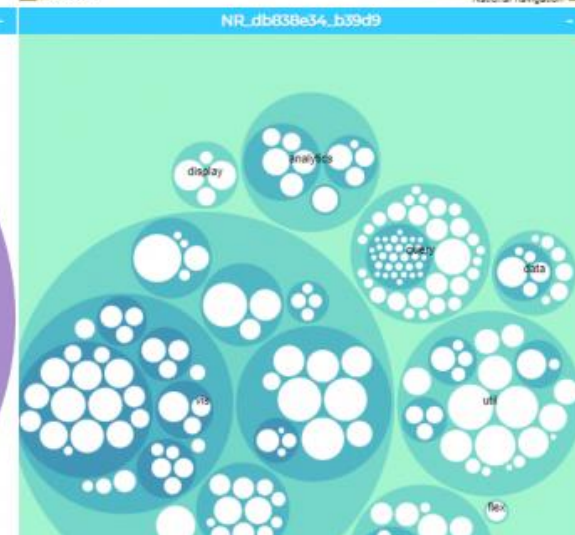
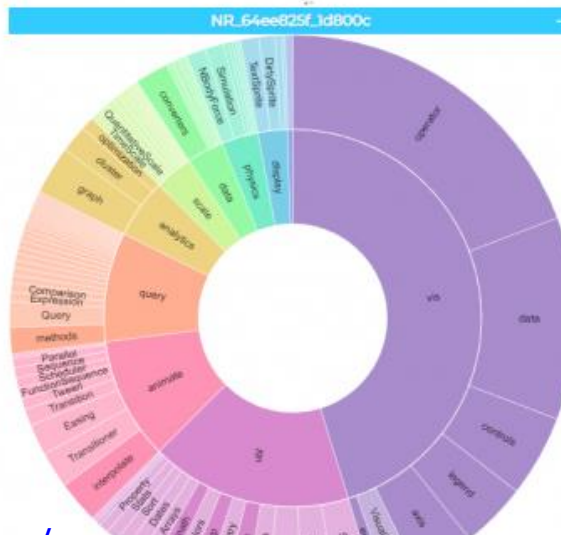
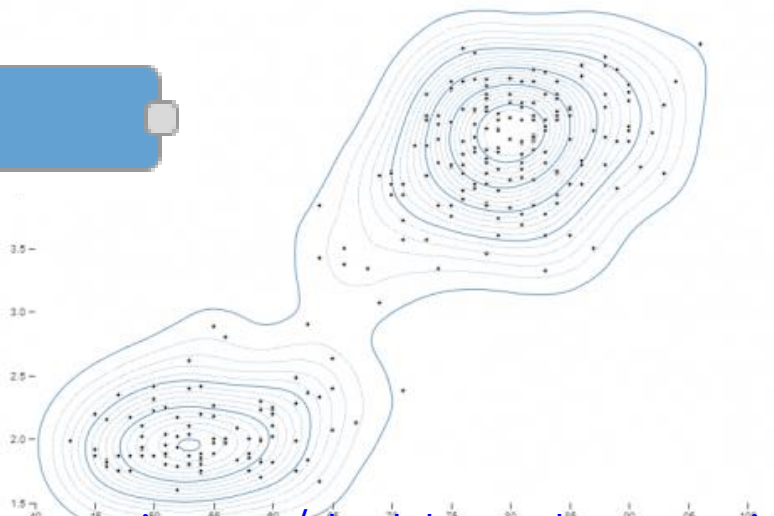
- Avg gas consumption (Gauge: 39.4)
- Avg heat consumption per user (Gauge: 44.7)
- Temperature (20.3°C)
- Pie Chart (PM2.5, PM10, O3)
- Line Chart (SRSensor_TOS01001095-air/temperature)
- Radar Series (Pollutant and Environmental Sensors)
- Bar Chart (Cinema)
- Time trend comparison (Line chart with multiple series)
- Table (Weather metrics and Pollutants)
- Calendar - s4cpaxant04 - wifi (Heatmap)

D3 library Example

Fri 10 Jun 19:46:06

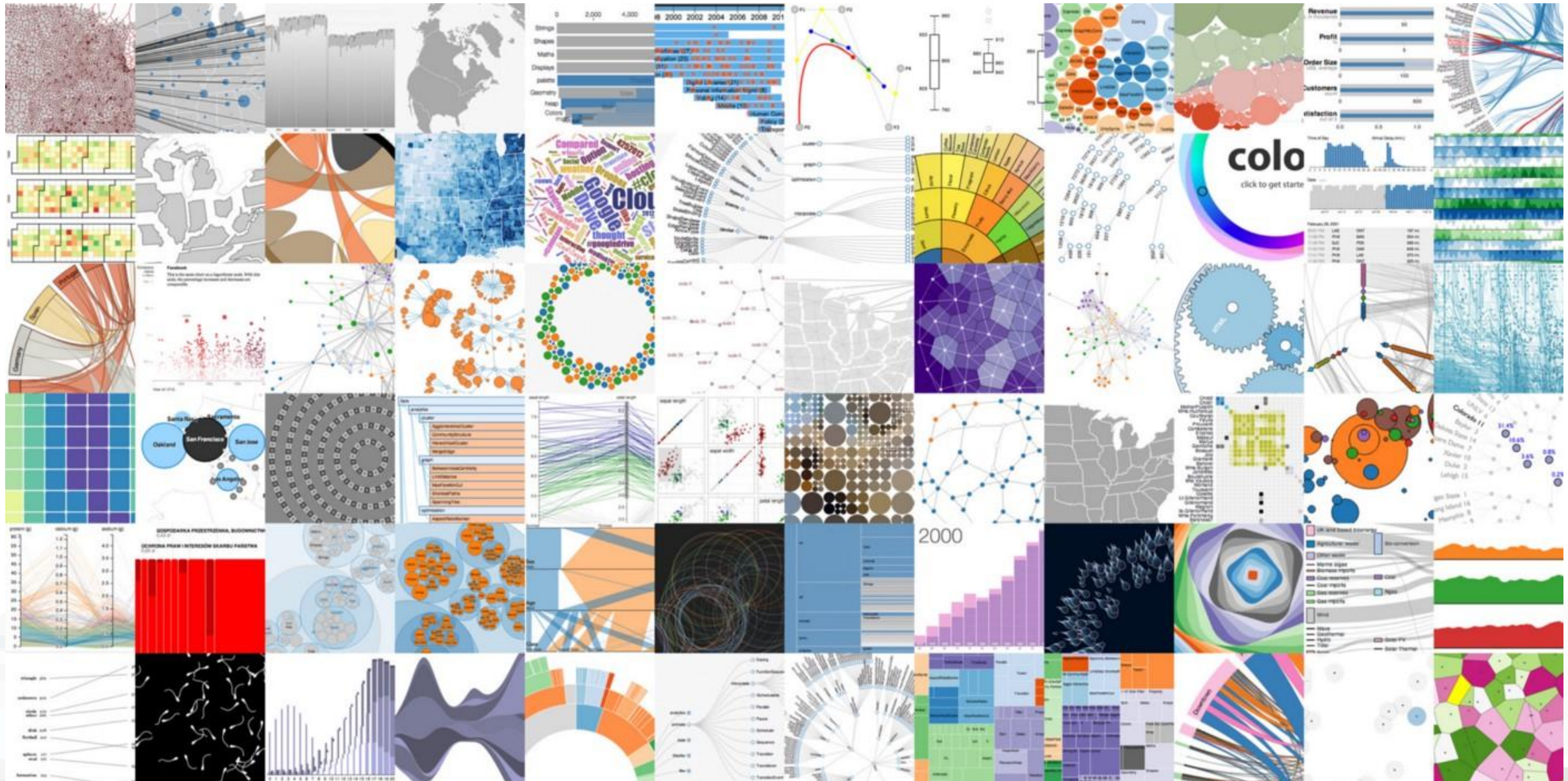


Snap4D3



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzQ4OQ==>

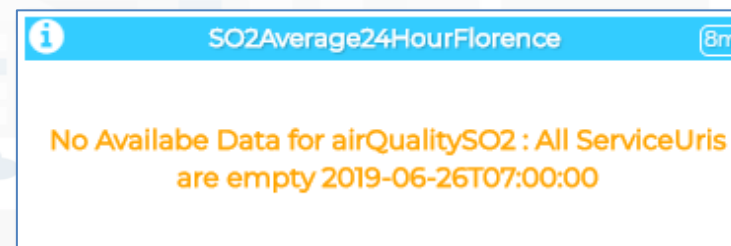
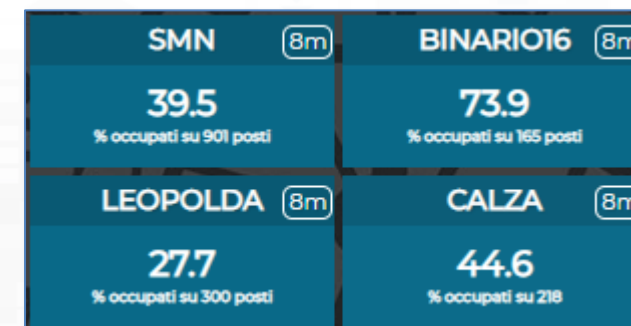
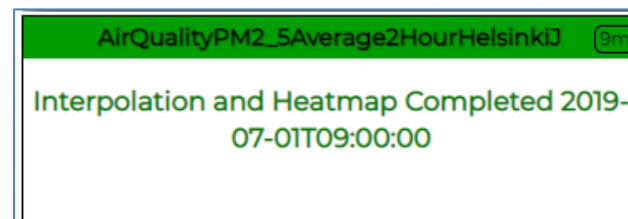
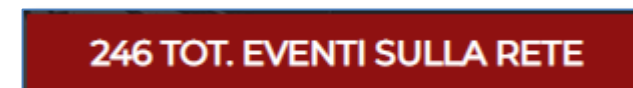
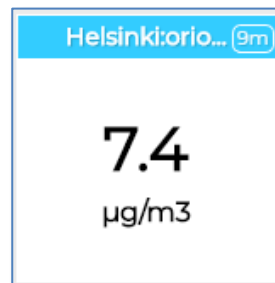
D3.js graphs



Single Content Widget (flexibility)

From Dashboard Editor and IOT Applications, accepts in input:

- Numbers
- String
- HTML code



<https://www.snap4city.org/578>

Controlling Single Content Wdgs from IoT App

```
{  
  "metricId": [The ID of a KPI], // or [Service Uri Of A Sensor]  
  "metricHighLevelType": "MyKPI", // or "Sensor"  
  "metricName": [The name of the MyKPI], // or [The name of the Sensor],  
  "metricType": [The type of the measure saved in the KPI] // or [A measure recorded by the sensor]  
}
```

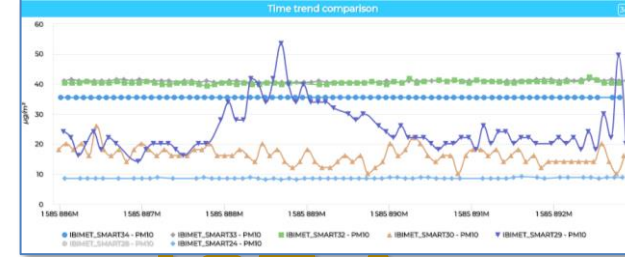
Two examples:

```
{  
  "metricId": "17056579",  
  "metricHighLevelType": "MyKPI",  
  "metricName": "OBD2 - Intake Air Temperature",  
  "metricType": "Temperature"  
}  
  
{  
  "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",  
  "metricHighLevelType": "Sensor",  
  "metricName": "tusc_weather_sensor_ow_3166540",  
  "metricType": "airTemperature"  
}
```

Similarly

- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- time trend

Send Control
The Widget
will get the
data from
storage



<https://www.snap4city.org/575>

Controlling MultiSeries from IOT App

Expected JSON in input

```
[
  {
    "metricHighLevelType": "Sensor",
    "metricName": [The name of the Sensor],
    "smField": [A measure recorded by the sensor],
    "serviceUri": [Service Uri Of A Sensor]
  },
  {
    "metricHighLevelType": "MyKPI",
    "metricName": [The name of the MyKPI],
    "smField": [The type of the measure saved in the KPI],
    "serviceUri": [The ID of a KPI]
  },
  {
    "metricHighLevelType": "Dynamic",
    "metricName": [The name of the dynamic data],
    "smField": [The type of the dynamic data],
    "metricValueUnit": [The unit of the dynamic data],
    "value": [An array of array of timestamp and value]
  }
]
```



```
[
  {
    "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
    "metricHighLevelType": "Sensor",
    "metricName": "tusc_weather_sensor_ow_3166540",
    "metricType": "airTemperature"
  },
  {
    "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3182522",
    "metricHighLevelType": "Sensor",
    "metricName": "tusc_weather_sensor_ow_3182522",
    "metricType": "airTemperature"
  },
  {
    "metricId": "17057447",
    "metricHighLevelType": "MyKPI",
    "metricName": "OBD2 - Intake Air Temperature",
    "metricType": "Temperature"
  },
  {
    "metricId": "17056579",
    "metricHighLevelType": "MyKPI",
    "metricName": "OBD2 - Intake Air Temperature",
    "metricType": "Temperature"
  },
  {
    "metricId": "",
    "metricHighLevelType": "Dynamic",
    "metricName": "BatteryGalaxyNote",
    "metricType": "Temperature",
    "metricValueUnit": "°C",
    "measuredTime": "2019-11-21T14:51:00Z",
    "value": 42
  },
  {
    "metricId": "",
    "metricHighLevelType": "Dynamic",
    "metricName": "Storage",
    "metricType": "Space",
    "metricValueUnit": "Gb",
    "measuredTime": "2019-11-21T14:51:00Z",
    "value": 12
  }
]
```



<https://www.snap4city.org/575>

Controlling BarSeries from IOT App

Similarly

- radar series
- pie chart
- table content

Expected JSON in input

```
[
  {
    "metricId": [Service Uri Of A Sensor],
    "metricHighLevelType": "Sensor",
    "metricName": [The name of the Sensor],
    "metricType": [A measure recorded by the sensor]
  },
  {
    "metricId": [The ID of a KPI],
    "metricHighLevelType": "MyKPI",
    "metricName": [The name of the MyKPI],
    "metricType": [The type of the measure saved in the KPI]
  },
  {
    "metricId": "",
    "metricHighLevelType": "Dynamic",
    "metricName": [The name of the dynamic data],
    "metricType": [The type of the dynamic data],
    "metricValueUnit": [The unit of the dynamic data],
    "measuredTime": [The ISO time of the measure of dynamic data],
    "value": [A dynamic value]
  }
]
```



```
[
  {"metricId":"17056320",
    "metricHighLevelType":"MyKPI",
    "metricName":"SiiMTuscanyTrackerLocation",
    "metricType":"Velocity"},
  {"metricId":"http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
    "metricHighLevelType":"Sensor",
    "metricName":"tusc_weather_sensor_ow_3166540",
    "metricType":"airTemperature"},
  {"metricId":"https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.d...",
    "metricHighLevelType":"Sensor",
    "metricName":"tusc_weather_sensor_ow_3182522",
    "metricType":"airTemperature"},
  {"metricId":"","
    "metricHighLevelType":"Dynamic", "metricName":"BatteryTemperatureGalaxyNote",
    "metricType":"Gradi Centigradi", "metricValueUnit":"°C",
    "measuredTime":"2019-11-21T14:51:00Z",
    "value":55.395468539280635},
  {"metricId":"","
    "metricHighLevelType":"Dynamic", "metricName":"BatteryTemperaturemia",
    "metricType":"Gradi Centigradi", "metricValueUnit":"°C",
    "measuredTime":"2019-11-21T14:51:00Z",
    "value":51.396725502373464},
  {"metricId":"","
    "metricHighLevelType":"Dynamic", "metricName":"BatteryTemperaturemia",
    "metricType":"airTemperature", "metricValueUnit":"°C",
    "measuredTime":"2019-11-21T14:51:00Z",
    "value":29.150364690965127}
]
```

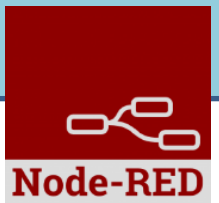


TOP

Device Tables vs IoT App data

Getting data from Dashboards

- 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



<https://www.snap4city.org/795>

<https://www.snap4city.org/809>

Device Table

Similar ma More Generic of the Event Table IoT App block and Widget

Device Table Node accepts multiple formats:

msg.payload =

```
{ ordering: "dateObserved",
```

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

```
  actions: ["https://upload.wikimedia.org/wikipedia/commons/thumb/6/6d/Windows_Settings_app_icon.png/1024px-Windows_Settings_app_icon.png", "pin"],
```

```
  columnsToShow: ["dateObserved", "vehicleFlow"]
```

```
}
```

