



www.snap4city.org
www.snap4solutions.org



www.km4city.org

IoT App. / Proc.Logic Server Side Business Logic

May 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



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

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



Be smart in a SNAP!



SMARTCITY
EXPO WORLD CONGRESS

IoT App. / Proc.Logic
Server Side Business Logic

May 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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AND INFRASTRUCTURE
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DISTRIBUTED SYSTEMS AND
INTERNET TECHNOLOGIES LAB
DISTRIBUTED DATA INTELLIGENCE
AND TECHNOLOGIES LAB

 **SNAP4city**



 **SNAP4city**





Smart Solutions and Decision Support Systems

Powered by
FIWARE

**FREE
TRIAL**

**PEN Test
Passed**

**EU GDPR
COMPLIANT**

SNAP4
Appliances and Dockers
Installations

**EUROPEAN OPEN
SCIENCE CLOUD**

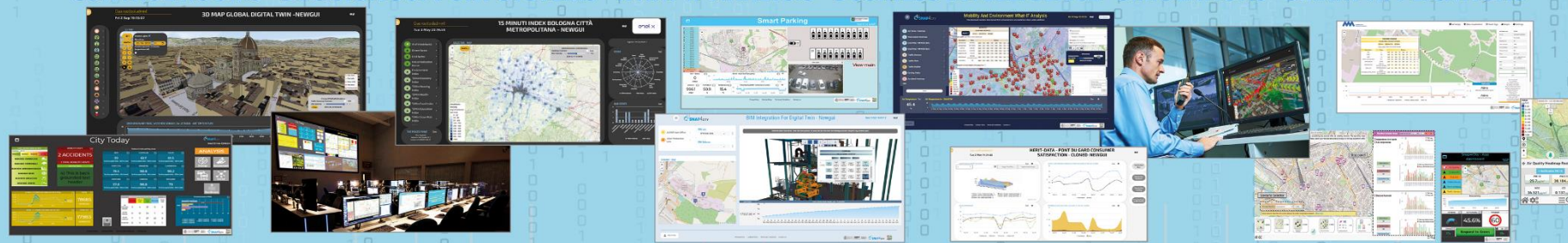


JS Foundation

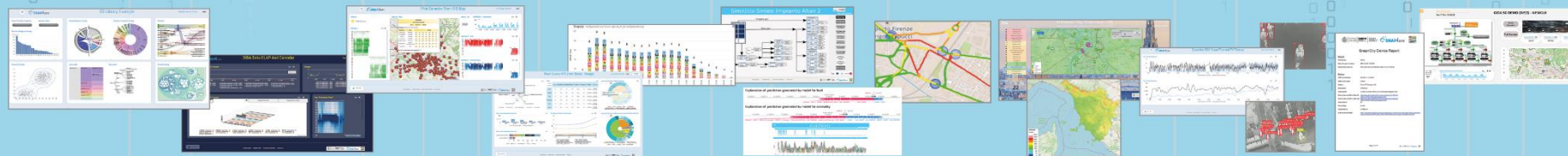
E015
digital ecosystem



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



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



**DASHBOARDS, WIDGETS
TEMPLATES**

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

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

ANY: DATA, BROKER, NETWORK AND VERTICAL

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

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

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

**Native and External
Smart Applications**

Mobility & Transport

Light & Energy

Waste

Environment

Building

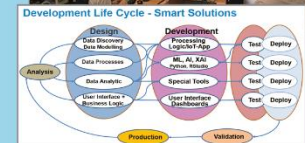
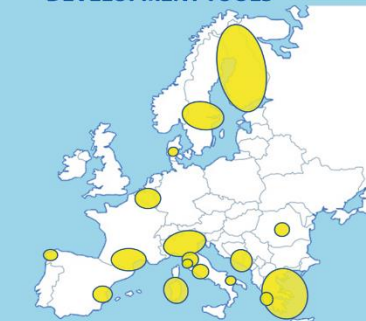
Tourism

Asset Management

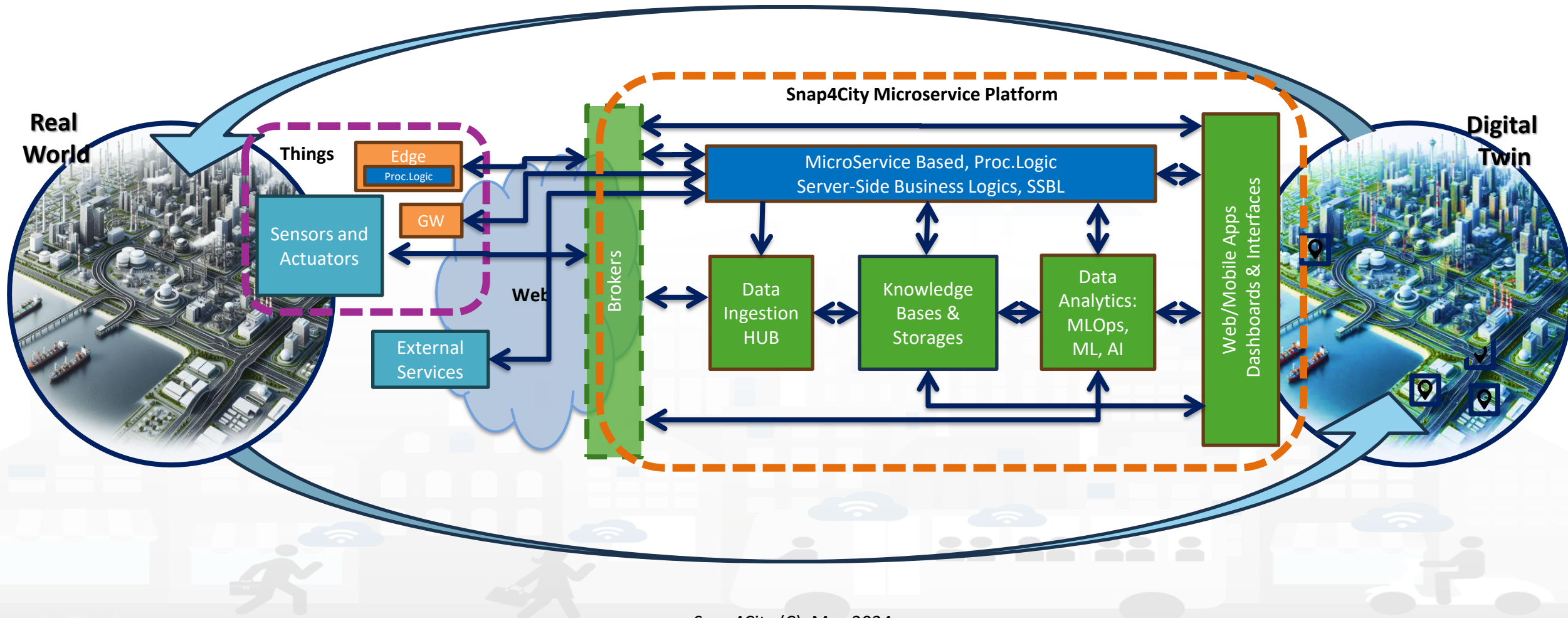
Security and Safety

Social Media

**METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS**



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

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

Development

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



Development Life-Cycle

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

From Snap4City:

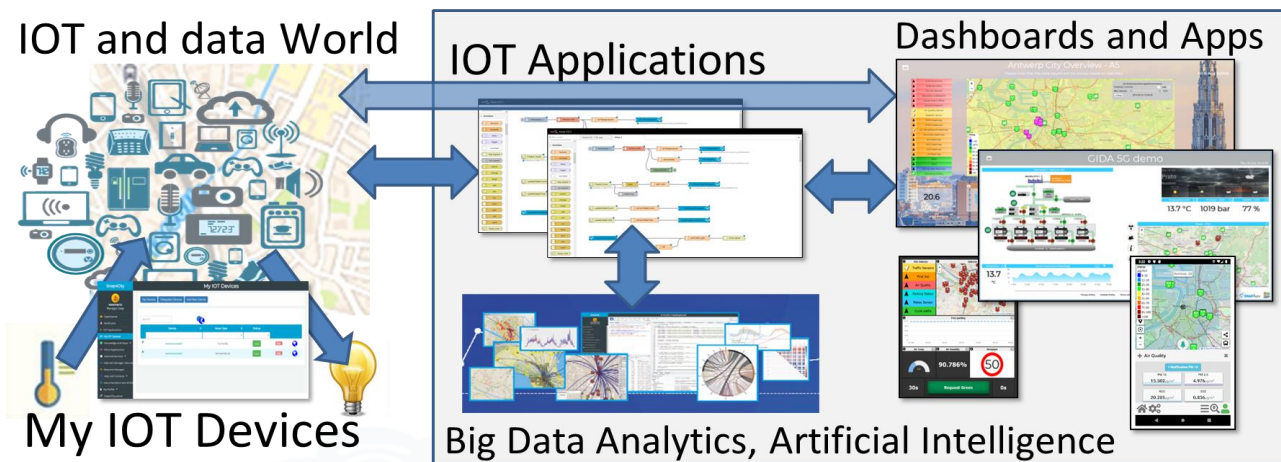
- We suggest you to read the **TECHNICAL OVERVIEW**:
 - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>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

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

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

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



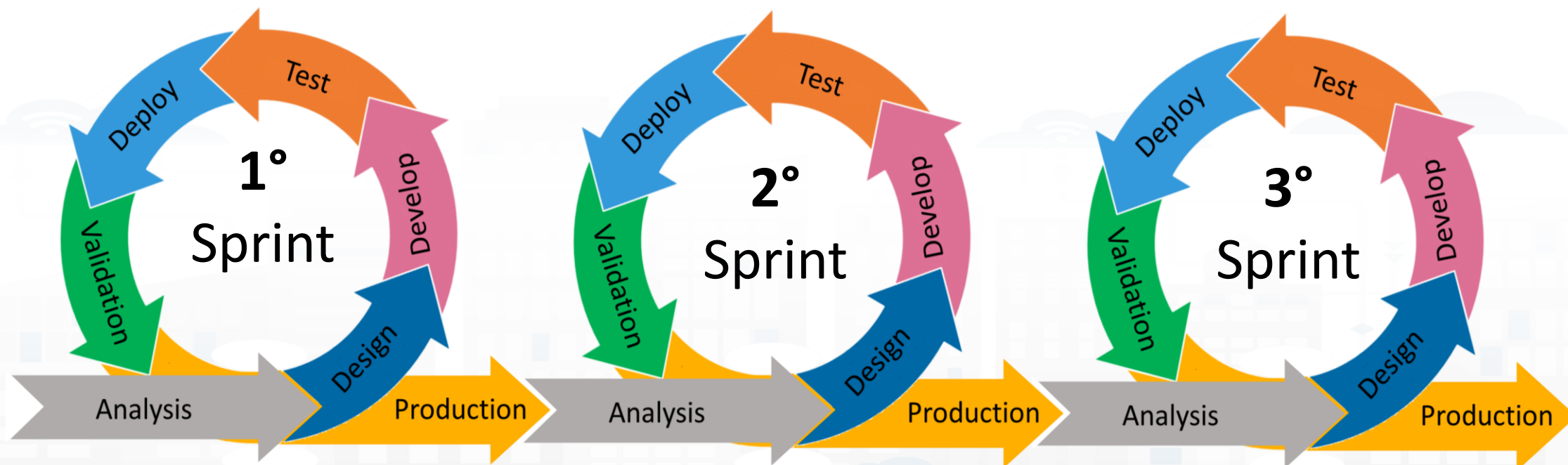
IF you need to go more in deep you can ask us to pass at the next Role becoming full AreaManager with full rights of development, also for Data Analytics, machine learning, etc.

Agenda of third part

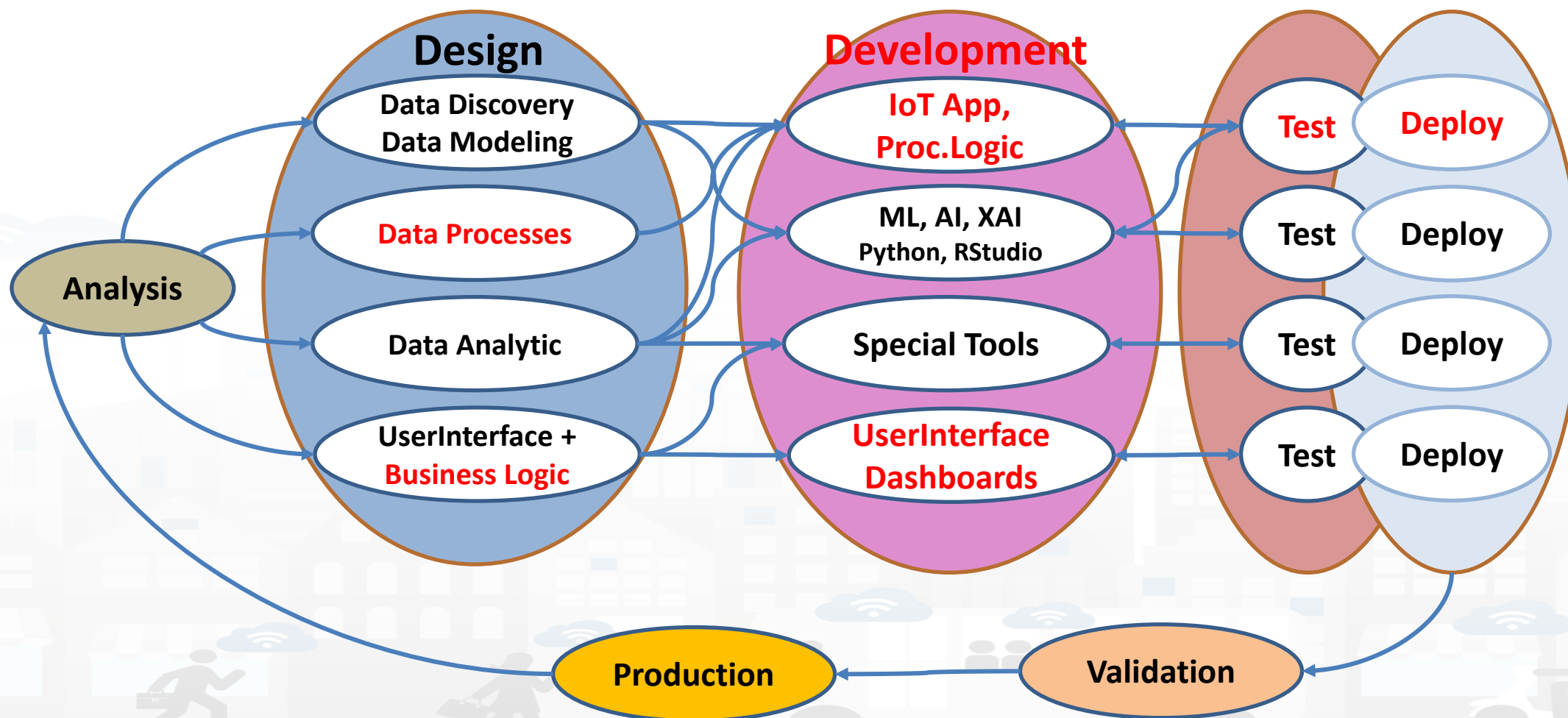
- Recall on Snap4City Architecture
- Node-RED
- IOT App = Node-RED + Snap4City
 - IoT App === Proc.Logic
- Examples of IOT App for Smartening Solutions
- Exploiting/Generating data by using: IoT App/Proc.Logic
- External Service $\leftrightarrow$ IoT App/Proc.Logic
- Dashboards $\leftrightarrow$ IoT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



Development Life Cycle Smart Solutions



Development Life Cycle Smart Solutions



Recall on Snap4City Architecture

**SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK**

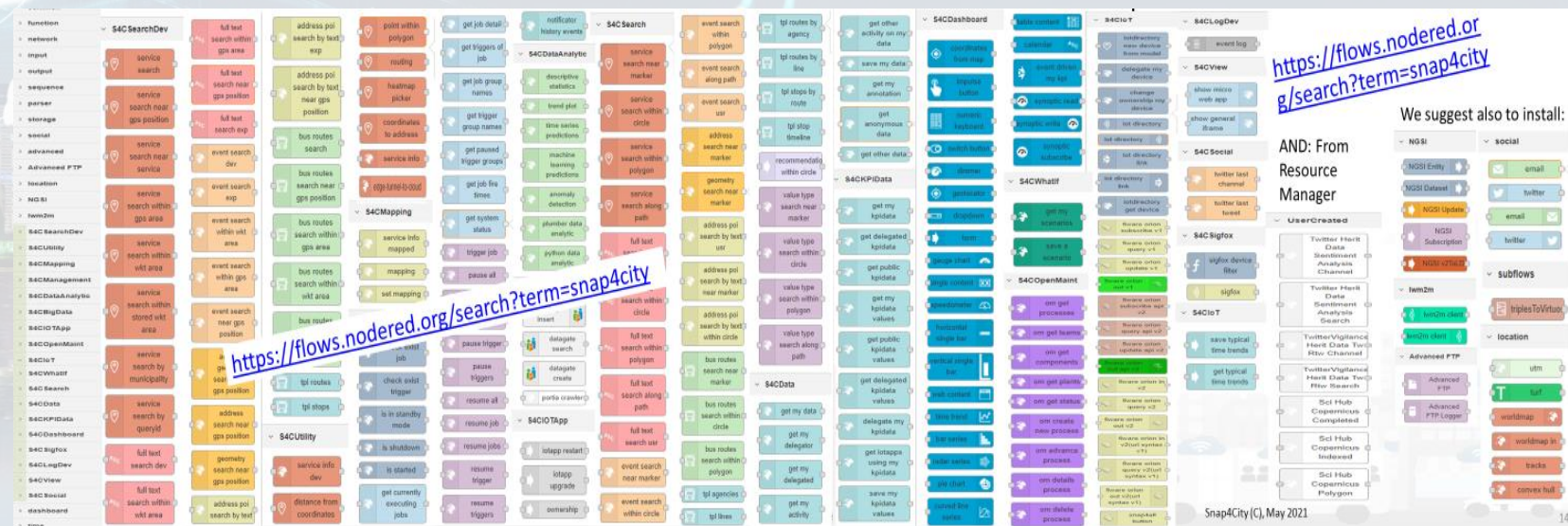
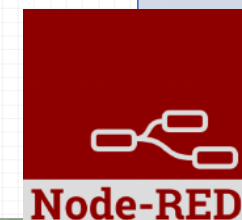
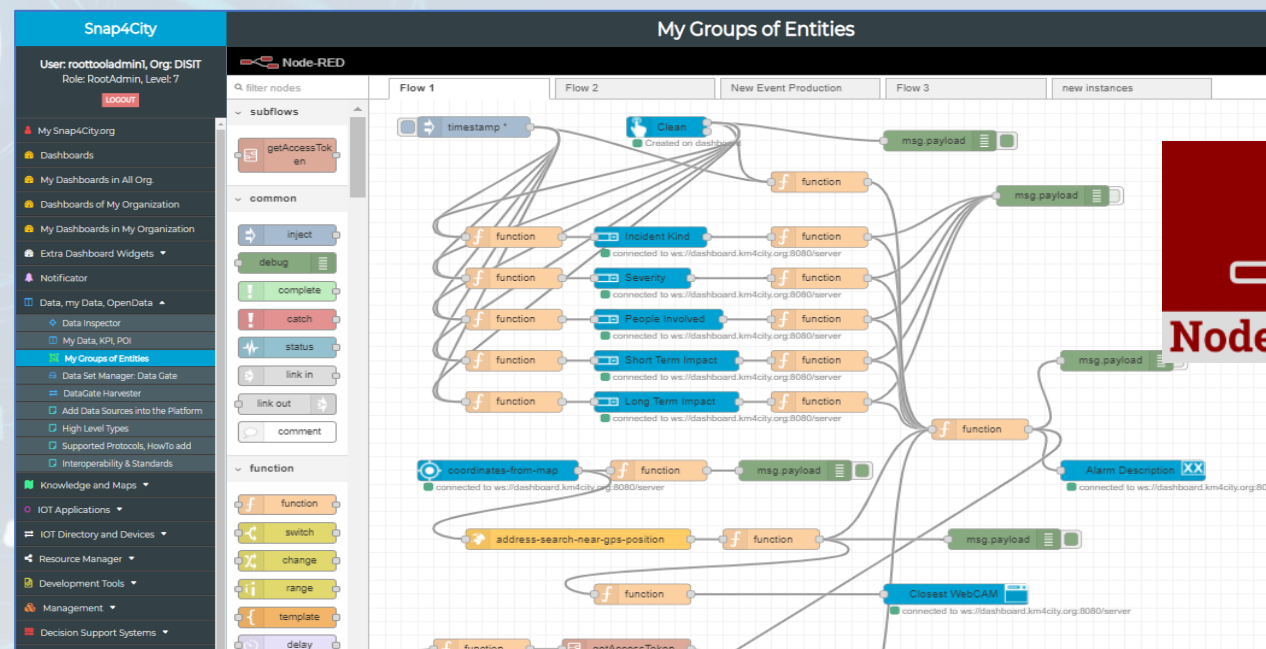
Ingestion, aggreg. → exploitation

• IoT App Visual Programming, no coding

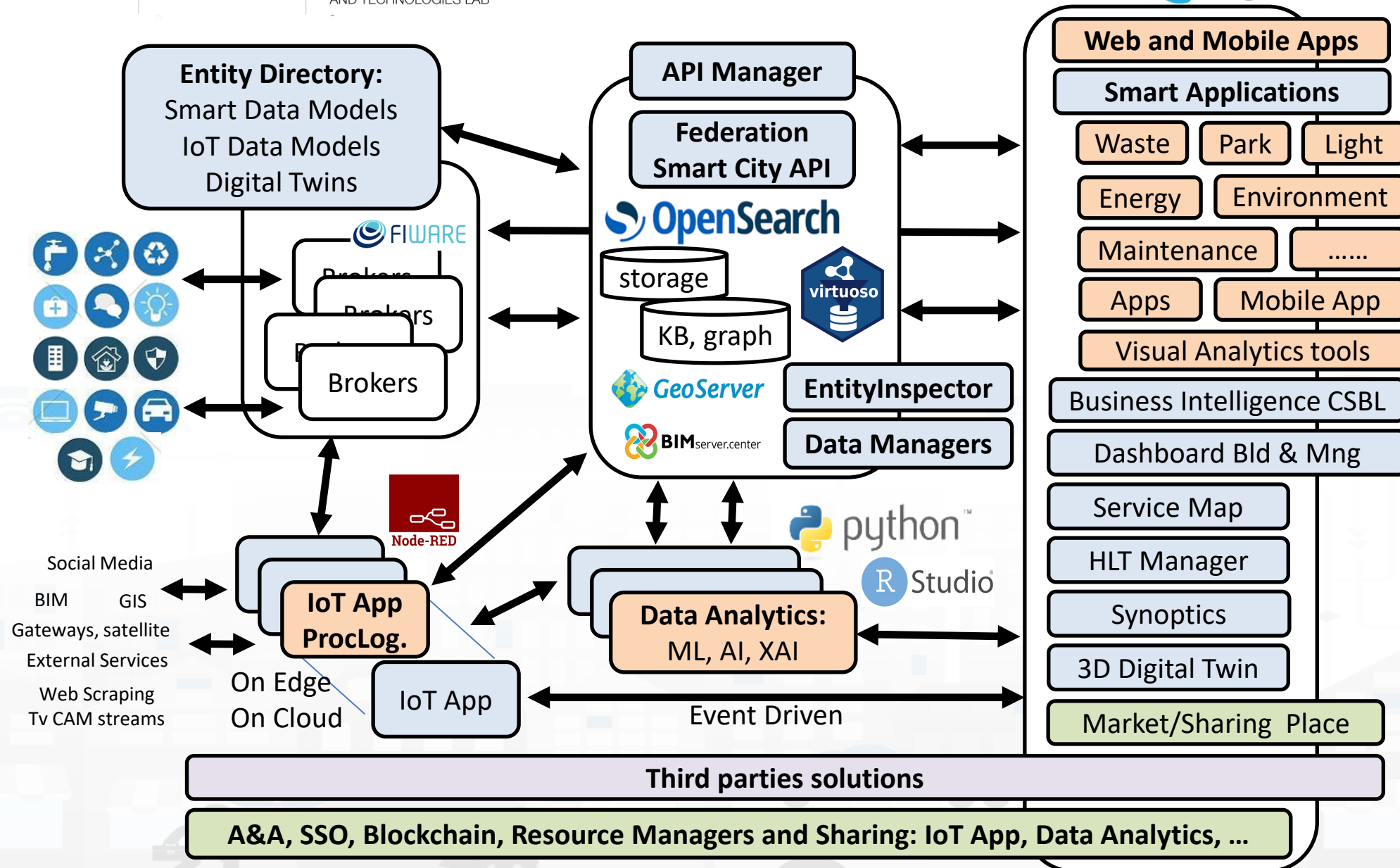
- Data transformation
- Integration, Interoperab.
- Scripting Data Analytics
- Data ingestion
- Business logic

• Edge and Cloud

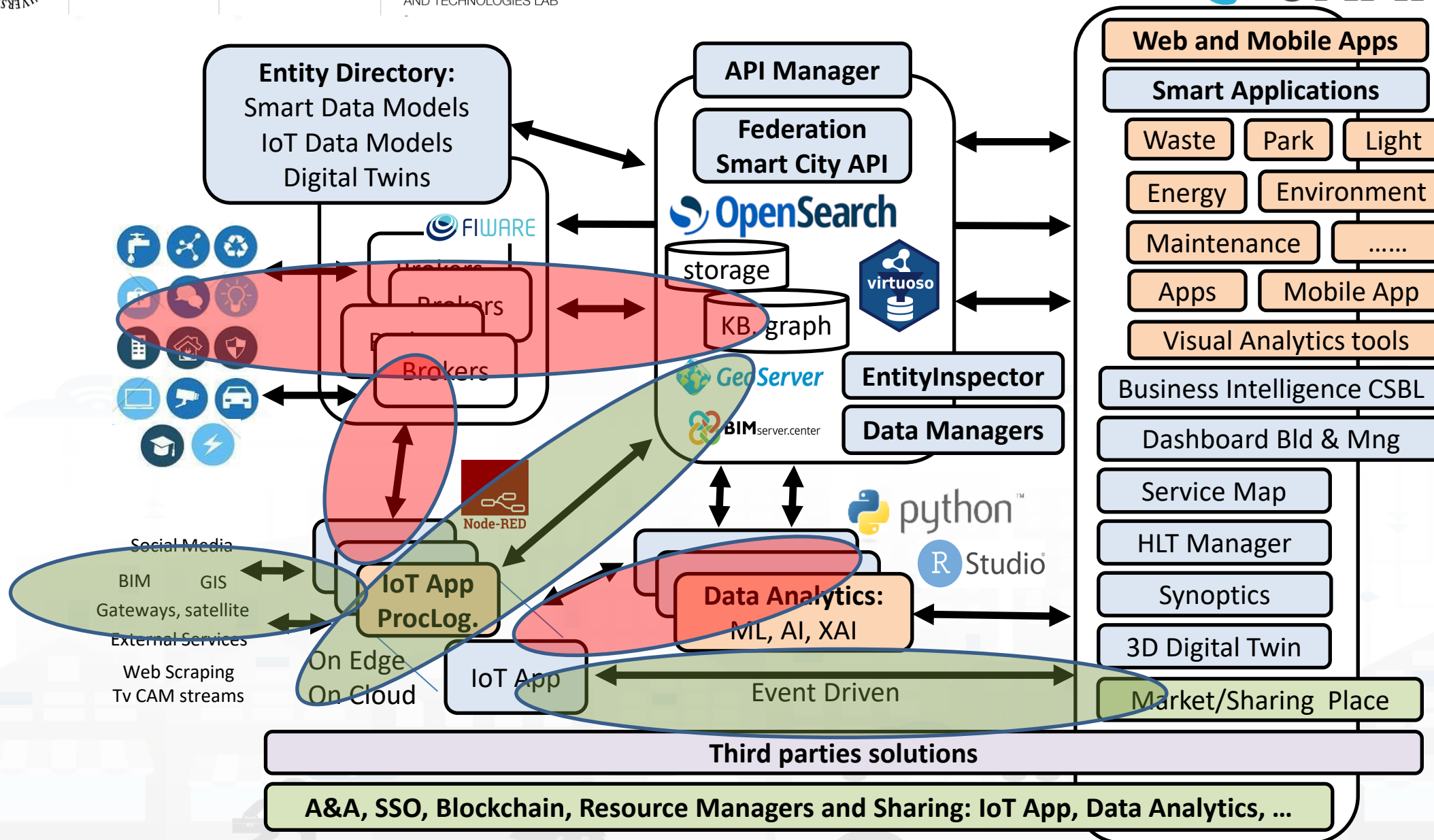
• MicroServices data driven develop via visual language Node-RED



Tech Arch

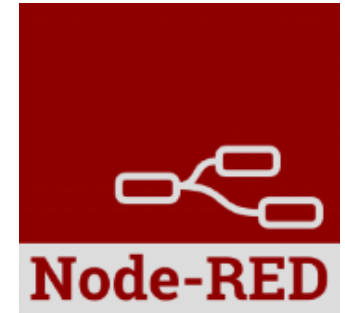


Tech Arch



IoT App / Proc.Logic

- Storage $\rightarrow$ IoT App / Proc.Logic
- External Service $\leftrightarrow$ IoT App / Proc.Logic
- Dashboards $\leftrightarrow$ IoT App / Proc.Logic



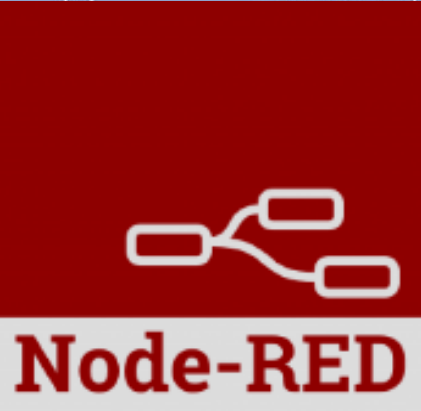
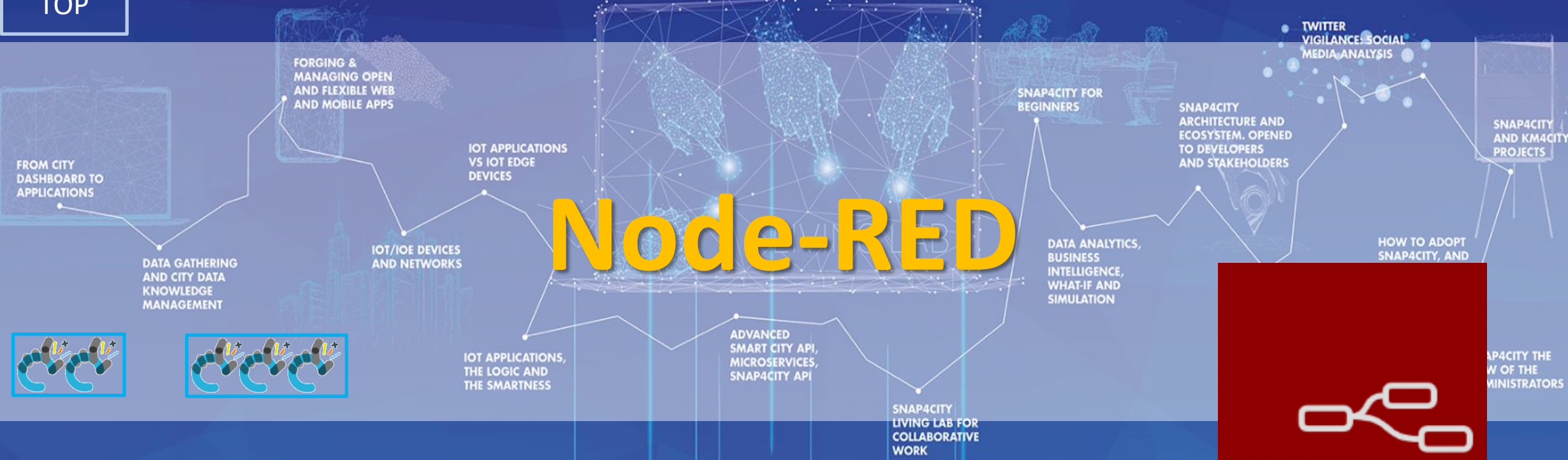
- Data Analytics $\leftrightarrow$ IoT App / Proc.Logic
- Broker $\rightarrow$ Storage
- IoT App / Proc.Logic $\rightarrow$ Broker
- Broker $\rightarrow$ IoT App / Proc.Logic
- IoT App / Proc.Logic $\rightarrow$ Storage

Part 4

Part 5

TOP

Node-RED



filter nodes

input

inject

catch

status

link

mqtt

http

websocket

tcp

udp

amqp

amqp2

output

debug

link

mqtt

http response

websocket

tcp

udp

amqp

amqp2

flow1

Flow 1

world map

f point

service-search-near-marker

show micro web app

f transform results

world map

event-log

f popupopen

msg.payload

timestamp

service-info

msg.payload

f vehicleFlow

vehicle flow (car/h)

worldmap

switch

sensor

timestamp

f last temperature

Dashboard

get value

temperature

Temperature

info

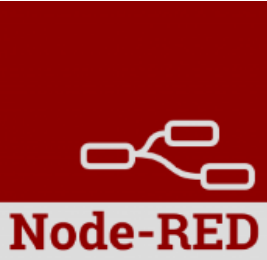
debug

dashb

Flow

Name	flow1
ID	"49a71aa0.b297b4"
Status	Enabled

Information

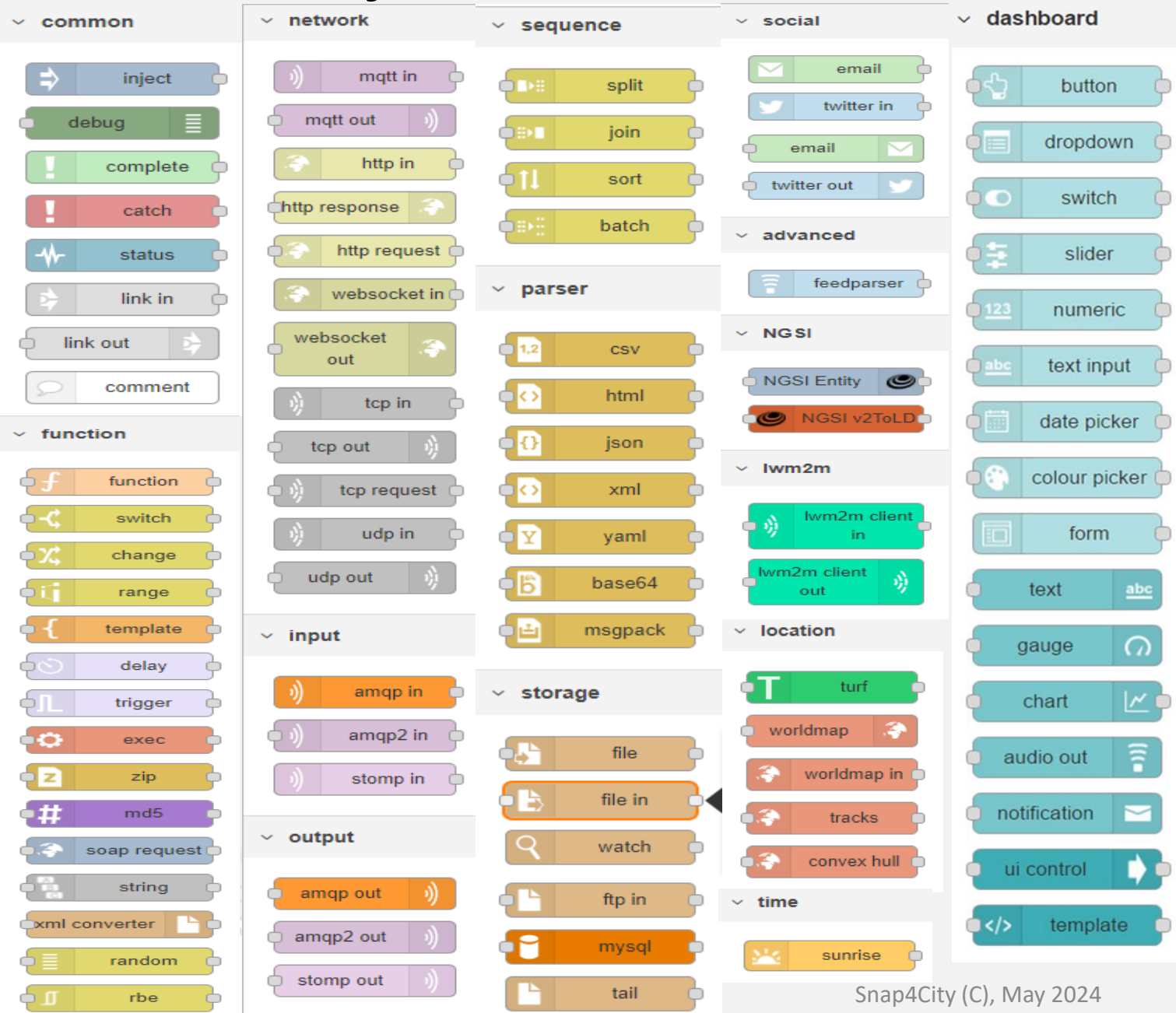


Node-RED

Search for nodes using

ctrl-f

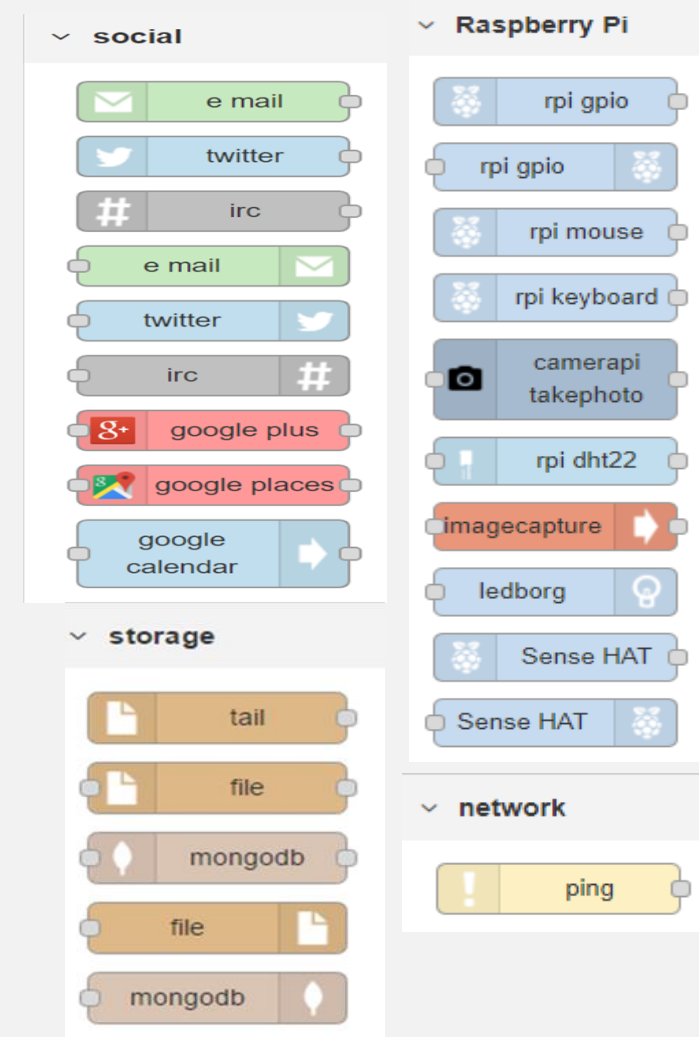
Basic Node.js Blocks on NodeRed on our Advanced IOT Apps



The screenshot displays 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 displays 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

+ on IOT Edge Raspberry

Categories shown in the main interface:

- 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), 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

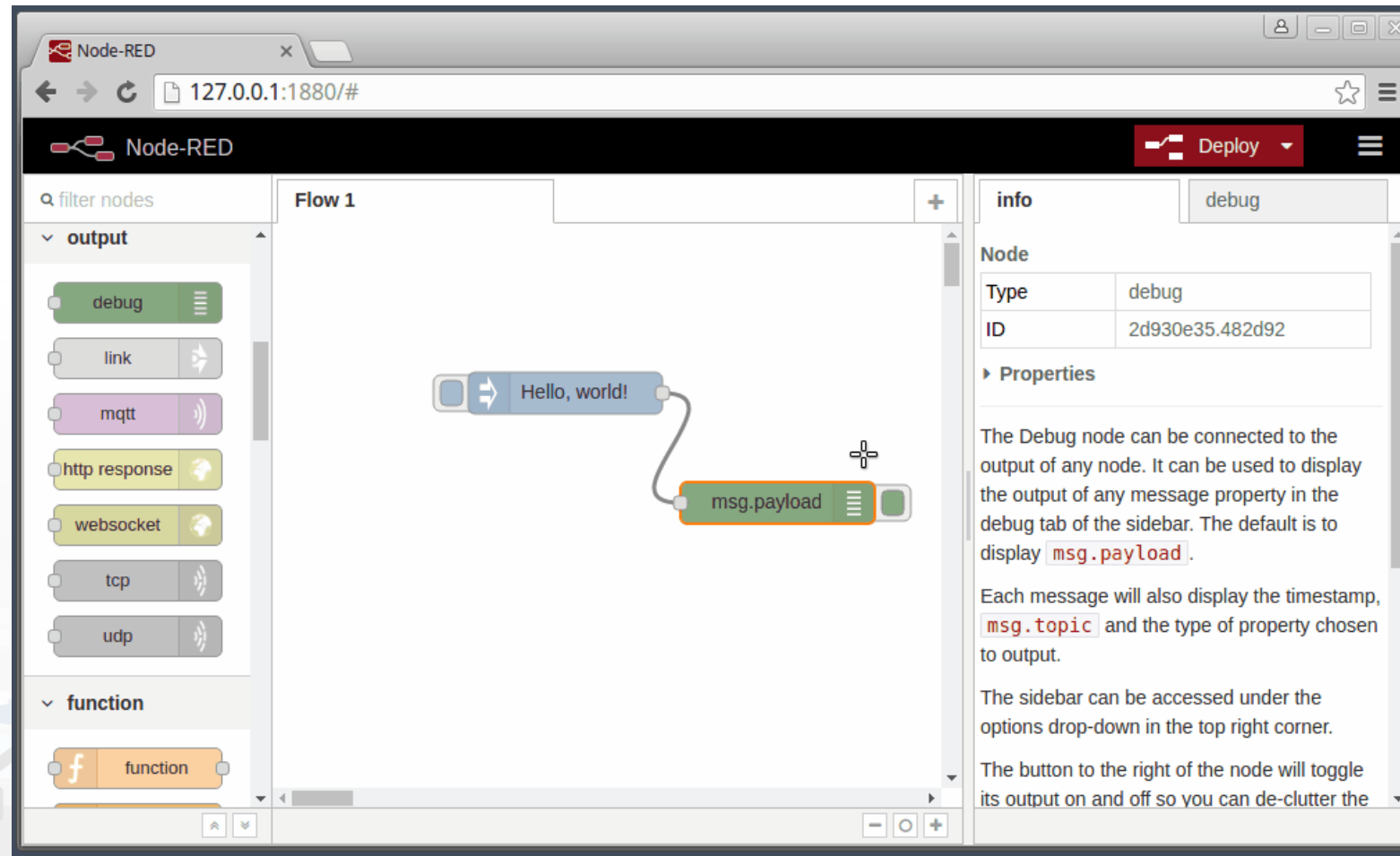
on IOT Edge Raspberry blocks:

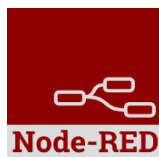
- social**: e mail, twitter, irc, e mail, twitter, irc, google plus, google places, google calendar
- Raspberry Pi**: rpi gpio, rpi gpio, rpi mouse, rpi keyboard, camerapi takephoto, rpi dht22, imagecapture, ledborg, Sense HAT, Sense HAT
- storage**: tail, file, mongodb, file, mongodb
- network**: ping

Snap4City (C), November 2020

Hello World of Node-RED

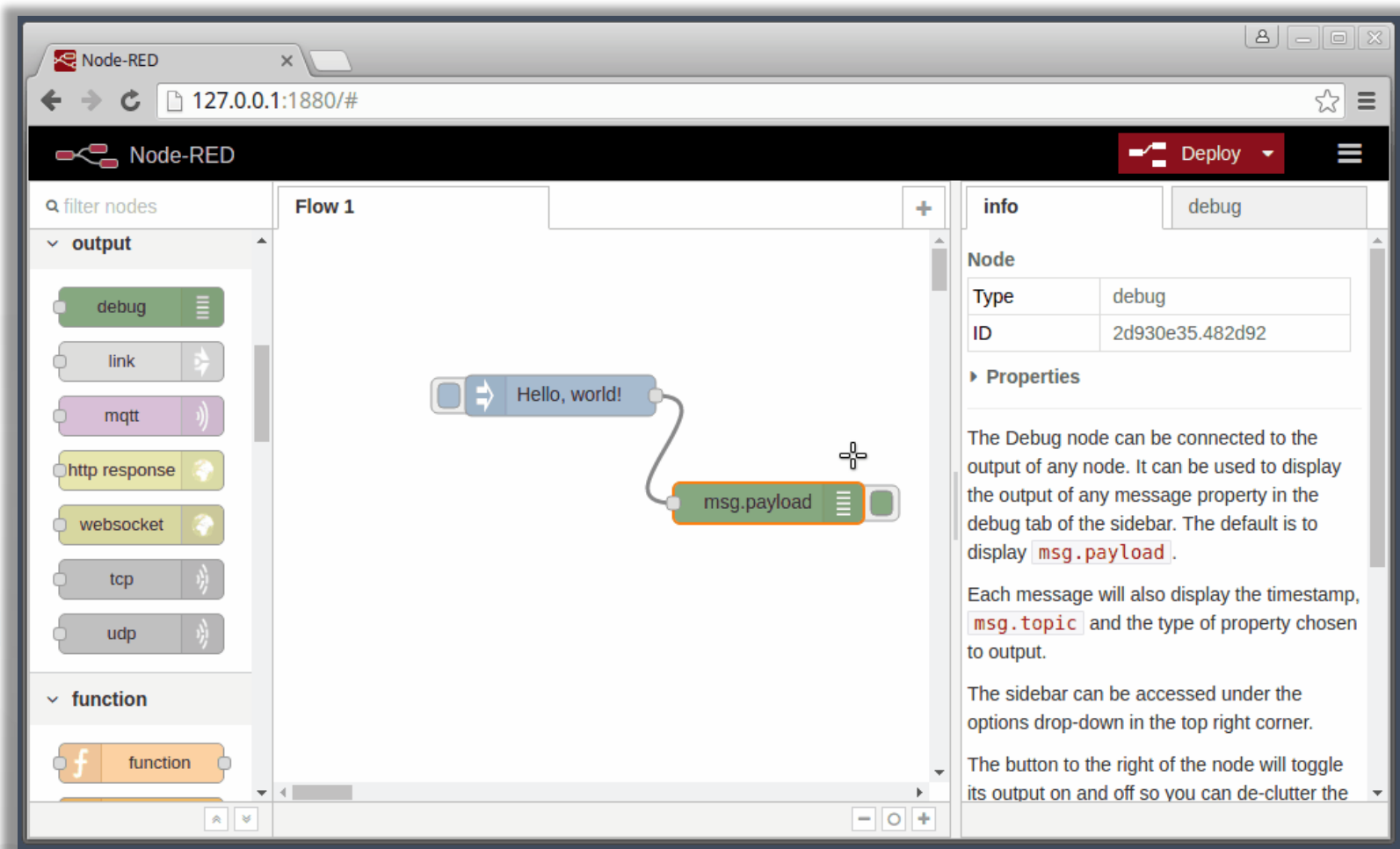
- <http://developer.opto22.com/nodered/general/getting-started/node-red-hello-world/>





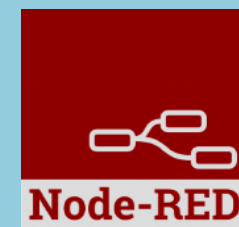
Node-RED

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



TOP

Node-RED Demo 0

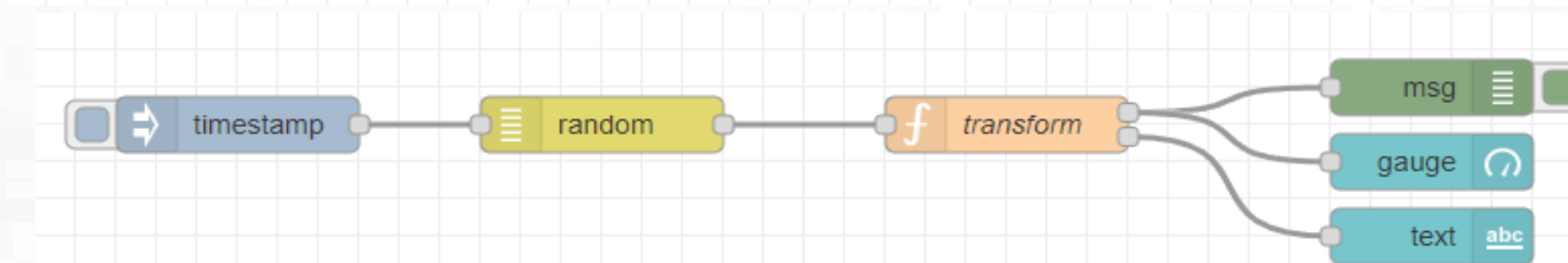
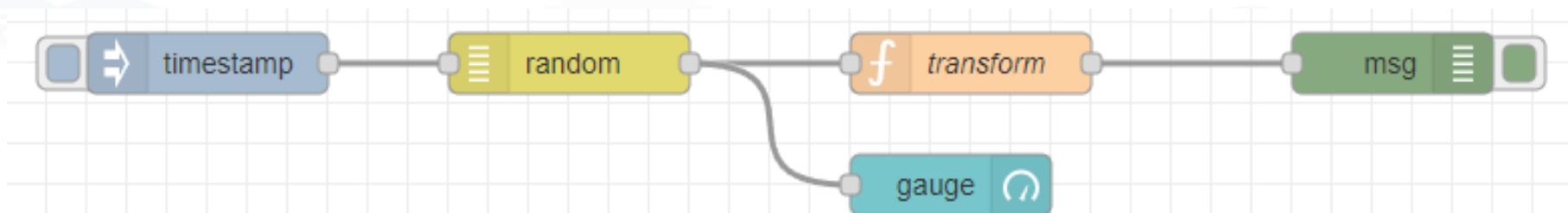


Course 2023 IoT App / Proc.Logic

- Pattern:



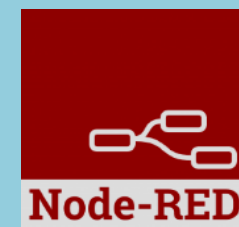
- Pattern:



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



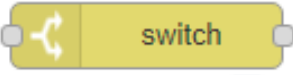
Generates an input for the other nodes. It can be repeated at predefined intervals, entered manually and of various types (timestamp, string, number, boolean, JSONetc)



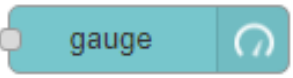
Each message that enters the debug node is shown in the "debug" tab on the right of node-red (you can choose which part of the message to show)



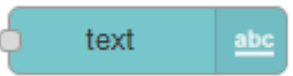
Generates a random number. You can configure the number generation interval and the type (integer or float).



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



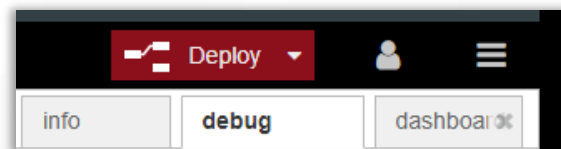
- Connect

- Configure

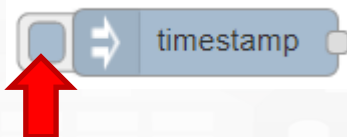
☒ Payload timestamp

☒ Repeat interval
 every minutes
☒ Inject once at start?

