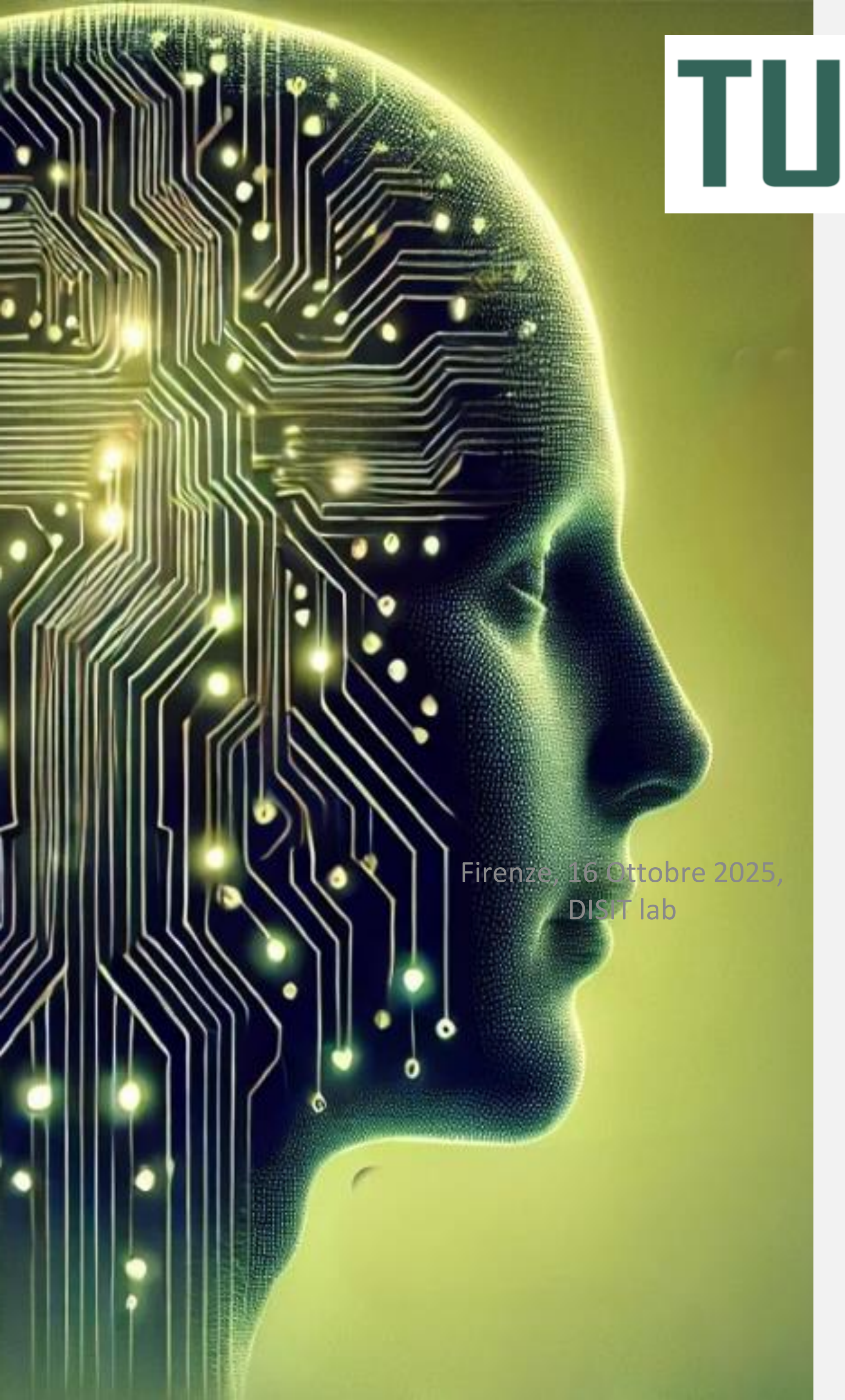

TUSCANY X.0

Internet delle cose, IoT, dai protocolli/formati, broker fino ai processi event driven

Paolo Nesi, paolo.nesi@unifi.it
Dipartimento di Ingegneria dell’Informazione, DISIT Lab
https://www.disit.dinfo.unifi.it
Https://www.snap4city.org

Martedì 16 Ottobre 2025 | ore 15.00

UNIVERSITÀ DEGLI STUDI FIRENZE
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB
SNAP4CITY
TUSCANY X.0
EDIH European Digital Innovation Hubs Network
Finanziato dall'Unione europea NextGenerationEU

Agenda

- Architetture IoT/IoE, reti, formati e protocolli, pattern
- Protocolli tipi IoT vs protocolli industriali
- Interoperabilità, protocolli push e pull
- Concetti di broker, gateway, adapter
- JSON, JavaScript, Node-RED
- Data Ingestion processing
- Esercitazione on Node-RED JavaScript
- Test

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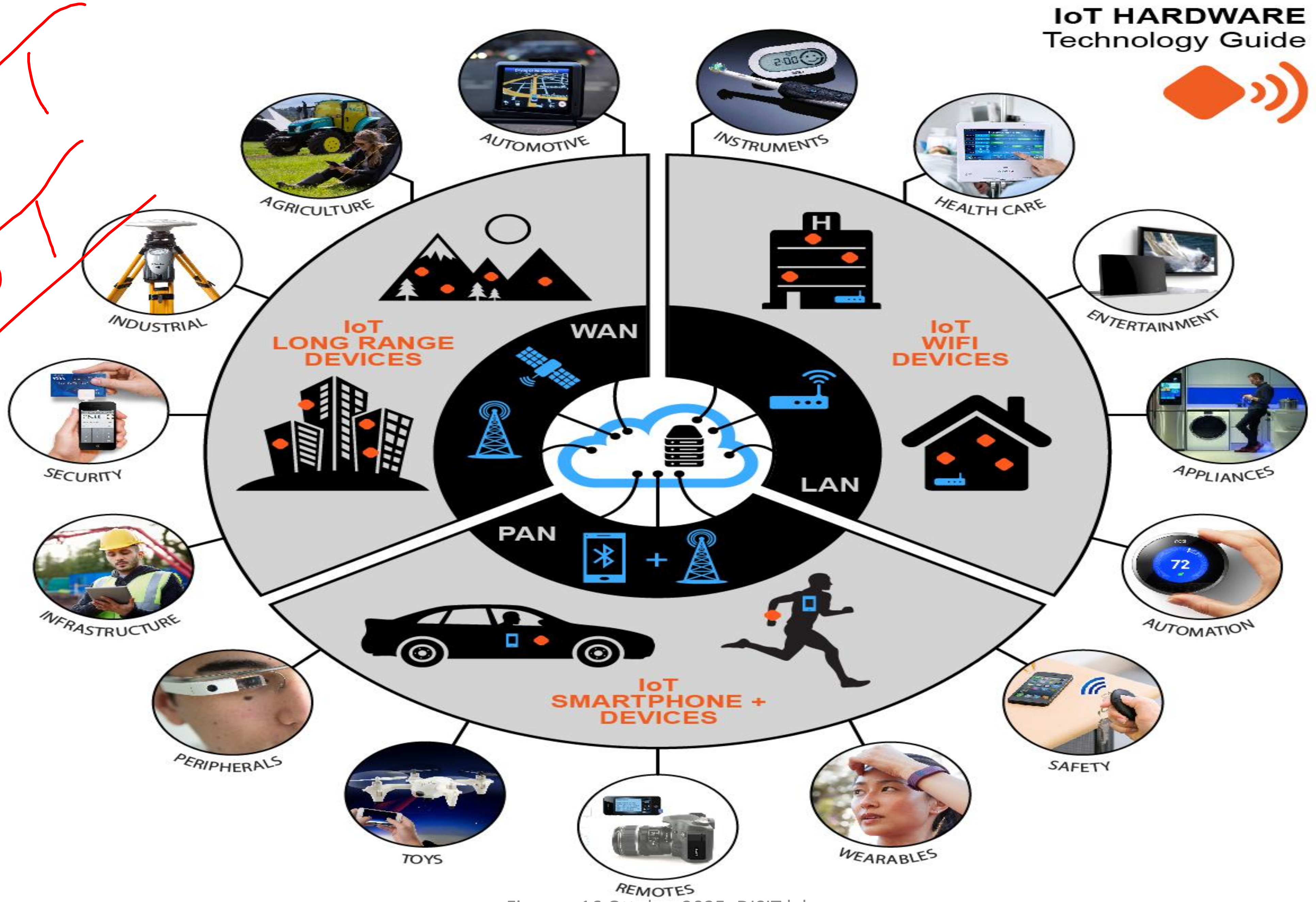
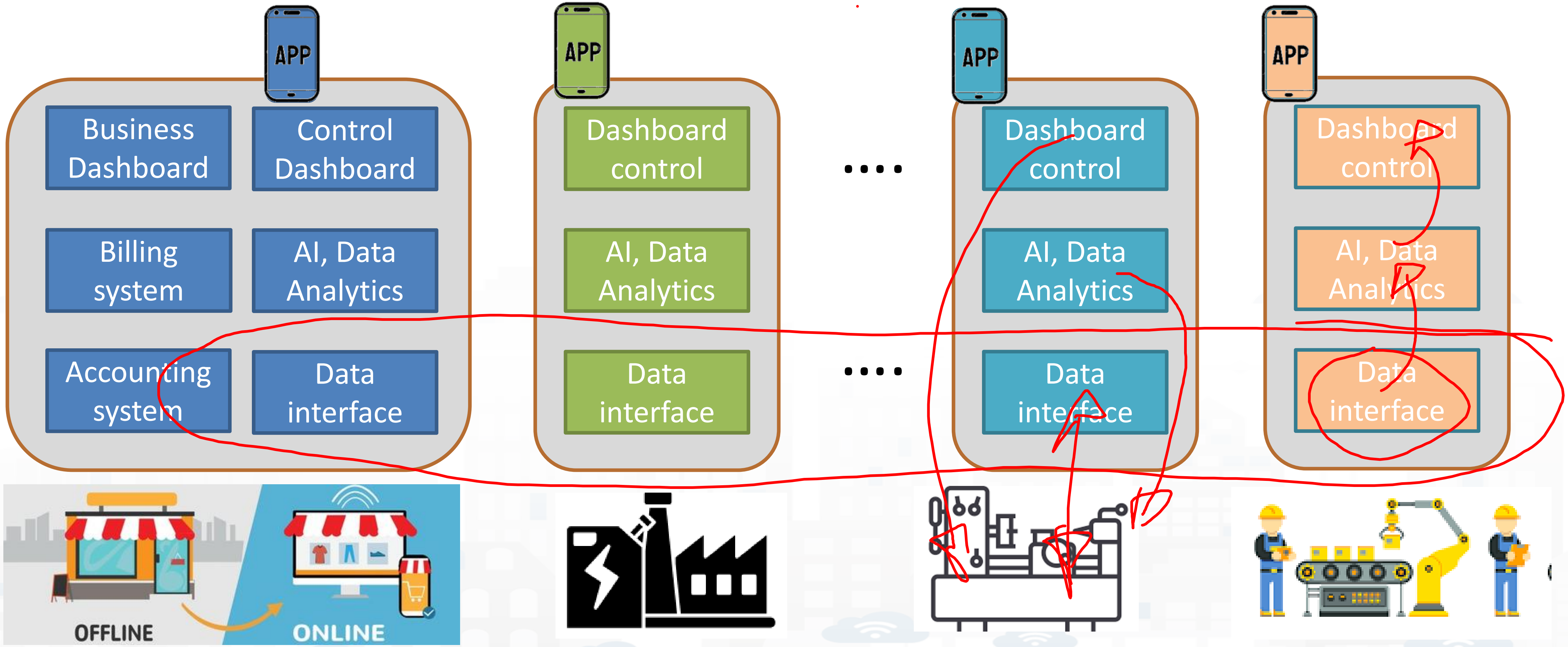
INTERNET of THINGS

IoT

WoT



Avoiding to have a collection of verticals



Business Dashboard | Control Dashboard

Billing system | AI, Data Analytics

Accounting system | Data interface

Dashboard control

AI, Data Analytics

Data interface

….

….

Dashboard control

AI, Data Analytics

Data interface

Dashboard control

AI, Data Analytics

Data interface

Simplifying the development and integration of verticals

Standards and Interoperability (10/2024)

Compliant with:

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

https://www.snap4city.org/65

What About a Time Series

IOT Device

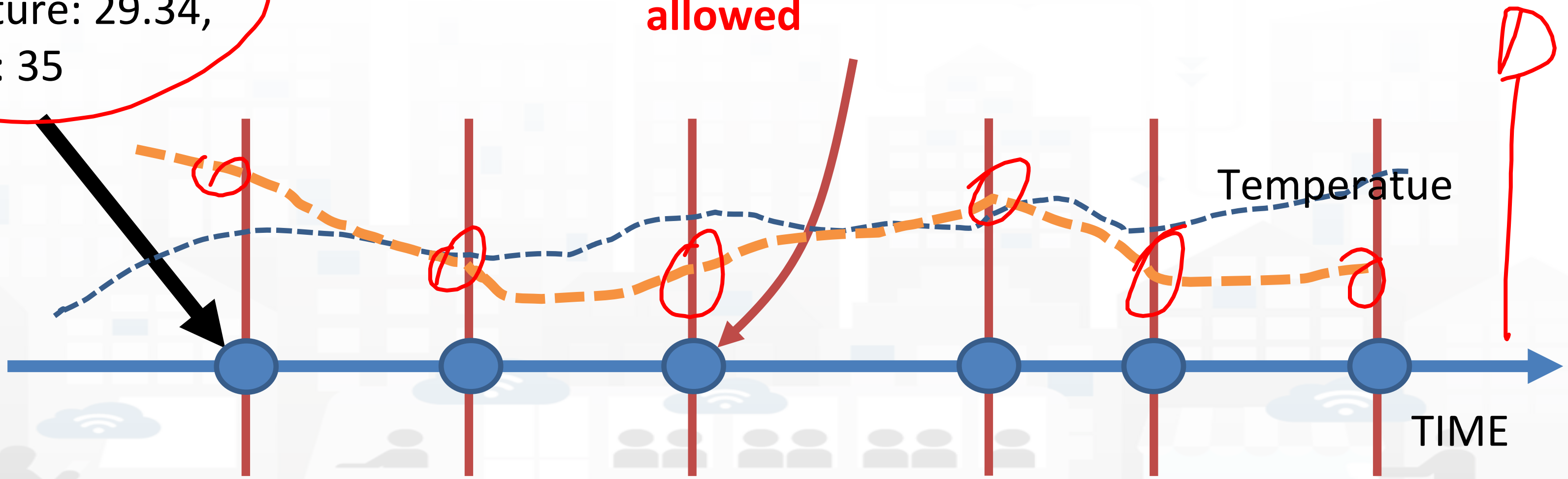
Entity: IOT Device

Sends a message

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

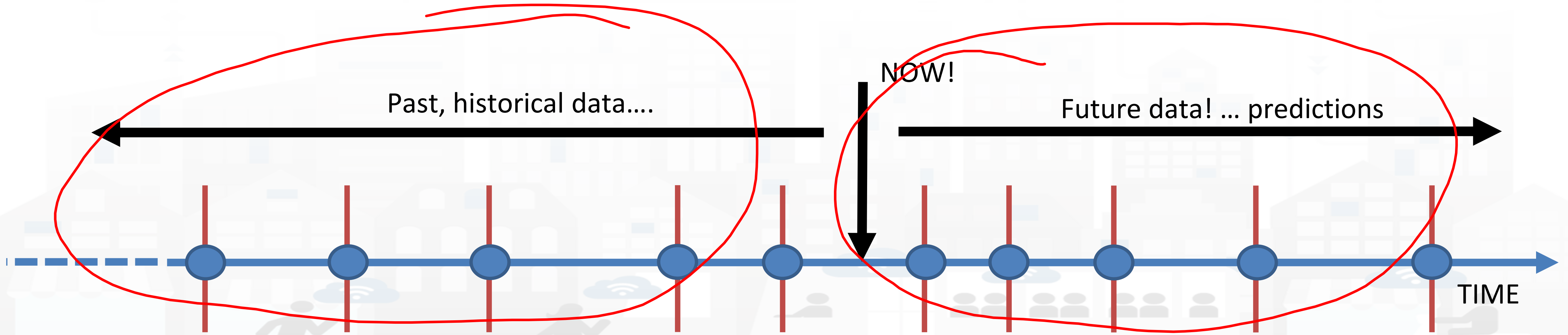
dateObserved	Temp	Humidity
02-04-2020 10:30	34.5	23
02-04-2020 10:40	36.5	24
02-04-2020 10:50	36.0	22.5

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



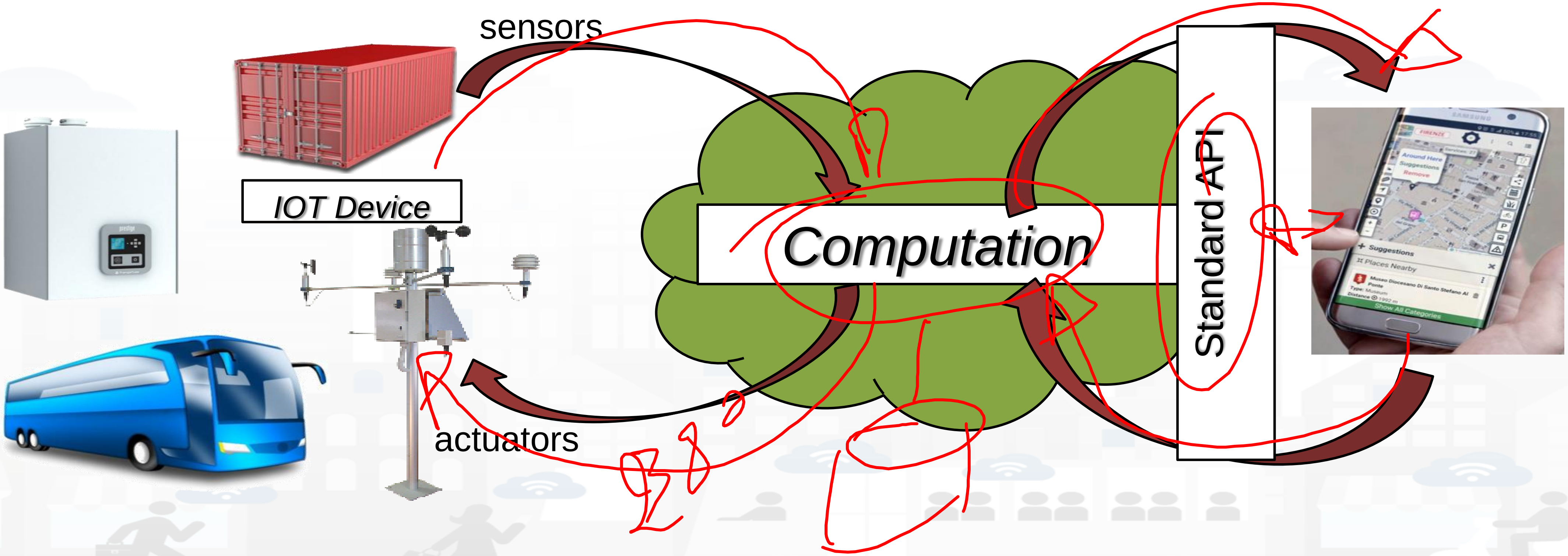
Time Series: they are data streams

- As soon as you have a variable changing over time → time series
  - You are ready to get Future data, may be arriving in PUSH
  - Recall and store historical data as well, but they have to be
    - recalled in PULL with some process taking from API, database,..