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

- query: "https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=43.77;11.2&maxDists=700.2&model=CarPark",
- query: "https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=42.014990;10.217347;43.7768;11.2515&model=metrotrafficsensor&valueFilters=vehicleFlow>0.5;vehicleFlow<300",
- query: "https://www.snap4city.org/superservicemap/api/v1/iot-search/?selection=43.77;11.2&maxDists=200.2&model=metrotrafficsensor&valueFilters=vehicleFlow>10;vehicleFlow<400&serviceUri=http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO1;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO10;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO11;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO13;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO14;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO15;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO16;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO17;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO18;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO19;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO2;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO20;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO21;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO22;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO23;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO24;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO25;http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/METRO26 ",



ASCAP

Device Table Testing double

Thu 1 Sep 13:44:38

DT2 (4m)

Show 5

Search:

First << Prev 1 2 3 Next >> Last

device	capacity	dateObserved	Actions
CarParkStazioneFirenzeS.M.N.	877	2022-09-01T11:33:01.681Z	
CarParkStazioneFortezzaFiera	530	2022-09-01T11:33:01.681Z	
CarParkS.Ambrogio	379	2022-09-01T11:33:01.681Z	
CarParkAlberti	313	2022-09-01T11:33:01.681Z	
CarParkPieracciniMeyer		2022-09-01T11:33:01.681Z	

DT1 (43s)

Show 5

Search:

First << Prev 1 2 3 Next >> Last

device	capacity	dateObserved	Actions
CarParkStazioneFortezzaFiera	530	2022-09-01T11:33:01.681Z	
freeParkingLots 277			
occupancy			
occupiedParkingLots 253			
status			
CarParkStazioneFirenzeS.M.N.	877	2022-09-01T11:33:01.681Z	
CarParkS.Ambrogio	379	2022-09-01T11:33:01.681Z	
CarParkParterre	1006	2022-09-01T11:33:01.681Z	
CarParkCareggi	514	2022-09-01T11:33:01.681Z	

- The **Node accepts in Input:**
 - Ordering by a variable/attribute
 - List of SURJ (one prefix and a number of Names)
 - List of Actions as icons to be clicked
 - List of Columns to be shown on the table
 - Query selection + filters

```
msg.payload = {
  ordering: "status",
  prefix: "http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/",
  devices: ["Alarm001", "Car001", "Velox001",
    "Earthquake001", "Theater002", "Landslide001", "Theater002",
    "Landslide001"],
  actions: ["pin", "Action1", "Action1", "https://www.aa.org/my.img", ],
  columnsToShow: ["device", "startDate", "endDate", "status"]
}
```



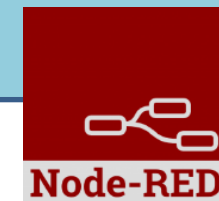
device	capacity	dateObserved	Actions
CarParkStazioneFortezzaFiera	530	2022-09-01T11:33:01.681Z	📍
freeParkingLots 277			
occupancy			
occupiedParkingLots 253			
status			
CarParkStazioneFirenzeS.M.N.	877	2022-09-01T11:33:01.681Z	📍
CarParkS.Ambrogio	379	2022-09-01T11:33:01.681Z	📍

- **Output:**
 - The Action clicked by the user with the name of the SURJ and ID

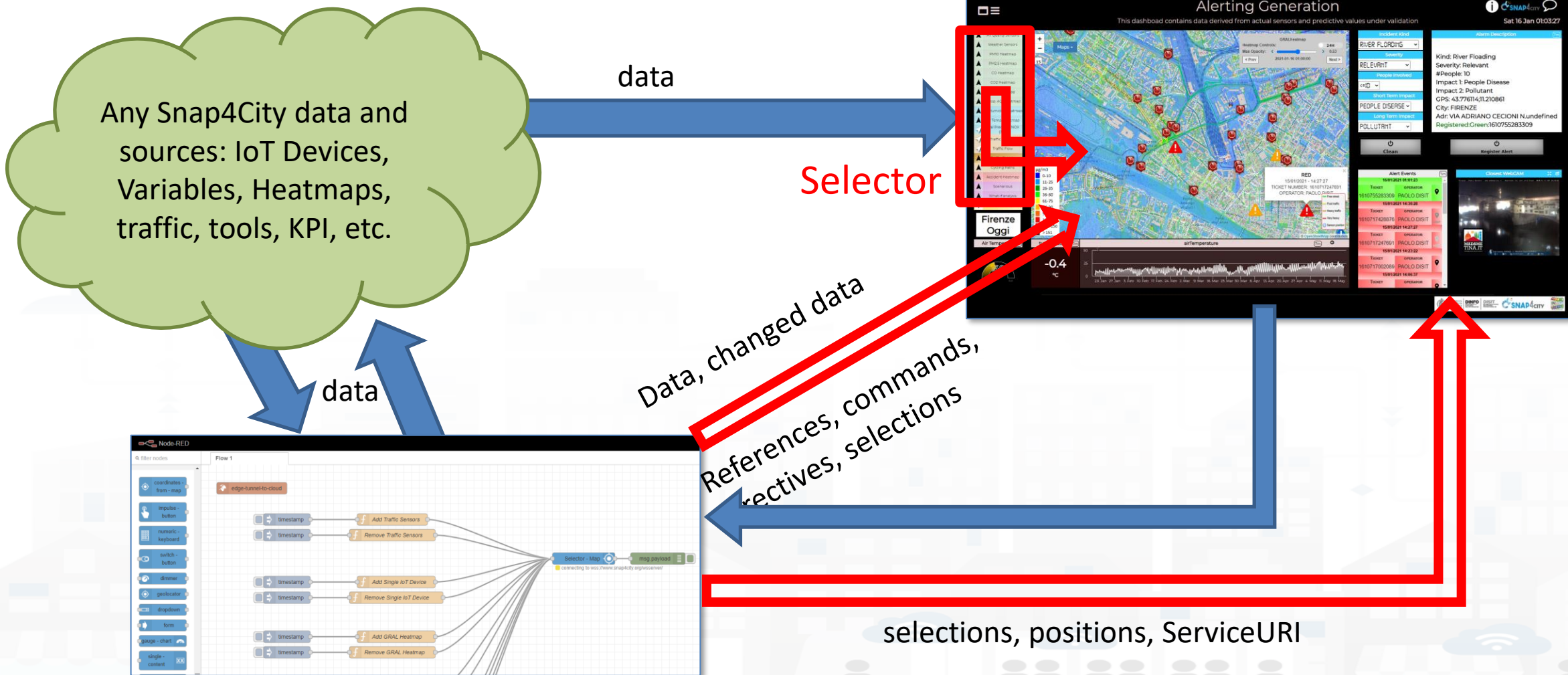
```
{"device": "Car001",
  "prefix": "http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/",
  "ordering": "startDate",
  "action": "Pin"
}
```

Widgets **MAP** with business intelligence on IoT Apps

- 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

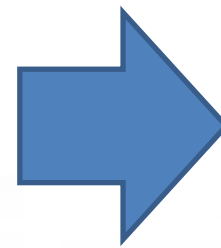


Maps Business Logic vs IOT Apps

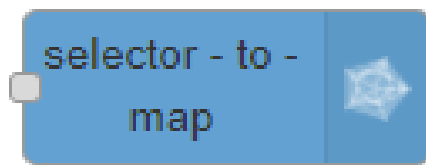


IoT App, Node-RED nodes: IoT App vs Dashboards

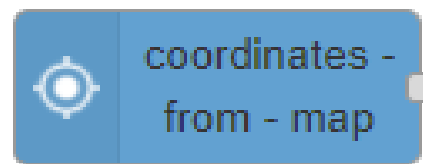
- **Coordinates From Map:**
 - Get GPS click from Map
 - Get Selected ServiceURI from Map
- **SelectorMap:**
 - Send commands, references, data to Maps



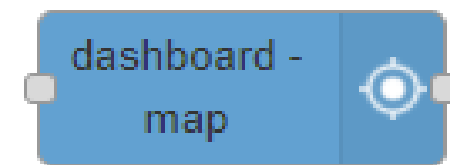
- **Dashboard Map provides:**
 - All Features of
 - Coordinate From Map:
 - SelectorMap:



+



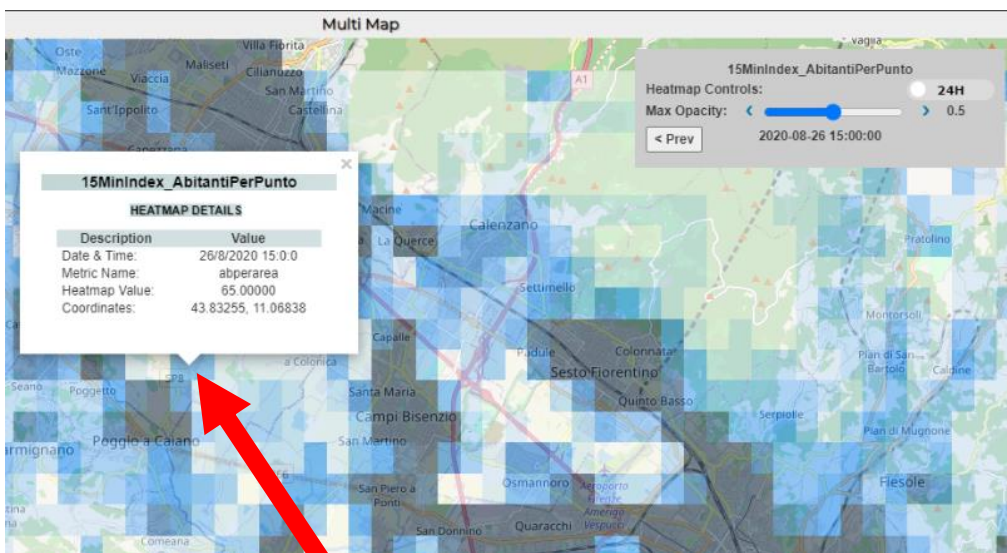
= =



SelectorMap and Coordinates From Map will be Deprecated from Snap4City Library in late 2022

Dashboard Map will be the only one supported since April 2022 and after

Multi Data Map GPS Location Picking vs IOT App



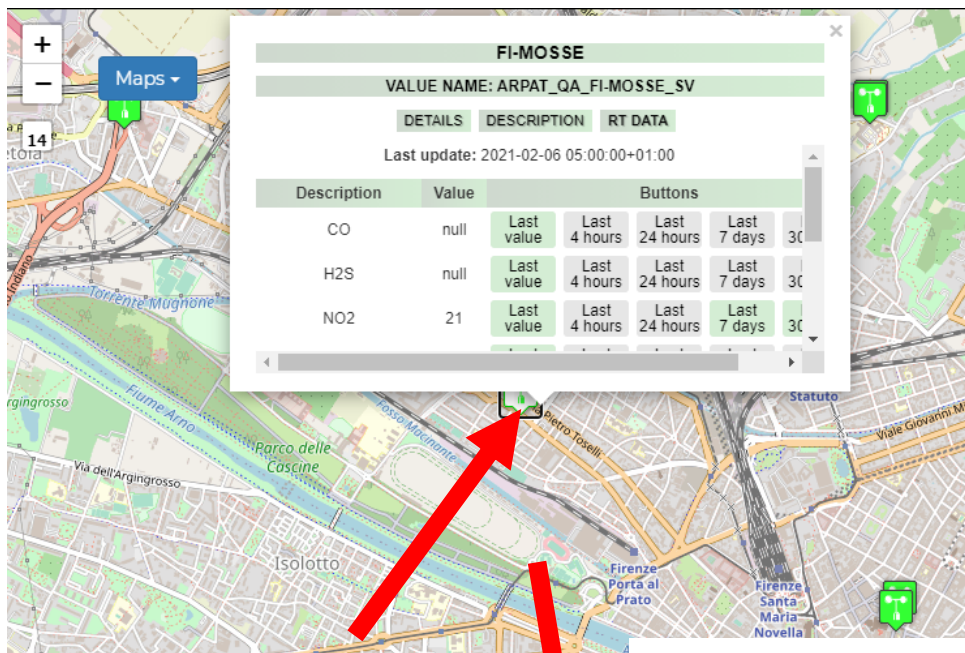
1) Click

2) GET event with:

- Lat,Long
- ServiceURI

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

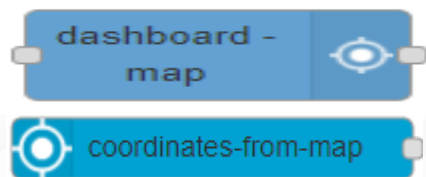
Multi Data Map ServiceURI selection vs IOT App



- 3) The click on the map passes GPS coordinates into IOT App and the ServiceURI. Thus you can use them to:

- search for location
- picking the value of one or more heatmaps
- dynamically change data on widgets and dashboards
- **Get all the ServiceURI information and exploit them on Business Logic**
- Etc.

1) Click on PIN

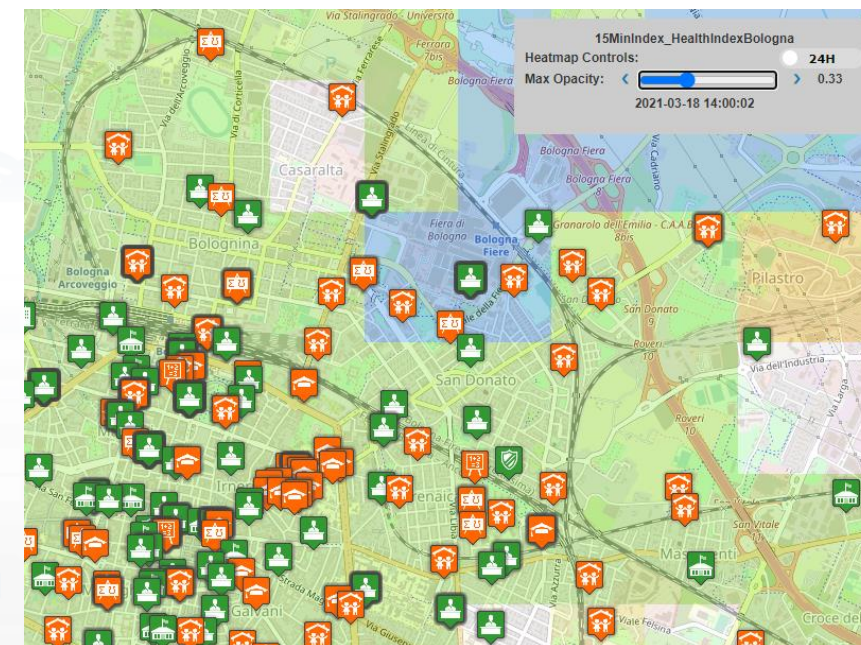
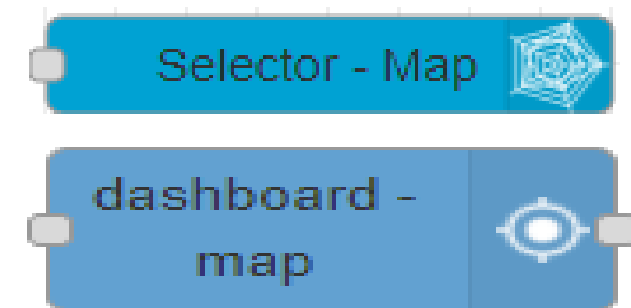


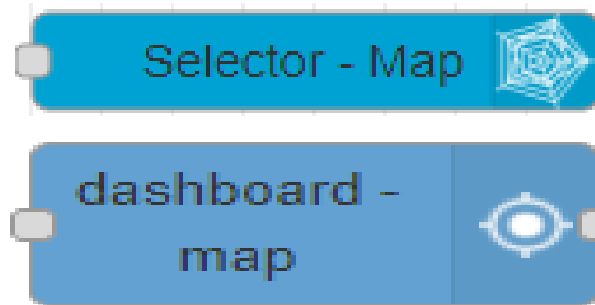
2) GET event with:

- Lat,Long
- **ServiceURI**

Controlling Maps from IOT Apps

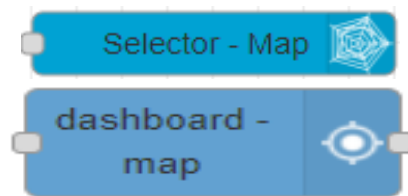
- User manual: <https://www.snap4city.org/774>
- To control Multi Data Map from IOT App
 - Add/remove a Category/SubCategory of Entities, via *more option query*
 - Add/remove a single Device/PIN, MyPOI, MyKPI, Dynamic Pins, moving devices, etc.....
 - Add/remove cycling paths
 - Add/remove OD Matrix
 - Add/remove an Heatmap, a Traffic Flows, ...
 - Add/remove multiple entities with multiple More Option Queries
 - Add/remove Special Tools: scenarios, whatif, etc.
 - Add/remove a set/single temporary GeoInfoPin





```
msg.payload = {  
  "type": "addSelectorPin",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData": {  
    "desc": "my studio temperature - GP -",  
    "query": "datamanager/api/v1/poidata/17055853",  
    "color1": "#ffdb4d",  
    "color2": "#fff5cc",  
    "display": "pins",  
    "queryType": "MyPOI",  
    "pinattr": "square",  
    "pincolor": "#959595",  
    "symbolcolor": "undefined",  
    "iconTextMode": "text",  
    "altViewMode": "None",  
    "bubbleSelectedMetric": ""  
  }  
};  
return msg;
```