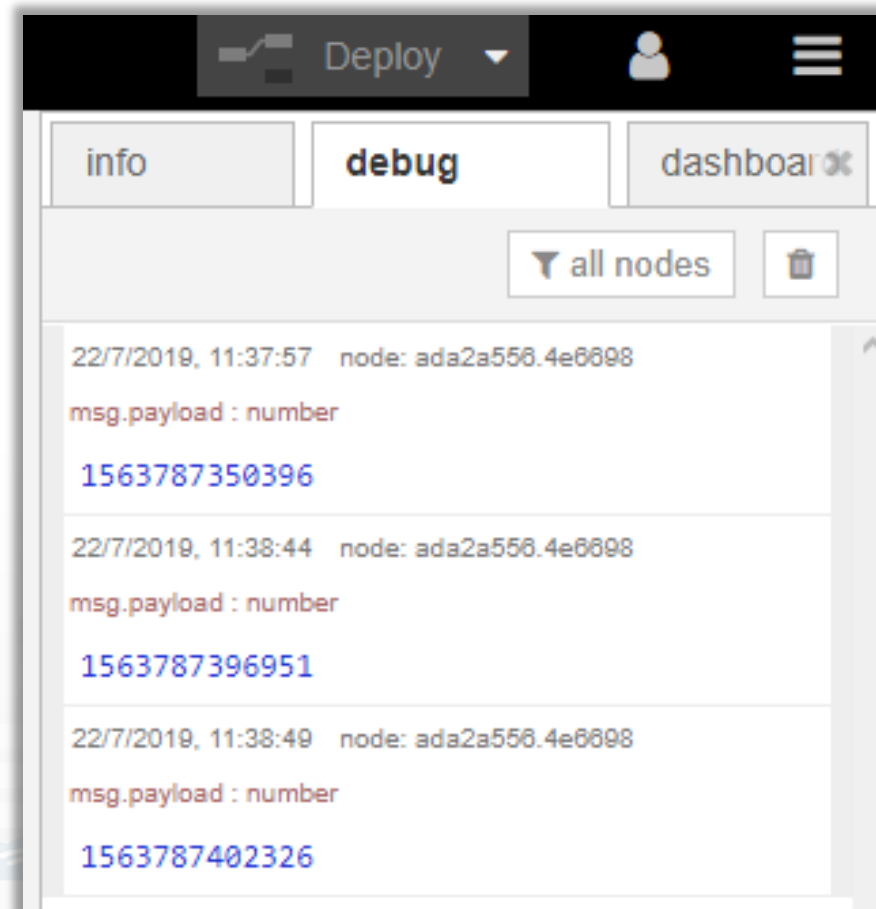
- Deploy



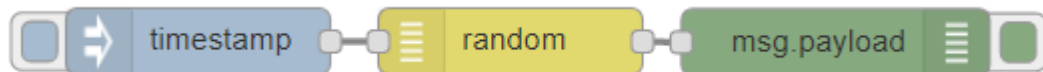
- Click



- Observe



Step 2



- Random
- Connect
- Configure

random

msg.payload

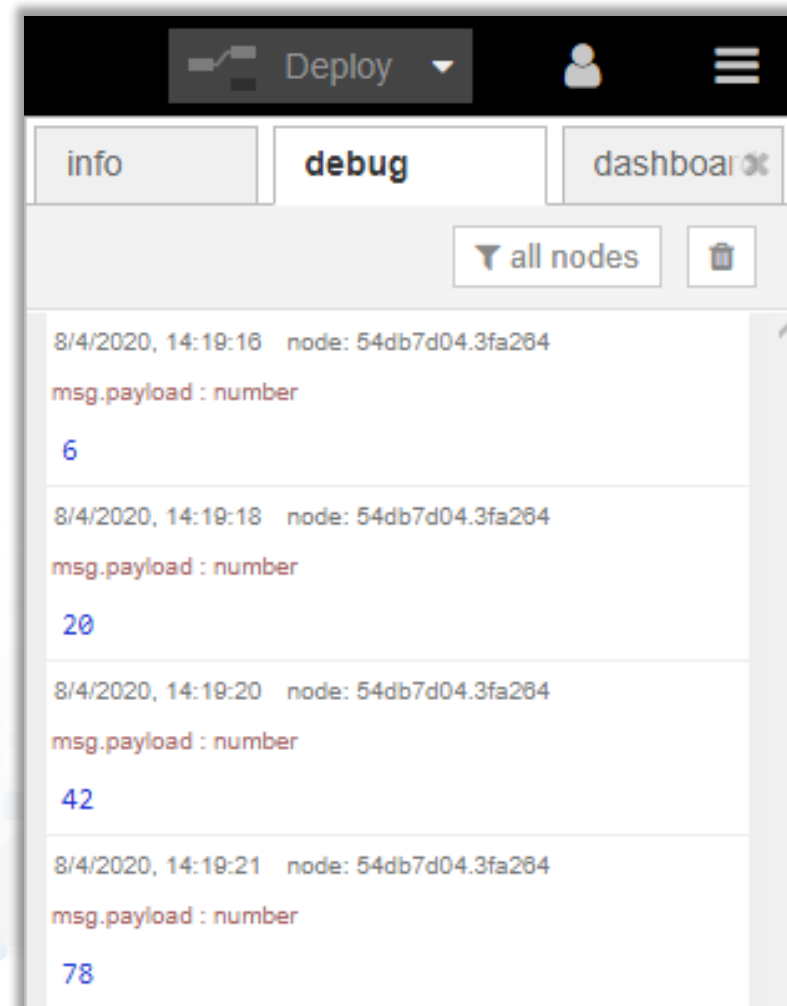
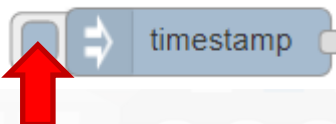
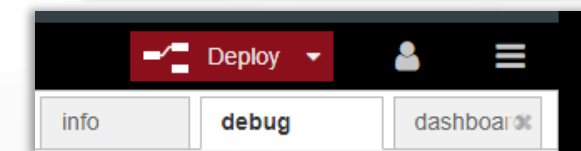
Generate: a whole number - integer

From: 1

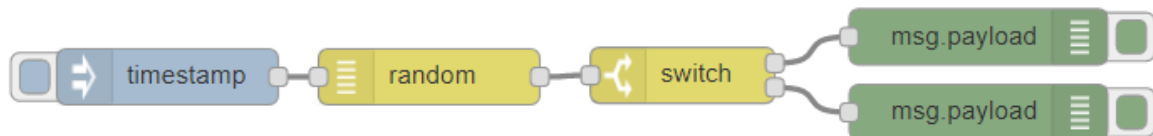
To: 100

Name: Name

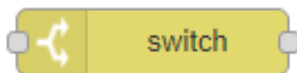
- Deploy
- Click
- Observe



Step 3



- Switch
- Connect
- Configure
- Deploy
- Click
- Observe

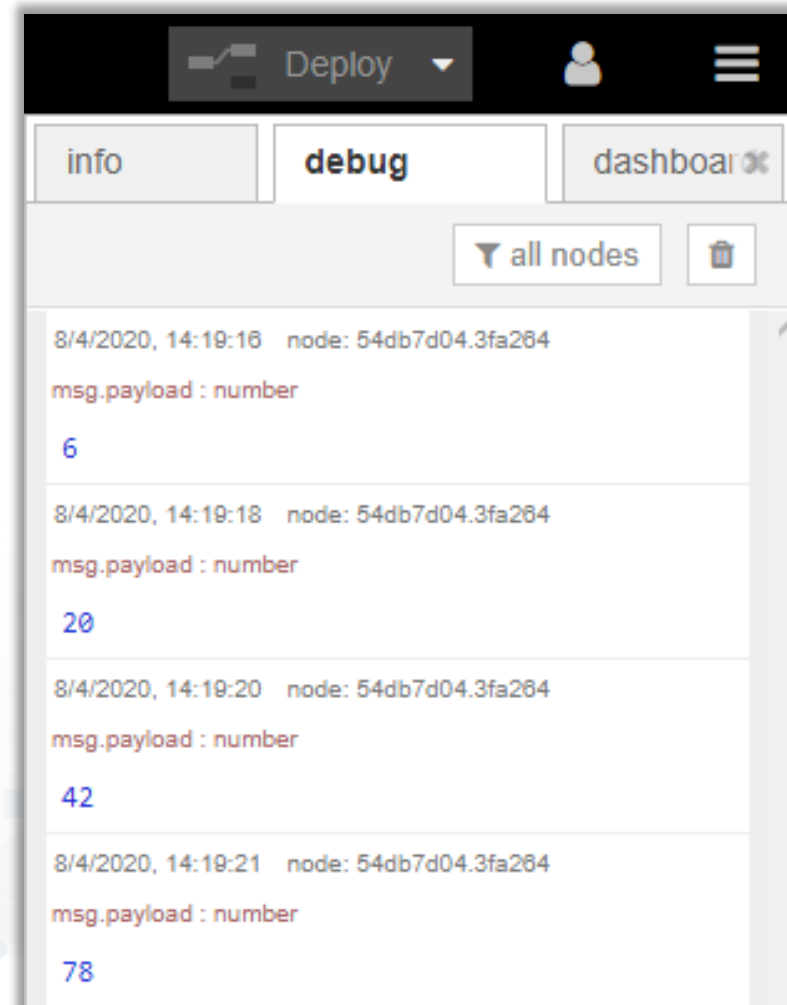
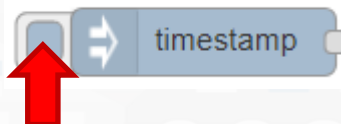
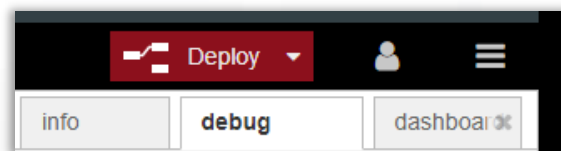


Name:

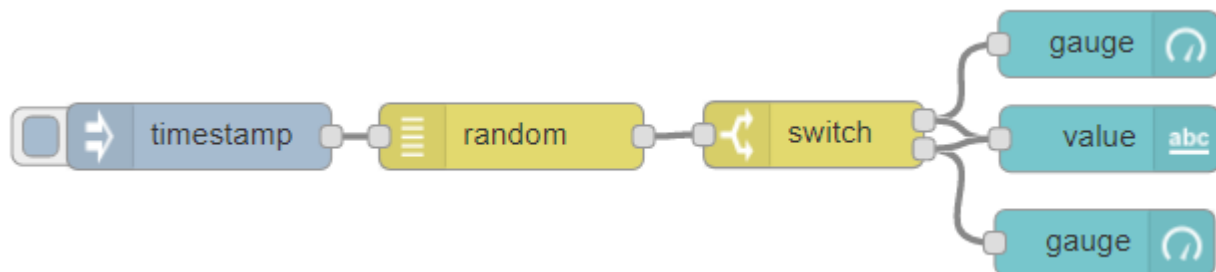
Property:

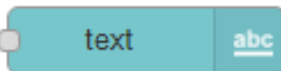
Condition:

Otherwise:



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

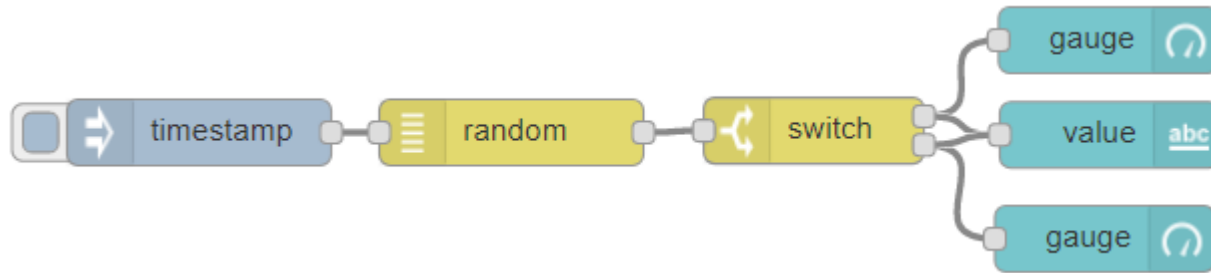
Colour gradient

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

label value

label value

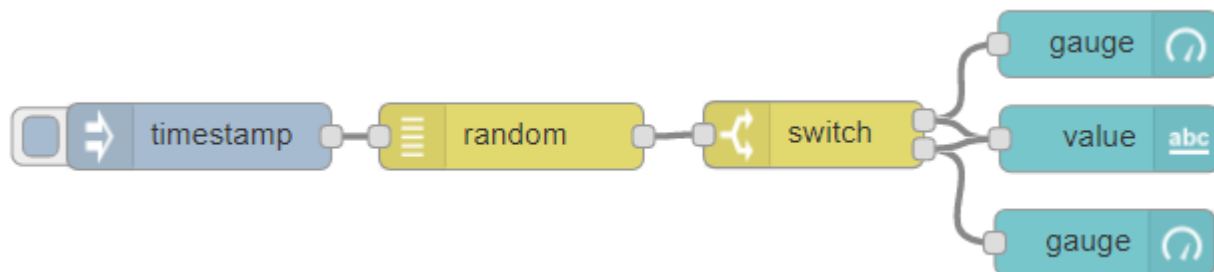
label value

label value

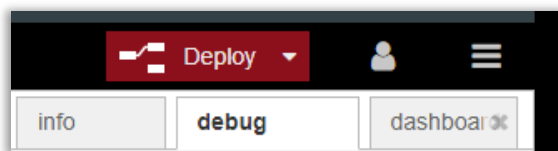
label value

Name

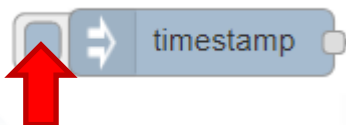
Step 5



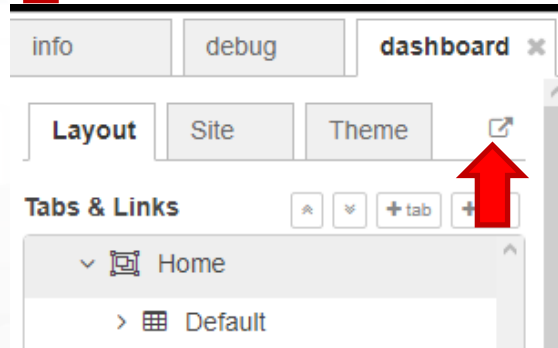
- Deploy



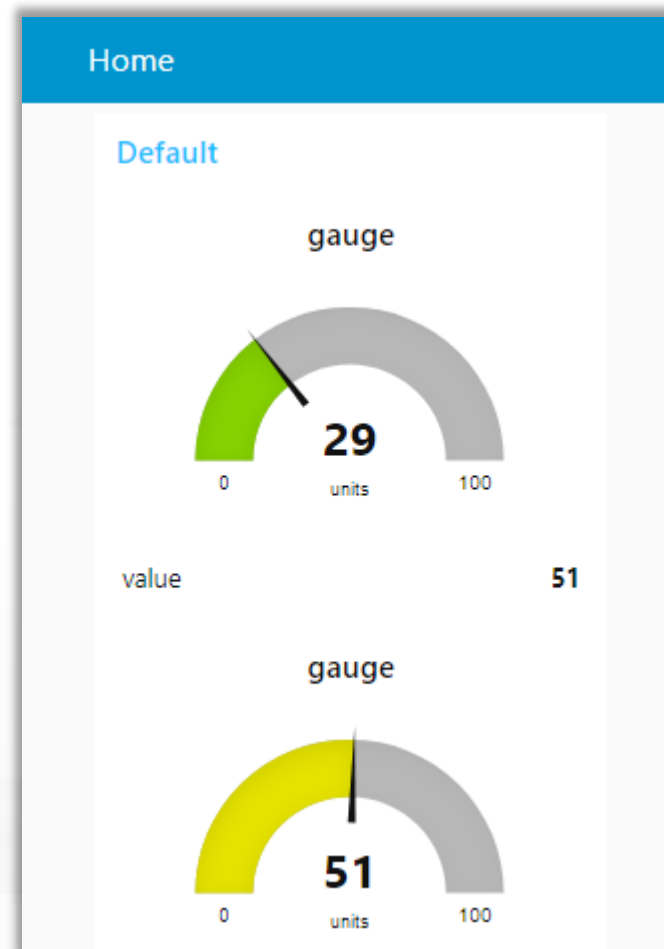
- Click



- 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

switch

Name

Property msg.payload

>= 50 → 1

otherwise → 2

random

Generate a whole number - integer

From 1

To 100

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}}

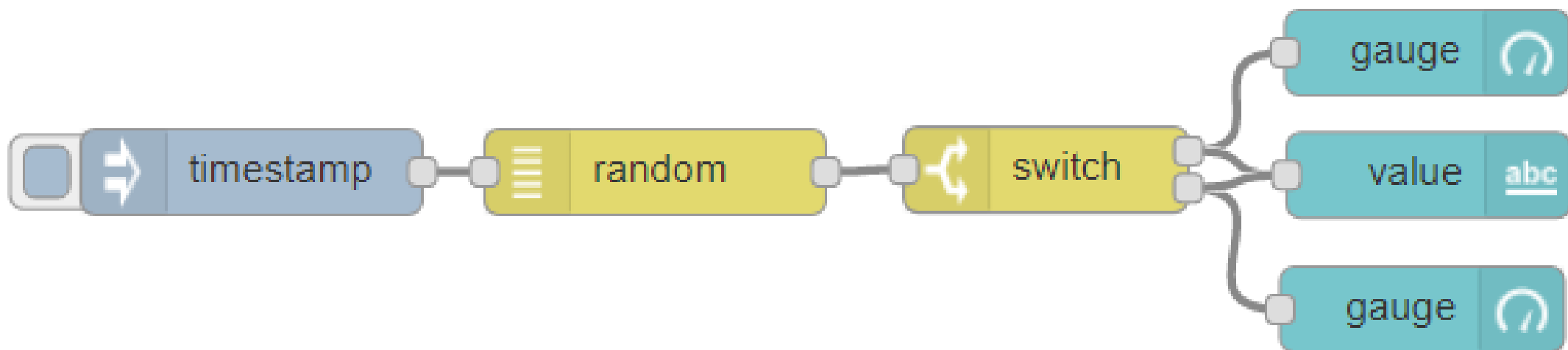
Layout

label value label value label value

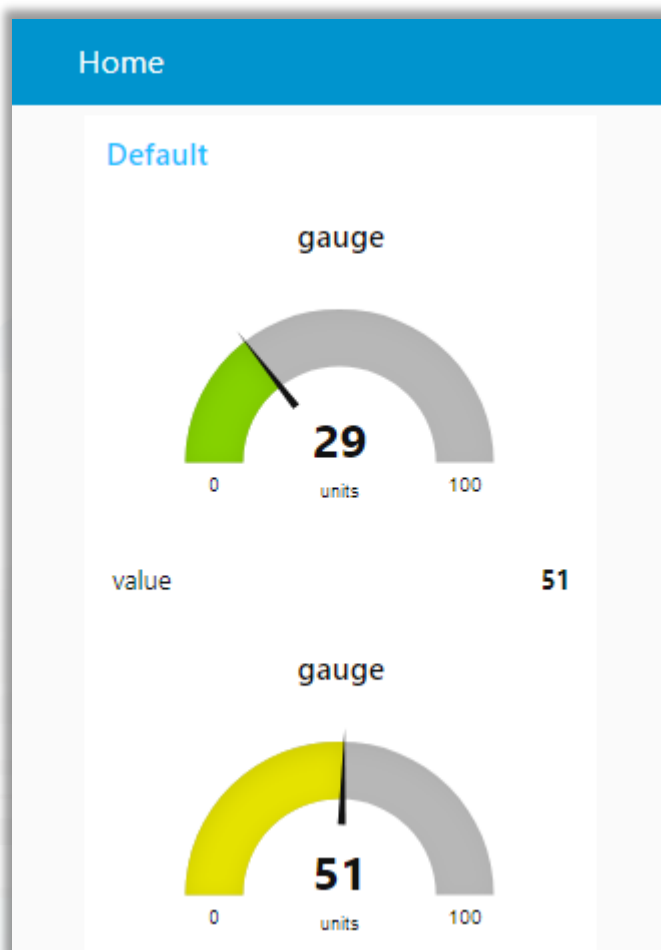
label value label value

Name

Nodes connections



Resulting Dashboard

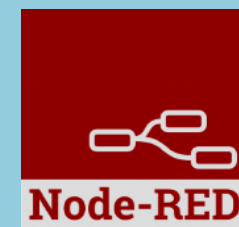


This is a local Node-RED dashboard.
Simple to be created, very limited for many aspects.

Snap4city dashboards are more :

- Powerful
- Flexible
- Secure
- nicer

Node-RED Libraries



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

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

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

[nodes](#)[flows](#)[collections](#)

[recent](#)[downloads](#)[rating](#)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 of 429 [Next](#)

Load Library from Palette

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

The screenshot shows the Snap4City interface with the Node-RED editor. The left sidebar contains a 'common' palette with various nodes like inject, debug, complete, catch, status, link in, link out, and comment. The main workspace shows a 'User Settings' dialog box. The 'Nodes' tab is active, displaying a list of installed and available nodes. A red circle highlights the 'Manage palette' option in the top right menu, with a red arrow pointing to it.

The top screenshot shows the Node-RED Library homepage with a search bar and a list of recent nodes and flows. The bottom screenshot shows the details page for the 'node-red-contrib-heatweb' node. A red circle highlights the 'Downloads' section, which shows the number of downloads in the last day, last week, and last month.

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

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

+[Sign in with GitHub](#)

nodes

flows

collections

recent

downloads

rating

node-red-contrib-snap4city-milestone
Node-Red integration to communicate with Milestone XProtect VMS
v0.0.3  34  5.0 node

node-red-contrib-snap4city-developer
A description of the available nodes can be found [here](https://www.km4city.org/iot-micro-
v0.5.13  7  5.0 node

node-red-contrib-snap4city-user
Nodes for Snap4city project, targeted to standard user (no developer)
v0.9.45  21  4.0 node

node-red-contrib-snap4city-d3-dashboard-widgets
Nodes for Snap4city project for D3 Dashboard Widgets
v0.0.13  5  5.0 node

node-red-contrib-snap4city-tunnel
Nodes for Snap4city project, targeted to tunneling edge device
v0.0.3  2 node

Snap4City module for tunneling on IOT Edge
Snap4City module for tunneling on IOT Edge
disit  NaN collection

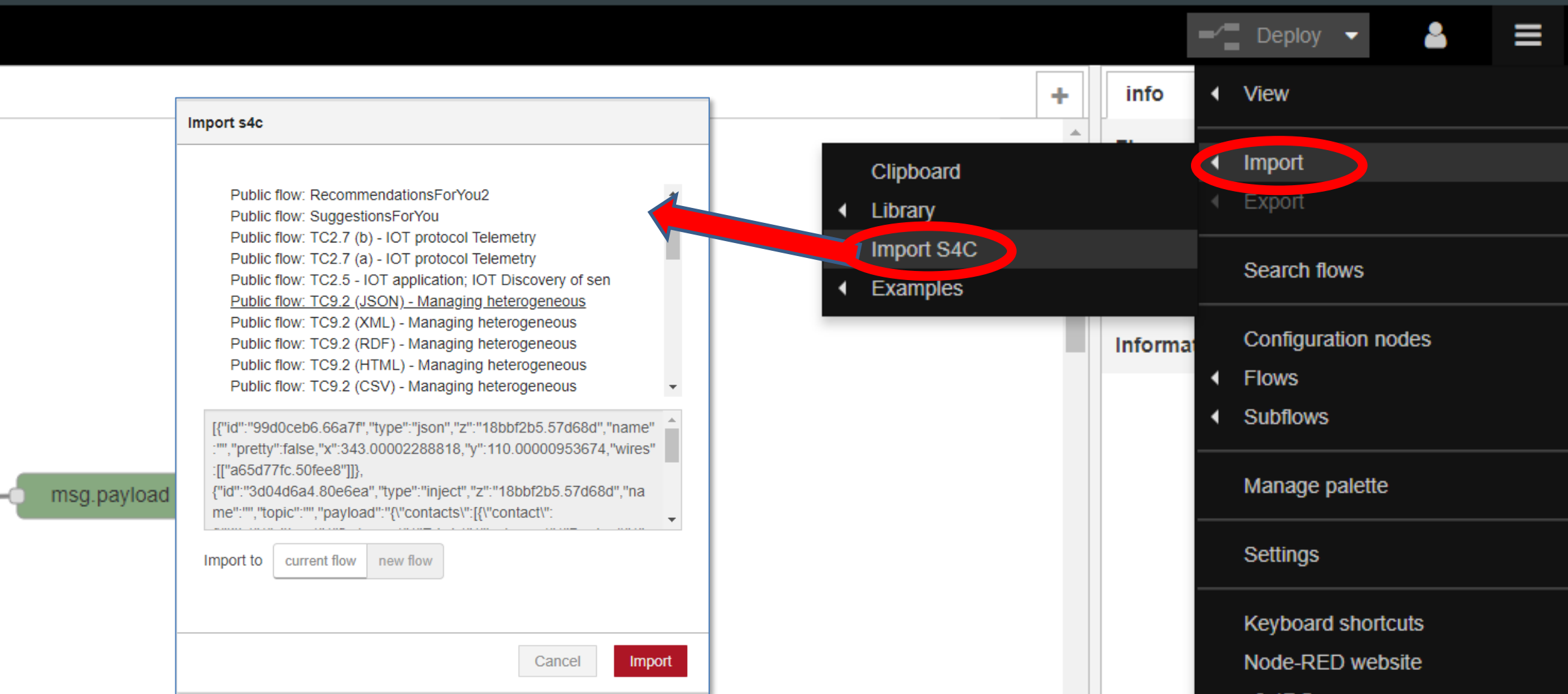
1 of 1

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

Load an IOT application of example



aaa



The screenshot shows the Node-RED web interface. On the left, a 'msg.payload' node is connected to a 'Public flow: RecommendationsForYou2' node. A red arrow points from the 'Import S4C' menu item to the 'Import s4c' dialog box. The dialog box lists several public flows, including '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', and 'Public flow: TC9.2 (CSV) - Managing heterogeneous'. Below the list, there is a text area containing JSON data. At the bottom of the dialog, there are buttons for 'Import to', 'current flow', 'new flow', 'Cancel', and 'Import'. On the right side of the interface, a menu is open with the 'Import' option highlighted by a red circle. Other menu items include 'View', 'Export', 'Search flows', 'Configuration nodes', 'Flows', 'Subflows', 'Manage palette', 'Settings', 'Keyboard shortcuts', and 'Node-RED website'.

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

Import to:

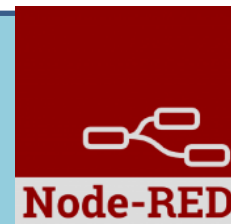
Clipboard
Library
Import S4C
Examples

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

TOP

Snap4City Node-RED

Debug extending Cauldron



App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCenter Trello Km4City major tools Impostazioni YouTube Google Forms News Tutti i preferiti

Snap4City

Switch To New Layout (Beta)

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

LOGOUT

My Snap4City.org

Tour Again

www.snap4solutions.org

ダッシュボード

Dashboards (Public)

My Dashboards in All Org.

Dashboards of My Organization

My Dashboards in My Organization

My Data Dashboard Dev Kibana

My Data Dashboard Kibana

Extra Dashboard Widgets

Notifier

Data Management, HLT

Knowledge and Maps

Processing Logics / IOT App

Processing Logics / IOT App

MicroServices for Proc.Logic/IOT App

MicroServices from DataAnalytic

IOT MicroServices for Final Users

IOT MicroServices for Developers

DOC: Processing Logic/IOT App

How to Develop Proc.Logic / IOT App

Create A MicroService from RestCall

Entity Directory and Devices

Resource Manager

Development Tools

advanced3debug

Node-RED

filter nodes

Flow 4 Flow 3 Flow 1 R - Python

subflows

- getAccessTok en
- getAccessTok en (2)
- getAccessTok en (3)
- getAccessTok en (2) (2)

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change

timestamp

debug 6

function 4

function 5

chart

debug 7

info

Search flows

Flows

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

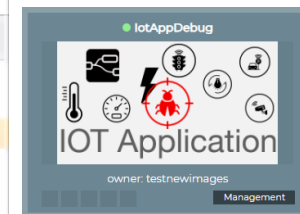
Subflows

Global Configuration Nodes

Flow 3

Flow "ff58664fe453ec66"

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

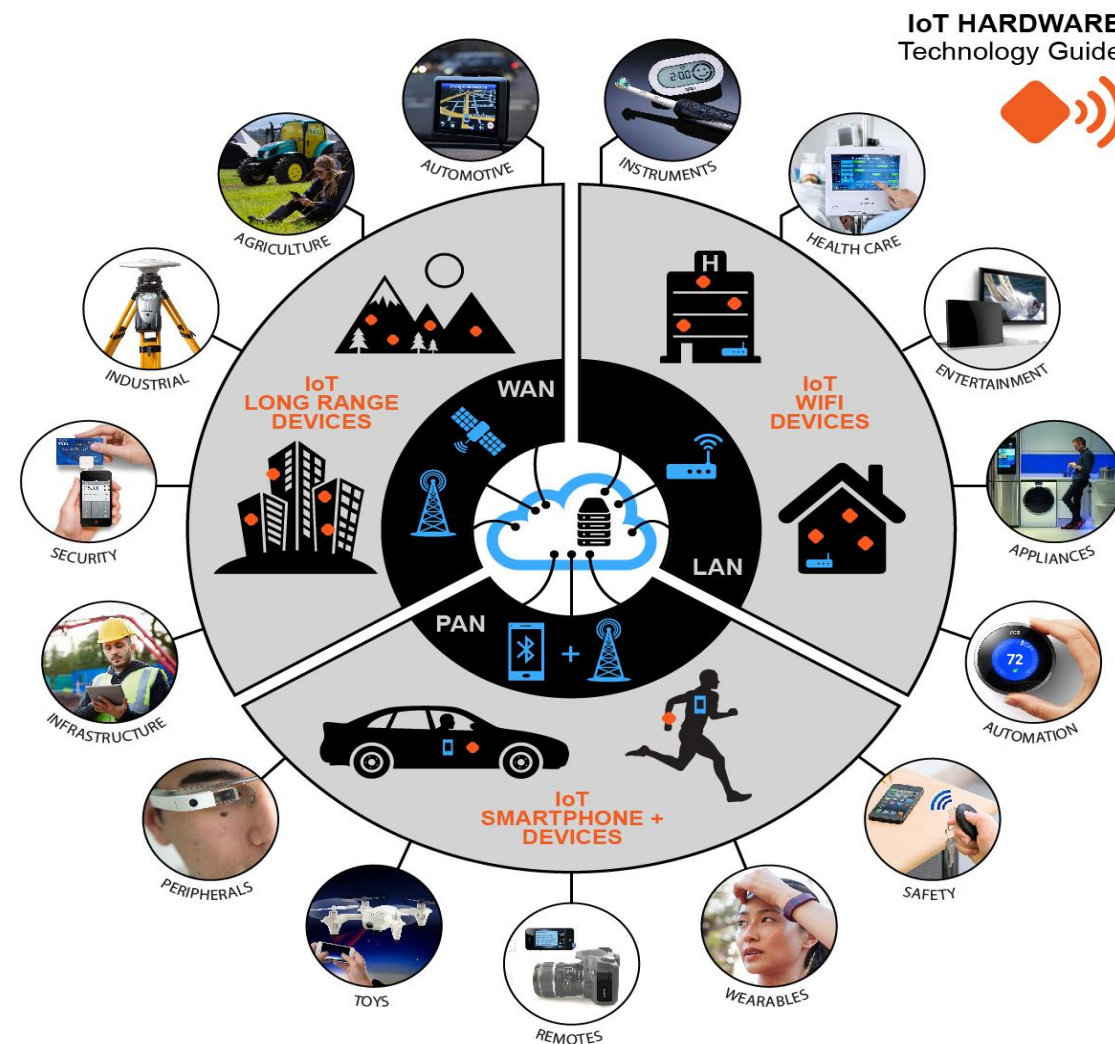
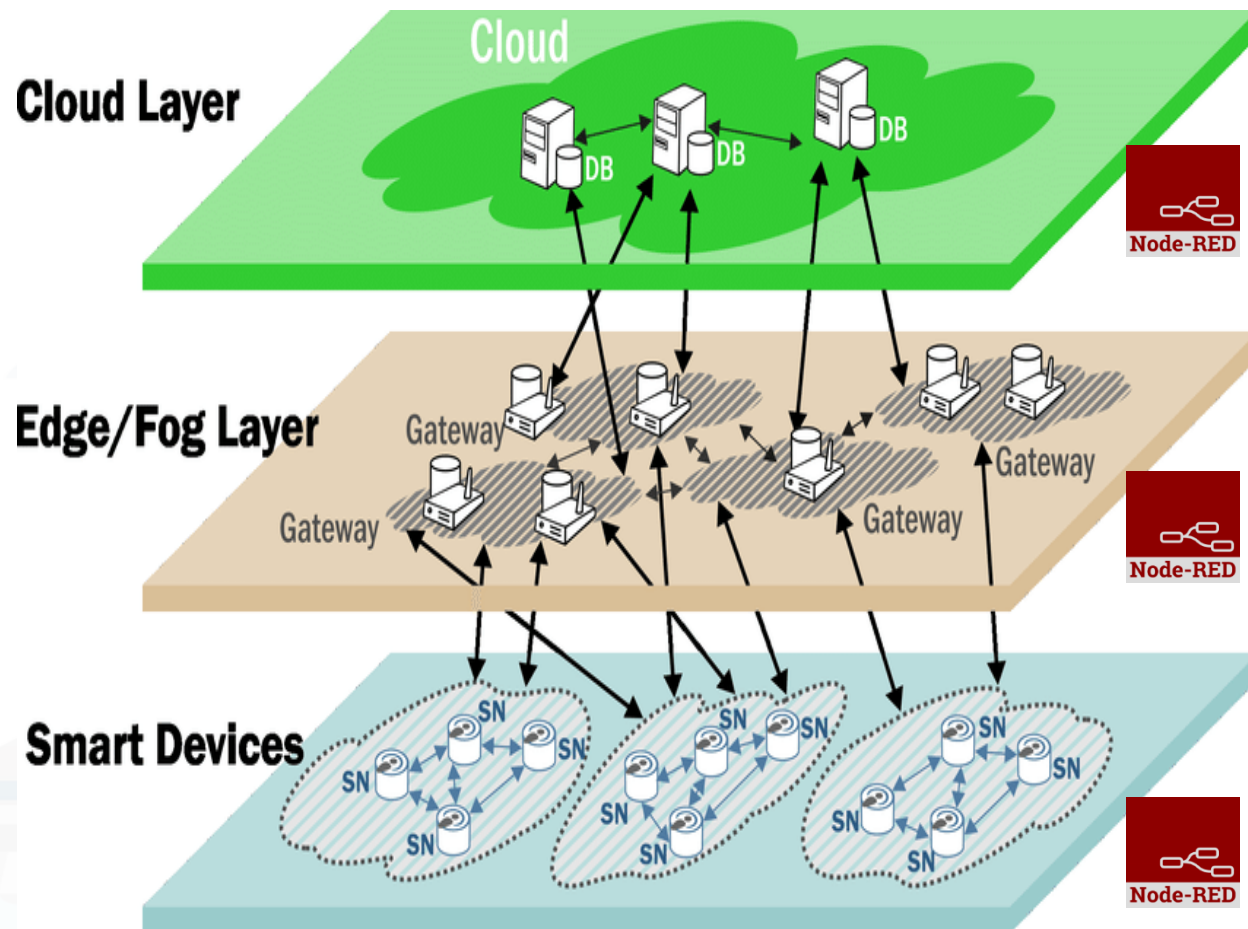


TOP

IoT App = Node-RED + Snap4City
IoT App === Proc.Logic

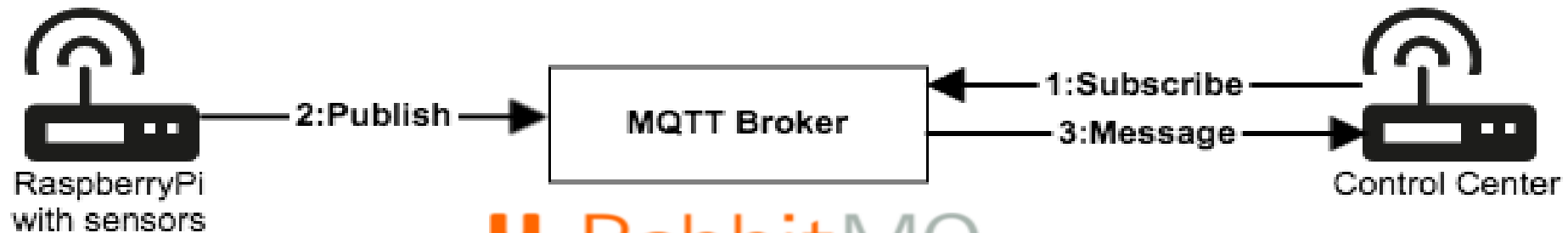


WoT: Cloud vs Fog/Edge Computing



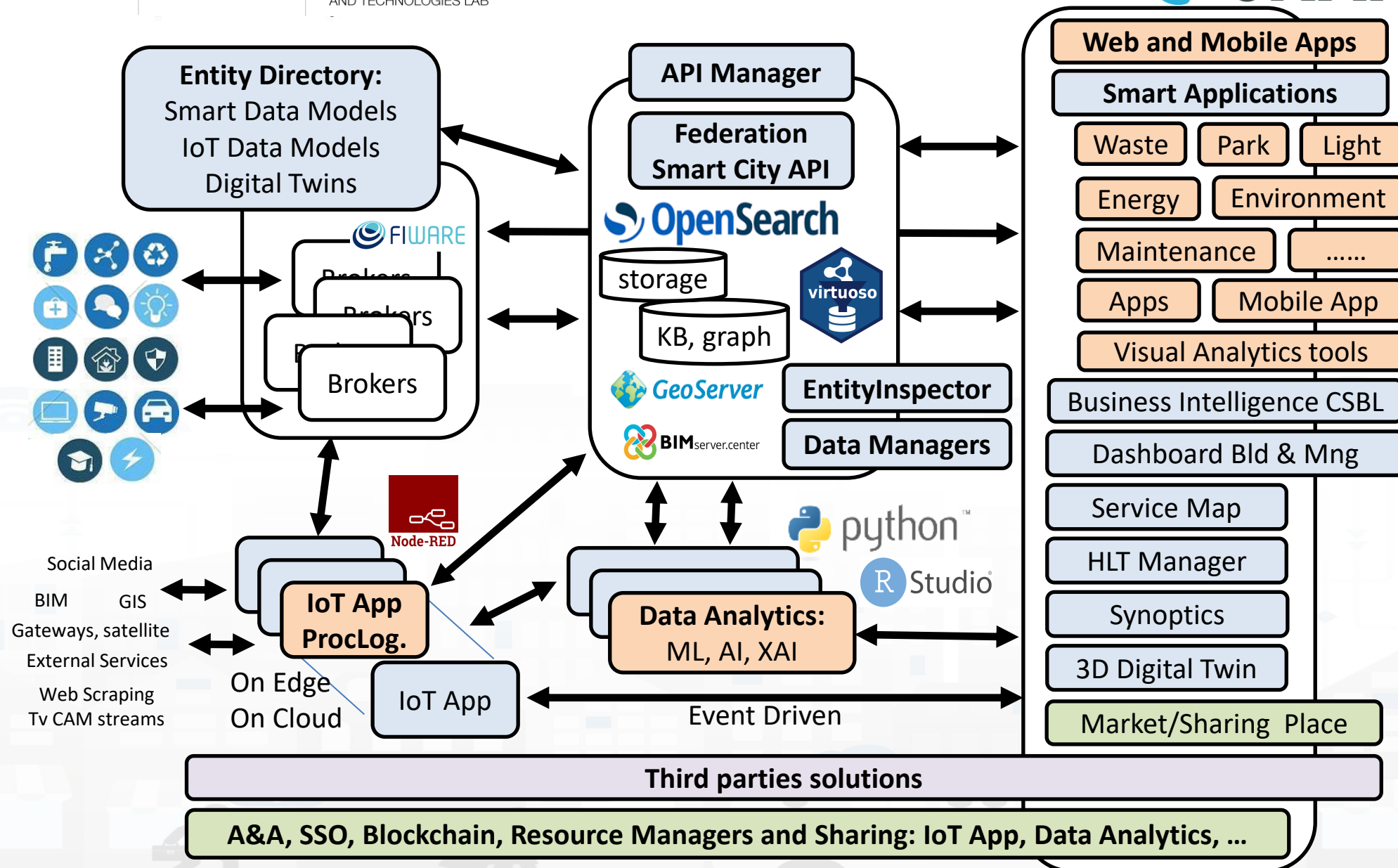
Brokers

	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



RabbitMQ
Open Source Enterprise Messaging

Tech Arch



IOT Device

What About IoT Devices, Time Series



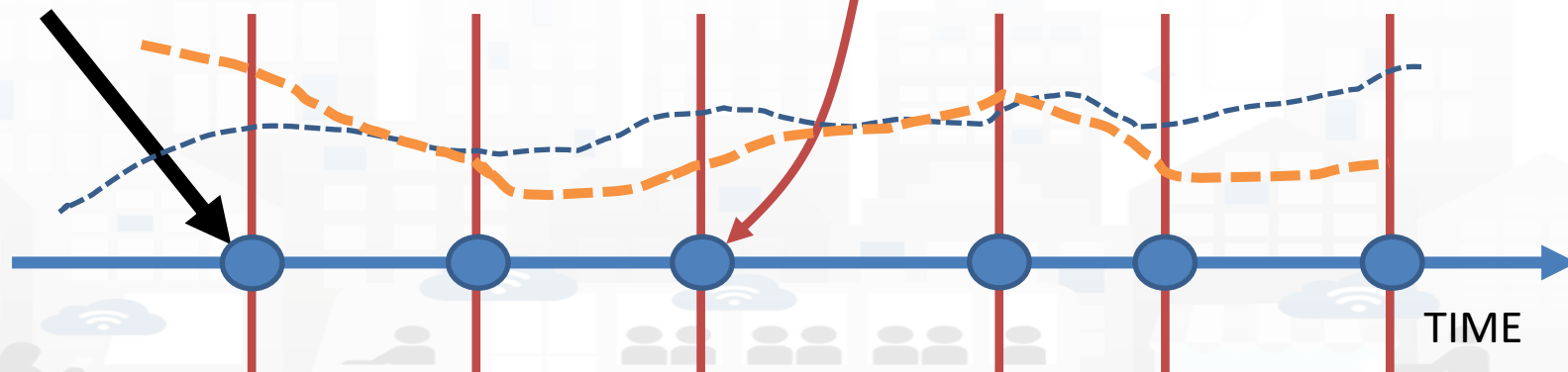
Entity: IOT
Device

Sends a
message

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

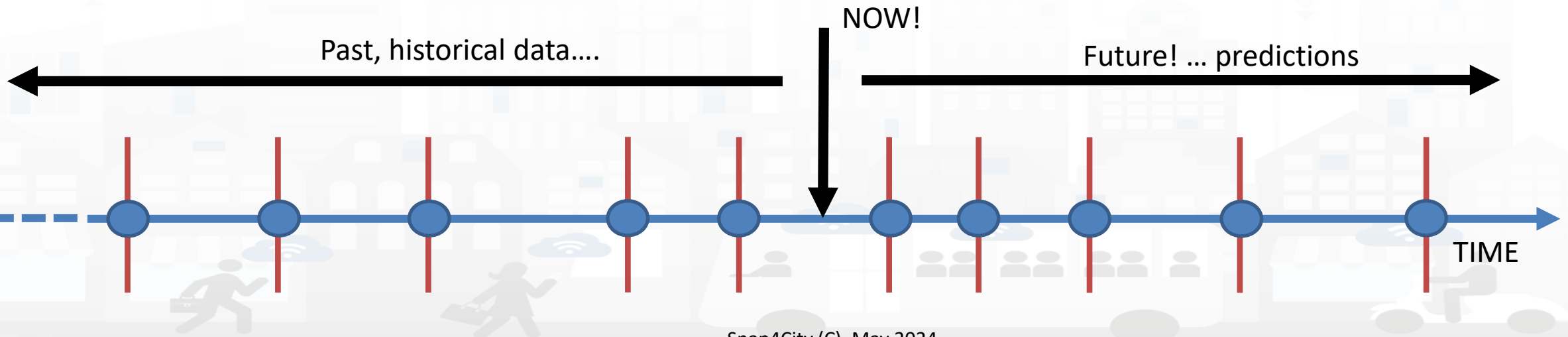
- A set of data coming from an IoT Device with multiple sensor become a time series of values for devices.
 - For example: taking a new measure every 10 minutes (**Red Lines**)
 - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «**dateObserved**»,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

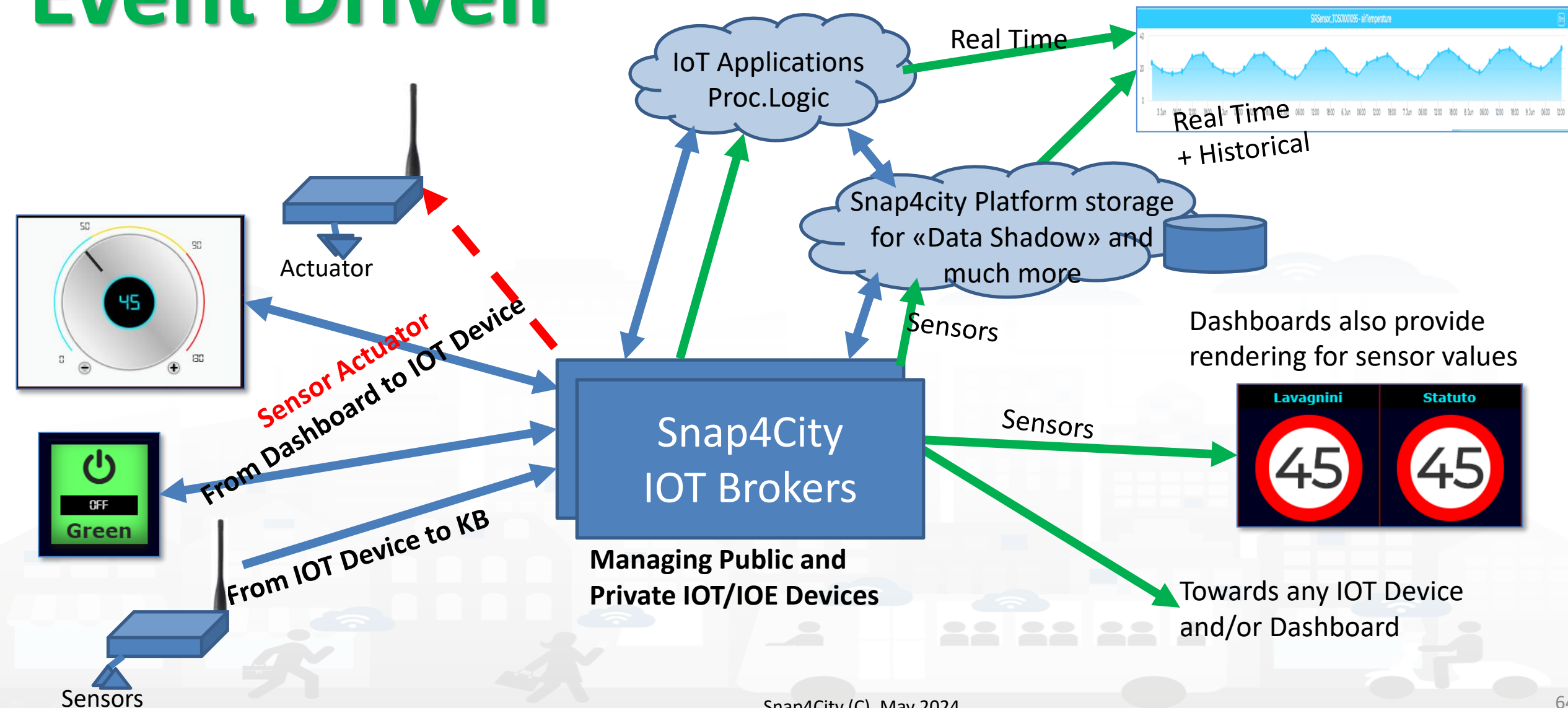


Time Series: they are data streams

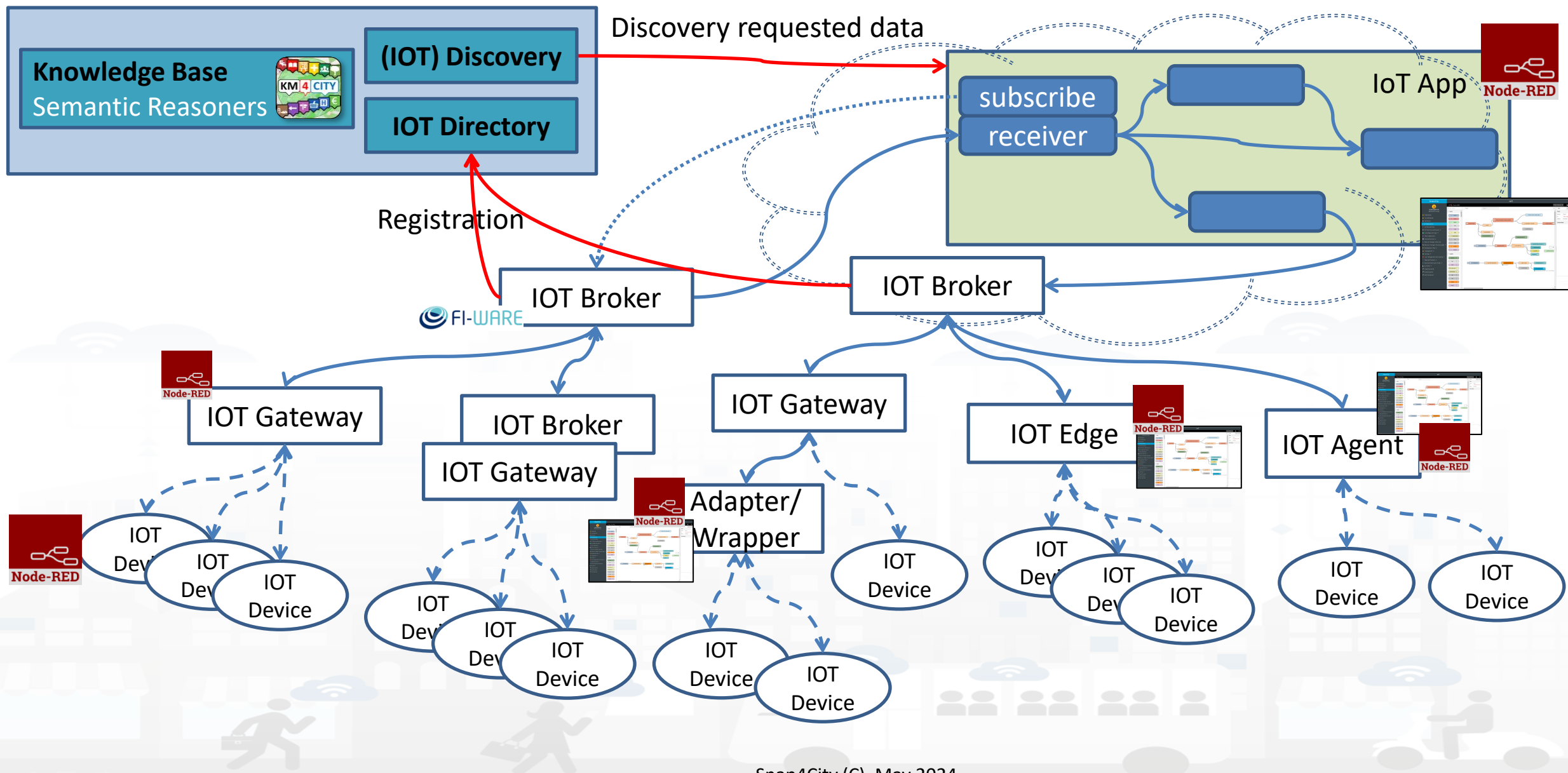
- As soon as you have registered an Entity Instance / IoT Device
 - You are ready to get Future data, may be arriving in PUSH
 - Recall and store historical data as well, but they have to be
 - recalled in PULL with some IoT App.
 - Loaded in PULL with some File or Data Table Loader



Event Driven



IoT Network



IoT/IoE 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](#)

 Dashboards (Public)



My Snap4City.org



Tour Again

[+ CREATE NEW](#)

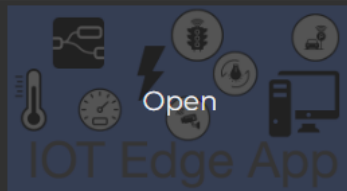


Prev 1 2 3 Next

Filter



● 2020-07-28T10:20

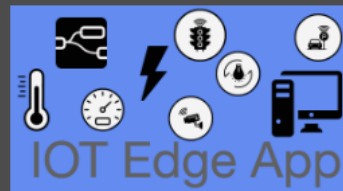


My own



Management

● 2020-07-28T12:32

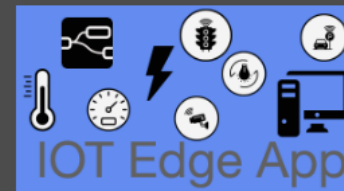


My own



Management

● 2020-08-18T08:38

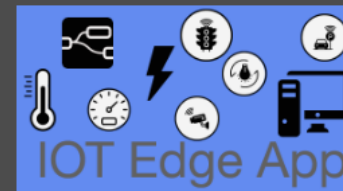


My own



Management

● 2021-01-19T16:25

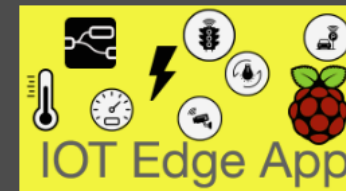


My own



Management

● 2021-08-21T13:26

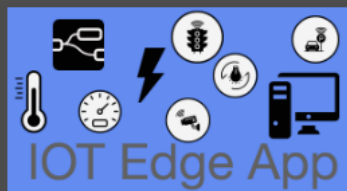


My own



Management

● 2022-05-28T14:50



My own



Management

● actionurltest

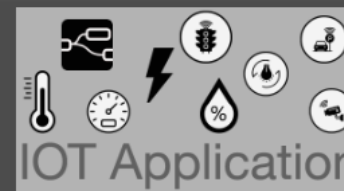


My own



Management

● Alarm Management



My own



Management

● corona1

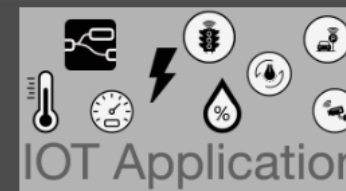


My own



Management

● coronaR



My own



Management

 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

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

lot-App

IOT Application

owner: tester14

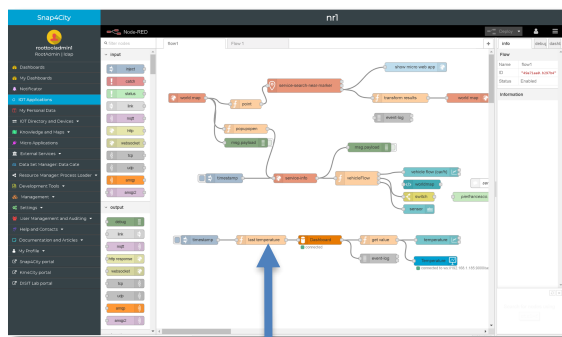
Management

IOT Application Listing, they can be

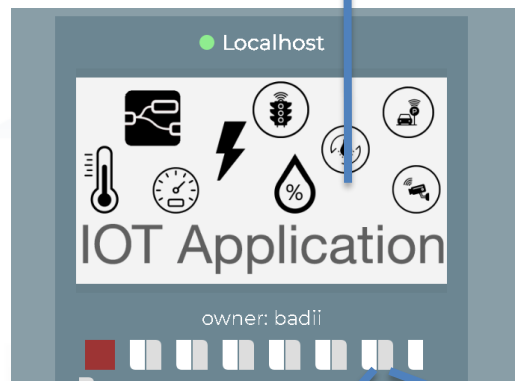
- Basic (white)
- Advanced (red)
- IOT Edge
 - Raspberry Pi
 - Android
 - Win/Linux
- Data Analytic (Plumber)
- Web Scraper (Portia)

IOT Applications Listing

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

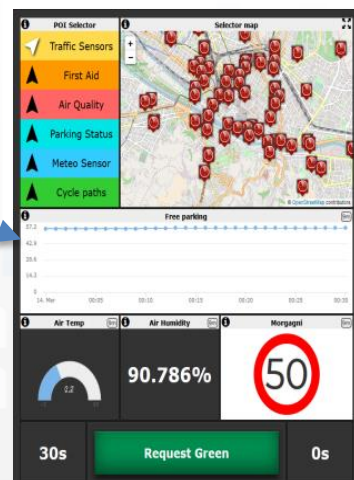


EDIT IOT APP



VIEW

EDIT



IOT App title

Ownership of the IOT App

Click the icon to edit the IOT App

Click to open the Node-RED IOT App dashboard

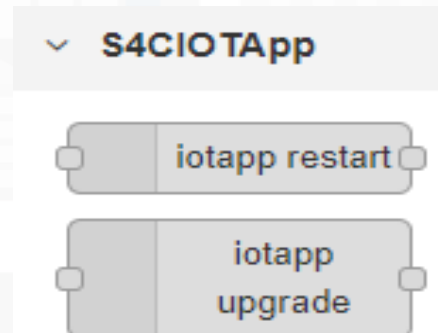
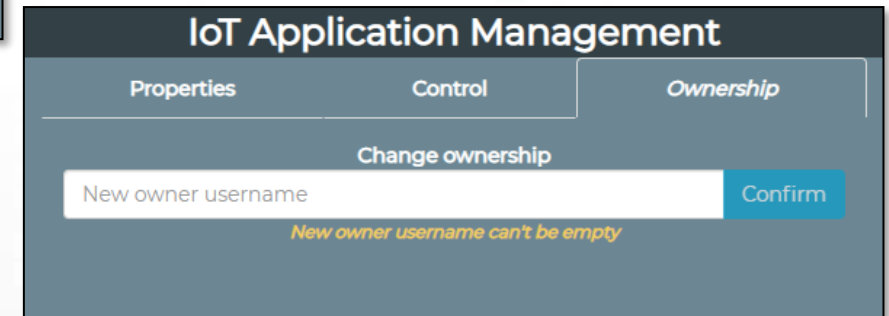
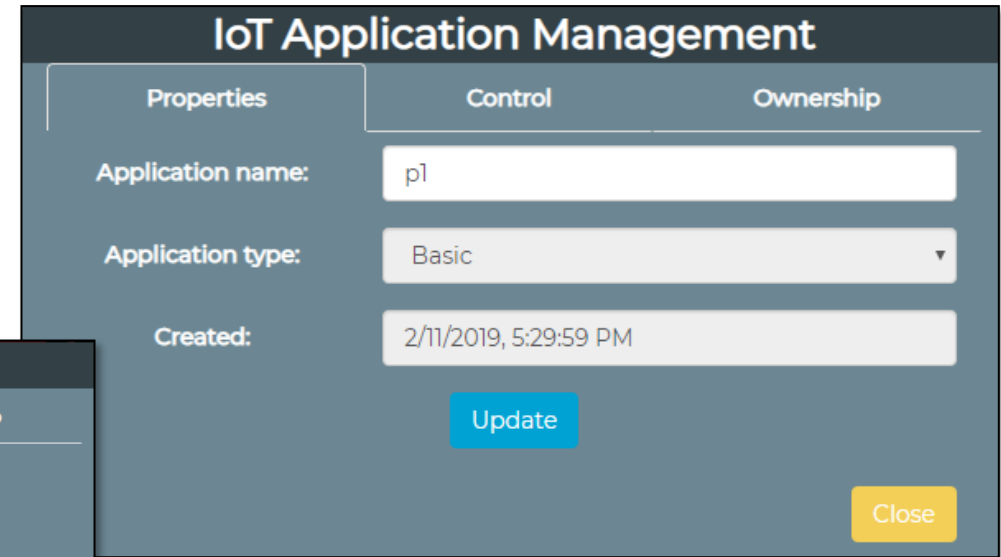
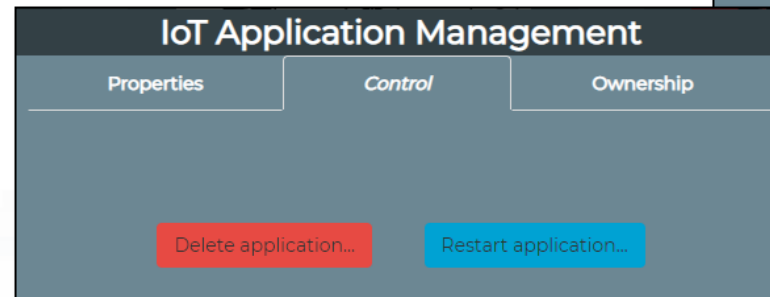
Click to edit IOT App properties

Click to view the Snap4City Dashboard

Click to edit the Snap4City Dashboard

IOT Application Self Control

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

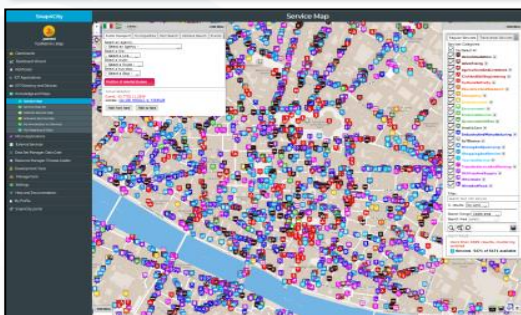
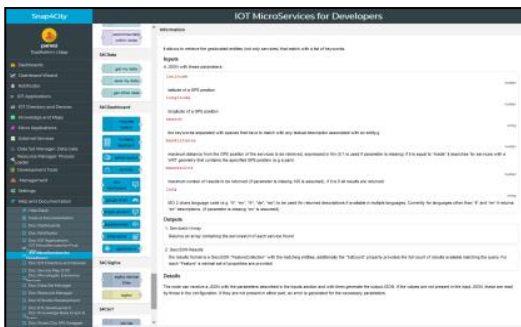


Automating restart
and update

IOT Applications Development

IOT Discovering

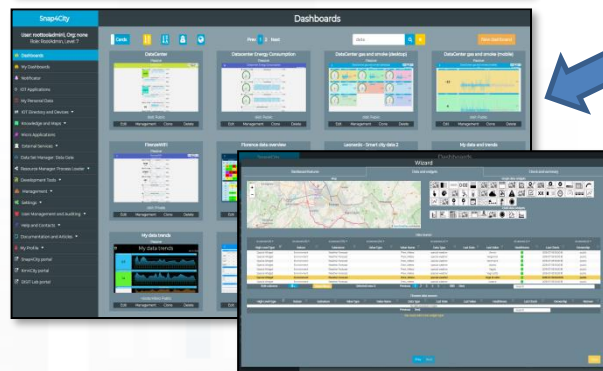
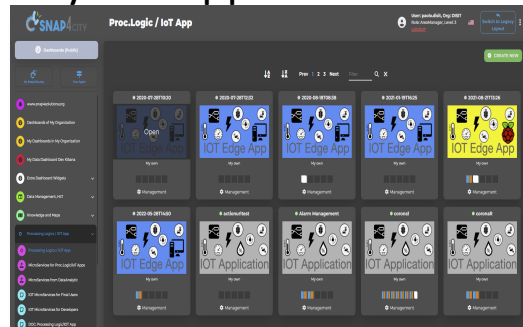
MicroServices collections