IOT Main Concept

- The implementation of smart services may implies the:
  - acquisition of data from the field
  - computation and imposition of actions/values
  - Save of historical values, computer data analytics, etc.



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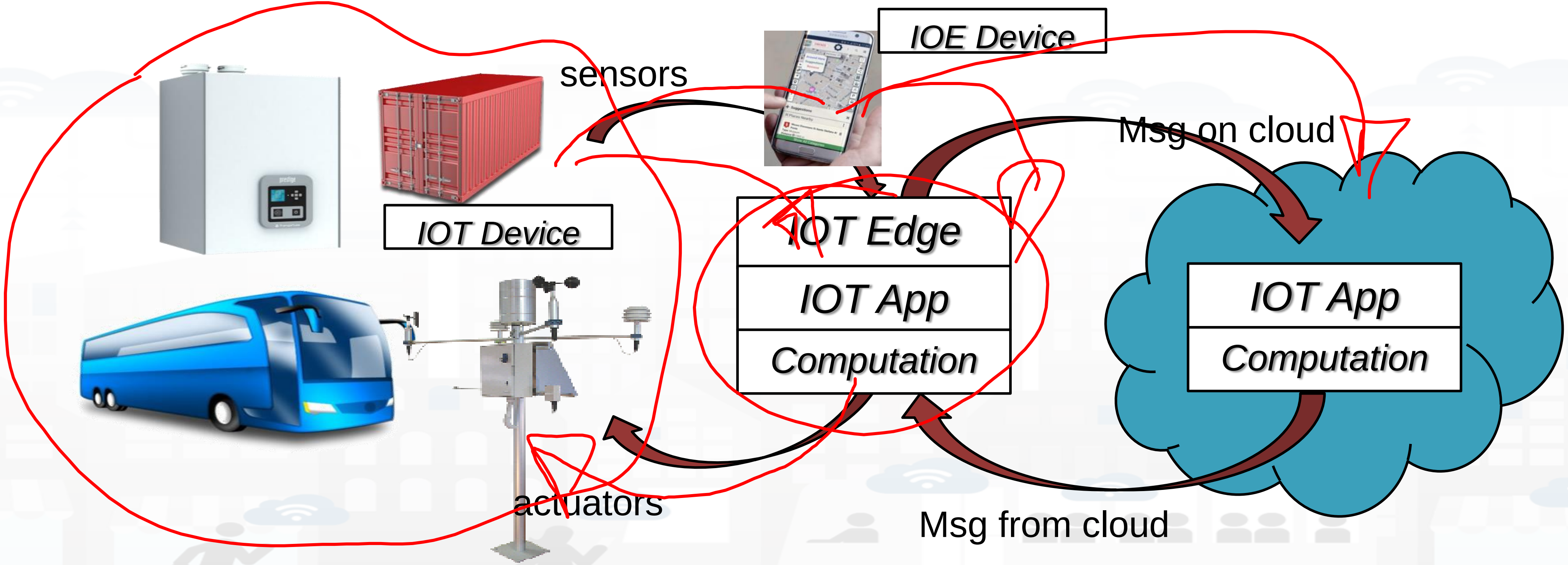
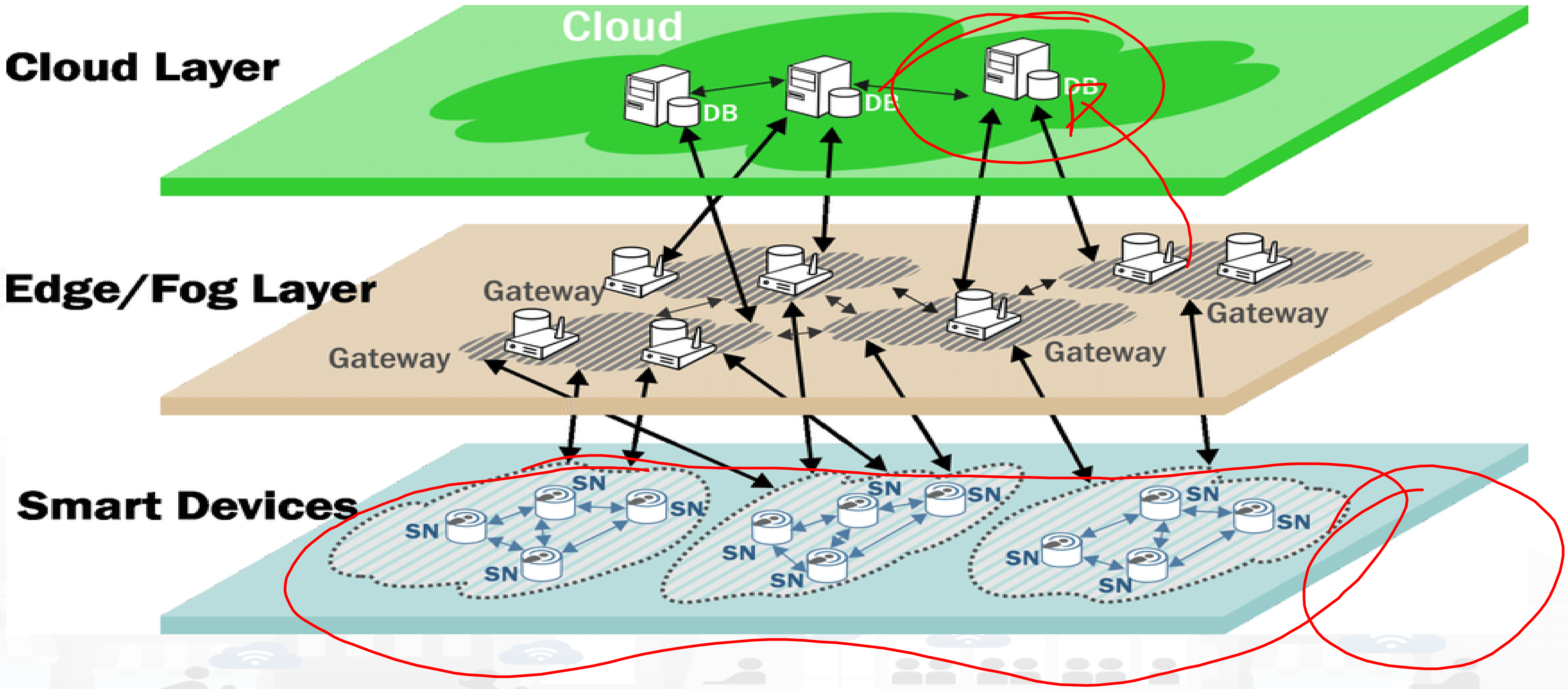


Cloud vs Fog/Edge Computing



Agenda

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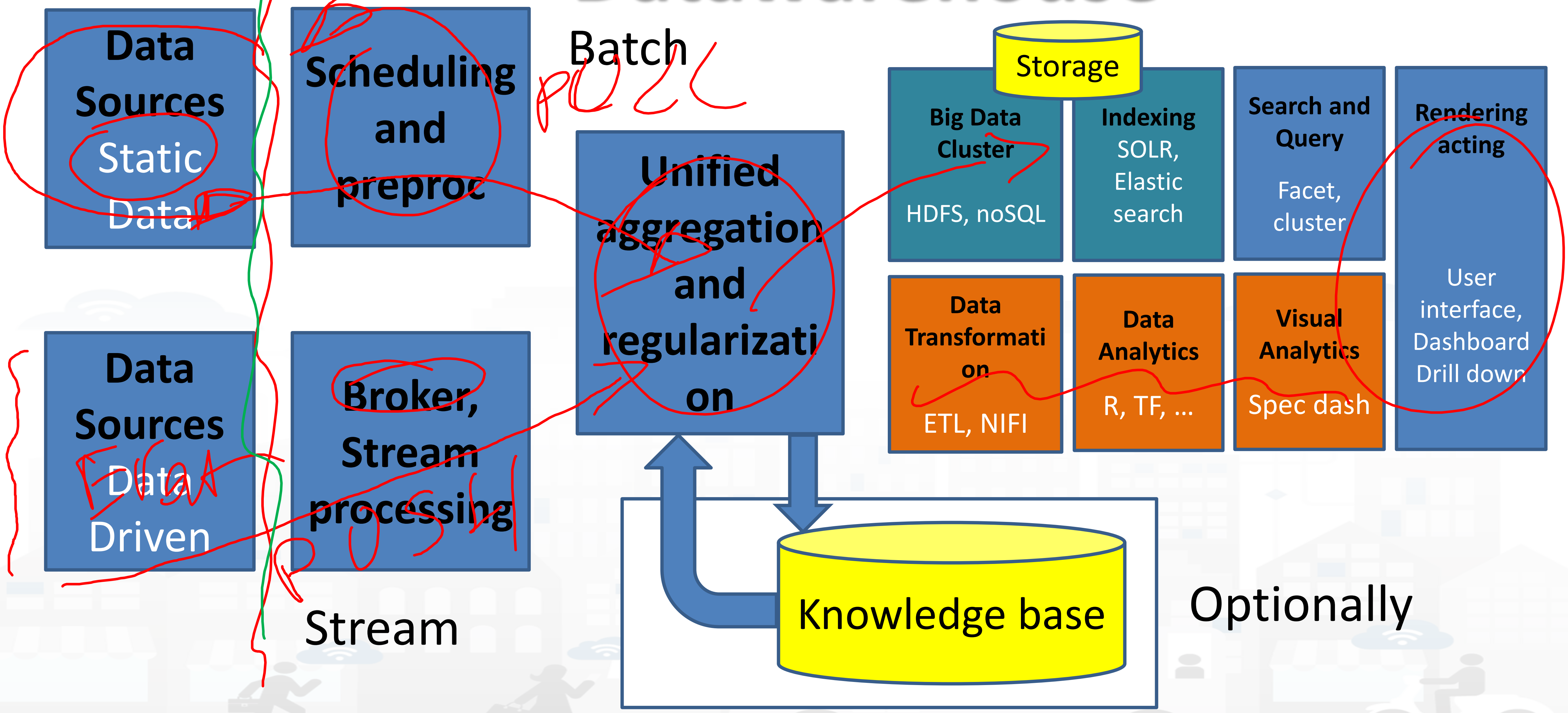
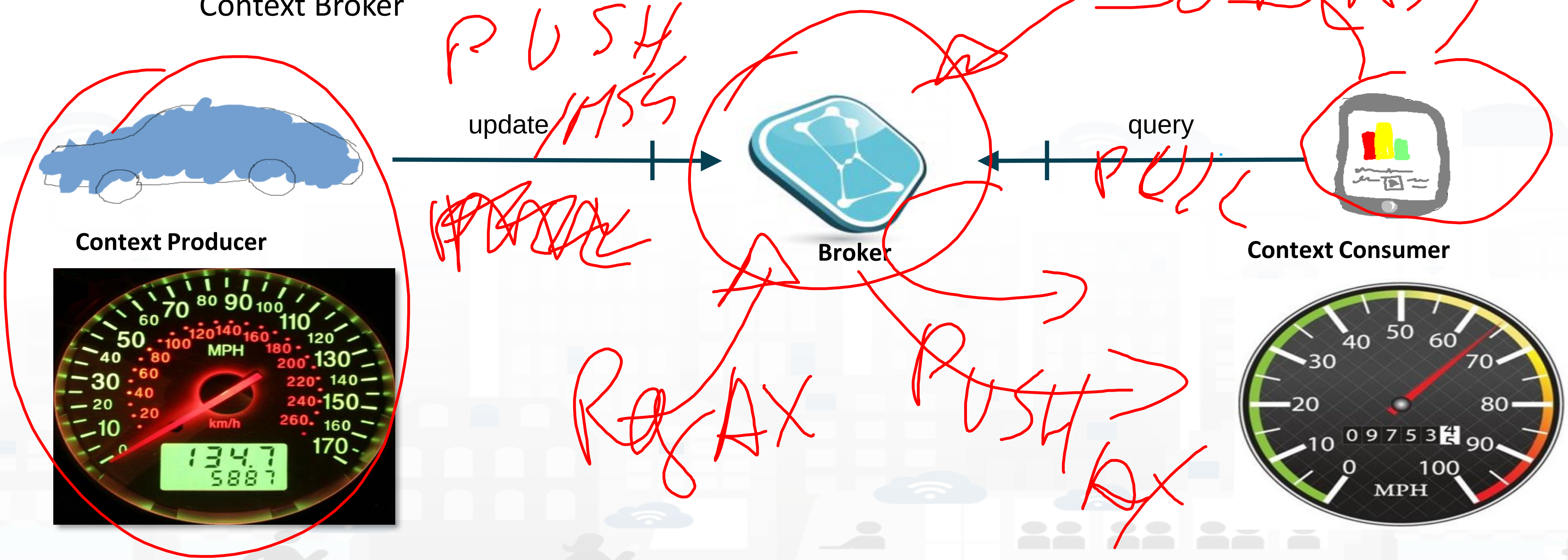
[illegible] → Cloud

Datawarehouse

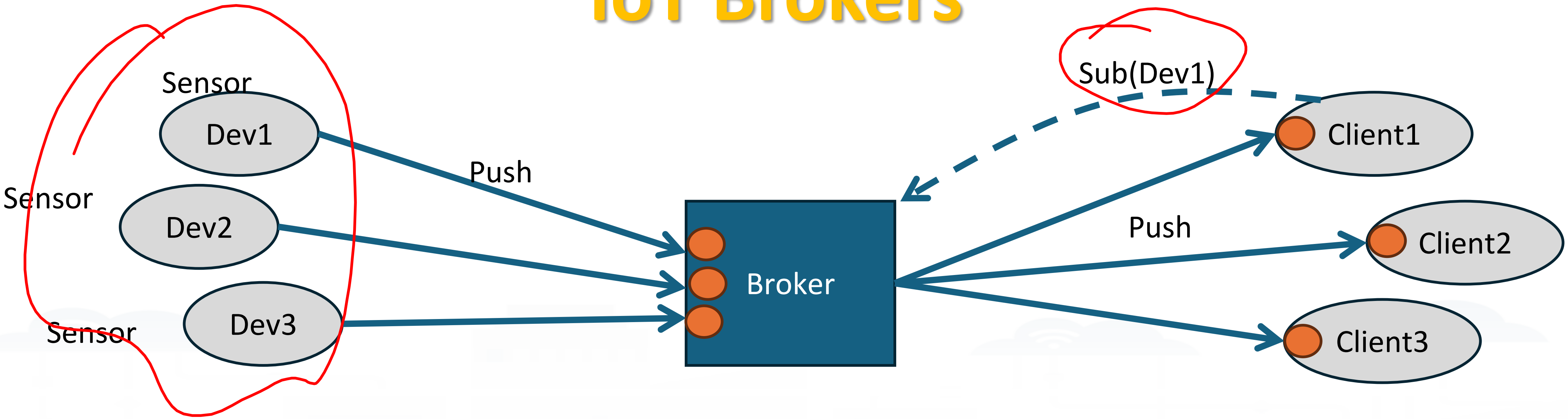


IOT Broker

- **Broker operations: create & pull data**
  - **Context Producers** publish data/context elements by invoking the update operations on a Context Broker.
  - **Context Consumers** can retrieve data/context elements by invoking the query operations on a Context Broker