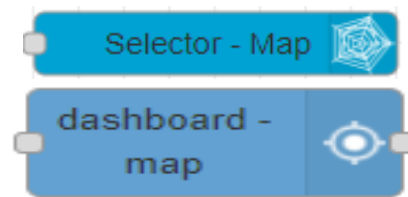
Add MyKPI
Add MyPOI



```
msg.payload = {  
  "type": "addHeatmap",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData": "https://wmserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=FirenzeTrafficRealtime&trafficflowmanager=true",  
  "passedParams": {  
    "desc": "Traffic Heatmap",  
    "color1": "rgba(0,179,61,0)",  
    "color2": "rgba(114,235,133,1)"  
  }  
}
```

Remove Heatmap

```
msg.payload = {  
  "type": "removeHeatmap",  
  "target": "w_Map_956_widgetMap32131«,  
  "isTrafficHeatmap": true  
}  
}
```

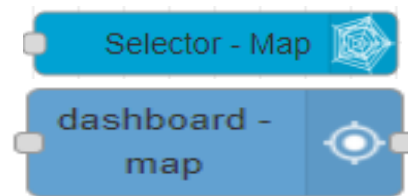


```
payload : {  
  "type": "addOD",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData" : "https://odmm.snap4city.org/api/get?precision=communes&from_date=2017-10-19%2000:00:00&organization=Tuscany&inflow=True&longitude=11.257123947143556&latitude=43.771837562821375",  
  "passedParams": {  
    "desc": "OD Matrix Toscana",  
    "color1": "rgba(172,82,254,1)",  
    "color2": "rgba(172,82,254,0.46)",  
  }  
}
```

Add OD Matrix

```
payload = {  
  "type": "removeOD",  
  "target": "w_Map_956_widgetMap32131",  
}
```

Remove OD Matrix



```
payload : {  
  "type": "addGeoInfoPin",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData": [{  
    "id": "GeoInfoPin-01",  
    "eventType": "GeoInfoPin",  
    "textHtml": "<b>Title</b><br>Text Info2.<br><br><a href='http://www.disit.org/' target='_blank'>DISIT Lab</a>",  
    "lat": " 43.76950",  
    "lng": "11.125835"  }, ... ]  
}
```

Add GeoInfoPin set of

```
payload : {  
  "type": "removeGeoInfoPin",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData": [{  
    "id": "GeoInfoPin-01",  
    "eventType": "GeoInfoPin",  
    "lat": " 43.76950",  
    "lng": "11.125835"  
  }, ...]  
}
```

Remove GeoInfoPin set of

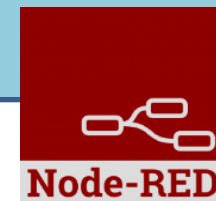


TOP

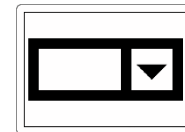
Selector and Forms vs IOT App data

Getting data from Dashboards

- Processing Logics / IOT App ▾
- Processing Logics / IOT App
- ↑ MicroServices for Proc.Logic/IoT App
- ↑ MicroServices from DataAnalytic
- ☐ IOT MicroServices for Final Users
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DropDown Selector



Dashboard Name: SVG Custom Widgets Examples 2

Widget Name: Traffic Light status set

OFF	0	x
RED LIGHT	1	x
RED and YELLOW LIGHT	2	x
YELLOW LIGHT	3	x
YELLOW and GREEN LIK	4	x
GREEN LIGHT	5	x

+ add

Edit Dashboard View Dashboard

Traffic Light status set

RED LIGHT

Traffic Light status set

RED LIGHT

OFF

RED LIGHT

RED AND YELLOW LIGHTS

YELLOW LIGHT

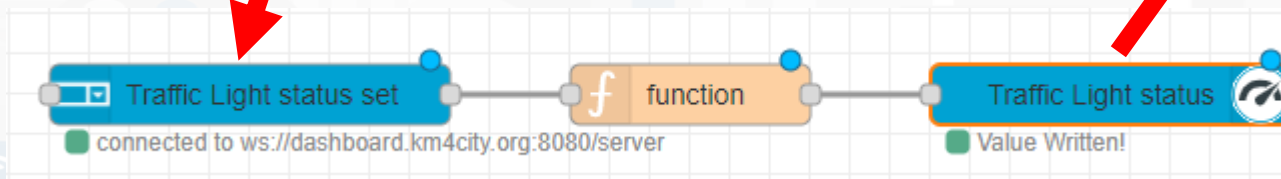
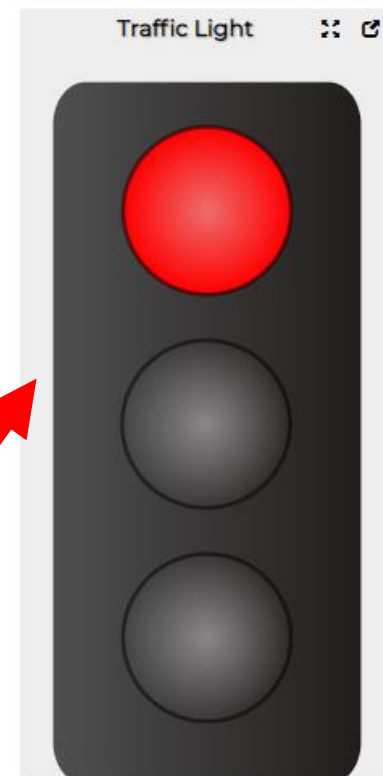
YELLOW AND GREEN LIGHTS

GREEN LIGHT

RED, YELLOW AND RED LIGHTS

BLINKING YELLOW

- Selecting MSG to be sent on the Business Logic IOT Application



Traffic Light status set

RED LIGHT

HTML

```

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

```

Form

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

HTML



IOTDevice Data

enter text	<input type="text"/>
enter number	<input type="text"/>
enter email	<input type="text"/>
enter password	<input type="password"/>
<input checked="" type="checkbox"/> enter check	
<input type="checkbox"/> enter check2	
enter switch	<input type="checkbox"/>
enter switch2	<input type="checkbox"/>
enter date	<input type="text" value="gg/mm/aaaa"/>
enter time	<input type="text" value="--:--"/>

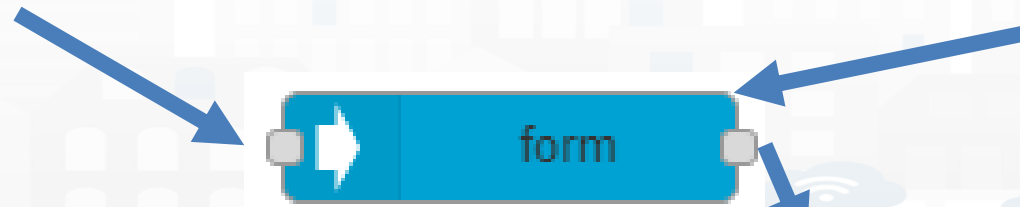
Submit

Form

```
msg.payload = { "form": { "options": [
  { "label": "enter text", "value": "", "type": "text", "required": true },
  { "label": "enter number", "value": "", "type": "number", "required": false },
  { "label": "enter email", "value": "", "type": "email", "required": false },
  { "label": "enter password", "value": "", "type": "password", "required": false },
  { "label": "enter check", "value": "checked", "type": "checkbox", "required": false },
  { "label": "enter check2", "value": "", "type": "checkbox", "required": false },
  { "label": "enter switch", "value": "on", "type": "switch", "required": false },
  { "label": "enter switch2", "value": "", "type": "switch", "required": false },
  { "label": "enter date", "value": "", "type": "date", "required": false },
  { "label": "enter time", "value": "", "type": "time", "required": true }
], "selected": [] } }
```

return msg;

HTML



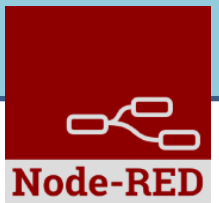
```
"selected": ["a text", "123", "paolo.nesi@unifi.it", "aaaaaa",  
"checked", "", "on", "", "2021-03-19", "09:38"]
```

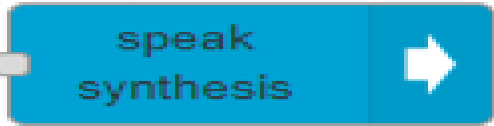

TOP

Talk to your users


Producing voice on Dashboards

- Processing Logics / IOT App ▾
- Processing Logics / IOT App
- ↑ MicroServices for Proc.Logic/IoT App
- ↑ MicroServices from DataAnalytic
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Send Voice Messages on Dashboards

- **Connectable** on all «String» Variables
- **Controllable** from IoT Applications
- Play button on Dashboard 
- **Configurable** as:
 - Voice Language and male, female, ...
 - rate, pitch
 - ..

Edit speak-synthesis node

Delete Cancel Done

Properties

Authentication: Add new snap4city-authentication...

text: insert text

rate: insert rate. 1 is the default

pitch: insert pitch. 1 is the default

lang: [dropdown]

Dashboard Name: [dropdown] New Dashboard

Widget Name: Widget Name

Edit Dashboard View Dashboard

You must have an account with Snap4city to use this node. You can register for one [here](#).

help

search help

speak-synthesis

With this node you can send a voice message to an existing dashboard or a new one created by the node.

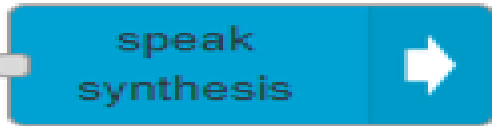
Configuration

text *string*
Text of the message to be sent

rate *string*
Speed of execution. 1 is the default value

pitch *string*
Running tone. 1 is the default value

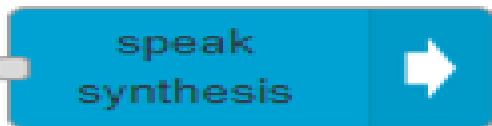
lang *string*
String to select language and voice. The possible choices are:
'engF' for English woman
'engM' for English man
'itF' for Italian woman
'itM' for Italian man
'frF' for French woman
'frM' for French man
'esF' for Spanish woman
'esM' for Spanish man



Send Voice Messages on Dashboards

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





Send Voice Messages on Dashboards

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



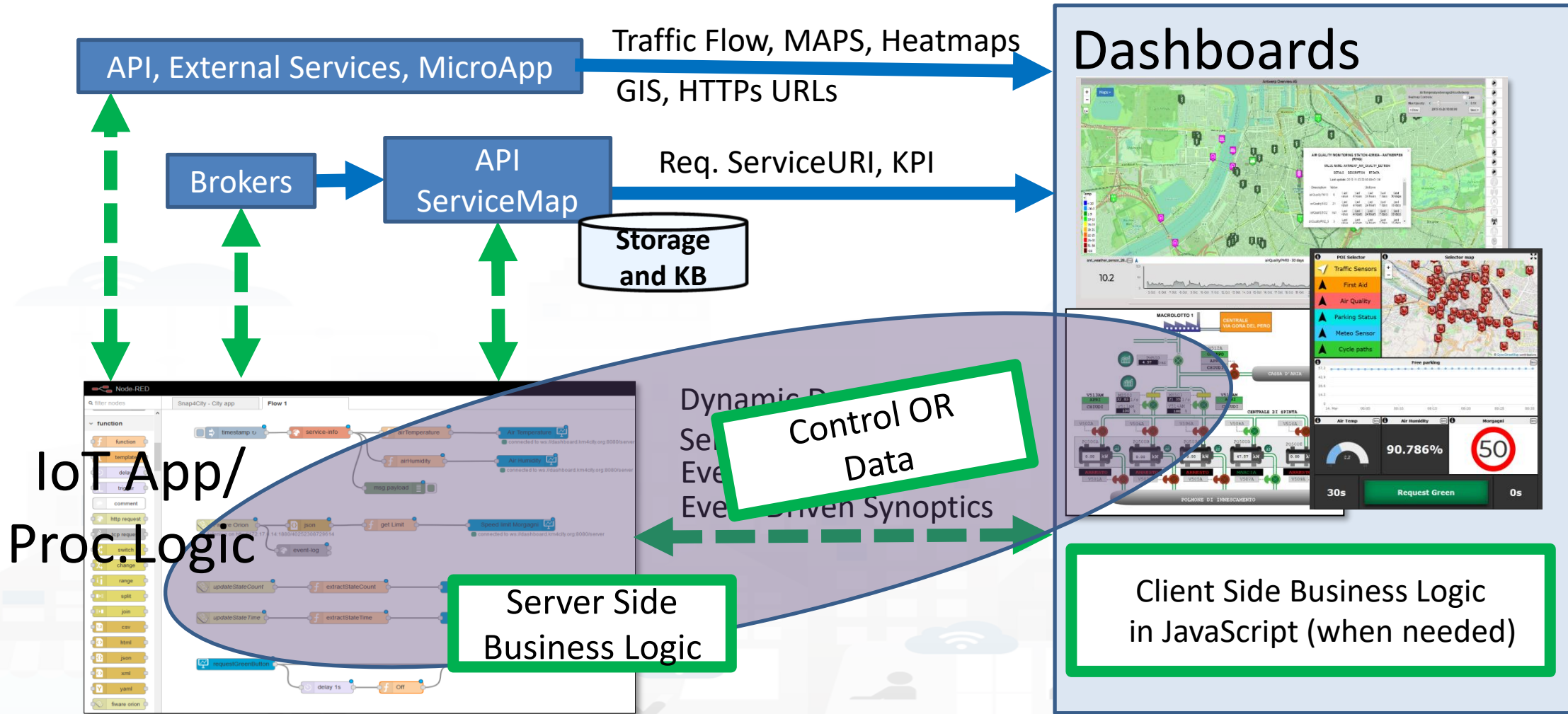
TOP

Dynamic Widgets data on Dashboard from IOT Applications

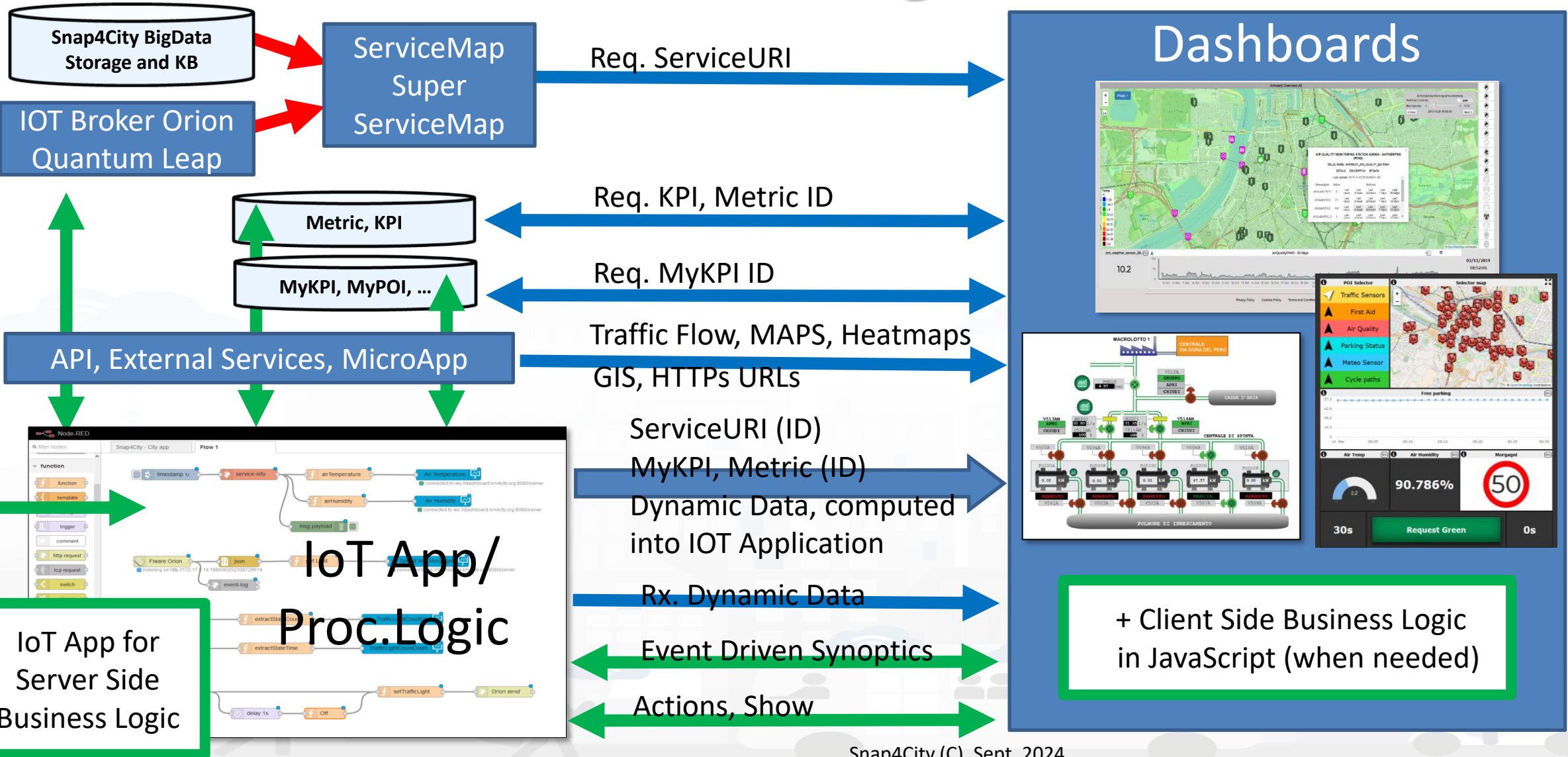
- Processing Logics / IOT App ▾
- Processing Logics / IOT App
- 👤 MicroServices for Proc.Logic/IoT App
- 👤 MicroServices from DataAnalytic
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How the Dashboards exchange data