ServiceMap Discovery
Knowledge Base, Km4City

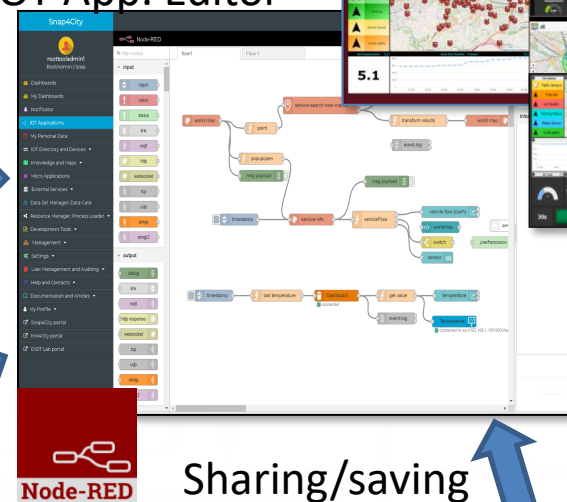


My IOT Applications



Dashboard Collection,
Editor and Wizard

IOT App. Editor



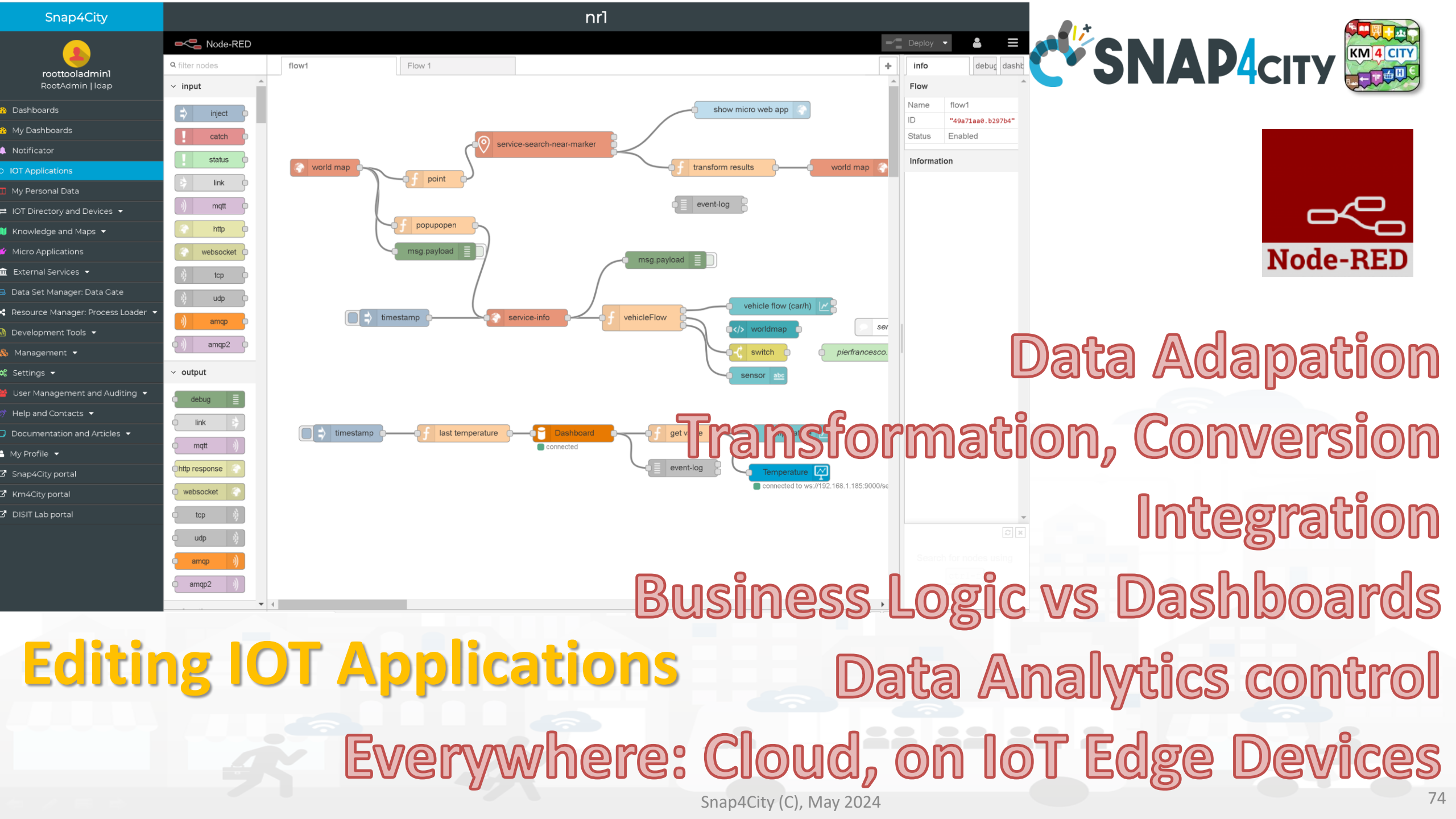
Sharing/saving
reusing IOT App



Resource Manager

Generating IOT App
With Dashboard

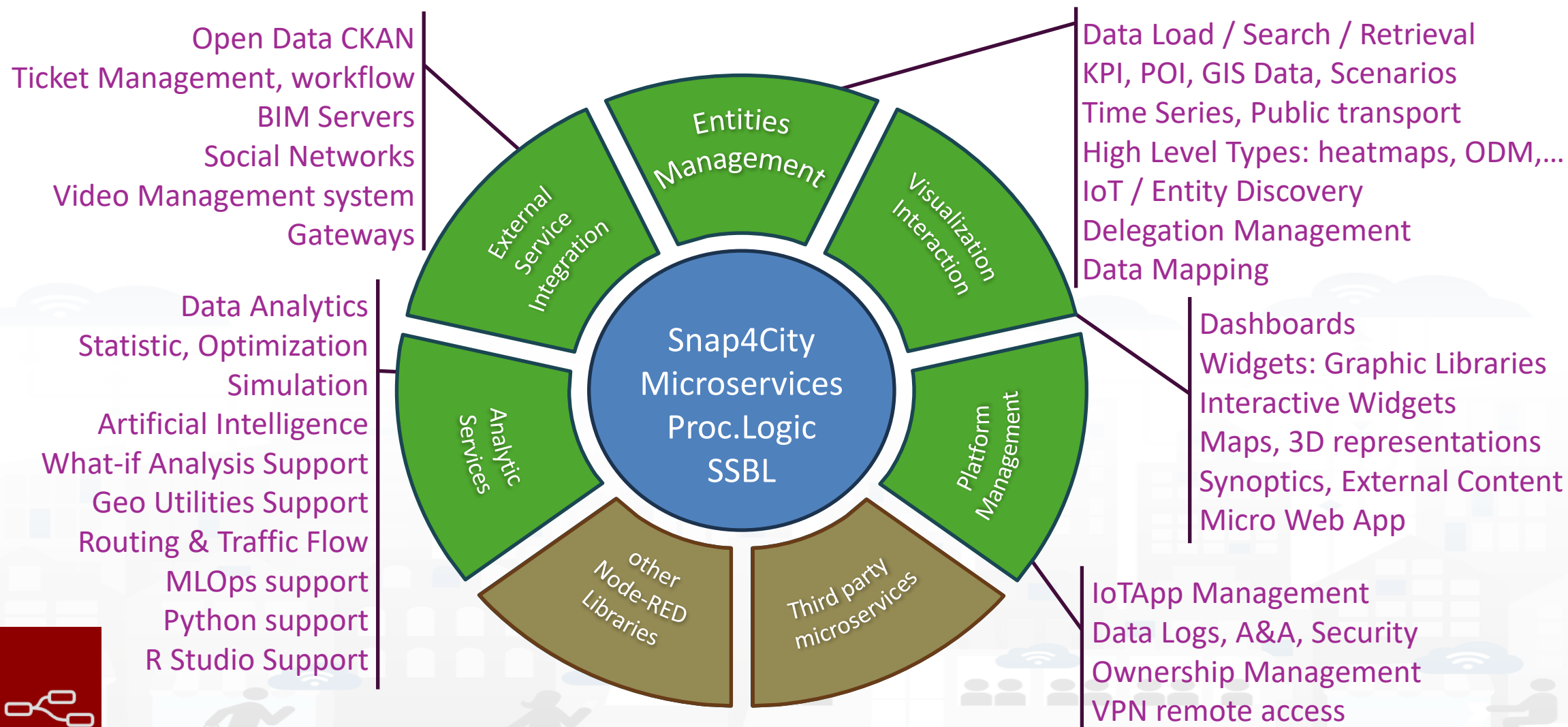




Editing IOT Applications

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.**



DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

Sept 2023 collection

Two Snap4City Libraries



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



Sept 2023 collection

Two Snap4City Libraries



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

We suggest also to install:

AND: From Resource Manager

Snap4City (C), May 2024

81

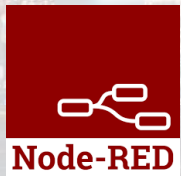
Standards and Interoperability (6/2023)



Compliant with:

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

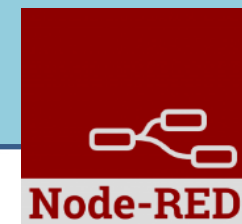
<https://www.snap4city.org/65>



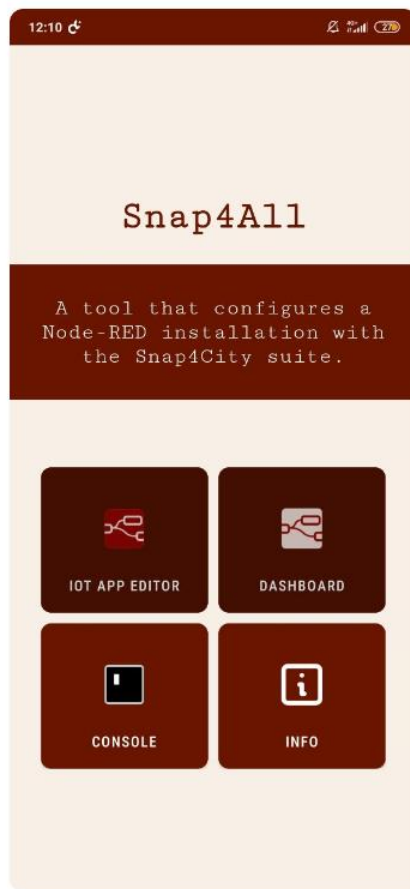
TOP

Snap4All Mobile App

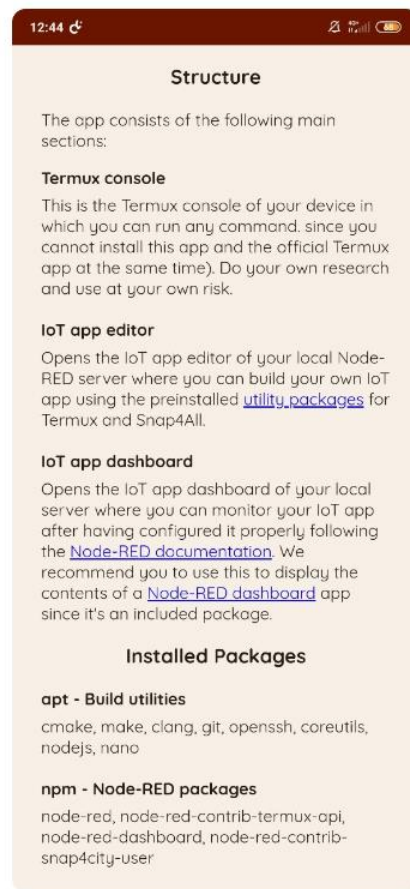
Node-RED on Android



Snap4All mobile app for Android



(a) Home



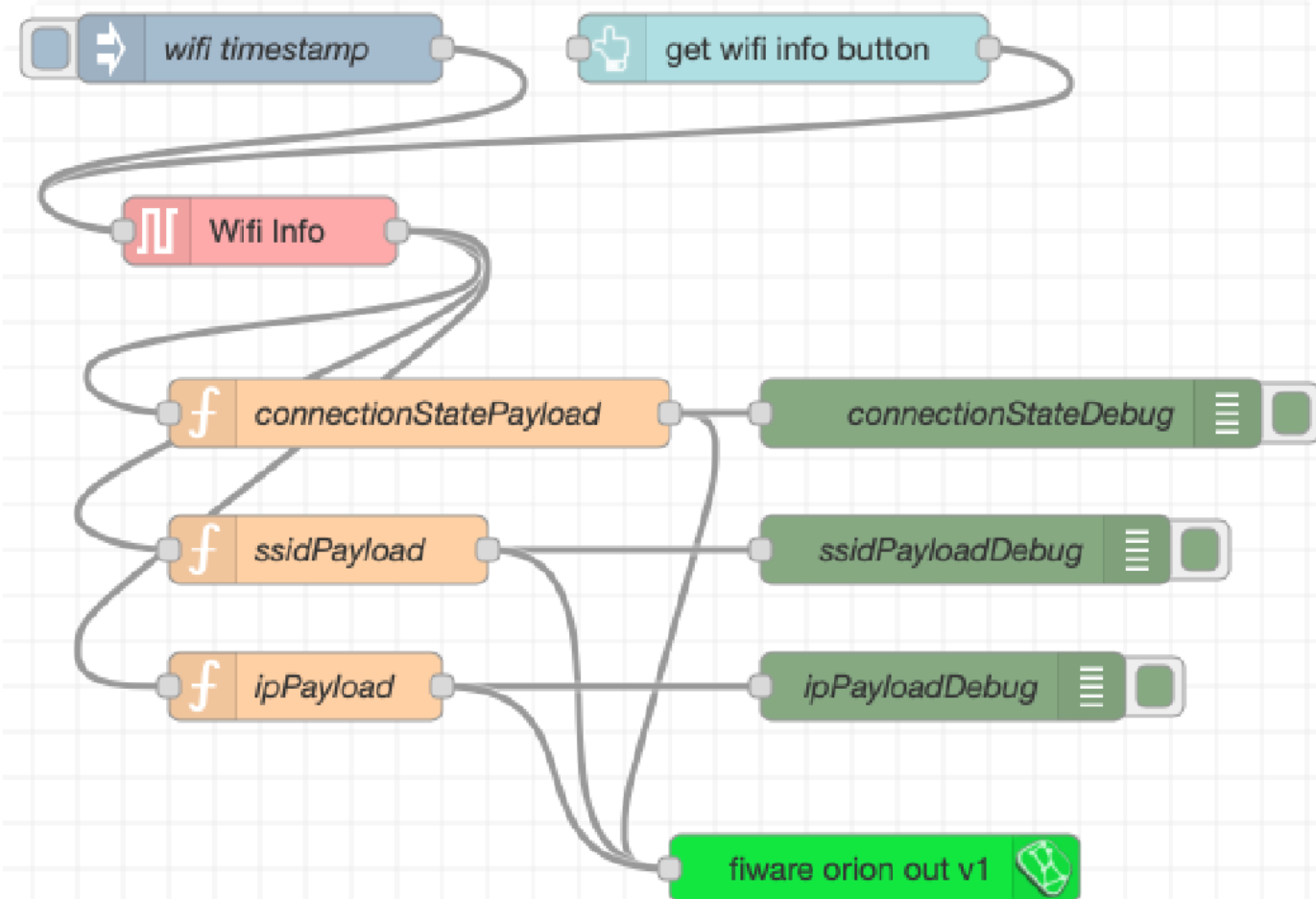
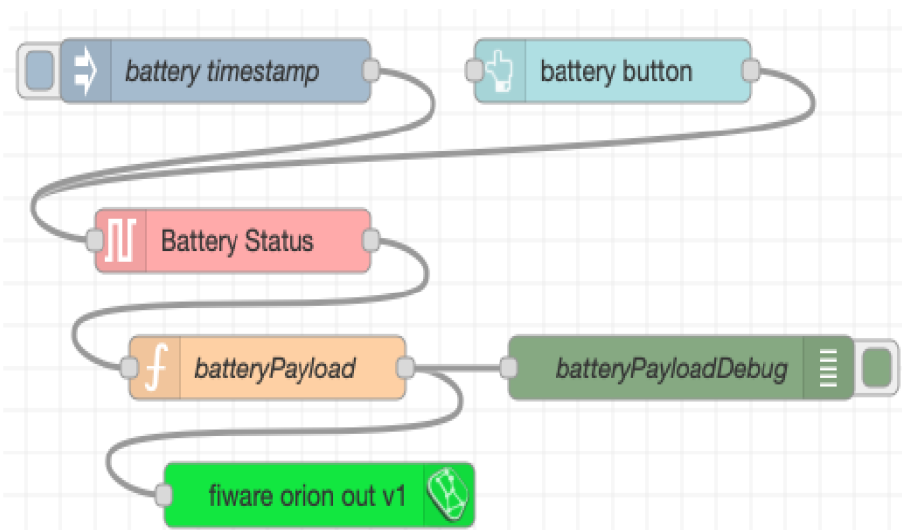
(b) Info



(c) Console



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



TOP

Examples of IoT App/Proc.Logic for Smartening Solutions



DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IoT APPLICATIONS
VS IoT ED
VICES

IoT/IOE DEVICES
AND NETWORKS

IoT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADVANCED
SMART CITY API,
MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

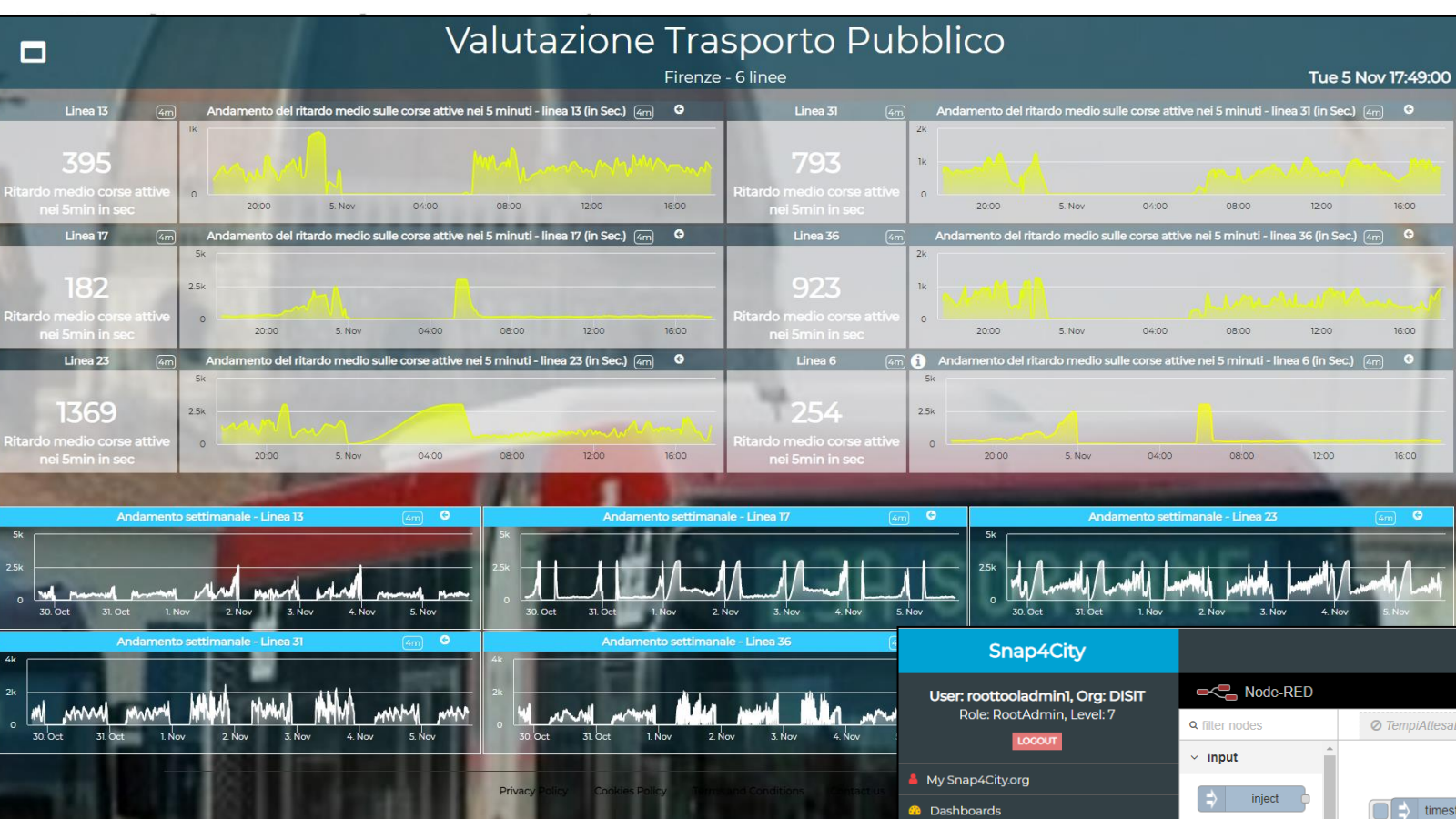
SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM. OPENED
TO DEVELOPERS
AND FUNDERS

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

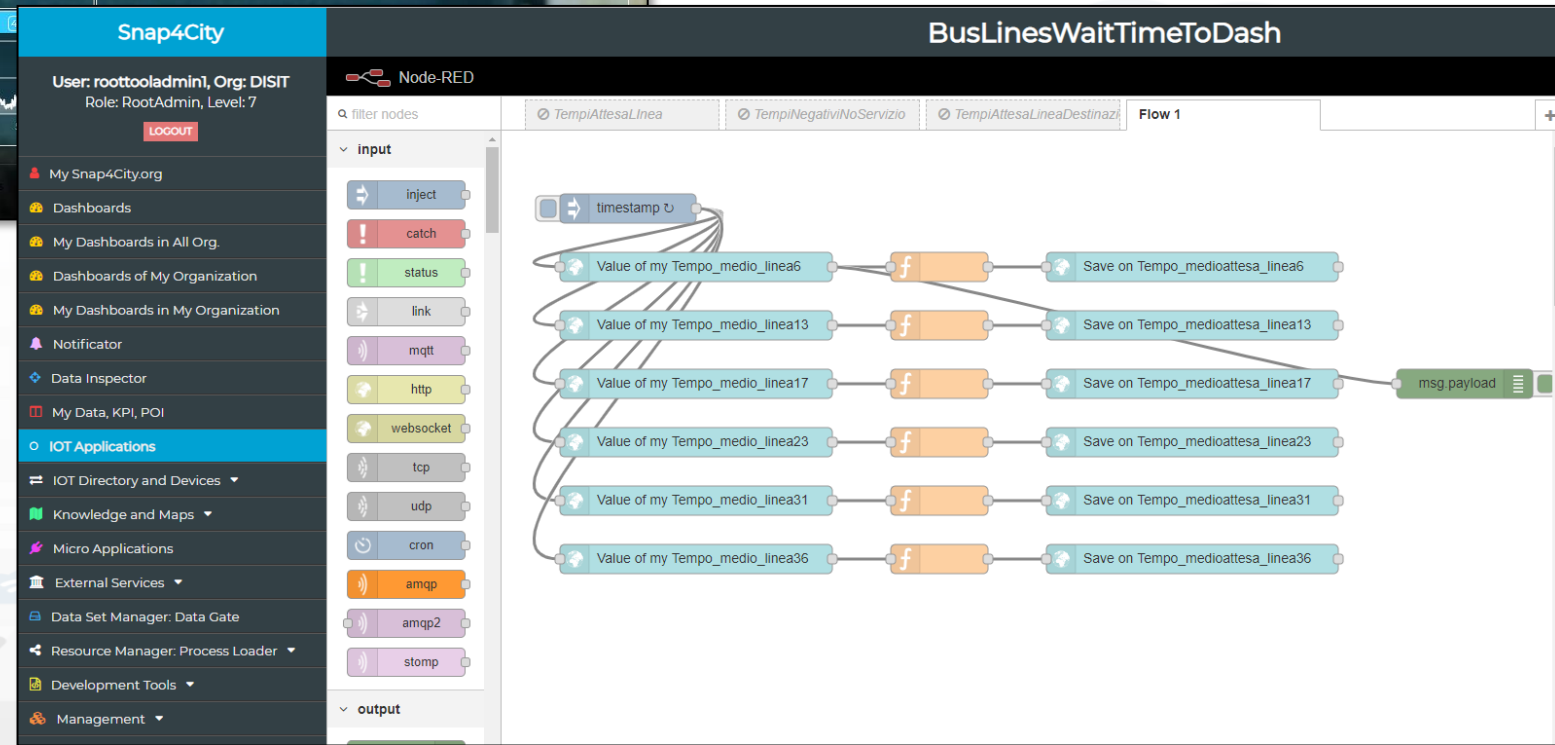
SNAP4CITY
AND KM4CITY
PROJECTS

HOW TO ADOPT
SNAP4CITY
OUR ROAD



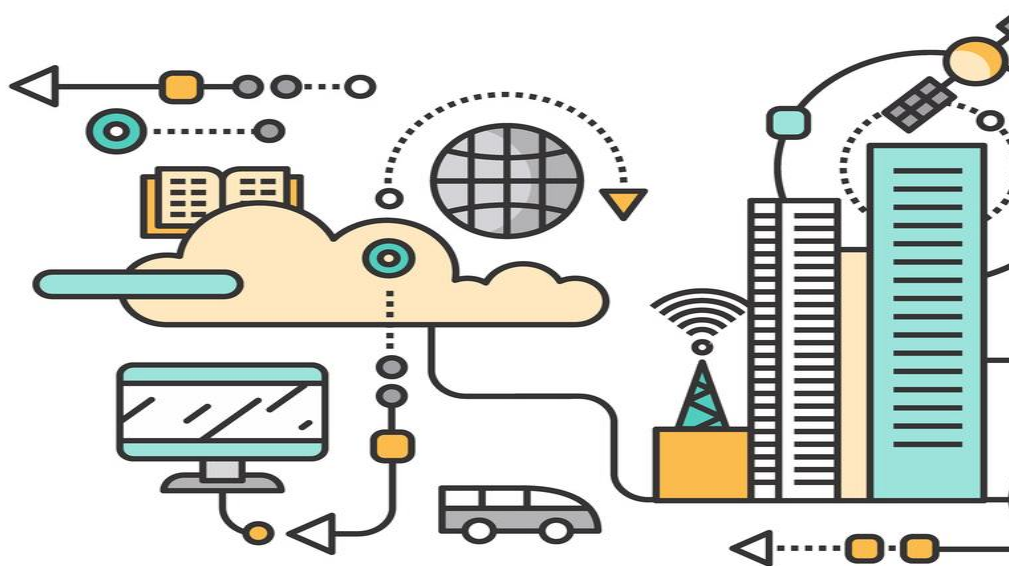


Estimation of the mean waiting time at bus stops



TOP

IoT App Smartening Devices and Dashboards



Antwerp, Belgium



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

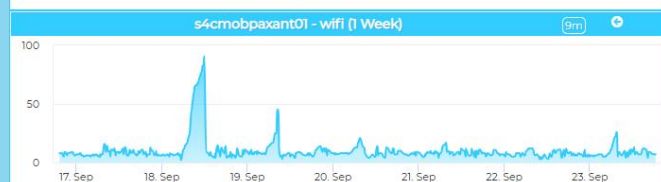
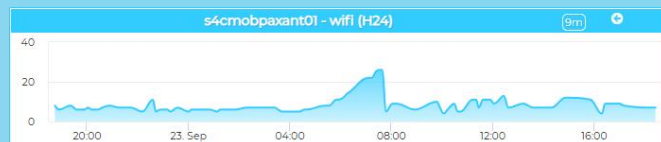


<https://www.snap4city.org/456>

Programmable PAX counting

Mobile PAXCounter 01 in Antwerp

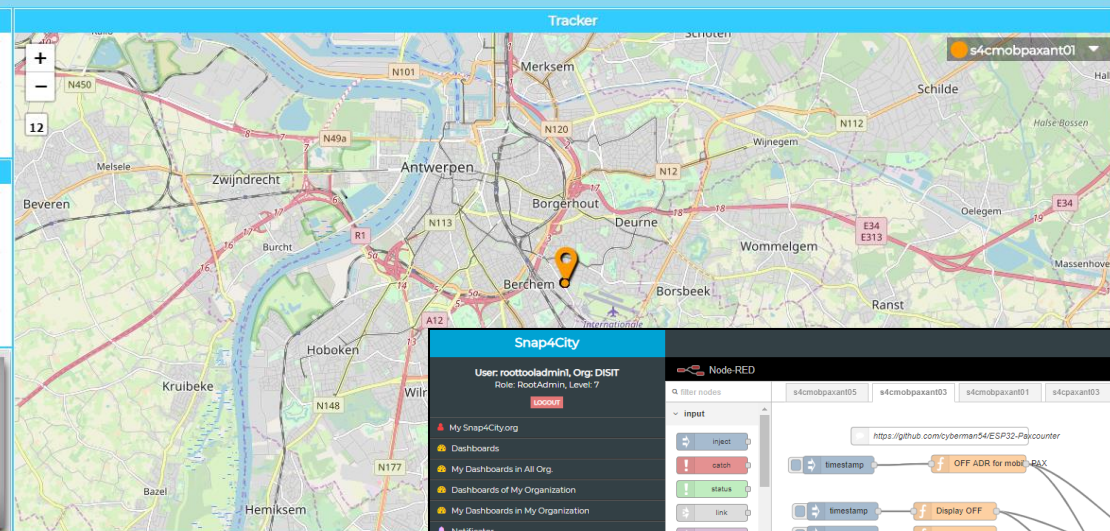
Mon 23 Sep 18:39:46



Begin
Finish

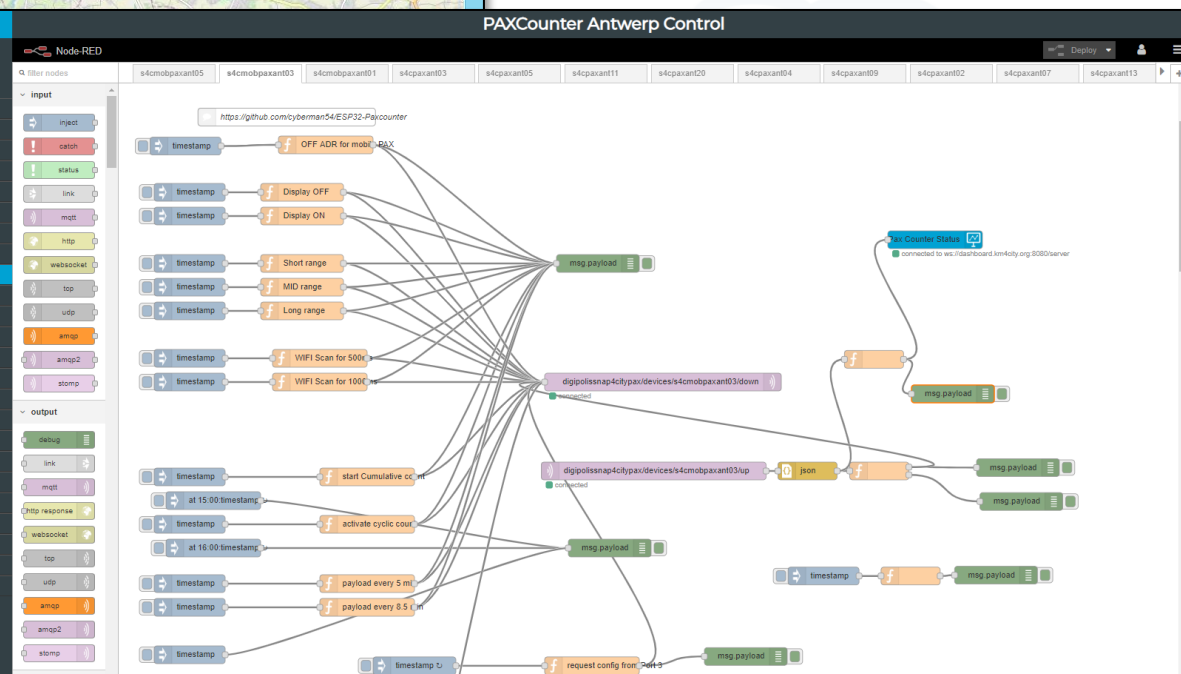


Status Pax Counter Status
CUMULATIVE MODE OFF Cumulative Mode Active from 2019-09-23T03:00:00.000Z and 2019-09-23T05:30:00.000Z
Device in Cumulative Mode OFF



Snap4City
User: rootloadmini, Org: DISIT
Role: RootAdmin, Level: 7

- 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



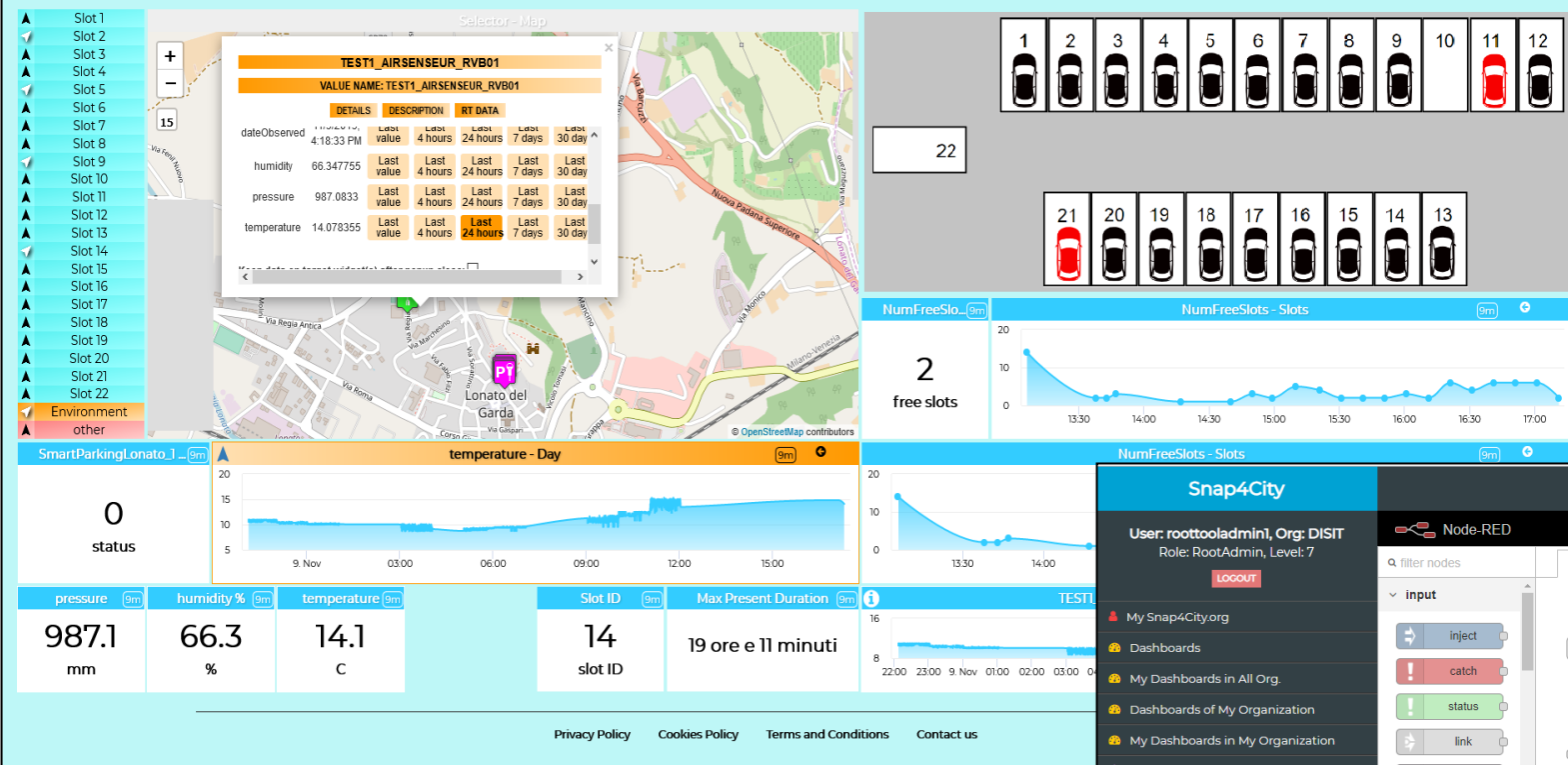
Antwerp

IoT App Smart Parking



Smart Lonato del Garda

Sat 9 Nov 17:20:59



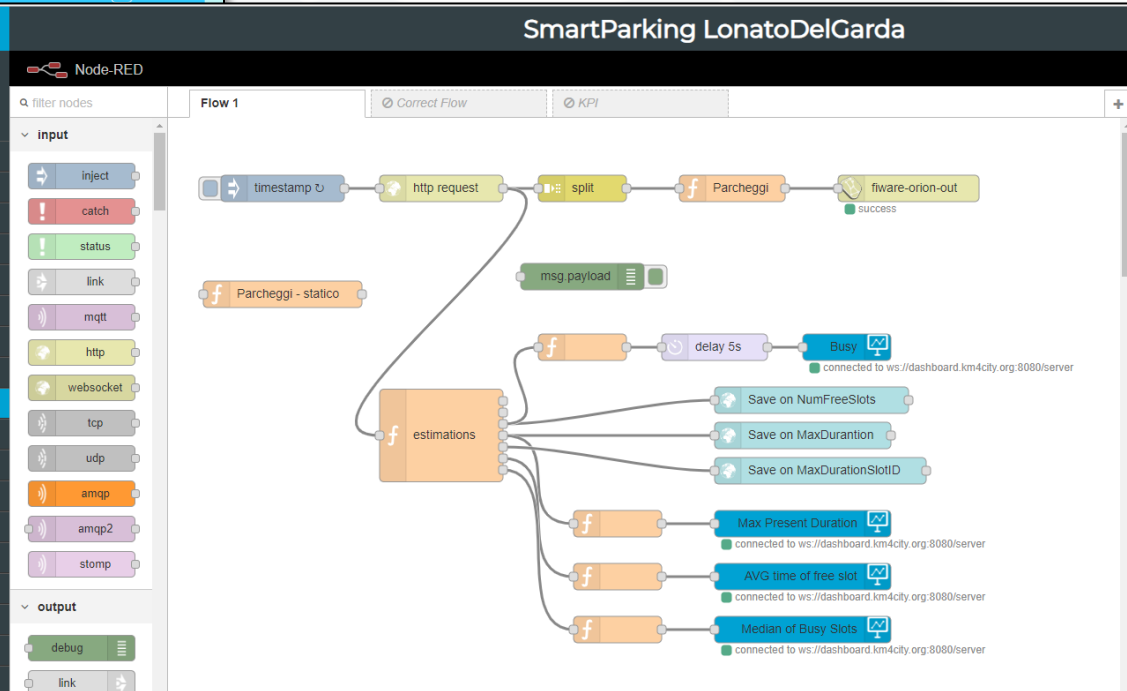
Smart Parking Monitoring (SVG, statistic, overparking)

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
- 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



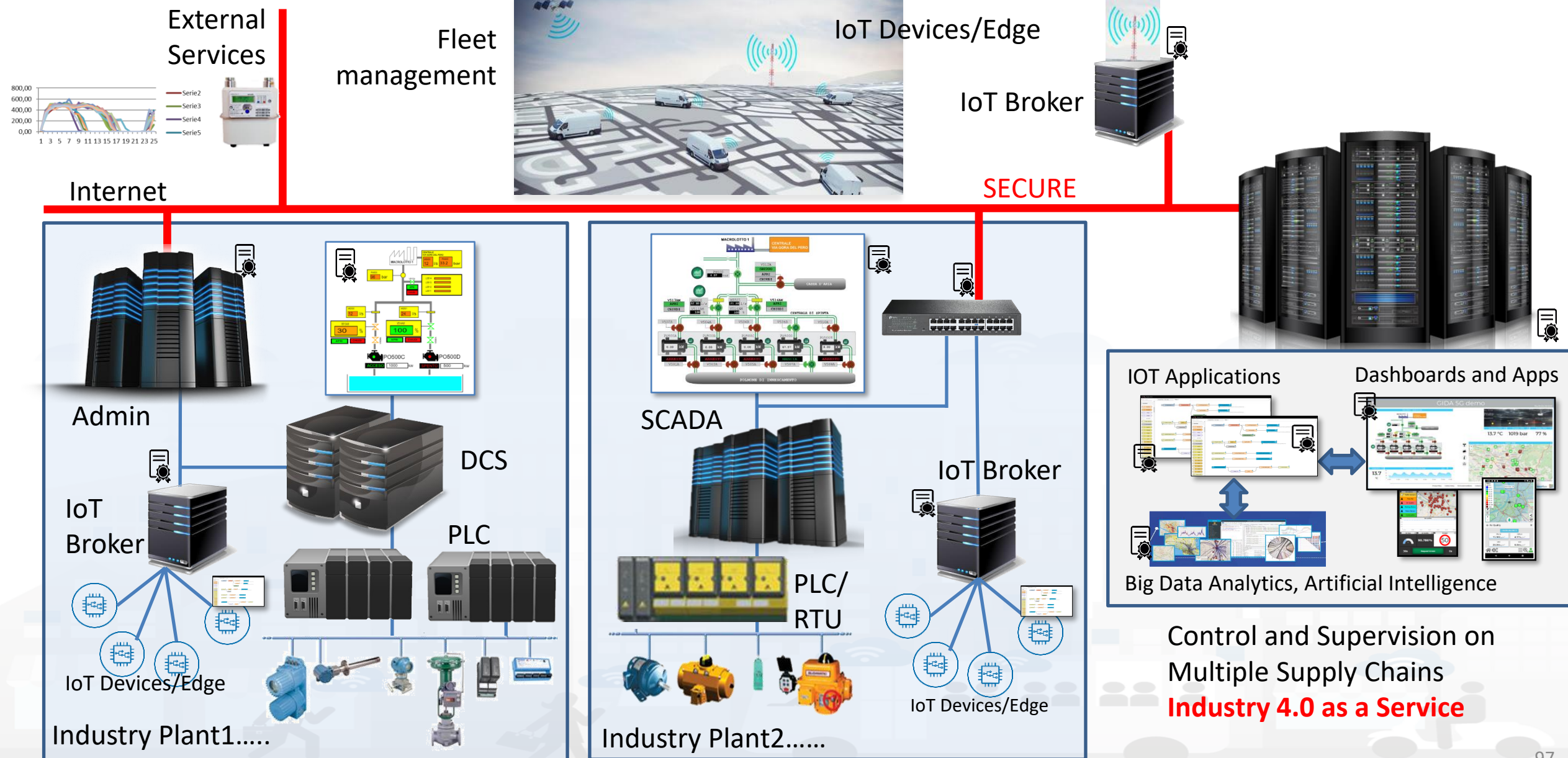
Lonato del Garda

TOP

IoT App Smart Industry 4.0

Snap4Industry







Prato

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

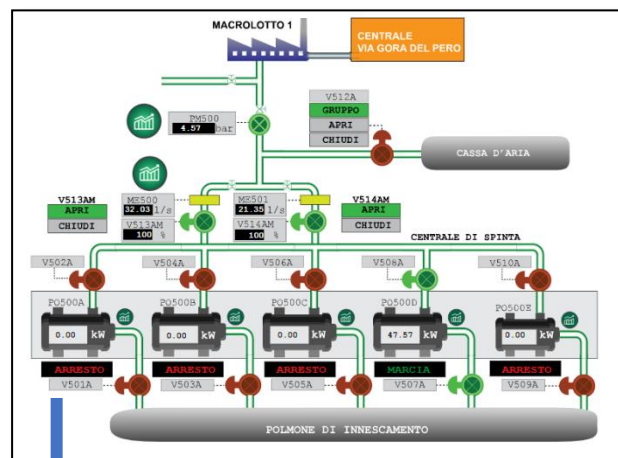
Smart City vs Industry 4.0

GIDA set up



GESTIONE
IMPIANTI
DEPURAZIONE
ACQUE S.p.A.

Smart City
data from
many
sources

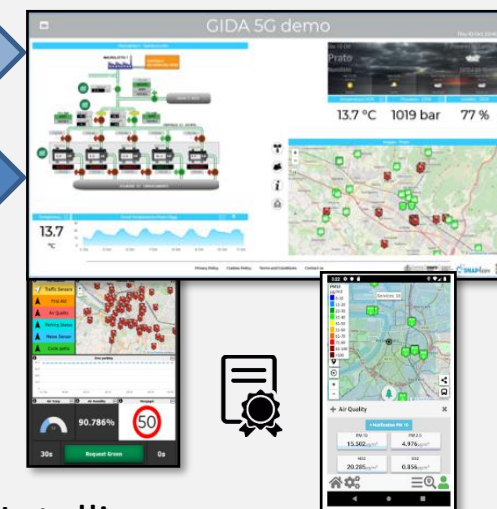


GESTIONE
IMPIANTI
DEPURAZIONE
ACQUE S.p.A.

IOT Data
Shadow
Snap4City

IOT Applications

Dashboards and Apps



Big Data Analytics, Artificial Intelligence



ModBus to
Snap4City
Gateway Edge

5G network
devices

Telemonitoring Telecontrol

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

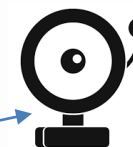
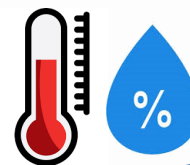
5G



Measuring any kind of sensors values

Controlling Energy Power

Measuring
Energy Consumption



Any kind of notification channel



IOT Edge:
Node-RED
+
Snap4City

Local Control



Administrative Servers



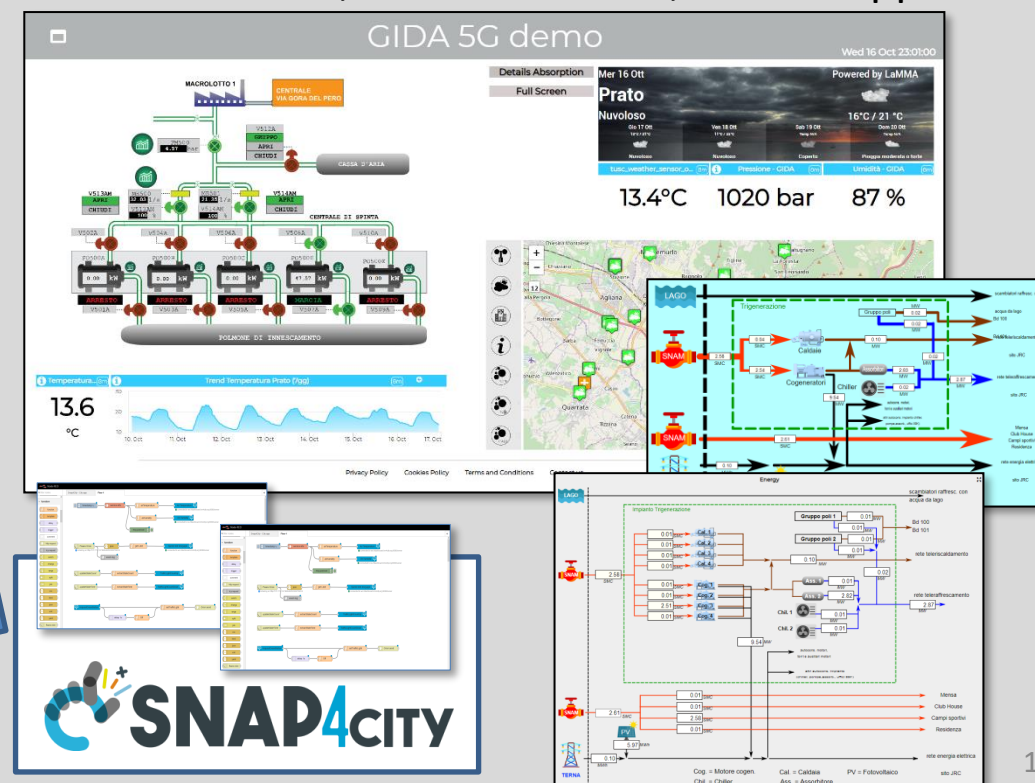
ODBC



Alexa: Voice Commands

Snap4City (C), May 2024

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





*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

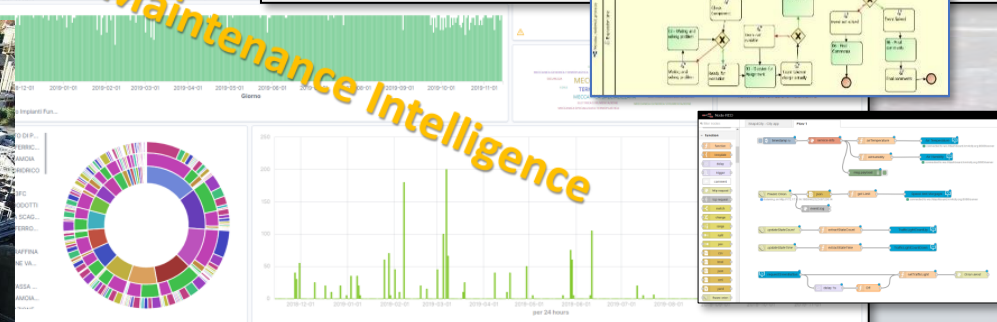
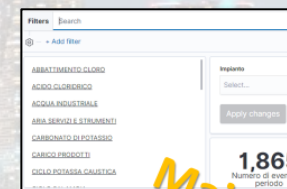
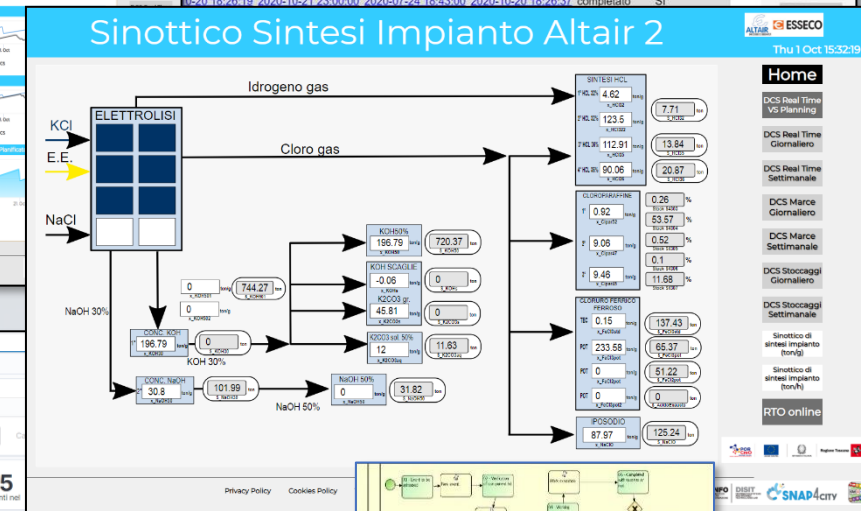
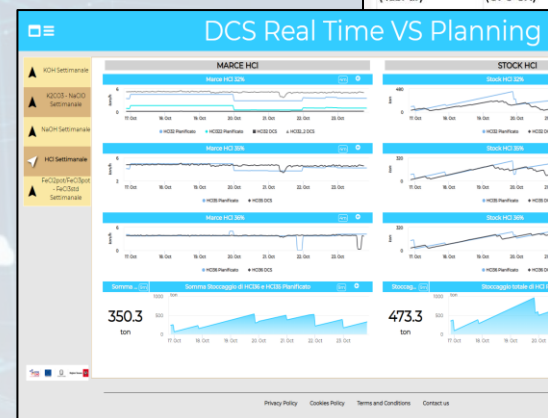
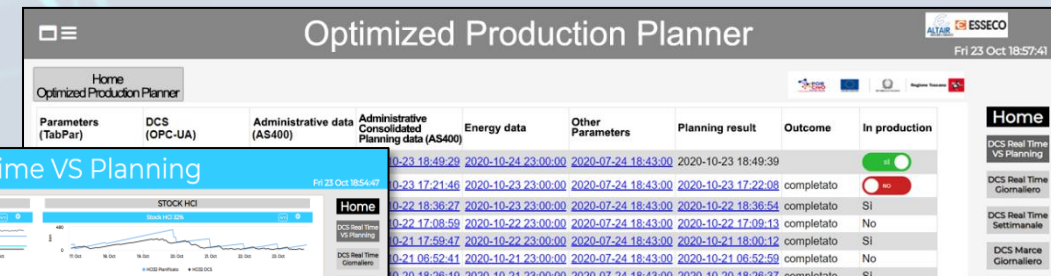
- Billions of Data

• Services Exploited on:

- Multiple Levels, Mobile Apps, API

• Since 2020

Snap4City (C), May 2024



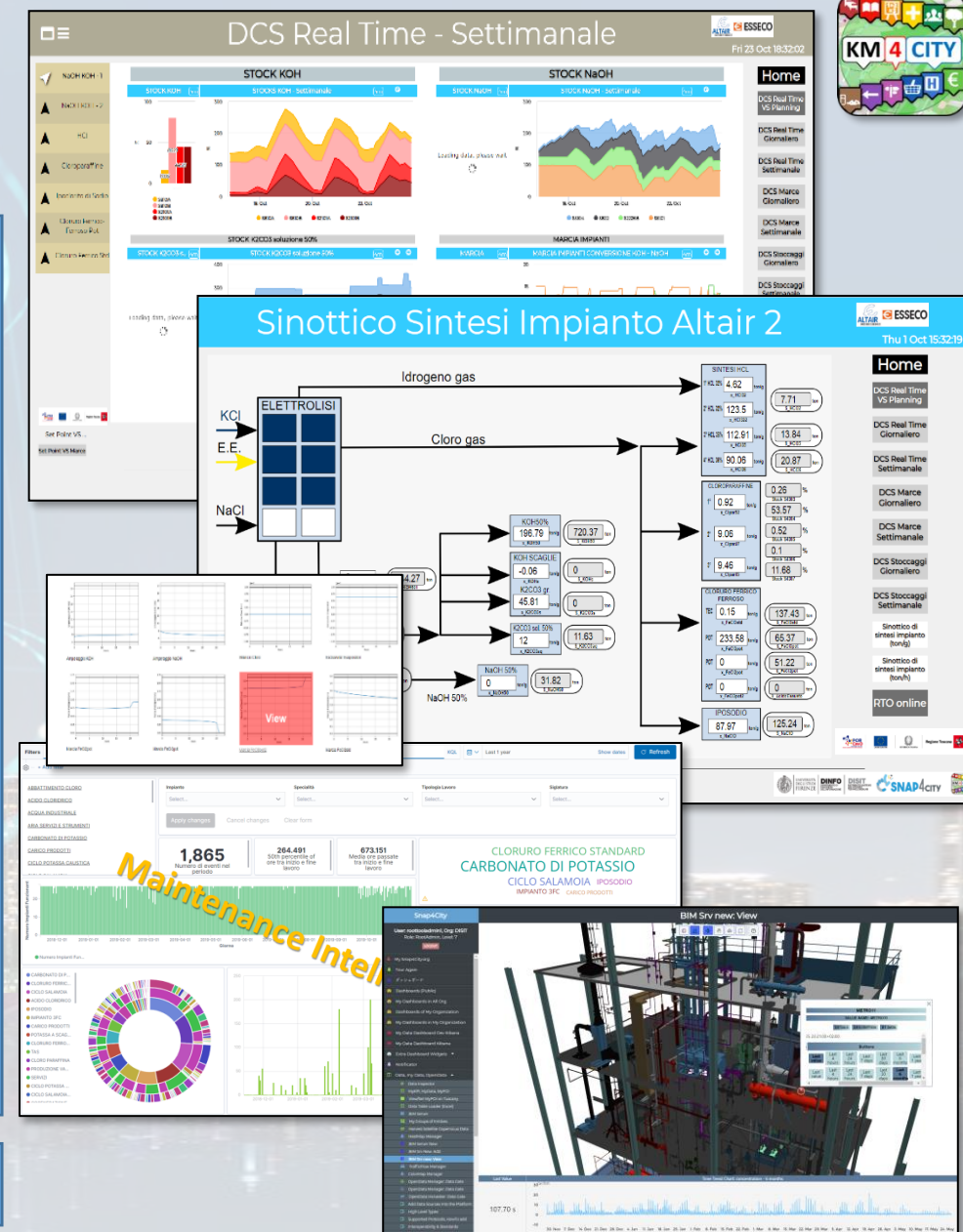
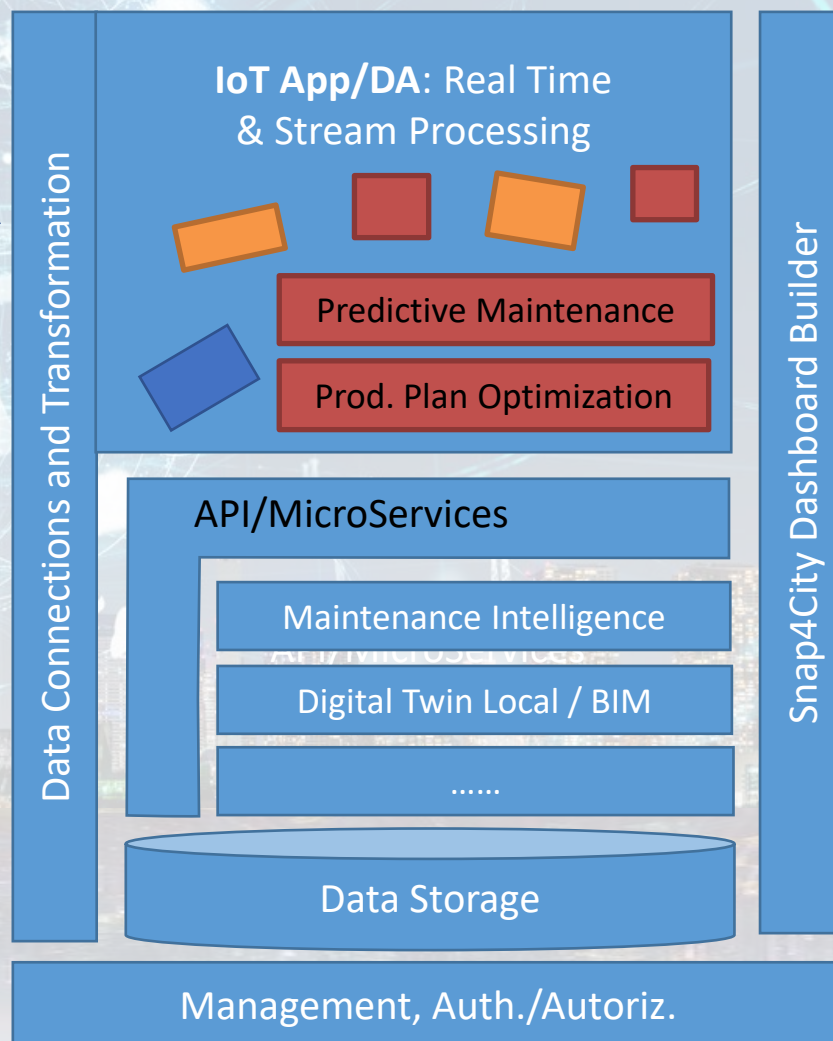
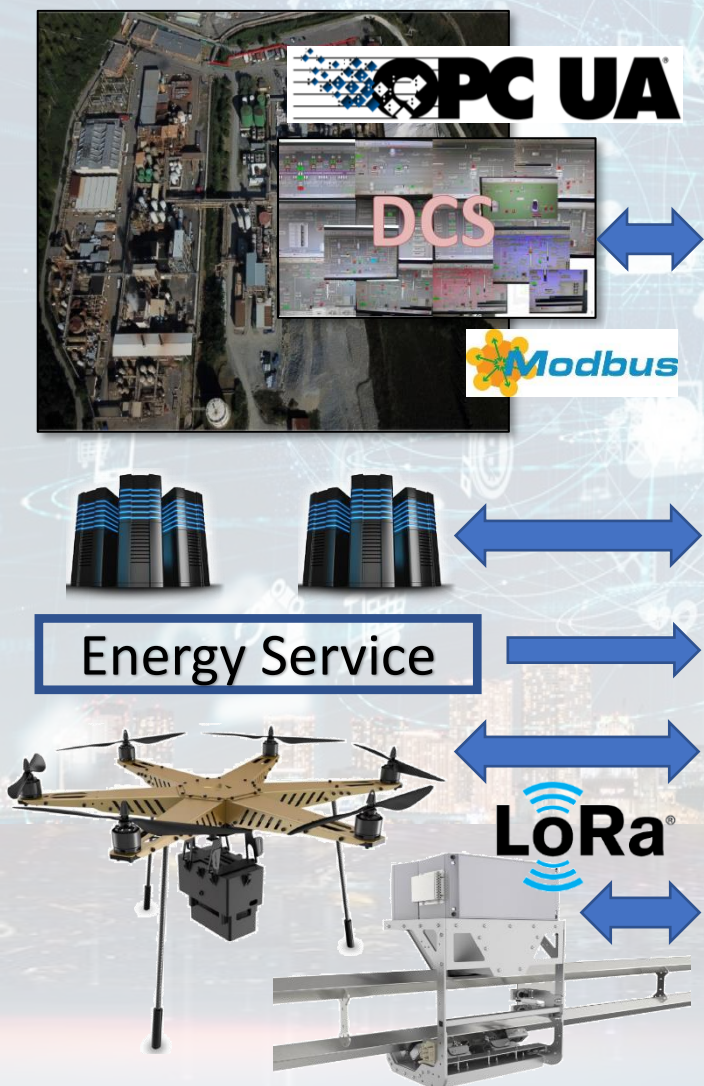
Industry Plant Supervision and Maintenance