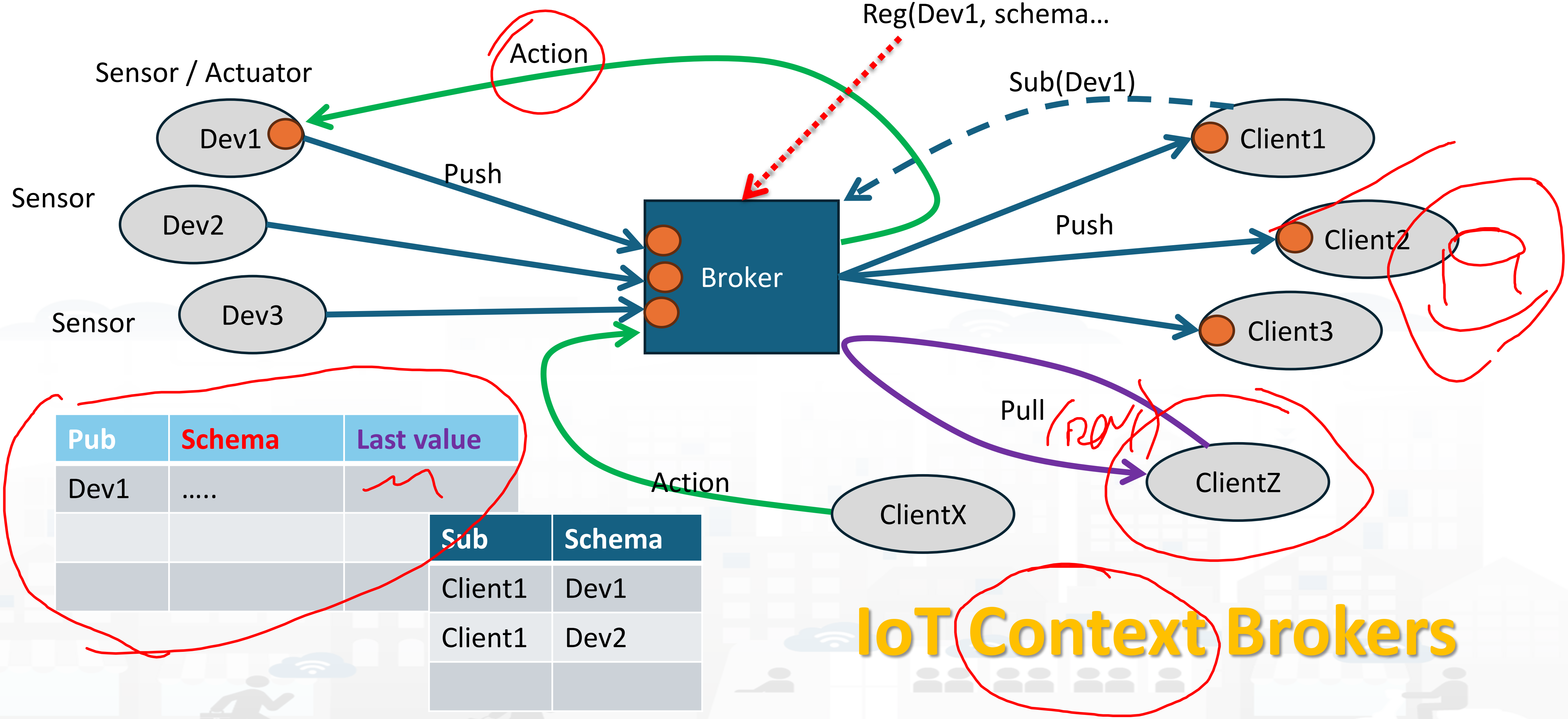


IoT Brokers



Pub
Dev1

Sub	Schema
Client1	Dev1
Client1	Dev2

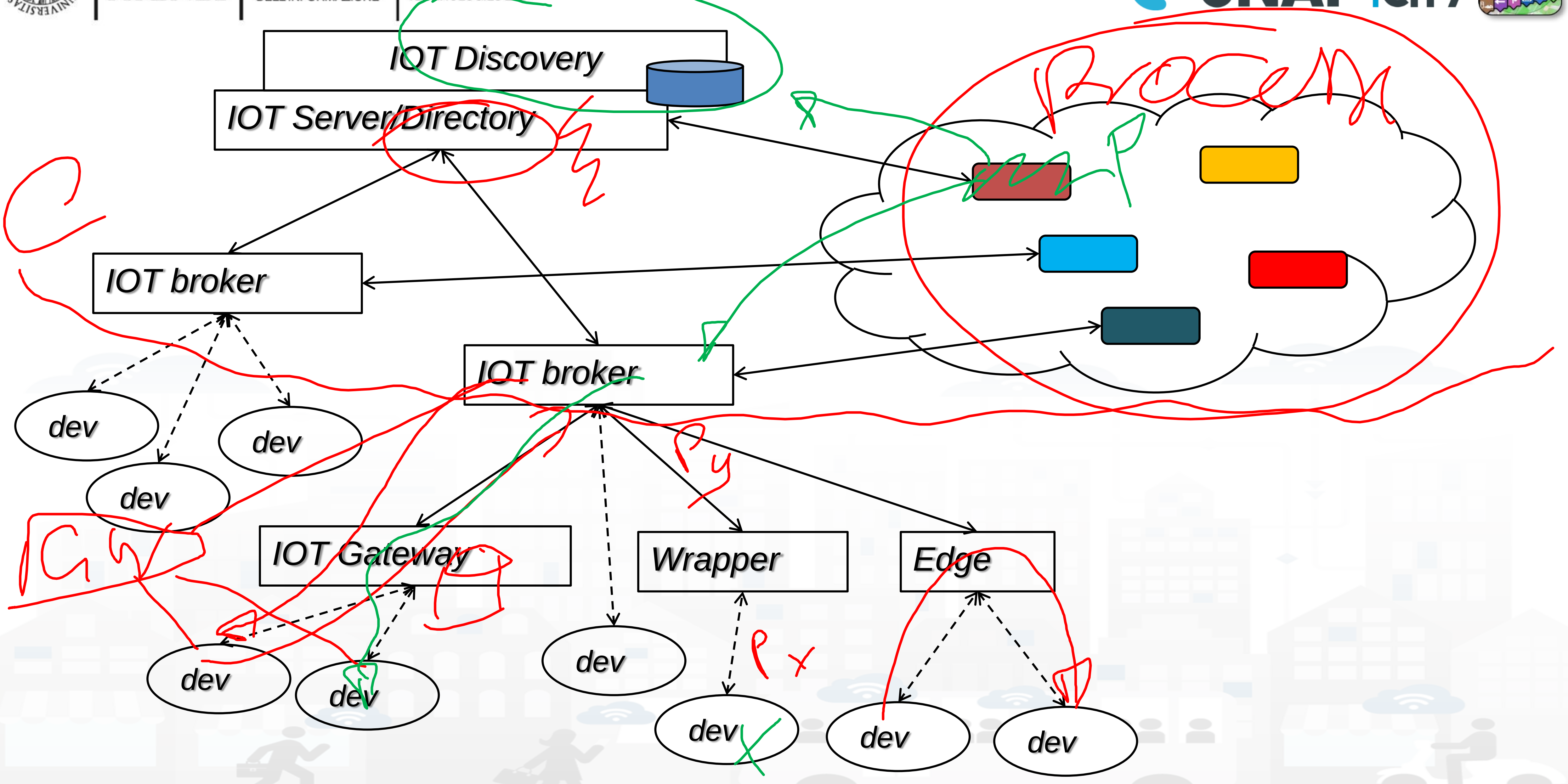


Pub	Schema	Last value
Dev1	.....	

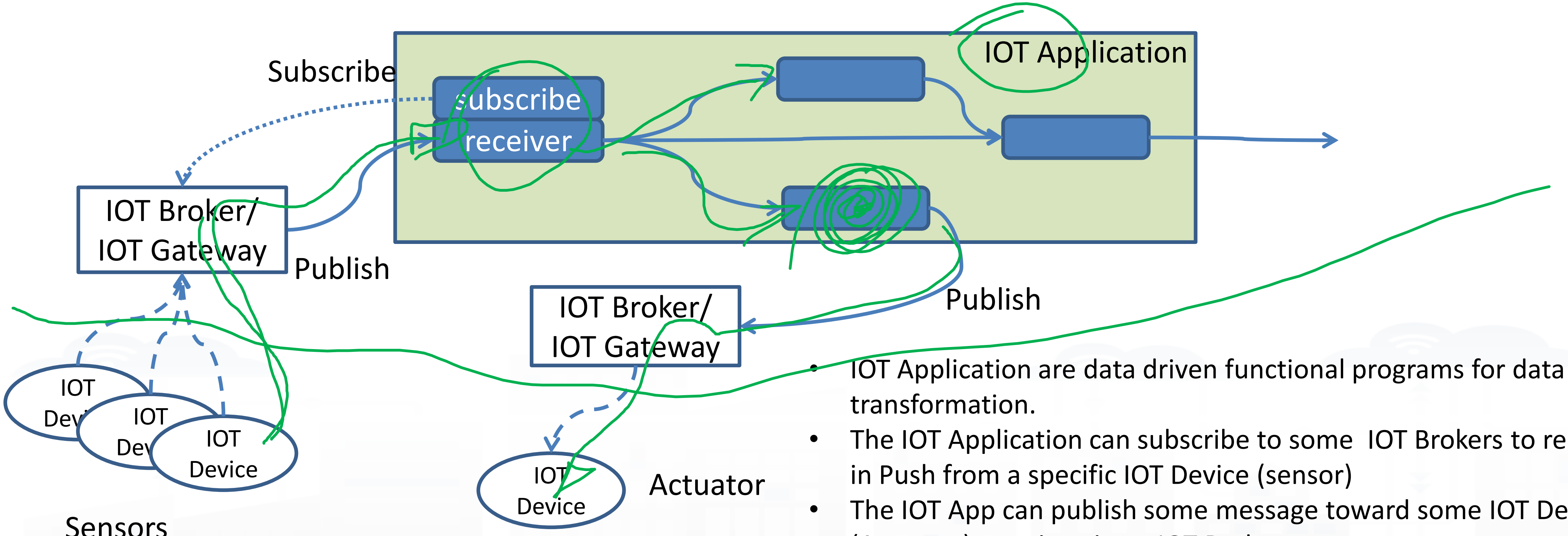
Sub	Schema
Client1	Dev1
Client1	Dev2

IoT Context Brokers

architettura



IOT Basic



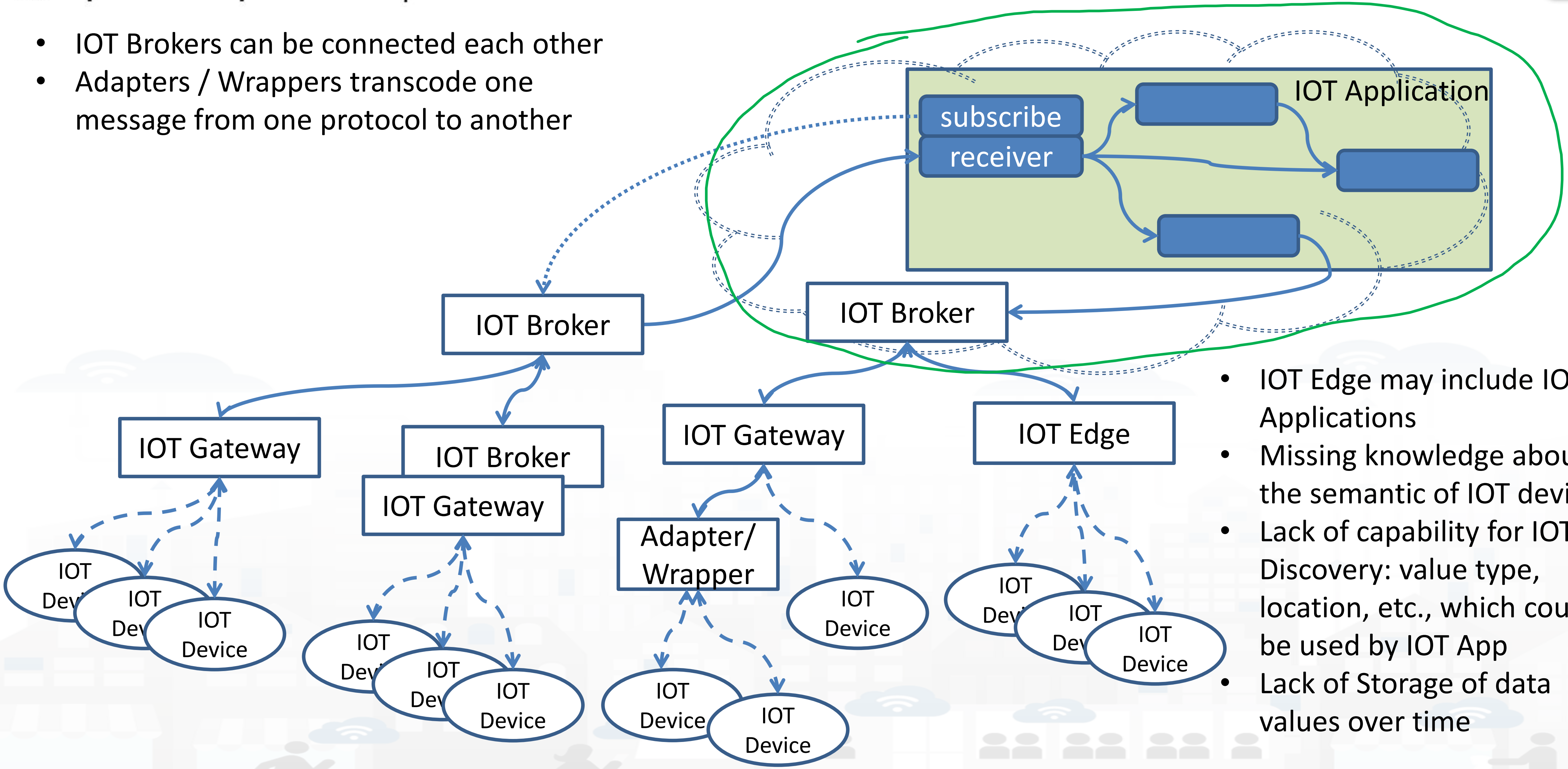
Sensors

- Sensors are programmed to send data (i) periodically, or (ii) when a relevant change occurs in the sensor value, or (iii) when events occur (for example a change of status of something), etc.
- Actuator perform some action on the field: change of status, reset, turn on something, change setting value, etc.

- IOT Application are data driven functional programs for data transformation.
- The IOT Application can subscribe to some IOT Brokers to receive data in Push from a specific IOT Device (sensor)
- The IOT App can publish some message toward some IOT Device (Actuator), passing via an IOT Broker.
- Continuous lines are messages via TCP/IP
- Dashed lines are message via some radio channel (Lora, BT, Wi-Fi, …)
- IOT Brokers and IOT Gateway can be distinct servers
- IOT Brokers can be on cloud
- IOT Gateway performs the SW update, the business management, access in Push and Pull

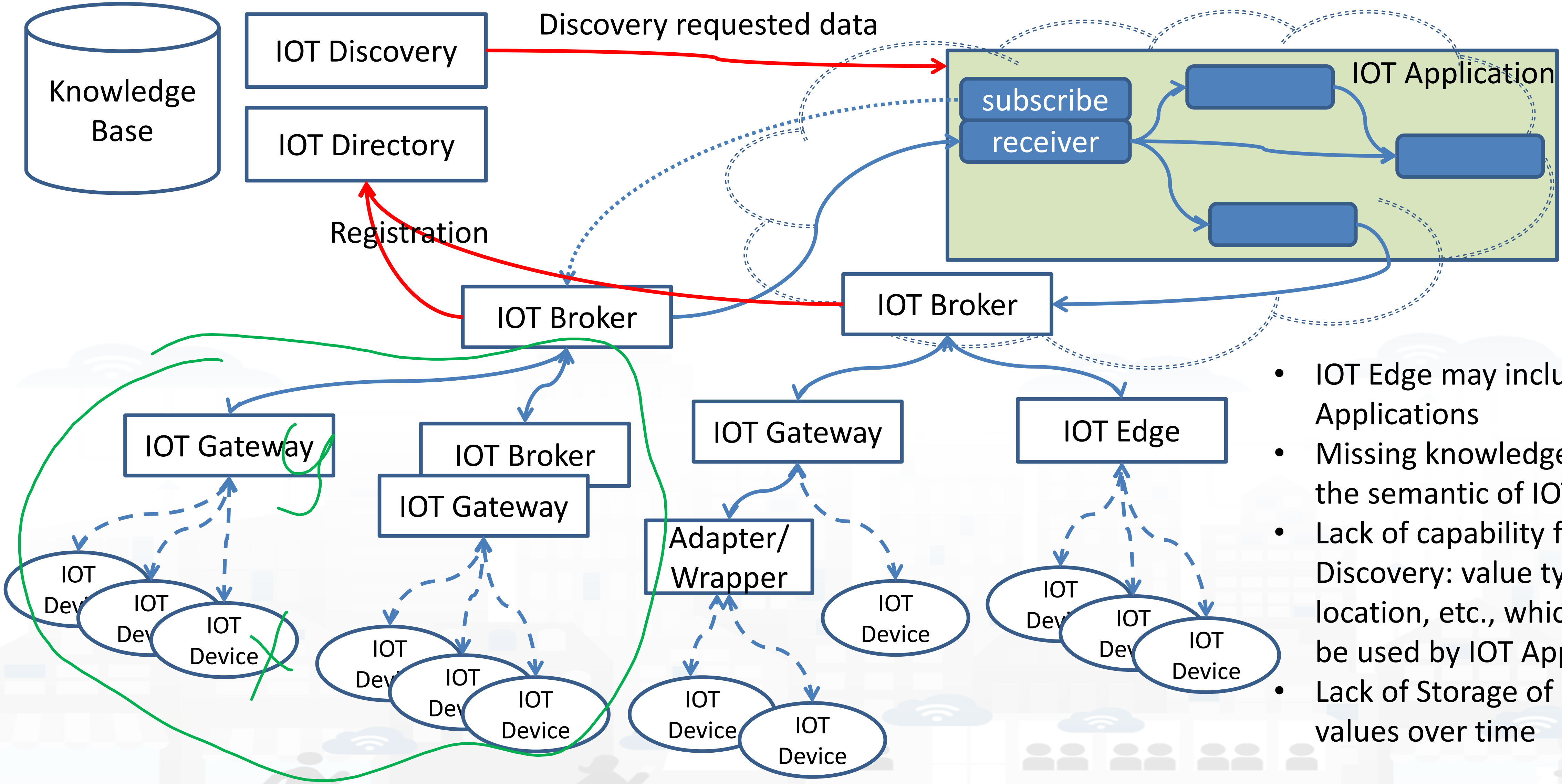
Definitions

- IOT Brokers can be connected each other
- Adapters / Wrappers transcode one message from one protocol to another



- IOT Edge may include IOT Applications
- Missing knowledge about the semantic of IOT devices
- Lack of capability for IOT Discovery: value type, location, etc., which could be used by IOT App
- Lack of Storage of data values over time