How the Dashboards exchange data



Widgets ICONS	Widget Name, Description	IOT App	Dashboard-IOT App	KPI (metric)	MyPersonalID ata	MyData	My KPI	Sensor
	Single Content	X (cs)	X (ED)	X	X	X	X	X
	Custom widgets in SVG are data driven	X (cs)	X (ED)				X	X
	Speedometer, Gauge	X (cs)	X (ED)	X	X	X	X	X
	Device Table	X (cs)	X (ED)				X	X
	Single Bar, V/H	X	X (ED)	X				
	Single and Multiple Bars, stacked or not, ordered	X (cs)	X (ED)	X	X	X	X	X
	MultiSeries, shaded, staked and non staked, TTT	X (cs)	X (ED)	X	X	X	X	X
	Time Trend (single)	X	X (ED)	X	X	X	X	X
	Time Trend Compare			X			X	X
	SpiderNet, radar, Kiviati	X (cs)	X (ED)	X	X	X	X	X
	Pie, Donut, 2 layers Donut	X (cs)	X (ED)	X	X	X	X	X
	Table	X (cs)	X (ED)	X	X	X	X	X
	Calendar	X (cs)	X (ED)				X	X
	Speak Synthesis	X (cs)	X (ED)				string	string
	Maps	X (cs)	X (ED)	Many High Level Types			X	X

DD: Event Driven

- **IoT App / Proc.Logic column in previous table:**
 - **X:** means that from the IoT App you can send a new value or array to the widget directly, without the need to have is stored into Sensor or MyKPI variable, etc.
 - **CS, widget supports Change (data) Source**, in the sense that: from the IoT App is possible to send a command to the Widget to change the data source. E.g., selecting sources among: Sensors (serviceURI), MyKPI (ID), any value produced on the IoT App directly. **(cs) recent additions**
- **Dashboard IoT App column in previous table:**
 - **X:** there is a MicroService / node on IoT App to act on those widgets on dashboard. The data are visualized.
 - **ED, widget is Data/Event Driven**, in the sense that new data in push can be sent and the widget is updated in real time on web page without web page reloading

[TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications](#) (partially obsolete)

TOP

Demo IoT Application exploiting Snap4City Dashboard

- Processing Logics / IOT App ▾
- Processing Logics / IOT App
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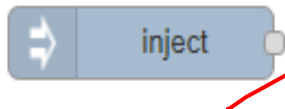


Example of complex IOT Application

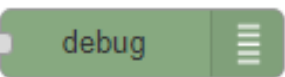
In this demo let's create an IoT Application that:

- send random values on Snap4city's Dashboard
- create complex widget based on MyKPI e SURI

Nodes for flow



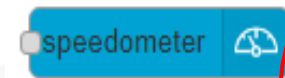
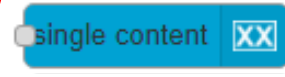
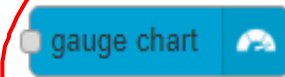
Generates an input for the other nodes. It can be repeated at predefined intervals, entered manually and of various types (timestamp, string, number, boolean, JSONetc)



Each message that enters the debug node is shown in the "debug" tab on the right of nodered (you can choose which part of the message to show)



Generates a random number. You can configure the number generation interval and the type (integer or float).



Display values in different modes on a dashboard. The node called single content accepts strings, numbers and html. The others only accept numbers.

Step 1



- Inject and Debug

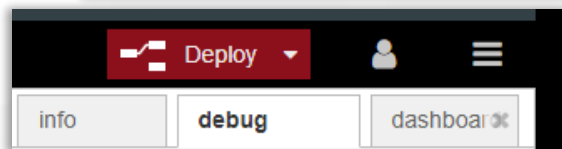


- Connect

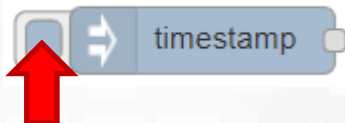
Payload: timestamp
Topic:
Repeat: interval
every 15 minutes
 Inject once at start?

- Configure

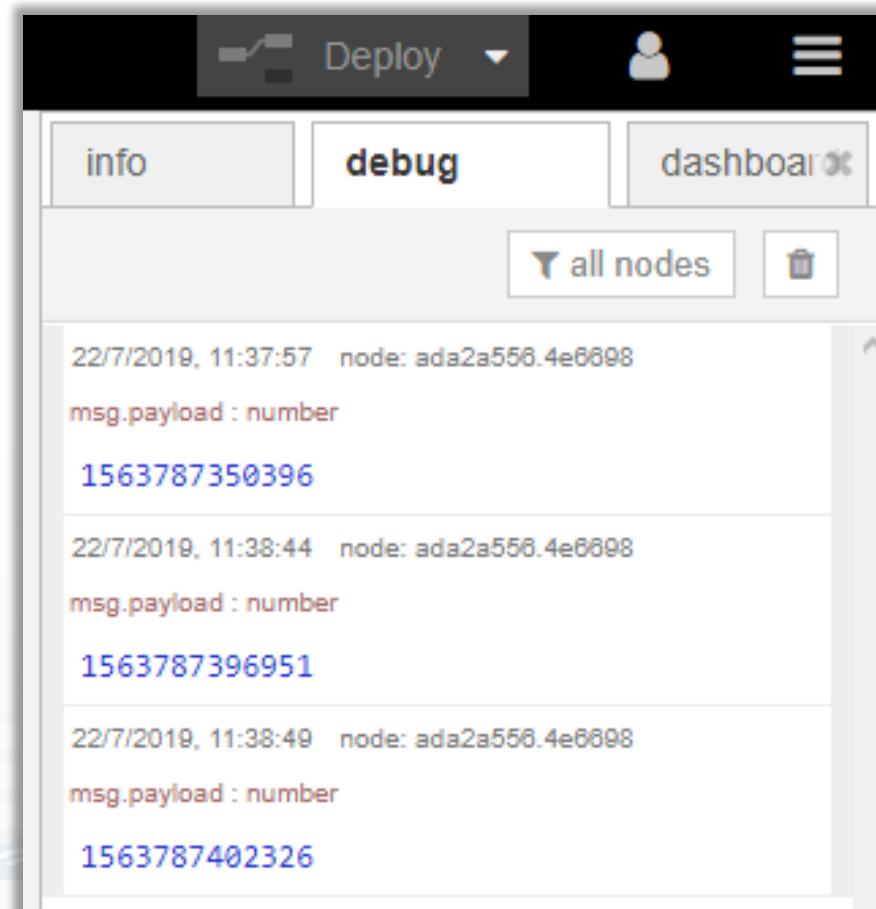
- Deploy



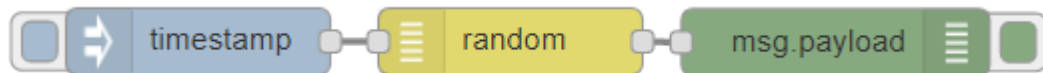
- Click



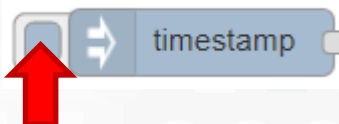
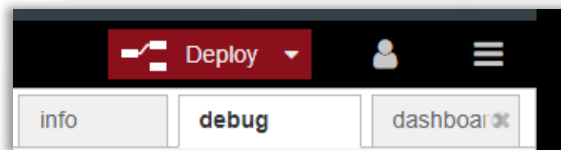
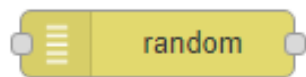
- Observe



Step 2



- Random
- Connect
- Configure
- Deploy
- Click
- Observe



```
8/4/2020, 14:19:16 node: 54db7d04.3fa264
msg.payload : number
6

8/4/2020, 14:19:18 node: 54db7d04.3fa264
msg.payload : number
20

8/4/2020, 14:19:20 node: 54db7d04.3fa264
msg.payload : number
42

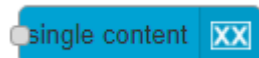
8/4/2020, 14:19:21 node: 54db7d04.3fa264
msg.payload : number
78
```



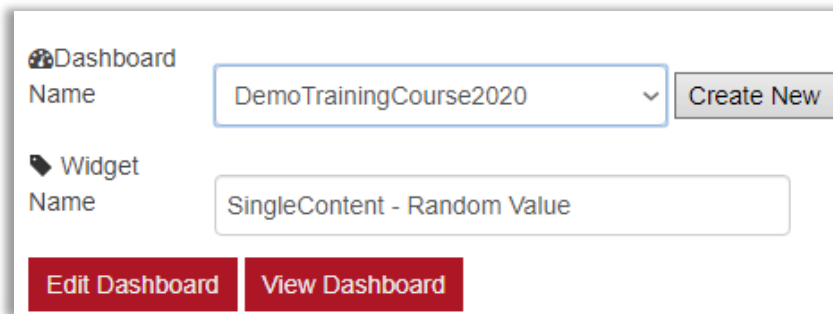
Step 3



- Single content

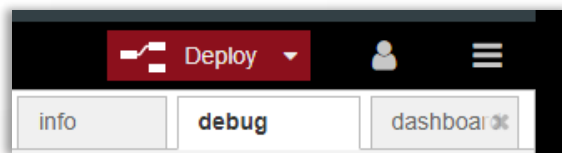


- Connect

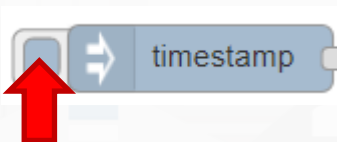


- Configure

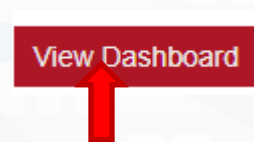
- Deploy



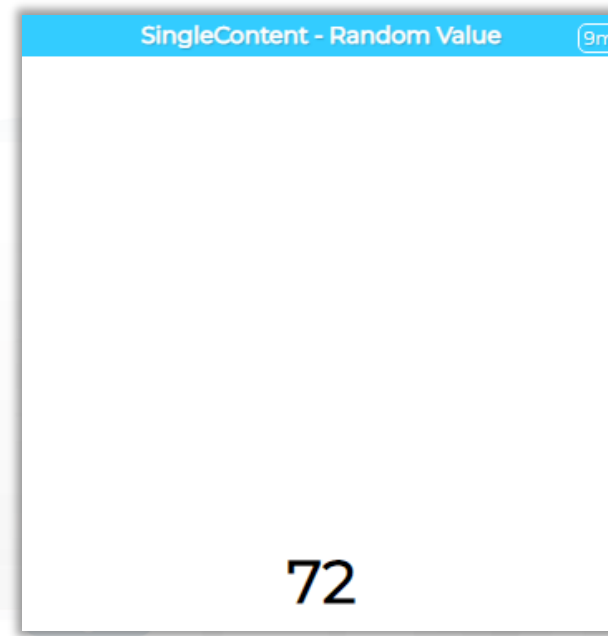
- Click



- Click



- Observe



Nodes configuration

inject

Payload timestamp

Topic

Repeat interval

every 15 minutes

Inject once at start?

debug

Output msg.payload

to debug tab

Name Name

gauge chart

single content

speedometer

time trend

Dashboard Name DemoTrainingCourse2020 **Create New**

Widget Name SingleContent - Random Value

Edit Dashboard **View Dashboard**

random

msg.payload

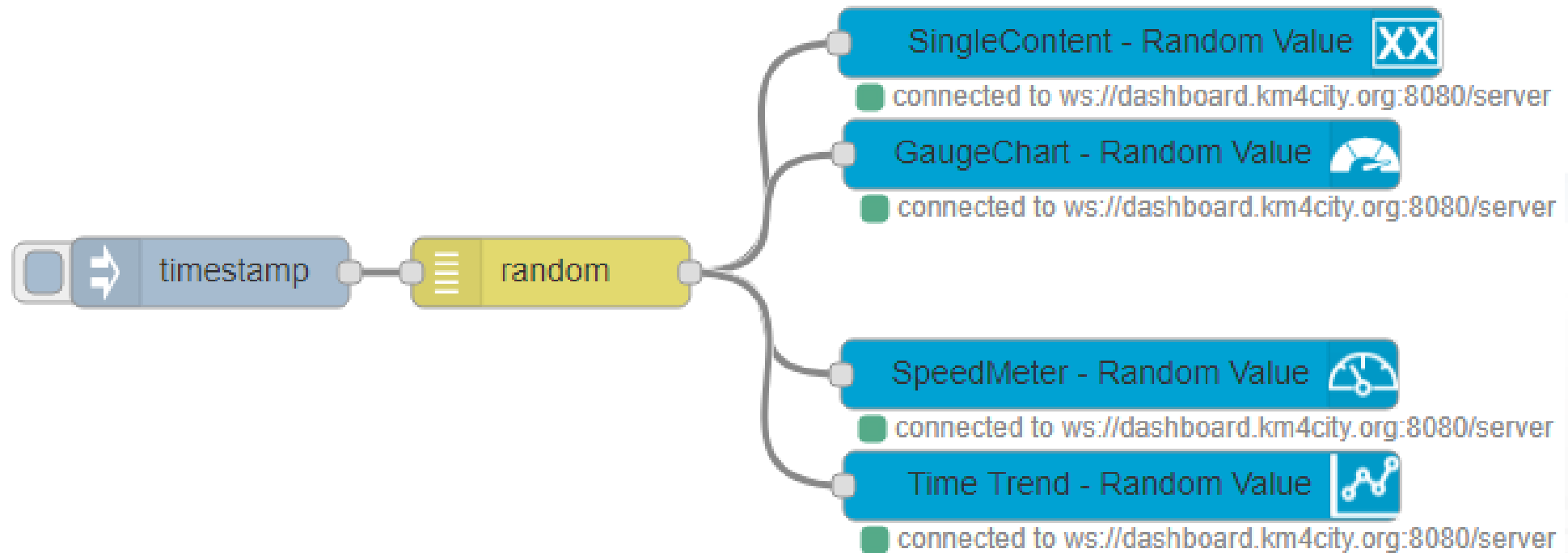
Generate a whole number - integer

From 1

To 100

Name Name

Nodes connections

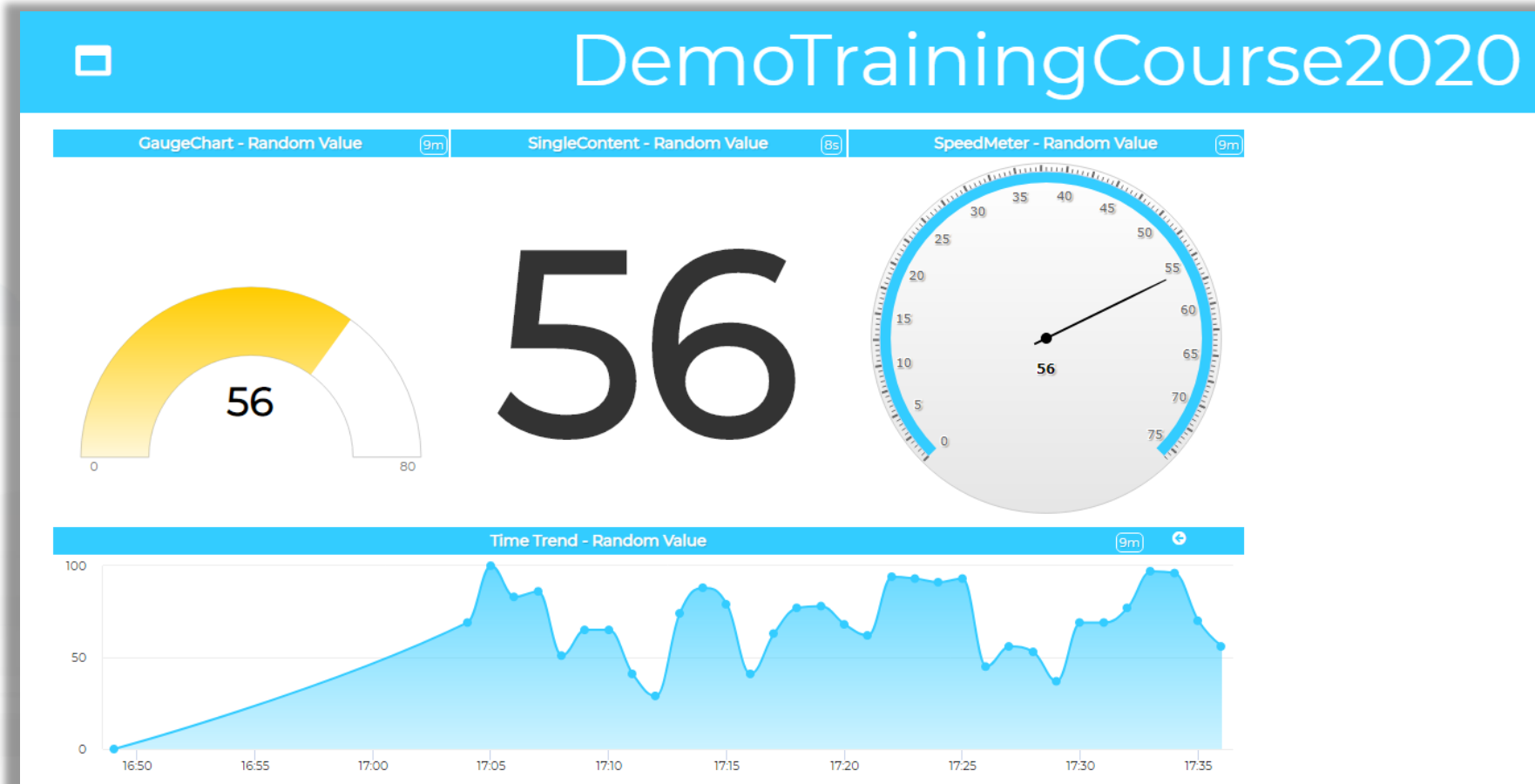


Explaining: IOT Application Flow

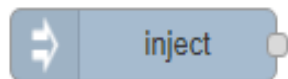
- On Click or Every 15 minutes the ***timestamp*** node sends a message to the ***random*** node.
- When the message arrives, the ***random*** node generates a random number as output message.
- The Number can be sent to Different kinds of nodes to show it on NodeRed Dashboard.