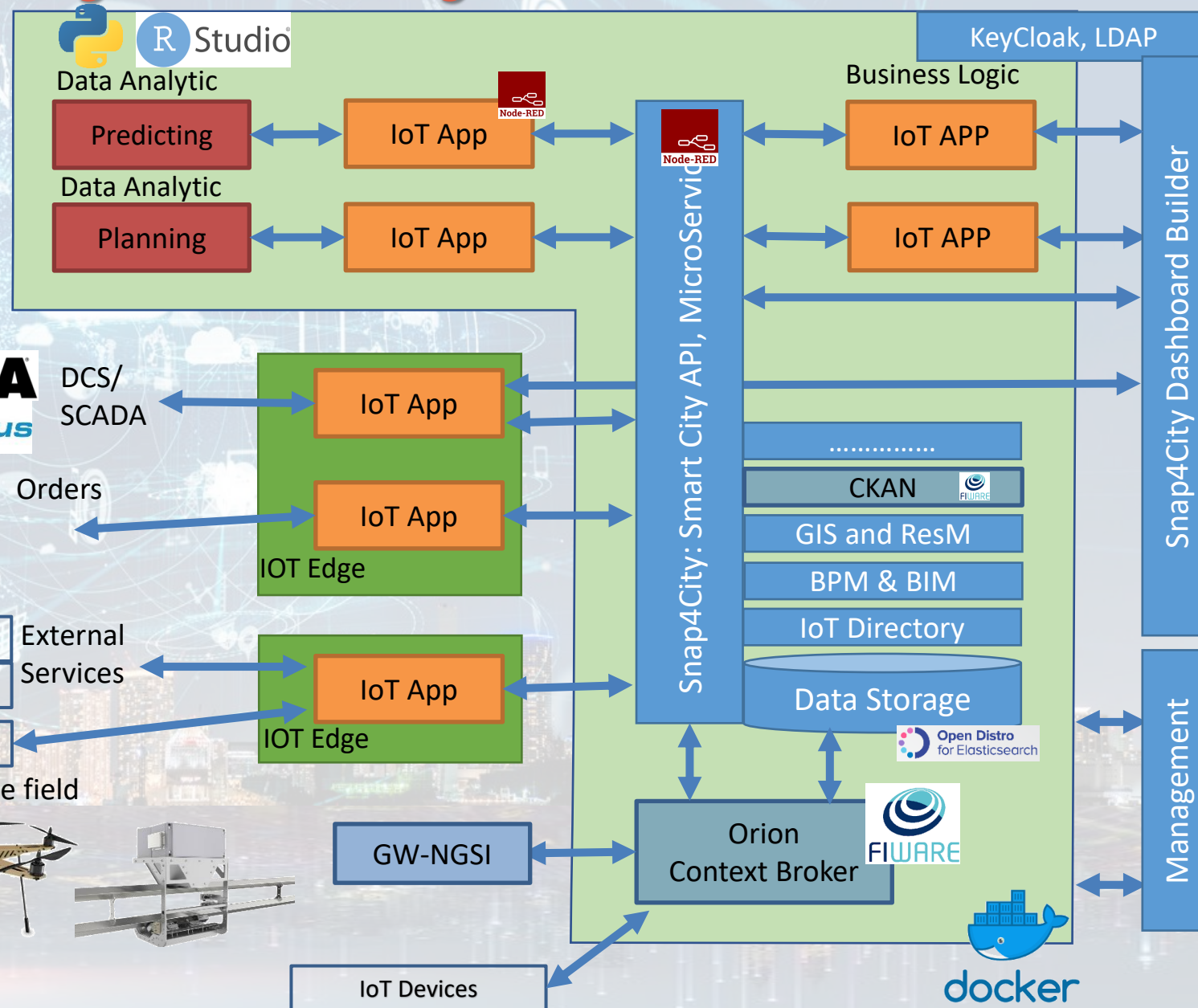
Aims

- **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

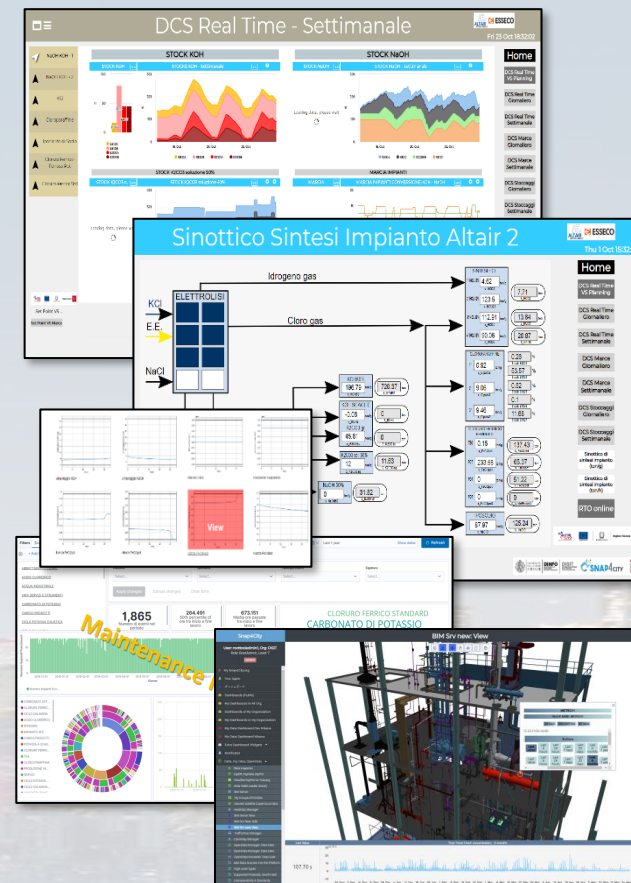


Snap4City/Industry Detailed Architecture



Production Parameters

Dashboards, Visual Analytics, Synoptics, 3D, Maps





Thu 1 Oct 15:34:29

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

[Home](#)

DCS Real Time VS Planning

DCS Real Time
Giornaliero

DCS Real Time
Settimanale

DCS Marce
GiornalieroDCS Marce
Settimanale

DCS Stoccagg
Giornaliero

DCS Stoccaggio
Settimanale

Sinottico di
sintesi impianto

Thu 1 Oct 15:32:19

[Home](#)

DCS Real Time VS Planning

DCS Real Time
Giornaliero

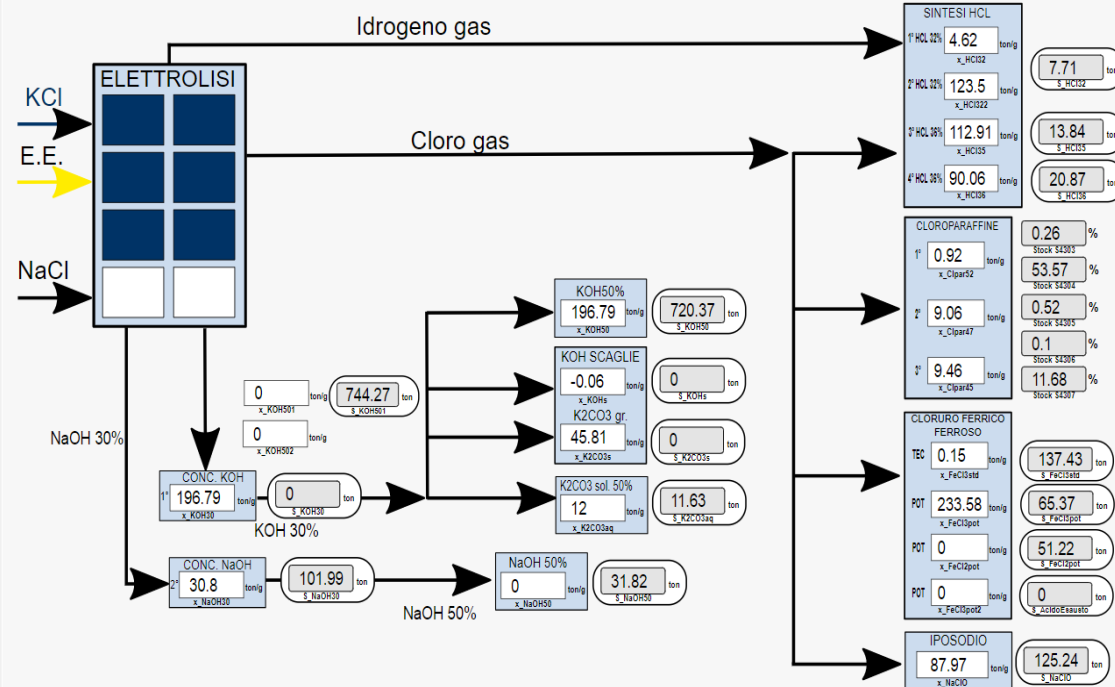
DCS Real Time
Settimanale

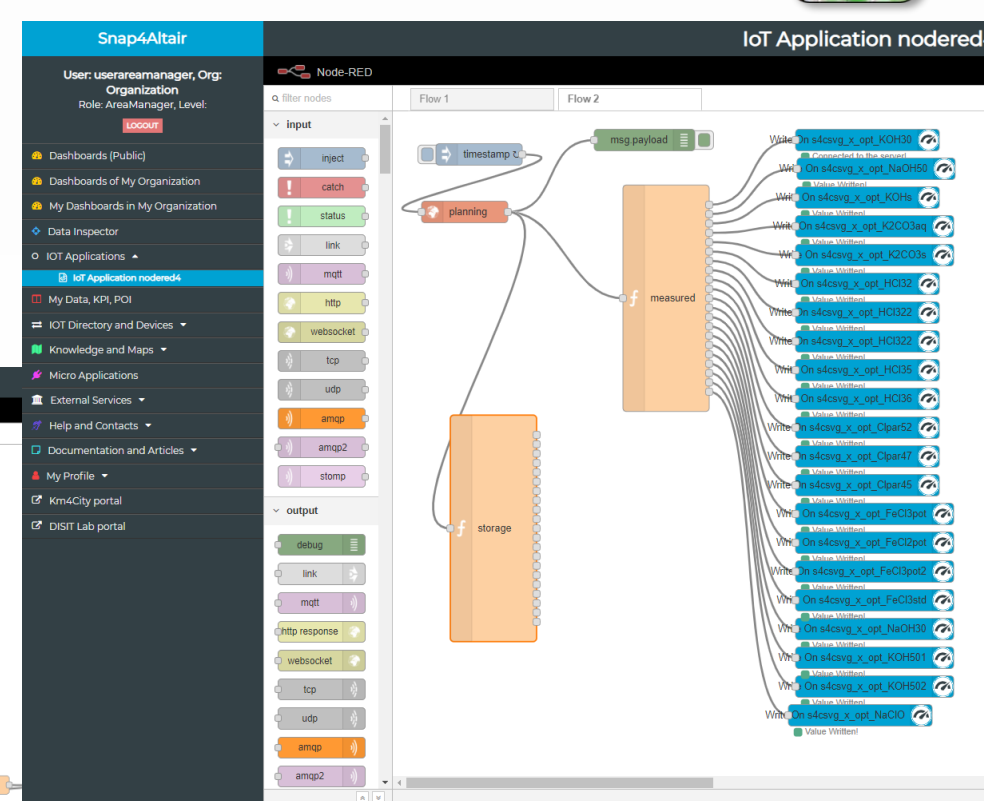
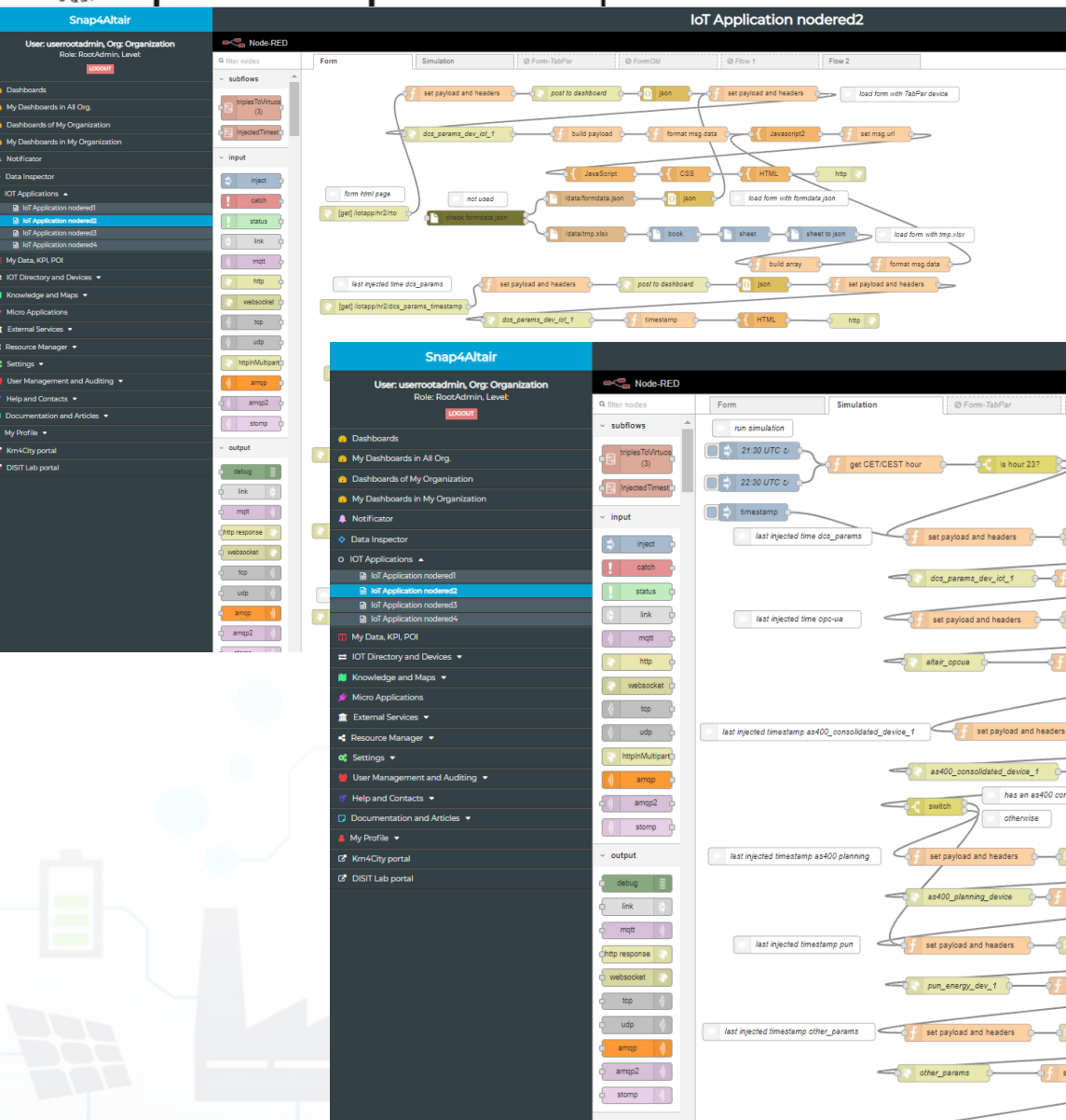
DCS Marce
GiornalieroDCS Marce
SettimanaleDCS Stoccagg
GiornalieroDCS Stoccaggio
Settimanale

Sinottico di
sintesi impianto
(kg/m^3)

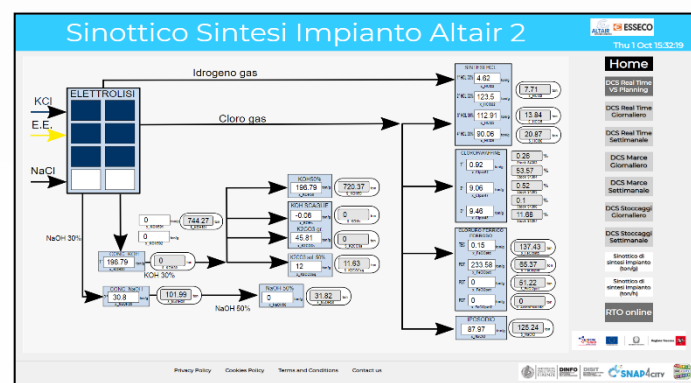
Sinottico di
sintesi impianto
(pag. 8)

RTO online

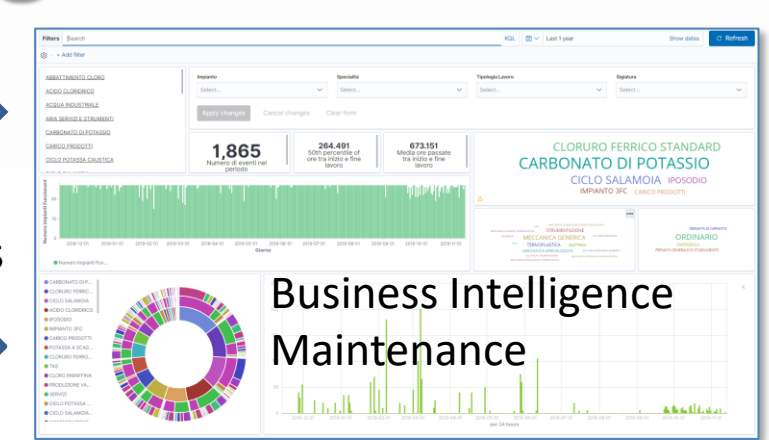




Workflow for Ticket management



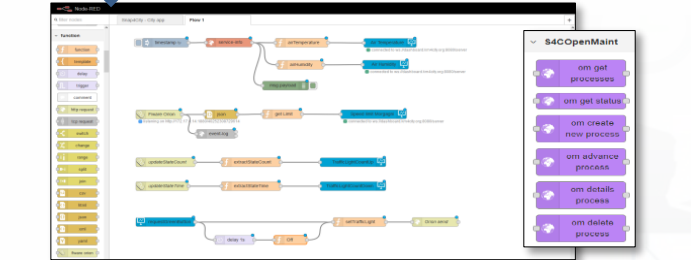
Consumptions/productions



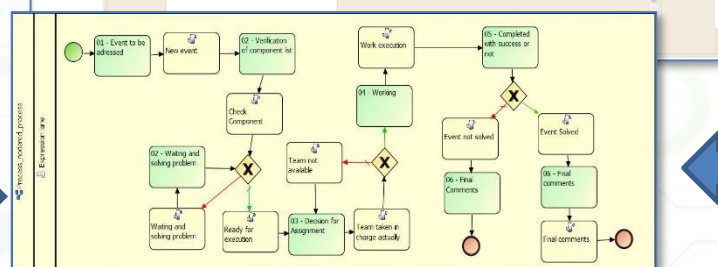
Events/actions

ID	Descrizione	Importo	Importo Estimo	Spesita	Importo Totale	Data Inizio	Data Fine	Importo Totale
100	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
101	Verifica	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
102	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
103	Verifica	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
104	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
105	Verifica	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
106	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
107	Verifica	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
108	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
109	Verifica	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00
110	Completamento	100.00	100.00	100.00	100.00	2023-10-01	2023-10-01	100.00

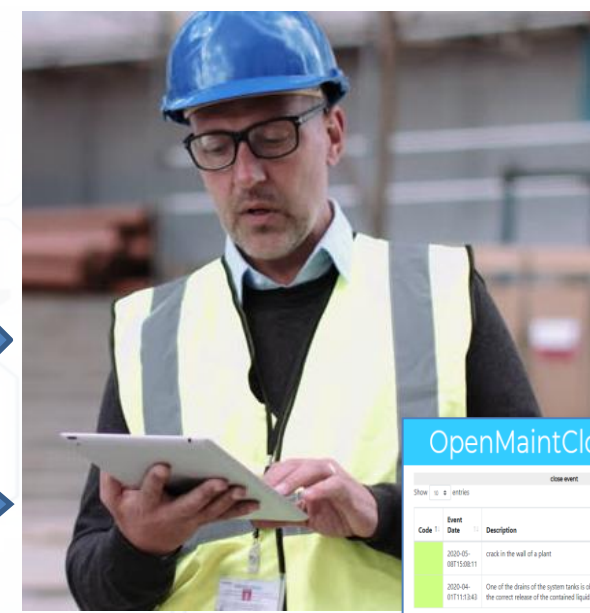
Dashboards and actions



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



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



OpenMaintCloseEvent

Code	Date	Description	Controls
2020-05-18T15:08:11	2020-05-18T15:08:11	crack in the wall of a plant	Adesso
2020-04-07T11:13:40	2020-04-07T11:13:40	One of the drains of the system tanks is obstructed and does not allow the correct release of the contained liquid.	Adesso

An aerial photograph of Västerås, Sweden, showing the city and surrounding water. The city is densely packed with buildings, mostly with red-tiled roofs, and is surrounded by green trees. The water is a deep blue, and there are several small islands and peninsulas visible. The sky is a pale blue with some light clouds.

CAPELON

Västerås, Sweden

Smart Light Control of CAPELON

• Energy Domain

- Smart Light, MQTT,
- IoT Orion Broker FIWARE

• Dashboards

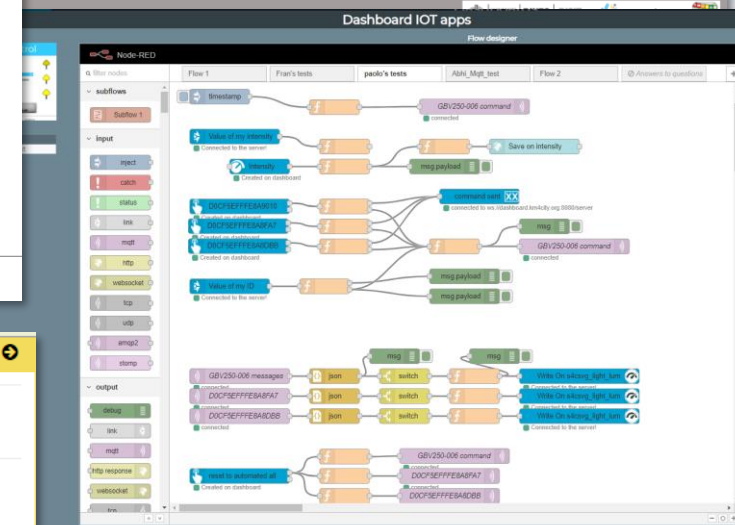
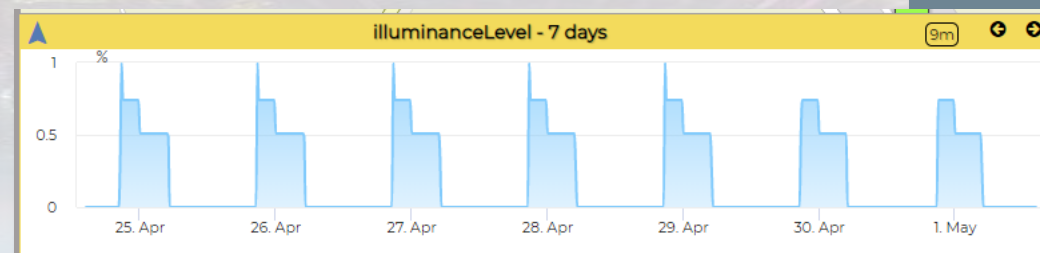
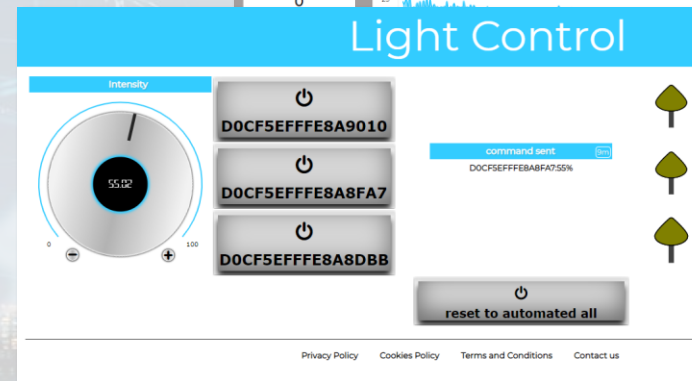
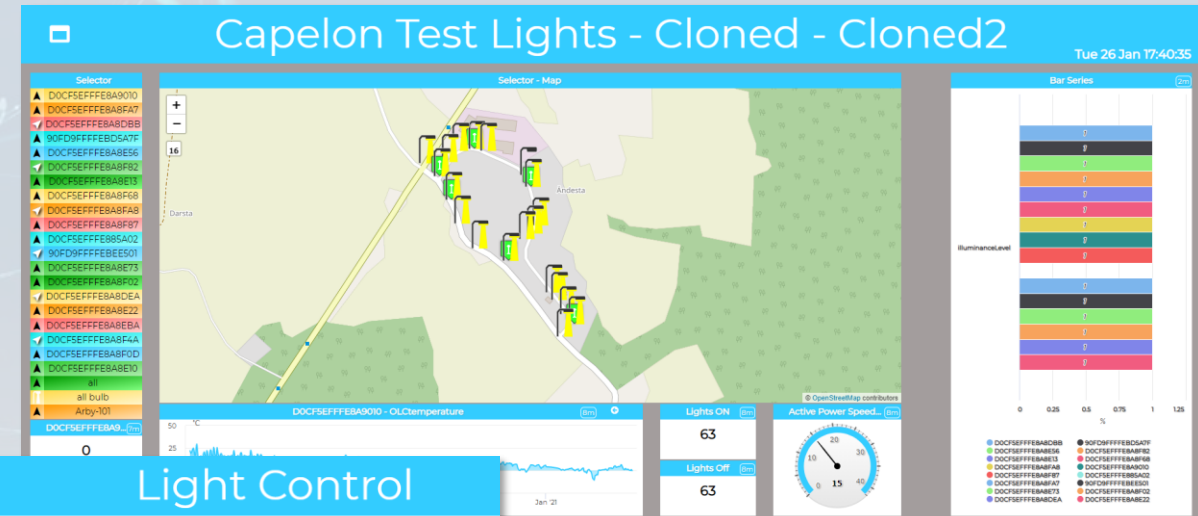
- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control

• Historical and Real Time data

• Services Exploited on:

- Multiple Levels, API
- Dashboards

• Since 2020



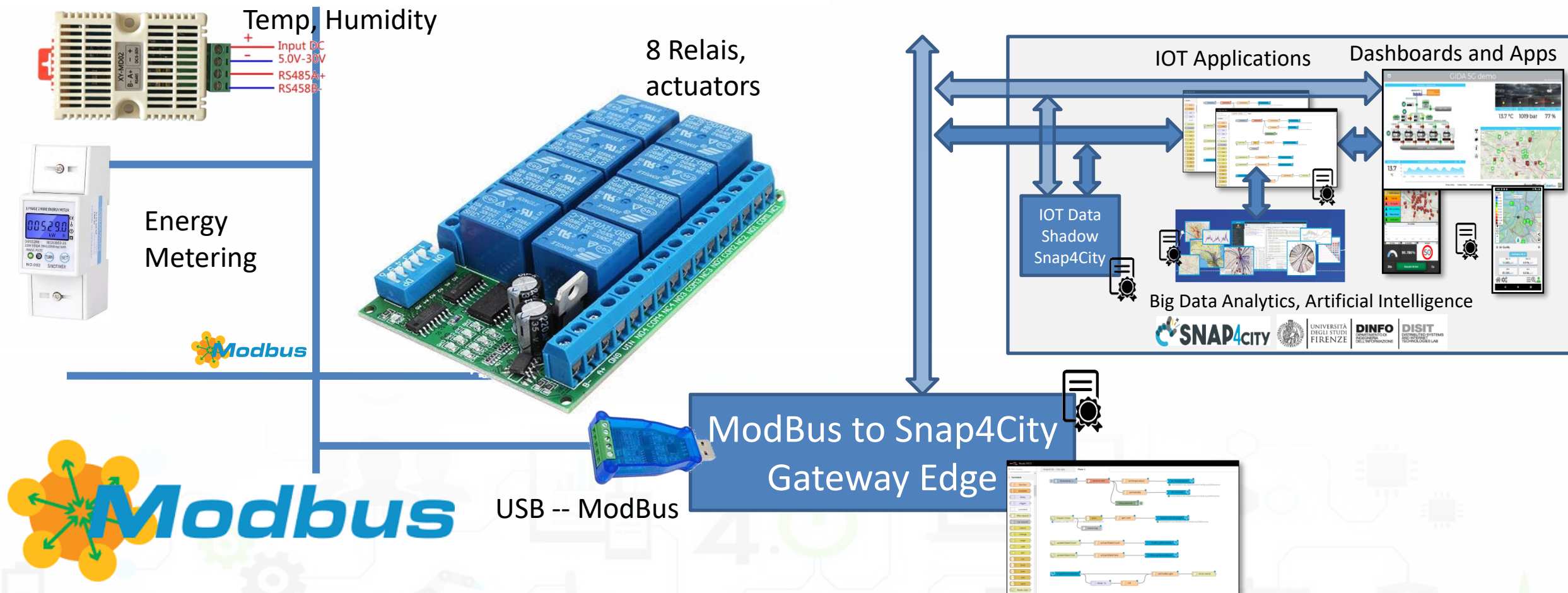
TOP

IoT App Smart Industry 4.0

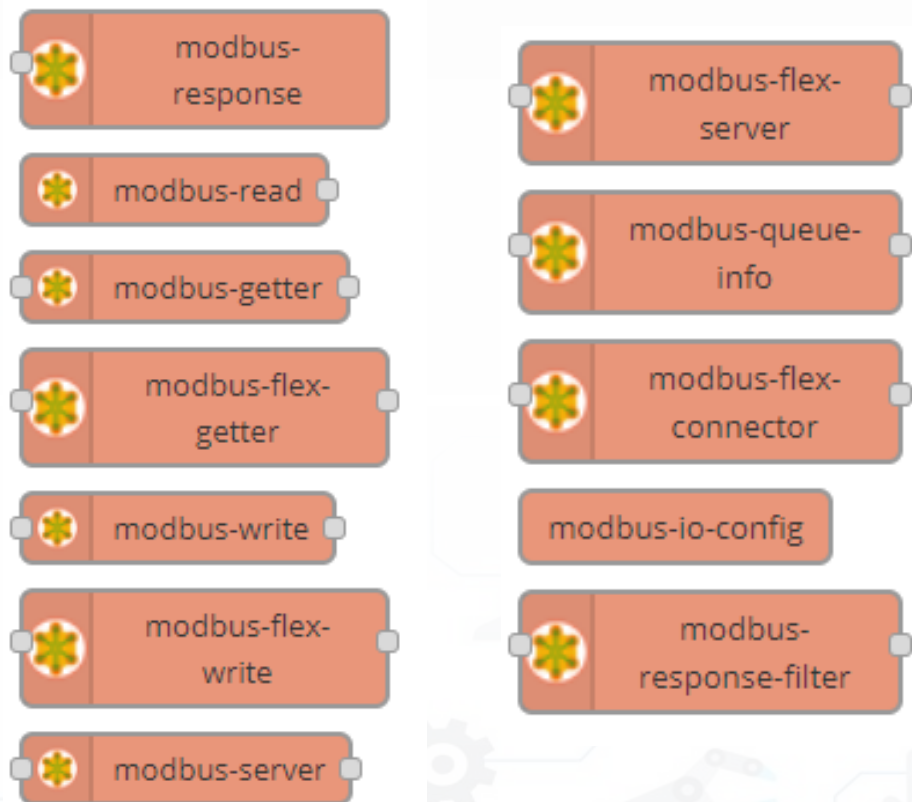
ModBus Integration



Devices



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

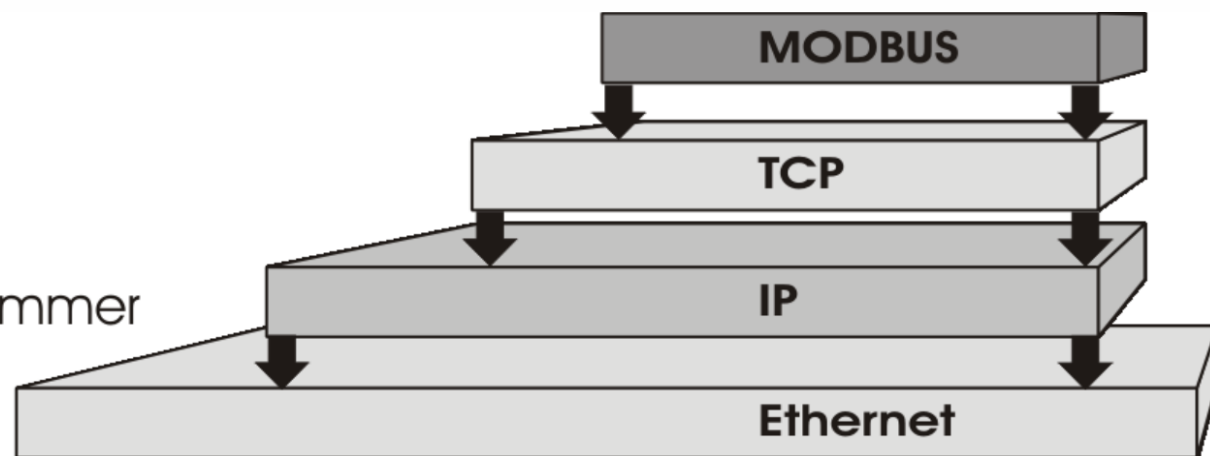


UNIT

PORT

TCP/IP Nummer

MAC ID

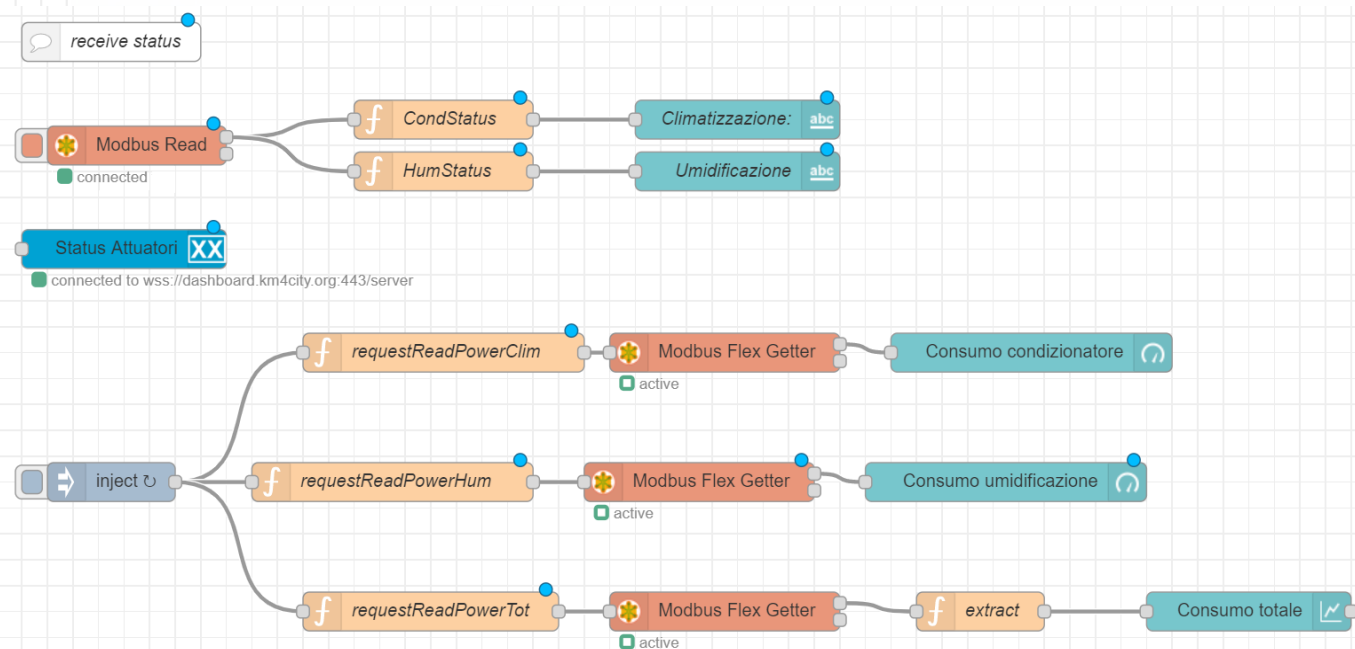
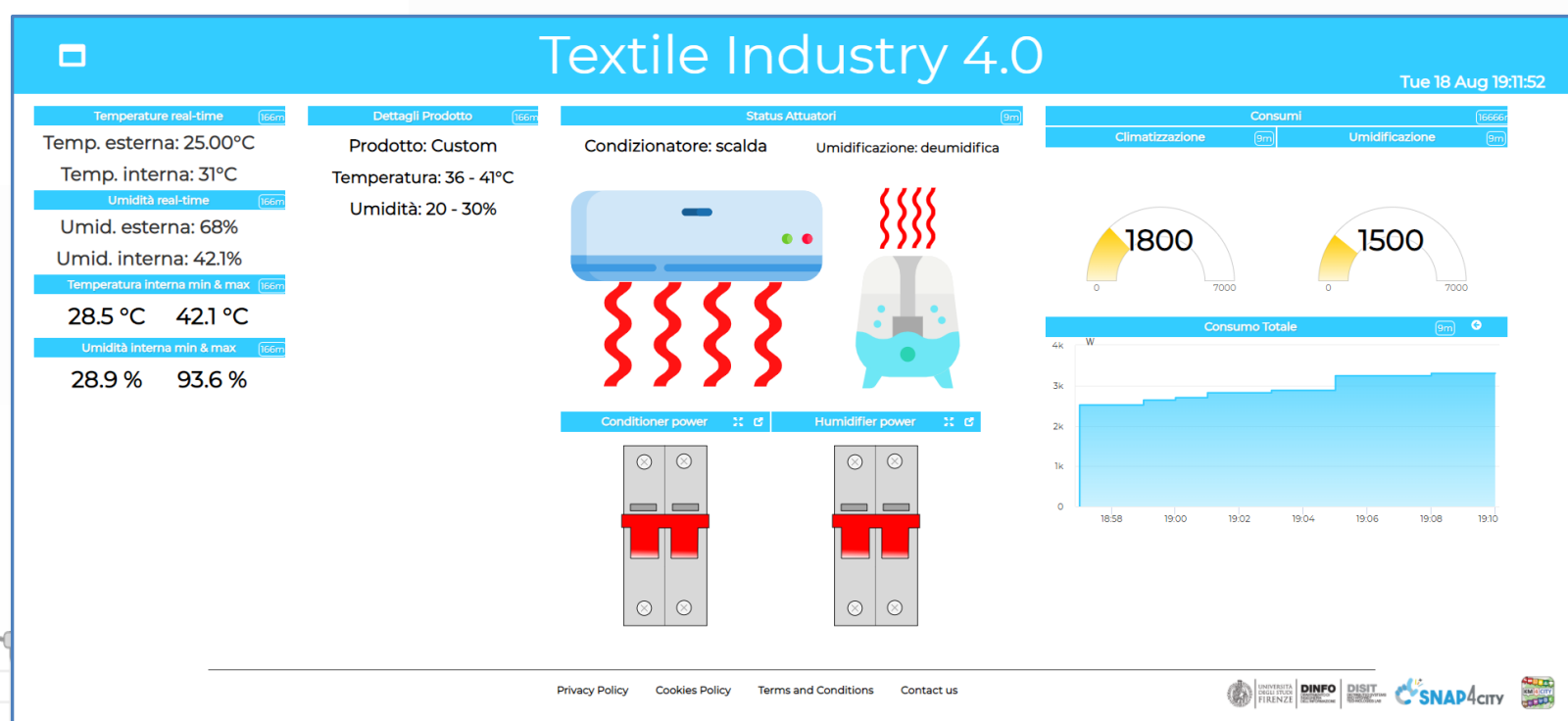
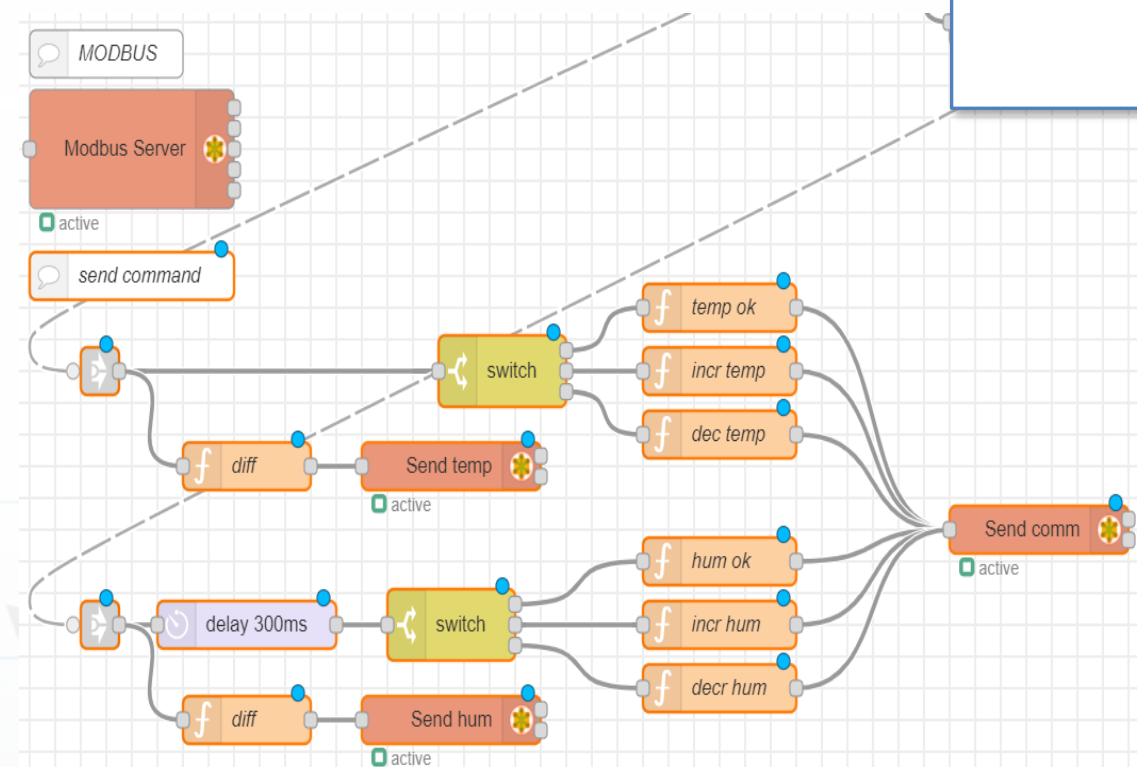




UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB



TOP

IoT App vs Smart Home

Snap4Home



Sonoff: Controlling Energy Power



Philips Hue: Controlling Lights



Hue: Motion Control / Alarm



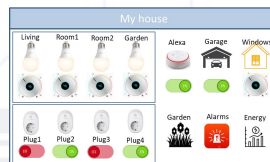
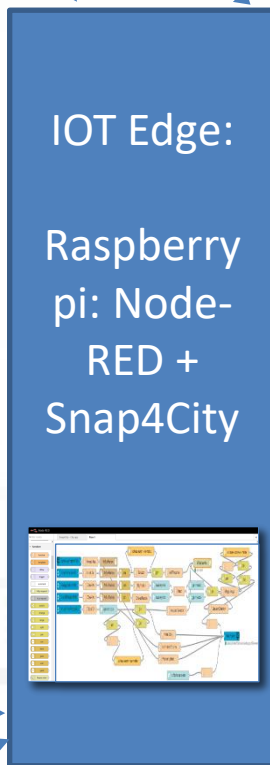
Measuring
Energy Consumption



TP Link: Controlling / Measuring Energy Plugs

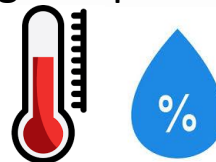


Alexa: Voice Control



Local Control

Measuring Temperature and Humidity



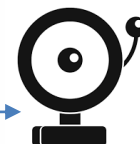
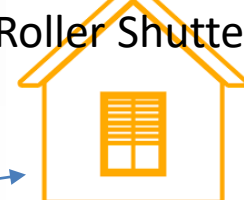
Controlling Motors



Garage Door



Window
Roller Shutters

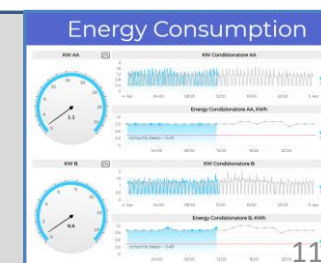
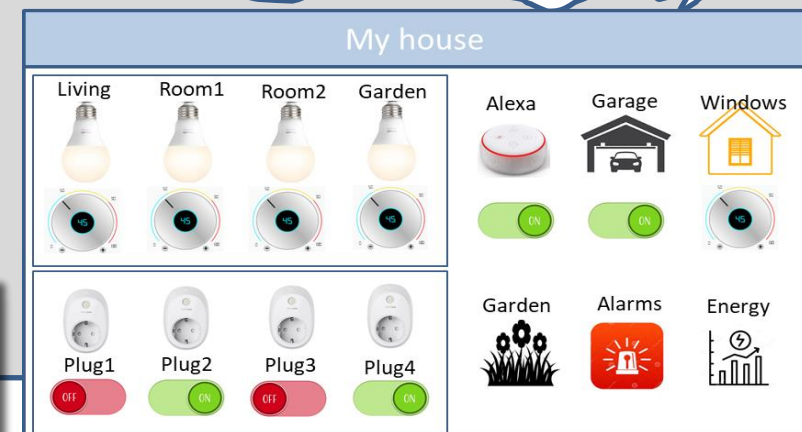


Alarm sound
and light

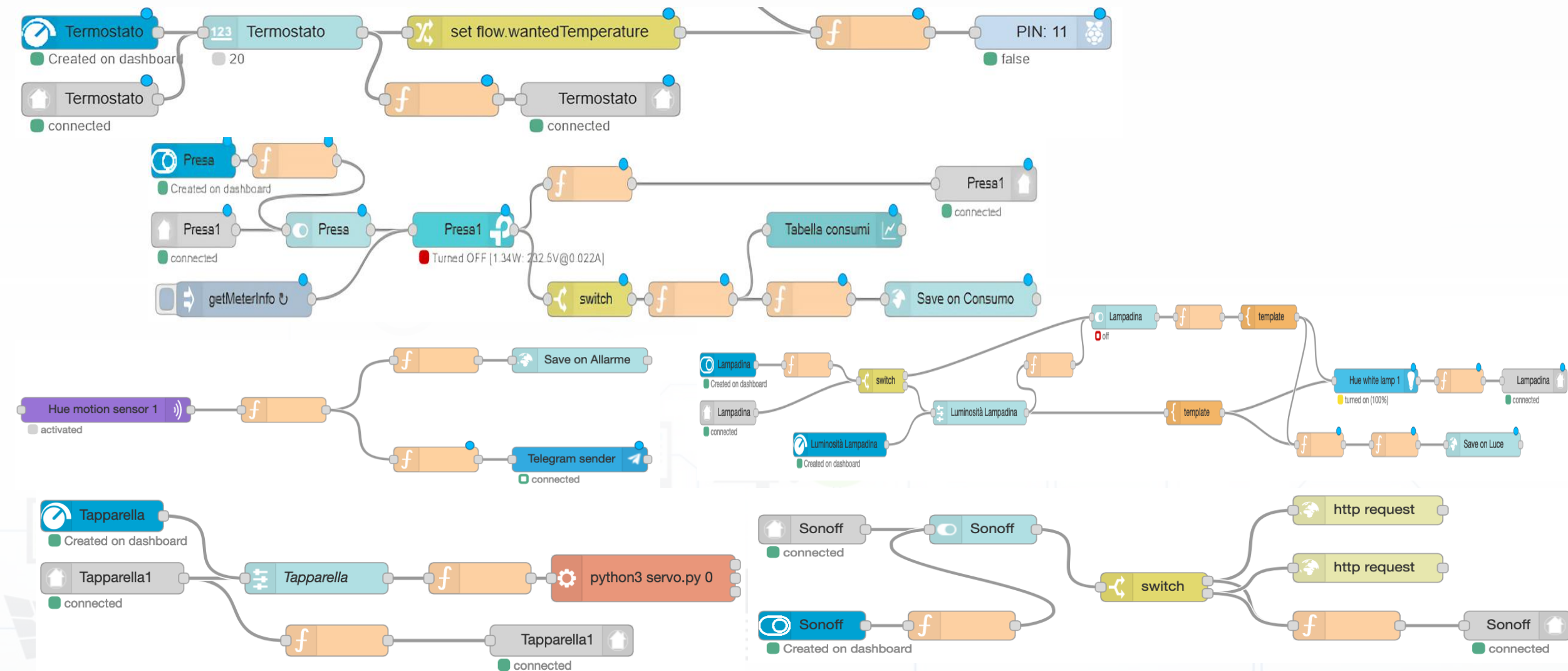
Controlling
Irrigators



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



Example: IOT App on Snap4Home



Hue Hub



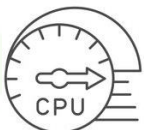
Motion Control / Alarm



TP Link
plugs:
meter



Alexa: Voice Control

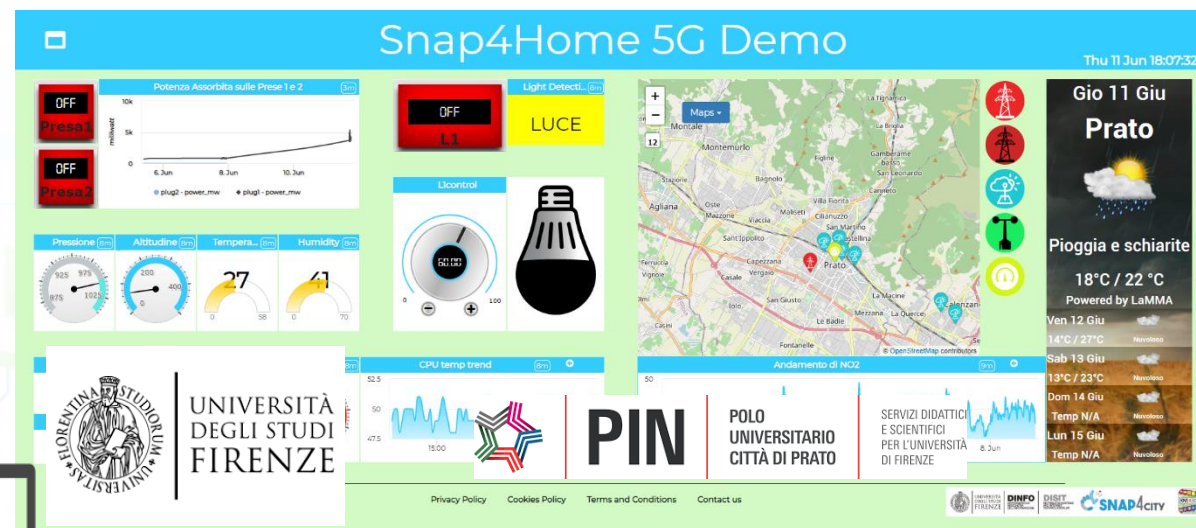
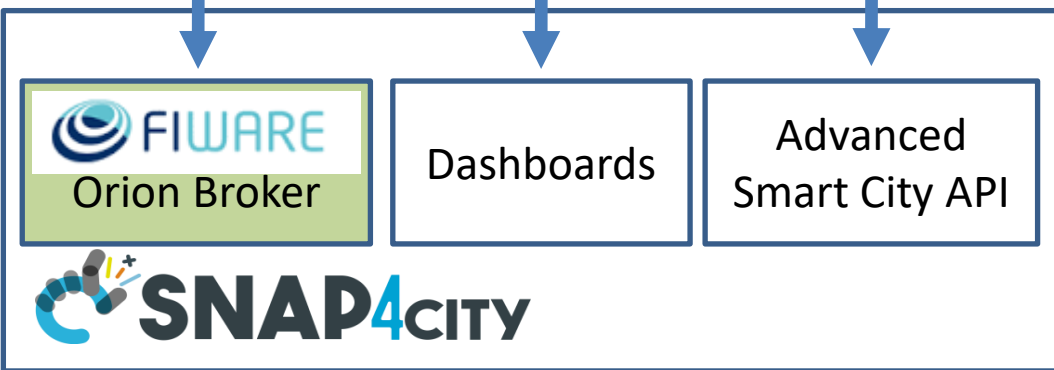


IOT Edge:

**Raspberry
pi:
Node-RED
+
Snap4City
MicroServ
ice Library**

5G gateway

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



Philips Hue: Controlling Lights



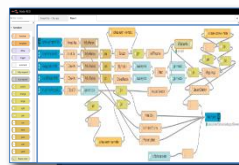
Hue: Motion Control / Alarm



TP Link: Controlling / Measuring Energy Plugs

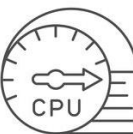


Alexa: Voice Control



IOT Edge:
Raspberry
pi: Node-
RED +
Snap4City

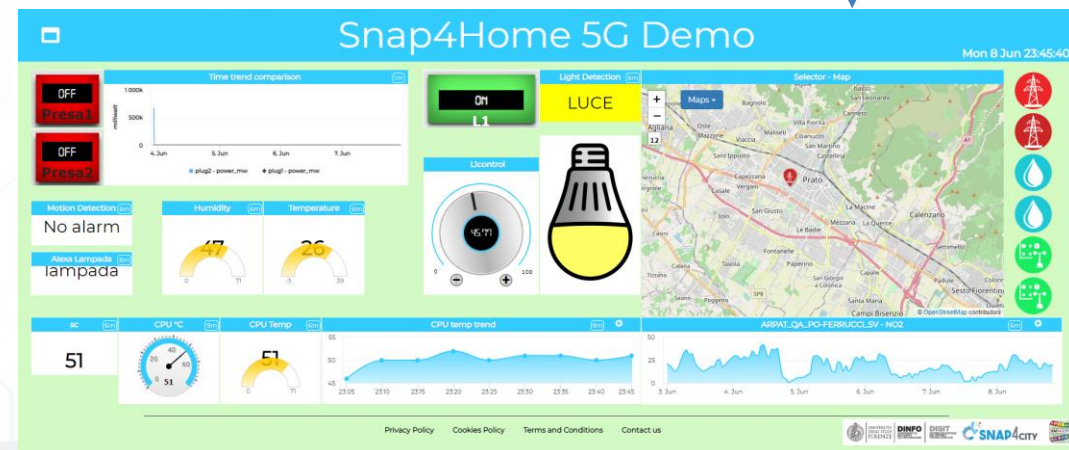
Measuring: Temperature, Humidity, light in the room



Monitoring: CPU clock, status

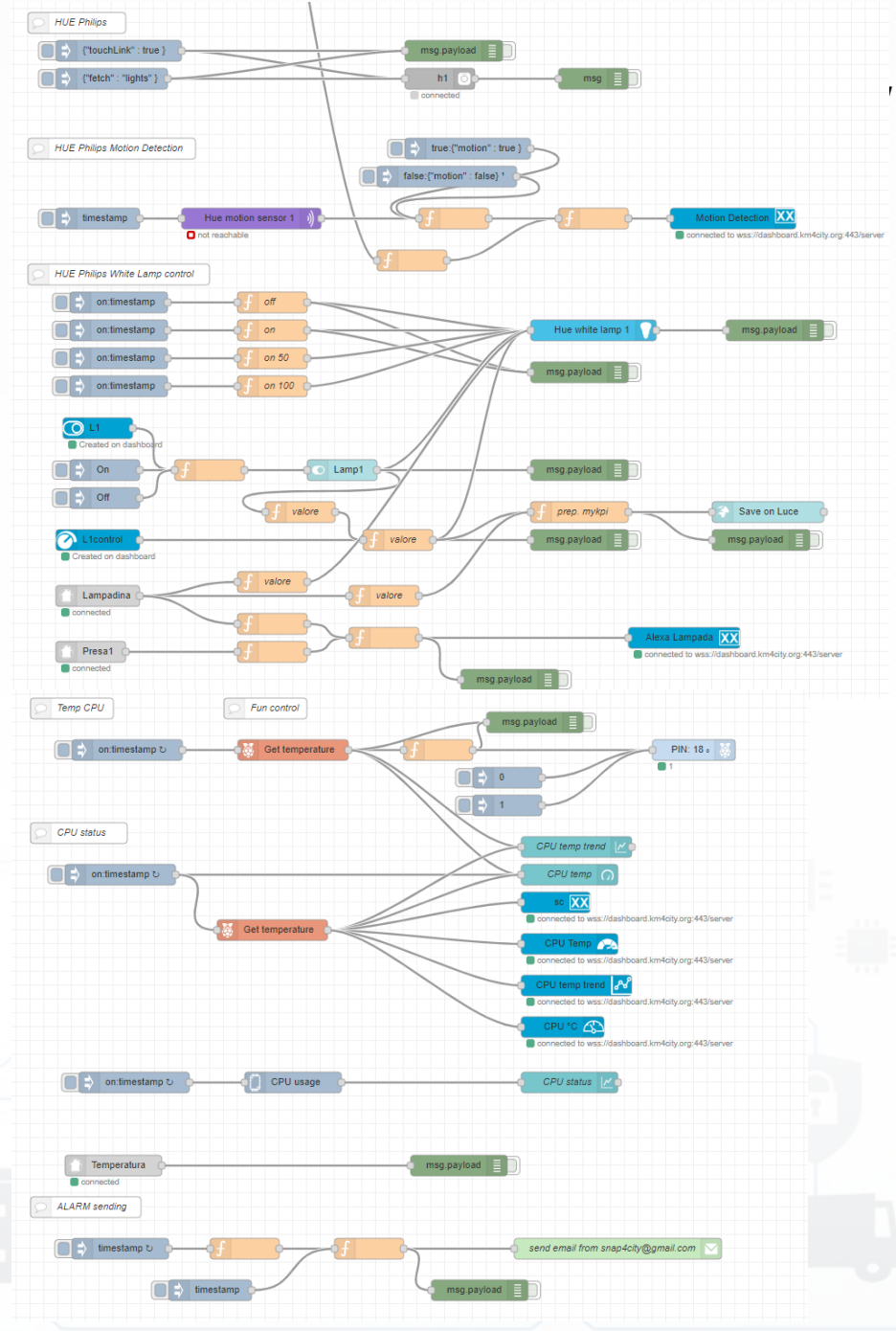
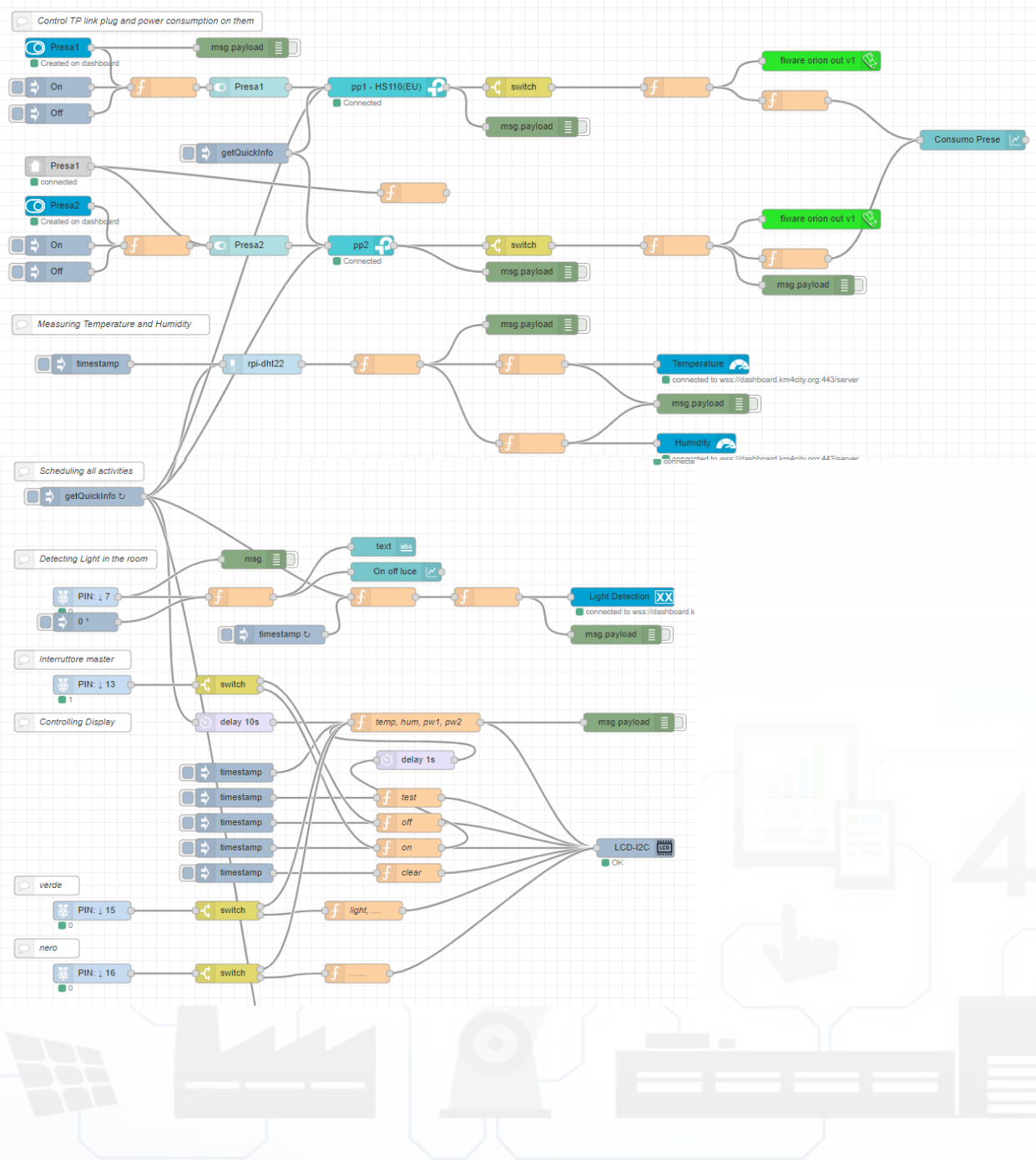
5G gateway