Definitions



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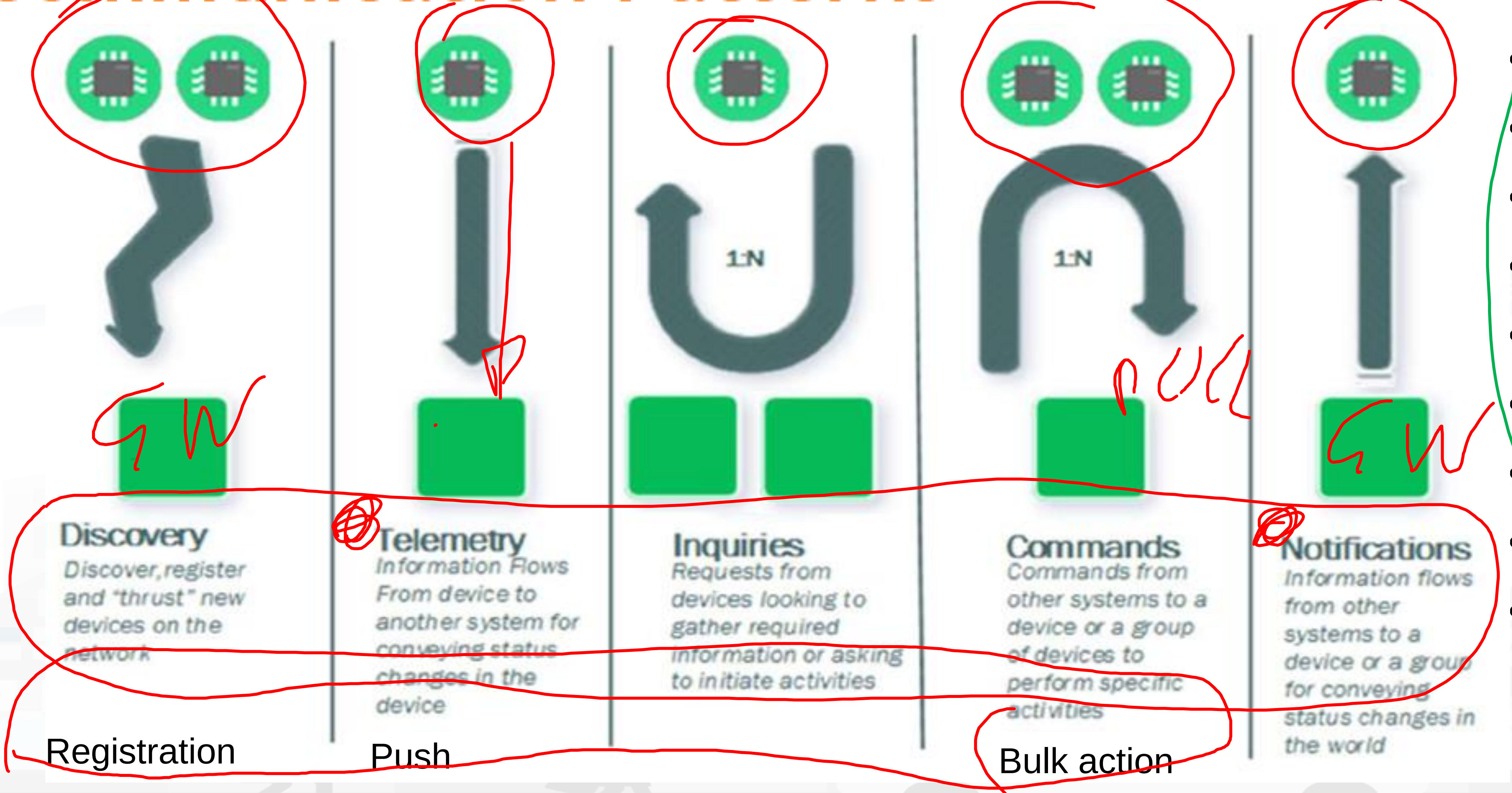
- Missing knowledge about the semantic of IOT devices
- Lack of capability for IOT Discovery: value type, location, etc., which could be used by IOT App
- Lack of Storage of data values over time

IOT/IOE Protocols

Communication Patterns



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

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

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

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

Registration

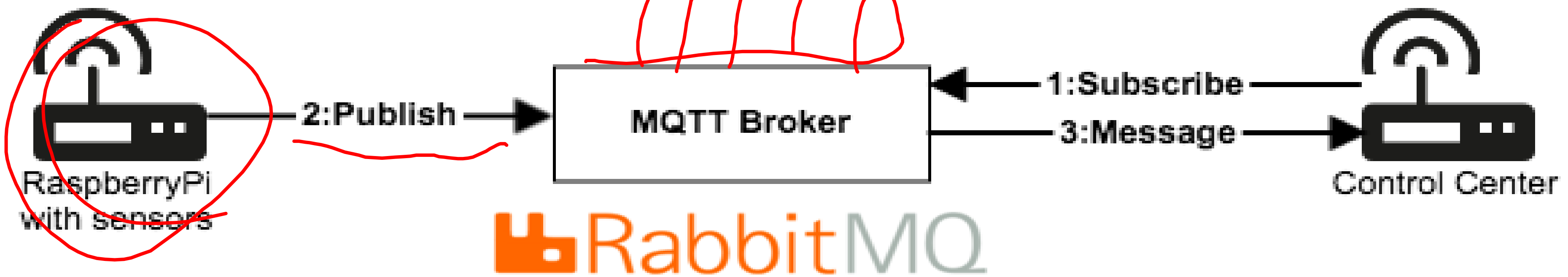
Push

Bulk action

- MQTT
- HTTP(s)
- AMQP
- COAP
- NGSI
- OneM2M
- WebSockets
- ……..
- Etc.

IOT Brokers

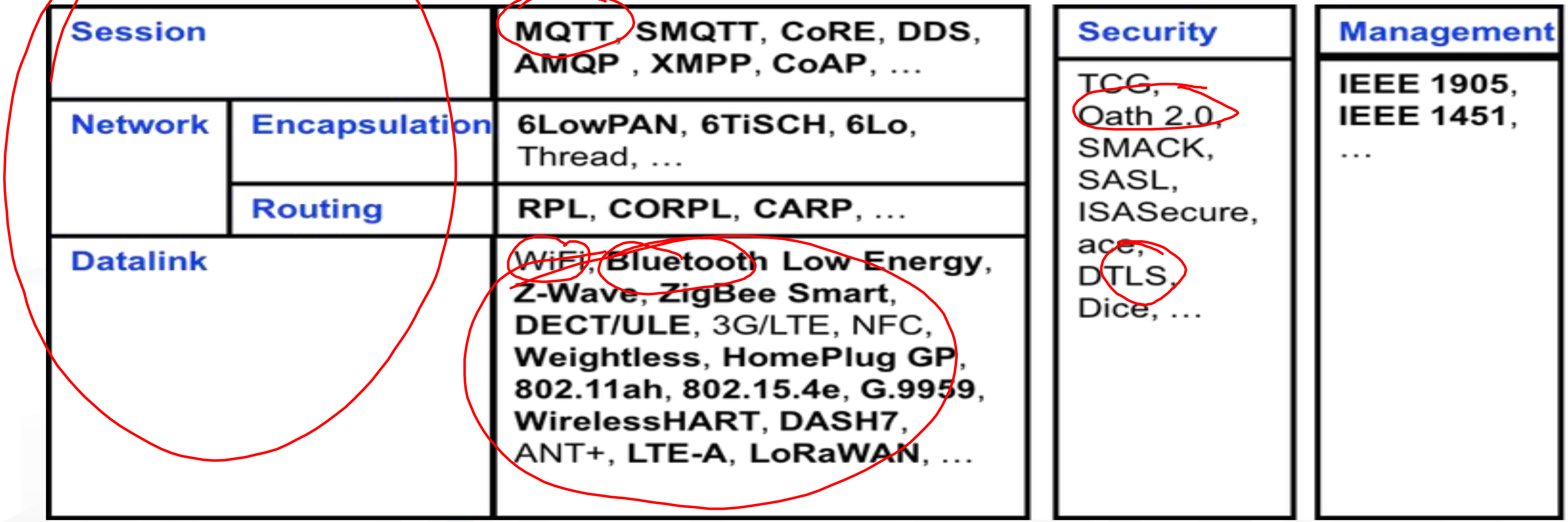
	AMQP	STOMP	JMS	COAP	NGSI	MQTT OASIS
RabbitMQ	X	X	X	X		X
Mosquitto						X
ActiveMQ	X	X	X			X
StormMQ	X					
HIVEMQ			X			X
ORION BROKER				X	X	X



RabbitMQ
Open Source Enterprise Messaging

IOT stack protocols

ISO



Session		MQTT, SMQTT, CoRE, DDS, AMQP , XMPP, CoAP, ...
Network	Encapsulation	6LowPAN, 6TiSCH, 6Lo, Thread, ...
	Routing	RPL, CORPL, CARP, ...
Datalink		WiFi, Bluetooth Low Energy, Z-Wave, ZigBee Smart, DECT/ULE, 3G/LTE, NFC, Weightless, HomePlug GP, 802.11ah, 802.15.4e, G.9959, WirelessHART, DASH7, ANT+, LTE-A, LoRaWAN, ...

Security
TCG, Oath 2.0, SMACK, SASL, ISASecure, ace, DTLS, Dice, ...

Management
IEEE 1905, IEEE 1451, ...

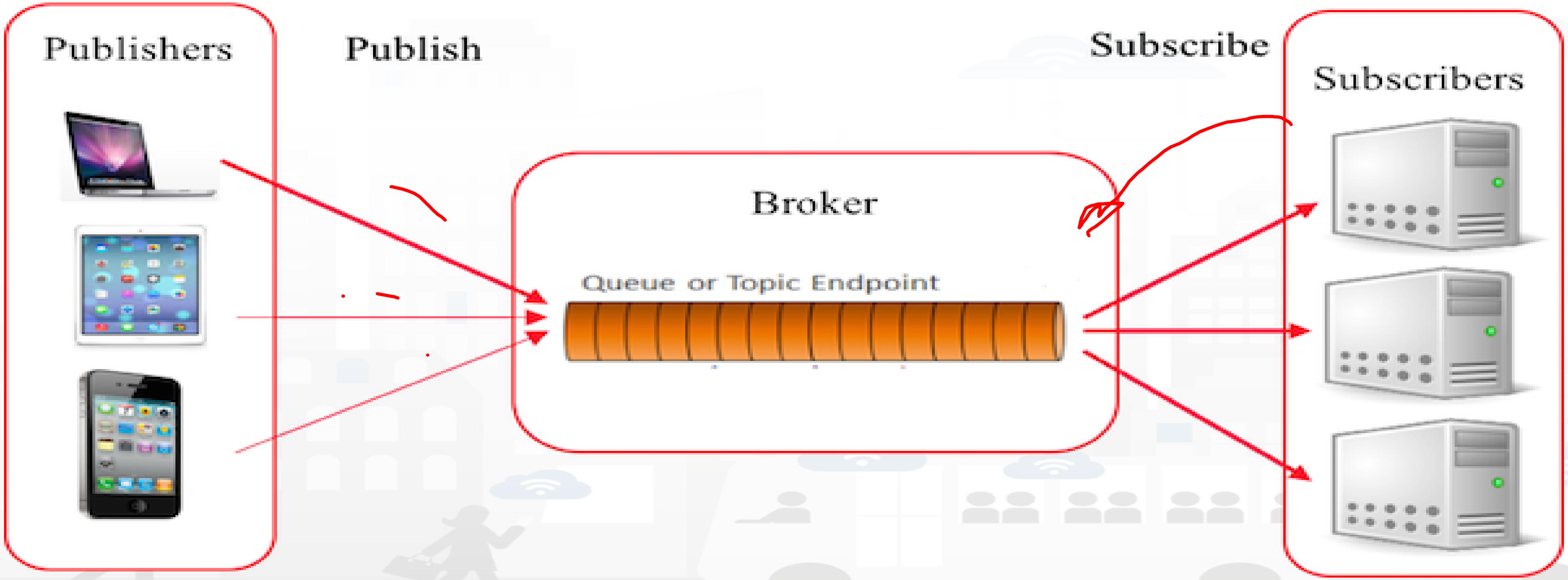
https://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/

Comparison high level IOT protocols

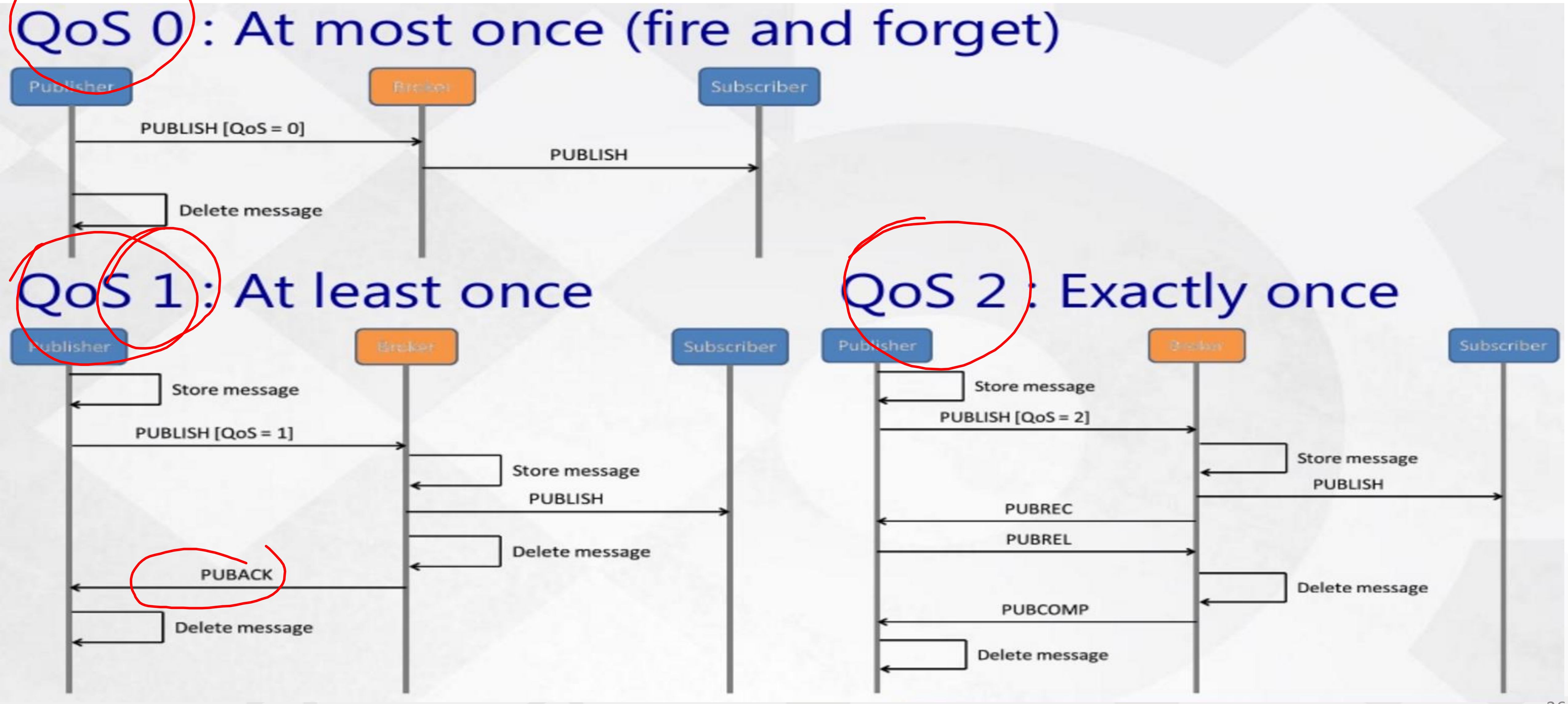
Protocols	UDP/TCP	Architecture	Security and QoS	Header Size (bytes)	Max Length(bytes)
MQTT	TCP	Pub/Sub	Both	2	5
AMQP	TCP	Pub/Sub	Both	8	-
CoAP	UDP	Req/Res	Both	4	20 (typical)
XMPP	TCP	Both	Security	-	-
DDS	TCP/UDP	Pub/Sub	QoS	-	-
NGSI	TCP/IP	Pub/Sub			

MQTT: Message Queue Telemetry Transport

- ❑ security obtained with SSL/TLS since it is over TCP
- ❑ ISO/IEC PRF 20922
- ❑ Over TCP/IP, Async, pub/subscribe,
- ❑ payload agnostic (can be encrypted)



MQTT QoS



QoS 0 : At most once (fire and forget)

Publisher — Broker — Subscriber

- PUBLISH [QoS = 0] (Publisher → Broker)
- PUBLISH (Broker → Subscriber)
- Delete message (Publisher)

QoS 1 : At least once

Publisher — Broker — Subscriber

- Store message (Publisher)
- PUBLISH [QoS = 1] (Publisher → Broker)
- Store message (Broker)
- PUBLISH (Broker → Subscriber)
- Delete message (Broker)
- PUBACK (Broker → Publisher)
- Delete message (Publisher)

QoS 2 : Exactly once

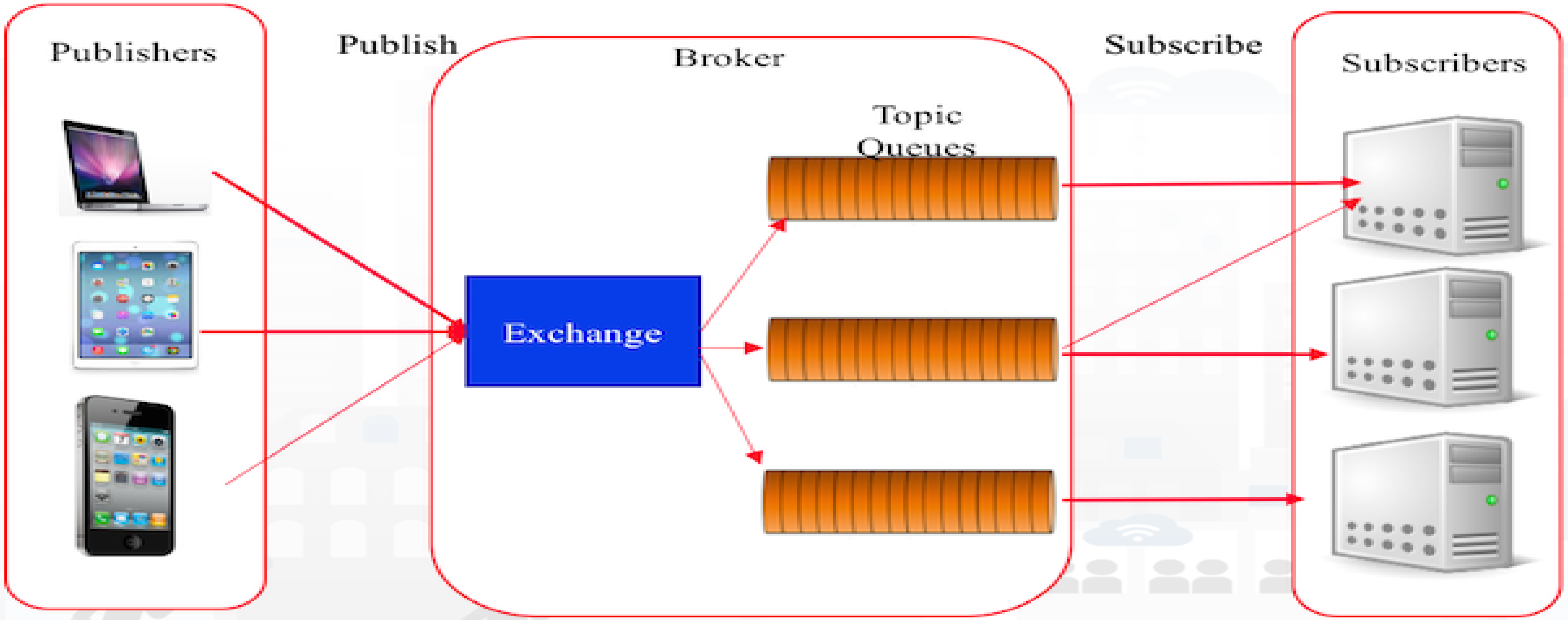
Publisher — Broker — Subscriber

- Store message (Publisher)
- PUBLISH [QoS = 2] (Publisher → Broker)
- Store message (Broker)
- PUBLISH (Broker → Subscriber)
- PUBREC (Broker → Publisher)
- PUBREL (Publisher → Broker)
- Delete message (Broker)
- PUBCOMP (Broker → Publisher)
- Delete message (Publisher)