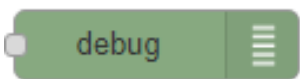
Resulting Dashboard



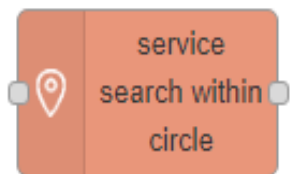
Nodes for flow



Generates an input for the other nodes. It can be repeated at predefined intervals, entered manually and of various types (timestamp, string, number, boolean, JSONetc)

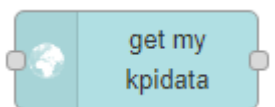


Each message that enters the debug node is shown in the "debug" tab on the right of nodered (you can choose which part of the message to show)



Search in around a certain point of the indicated service. It returns:

- servicesUri of all the services found,
- a GeoJSON containing a minimum of information about the services found, including the coordinates and the name of the service.



Retrieve the information about My KPIData saved on the Snap4city platform



Display values in different modes on a dashboard. Check info of the node in the Node-RED tab.



Step 1



- Inject and Debug



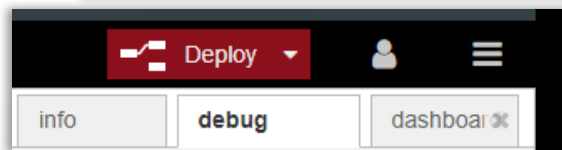
- Connect

- Configure

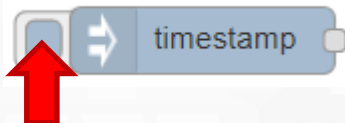
Node-RED configuration for the inject node:

- Payload: timestamp
- Topic: (empty)
- Repeat: interval
- every: 15 minutes
- Inject once at start?

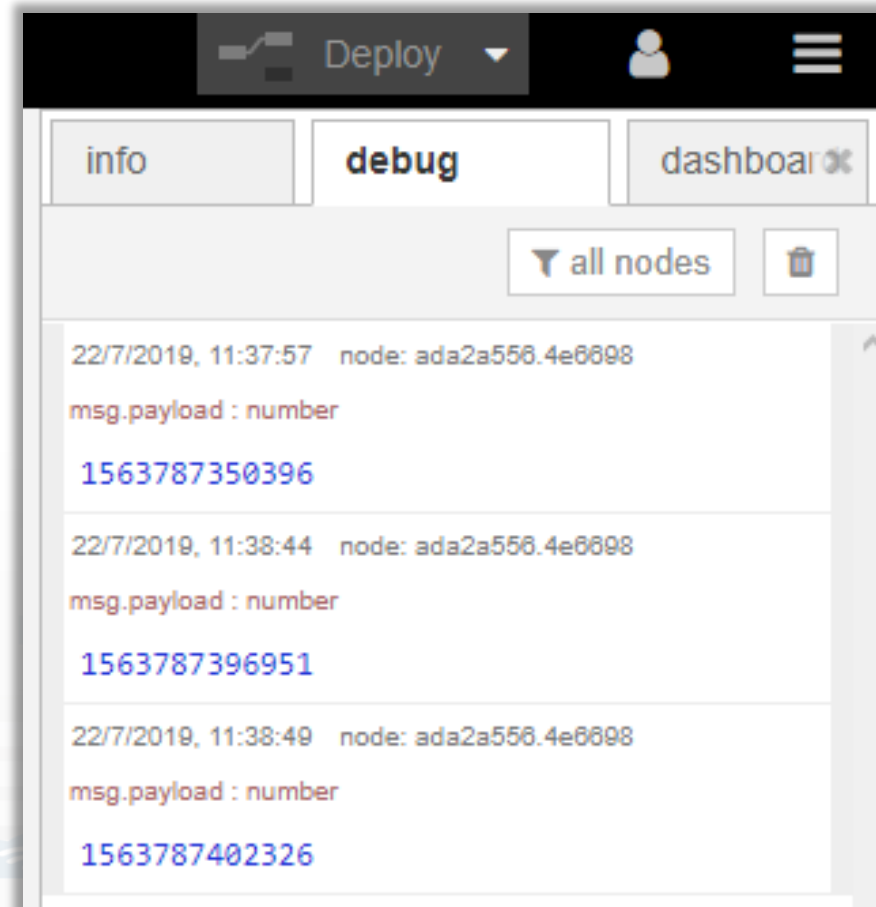
- Deploy



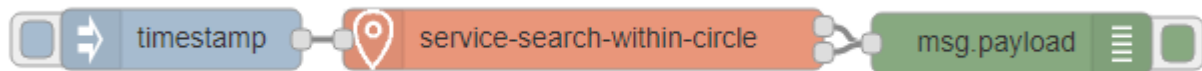
- Click



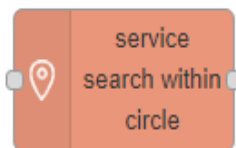
- Observe



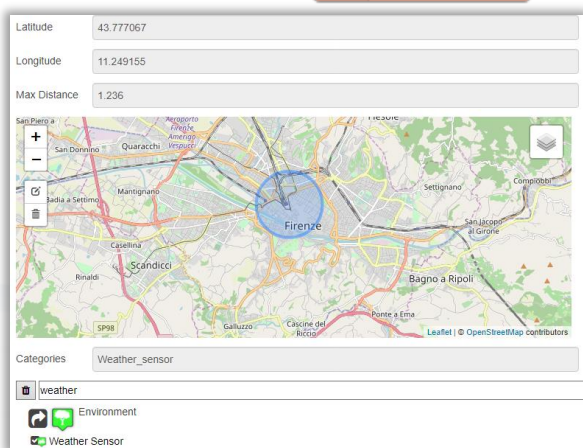
Step 2



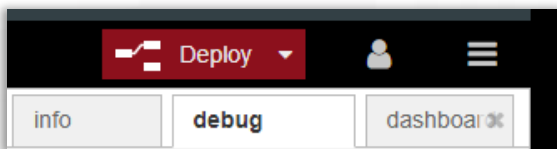
- Service Search Within Circle



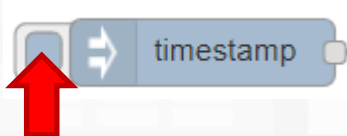
- Connect
- Configure



- Deploy



- Click



- Observe



Copy the path

Copy the value



Step 1 Bis



- Inject and Debug



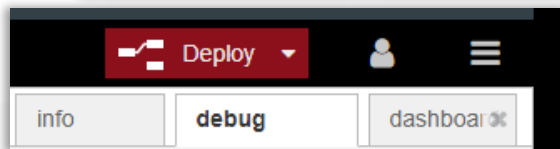
- Connect

- Configure

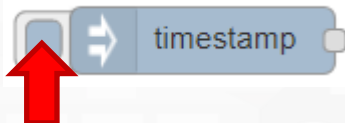
Node-RED configuration for the inject node:

- Payload: timestamp
- Topic: [empty]
- Repeat: interval
- every: 15 minutes
- Inject once at start?

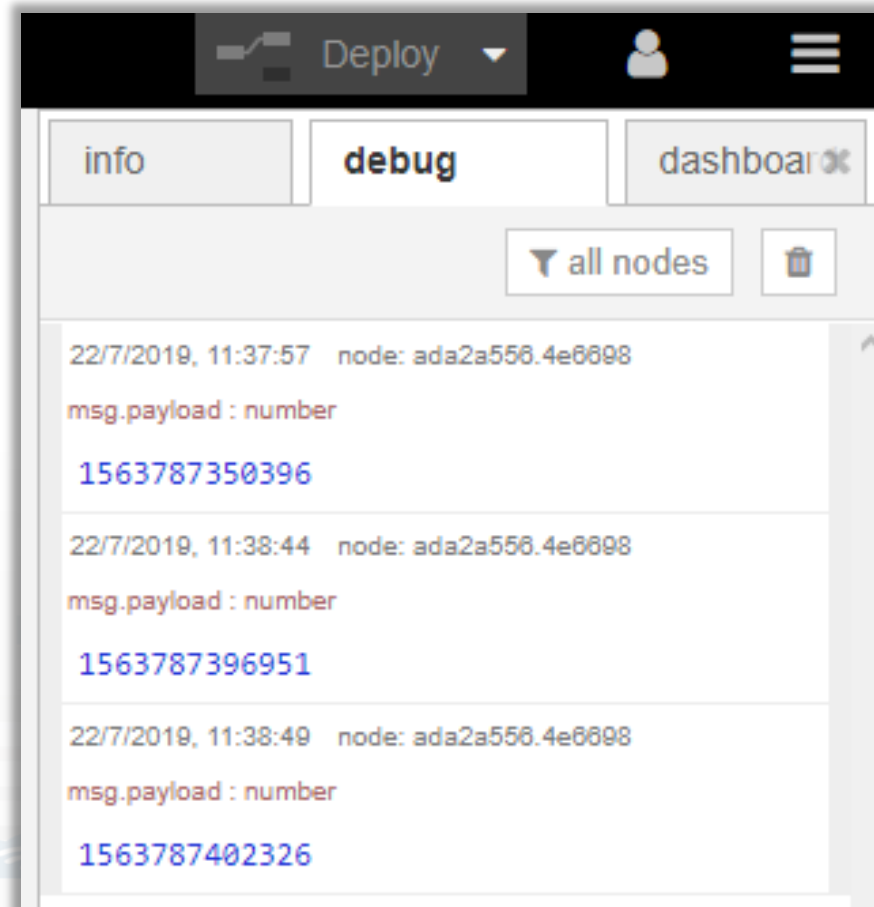
- Deploy



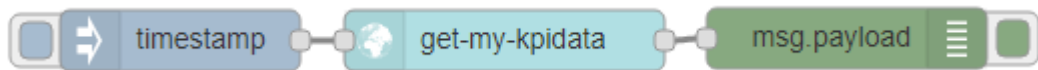
- Click



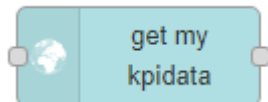
- Observe



Step 2 Bis

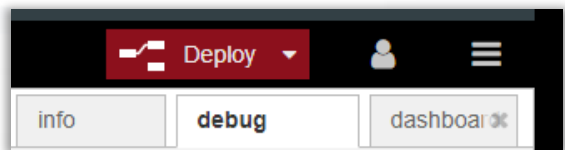


- Get My KPIData

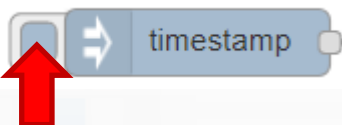


- Connect

- Deploy



- Click



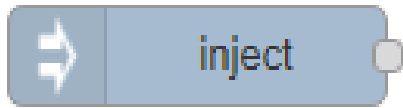
- Observe

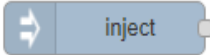


```
id: 17057458
description: ""
healthiness: "false"
highLevelType: "MyKPI"
info: ""
insertTime: 1586359858000
valueName: "Room 1"
lastDate: 1586359858000
lastValue: "0.054644625420117166"
latitude: ""
longitude: ""
valueType: "Temperature"
valueUnit: "°C"
nature: "Environment"
organizations: "[ou=DISIT,dc=ldap,dc=disit,dc=unifi]"
ownership: "private"
subNature: "Weather_sensor"
dataType: "float"
username: "badii"
[40 ... 40]
  40: object
    id: 17057459
    description: ""
    healthiness: "false"
    highLevelType: "MyKPI"
    info: ""
    insertTime: 1586359858000
    valueName: "Room 2"
    lastDate: 1586359858000
    lastValue: "1.3839476707239307"
```



Step 3



- Inject Node 
- Configure with data of Weather Sensors and MyKPI retrieved at the previous steps

```
1 [
2   {
3     "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
4     "metricHighLevelType": "Sensor",
5     "metricName": "tusc_weather_sensor_ow_3166540",
6     "metricType": "airTemperature"
7   },
8   {
9     "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3182522",
10    "metricHighLevelType": "Sensor",
11    "metricName": "tusc_weather_sensor_ow_3182522",
12    "metricType": "airTemperature"
13  },
14  {
15    "metricId": "17057458",
16    "metricHighLevelType": "MyKPI",
17    "metricName": "Room 1",
18    "metricType": "Temperature"
19  },
20  {
21    "metricId": "17057459",
22    "metricHighLevelType": "MyKPI",
23    "metricName": "Room 2",
24    "metricType": "Room Temperature"
25  }
26 ]
```



Step 4



- Bar Series



- Connect

Dashboard configuration form:

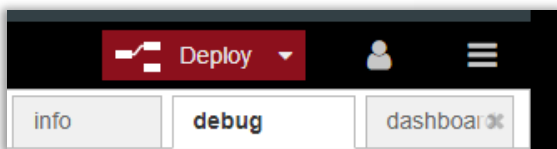
Name: DemoTrainingCourse2020 [Create New]

Widget Name: Bar Series

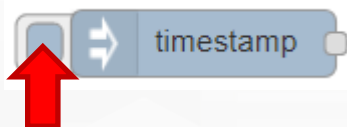
[Edit Dashboard] [View Dashboard]

- Configure

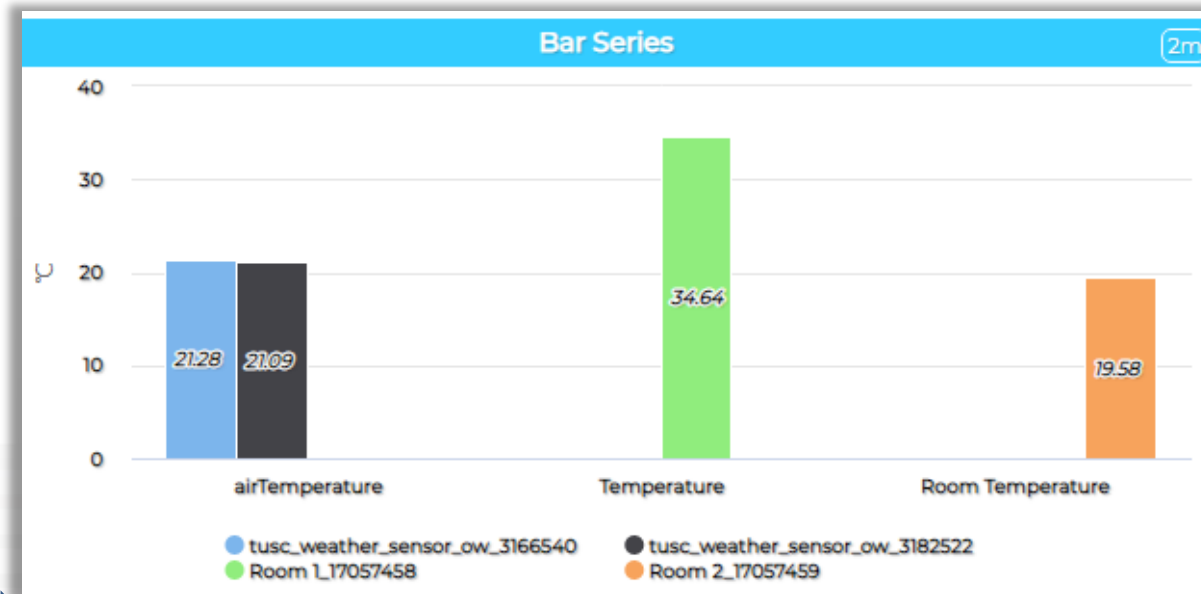
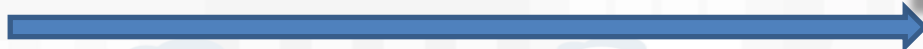
- Deploy