Internet



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





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

My Data, KPI, POI

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

10 entries

No. +	High Level Type	Nature	Sub Nature	Value Name
17057634	MyKPI	Environment	Weather_sensor	slider
17057633	MyKPI	Environment	Weather_sensor	maxslider
17057632	MyKPI	UtilitiesAndSupply	Energy_supply	minslider
17057631	MyKPI	UtilitiesAndSupply	Energy_supply	button
17057453	MyKPI	UtilitiesAndSupply	Agents	S4CTuscanyApp
17057452	MyKPI	UtilitiesAndSupply	Agents	S4CTuscanyTra
17057448	MyKPI	HealthCare	Health_district	corkpim2liguria

KPI Data Details

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: 27/10/2020, 09:49:25
Username: paolo.disit
Organizations: [ou=DISIT,dc=ldap,dc=disit,dc=org]
Healthiness: false
Ownership: public
Description: Info
Latitude: 27/10/2020, 09:49:25
Longitude: 27/10/2020, 09:49:25
Insert Time: 27/10/2020, 09:49:25

IOT Device Models

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

55 MODELS

Show 10 entries

Device Model	Device	Device Type	Device	Device Type	Device	Device Type	Device	Device Type	Device	Device Type
Raspberry snap4city 1	Rasp	DELEGATED	DISIT	sensor	Raspberry PI	Ambiental				
Raspberry snap4city 2	Rasp	DELEGATED	DISIT	sensor	Raspberry PI	Ambiental				
Arduino Uno	Ardu	DELEGATED	DISIT	sensor	Arduino	Ambiental				
Arduino uno-bis	Ardu	DELEGATED	DISIT	sensor	Arduino	Ambiental				
sigfox	Sig	DELEGATED	DISIT	sensor	SigFox	Ambiental				

Add New Model

General Info | IOT Broker | Static Attributes | Values

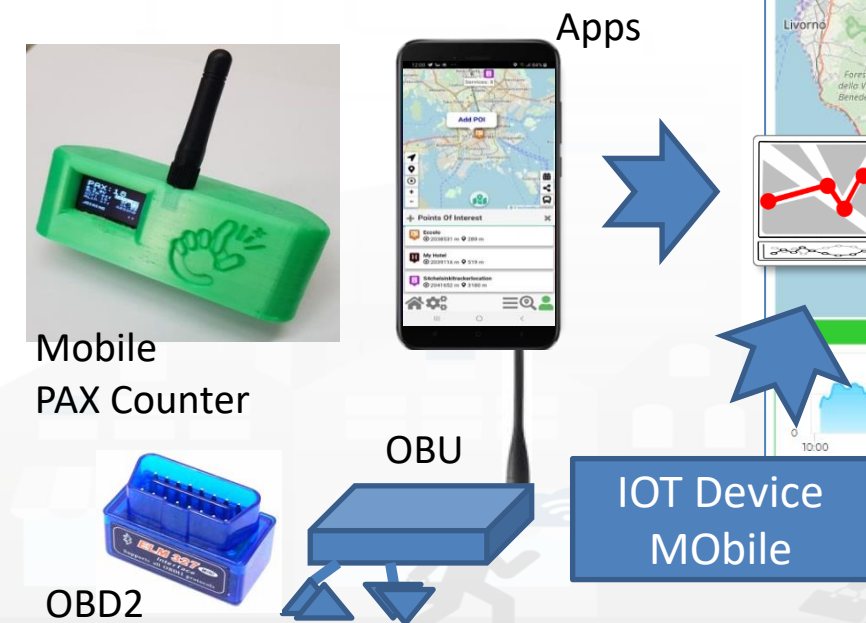
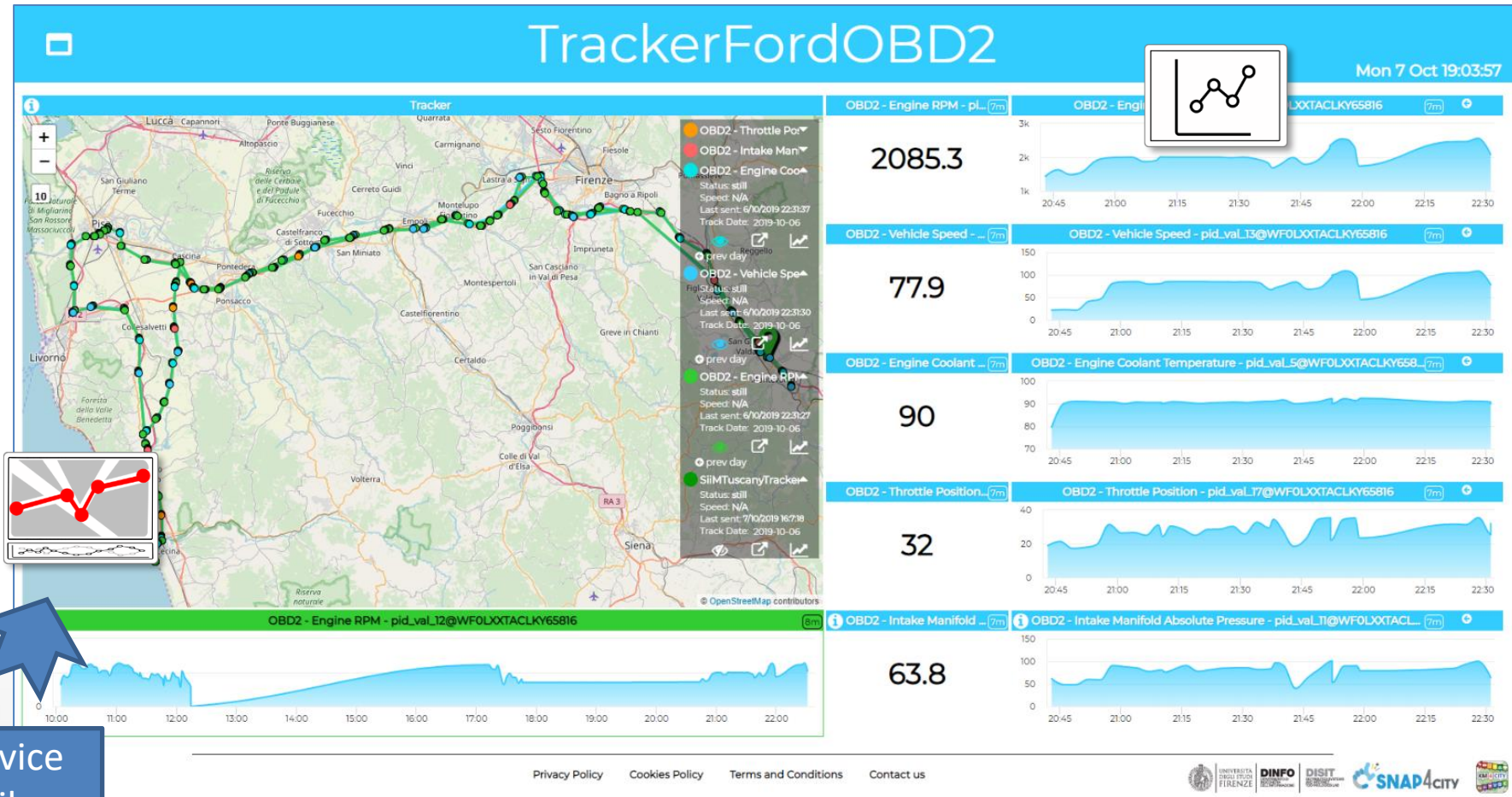
☒ Device in Mobility

Subnature: Select an option

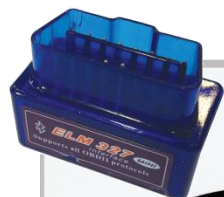
Cancel Confirm

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



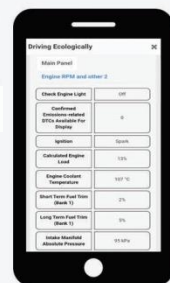
IOE – Vehicle Monitoring



CANBUS
sniffer

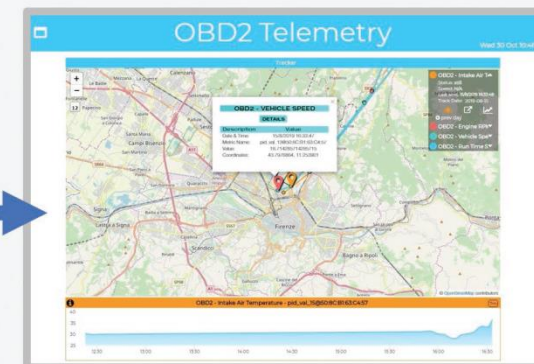


Bluetooth

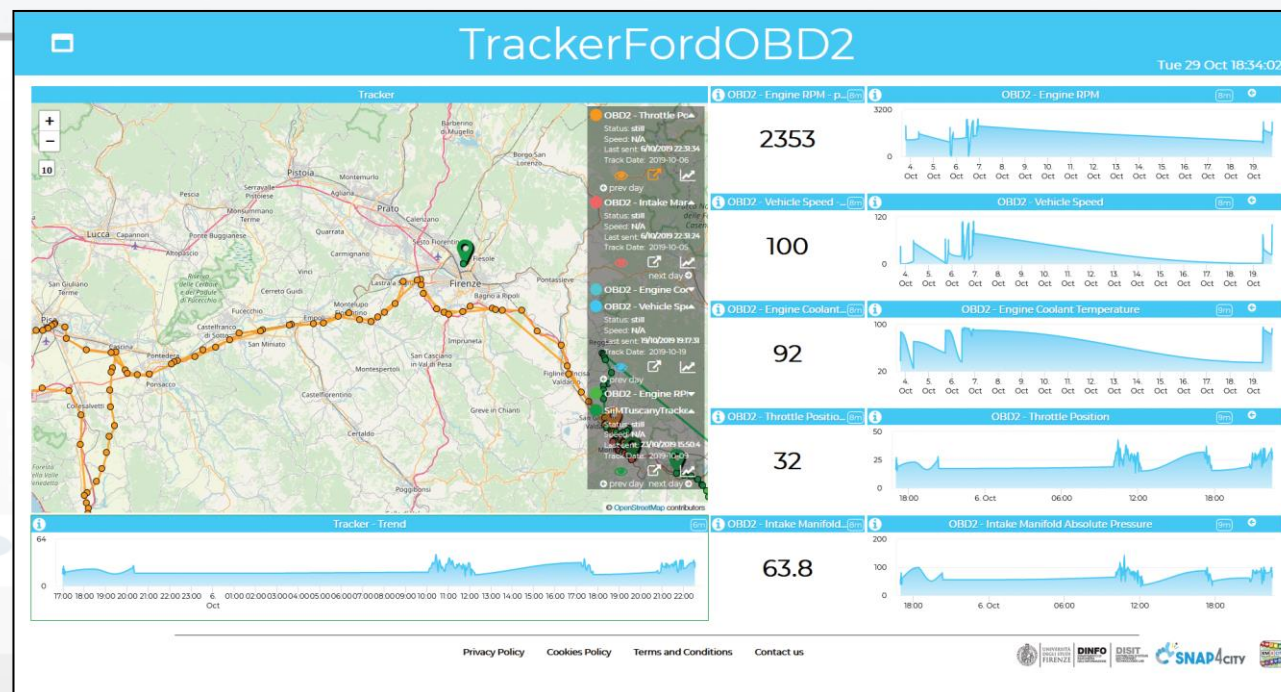
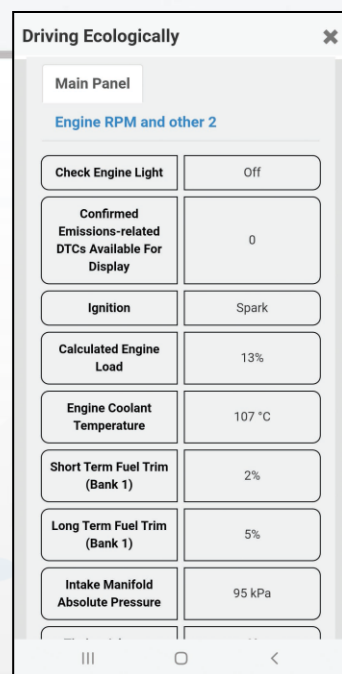


My Data, KPI, POI

No.	High Level	Nature	Sub Nature	Value Name	Value Type	Data Type	Last Date	Last Value	Ownership	Username	Control	Data	Visibility
17057177	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13(IG)C5444725267	integer	27/10/2019 15:26:00	0	private	badianoverg	OK	OK	OK
17057156	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13(IG)C5444725267	integer	27/10/2019 12:58:55	0	private	badihelinski	OK	OK	OK
17057137	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13(IG)C5444725267	integer	23/10/2019 15:49:04	126	private	badi toscana	OK	OK	OK
17056990	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_val_13(IG)B434700028384	integer	5/10/2019 15:36:02	10,75	private	paolotto2	OK	OK	OK
17056968	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_13(IG)WFL0X7ACLV056816	integer	19/10/2019 19:17:31	100	public	badi toscana	OK	OK	OK



Tuscany in a
Snap Mobile
App on
Android



TOP

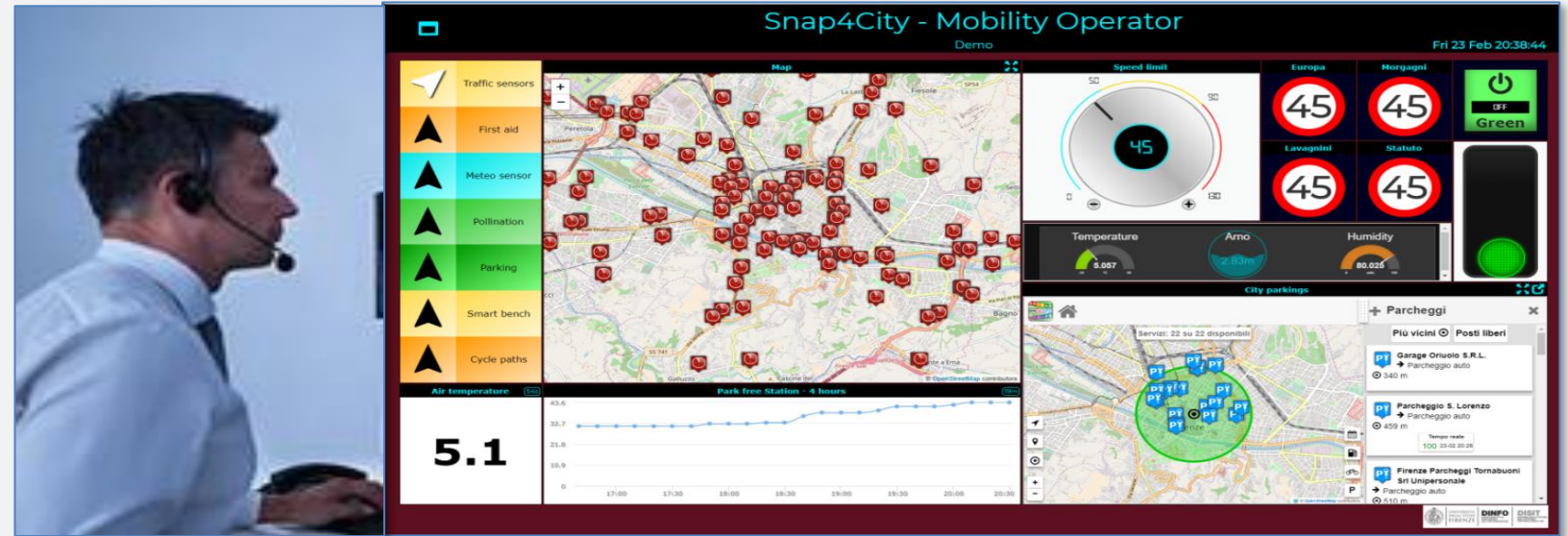
IOT App vs Smart City Solutions



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

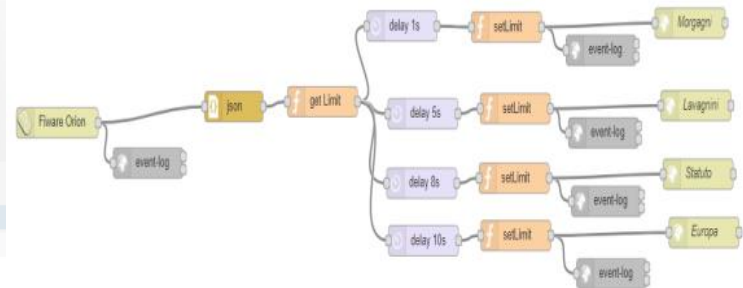
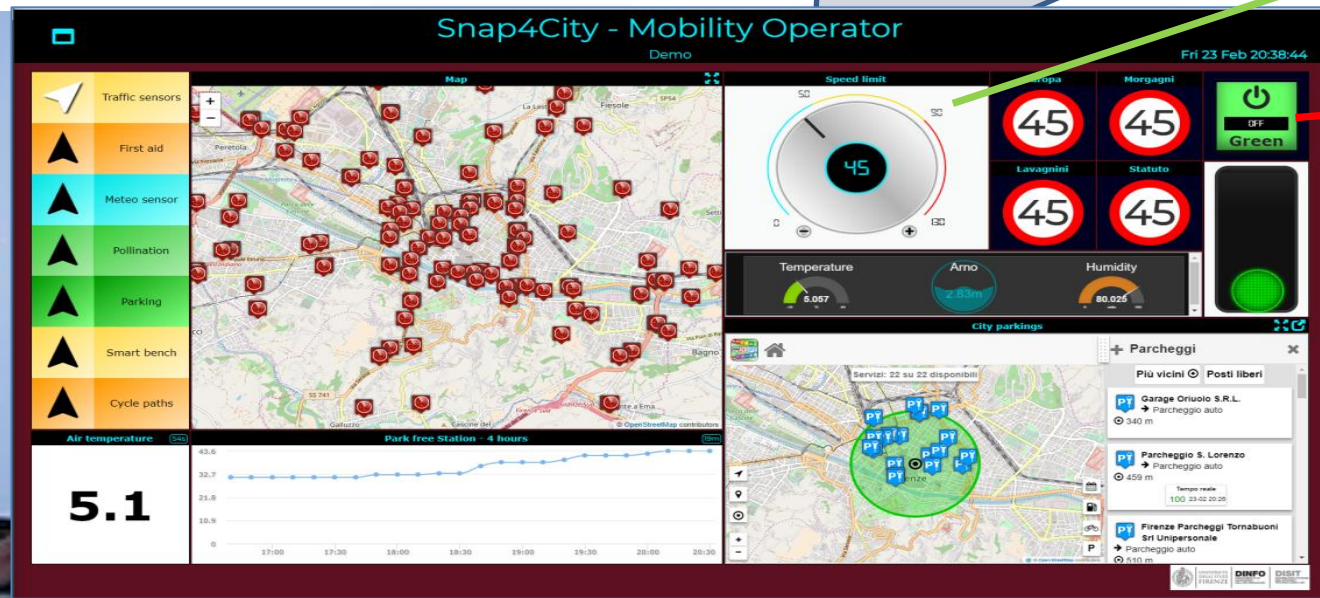
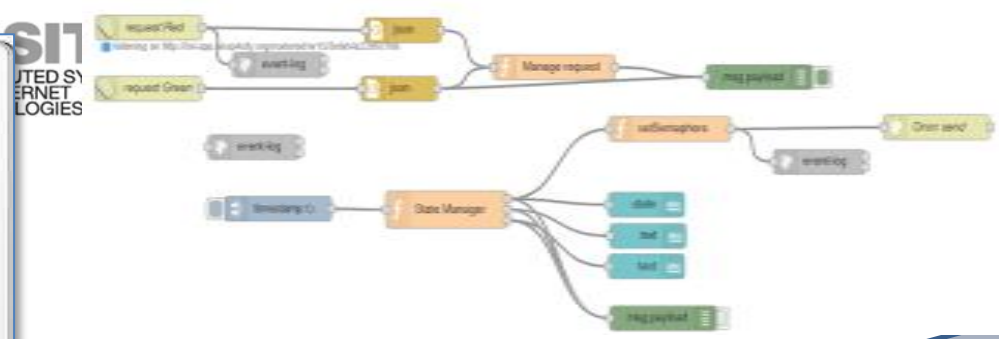
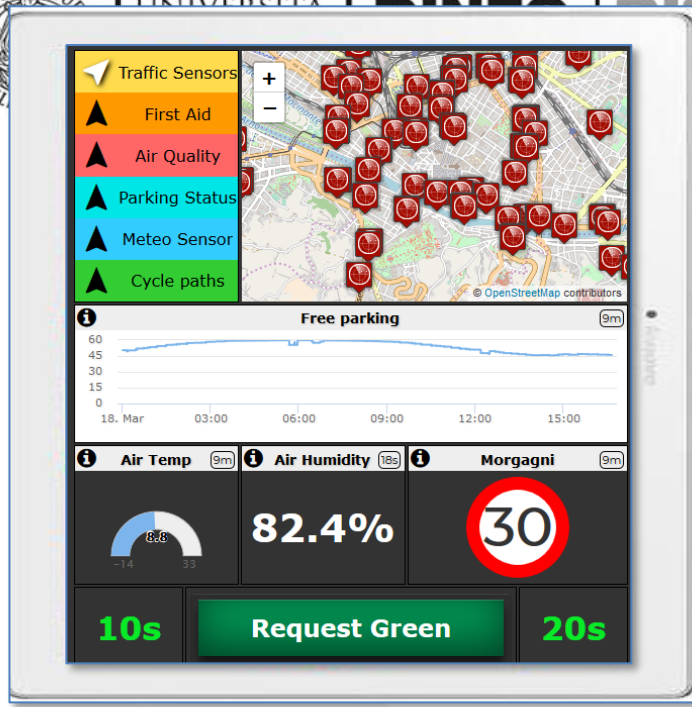


Driver, Policeman

Would like to:

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

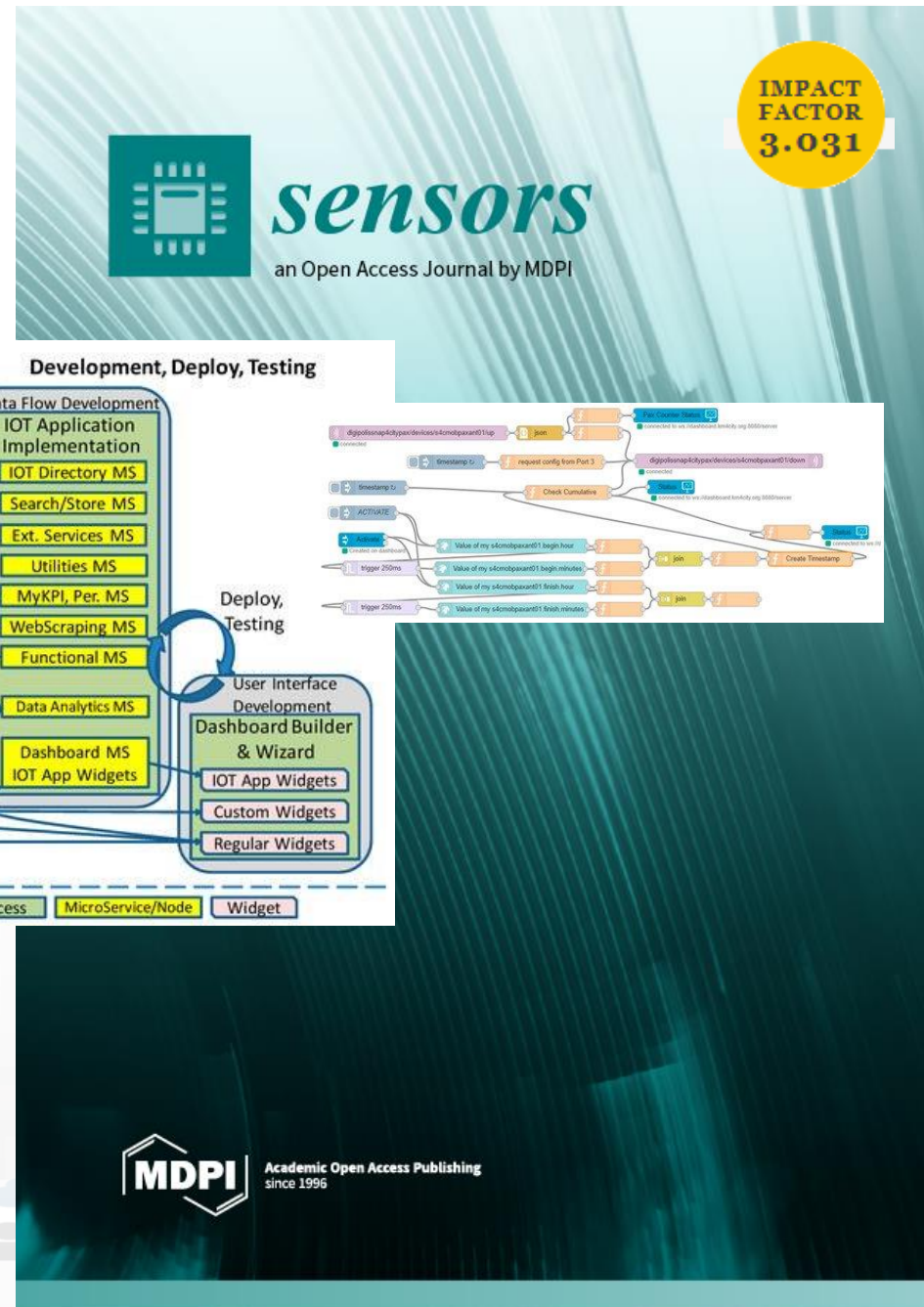
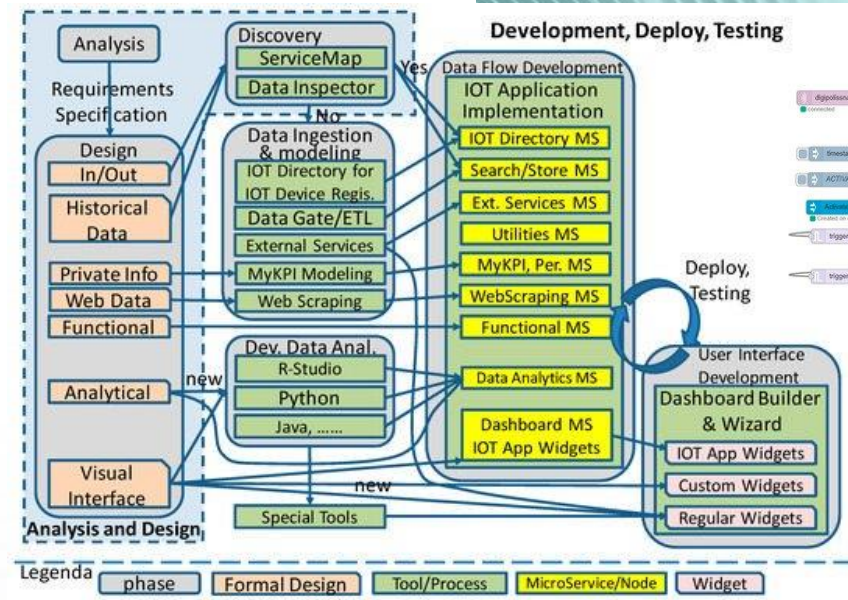




MicroServices Suite for Smart City

- 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>



TOP

Exploiting Storage data by using: IoT App / Proc. Logic

FROM CITY
DASHBOARD TO
APPLICATIONS

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IoT APPLICATIONS
TO DC

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

IoT/IOE DEVICES
AND NETWORKS

IoT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADMIN
SMART CITY API,
MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM, OPENED
TO DEVELOPERS
AND SPOKESMEN

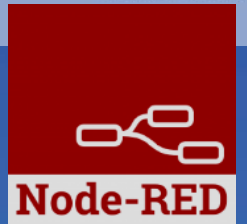
DATA ANALYTICS,
BUSINESS
INTELLIGENCE,
WHAT IF AND
SCENARIO

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

HOW TO ADOPT
SNAP4CITY, AND
OUR ROAD MAP

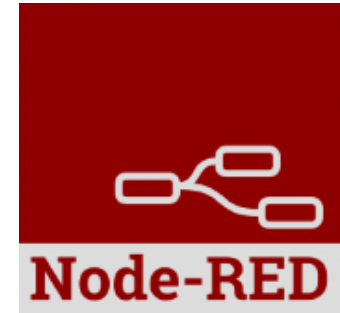
SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS



IoT App / Proc.Logic

- Storage → IoT App / Proc.Logic
- External Service $\leftrightarrow$ IoT App / Proc.Logic
- Dashboards $\leftrightarrow$ IoT App / Proc.Logic

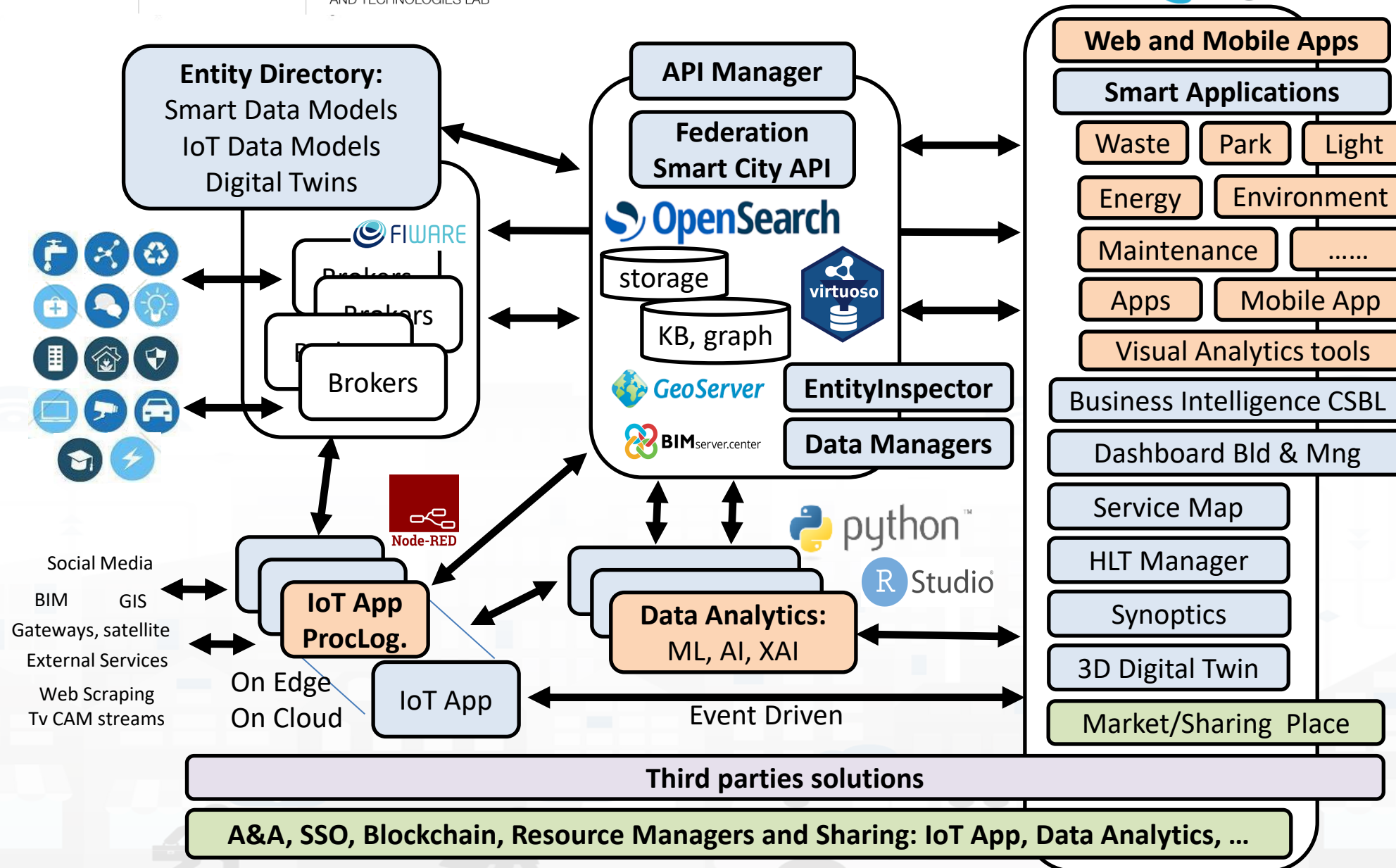


- Data Analytics $\leftrightarrow$ IoT App / Proc.Logic
- Broker → Storage
- IoT App / Proc.Logic → Broker
- Broker → IoT App / Proc.Logic
- IoT App / Proc.Logic → Storage

Part 4

Part 5

Tech Arch



- 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.



- **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

Notificator

Data, my Data, OpenData

Knowledge and Maps

Service Map (Toscana)

Service Map 3D (Firenze)

Helsinki Service Map

Antwerp Service Map

Garda Lake Service Map

Cagliari Service Map

Lonato Del Garda Service Map

Valencia Service Map

Pont Du Gard Service Map

Dubrovnik Service Map

WestGreece Service Map

Mostar-Bosnia Service Map

Svealand Service Map

Roma Service Map

Pisa Service Map

Creating WKT

Service Map 3D (Antwerp)

Service Map 3D (Helsinki)

Producing POI triples for KB

Load WKT on ServiceMap (Helsinki)

Load WKT on ServiceMap (Toscana)

Load WKT on ServiceMap (Antwerp)

Service Map (Toscana)

Public transport Municipalities Text Search Address Search Events

Select an agency:
- Select an Agency -

Select a line:
- Select a Line -

Select a route:
- Select a Route -

Select a bus stop:
- Select a Stop -

Position of selected Buses

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

IBIMET Air Quality Sensor - BORGO SAN LORENZO

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

Name: IBIMET_SMART01

Nature: Environment

Subnature: Air_quality_monitoring_station

Address: BORGO SAN LORENZO

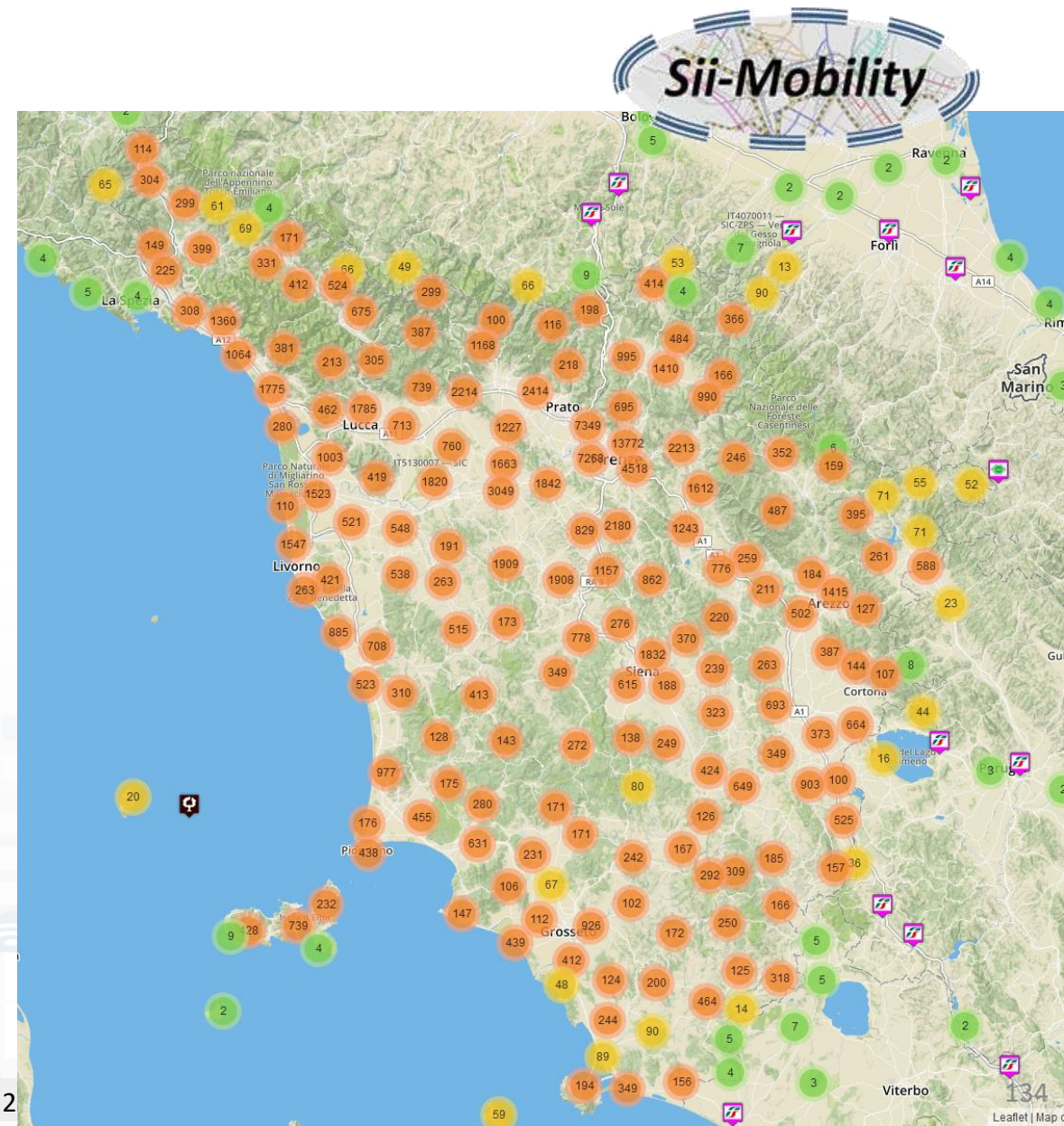
City: FIRENZE

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+02:00

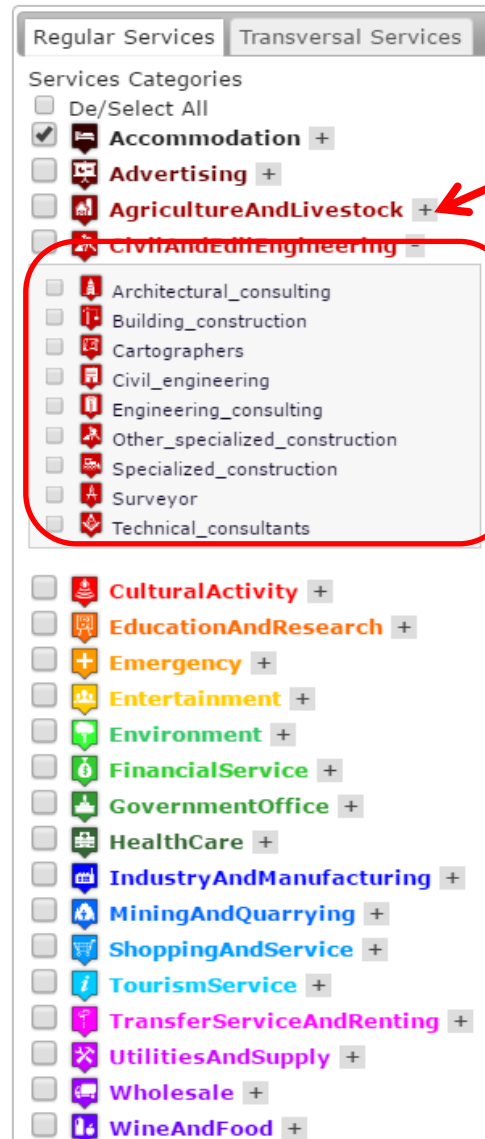
Serviceuri: http://www.disit.org/km4city/resource/IBIMET_SMART01

- **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, ...



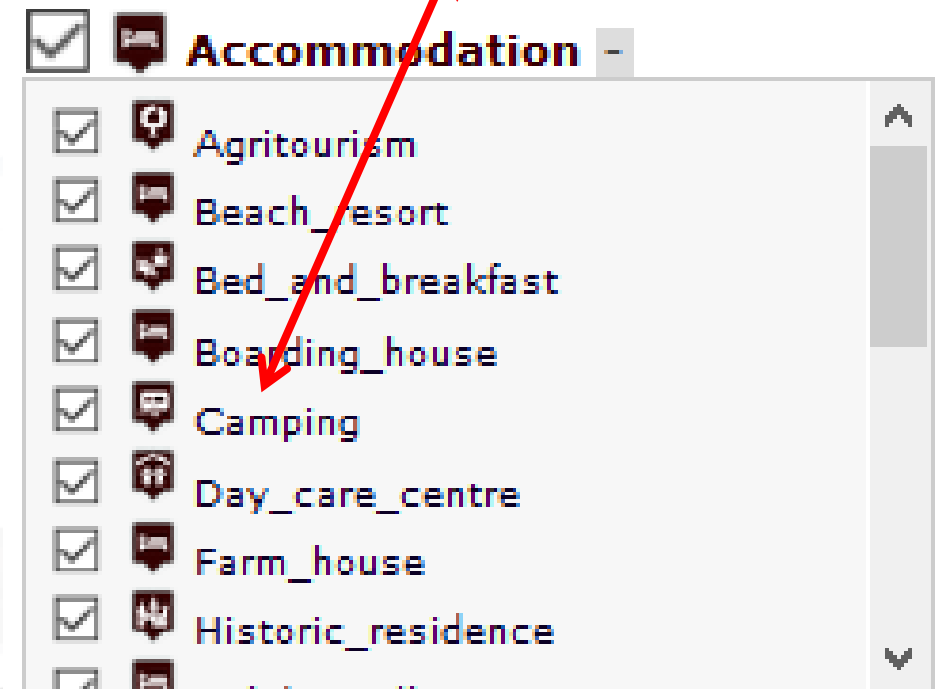
Concepts of Services: Macro and subcategory

A SKOS area into
the Km4CITY
Ontology and
Knowledge base
for modeling POI
and any element
on map



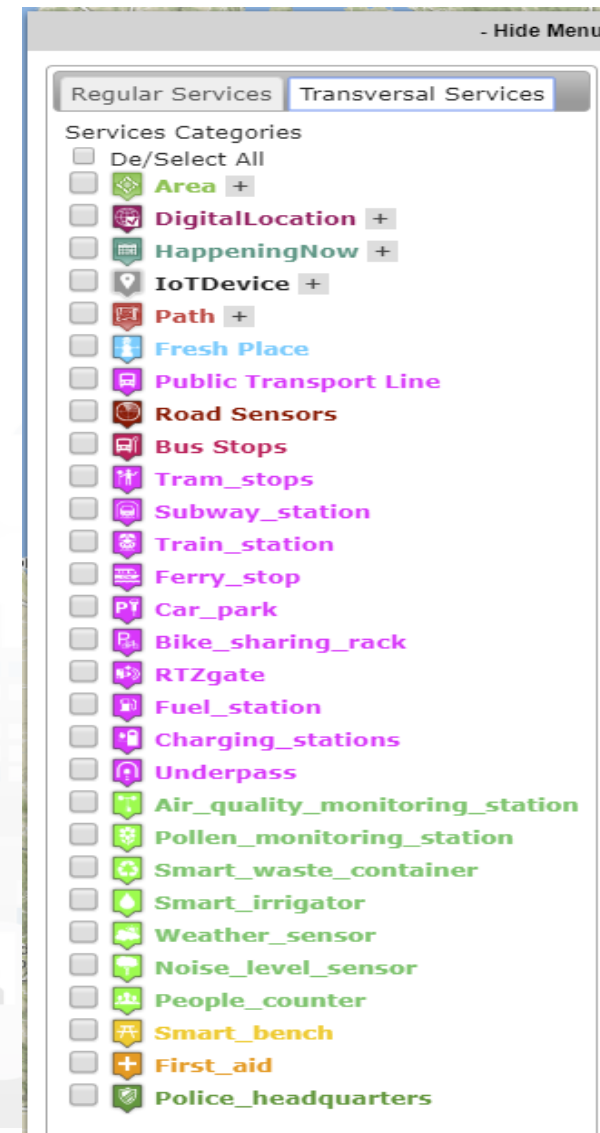
20 Service Macro Classes (The Nature)

Service subClasses (the SubNature)

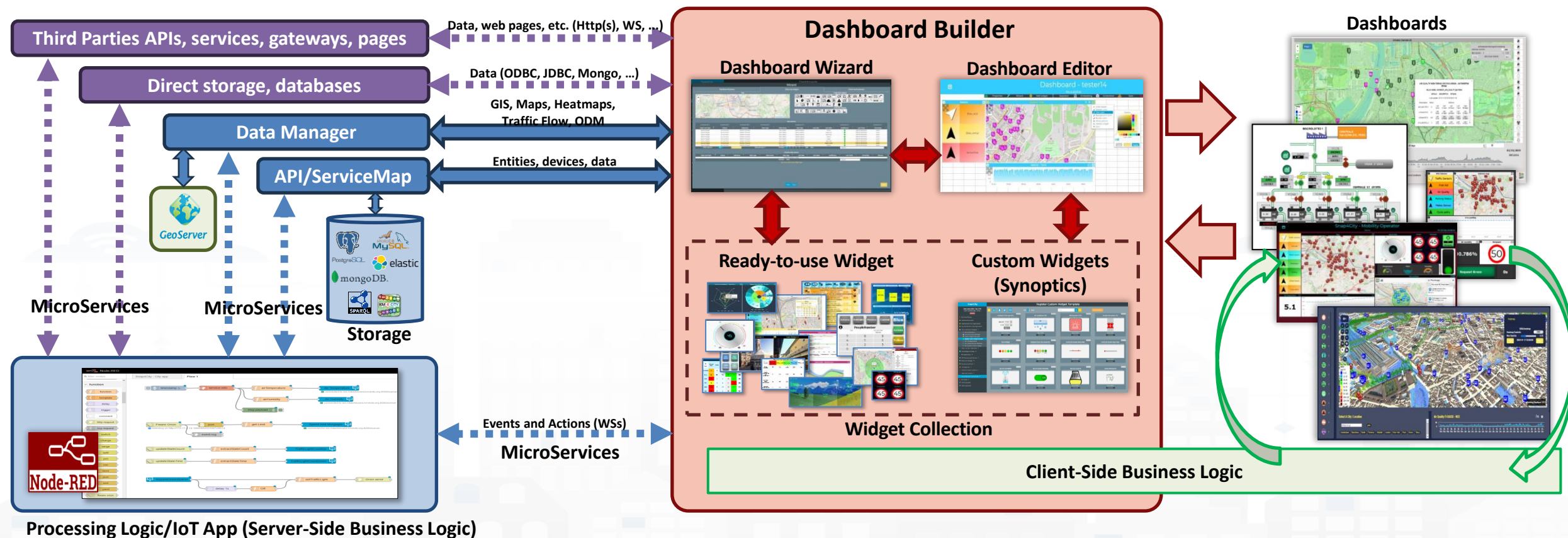


Access to Entities

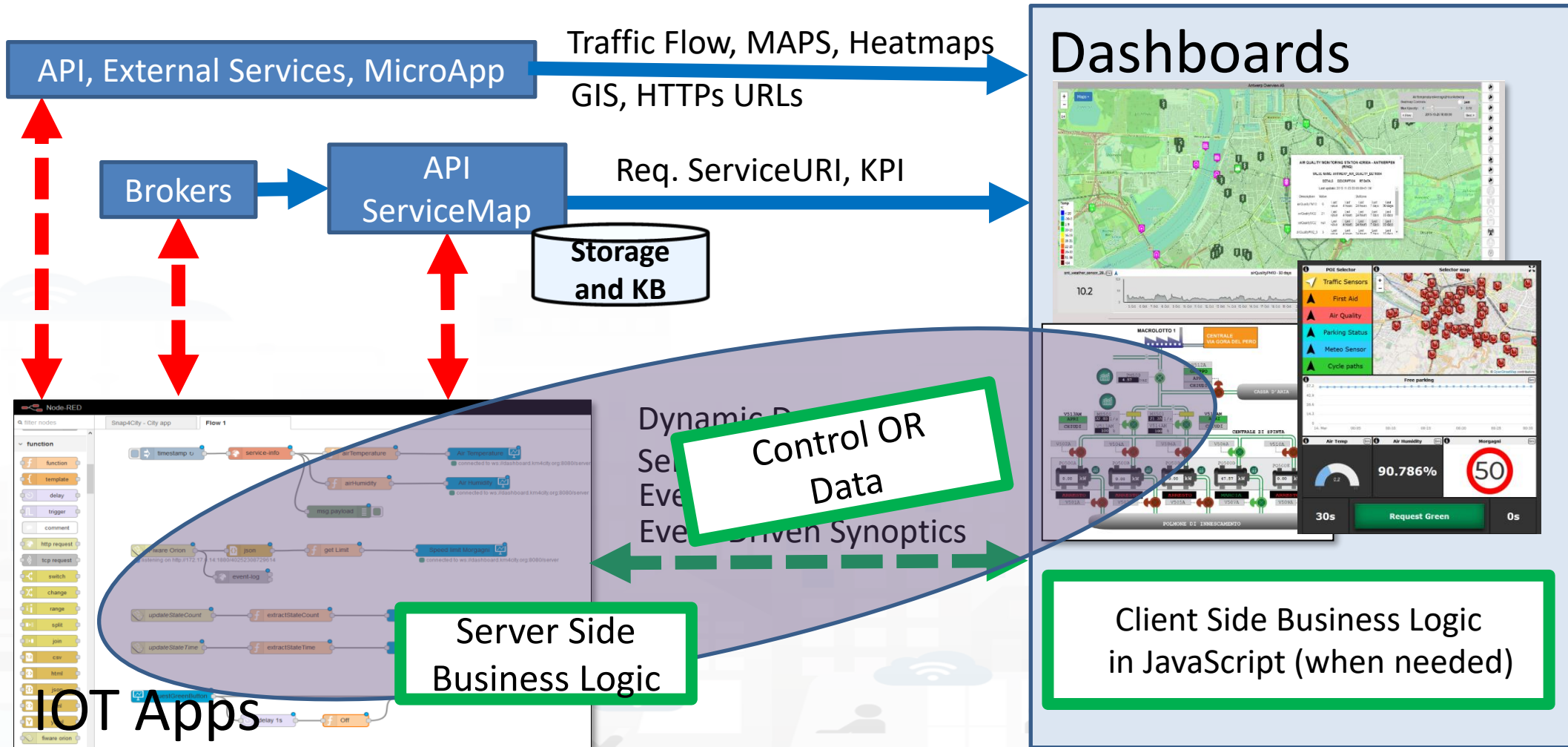
- IoT, POI, etc.
- **Classif**: macro (nature) and subcategories (subnature)
- **Position**: GPS, address, telephone, fax, email, URL, ...
- **Description**: textual, multilingual, with images, ...
- **Link** to dbPedia, Linked Open Data
- **Links to other services**
- **ActionURL**: links to actions 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

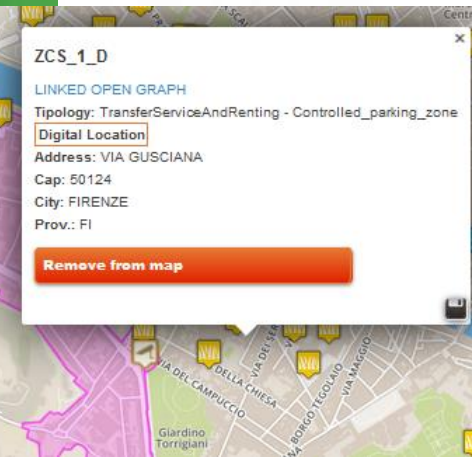
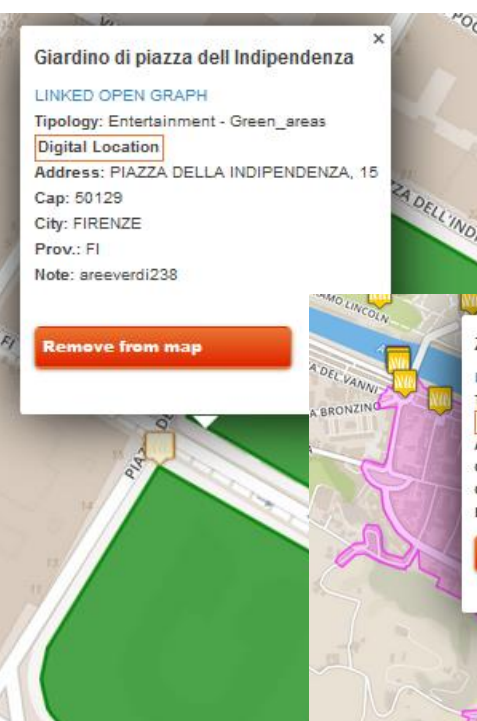
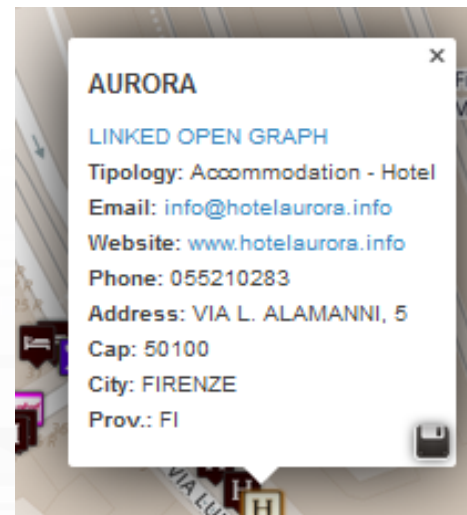
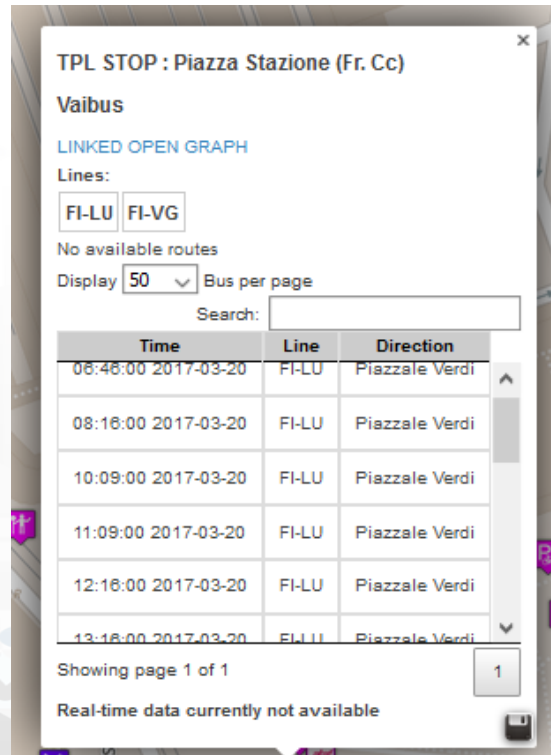
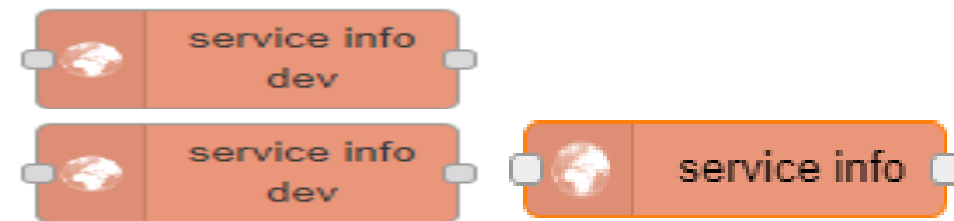