AMQP Advanced Message Queuing Protocol

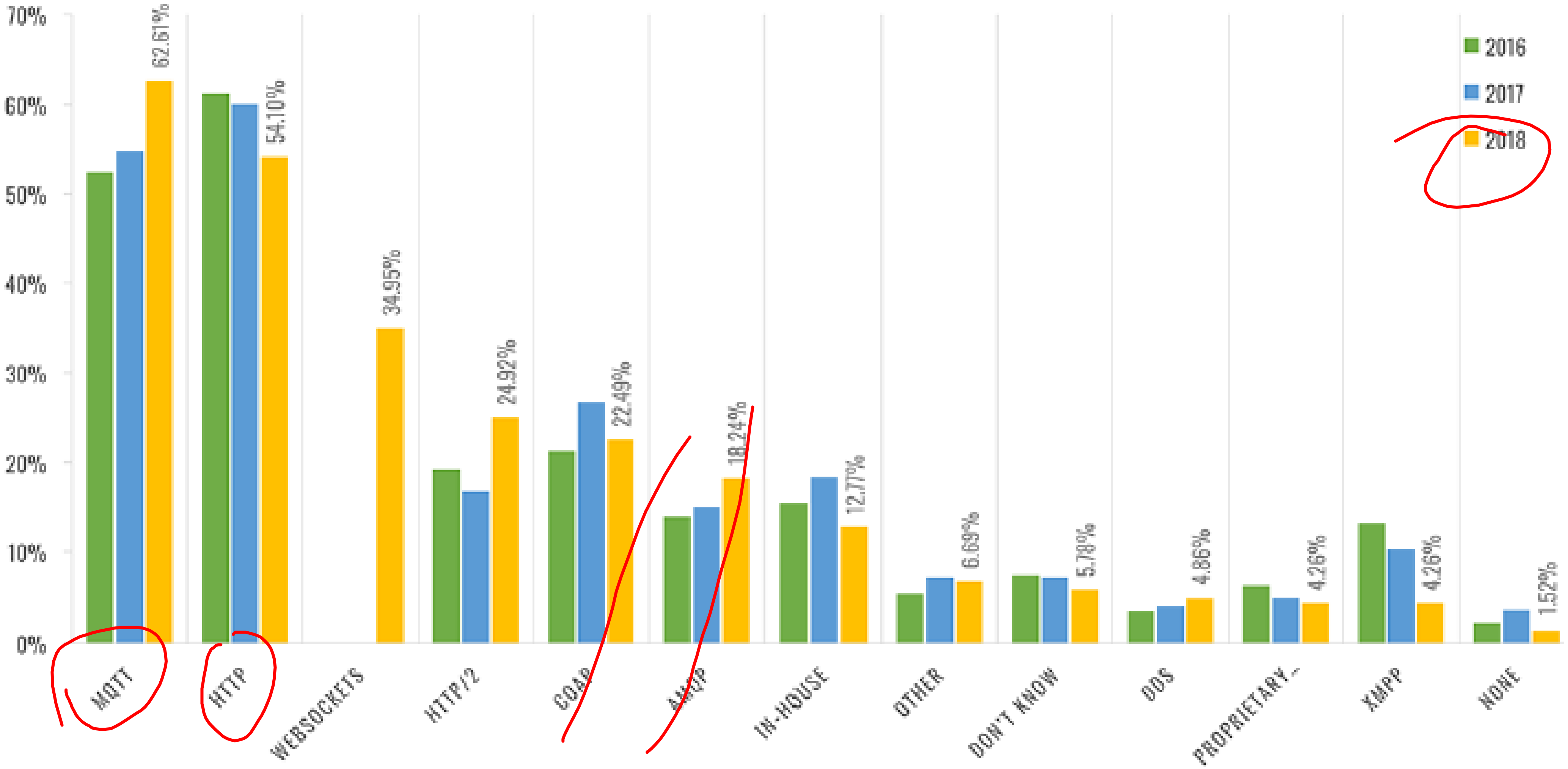
❑Over TCP, binary wire protocol

❑Exchange decoupling

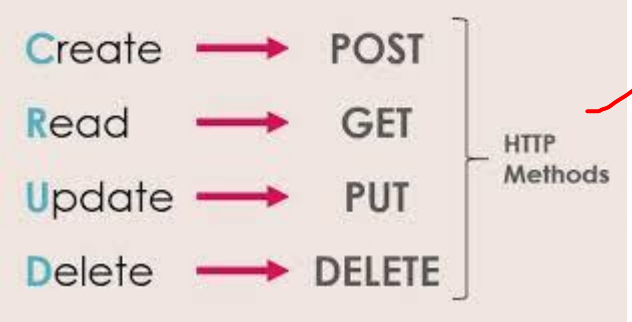


Comparison of lowlevel IOT prot.

Protocolli IoT	Standard	Frequenza	Range	Data Rates
Bluetooth	Bluetooth 4.2	2.4GHz (ISM)	50-150m (Smart/BLE)	1Mbps (Smart/BLE)
ZigBee	ZigBee 3.0 based on IEEE802.15.4	2.4GHz	10-100m	250kbps
6LoWPAN	RFC6282	(adapted and used over a variety of other networking media including Bluetooth Smart (2.4GHz) or ZigBee or low-power RF (sub-1GHz)	Vedi protocollo di supporto	Vedi protocollo di supporto
WiFi	Based on 802.11n (most common usage in homes today)	2.4GHz and 5GHz bands	Approximately 50m	600 Mbps maximum, but 150-200Mbps is more typical, depending on channel frequency used and number of antennas (latest 802.11-ac standard should offer 500Mbps to 1Gbps)
Cellular	GSM/GPRS/EDGE (2G), UMTS/HSPA (3G), LTE (4G)	900/1800/1900/2100MHz	35km max for GSM; 200km max for HSPA	(typical download): 35-170kps (GPRS), 120-384kbps (EDGE), 384Kbps-2Mbps (UMTS), 600kbps-10Mbps (HSPA), 3-10Mbps (LTE)
NFC	ISO/IEC 18000-3	13.56MHz (ISM)	10cm	100–420kbps
LoRaWAN	LoRaWAN	Various (europe, 868Mhz)	2-5km (urban 300 environment), 15km (suburban environment)	0.3-50 kbps

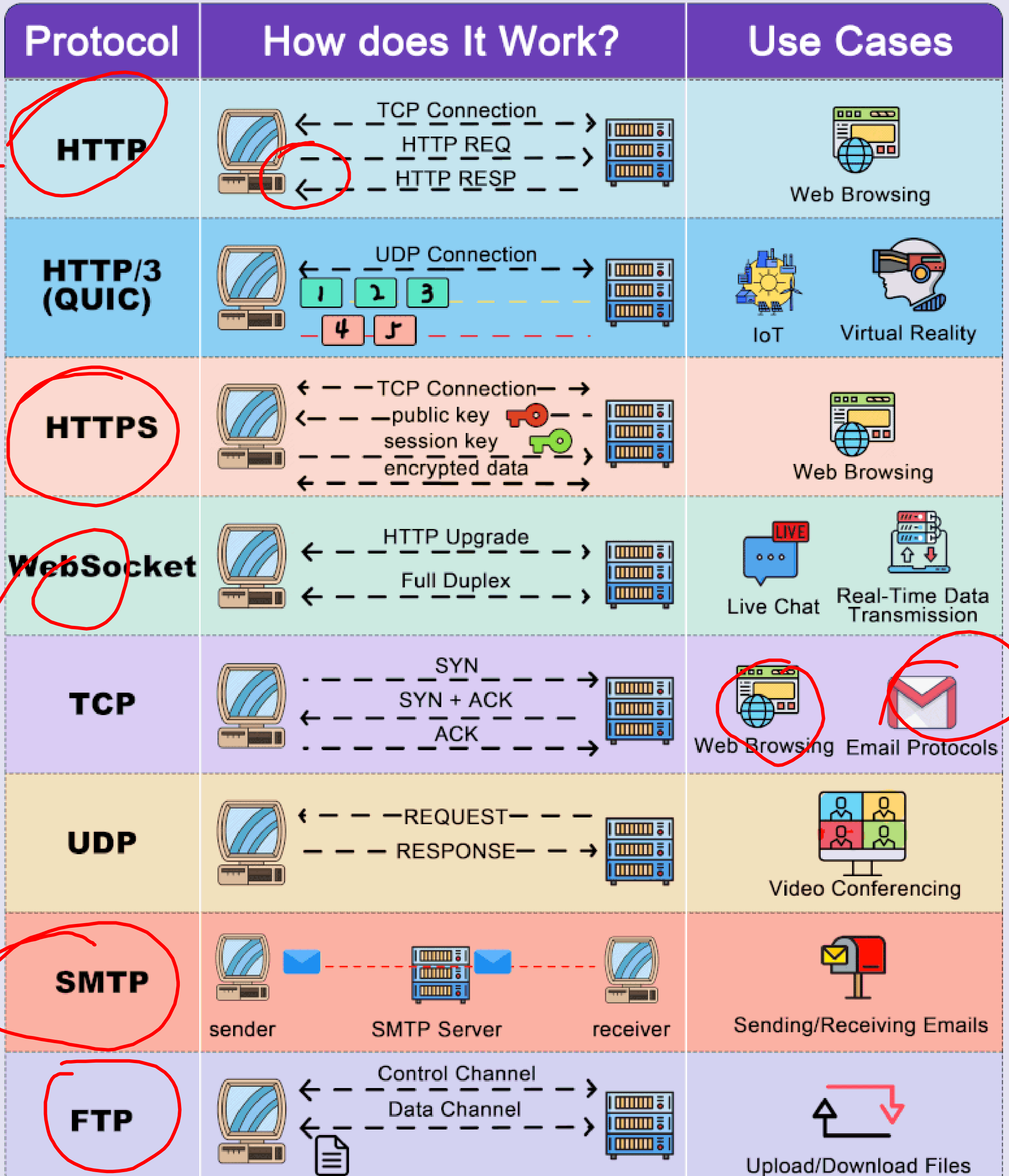

70%
60%
50%
40%
30%
20%
10%
0%
🟩 2016
🟦 2017
🟨 2018
62.61%
54.10%
34.95%
24.92%
22.49%
18.24%
12.77%
6.69%
5.78%
4.86%
4.26%
4.26%
1.52%
MQTT
HTTP
WEBSOCKETS
HTTP/2
COAP
AMQP
IN-HOUSE
OTHER
DON'T KNOW
DDS
PROPRIETARY..
XMPP
NONE

Main protocols



Create	→	POST
Read	→	GET
Update	→	PUT
Delete	→	DELETE

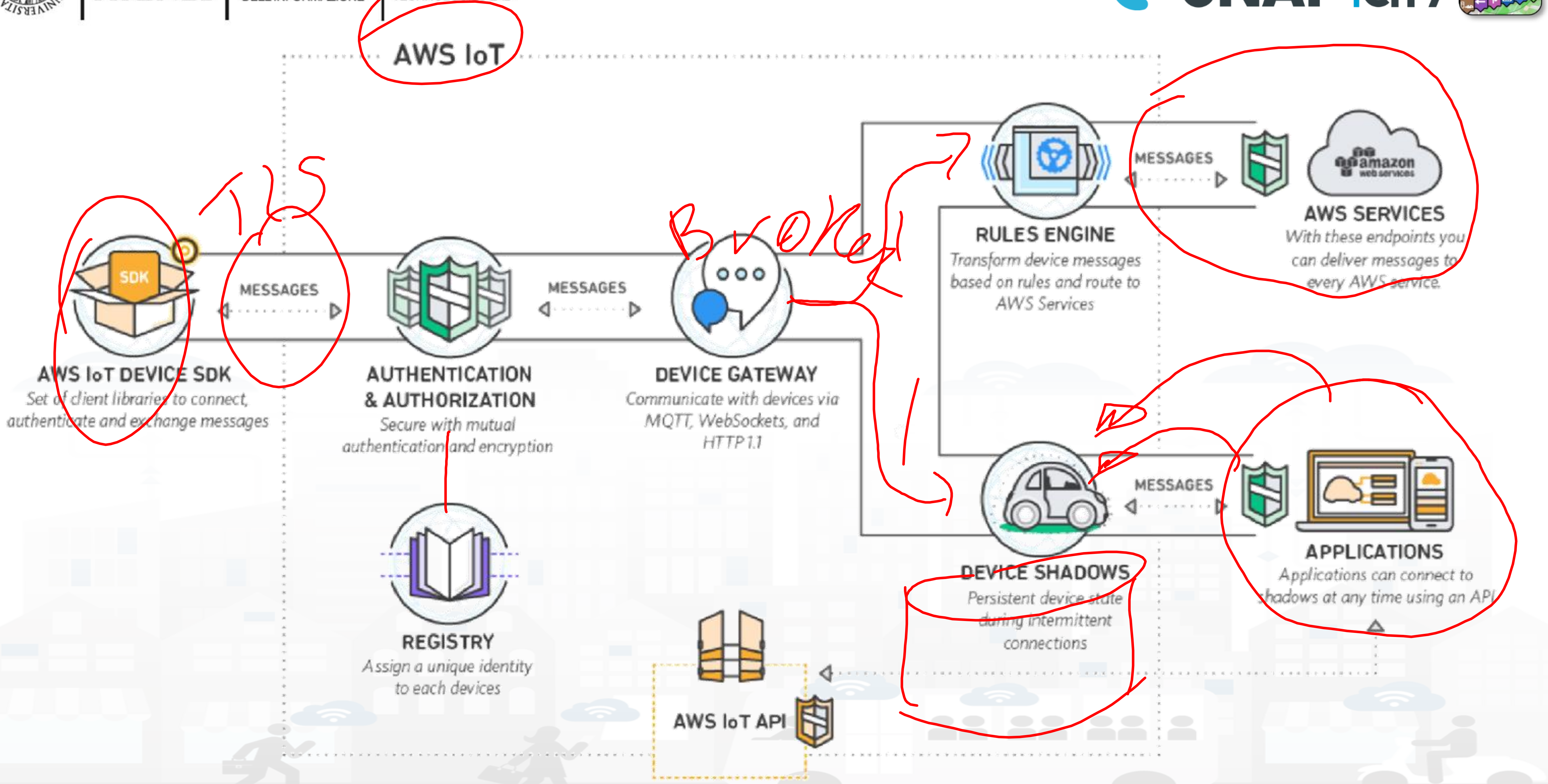
HTTP Methods



Protocol	How does It Work?	Use Cases
HTTP	TCP Connection HTTP REQ HTTP RESP	Web Browsing
HTTP/3 (QUIC)	UDP Connection 1 2 3 4 5	IoT Virtual Reality
HTTPS	TCP Connection public key session key encrypted data	Web Browsing
WebSocket	HTTP Upgrade Full Duplex	Live Chat Real-Time Data Transmission
TCP	SYN SYN + ACK ACK	Web Browsing Email Protocols
UDP	REQUEST RESPONSE	Video Conferencing
SMTP	sender SMTP Server receiver	Sending/Receiving Emails
FTP	Control Channel Data Channel	Upload/Download Files

http GET vs POST

	GET	POST
BACK button/Reload	Harmless	Data will be re-submitted (the browser should alert the user that the data are about to be re-submitted)
Bookmarked	Can be bookmarked	Cannot be bookmarked
Cached	Can be cached	Not cached
Encoding type	application/x-www-form-urlencoded	application/x-www-form-urlencoded or multipart/form-data. Use multipart encoding for binary data
History	Parameters remain in browser history	Parameters are not saved in browser history
Restrictions on data length	Yes, when sending data, the GET method adds the data to the URL; and the length of a URL is limited (maximum URL length is 2048 characters)	No restrictions
Restrictions on data type	Only ASCII characters allowed	No restrictions. Binary data is also allowed
Security	GET is less secure compared to POST because data sent is part of the URL Never use GET when sending passwords or other sensitive information!	POST is a little safer than GET because the parameters are not stored in browser history or in web server logs
Visibility	Data is visible to everyone in the URL	Data is not displayed in the URL



AWS IoT

TLS

Broker

AWS IoT DEVICE SDK
Set of client libraries to connect, authenticate and exchange messages

AUTHENTICATION & AUTHORIZATION
Secure with mutual authentication and encryption

DEVICE GATEWAY
Communicate with devices via MQTT, WebSockets, and HTTP 1.1

REGISTRY
Assign a unique identity to each devices

RULES ENGINE
Transform device messages based on rules and route to AWS Services

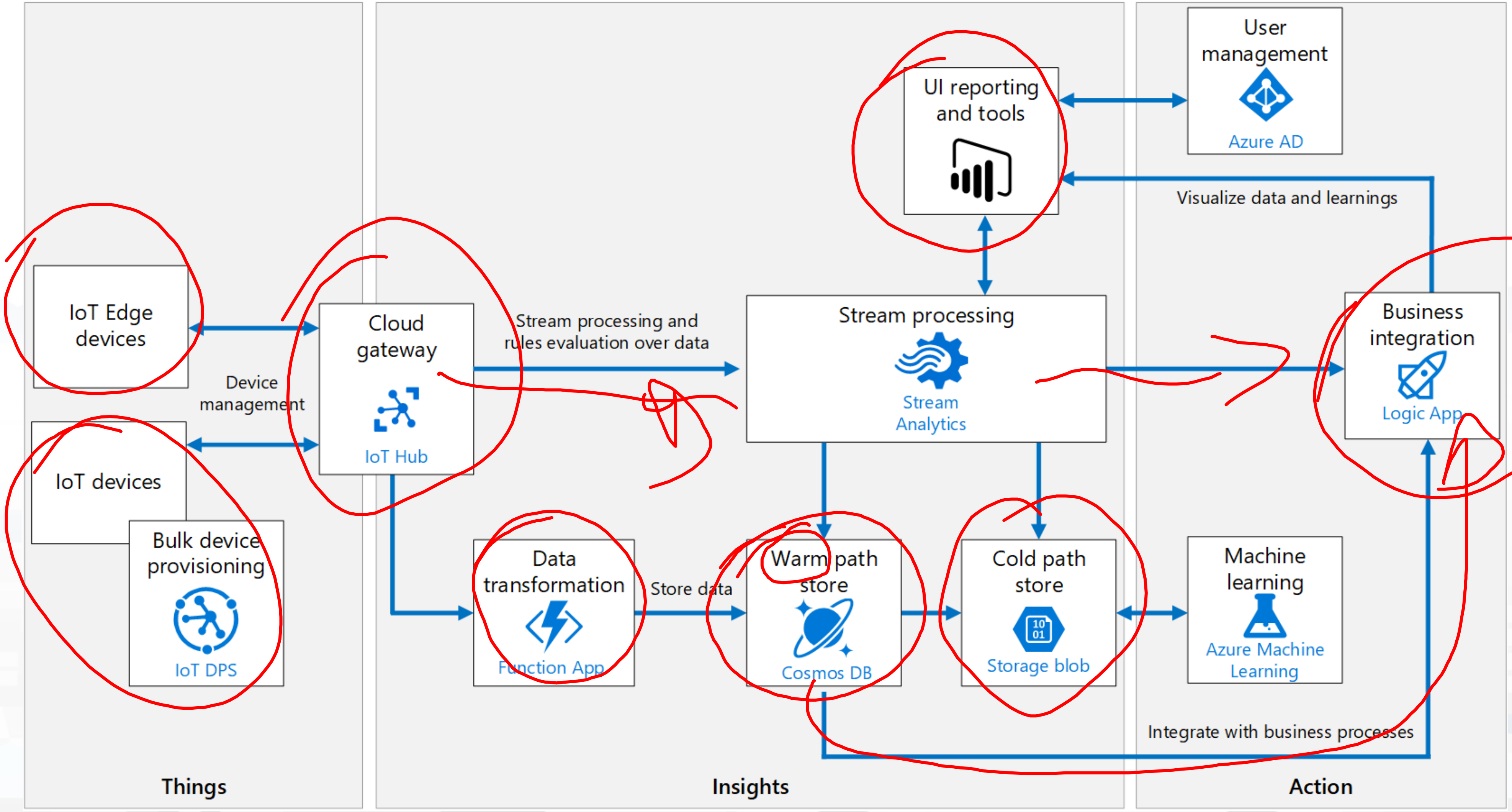
AWS SERVICES
With these endpoints you can deliver messages to every AWS service.