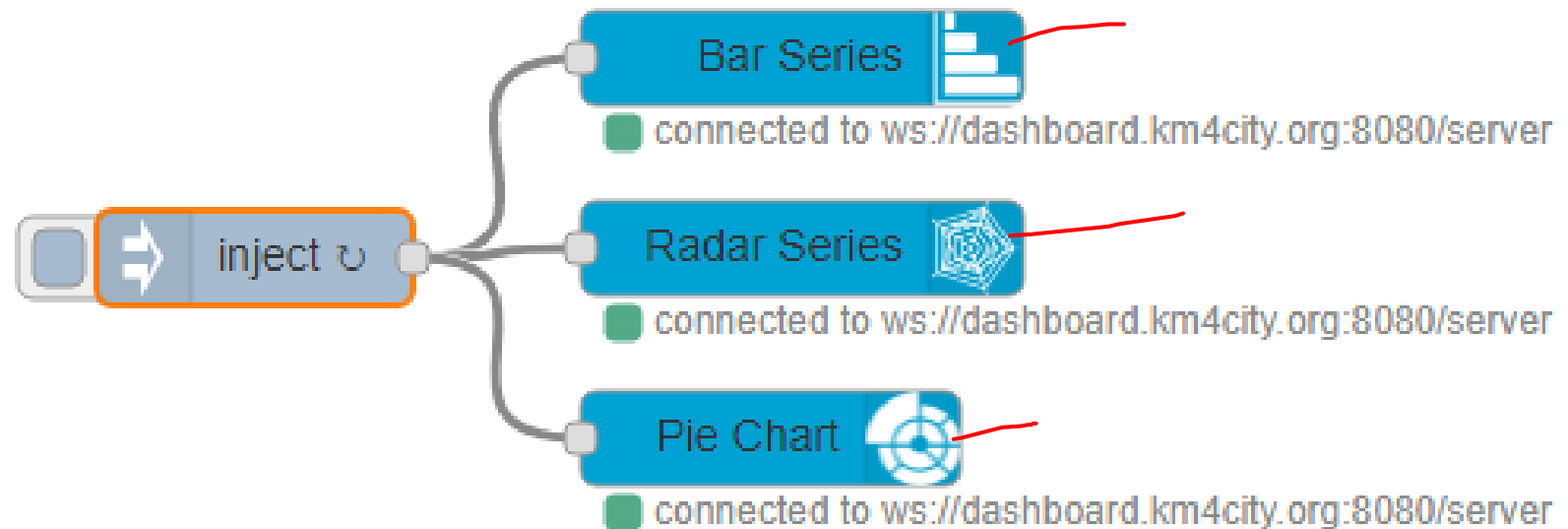
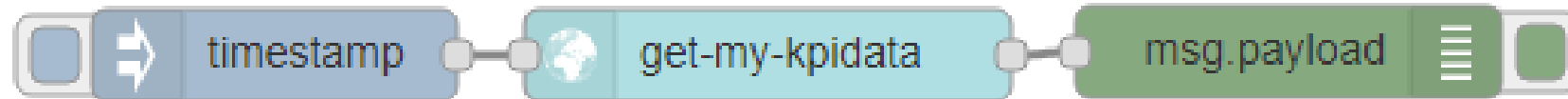
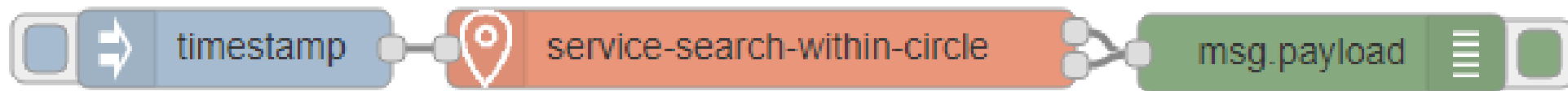
- Click



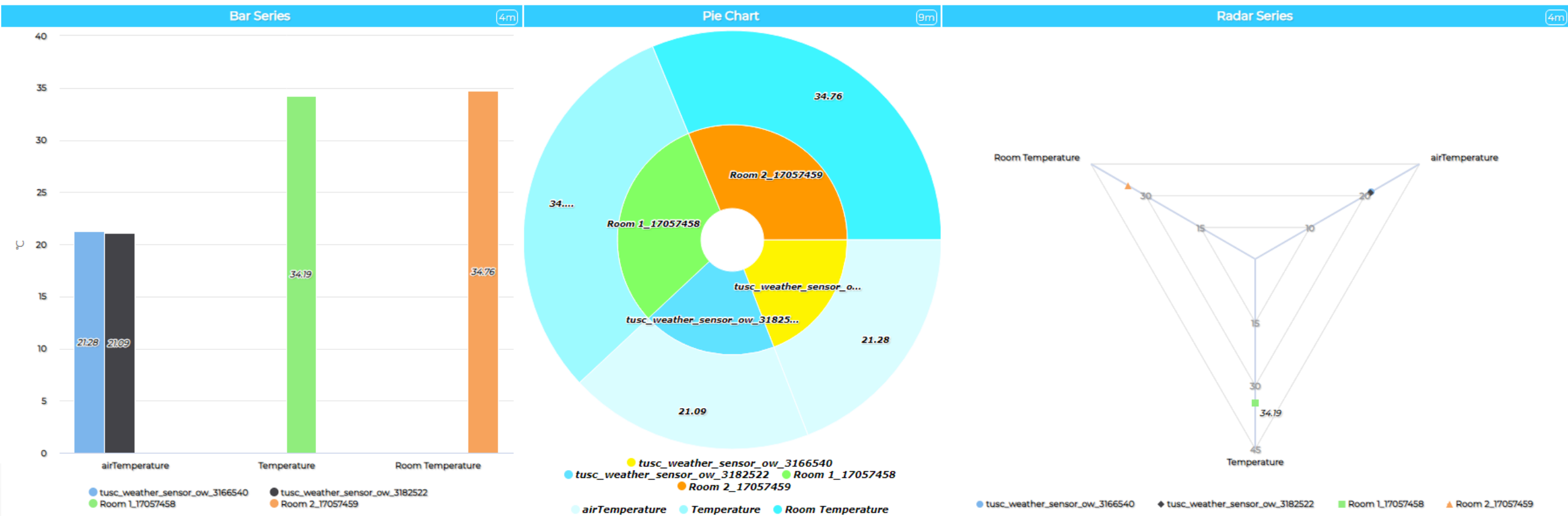
- Observe



Nodes connections



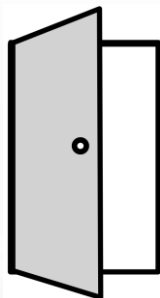
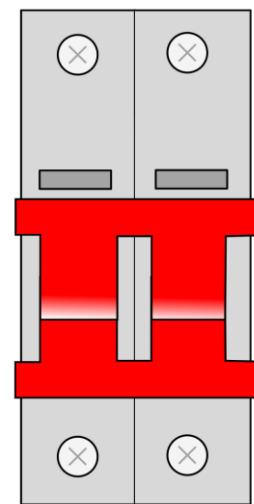
Resulting Dashboard



Other examples

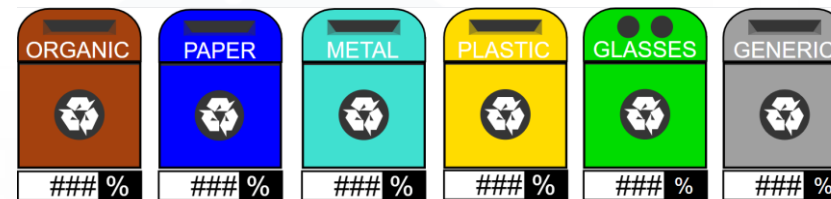
Virtual Actuators (sensor-actuator)