How the Dashboards exchange data



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

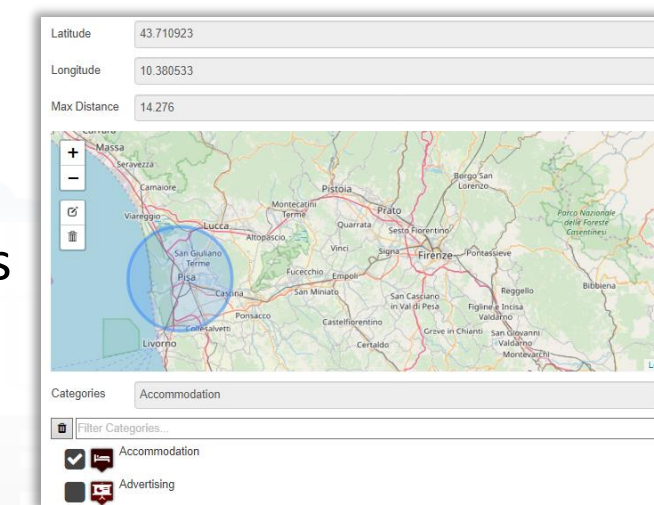
S4CUtility



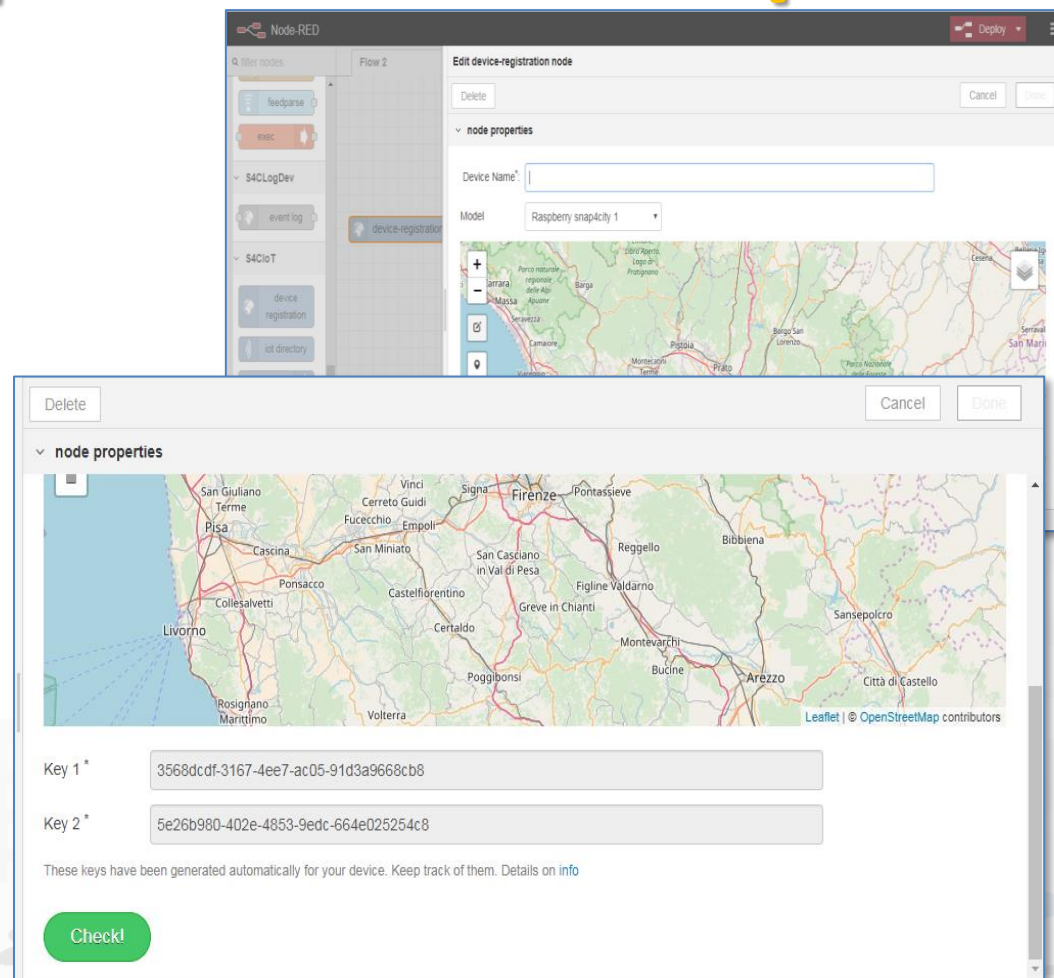
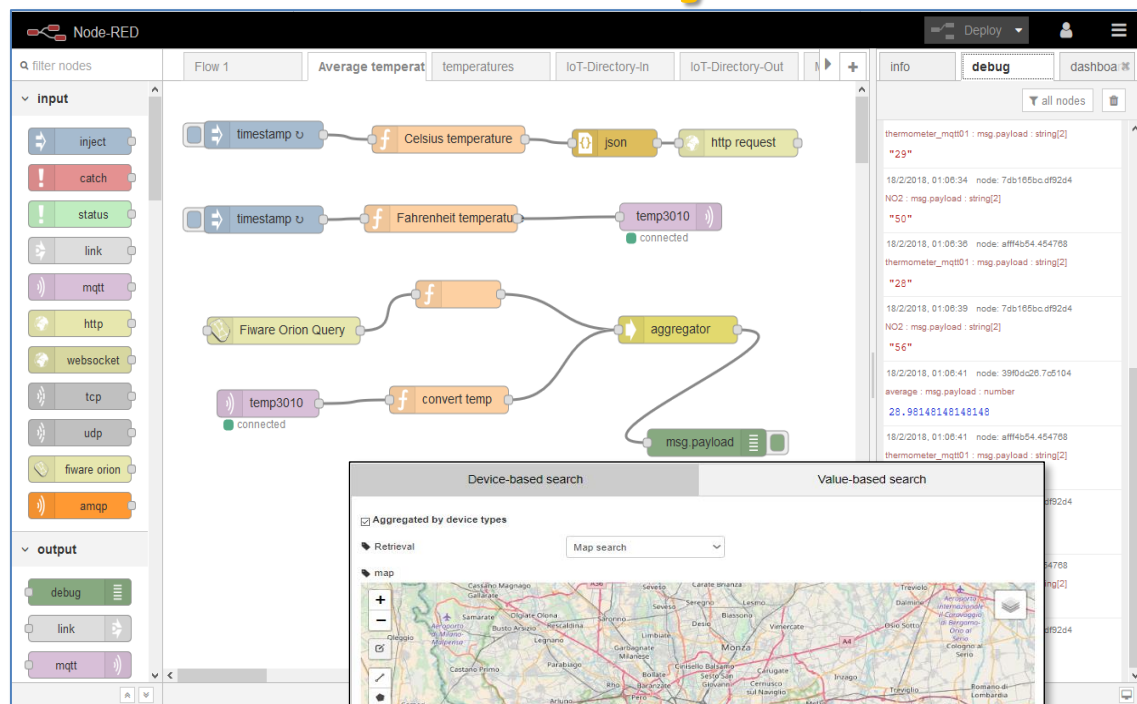
Smart City Entities Search

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



IOT Discovery on IOT Application Development



Smart City Entities Advanced Search

Flexibility

S4CSearchDev

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

service info dev

full text search dev

full text search within wkt area

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

tpl routes

tpl stops

address geometry search near gps position

address search near gps position

geometry search near gps position

address poi search by text

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 search within stored wkt area

- 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

0

Longitude

0

Categories

Categories

Max Distance (in km)

1

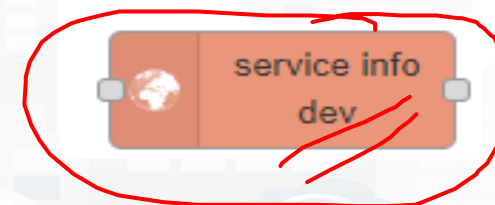
Max Results (0 for all Results)

100

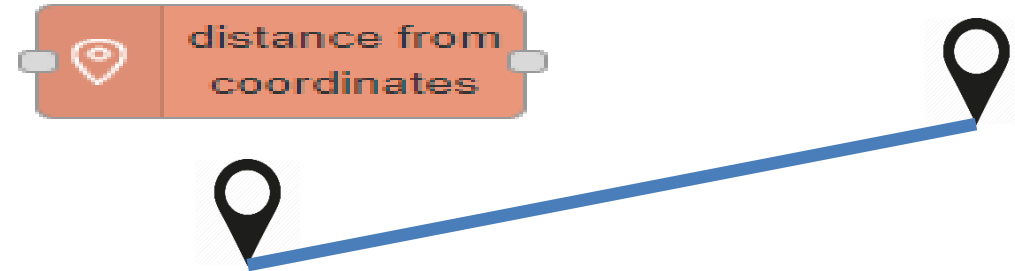
Geometry

☐

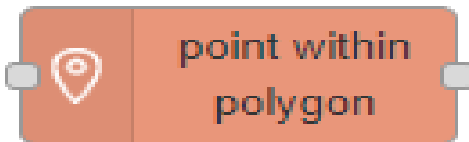
Language



- 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

Entity Directory and Devices
My IOT Sensors and Actuators
IOT Sensors and Actuators
Entity Instances, IoT Devices
IOT Brokers
FIWARE Smart Data Models
Entity Models/IoT Devices
IOT Devices Bulk Registration
Doc: IOT Directory and Devices

Data Management, HLT
Data Inspector
MyKPI, MyData, MyPOI
My Groups of Entities
View/Set MyPOI on Tuscany
Data Table Loader (Excel)
POI Loader (Excel)
Harvest Satellite Copernicus Dat...
File Manager
HeatMap Manager



Understanding / Testing an Entity/ IoT Device

	AdminDevice001	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW
Broker URI: https://broker1.snap4city.org					Broker Port: 8080					
Kind: sensor					Visibility: MyOwnPrivate					
Device Type: Ambiental					Format: json					
Protocol: ngsi					MAC:					
Model:					Producer: Raspberry PI					
Longitude: 9.228193					Latitude: 45.499369					
Device Uri: http://www.disit.org/km4city/source/iot/orionUNIFI/AdminDevice001					VIEW IN SERVICE MAP					
Organization: DISIT					VIEW DATA IN AdminDevice001					
PAYLOAD NGSI v1					PAYLOAD NGSI v2					
K1: b7c4f115-f25c-4cb6-95eb-e4b363222bef					K2: 441ffb6c-dc8a-4fc9-a415-7f6564d656f5					
Created at: 2018-05-24 21:54:03										



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: roottooladmin, 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	All selected (7)
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment

Hide columns

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:	IoT Sensor					
Value Name:	Dubrovnik:orionDubrovnik-UNIFI/camera_Dubrovnik_1_Place					
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

SNAP4CITY

- Click with the mouse on it

Data Inspector Wizard

Some functionalities are limited to certain roles

IOT Devices

IoT Device	IoT Broker	Device Type	Model	Ownership	Status	Soft	Delete	Location
AccessPoint_FerniaSuperstore	orionLanatoDeCarde-UNIFI	AccessPointSensor	AccessPointLanato	DELEGATED	active	EDIT	DELETE	
AccessPoint2_IT65	orionLanatoDeCarde-UNIFI	AccessPointSensor	AccessPointLanato	DELEGATED	active	EDIT	DELETE	
AccessPoint3_Paleopost	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	
AdminTest005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	

Showing 1 to 10 of 370 entries

Notation Terminology

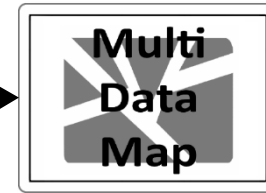
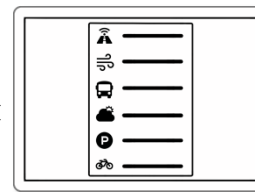
WHERE	Are synonymous at level of service which can be IoT device or entity with data and references to	Are synonymous at level of the single attribute of the entity , device, service, etc.
IoT Directory, Entity Directory	IoT Device, Entity Instance, Device URI	Sensor, Actuator, Attributes, Values (value 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%3A90FD9FFFE5BD5A7F>

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://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=Florence_PM10
 - Traffic flow
 - <https://wmsserver.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**

Snap4City

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

LOGOUT

- My Snap4City.org
- Tour Again
- ダッシュボード
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- My Data Dashboard Kibana
- Extra Dashboard Widgets
- Notifier
- Data, my Data, OpenData
- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
 - My IOT Sensors and Actuators
 - IOT Sensors and Actuators
 - IOT Devices**
 - IOT Devices Management
 - IOT Device Discovery
 - IOT Brokers
 - IOT Device Models
 - IOT Devices Bulk Registration
 - IOT Broker Periodic Update setting
 - IOT Orion Broker Mapping Rules
 - Doc: IOT Directory and Devices
 - Create an IOT Device Instance
 - Create an IOT Device Model
 - Add an IOT Device into Snap4City
- Resource Manager

IOT Devices

Show entries

Search: [New Device](#)

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

Broker URI: <https://broker1.snap4city.org> Broker Port: 8080

Kind: sensor Visibility: MyOwnPrivate

Device Type: Ambiental Format: json

Protocol: ngsi MAC:

Model: Producer: Raspberry Pi

Longitude: 9.228193 Latitude: 45.499369

Device Uri: <http://www.disit.org/km4city/resource/iot/orionUNIFI/AdminDevice001> [VIEW IN SERVICE MAP](#)

Organization: DISIT [NEW DATA IN AdminDevice001](#)

PAYLOAD NGSI v1 [PAYLOAD NGSI v2](#)

K1: b7c4c115-f25c-4cb6-95eb-e4b363222bef K2: 441ffb6c-dc8a-4fc9-a415-7f6564d656f5

Created on: 2018-05-24 21:54:03

+ AdminDevice002	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+ AdminDevice004	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+ AdminDevice005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW
+ AdminDevice1	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE		VIEW

Showing 1 to 10 of 462 entries

Previous 1 2 3 4 5 ... 47 Next

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

IOT Apps

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

Knowledge Base,
ServiceMap,
SuperServiceMap
SmartCity API,
ASCAPI

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

- Access to MyKPI and to those that other user have delegated to Me

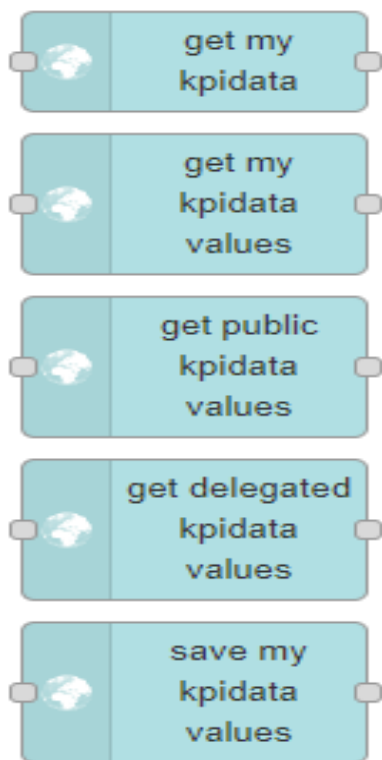
- **MyKPI are:**

- 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

▼ S4CKPIData



TOP

External Service ↔ IoT App / Proc.Logic

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB

SNAP4CITY FOR

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

SNAP4CITY
AND KM4CITY
PROJECTS

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS



THE LOGIC AND
THE SMARTNESS

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

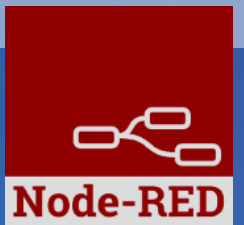
IOT MicroServices for Final Users

IOT MicroServices for Developers

DOC: Processing Logic/IoT App

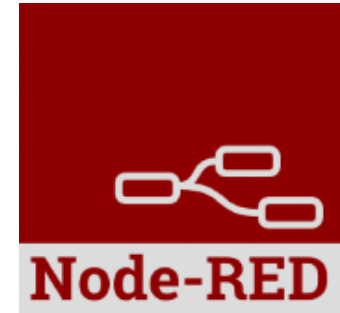
How to Develop Proc.Logic / IoT App

Create A MicroService from RestCall



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

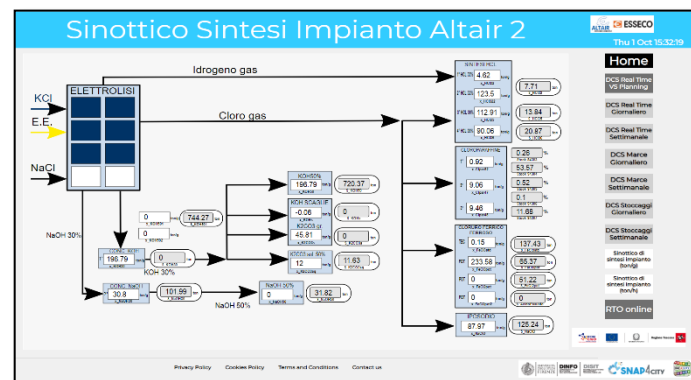
Basic Node.js Blocks on NodeRed on our Advanced IOT Apps

DISIT Lab, Distributed Data Intelligence and
Systems and Internet
Information Engine
<http://www.dit.ie>

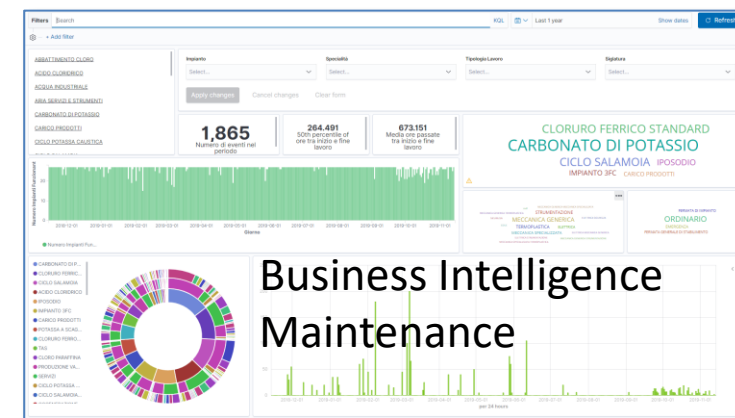


+ on IOT Edge Raspberry

Example of Integrated workflow



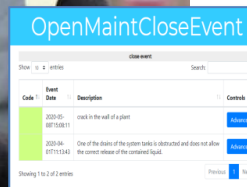
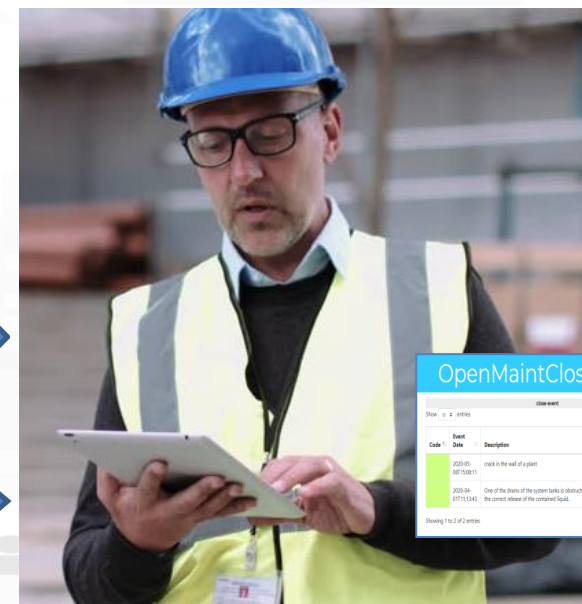
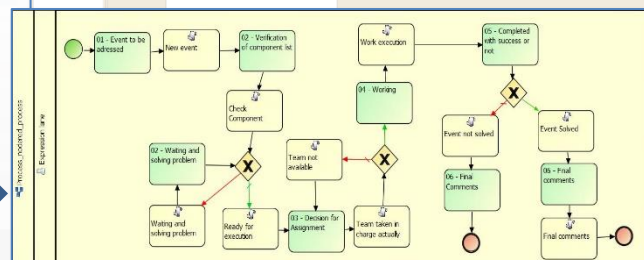
Consumptions/productions



Events/actions

Business Intelligence
Maintenance

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

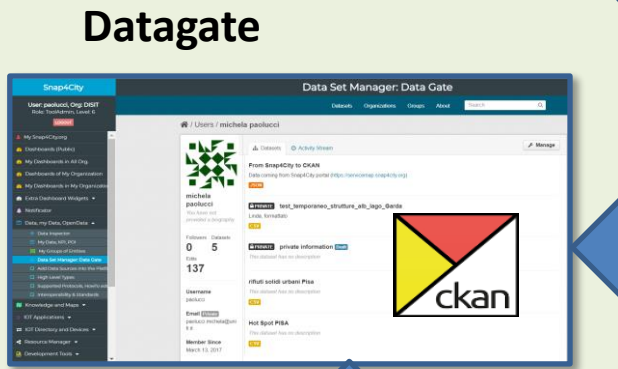


IOT App, Data event firing, event detection and firing Critical event management

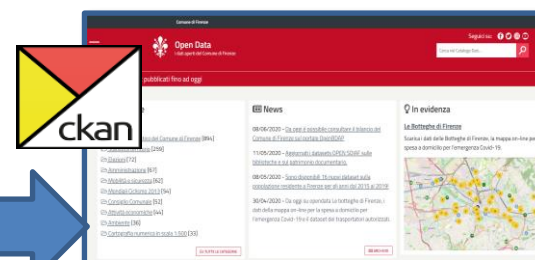
Snap4City vs CKAN

Snap4City Portal and Integrated tools

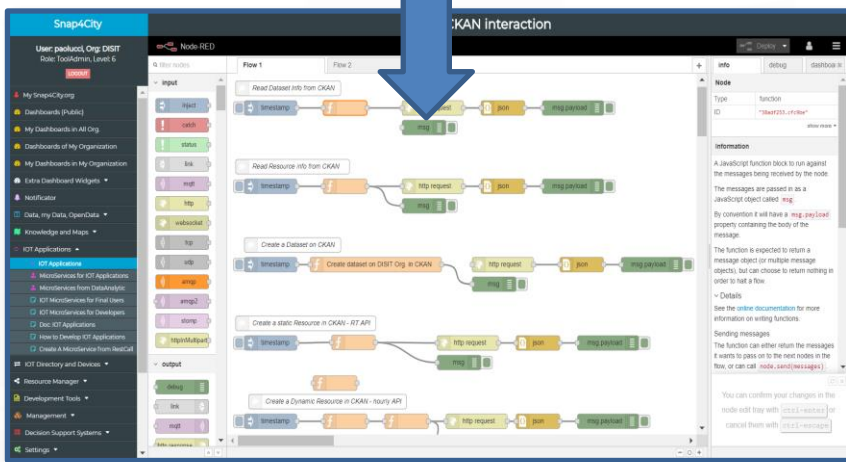
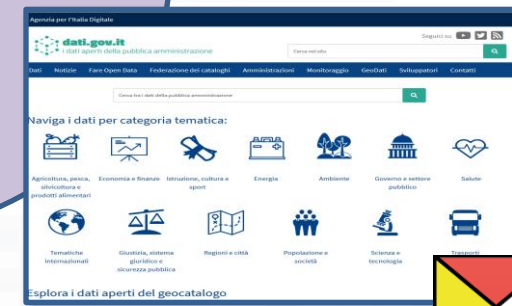
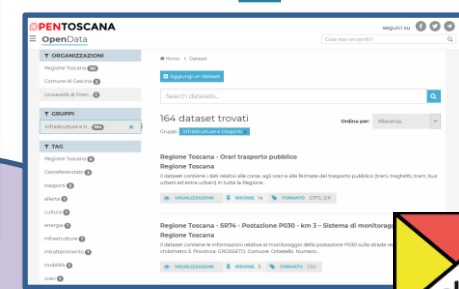
Advanced Snap4City APIs and Micro Services



Harvesting and Publishing



Open or Private External CKAN Data Portals



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

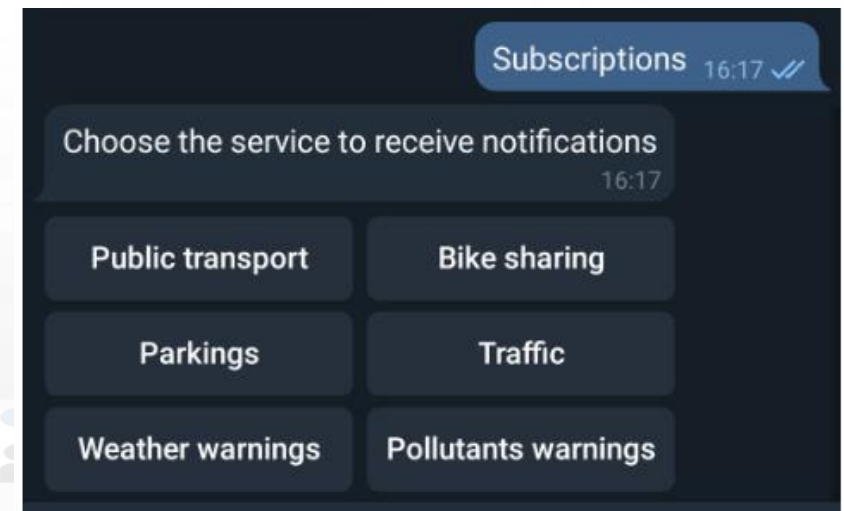
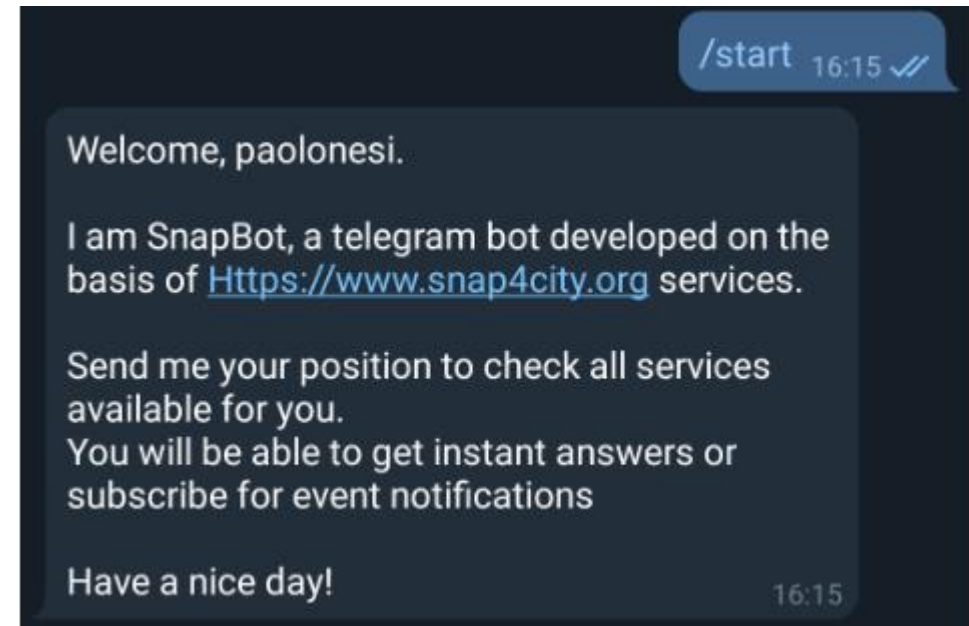
- Each Rest Call API can be automatically transformed into a MicroService for the IOT Applications

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

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 17:27:08	Antwerp museum (data coming from the A Open Data API)	OK - 2019-01-13 17:27:08	VIEW	EDIT	NO	DEL
Antwerp velo stations.zip	2019-01-13 17:32:17	Antwerp velo stations ocaion (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 Gelico.zip	2019-02-13 12:33:31	Statistiche	OK - 2019-02-13 12:33:31	VIEW	EDIT	NO	DEL
Firenze_gelico_interni.zip	2019-02-12 13:00:30	Ticket Gelico interni	OK - 2019-02-12 13:00:30	VIEW	EDIT	NO	DEL



- 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

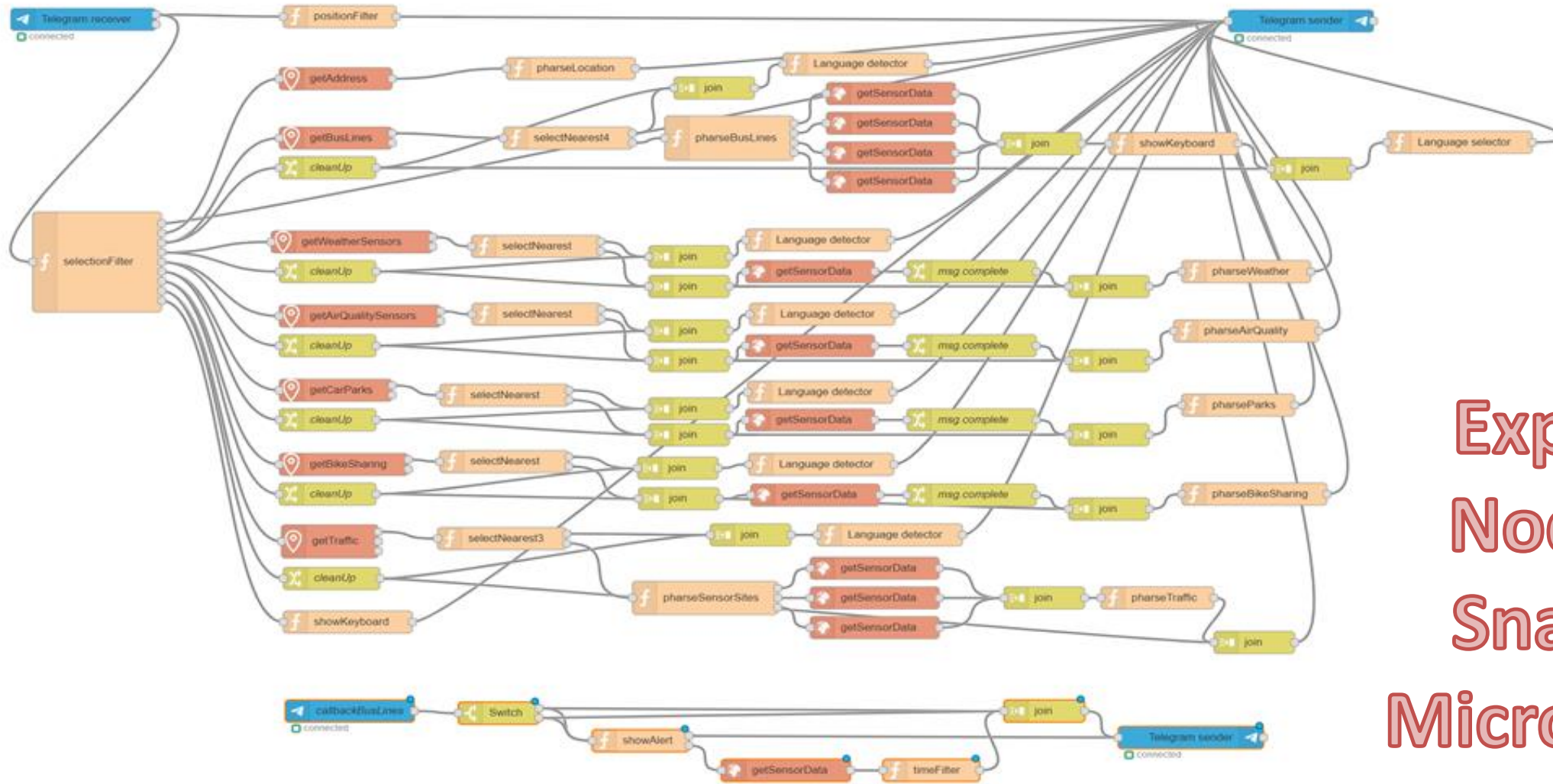
16:43

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
DASHBOARD
APPLICATION

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

TECHNICAL SUPPORT
TEAM AND CITY
INTELLIGENCE

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

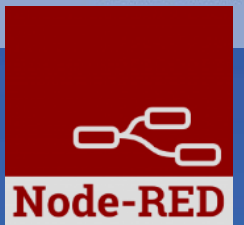
IOT MicroServices for Final Users

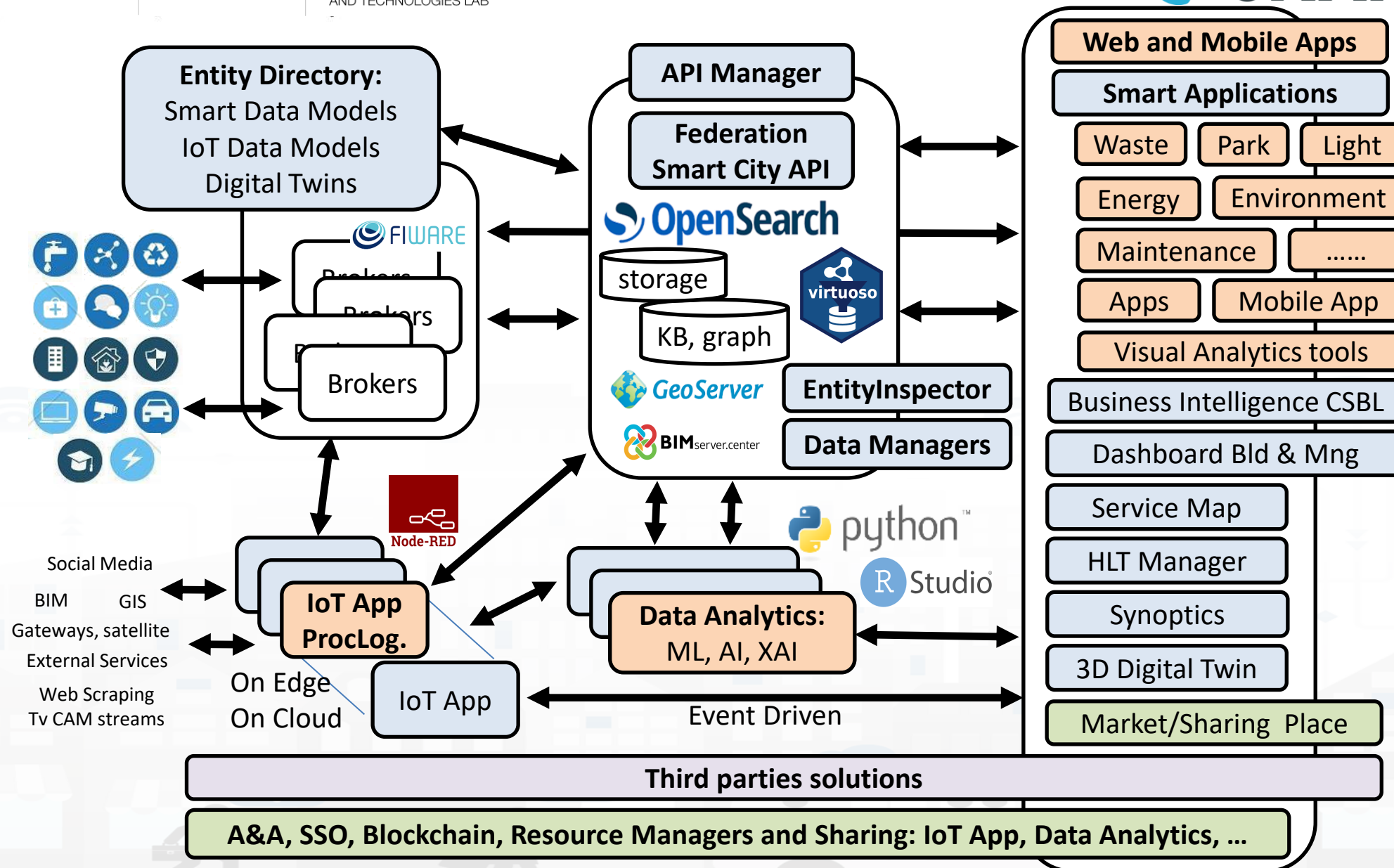
IOT MicroServices for Developers

DOC: Processing Logic/IoT App

How to Develop Proc.Logic / IoT App

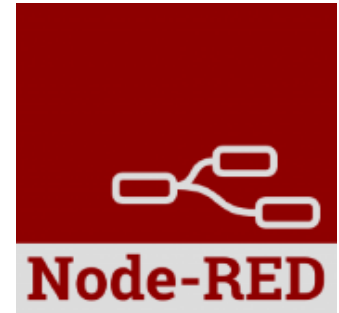
Create A MicroService from RestCall





IoT App / Proc.Logic

- Storage $\rightarrow$ IoT App / Proc.Logic
- External Service $\leftrightarrow$ IoT App / Proc.Logic
- **Dashboards $\leftrightarrow$ IoT App / Proc.Logic**

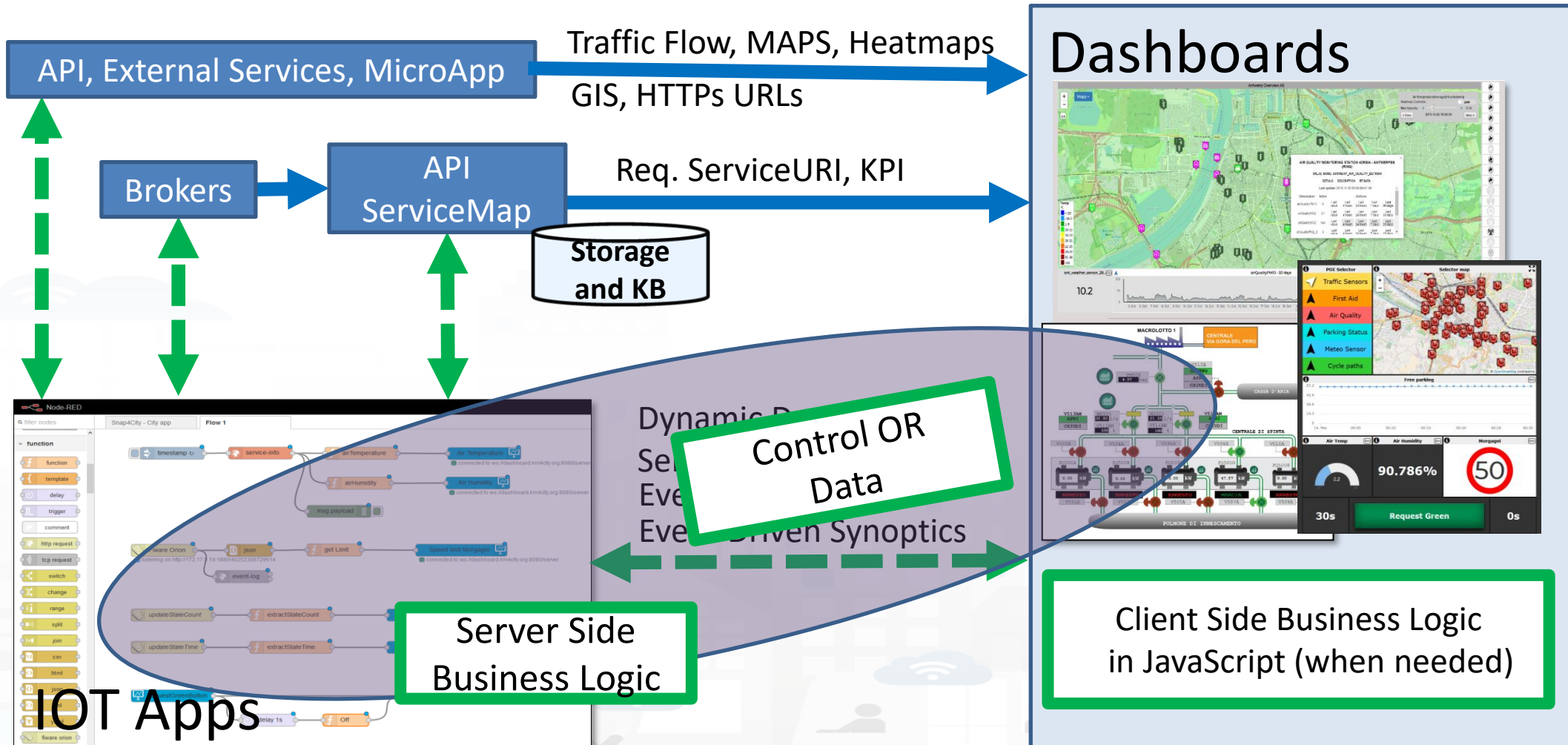


- Data Analytics $\leftrightarrow$ IoT App / Proc.Logic
- Broker $\rightarrow$ Storage
- IoT App / Proc.Logic $\rightarrow$ Broker
- Broker $\rightarrow$ IoT App / Proc.Logic
- IoT App / Proc.Logic $\rightarrow$ Storage

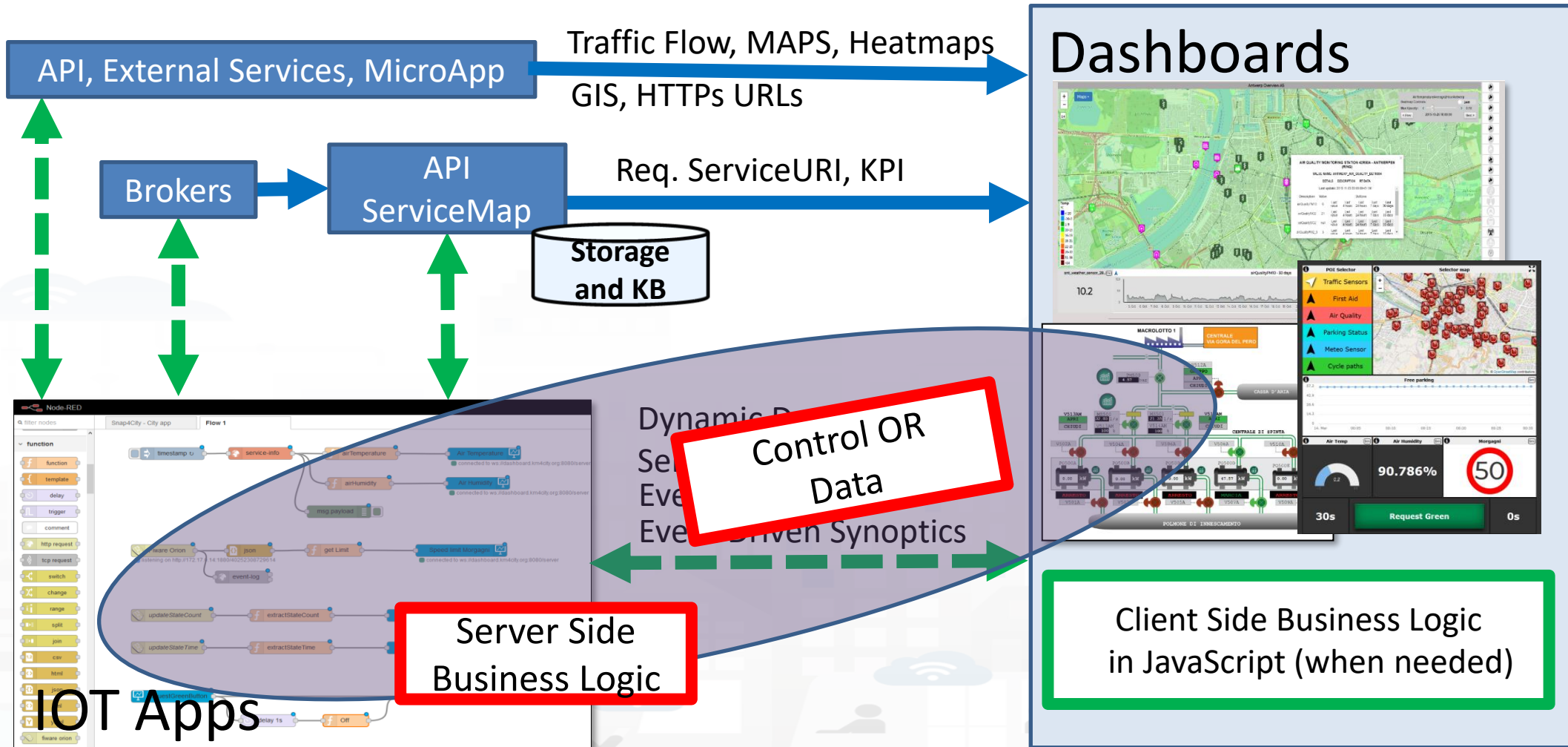
Part 4

Part 5

How the Dashboards exchange data



How the Dashboards exchange data



Snap4City Dashboards main concepts

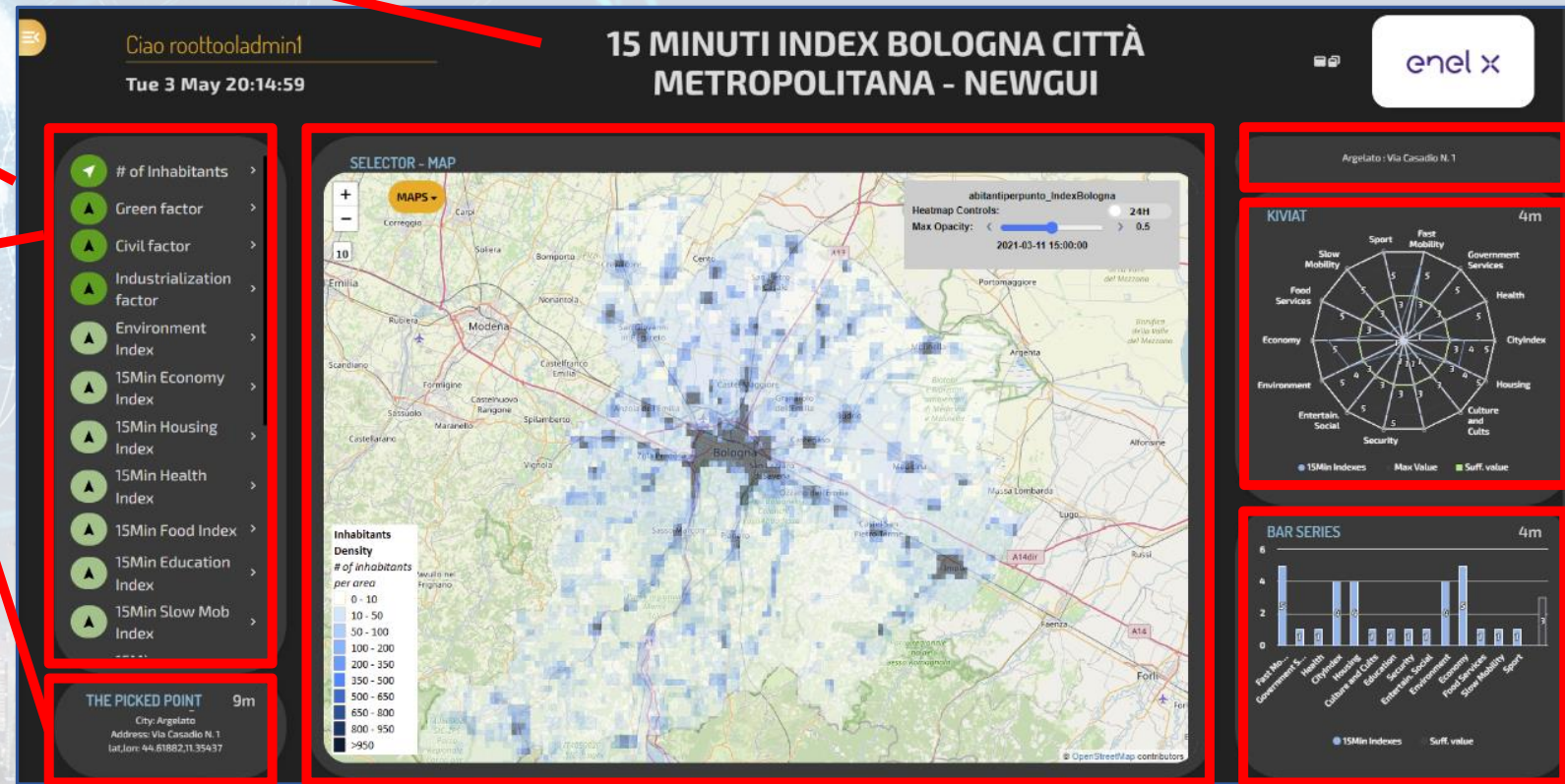
Header

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

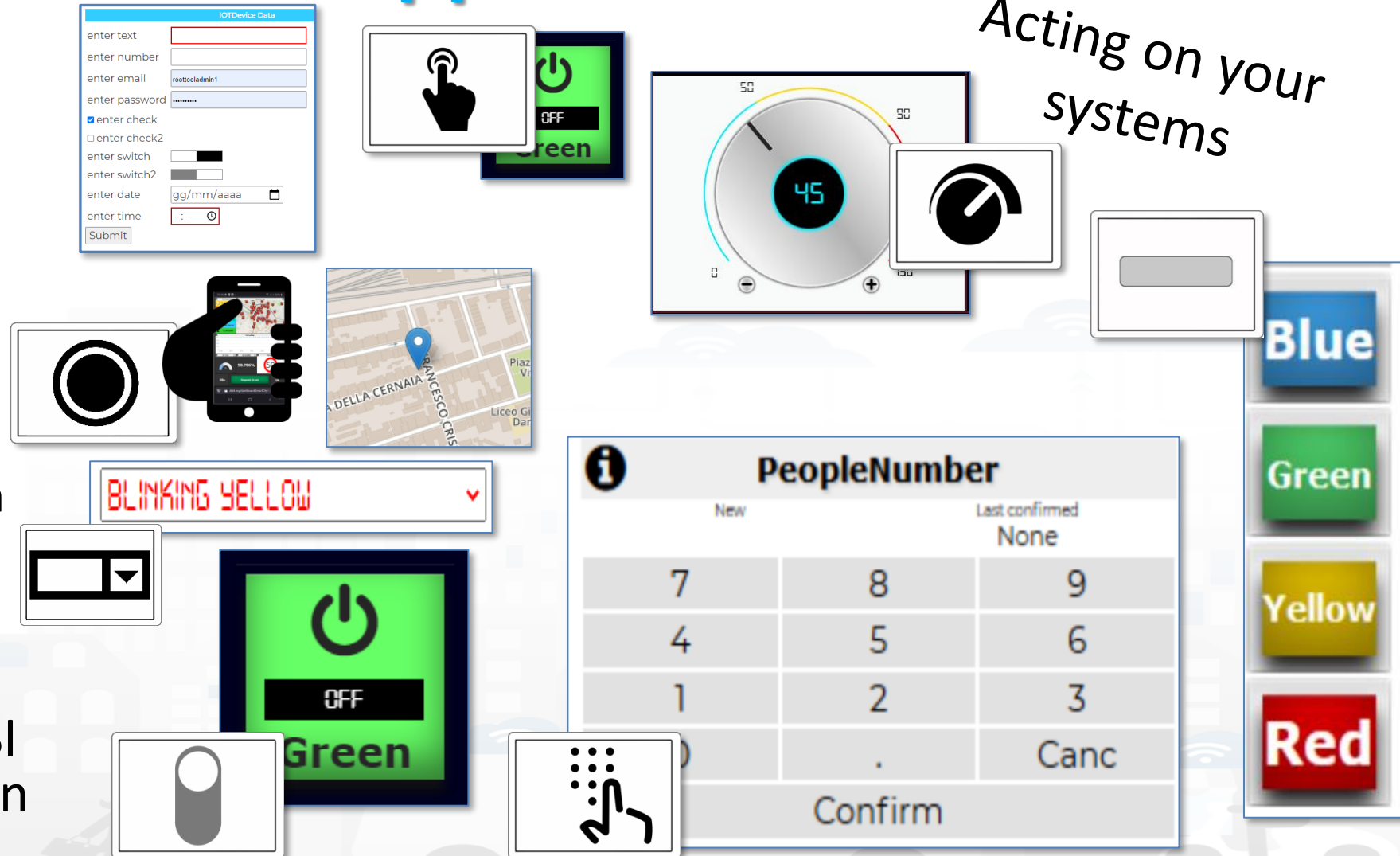
- button
- dropdown
- switch
- slider
- numeric
- text input
- date picker
- colour picker
- form
- text
- gauge
- chart
- audio out
- notification
- ui control
- template

From Dashboard to IoT App

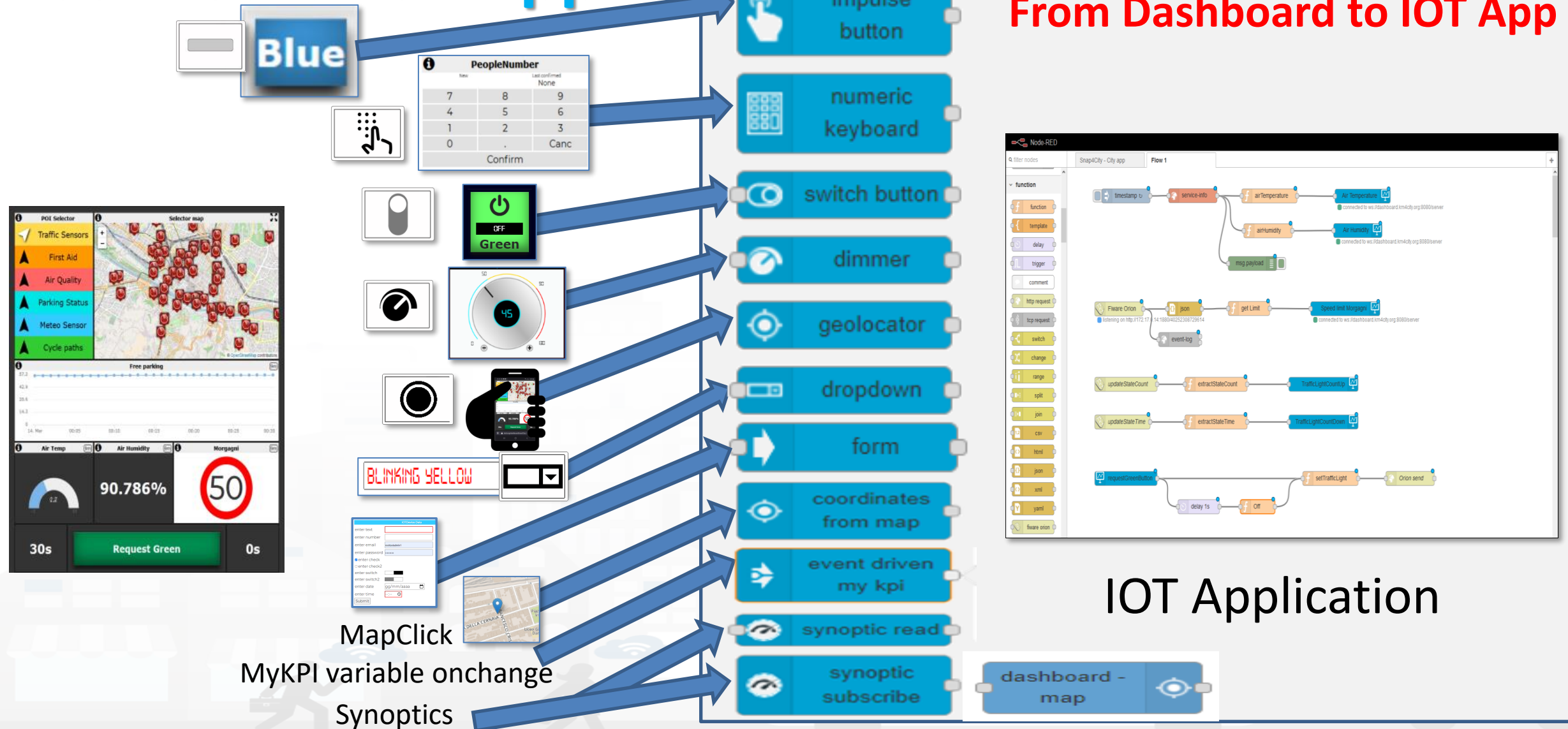
- **Widgets:**

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

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



Dashboard-IoT App

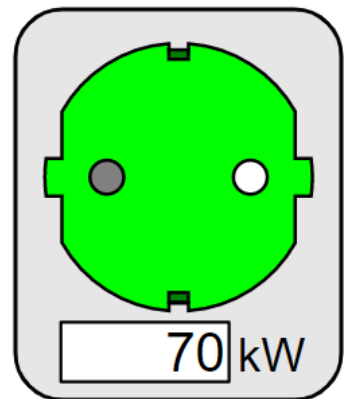




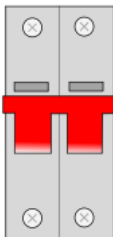
SVG Custom Widgets Examples 2

Tue 17 Nov 18:46:47

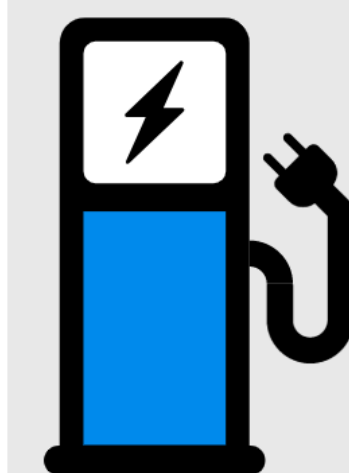
SVG shucko plug



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



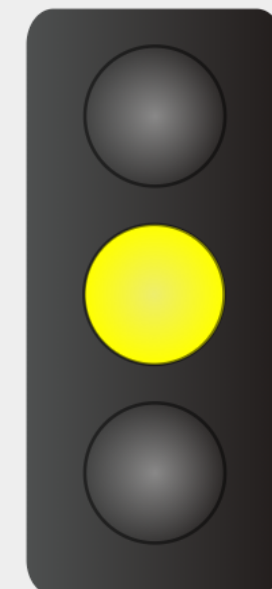
Set tunnel st...



Traffic Light status set

YELLOW LIGHT

Traffic 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

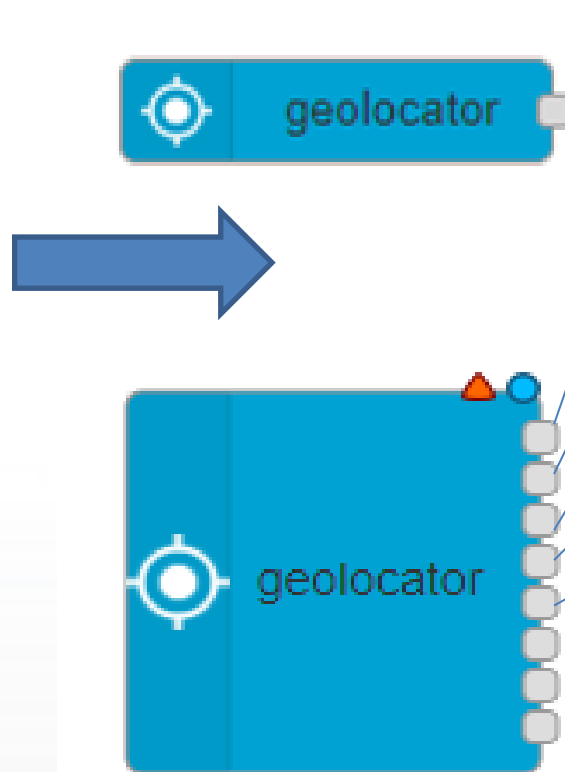
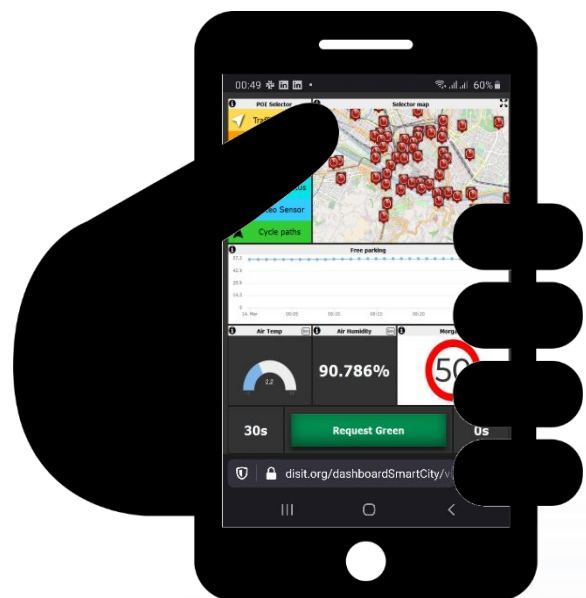
Speed Limit Custom Widget example

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

9999 = white sign.