DEVICE SHADOWS
Persistent device state during intermittent connections

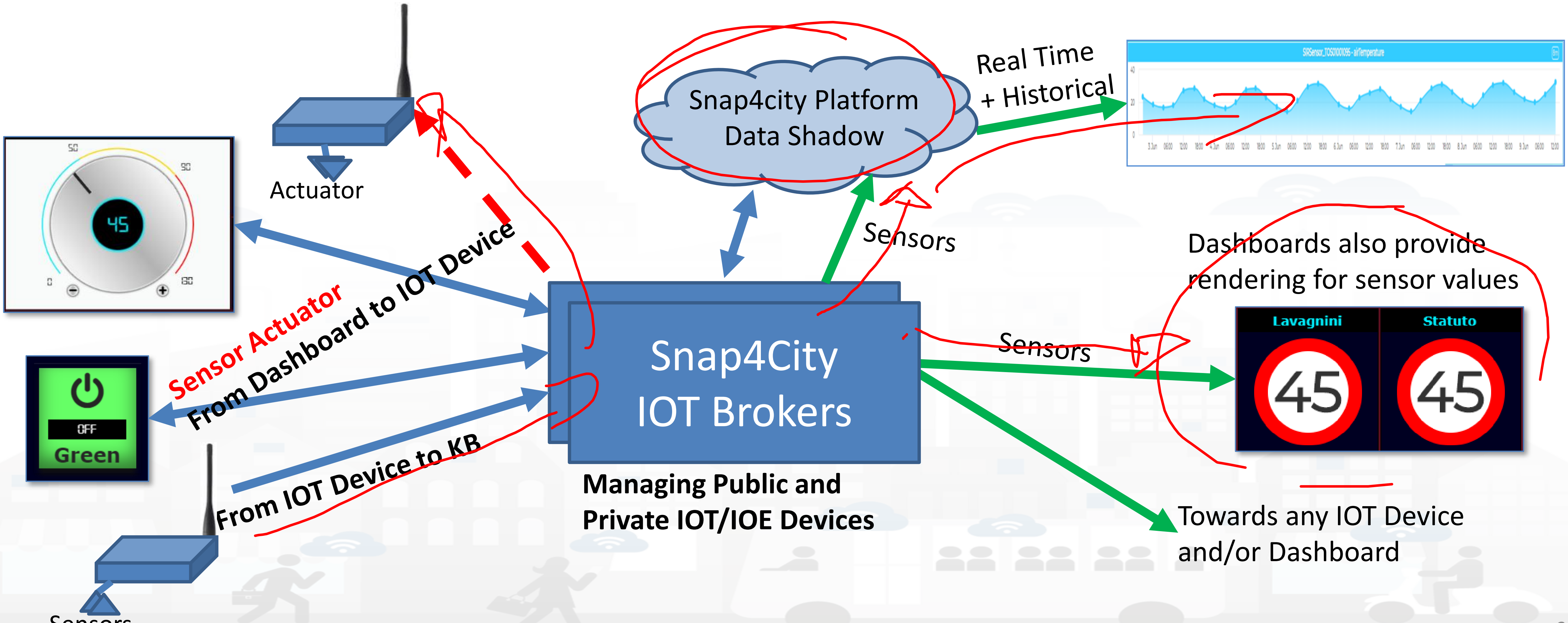
APPLICATIONS
Applications can connect to shadows at any time using an API

AWS IoT API

Azure Microsoft IoT (1)



IOT Event Driven

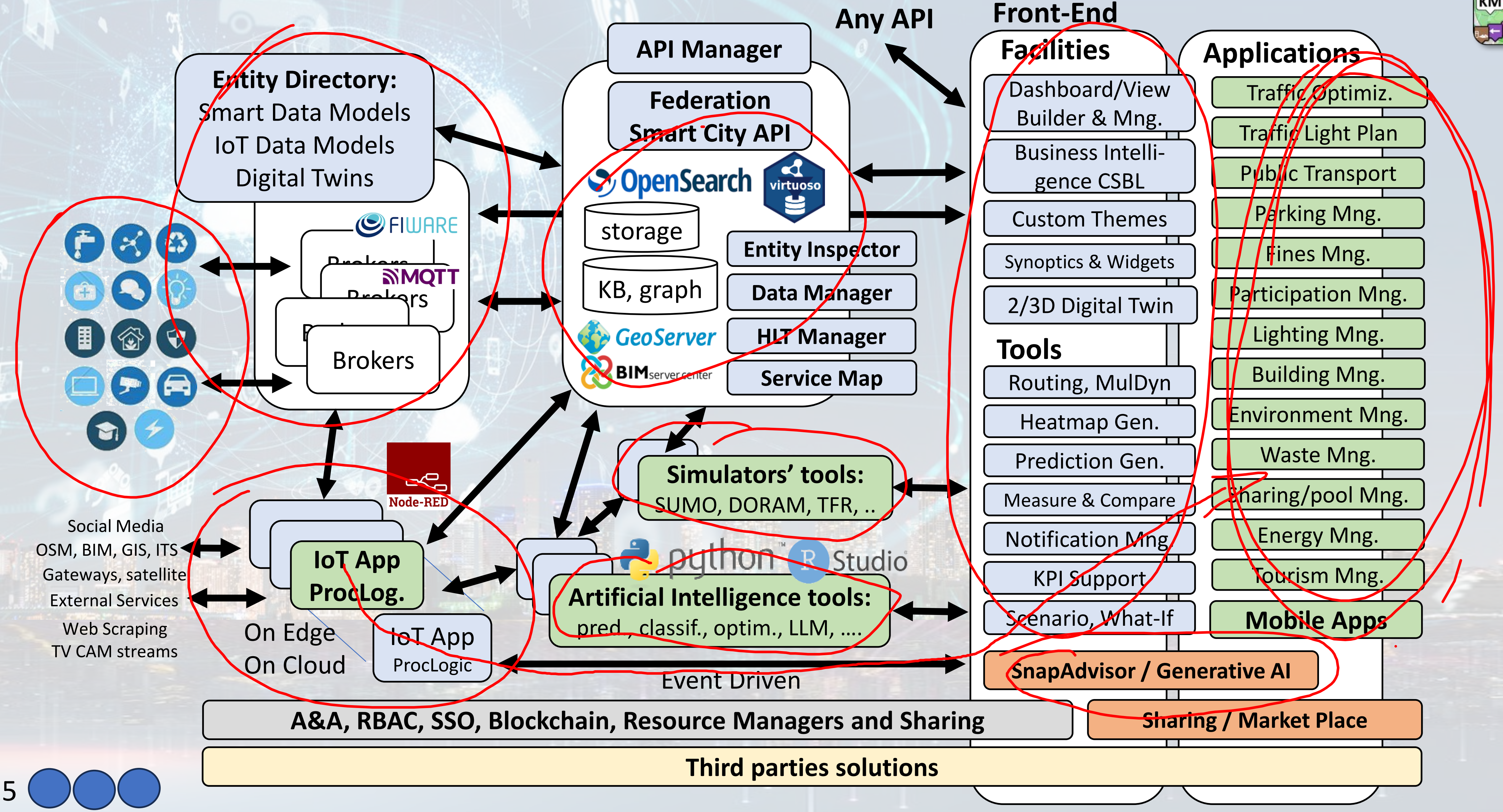


Managing Public and Private IOT/IOE Devices

Dashboards also provide rendering for sensor values

Towards any IOT Device and/or Dashboard

Technical Architecture



Any API

Front-End

Facilities

Dashboard/View Builder & Mng.

Business Intelligence CSBL

Custom Themes

Synoptics & Widgets

2/3D Digital Twin

Tools

Routing, MulDyn

Heatmap Gen.

Prediction Gen.

Measure & Compare

Notification Mng

KPI Support

Scenario, What-If

Applications

Traffic Optimiz.

Traffic Light Plan

Public Transport

Parking Mng.

Fines Mng.

Participation Mng.

Lighting Mng.

Building Mng.

Environment Mng.

Waste Mng.

Sharing/pool Mng.

Energy Mng.

Tourism Mng.

Mobile Apps

SnapAdvisor / Generative AI

Entity Directory: Smart Data Models IoT Data Models Digital Twins

FIWARE

MQTT

Brokers

API Manager

Federation Smart City API

OpenSearch

virtuoso

storage

KB, graph

GeoServer

BIMserver.center

Entity Inspector

Data Manager

HLT Manager

Service Map

Node-RED

Social Media

OSM, BIM, GIS, ITS

Gateways, satellite

External Services

Web Scraping

TV CAM streams

IoT App ProcLog.

On Edge

On Cloud

IoT App ProcLogic

Simulators' tools: SUMO, DORAM, TFR, ..

python

R Studio

Artificial Intelligence tools: pred., classif., optim., LLM, ...

Event Driven

A&A, RBAC, SSO, Blockchain, Resource Managers and Sharing

Sharing / Market Place

Third parties solutions

Standards and Interoperability (10/2024)

Compliant with:

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

https://www.snap4city.org/65

Agenda

- Architetture IoT/IoE, reti, formati e protocolli, pattern
- Protocolli tipi IoT vs protocolli industriali
- Interoperabilità, protocolli push e pull
- Concetti di broker, gateway, adapter
- **JSON, JavaScript, Node-RED**
- Esercitazione on Node-RED JavaScript
- Data Ingestion processing
- Test

IOT Application Editor: NODE-RED

Node-RED

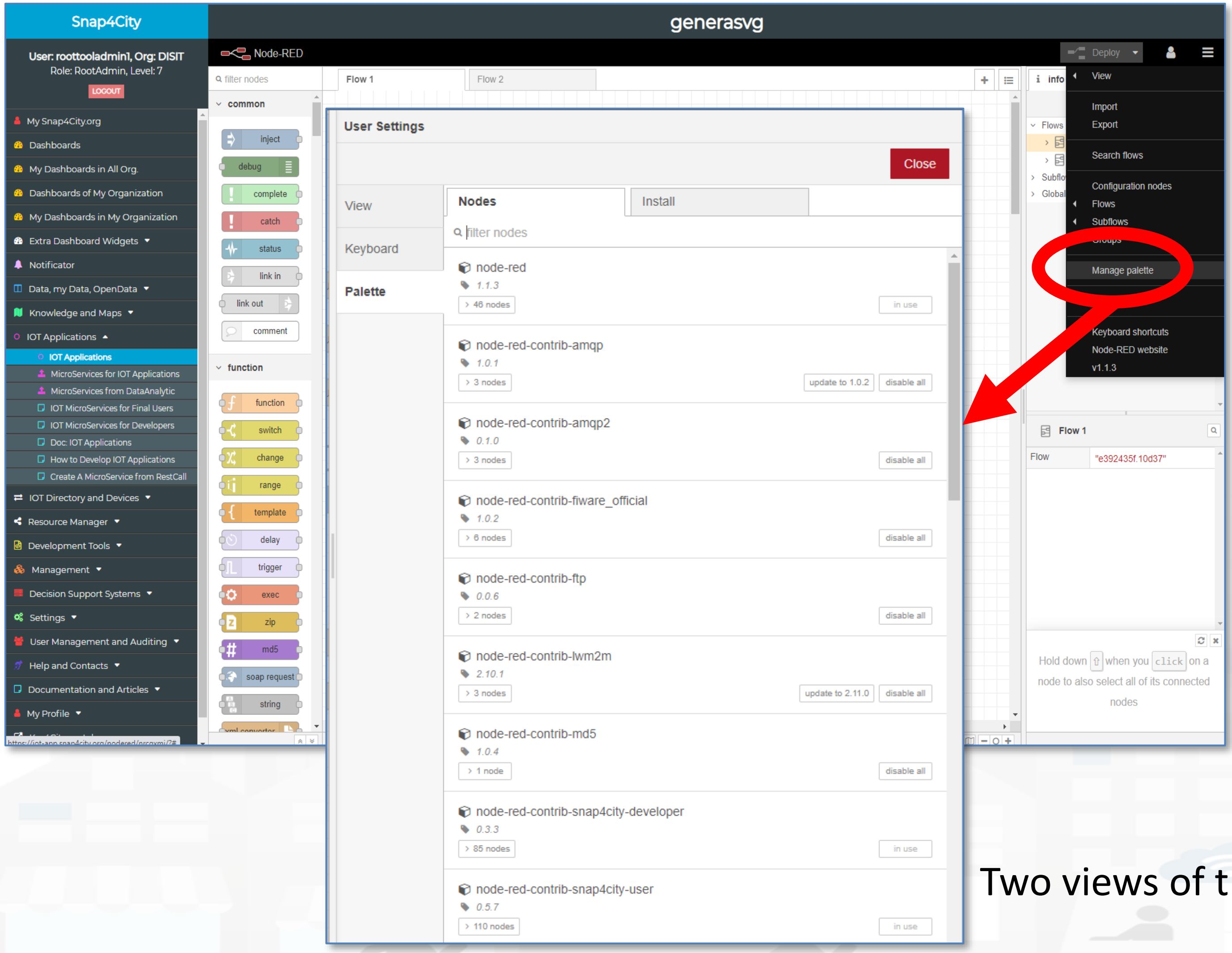
- In the **IOT Application of Snap4City**, it is possible to:
  - Execute flows that process data as: Event Driven, Batch (periodic or not)
  - Create multiple concurrent Flows for each IOT Application
  - Create subflows as macros to be reused
  - Create Groups of nodes as macro
  - **Save/load**, **share**, 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 Application Editor: NODE-RED

Node-RED

- In the **IOT Apps 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 Apps** above the Limit that may depend on the organization and/or on personal authorizations, ask to Admin
  - ..

Load Library from Palette



Snap4City

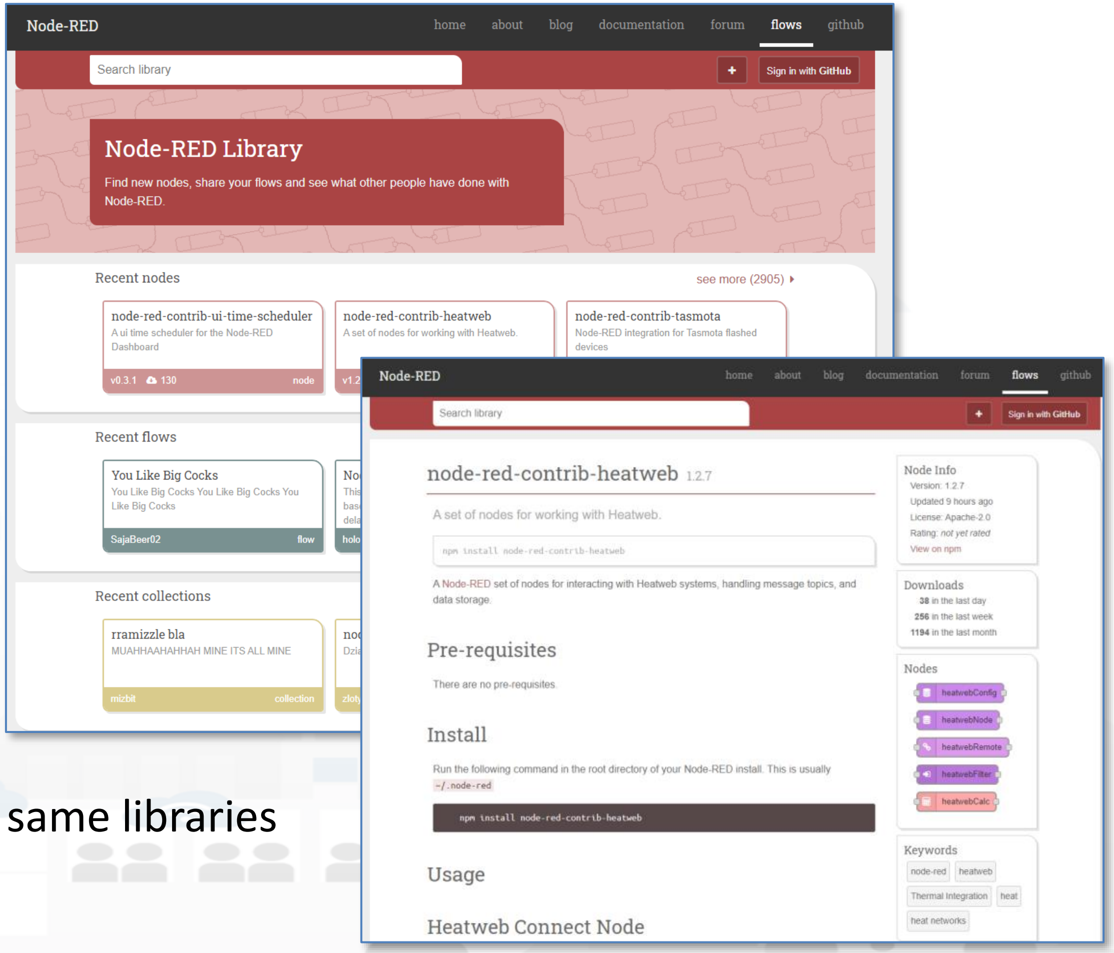
generasvg

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

User Settings

Node	Version	Nodes	Actions
node-red	1.1.3	46 nodes	in use
node-red-contrib-amqp	1.0.1	3 nodes	update to 1.0.2 · disable all
node-red-contrib-amqp2	0.1.0	3 nodes	disable all
node-red-contrib-fiware_official	1.0.2	6 nodes	disable all
node-red-contrib-ftp	0.0.6	2 nodes	disable all
node-red-contrib-lwm2m	2.10.1	3 nodes	update to 2.11.0 · disable all
node-red-contrib-md5	1.0.4	1 node	disable all
node-red-contrib-snap4city-developer	0.3.3	85 nodes	in use
node-red-contrib-snap4city-user	0.5.7	110 nodes	in use

https://flows.nodered.org/



Node-RED Library

Find new nodes, share your flows and see what other people have done with Node-RED.