- From: Dashboard
- To: IOT App, MyKPI, other Synoptics

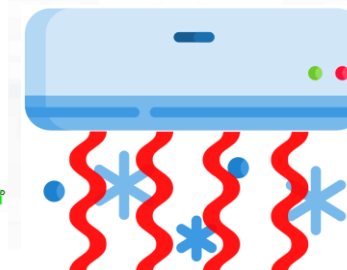


Virtual Sensors

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



#####.##



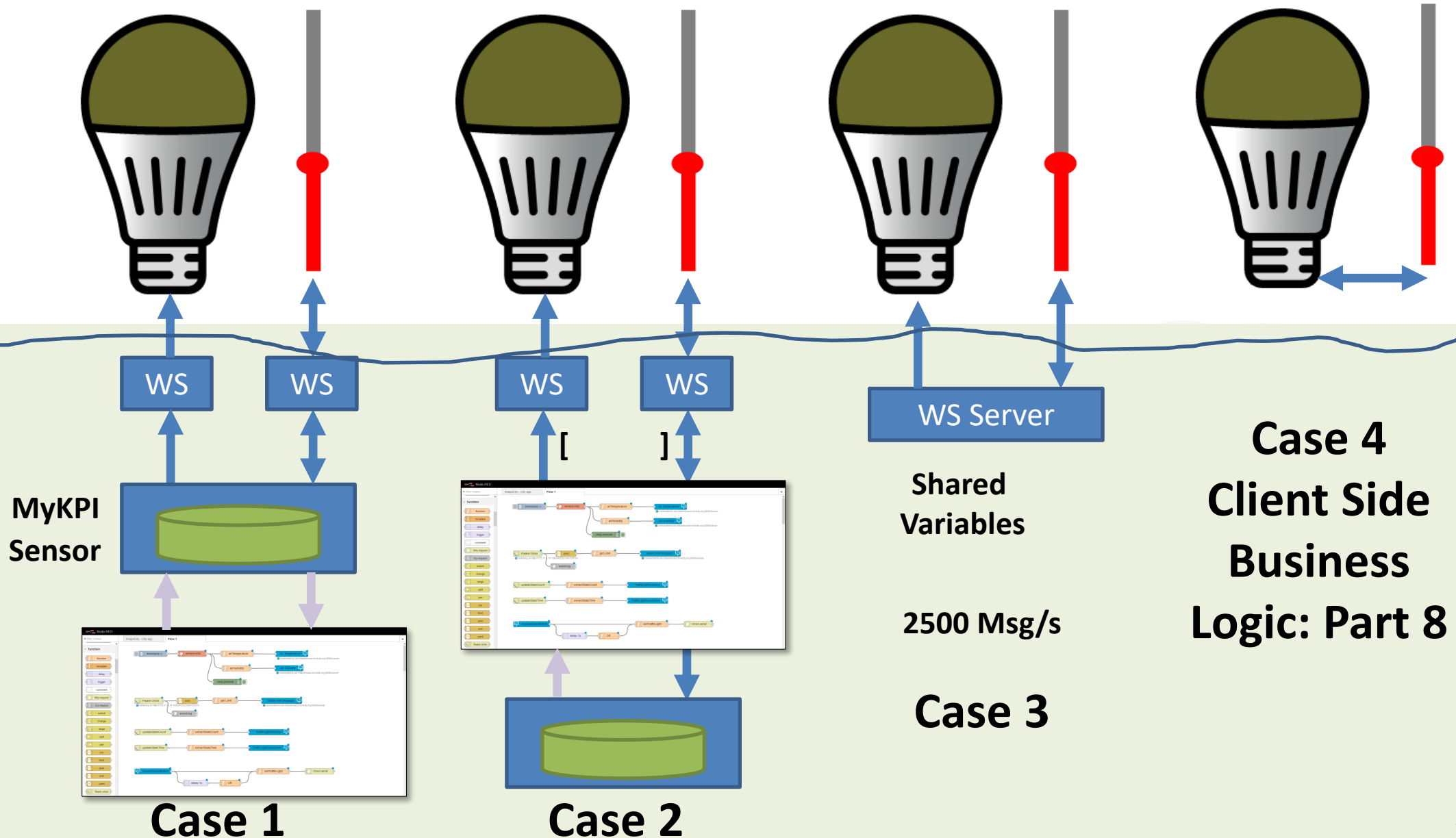
<https://www.snap4city.org/663>



Dashboard
on Browser

Internet

Storage and
IOT App on
cloud or on
Premise



Case 4
Client Side
Business
Logic: Part 8

Shared
Variables
2500 Msg/s
Case 3

Case 1

Case 2

Case 1 SVG ws3

Emergency_services

slider value 9m Energy_supply

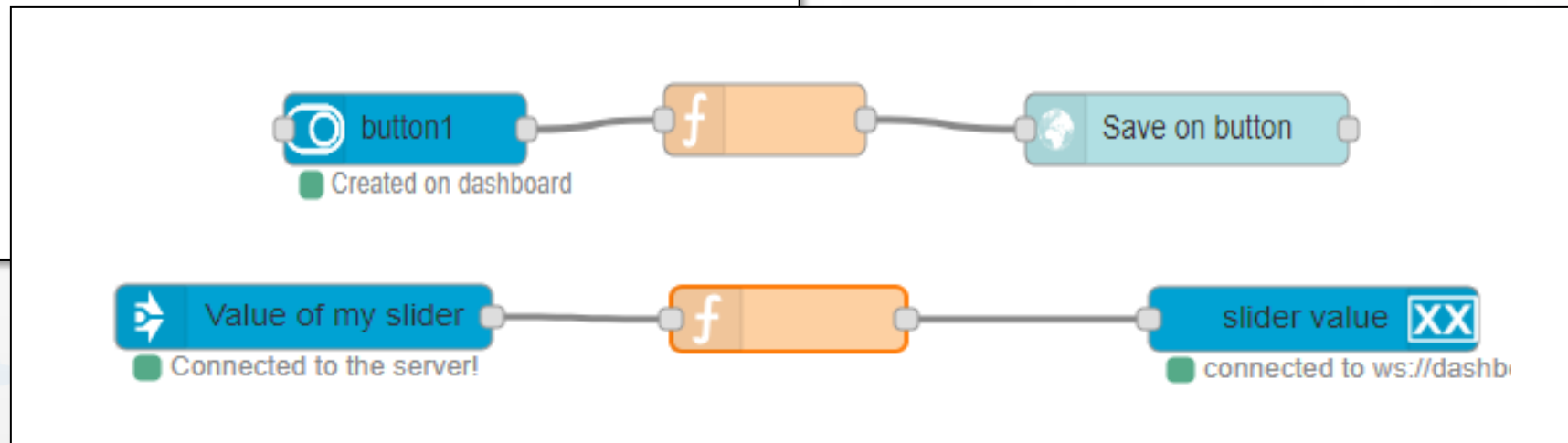
34.66563913330602

Emergency_services

button1

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=Mjc4NA==>

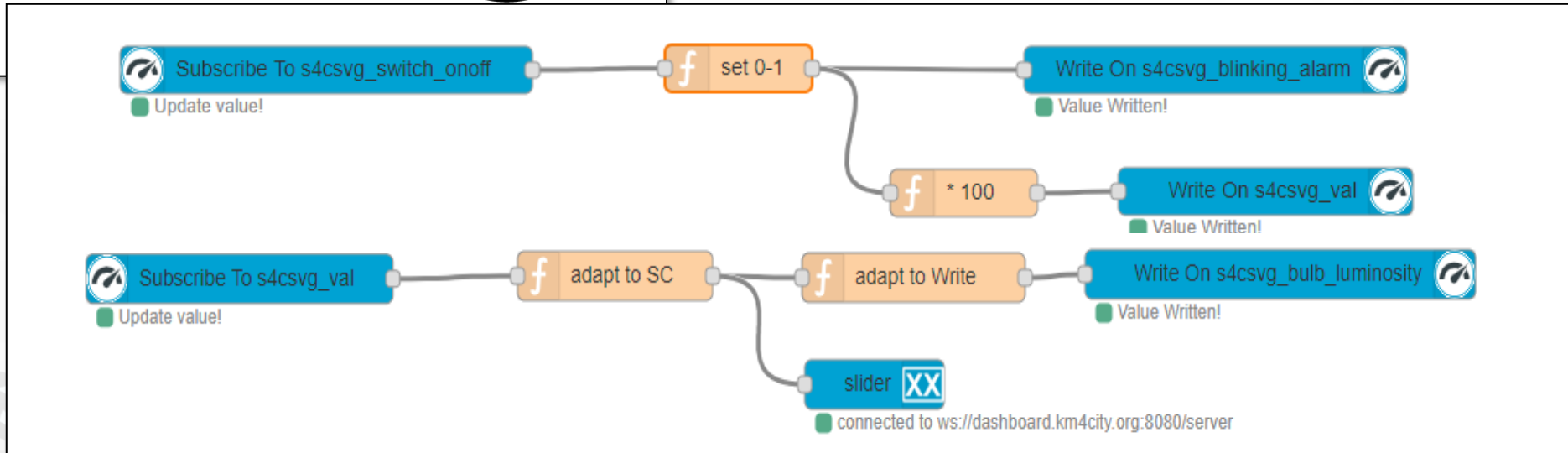
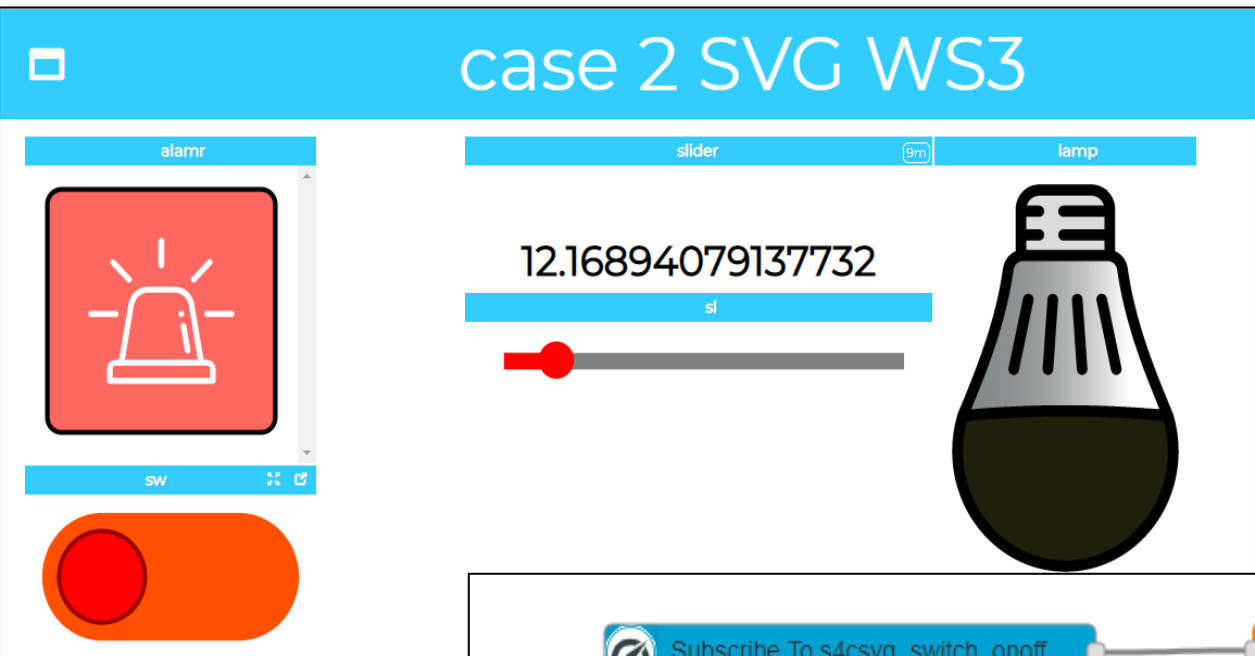
10 WS messages per second



Case 2: Event Driven 100%

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=Mjc4NQ==>

40 messages per second



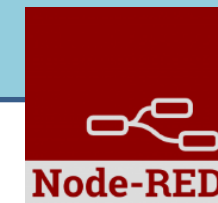
Read more on

- [TC9.19: Custom Widgets / Synoptics controlled by IOT Applications](#)
- [Custom Synoptics and Widgets for Dashboards](#)
- [Scenario: 5G Enabled Water Cleaning Control](#)
- [Snap4Industry: Snap4City for Industry 4.0](#)
- [TC1.22: Create and configure a Snap4City SVG Custom Widget for real-time interaction](#)

TOP

HTML on Dashboards: the last choice if none of the solutions satisfy your needs

- IOT Applications ▾
 - IOT Applications
 - 👤 MicroServices for IOT Applications
 - 👤 MicroServices from DataAnalytic
 - ☐ IOT MicroServices for Final Users
 - ☐ IOT MicroServices for Developers
 - ☐ Doc: IOT Applications
 - ☐ How to Develop IOT Applications
 - ☐ Create A MicroService from RestCal...



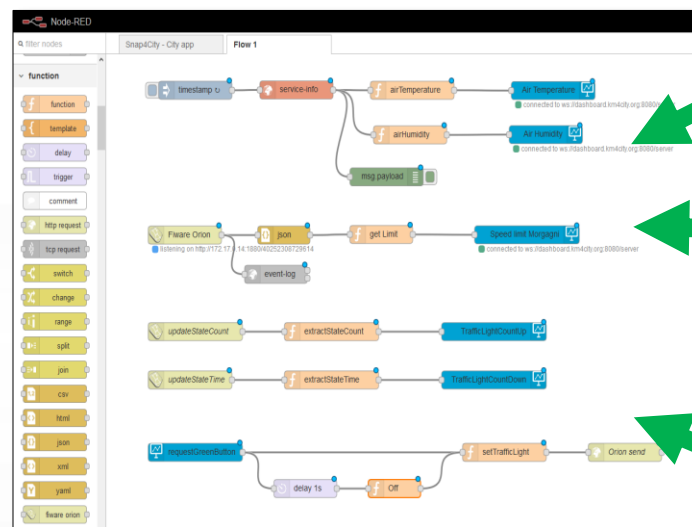
- You can send to the Web Content Widget an URL, a link to the web page to be loaded into an External Content Widget



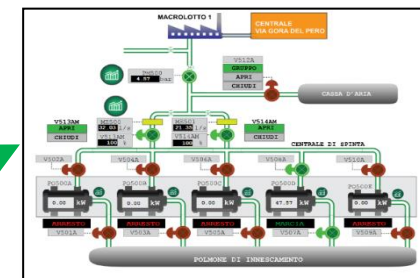
- You can create an HTML page by using the IoT App HTTP nodes
 - and then also send of the WebContent the URL to ask at the dashboard to show the HTML you created 😊

Advanced IOT Applications

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



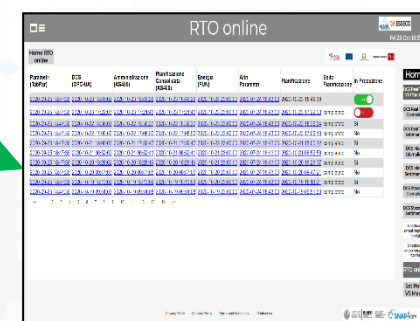
Synoptics
Custom
Widgets



Widgets
Maps
Buttons
Keypads
Controls



HTML pages
HTML Forms
HTML Tables



<https://www.snap4city.org/394>

<https://www.snap4city.org/596>

IOT App with Dynamic Web Pages

RTO online
Fri 23 Oct 18:57:41

Home RTO online

Parametri (TabPar)	DCS (OPC-UA)	Amministrazione (AS400)	Pianificazione Consolidata (AS400)	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
2020-09-25 18:47:36	2020-10-23 18:49:02	2020-10-23 18:49:29	2020-10-23 18:49:29	2020-10-24 23:00:00	2020-07-24 18:43:00	2020-10-23 18:49:39		<input type="checkbox"/>
2020-09-25 18:47:36	2020-10-23 17:22:03	2020-10-23 17:21:46	2020-10-23 17:21:46	2020-10-23 23:00:00	2020-07-24 18:43:00	2020-10-23 17:22:08	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-22 18:36:02	2020-10-22 18:36:27	2020-10-22 18:36:27	2020-10-23 23:00:00	2020-07-24 18:43:00	2020-10-22 18:36:54	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-22 17:09:02	2020-10-22 17:08:59	2020-10-22 17:08:59	2020-10-22 23:00:00	2020-07-24 18:43:00	2020-10-22 17:09:13	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-21 18:00:02	2020-10-21 17:59:47	2020-10-21 17:59:47	2020-10-22 23:00:00	2020-07-24 18:43:00	2020-10-21 18:00:12	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-21 06:52:02	2020-10-21 06:52:41	2020-10-21 06:52:41	2020-10-21 23:00:00	2020-07-24 18:43:00	2020-10-21 06:52:59	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-20 18:26:02	2020-10-20 18:26:19	2020-10-20 18:26:19	2020-10-21 23:00:00	2020-07-24 18:43:00	2020-10-20 18:26:37	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-20 09:47:03	2020-10-20 09:47:05	2020-10-20 09:47:05	2020-10-20 23:00:00	2020-07-24 18:43:00	2020-10-20 09:47:21	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-19 18:13:02	2020-10-19 18:13:09	2020-10-19 18:13:09	2020-10-20 23:00:00	2020-07-24 18:43:00	2020-10-19 18:13:21	completato	<input checked="" type="checkbox"/>
2020-09-25 18:47:36	2020-10-19 09:51:02	2020-10-19 09:51:08	2020-10-19 09:51:08	2020-10-19 23:00:00	2020-07-24 18:43:00	2020-10-19 09:51:59	completato	<input checked="" type="checkbox"/>

RTO online
Thu 1 Oct 15:33:23

Home RTO online

Visualizza ed Edita altri parametri | Visualizza e produci Pianificazione Consolidata da Pianificazione Ipotetica del 01-10-2020 15:32:05 | Non c'è una Pianificazione Consolidata attiva

Elenco esecuzioni pianificazioni | Elenco esecuzioni pianificazione in produzione | Avvia Pianificazione

Ultima data di aggiornamento parametri (TabPar): 25-09-2020 18:47:36
Ultima data di aggiornamento dati da DCS (OPC-UA): 01-10-2020 15:33:02
Ultima data di aggiornamento dati da amministrazione (AS400): 22-09-2020 14:51:06
Ultima data di aggiornamento dati da pianificazione vendite ipotetica (AS400): 01-10-2020 15:32:05
Ultima data di aggiornamento dati da pianificazione vendite consolidata (AS400): 01-10-2020 09:32:54
Ultima data di aggiornamento costo giornaliero energia h24 (PUN): 01-10-2020 23:00:00
Ultima data di aggiornamento altri parametri: 24-07-2020 18:43:00

Salva Parametri

Elenco Parametri Iniziali Algoritmo RTO SODA4.0

(effettuare cambiamenti che saranno utilizzati dalla prossima esecuzione)

5 days (N° di giorni su cui si vuole fare la pianificazione) [-]

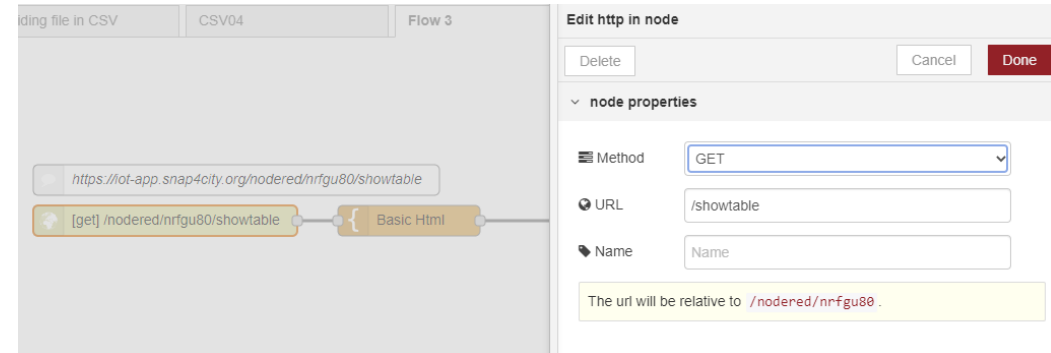
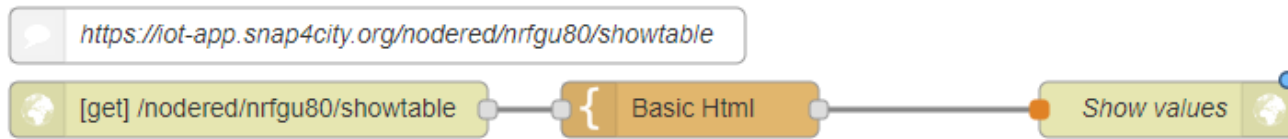
1 alpha_eco (Peso che decide l'importanza relativa di Stock e PUN nella funzione obiettivo) [-]

0.31 Cl2_HCl32 (Cl2 consumato per ton di prodotto) [ton Cl2/ton HCl32]

297.54 MAX_HCl32_s (Massimo stock HCl32) [ton]

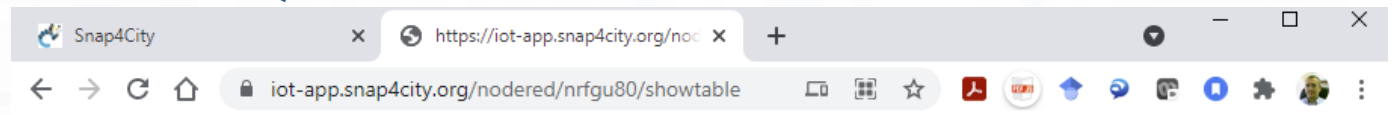
- **HTML pages can**
 - be dynamically generated from the IOT App
 - provide forms to produce data to the IOT App, also including interactive elements
 - collect file from users, and produce files to web and to the system
 - have CSS and AJAX controls

From IoT App to HTML pages



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

```
<html>
<style>table, th, td { border:1px solid black;}</style>
<head></head>
<body>
<h1>This is a table</h1><table style="width:100%">
  <tr>
    <th>Person 1</th>  <th>Person 2</th>  <th>Person 3</th>
  </tr>
  <tr>
    <td>Emil</td>  <td>Tobias</td>  <td>Linus</td>
  </tr>
  <tr>
    <td>16</td>  <td>14</td>  <td>10</td>
  </tr>
</table>
</body> </html>
```



This is a table

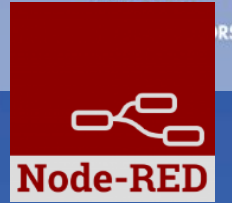
Person 1	Person 2	Person 3
Emil	Tobias	Linus
16	14	10

TOP

Proc.Logic / IoT App Programming Patterns



- IOT Applications ▲
 - IOT Applications
 - ⬆️ MicroServices for IOT Applications
 - ⬆️ MicroServices from DataAnalytic
 - ☐ IOT MicroServices for Final Users
 - ☐ IOT MicroServices for Developers
 - ☐ Doc: IOT Applications
 - ☐ How to Develop IOT Applications
 - ☐ Create A MicroService from RestCal...



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-u4vandq>

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

examples

Node shape	Description	Snap4City or standard
	To generate injection messages into a flow, scheduled or on manual demand by click it on left.	standard
	A java script function, from a JSON input to one or more JSON outputs, which can be produced by setting it.	standard
	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.	Snap4city
	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.	Snap4city
	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.	Snap4city
	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.	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.	standard

Part 5

Part 5

examples

Node shape	Description	Snap4City or 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.	standard
	To create a Entity Instance (device instance) from a model prepared on Entity Directory (IoT Directory).	Snap4city
	To change the ownership of an Entity Instance (IoT Device).	Snap4city
	To delegate a certain Entity Instance (IoT Device) to some other user for which you have to know the Nickname. Delegations can be: Read_access, Read_write, Modify (to modify the Entity Instance structure).	Snap4city
	To show something on Snap4City dashboard with a simple widget. A large set of dashboard nodes to send and retrieve data to/from dashboards. This specific Nodes allows to send on dashboard HTML formatted messages with some limitations. Full HTTP widget is also accessible.	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
	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

Part 5

Part 5

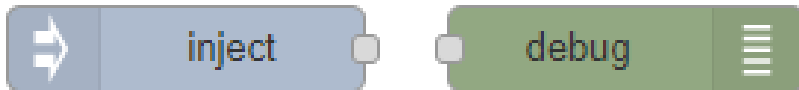
Part 5

Part 5

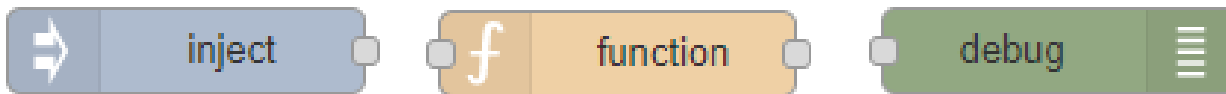
Part 4

Some patterns

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



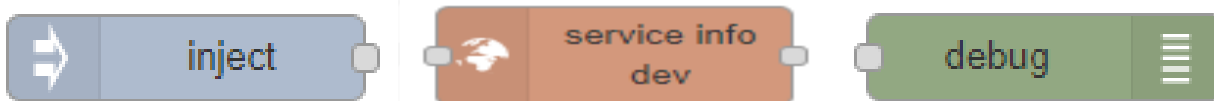
- 2) Hello world of node-red at two steps, the inject provides a push while a JSON is created into the function as `msg.payload = {.....}` and sent/shown to/by the debug.