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

gauge chart

single content

speedometer

horizontal single bar

vertical single bar

web content

time trend

bar series

radar series

pie chart

curved line series

table content

calendar

speak synthesis

synoptic write

Selector - Map

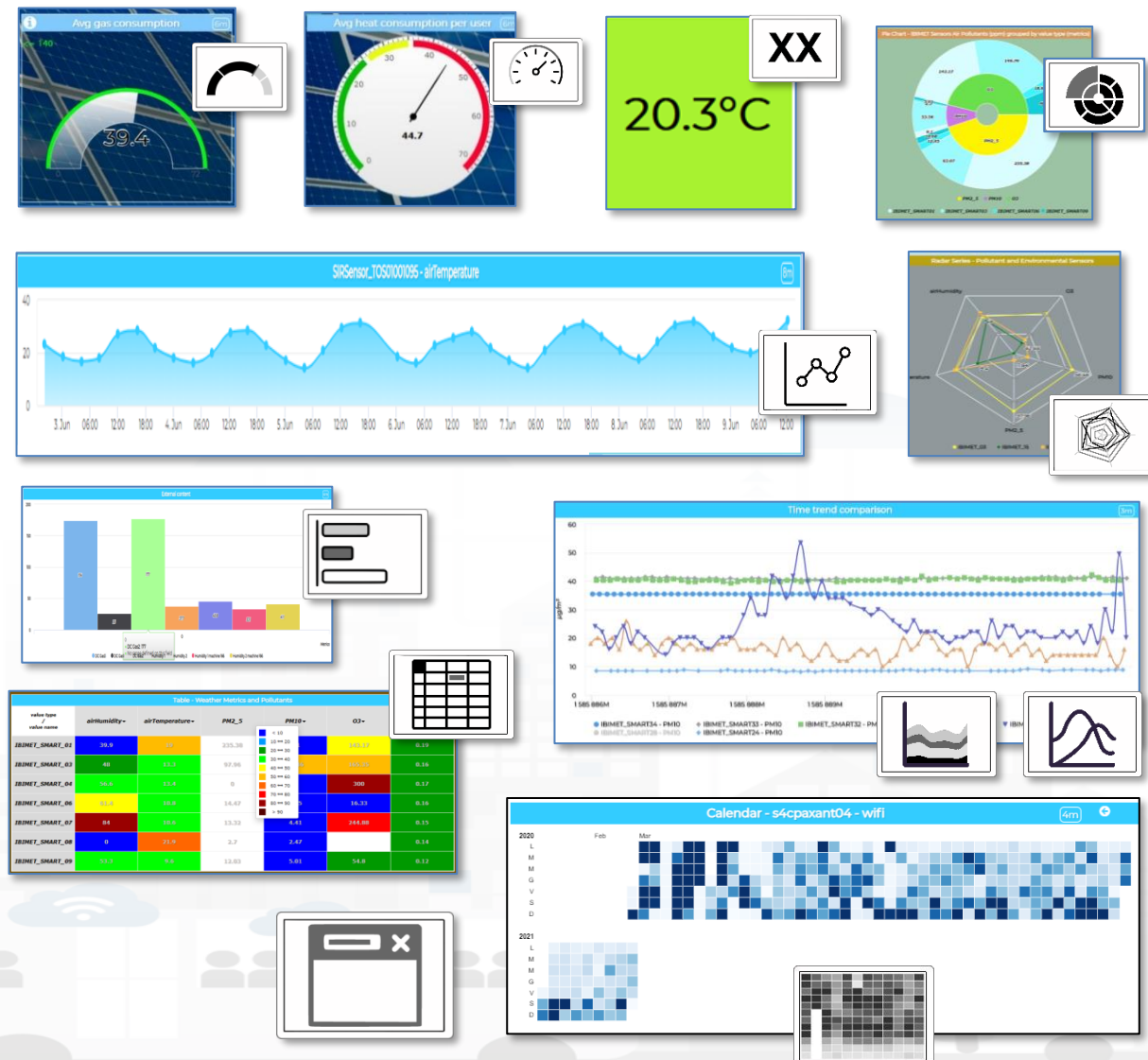
Snap4D3

dashboard - map

event table

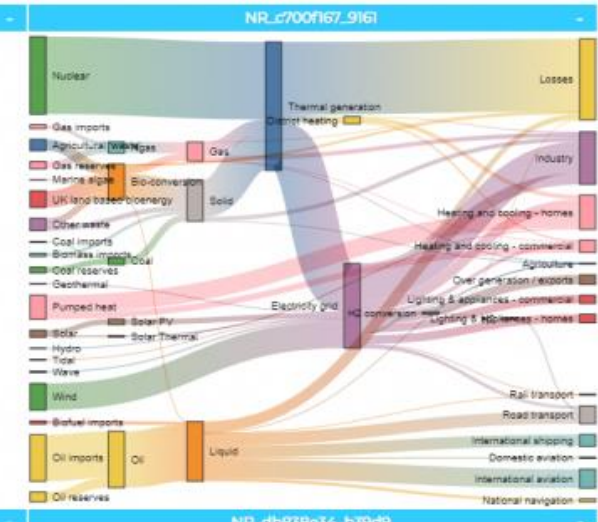
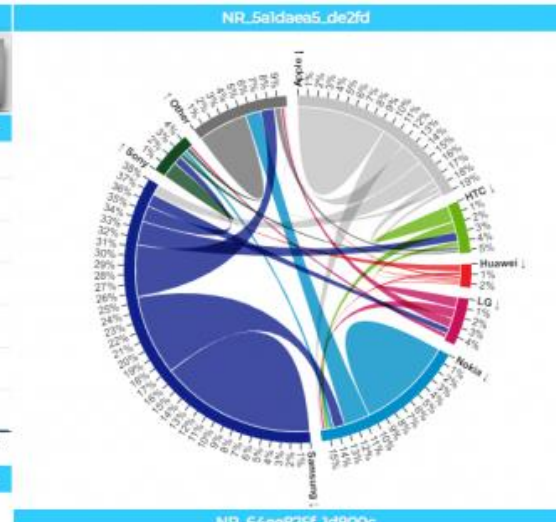
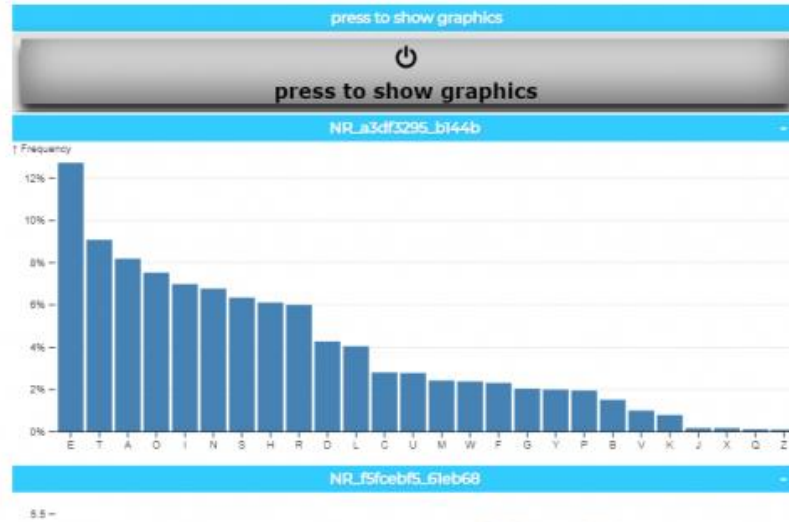
device table

IOT Application

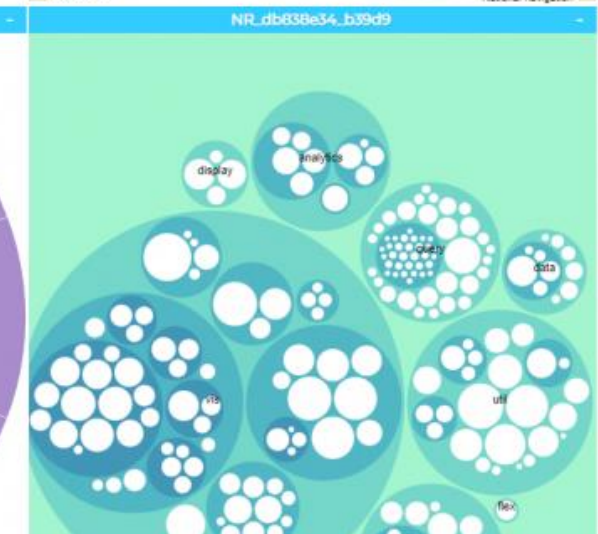
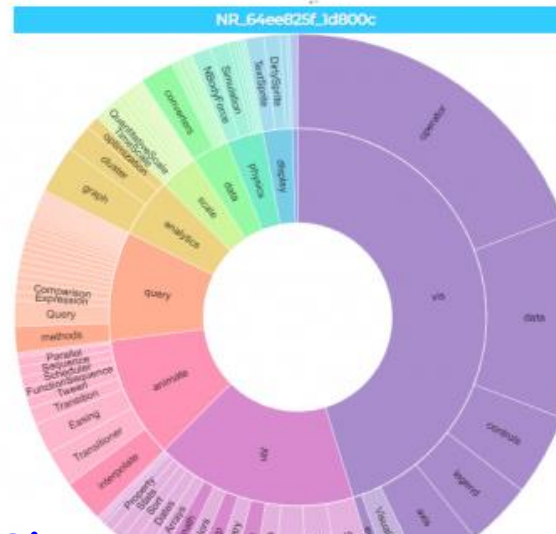
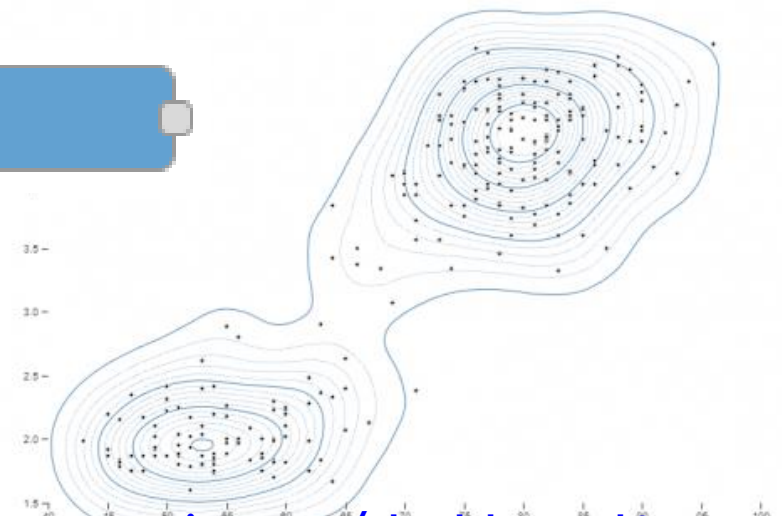


D3 library Example

Fri 10 Jun 19:46:06

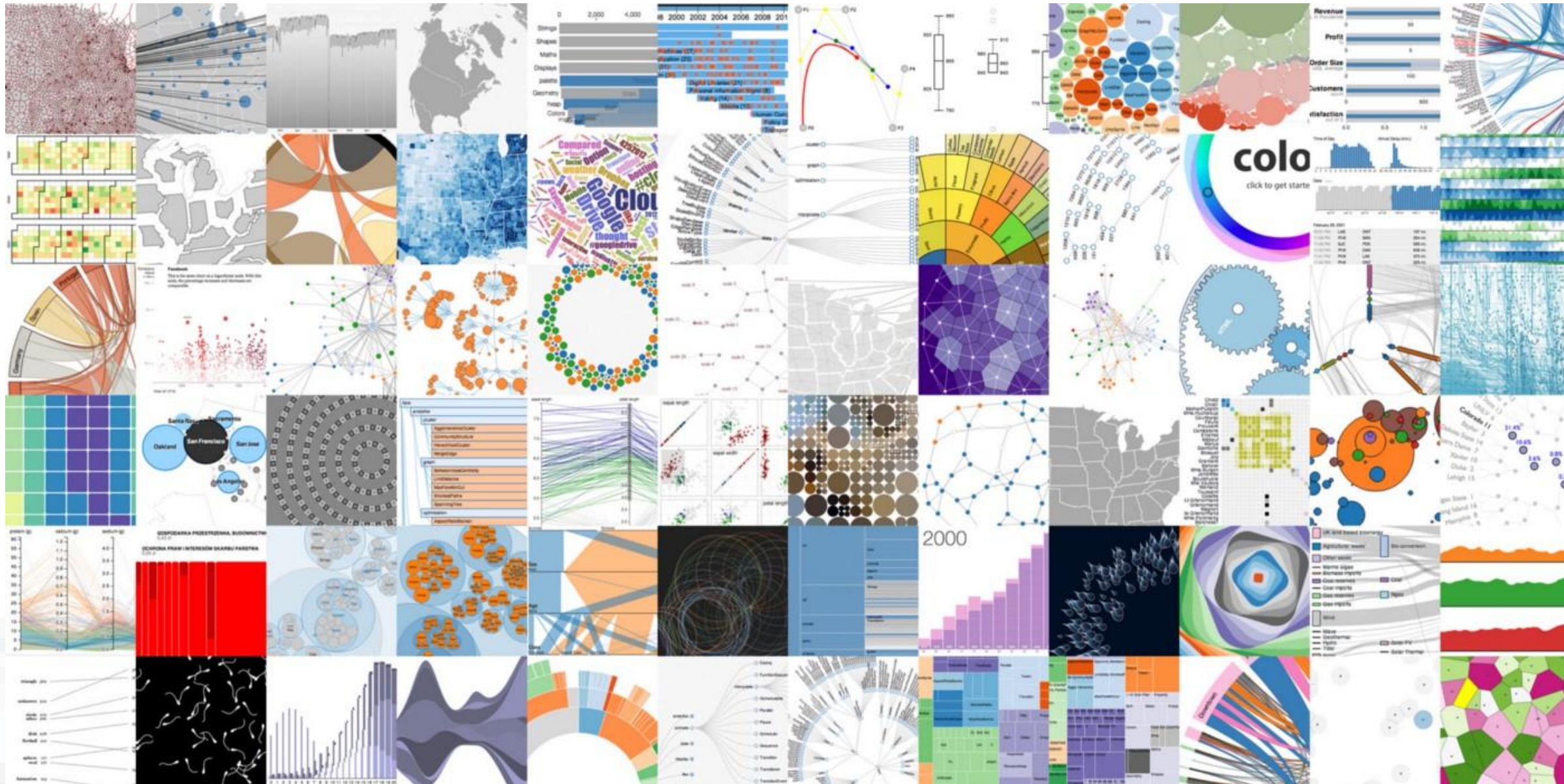


Snap4D3



<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:

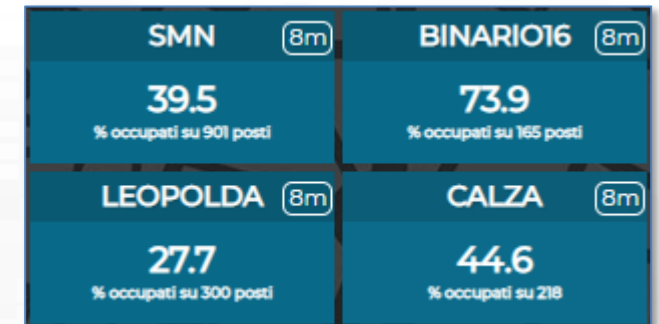
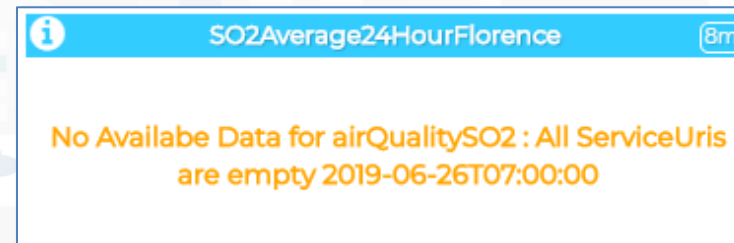
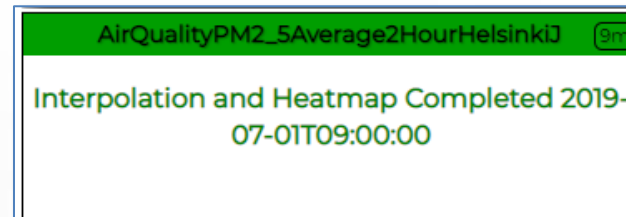
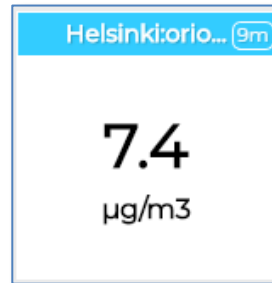
- Numbers
- String
- HTML code



single content



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



Controlling Single Content Wdgs from IoT App

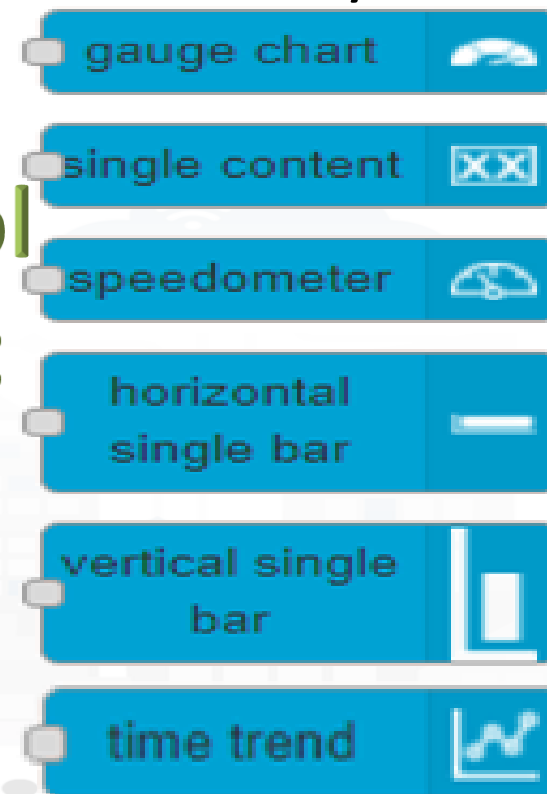
```
{  
  "metricId": [The ID of a KPI], // or [Service Uri Of A Sensor]  
  "metricHighLevelType": "MyKPI", // or "Sensor"  
  "metricName": [The name of the MyKPI], // or [The name of the Sensor],  
  "metricType": [The type of the measure saved in the KPI] // or [A measure recorded by the sensor]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

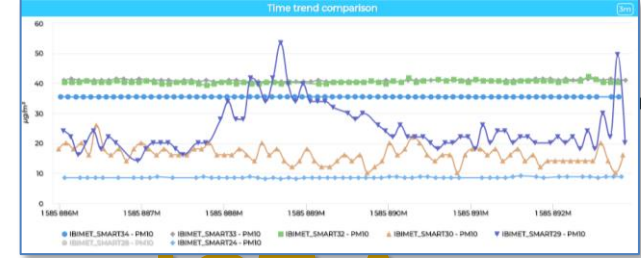
Two examples:

```
{  
  "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"  
}
```

Send Control
The Widget
will get the
data from
storage

Similarly





<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



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



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"]

}



ASCAPI

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 ",



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 SURI (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 SURI and ID

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

TOP

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


Node-RED



Maps Business Logic vs IOT Apps

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

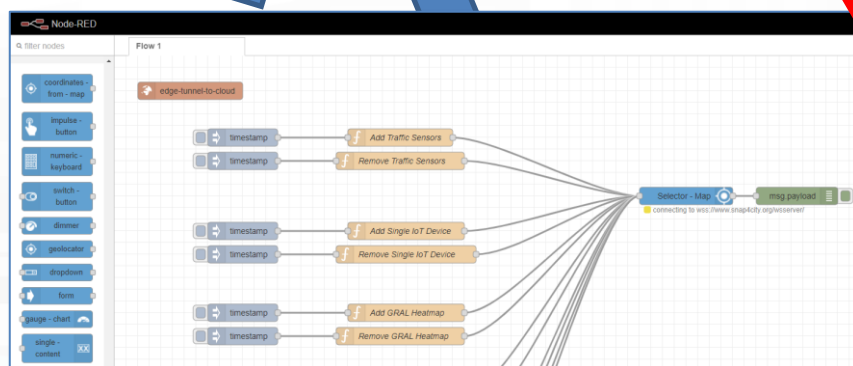
data

Selector

Data, changed data
References, commands,
selectives, selections

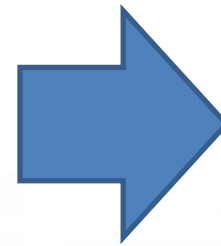
selections, positions, ServiceURI

data

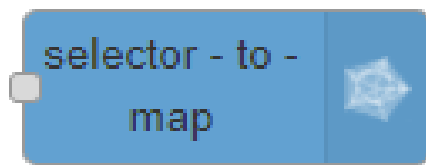


IoT App, Node-RED nodes: IoT App vs Dashboards

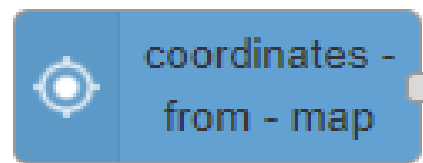
- **Coordinates From Map:**
 - Get GPS click from Map
 - Get Selected ServiceURI from Map
- **SelectorMap:**
 - Send commands, references, data to Maps



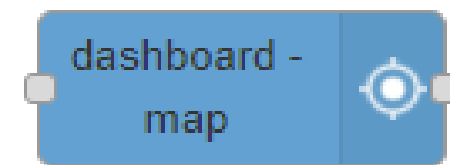
- **Dashboard Map provides:**
 - All Features of
 - Coordinate From Map:
 - SelectorMap:



+



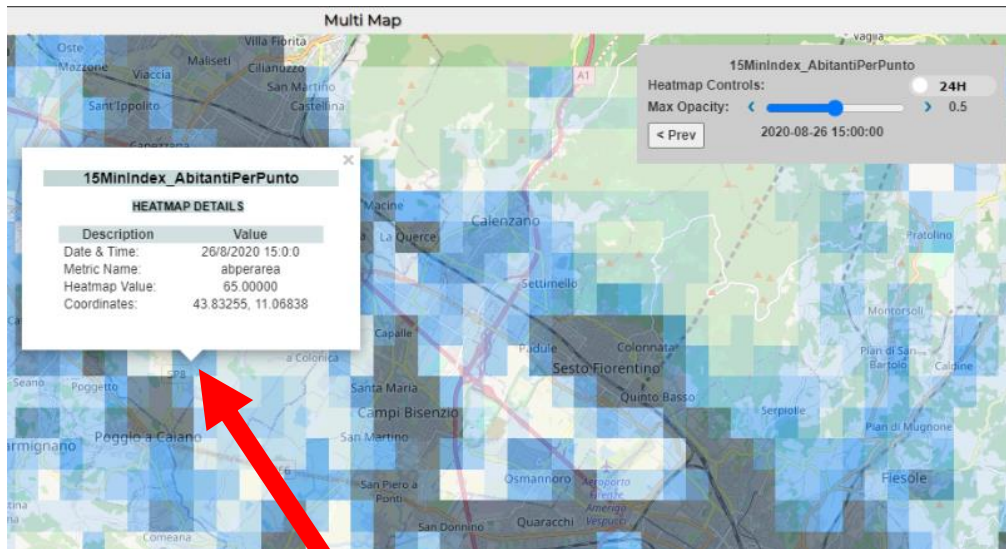
= =



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



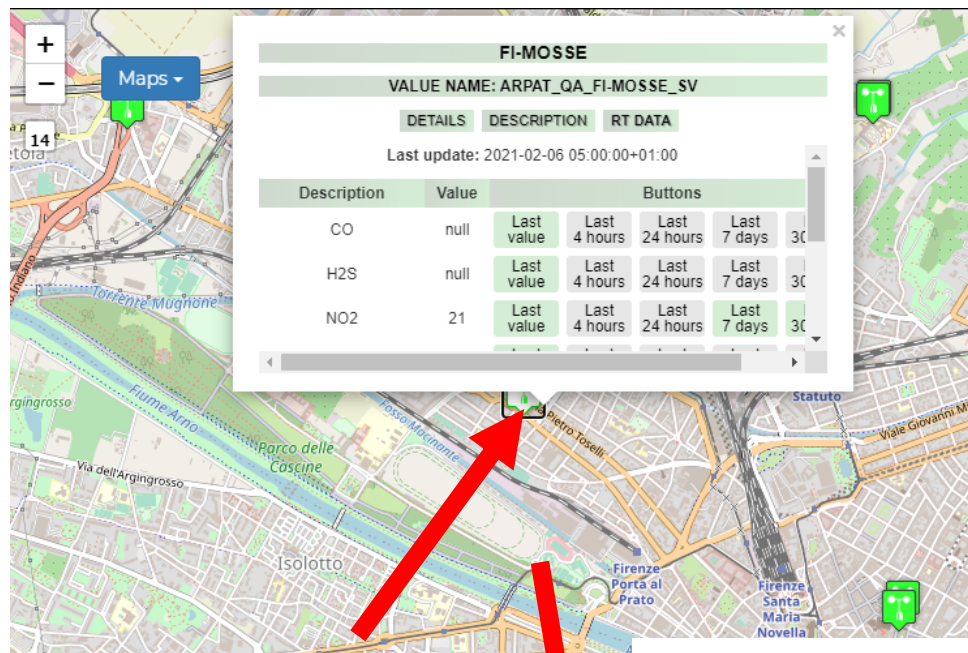
1) Click

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.

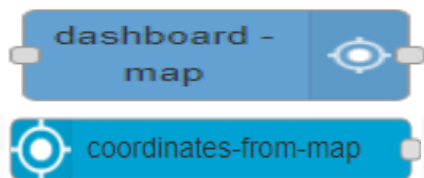
Multi Data Map ServiceURI selection vs IOT App



1) Click on PIN

2) GET event with:

- Lat,Long
- **ServiceURI**

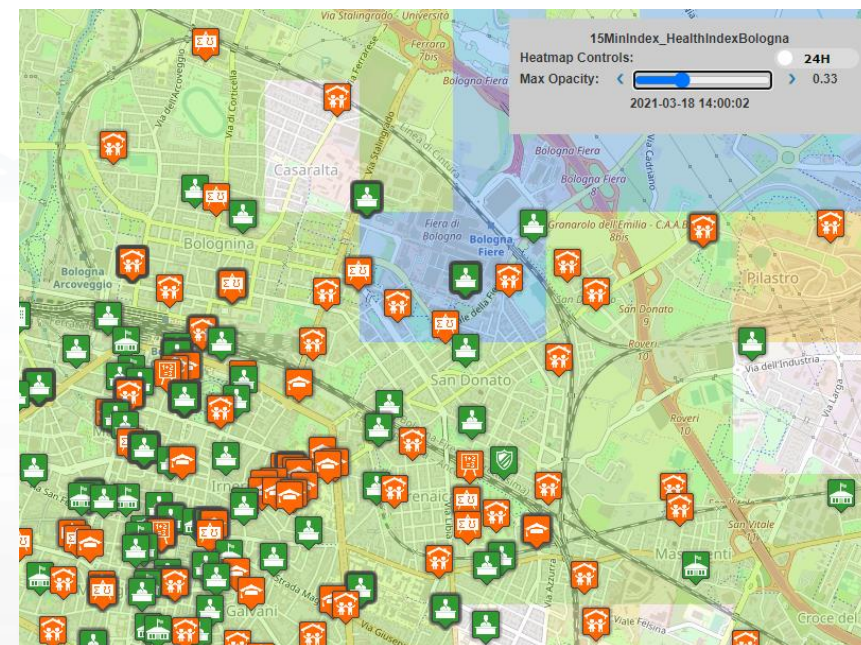
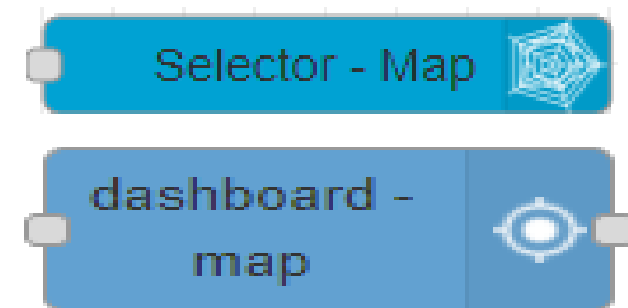


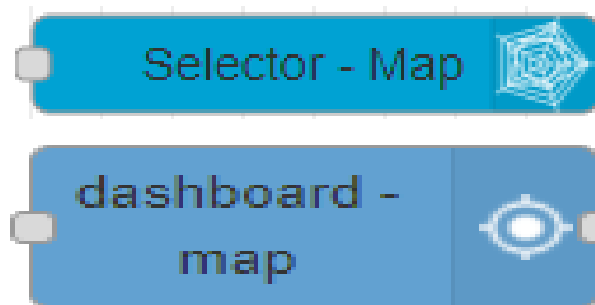
- 3) The click on the map passes GPS coordinates into IOT App and the ServiceURI. Thus you can use them to:
 - search for location
 - picking the value of one or more heatmaps
 - dynamically change data on widgets and dashboards
 - **Get all the ServiceURI information and exploit them on Business Logic**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

Selector Map

Controlling Maps from IOT Apps

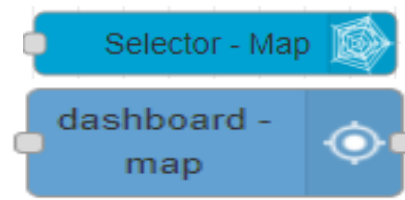
- User manual: <https://www.snap4city.org/774>
- To control Multi Data Map from IOT App
 - Add/remove a Category/SubCategory of Entities, via *more option query*
 - Add/remove a single Device/PIN, MyPOI, MyKPI, Dynamic Pins, moving devices, etc.....
 - Add/remove cycling paths
 - Add/remove OD Matrix
 - 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;
```

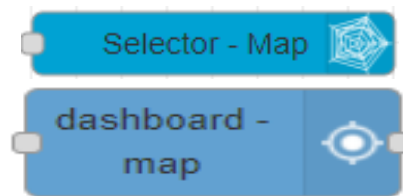
Add MyKPI
Add MyPOI



```
msg.payload = {  
  "type": "addHeatmap",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData": "https://wmsserver.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  
}
```

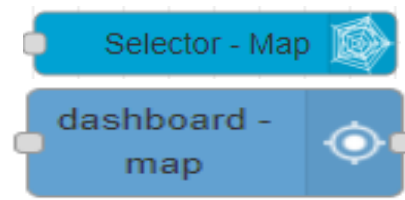


```
payload : {  
  "type": "addOD",  
  "target": "w_Map_956_widgetMap32131",  
  "passedData" : "https://odmm.snap4city.org/api/get?precision=communes&from_date=2017-10-  
19%2000:00:00&organization=Tuscany&inflow=True&longitude=11.257123947143556&latitude=43.77183756282  
1375",  
  "passedParams": {  
    "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

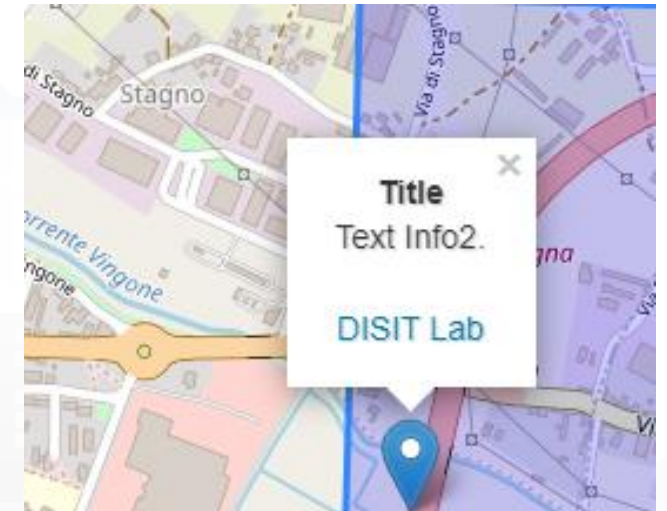


```
payload : {
  "type": "addGeoInfoPin",
  "target": "w_Map_956_widgetMap32131",
  "passedData": [{
    "id": "GeoInfoPin-01",
    "eventType": "GeoInfoPin",
    "textHtml": "<b>Title</b><br>Text Info2.<br><br><a href='http://www.disit.org/' target='_blank'>DISIT Lab</a>",
    "lat": " 43.76950",
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

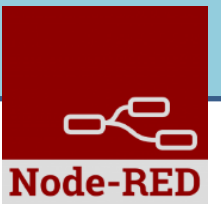


TOP

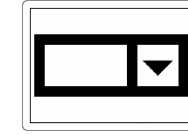
Selector and Forms vs IOT App data

Getting data from Dashboards

- Processing Logics / IOT App ▴
- Processing Logics / IOT App
- 👤 MicroServices for Proc.Logic/IoT App
- 👤 MicroServices from DataAnalytic
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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

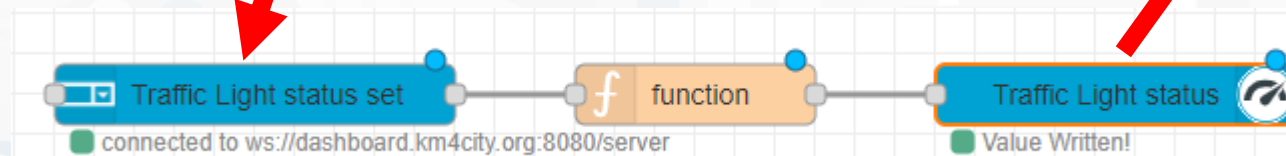
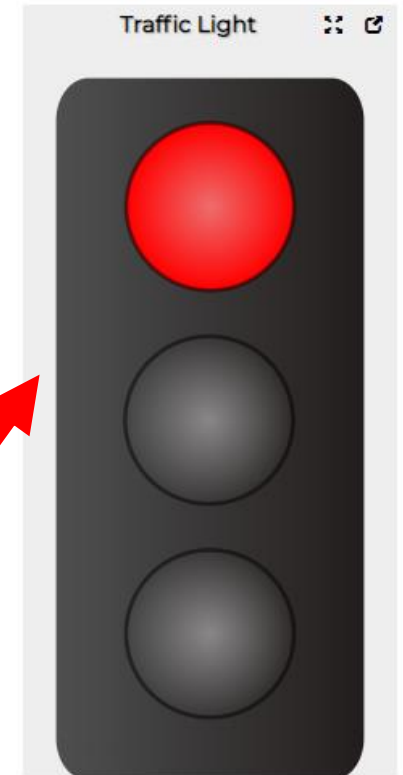
YELLOW AND GREEN LIGHTS

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

enter number

enter email

enter password

☒ enter check

☐ enter check2

enter switch

enter switch2

enter date

enter time

Submit

☒

☐

gg/mm/aaaa

--:--

⌚

Snap4City (C), May 2024

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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	a text
enter number	123
enter email	paolo.nesi@unifi.it
enter password	
☒ enter check	
☐ enter check2	
enter switch	☐
enter switch2	☐
enter date	19/03/2021
enter time	09:38
Submit	

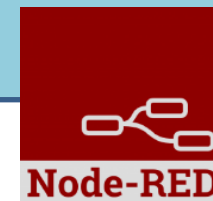
"selected": ["a text", "123", "paolo.nesi@unifi.it", "aaaaaa", "checked", "", "on", "", "2021-03-19", "09:38"]

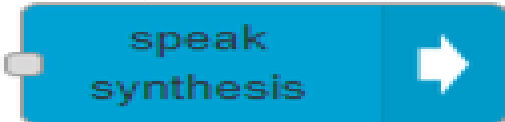
TOP

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

Dashboard Name
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

Text of the message to be sent

rate

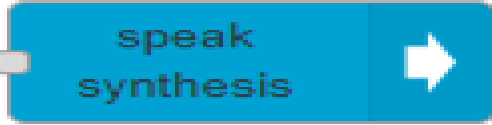
Speed of execution. 1 is the default value

pitch

Running tone. 1 is the default value

lang

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
 - ..



speech
synthesis



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
 - ..



Play

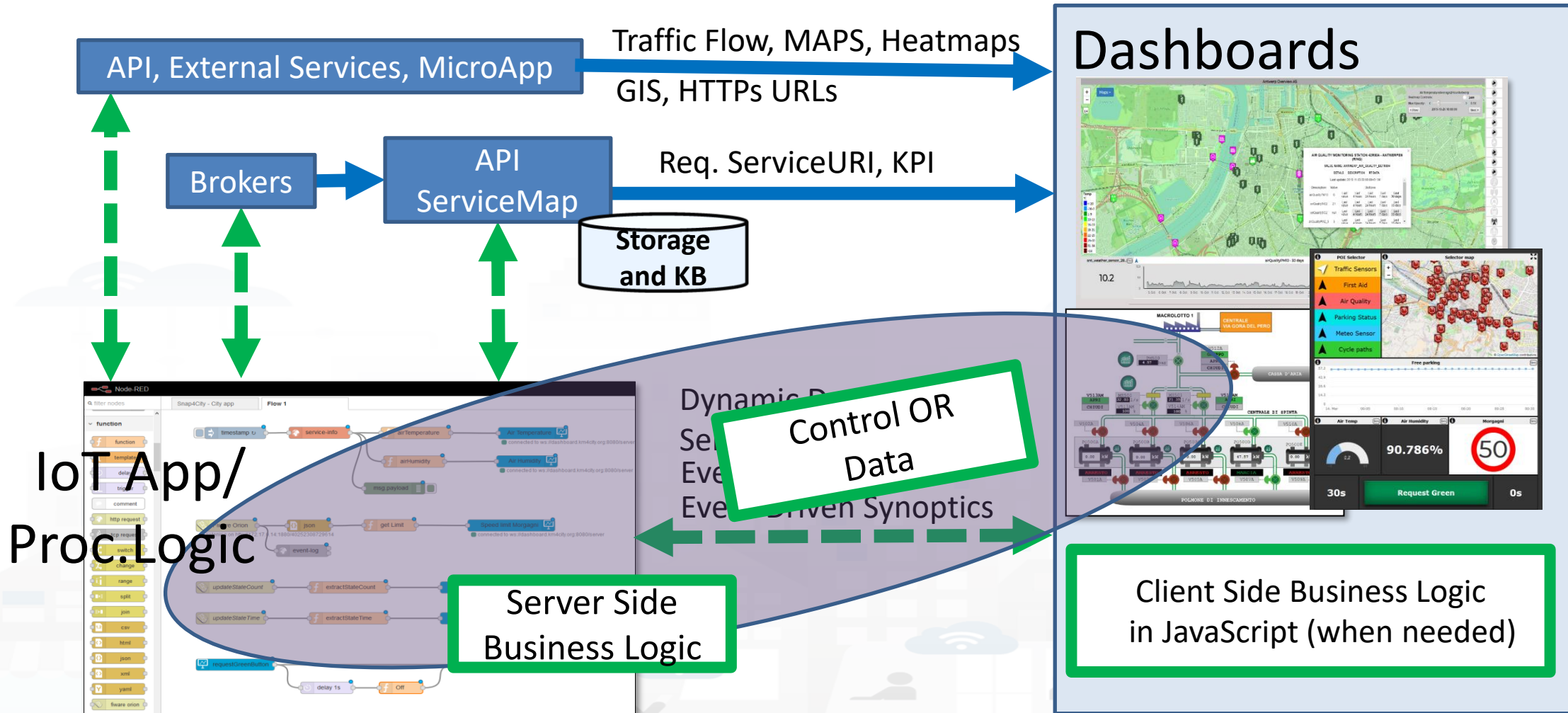
TOP

Dynamic Widgets data on Dashboard from IOT Applications

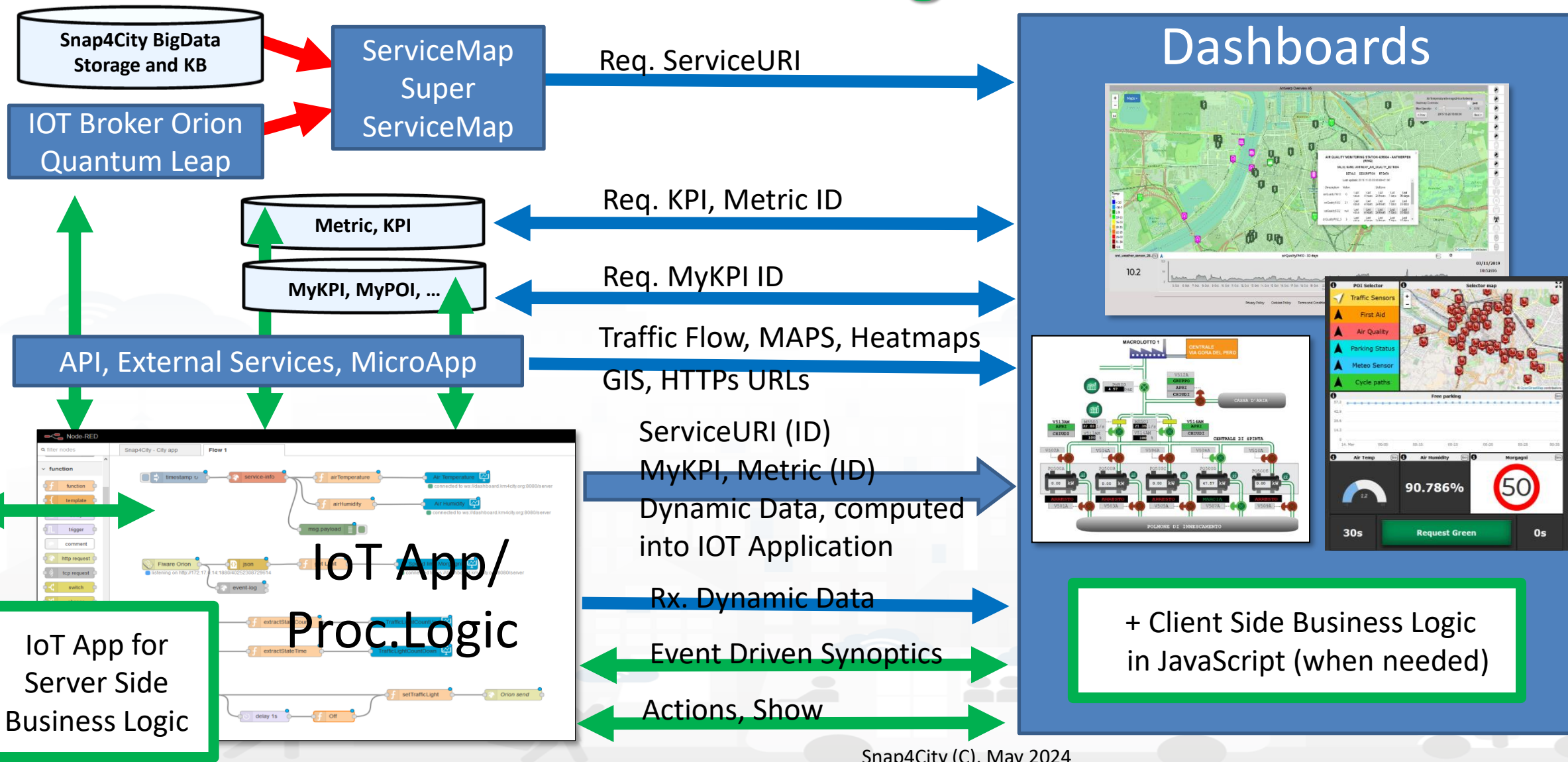
- Processing Logics / IOT App ▲
- Processing Logics / IOT App
- 👤 MicroServices for Proc.Logic/IoT App
- 👤 MicroServices from DataAnalytic
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How the Dashboards exchange data



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 it stored into Sensor or MyKPI variable, etc.
 - **CS, widget supports Change (data) Source**, in the sense that: from the IoT App it 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 ▴
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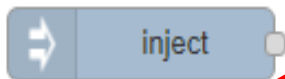


Example of complex IOT Application

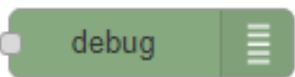
In this demo let's create an IoT Application that:

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

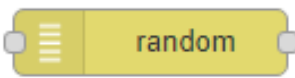
Nodes for flow



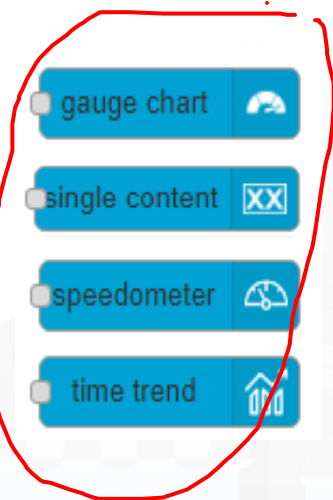
Generates an input for the other nodes. It can be repeated at predefined intervals, entered manually and of various types (timestamp, string, number, boolean, JSONetc)



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



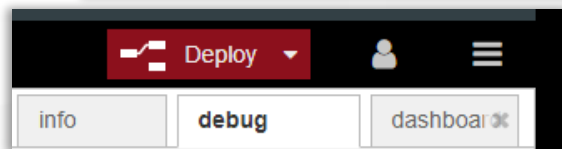
- Connect

- Configure

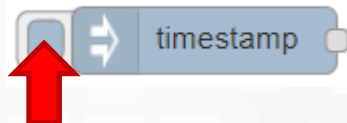
☒ Payload timestamp

☒ Repeat interval
 every minutes
☒ Inject once at start?

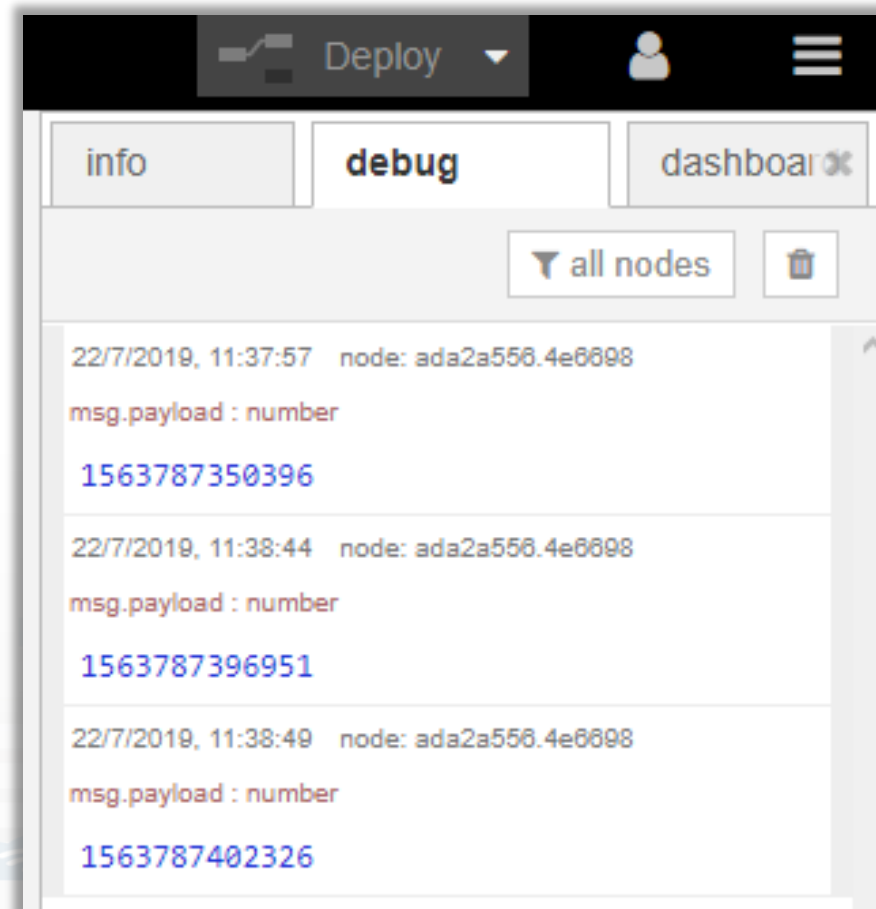
- Deploy



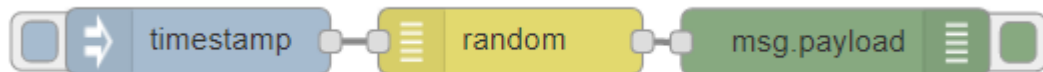
- Click



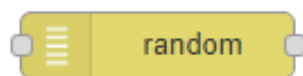
- Observe



Step 2



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



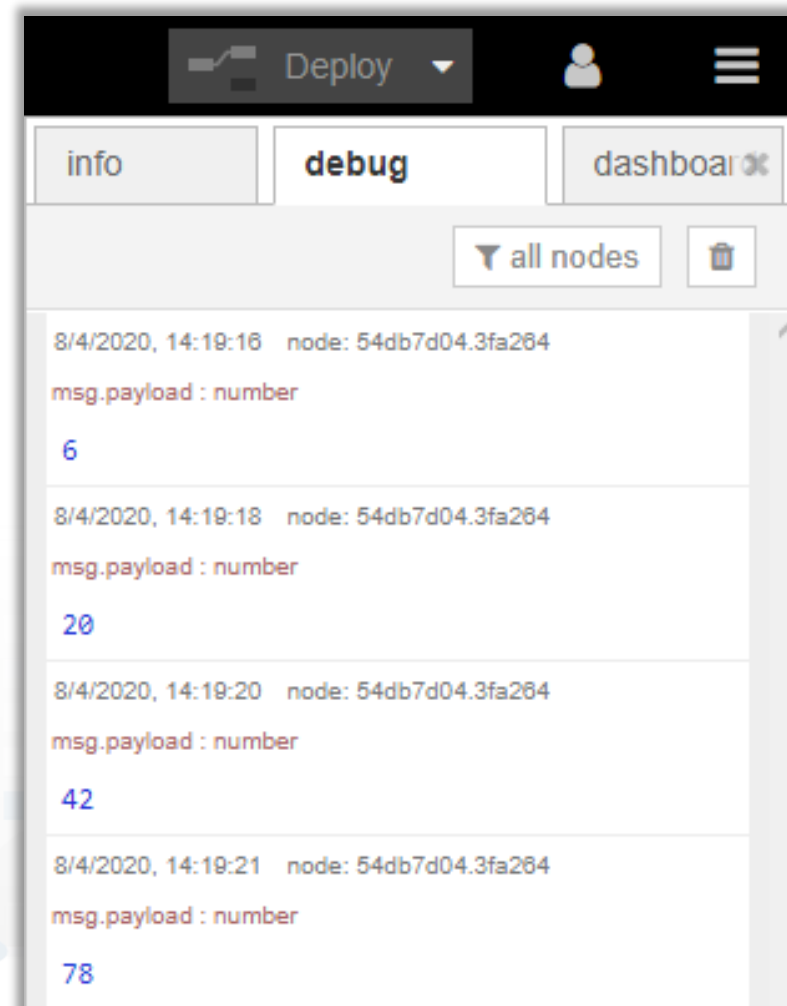
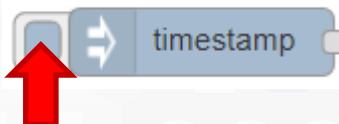
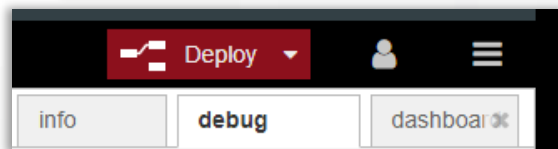
msg.payload

Generate: a whole number - integer

From: 1

To: 100

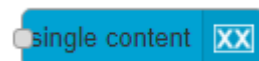
Name: Name



Step 3



- Single content



- Connect

- Configure

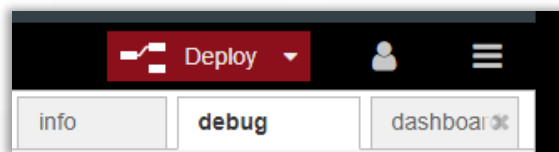
Dashboard configuration dialog:

Dashboard Name: DemoTrainingCourse2020 Create New

Widget Name: SingleContent - Random Value

Edit Dashboard View Dashboard

- Deploy



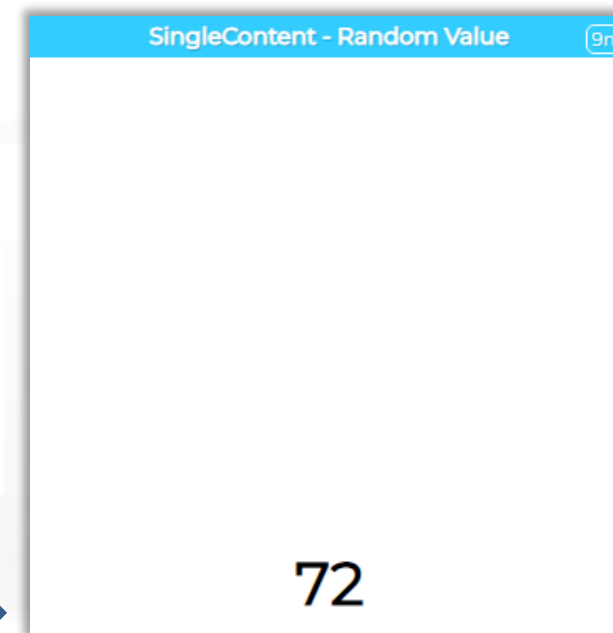
- Click



- 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

gauge chart

single content

speedometer

time trend

Dashboard Name DemoTrainingCourse2020

Widget Name SingleContent - Random Value

random

msg.payload

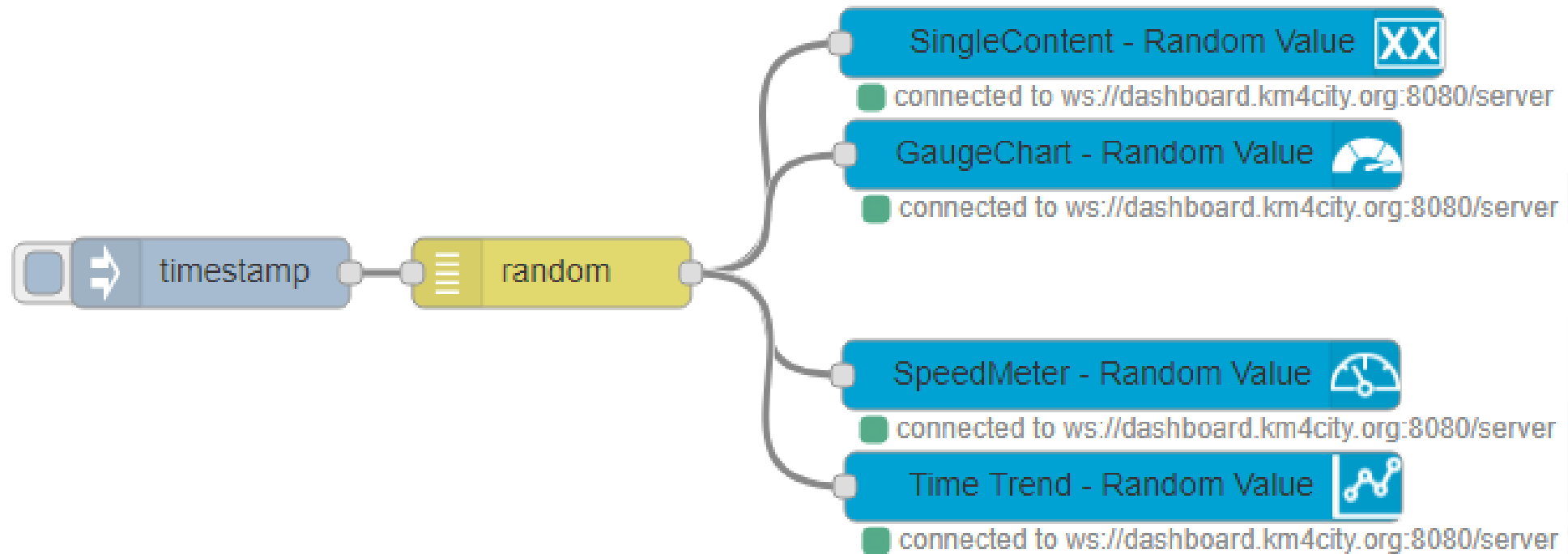
Generate a whole number - integer ▼

From 1

To 100

Name

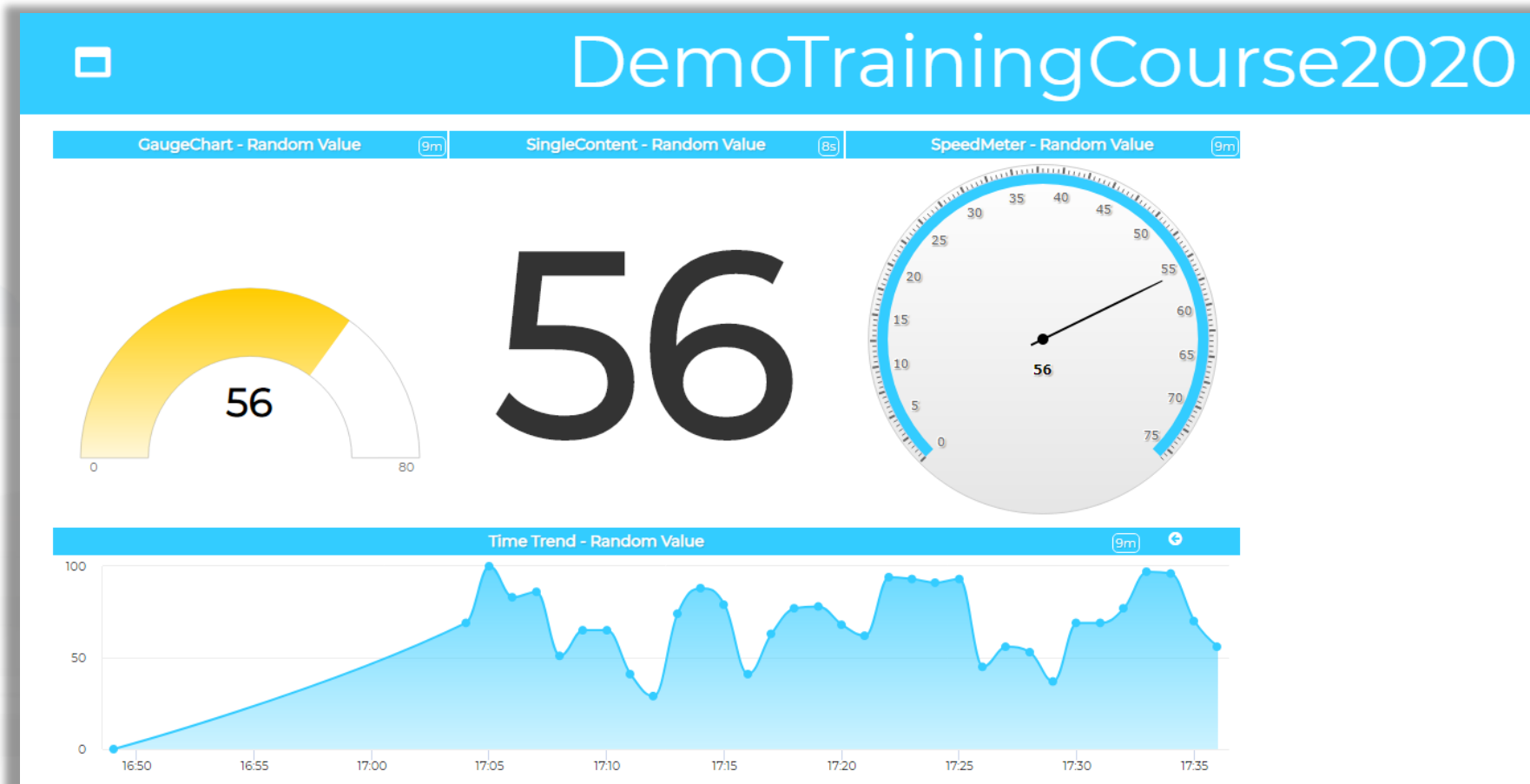
Nodes connections



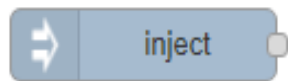
Explaining: IOT Application Flow

- 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.