Recent nodes — see more (2905)

- node-red-contrib-ui-time-scheduler — A ui time scheduler for the Node-RED Dashboard — v0.3.1 · 130 · node
- node-red-contrib-heatweb — A set of nodes for working with Heatweb.
- node-red-contrib-tasmota — Node-RED integration for Tasmota flashed devices

Recent flows

- You Like Big Cocks — You Like Big Cocks You Like Big Cocks You Like Big Cocks — SajaBeer02 · flow

Recent collections

- rramizzle bla — MUAHHAAHAHHAH MINE ITS ALL MINE — mizbit · collection

node-red-contrib-heatweb 1.2.7

A set of nodes for working with Heatweb.

```
npm install node-red-contrib-heatweb
```

A Node-RED set of nodes for interacting with Heatweb systems, handling message topics, and data storage.

Pre-requisites

There are no pre-requisites

Install

Run the following command in the root directory of your Node-RED install. This is usually ~/.node-red

```
npm install node-red-contrib-heatweb
```

Usage

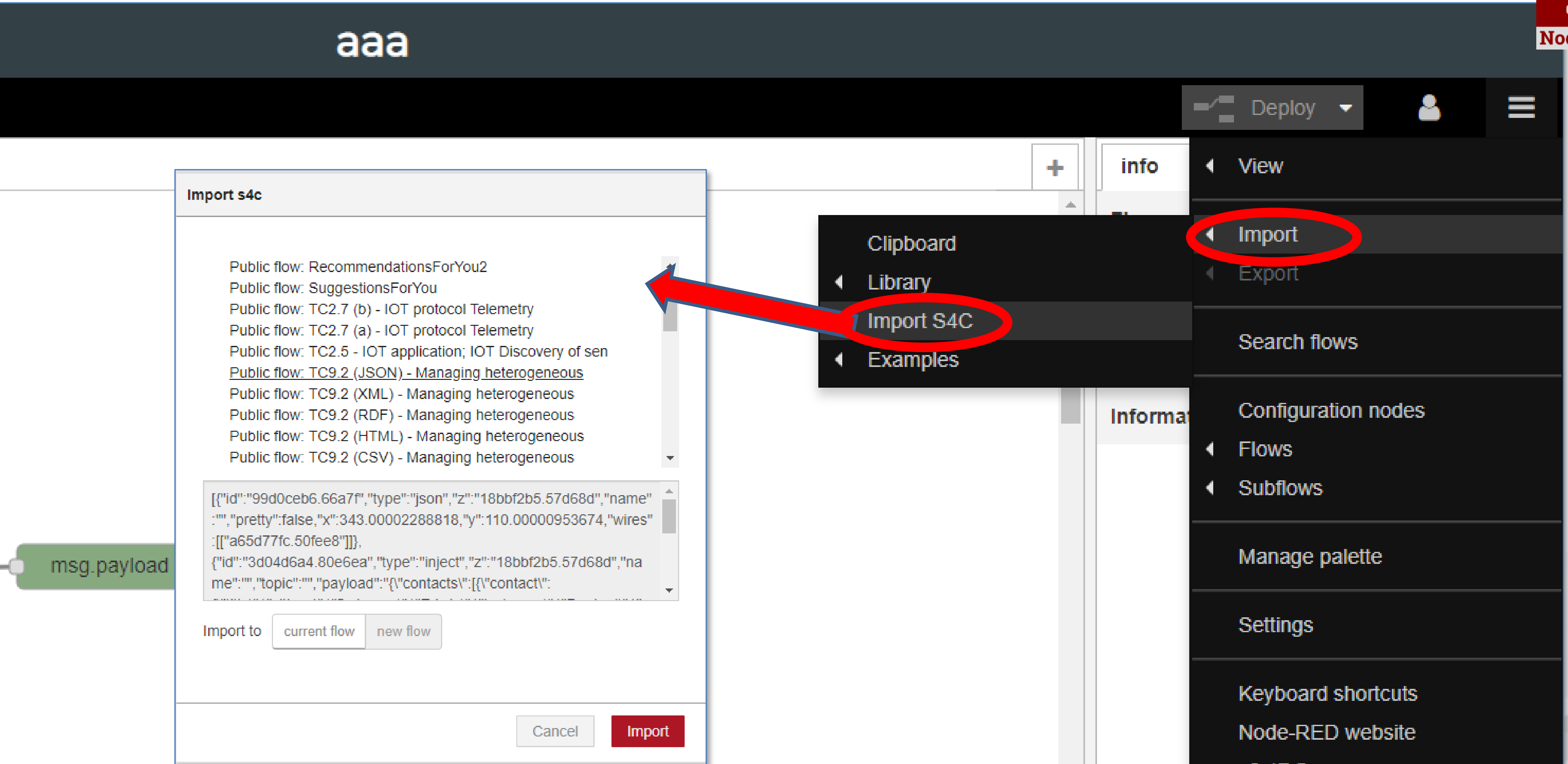
Heatweb Connect Node

Node Info
Version: 1.2.7
Updated 9 hours ago
License: Apache-2.0
Rating: not yet rated
View on npm

Downloads
38 in the last day
256 in the last week
1194 in the last month

Two views of the same libraries

Load an IOT application of example



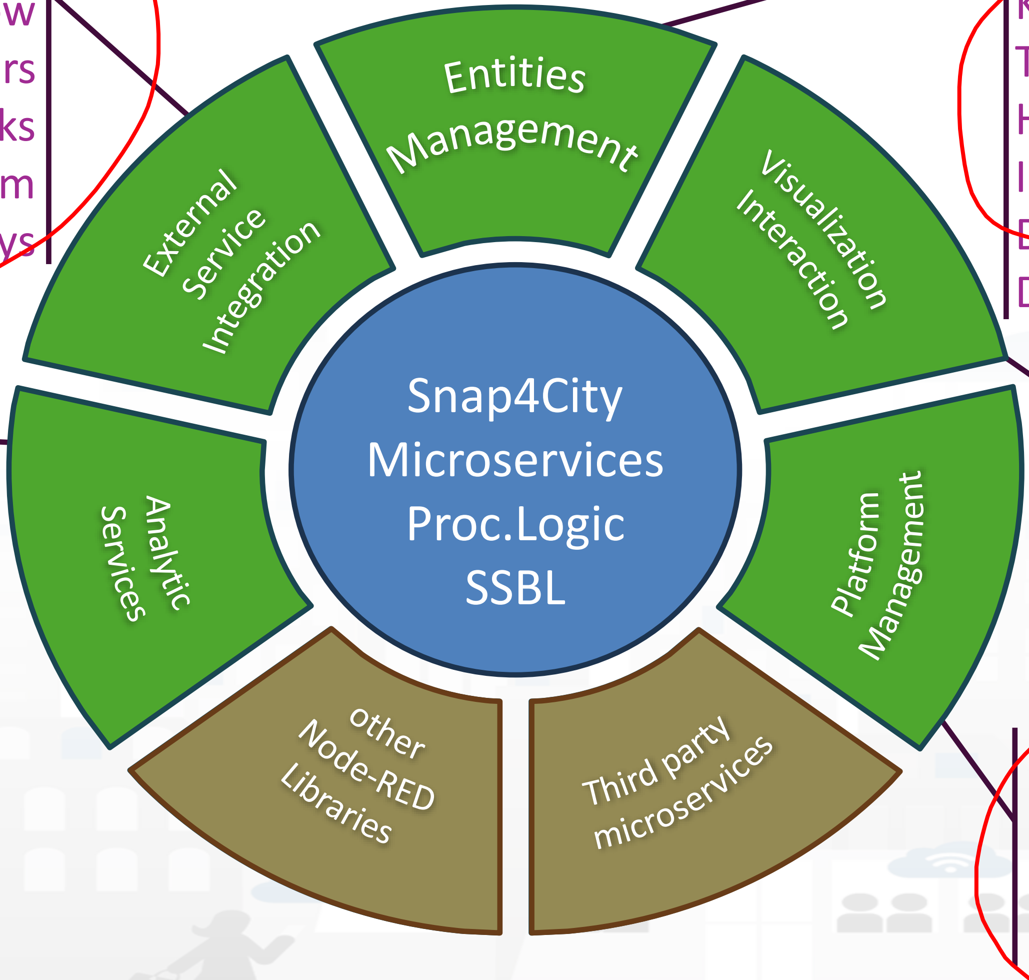
Public flow: RecommendationsForYou2
Public flow: SuggestionsForYou
Public flow: TC2.7 (b) - IOT protocol Telemetry
Public flow: TC2.7 (a) - IOT protocol Telemetry
Public flow: TC2.5 - IOT application; IOT Discovery of sen
Public flow: TC9.2 (JSON) - Managing heterogeneous
Public flow: TC9.2 (XML) - Managing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

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

MicroServices Areas

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

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


Entities Management
Visualization Interaction
Platform Management
Third party microservices
other Node-RED Libraries
Analytic Services
External Service Integration
Snap4City Microservices Proc.Logic SSBL

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

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

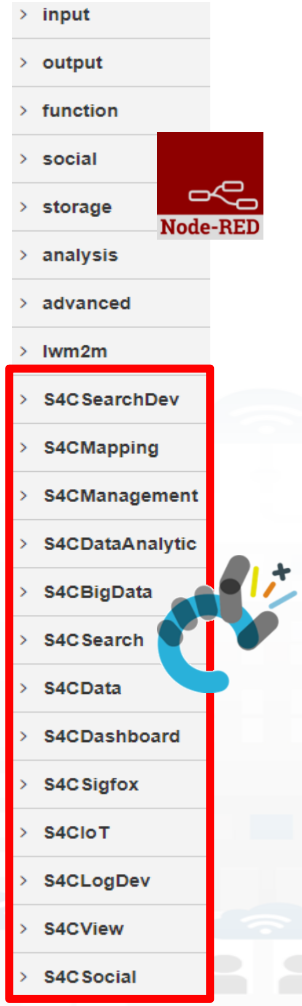
IoTApp Management
Data Logs, A&A, Security
Ownership Management
VPN remote access

Node-RED

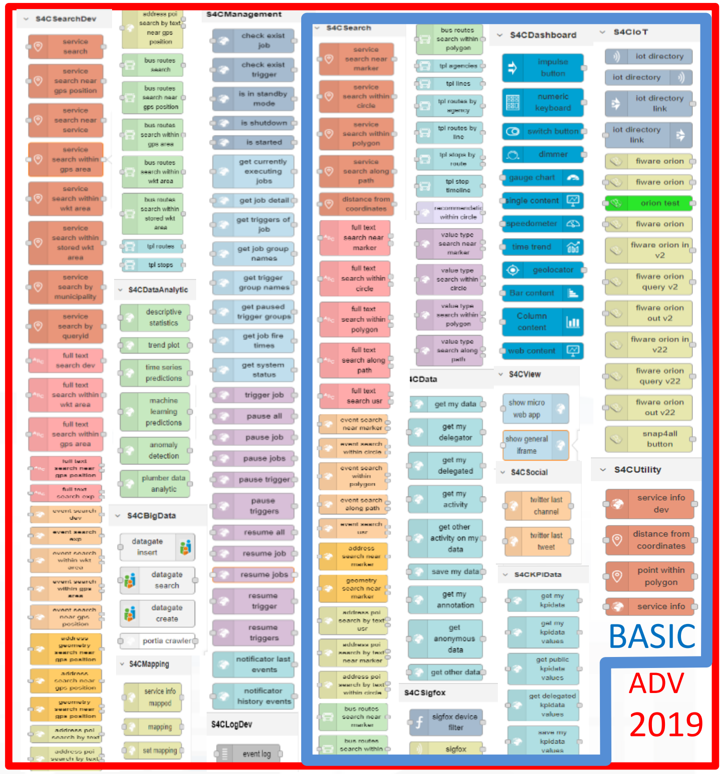
IOT Applications

IOT Applications = Node-RED + Snap4City Platform

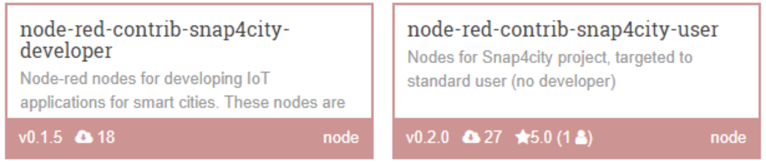
- A collection of more than **150 MicroServices** have been developed covering the above-mentioned requirements and much more.
- The issue was not only to formalize the MicroServices, but also to create the infrastructure that enable their usage. In many cases, the simple MicroServices hide very **complex** and **sophisticate tools and algorithms (Snap4city Platform)**.
- They are formally distributed as two official libraries of Node-RED nodes (**Snap4City Basic and Advanced**) by the JS Foundation portal.
- They can be **directly installed** in any Node-RED tool of any operating system.



- input
- output
- function
- social
- storage
- analysis
- advanced
- lwm2m
- S4CSearchDev
- S4CMapping
- S4CManagement
- S4CDataAnalytic
- S4CBigData
- S4CSearch
- S4CData
- S4CDashboard
- S4CSigfox
- S4CIoT
- S4CLogDev
- S4CView
- S4CSocial



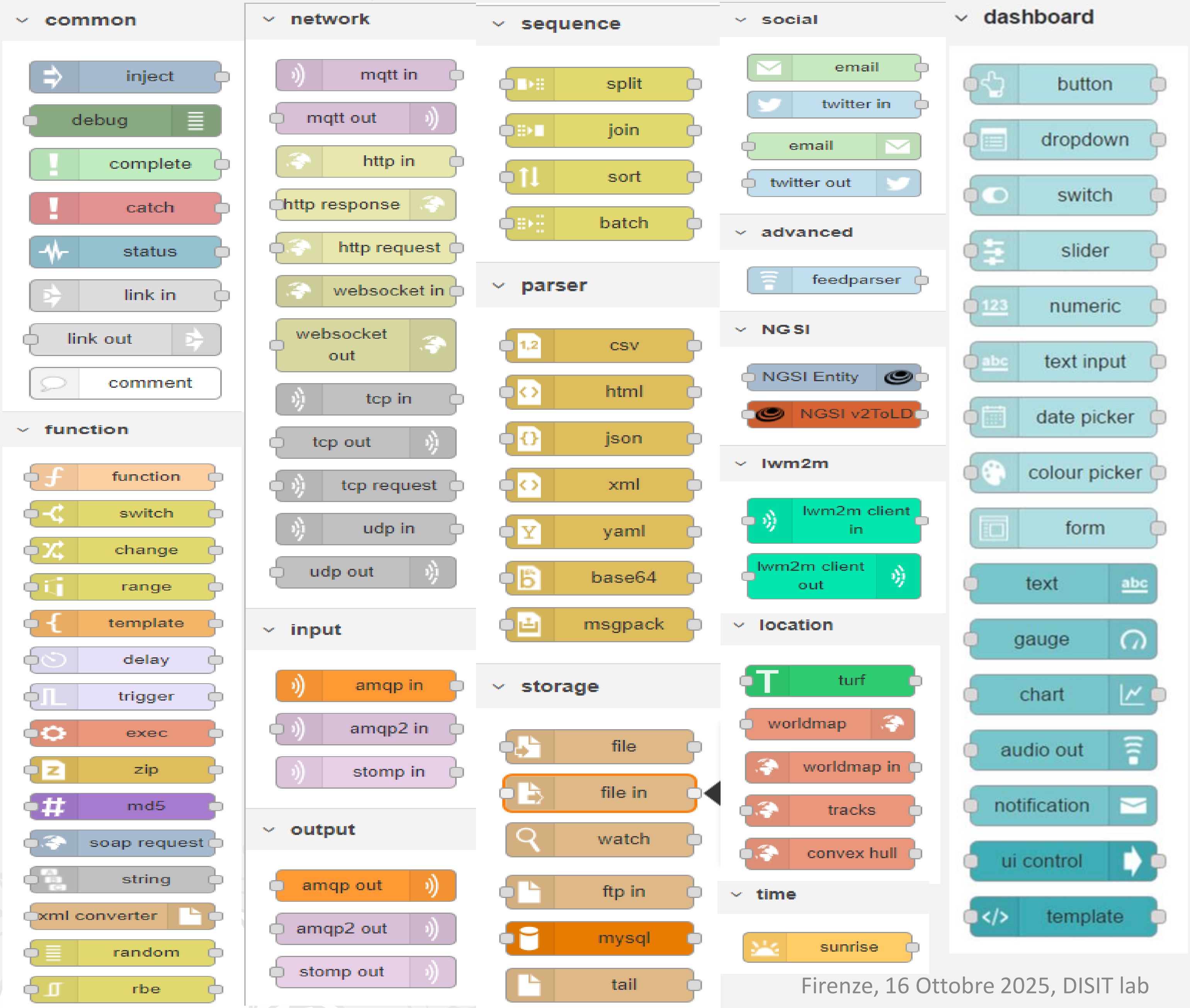
https://flows.nodered.org/?term=snap4city