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

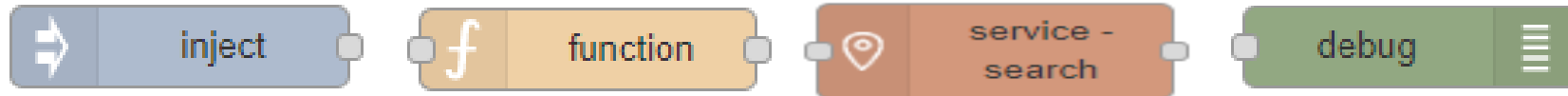


- 4) request on inject of a SURJ to the storage to see data on debug.

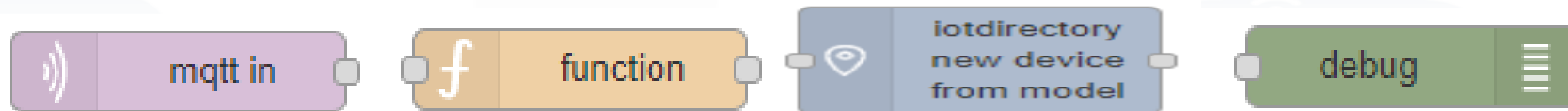


Part 5

- 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):



Part 5

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





Training Material



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	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
PDF 2022								
Interactive (2022) with video and animations								



In Part 5 and 6 we have

- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic

- IOT Network Management and Control
- IOT Devices hardware-software integration
- Using Data Models:
 - FIWARE Smart Data Models, Snap4City IoT Device Models
- Data Exchange and Distributed,
 - computing on multiple Snap4City Domains
- IOT end-2-end Secure Stack, IOT ↔ Dashboards

*Any other
Request
?*

<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

- **Course 2023:** <https://www.snap4city.org/944>
 - Introductionary course to Snap4City technology
- **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>



Home / Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

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Username: paolo.disit

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WHAT IS Snap4City | LATEST NEWS | SELECT for CISEN 1^o Place award to SNAP4CITY | Snap4City Training on Tools and Platform | Tutorials | Scenarios | Organizations

SMARTCITY EXPO WORLD CONGRESS 15 - 17 NOVEMBER 2022 BARCELONA & ONLINE GET YOUR PASS

Flyer | DATA ANALYTICS ARTIFICIAL INTELLIGENCE

Innovations | Interoperability | Installations

What People say | Mobile Apps | IOT Devices | IOT Applications | Data Analytics | Dashboards | Living Lab | Smart City API | Ontology | Work with Us

Articles | SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE | SNAP4CITY HACKATHON | INDUSTRY 4.0 | Snap4Industry | Snap4Home



Organization Groups

- DISIT
- Developer
 - Operativo

Updates on

- TECHNICAL OVERVIEW: <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- Development Life Cycle: <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- Client-Side Business Logic Widget Manual: <https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>
- Booklet Data Analytics, Snap4Solutions: https://www.snap4city.org/download/video/DBL_SNAP4SOLL.pdf

2023 booklets



- Smart City



https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf

- Industry



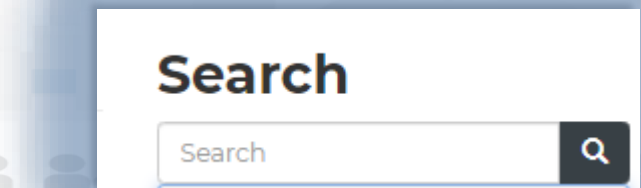
https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf

- Artificial Intelligence



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

- **Free Registration on Snap4City.org**
 - Please select DISIT ORG to be sure to access at the examples
 - Most of the cities / tenant are private and they do not left much visible
- **What you get** is probably the 10% of what is on the platform 😊
- **Training:** <https://www.snap4city.org/577>
- **Scenarious:** <https://www.snap4city.org/4>
- **Publications:** <https://www.snap4city.org/426>
- **WEB pages:** <https://www.snap4city.org/78>
- ***SEARCH on the right side***



Tech Overview

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



Technical Overview

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

Snap4City:

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

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

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

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-u4vandq>

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

Client Side Business Logic

<https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>



Client-Side Business Logic Widget Manual

From Snap4City:

- We suggest you read <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- We suggest you read the TECHNICAL OVERVIEW:
 - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- slides go to <https://www.snap4city.org/577>
- <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/UC3tAQ09EbNba8f2-u4vanda>

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



Overview



SMART CITIES AND SMART INDUSTRY

Snap4City:
FIWARE powered smart app
builder for sentient cities

With the contribution of



- <https://fiware-foundation.medium.com/snap4city-fiware-powered-smart-app-builder-for-sentient-cities-acfe24df49d5>
- https://www.snap4city.org/download/sites/default/files/files/FF_ImpactStories_Snap4City.pdf

TOP

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IOT APPLICATIONS VS IOT EDGE DEVICES

Acknowledgements

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE, SOCIAL MEDIA ANALYSIS

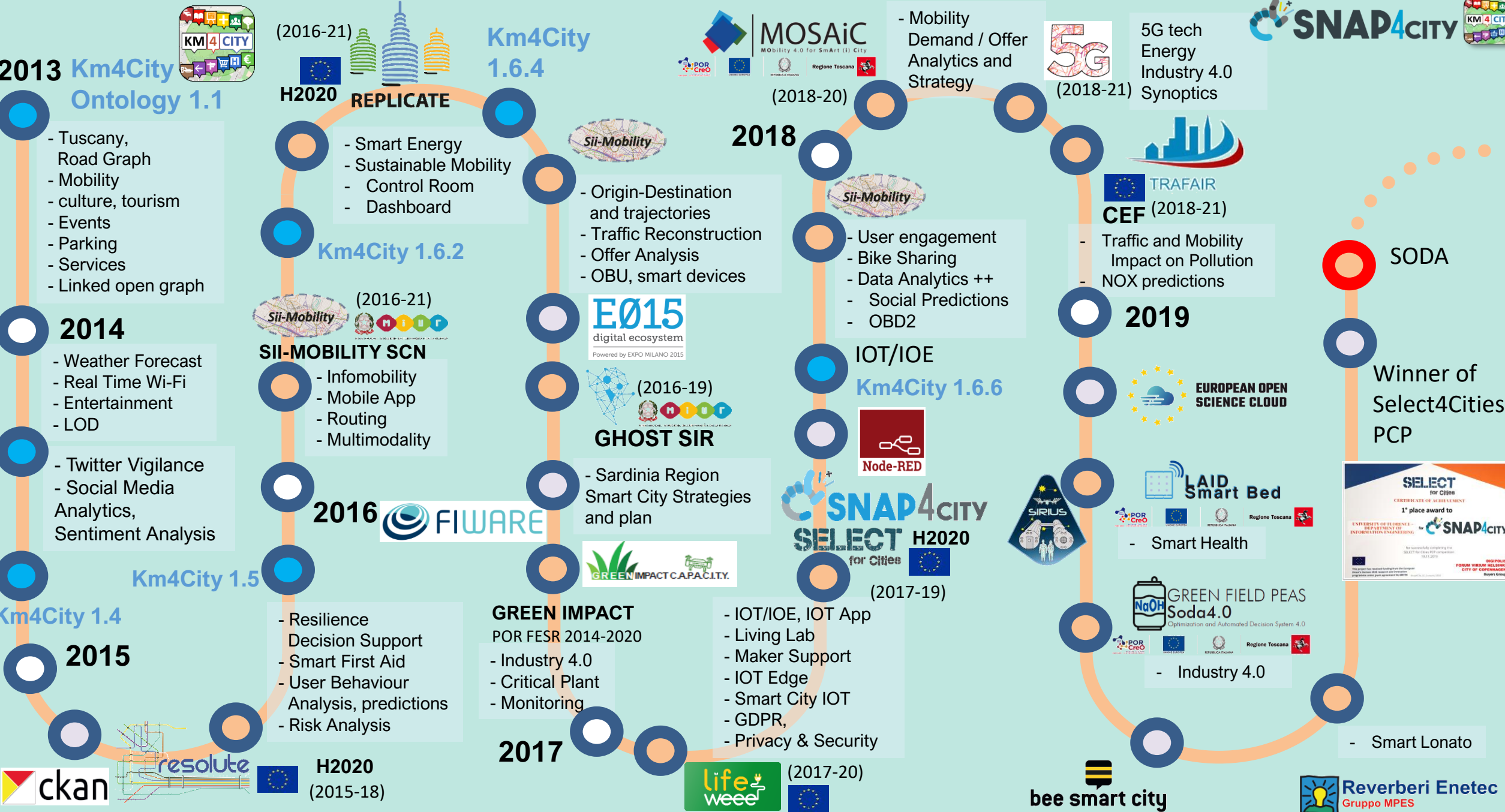
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY AND KM4CITY PROJECTS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

SNAP4CITY THE VIEW OF THE ADMINISTRATORS





2013 Km4City Ontology 1.1

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

2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

2015

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



(2016-21) H2020 REPLICATE Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

(2016-21) Sii-Mobility

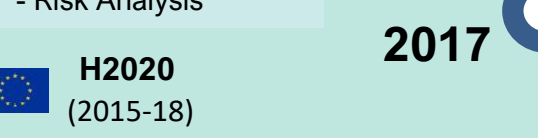
SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

2016 FIWARE

Km4City 1.5

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



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

- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

E015 digital ecosystem Powered by EXPO MILANO 2015

(2016-19) GHOST SIR

- Sardinia Region Smart City Strategies and plan

SNAP4CITY SELECT for Cities H2020 (2017-19)

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

2017 life weee (2017-20)

- Smart Waste

5G tech Energy Industry 4.0 Synoptics (2018-21)

- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

2018 IOT/IOE Km4City 1.6.6

Node-RED

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

EUROPEAN OPEN SCIENCE CLOUD

LAI Smart Bed

- Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0

- Industry 4.0

bee smart city

SNAP4CITY

SODA

2019

Winner of Select4Cities PCP

SELECT for Cities CERTIFICATE OF MERITMENT 1st place award to SNAP4CITY

Forum Virium Helveticum City of Copenhagen

Reverberi Enetec Gruppo MPES

Smart Lonato

bee smart city

Reverberi Enetec Gruppo MPES

DISIT lab roadmap vs model and tools' usage



2020



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



- Smart Mobility
- PISA, PUMS
- Living lab



Km4City 1.6.7

Smart Ambulance (2021-22)

Enterprise (2021-22)
Industry 4.0



Contract

2021

PC4City (2020-21)
Monitoring Terrain

Winner of Open Data Challenge of
enel x

CAPELON

- Smart Light
- Sweden

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22)
Industry 4.0

SYN-RG-AI
SmartCity



Industry 4.0

uni.systems

SmartCity, 2021-23



AXIS collab
SmartCity

2022



Asymmetrica
Smart City, 2022-23

Contract, 2022-23



Contract, 2022-23



2022-2023



Security and Risk



Italferr, Smart City

2023



CN MOST, 2022-26



EI THE, 2022-26



G. Agile, 2021-23



2023-26



Merano, smart light

OceanRace,
Genova, AWS

Cuneo,
smart city

2024

TOURISMO



Co-funded by
the European Union



AMMIRARE

ELLIE IA
2025-2027



Contract, 2024-25

CAI4DSA



OPTIFaaS



SASUAM



Rhodes,
smart city

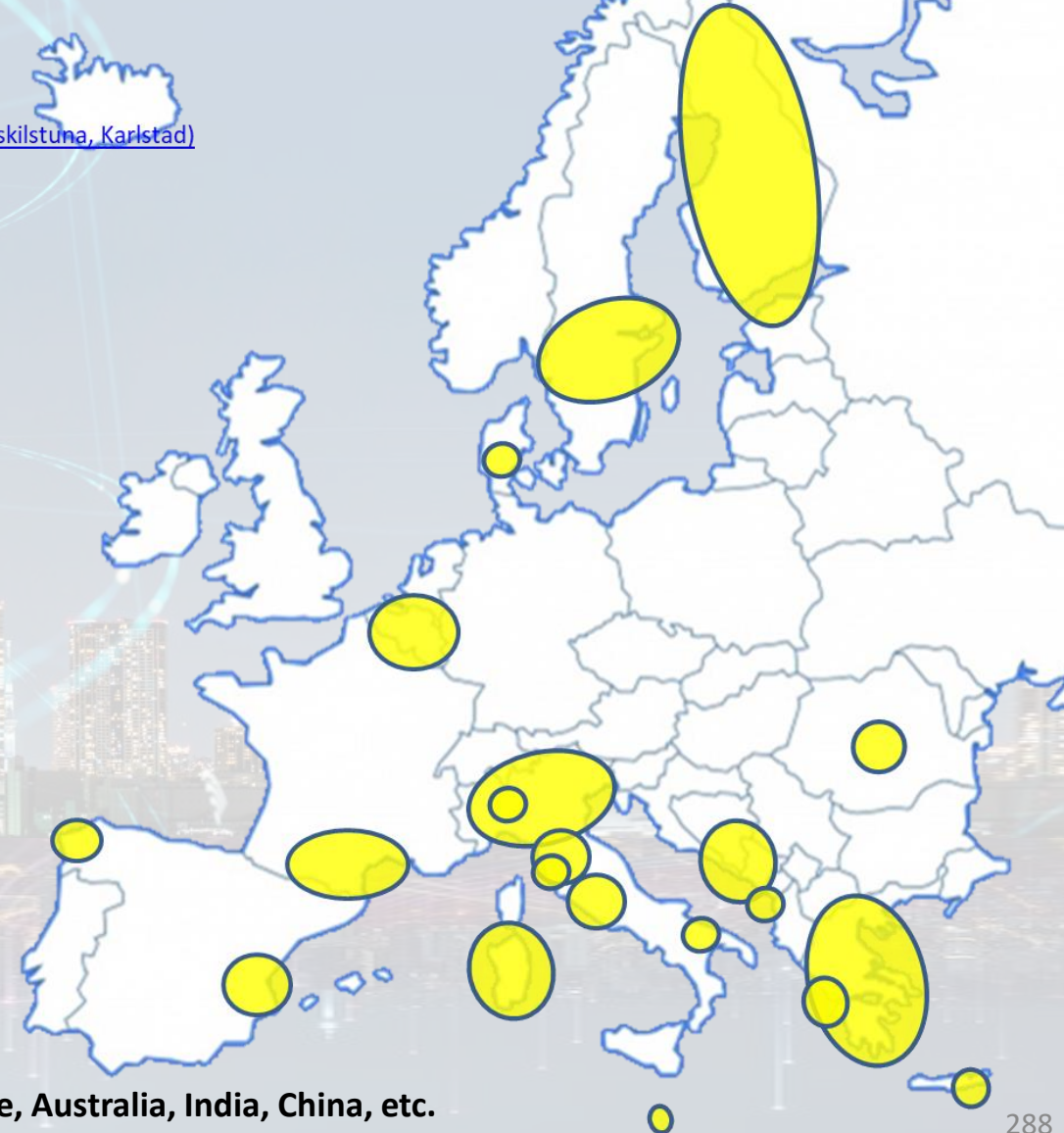
eShare
UNIFI TUSS



PEN Test
Passed



EU GDPR
COMPLIANT



Main Organizations/areas

- [Antwerp area \(Be\)](#)
- [Bari \(I\)](#)
- [Bisevo, Croatia](#)
- [Bologna \(I\)](#)
- Brasov (Ro)
- [Capelon \(Sweden: Västerås, Eskilstuna, Karlstad\)](#)
- [Cuneo \(I\)](#)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Greece \(Gr\)](#)
- [Helsinki area \(Fin\)](#)
- [Limassol \(Cy\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- Malta (Malta)
- Merano (I)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Oslo & Padova \(Impetus\)](#)
- [Pisa area \(I\)](#)
- [Pistoia \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Prato \(I\)](#)
- [Rhodes \(Gr\)](#)
- [Roma \(I\)](#)
- [Santiago de Compostela \(S\)](#)
- [Sardegna Region \(I\)](#)
- [Siena \(I\)](#)
- SmartBed (multiple)
- [Toscana Region \(I\), SM](#)
- [Valencia \(S\)](#)
- [Venezia area \(I\)](#)
- [WestGreece area \(Gr\)](#)

• + Israel, Colombia, Brasile, Australia, India, China, etc.

- 11 running installations in Europe
 - Snap4.city.org, Greece, Merano, Cuneo, ...
 - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
 - Altair, Italmatic, Romania,
- 16 projects, 12 pilots on 10 Countries
 - >40 cities/area
- **Widest MULTI-tenant deploy has**
 - 24 Organizations / tenant
 - > 8850 users on
 - > 1800 Dashboards
 - > 17 mobile Apps
 - > **2.2 Million of structured data per day**
 - > 580 IoT Applications/node-RED
 - > 750 web pages with training
 - > 75 videos, training videos

TOP



Be smart in a SNAP!



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