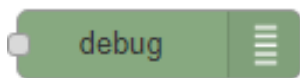
Resulting Dashboard



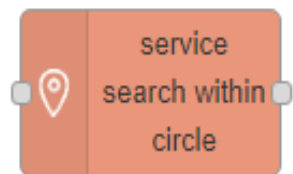
Nodes for flow



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)

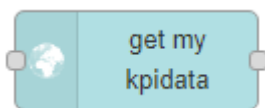


Each message that enters the debug node is shown in the "debug" tab on the right of nodered (you can choose which part of the message to show)



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



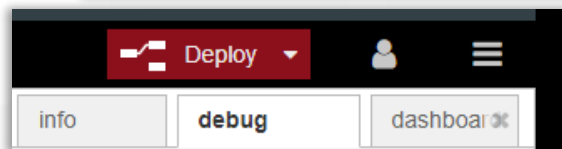
- Connect

- Configure

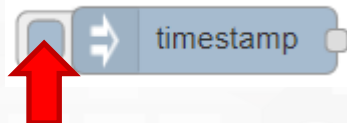
☒ Payload timestamp

☒ Repeat interval
 every minutes
☒ Inject once at start?

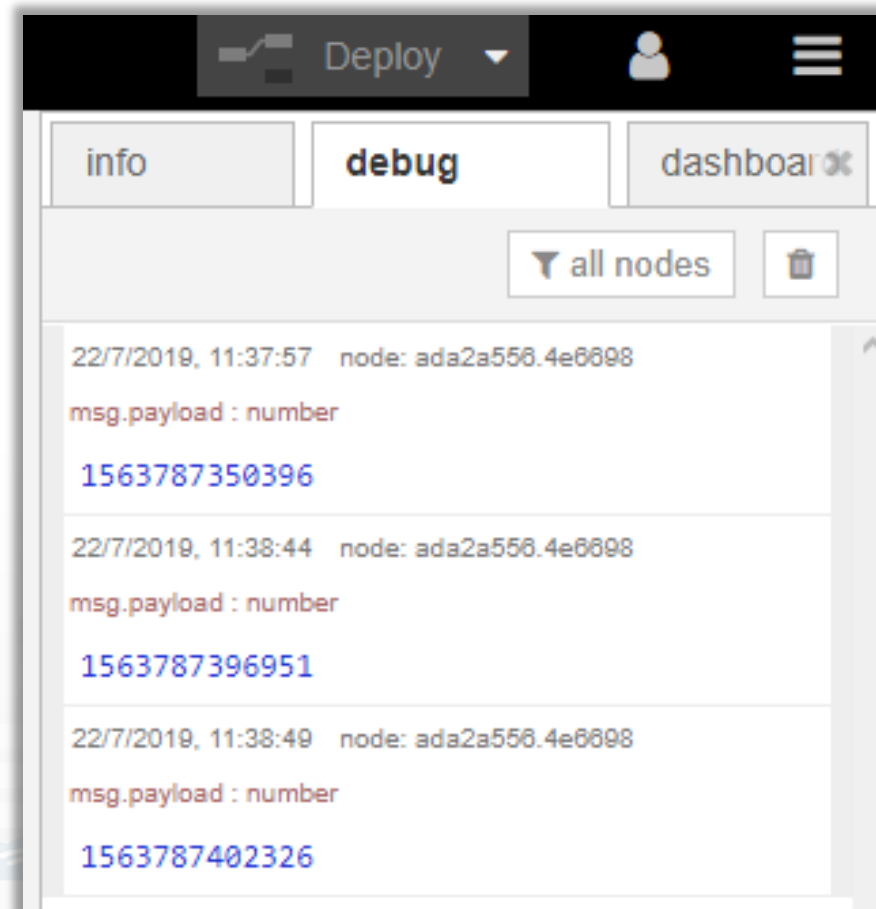
- Deploy



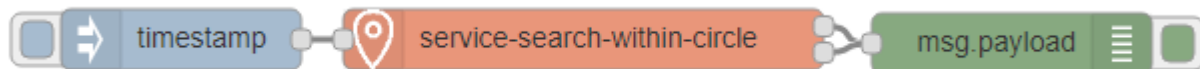
- Click



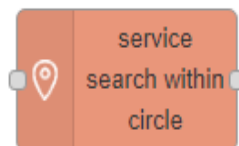
- Observe



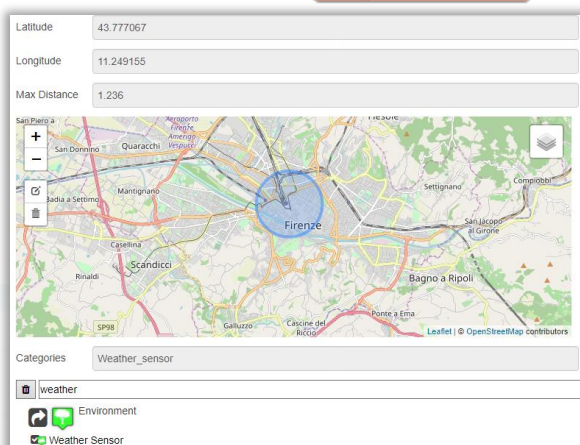
Step 2



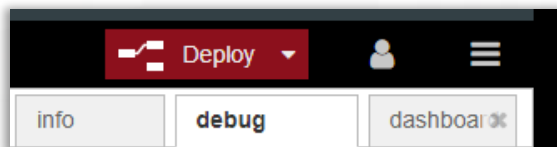
- Service Search Within Circle



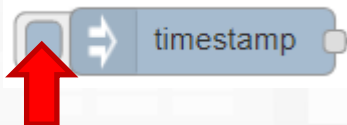
- Connect
- Configure



- Deploy



- Click



- Observe



Copy the path

Copy the value



Step 1 Bis



- Inject and Debug



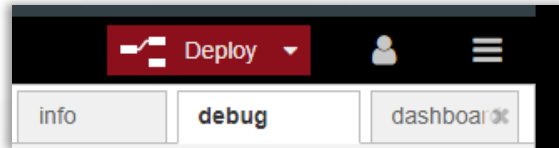
- Connect

- Configure

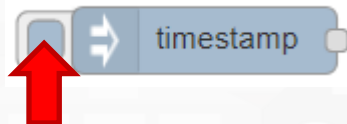
☒ Payload timestamp

☒ Repeat interval
 every minutes
☒ Inject once at start?

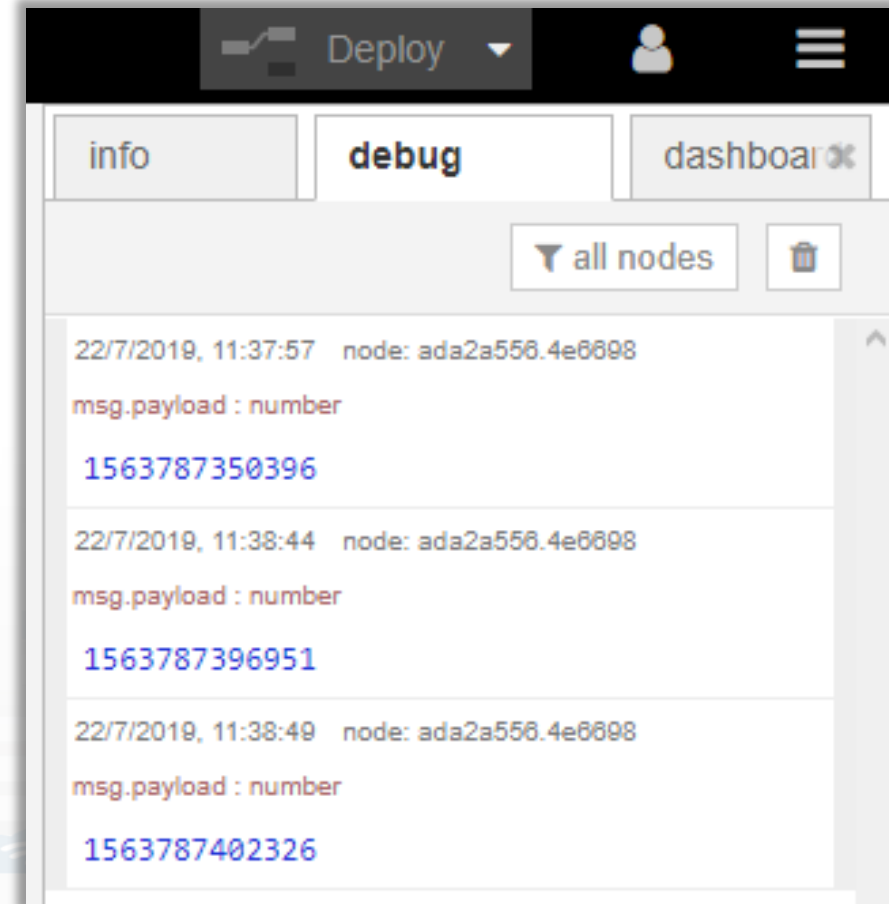
- Deploy



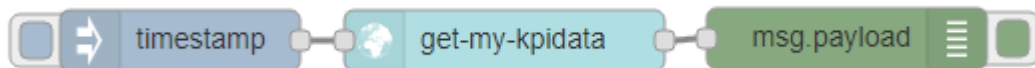
- Click



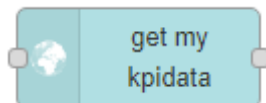
- Observe



Step 2 Bis

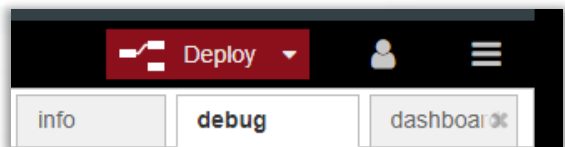


- Get My KPIData

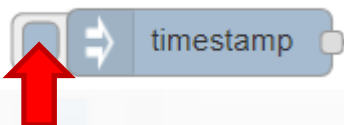


- Connect

- Deploy



- Click



- Observe

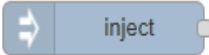


```

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"
  
```

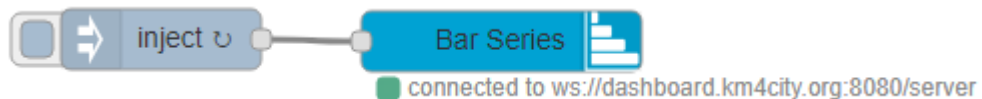
Step 3



- 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

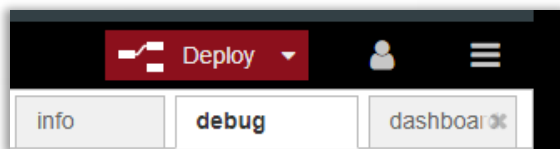
Name: DemoTrainingCourse2020 Create New

Widget Name: Bar Series

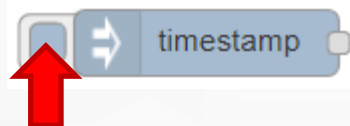
Edit Dashboard View Dashboard

- Configure

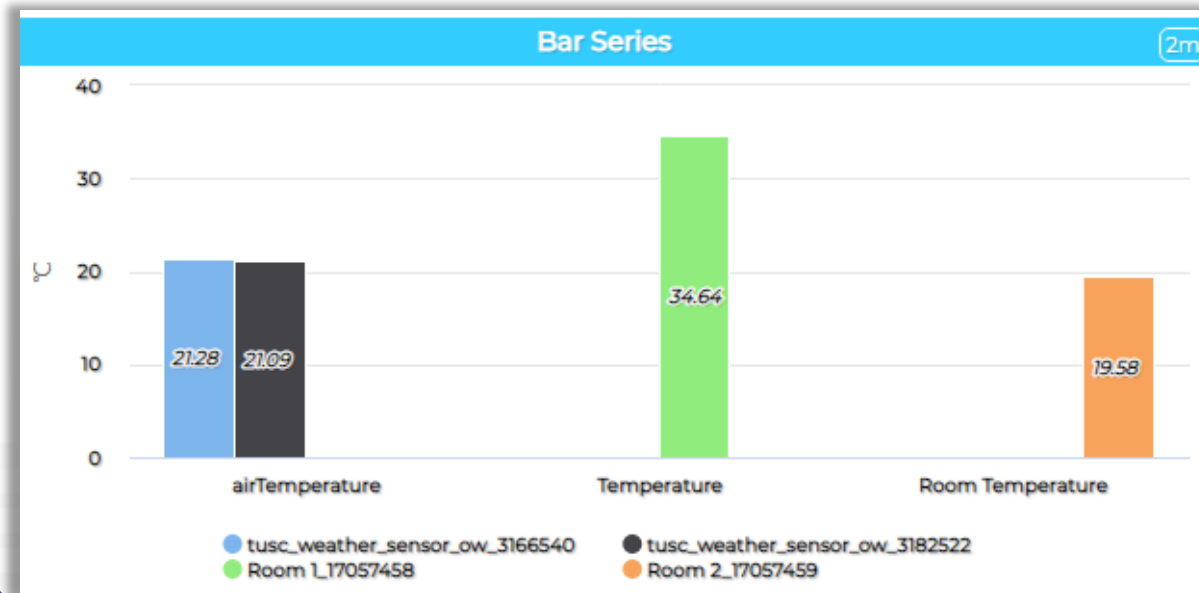
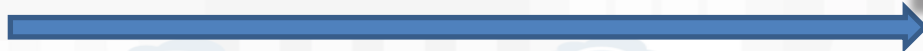
- Deploy



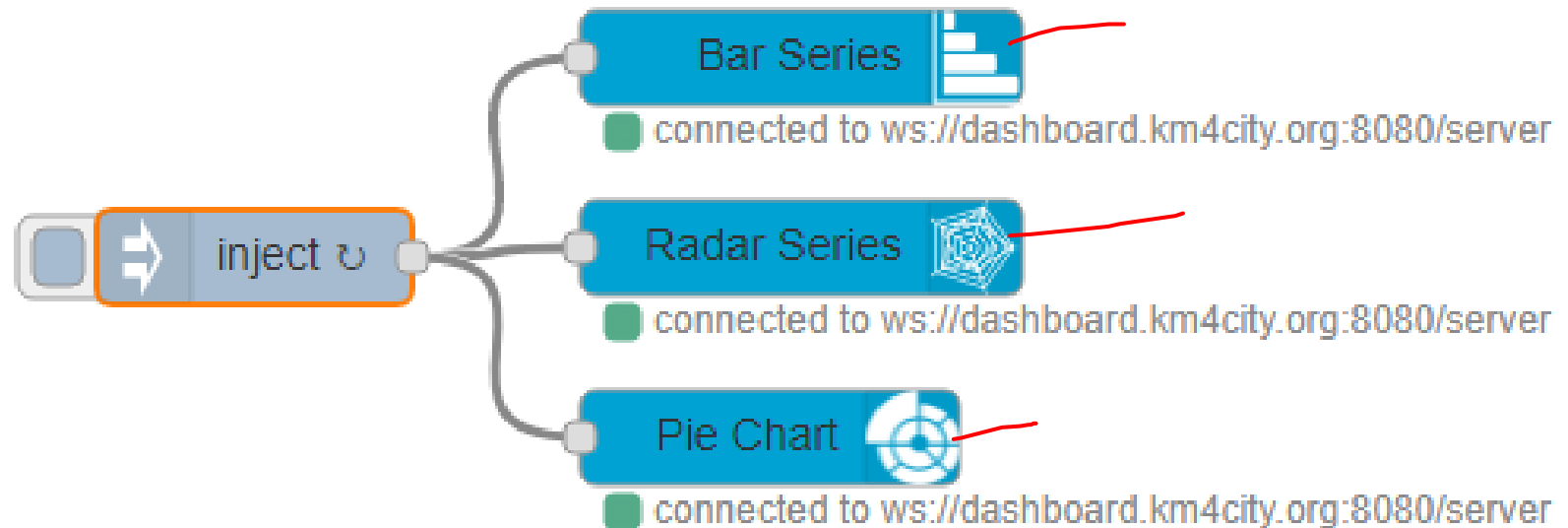
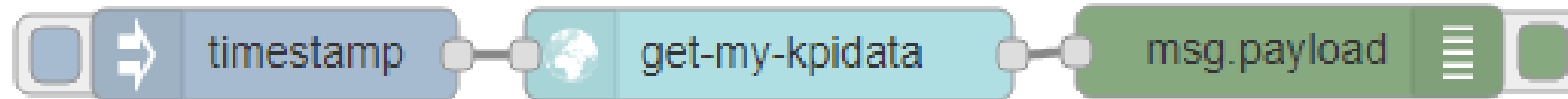
- Click



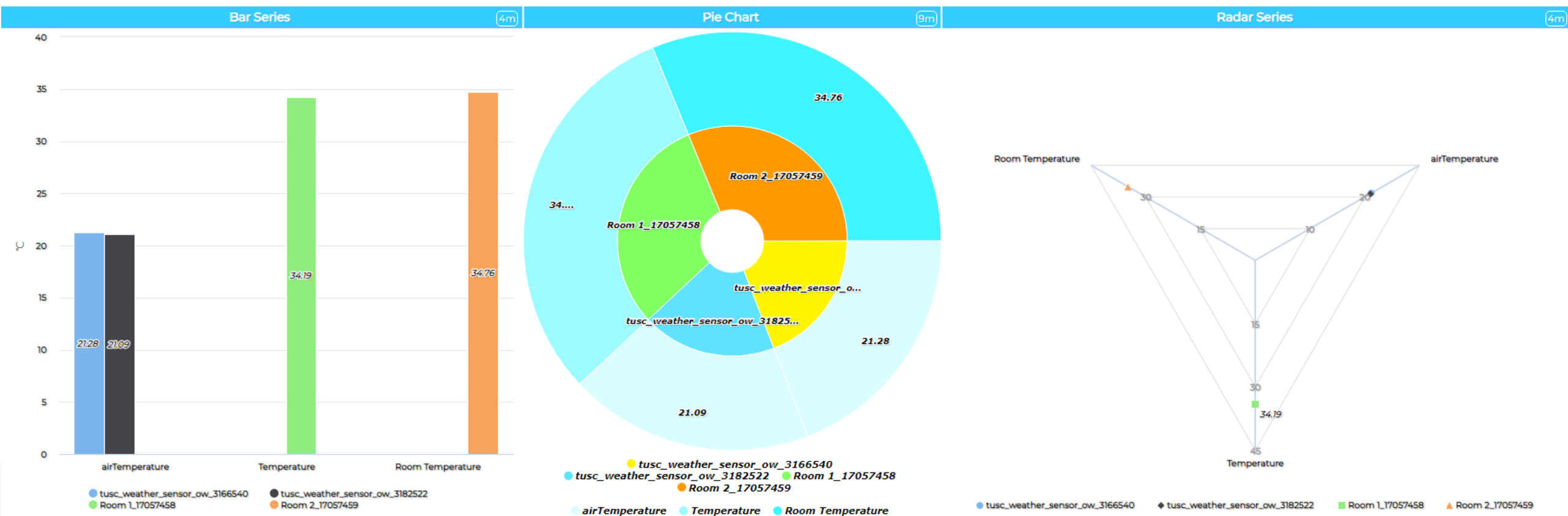
- Observe



Nodes connections



Resulting Dashboard

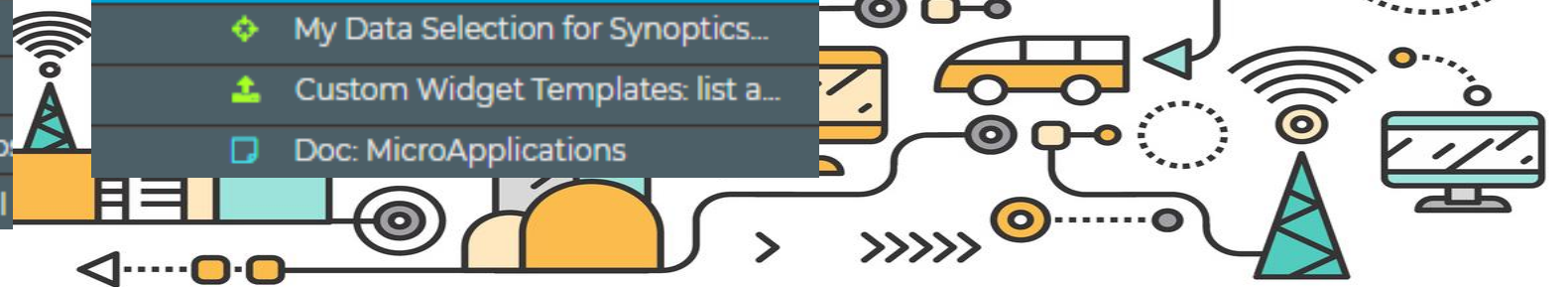
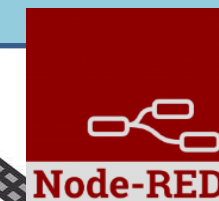


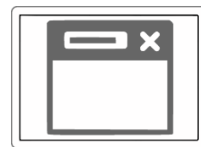
TOP

IoT Application Integration with Synoptics

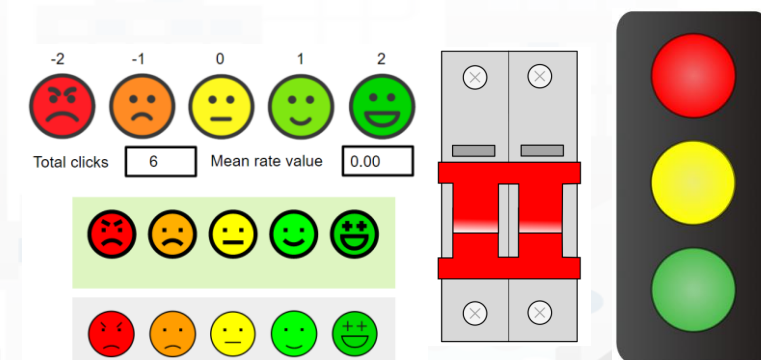
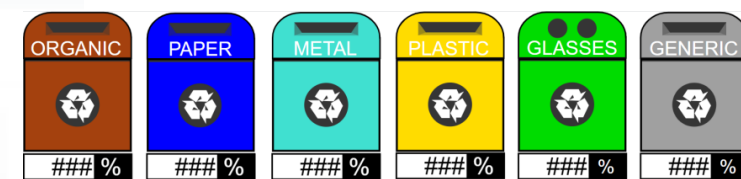
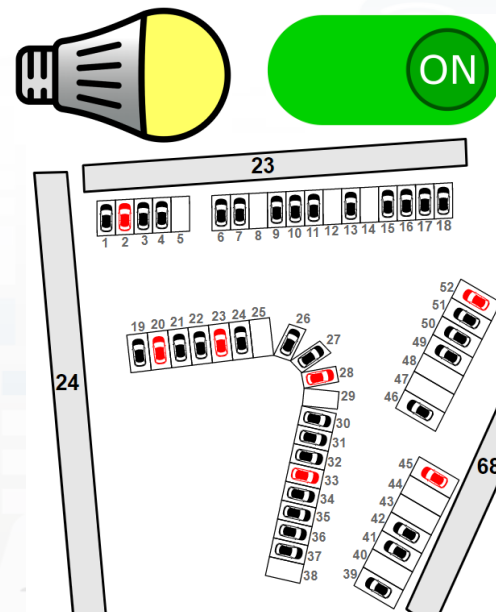
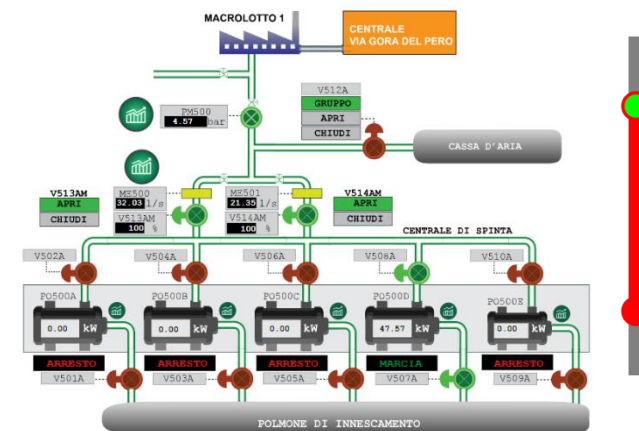
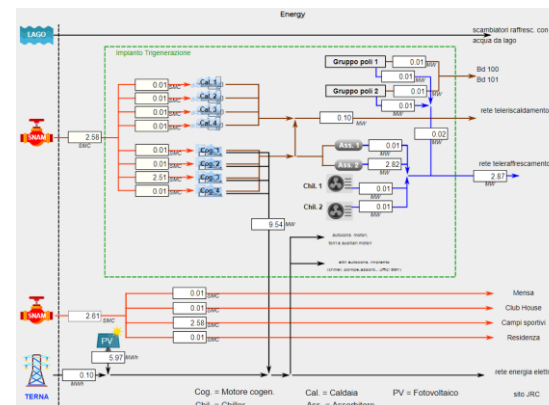
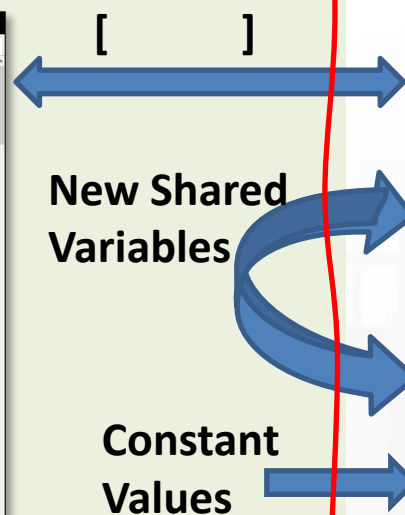
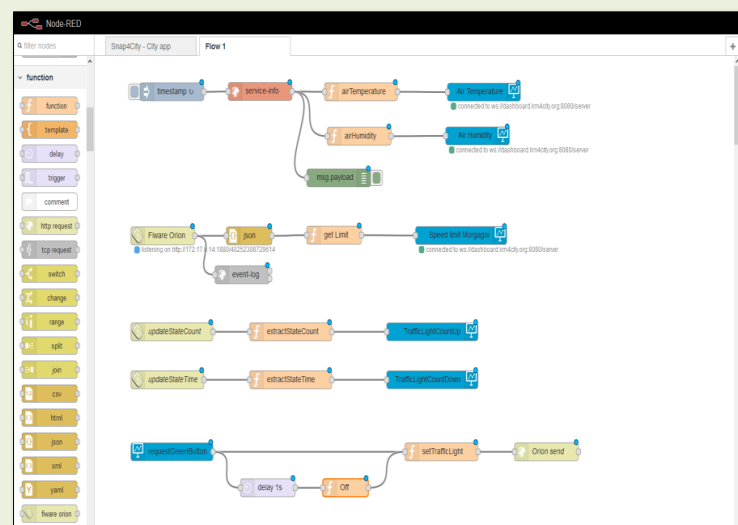
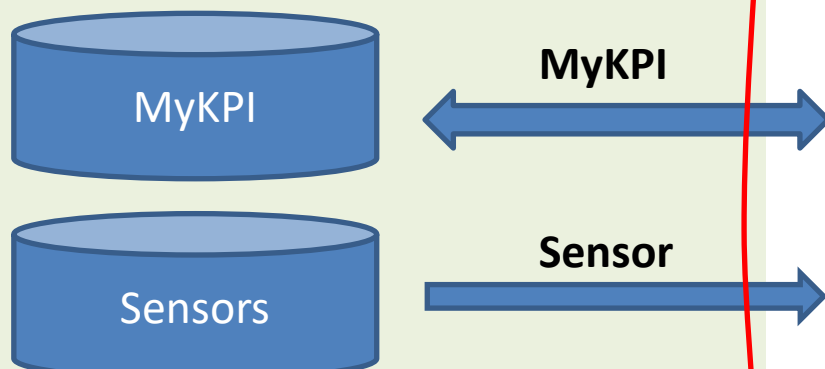
- Processing Logics / IOT App
- Processing Logics / IOT App
- MicroServices for Proc.Logic/IOT App
- MicroServices from DataAnalytic
- IOT MicroServices for Final Users
- IOT MicroServices for Developers
- DOC: Processing Logic/IOT App
- How to Develop Proc.Logic / IoT App
- Create A MicroService from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

- Extra Dashboard Widgets
- Micro Applications
- External Services, WebPages
- Register External Service, WebP...
- Custom Widgets / Synoptics
- My Data Selection for Synoptics...
- Custom Widget Templates: list a...
- Doc: MicroApplications





From-To Custom Widgets / Synoptics to Storage in WS

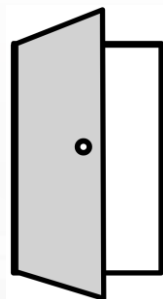
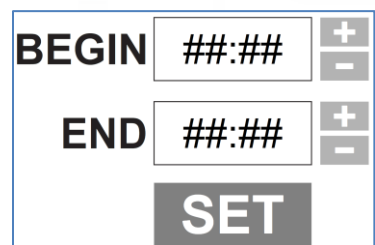
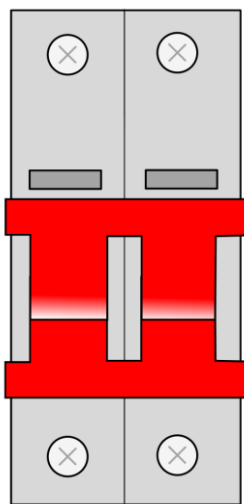


Web Socket Secure

Other examples

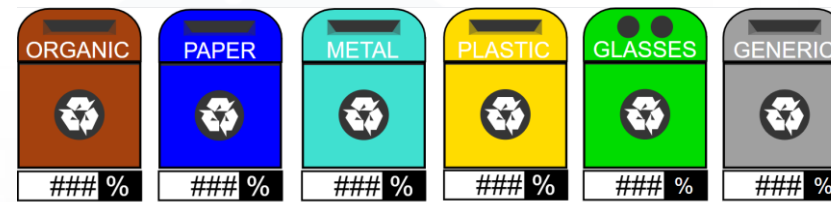
• Virtual Actuators (sensor-actuator)

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

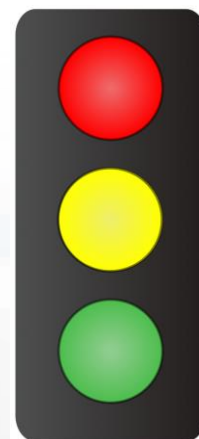
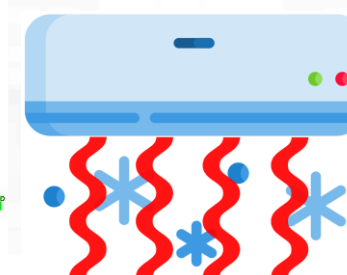


• Virtual Sensors

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



#####.##



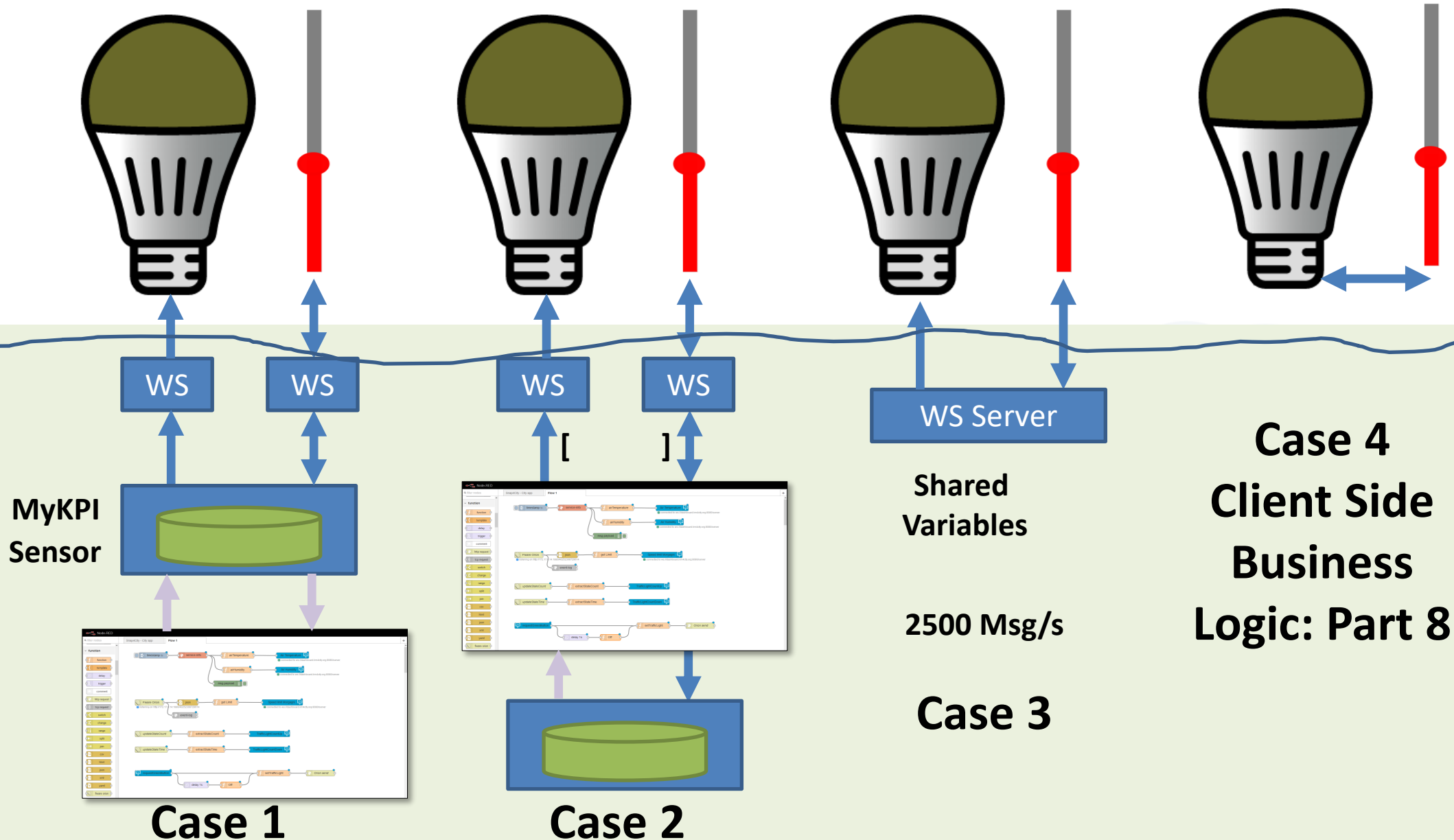
<https://www.snap4city.org/663>



Dashboard
on Browser

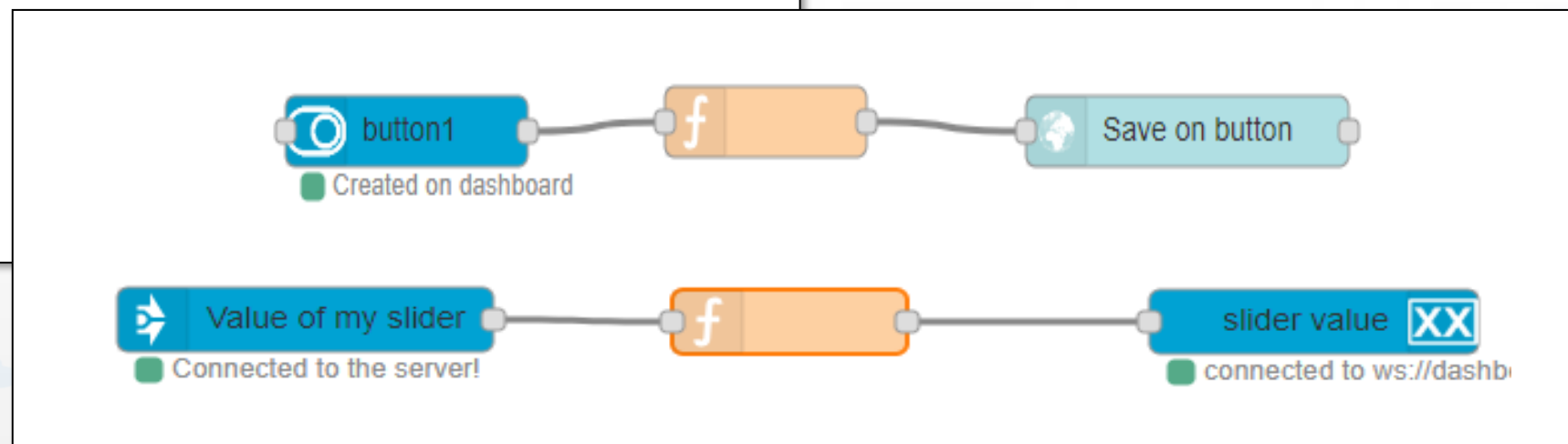
Internet

Storage and
IOT App on
cloud or on
Premise



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

10 WS messages per second

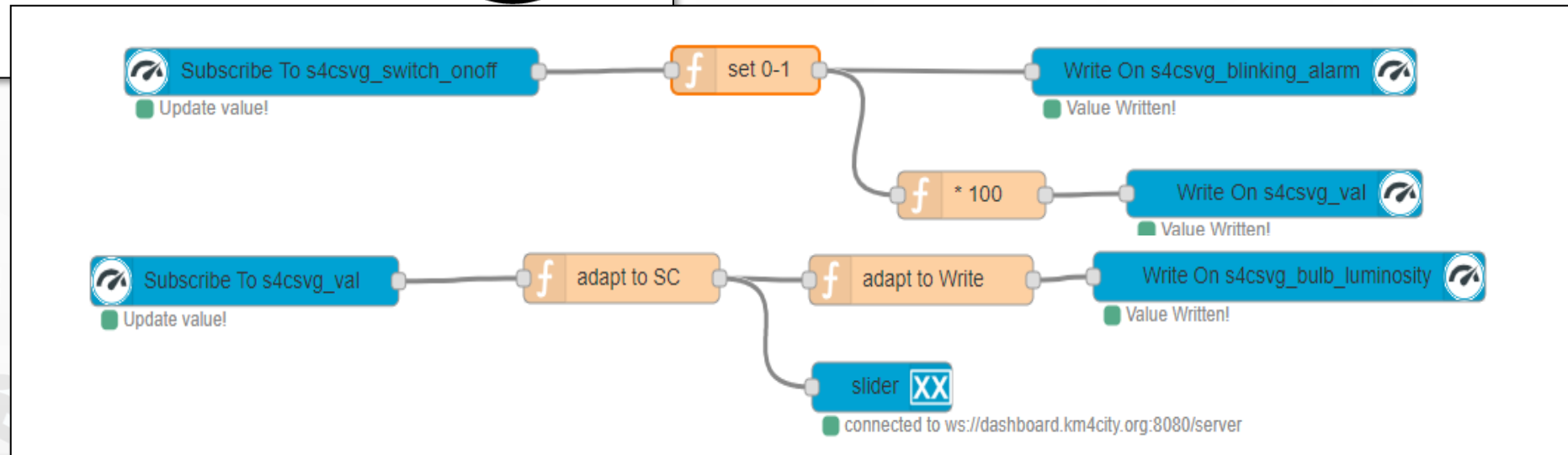
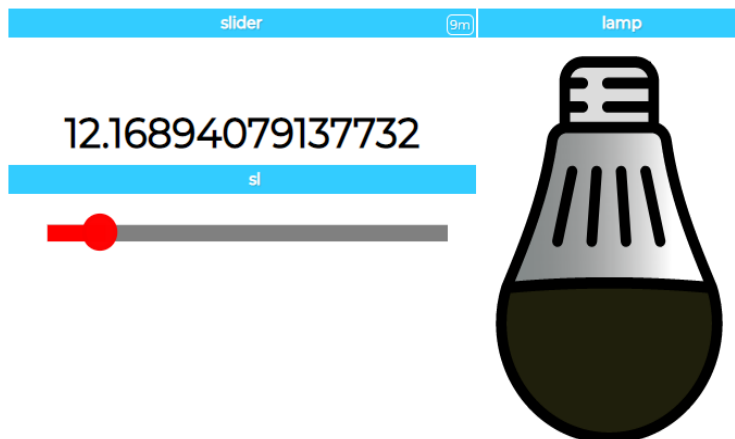


Case 2: Event Driven 100%

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

40 messages per second

case 2 SVG WS3



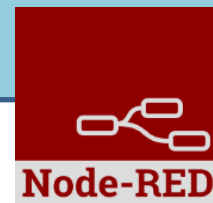
Read more on

- [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...



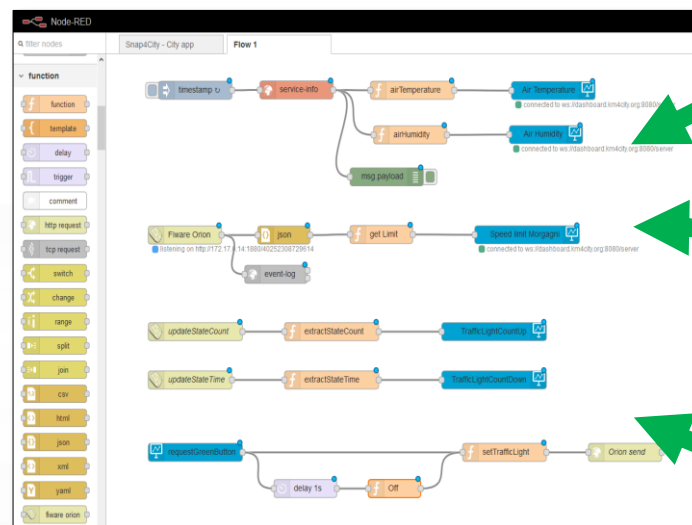
- You can send to the Web Content Widget an URL, a link to the web page to be loaded into an External Content Widget



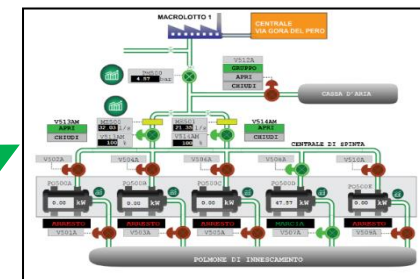
- You can create an HTML page by using the IoT App HTTP nodes
 - and then also send of the WebContent the URL to ask at the dashboard to show the HTML you created 😊

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



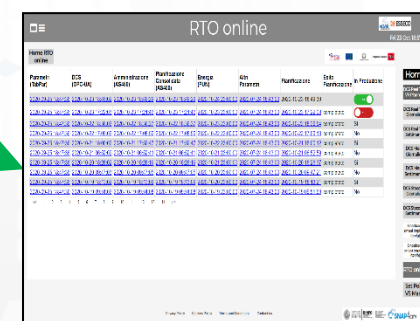
Synoptics
Custom
Widgets



Widgets
Maps
Buttons
Keypads
Controls



HTML pages
HTML Forms
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		☒
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	☒
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	☒
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	No
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	Si
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	No
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	Si
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	No
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	Si
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	No

Home

- DCS Real Time VS Planning
- DCS Real Time Giornaliero
- DCS Real Time Settimanale
- DCS Marce Giornaliero
- DCS Marce Settimanale
- DCS Stoccaggi Giornaliero
- DCS Stoccaggi Settimanale
- RTO online
- Set Point VS Marce

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 pianificazione 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 C12_HC132 (C12 consumato per ton di prodotto) [ton C12/ton HC132]
 297.54 MAX_HC132_s (Massimo stock HC132) [ton]

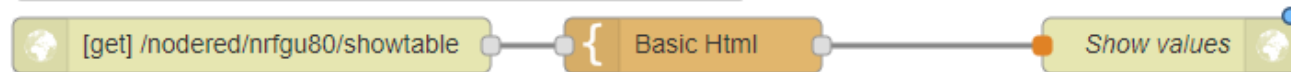
Home

- DCS Real Time VS Planning
- DCS Real Time Giornaliero
- DCS Real Time Settimanale
- DCS Marce Giornaliero
- DCS Marce Settimanale
- DCS Stoccaggi Giornaliero
- DCS Stoccaggi Settimanale
- RTO online

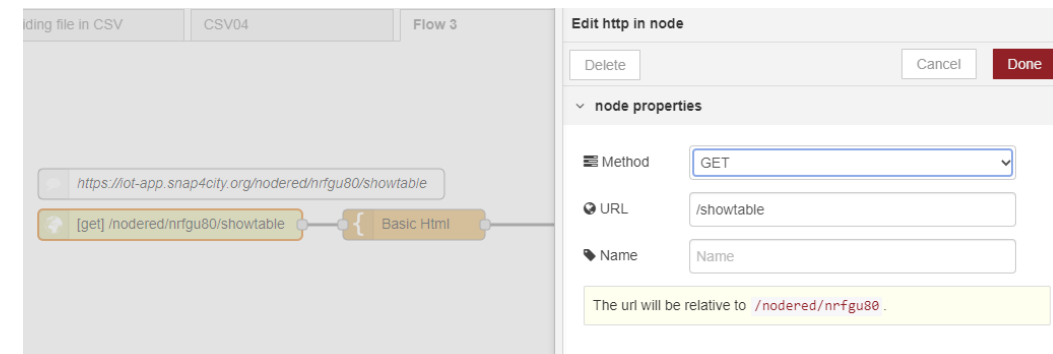
- **HTML pages** can
 - be dynamically generated from the IOT App
 - provide forms to produce data to the IOT App, also including interactive elements
 - collect file from users, and produce files to web and to the system
 - have CSS and AJAX controls

From IoT App to HTML pages

<https://iot-app.snap4city.org/nodered/nrfgu80/showtable>



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



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

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

TOP

Proc.Logic / IoT App Programming Patterns

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT/IOE DEVICES
AND NETWORKS

IOT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADVANCE
SMART CITY API,
MICROSERVICES,
SNAP4CITY API

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WORK

SNAP4CITY FOR
BEGINNERS

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ARCHITECTURE AND
ECOSYSTEM, OPENED
TO DEVELOPERS
AND PARTNERS

DATA ANALYTICS,
BUSINESS
INTELLIGENCE,
WEBIF AND

DECISION SUPPORT
SYSTEMS FOR CITY
MANAGEMENT

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

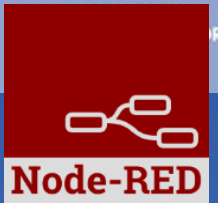
HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

SNAP4CITY
AND KM4CITY
PROJECTS

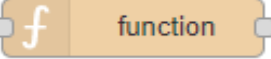
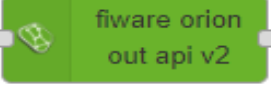
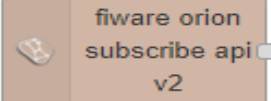
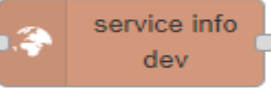
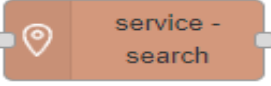
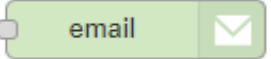
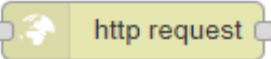
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IoT Applications

- 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...



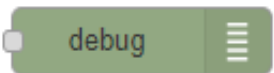
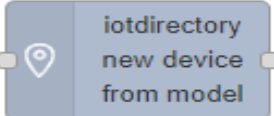
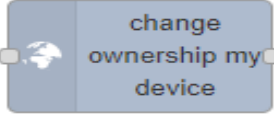
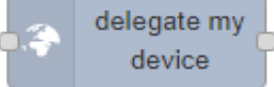
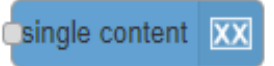
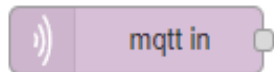
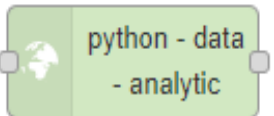
examples

Node shape	Description	Snap4City or standard
 inject	To generate injection messages into a flow, scheduled or on manual demand by click it on left.	standard
 function	A java script function, from a JSON input to one or more JSON outputs, which can be produced by setting it.	standard
 fiware orion out api v2	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
 fiware orion subscribe api v2	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
 service info dev	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
 service - search	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
 email	Send email. With other nodes you can send Telegram, SMS, etc.	standard
 http request	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

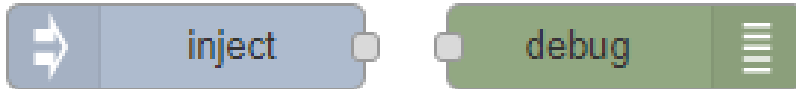
Part 5

Part 5

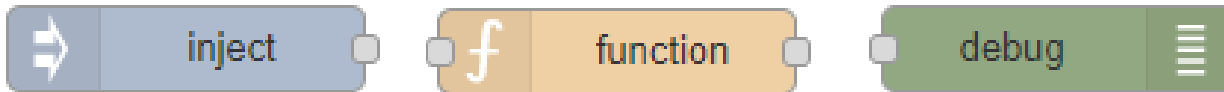
Part 4

Some patterns

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



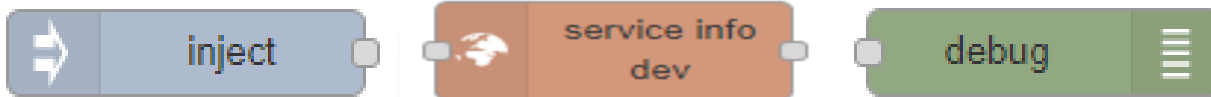
- 2) Hello world of node-red at two steps, the inject provides a push while a JSON is created into the function as *msg.payload = {.....}* and sent/shown to/by the debug.



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

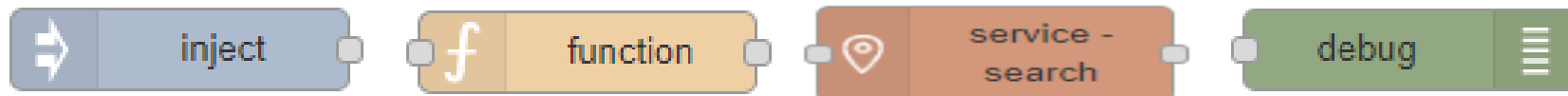


- 4) request on inject of a SURJ to the storage to see data on debug.



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>

HOW ARE YOU GOING TO BUILD THE FUTURE?

Snap4City: a framework for rapid implementation of Decision Support Systems and Smart Applications.


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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_SNAP4SOLUTION.pdf

2023 booklets



- Smart City



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

- Industry



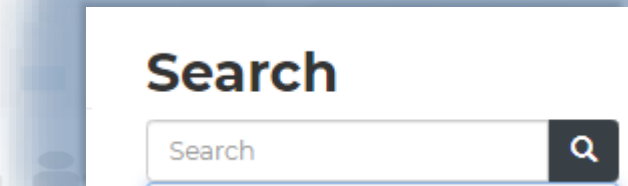
https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf

- 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>
- **Scenariious:** <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

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

Development

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



Development Life-Cycle

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

From Snap4City:

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

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

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

Client Side Business Logic

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



Client-Side Business Logic Widget Manual

From Snap4City:

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



- <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

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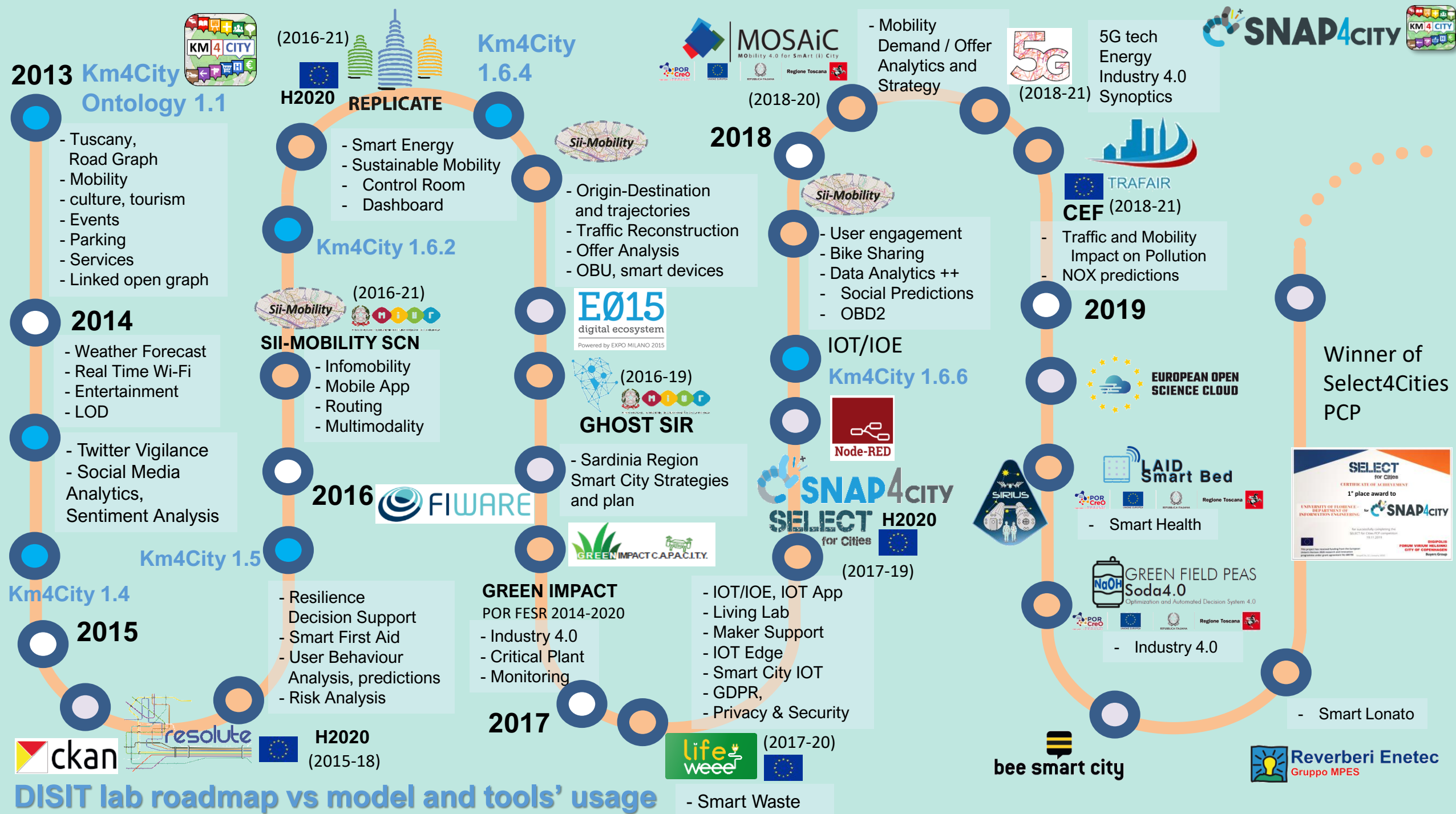
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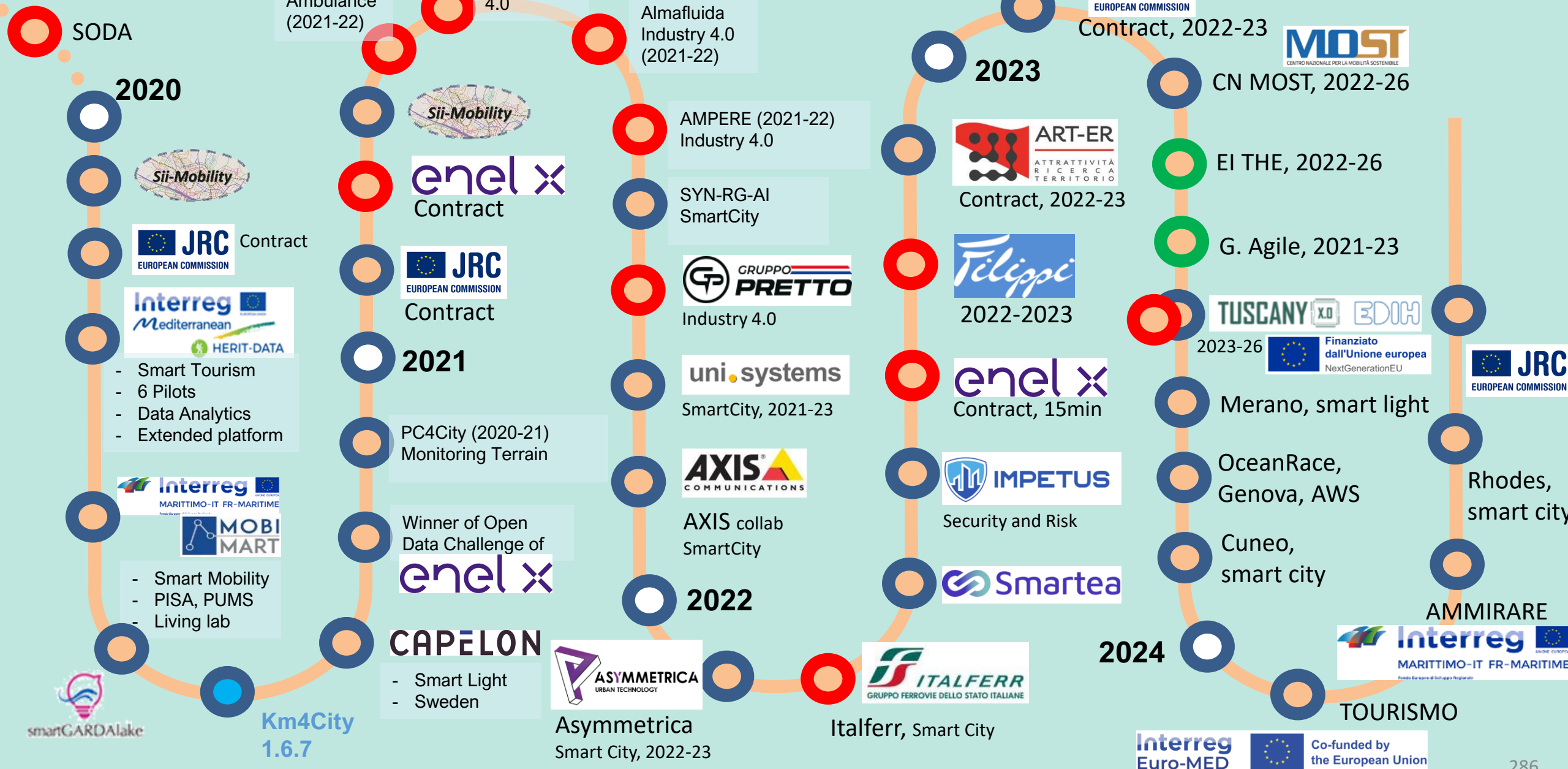
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