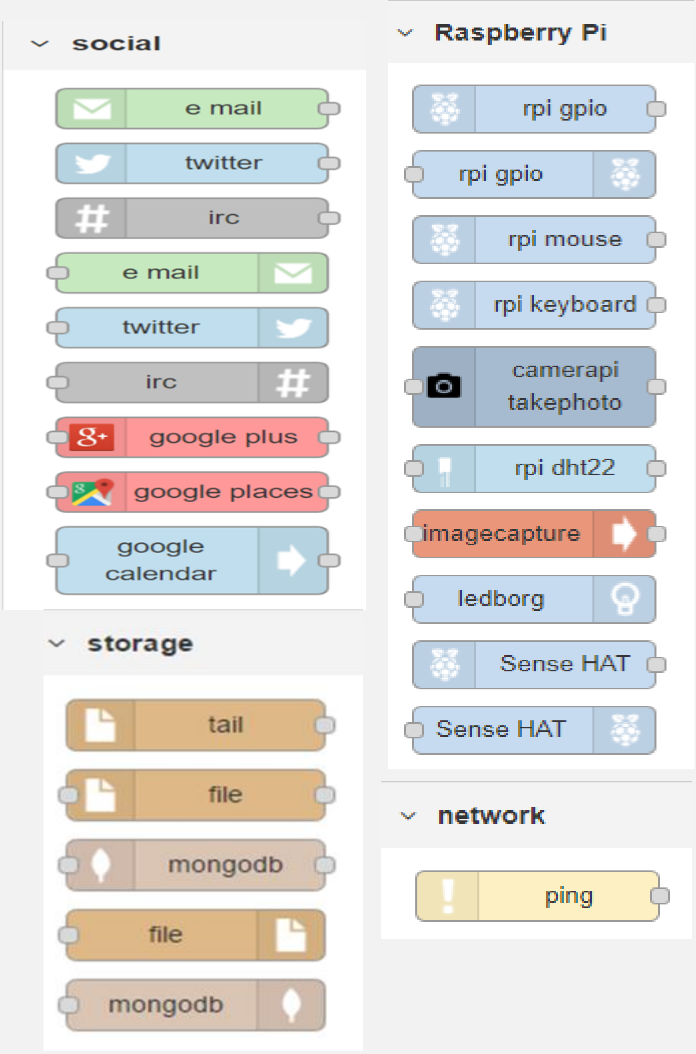
node-red-contrib-snap4city-developer
Node-red nodes for developing IoT applications for smart cities. These nodes are
v0.1.5 18 node

node-red-contrib-snap4city-user
Nodes for Snap4city project, targeted to standard user (no developer)
v0.2.0 27 ★5.0 (1) node

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



+ on IOT Edge Raspberry

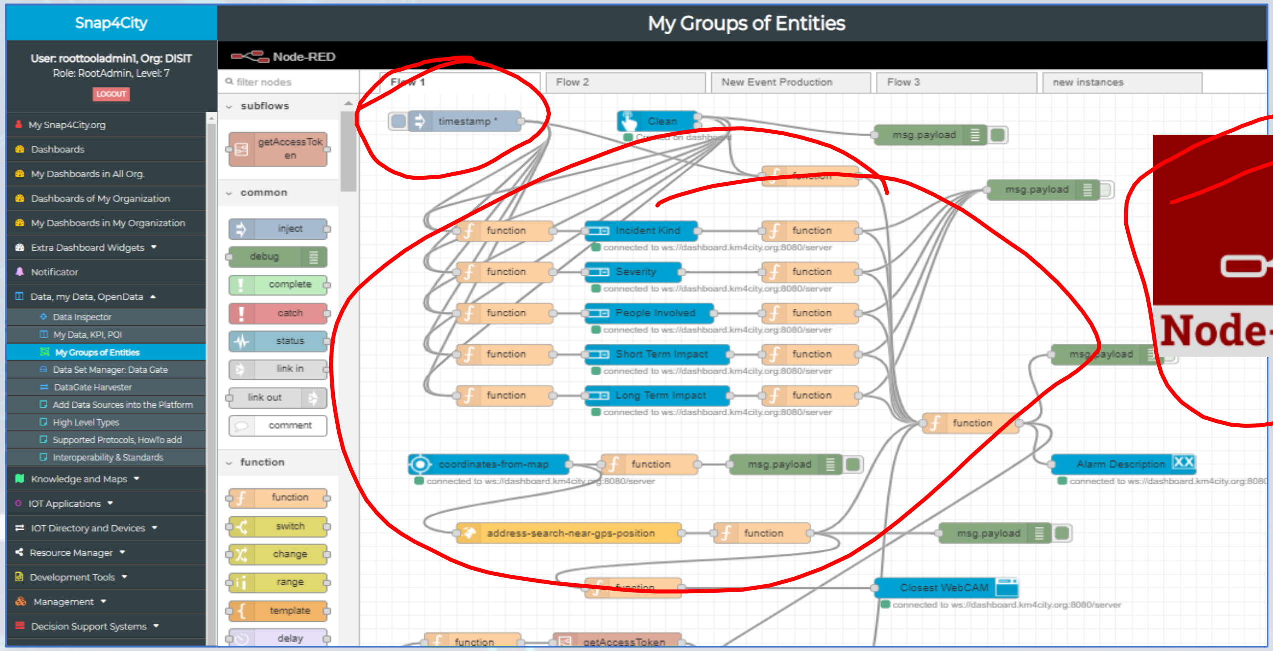


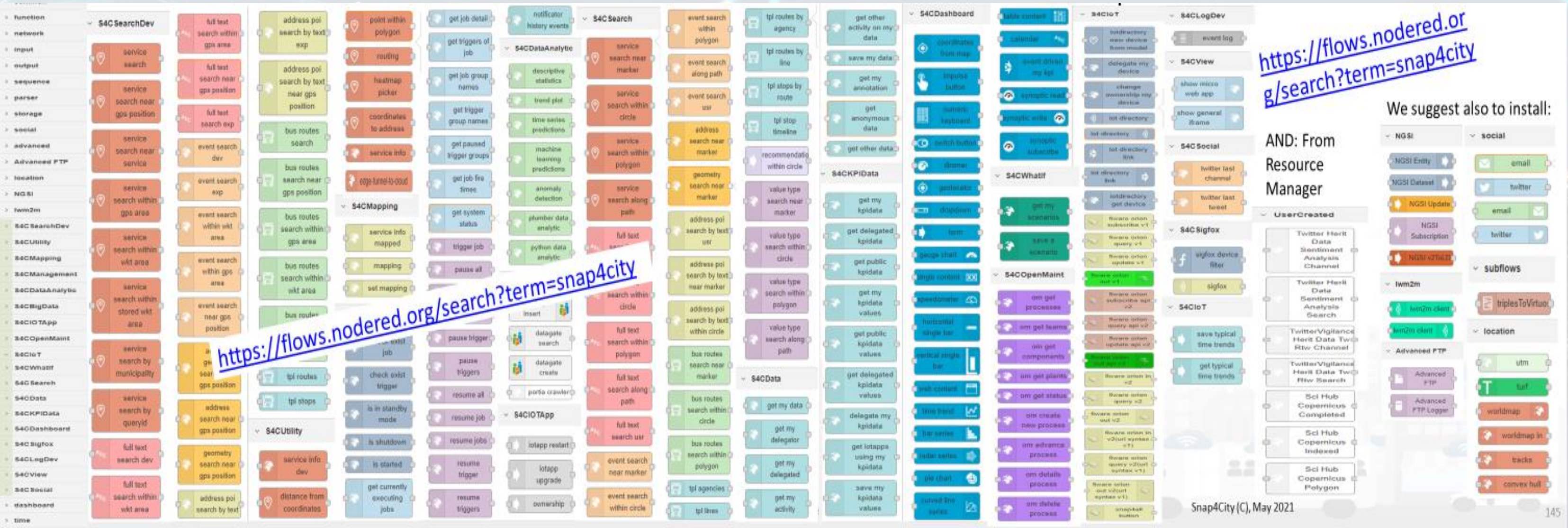
IoT Applications

- **Data ingestion**: more than 70 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.
- **Data access**: save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, etc.
- **Data Transformation/transcoding:** binary, hexadecimal, XML, JSON, String, any format
- **Integration**: CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIMServer, any external service REST Call, etc.
- **Manipulation of complex data**: heatmaps, scenarios, typical time trend, multi series, calendar, maps, etc.
- **Access to Smart City Entities and exploitation of Smart City Services**: transport, parking, POI, KPI, personal data, scenarios, etc.
- **Data Analytic**: managing Python native, calling and scheduling Python/Rstudio containers as snap4city microservices (predictions, anomaly detection, statistics, etc.)
- **User interaction on Dashboard**: get data and message from the user interface, providing messages to the user (form, buttons, switches, animations, selector, maps, etc.)
- **Custom Widgets**: SVG, synoptics, animations, dynamic pins on maps, etc
- **Event management**: Telegram, Twitter, Facebook, SMS, WhatsApp, CAP, etc.
- **Hardware Specific Devices**: Raspberry Pi, Android, Philips, video wall management, etc.

Ingestion, aggreg. → exploitation

- **IoT App Visual Programming, no coding**
  - **Data transformation**
  - **Integration, Interoperab.**
  - **Scripting Data Analytics**
  - **Data ingestion**
  - **Business logic**
- **Edge and Cloud**
- **MicroServices** data driven develop via visual language Node-RED





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

https://flows.nodered.or g/search?term=snap4city

AND: From Resource Manager

We suggest also to install:

Snap4City (C), May 2021

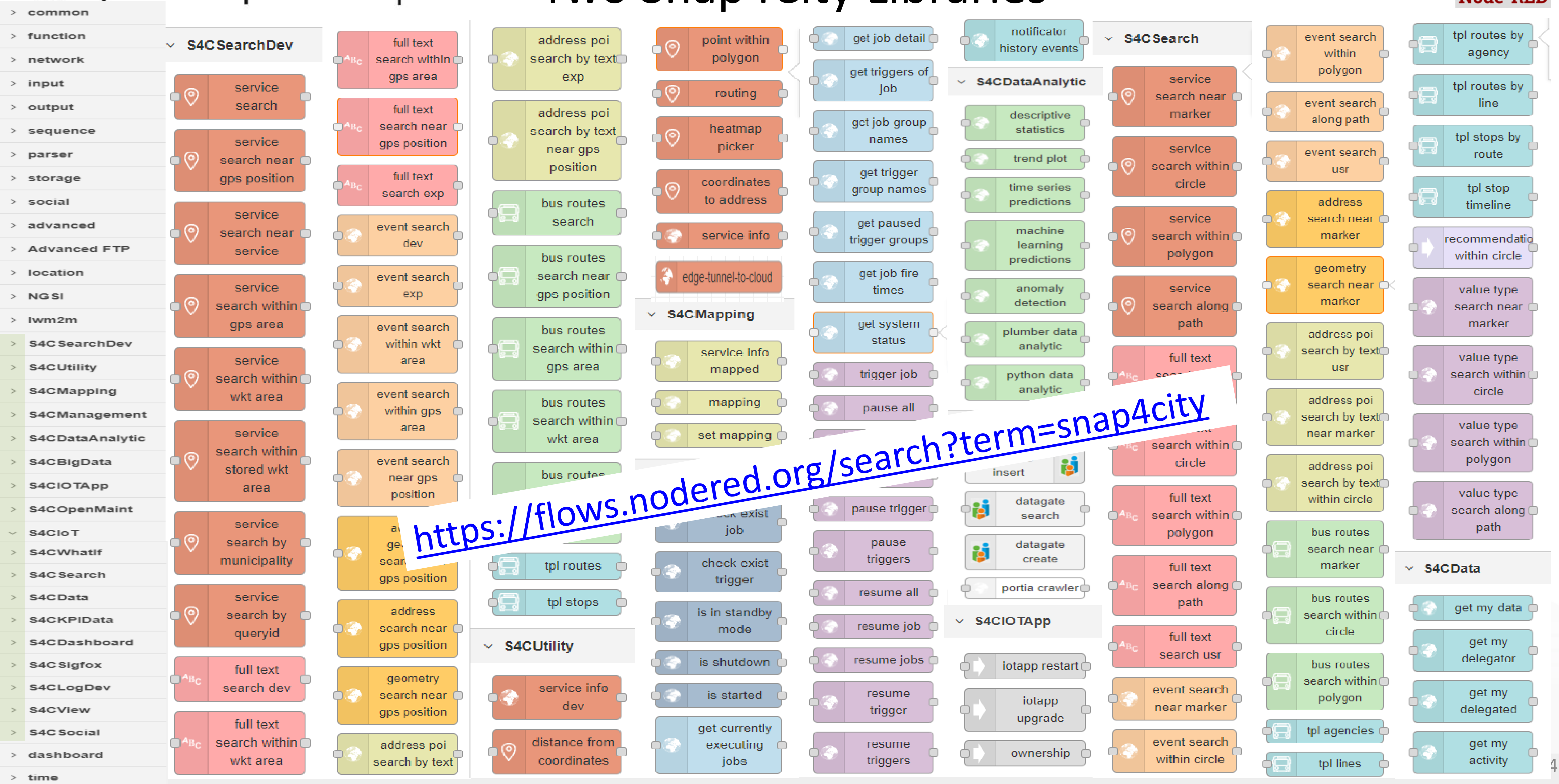
UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

2024 collection
Two Snap4City Libraries

SNAP4CITY Node-RED



- common
- function
- network
- input
- output
- sequence
- parser
- storage
- social
- advanced
- Advanced FTP
- location
- NGSI
- lwm2m
- S4CSearchDev
- S4CUtility
- S4CMapping
- S4CManagement
- S4CDataAnalytic
- S4CBigData
- S4CIOTApp
- S4COpenMaint
- S4CIoT
- S4CWhatIf
- S4CSearch
- S4CData
- S4CKPIData
- S4CDashboard
- S4CSigfox
- S4CLogDev
- S4CView
- S4CSocial
- dashboard
- time

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
- 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
- a ge sear 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
- tpl routes
- tpl stops

S4CUtility

- service info dev
- distance from coordinates
- point within polygon
- routing
- heatmap picker
- coordinates to address
- service info
- edge-tunnel-to-cloud

S4CMapping

- service info mapped
- mapping
- set mapping
- ck exist job
- check exist trigger
- is in standby mode
- is shutdown
- is started
- get currently executing jobs
- get job detail
- get triggers of job
- get job group names
- get trigger group names
- get paused trigger groups
- get job fire times
- get system status
- trigger job
- pause all
- pause trigger
- pause triggers
- resume all
- resume job
- resume jobs
- resume trigger
- resume triggers
- notificator history events

S4CDataAnalytic

- descriptive statistics
- trend plot
- time series predictions
- machine learning predictions
- anomaly detection
- plumber data analytic
- python data analytic
- insert
- datagate search
- datagate create
- portia crawler

S4CIOTApp

- iotapp restart
- iotapp upgrade
- ownership

S4CSearch

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

S4CData

- get my data
- get my delegator
- get my delegated
- get my activity

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

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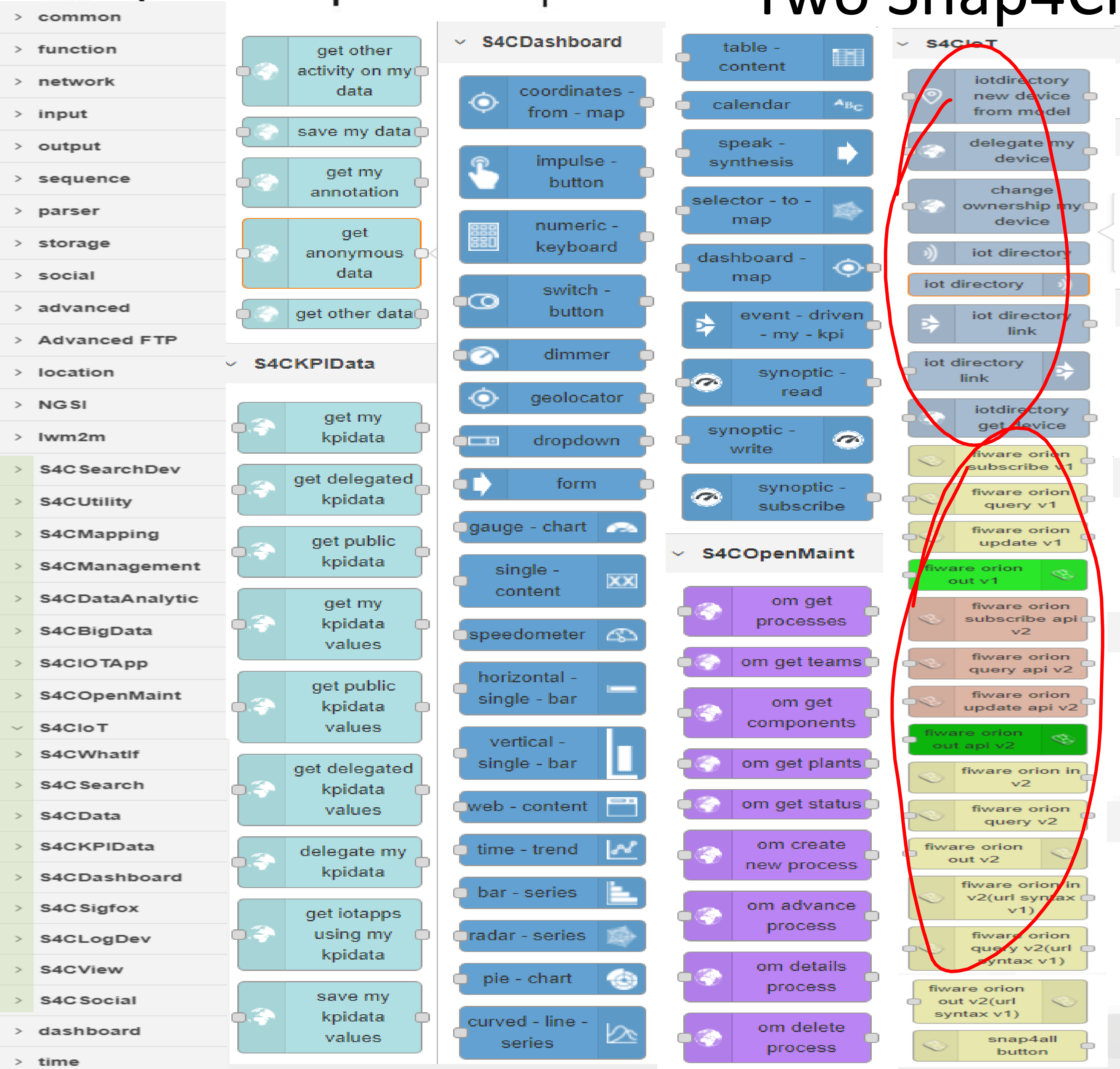
2024 collection

Two Snap4Citv Libraries

SNAP4CITY | Node-RED



common
function
network
input
output
sequence
parser
storage
social
advanced
Advanced FTP
location
NGSI
lwm2m
S4CSearchDev
S4CUtility
S4CMapping
S4CManagement
S4CDataAnalytic
S4CBigData
S4CIOTApp
S4COpenMaint
S4CIoT
S4CWhatIf
S4CSearch
S4CData
S4CKPIData
S4CDashboard
S4CSigfox
S4CLogDev
S4CView
S4CSocial
dashboard
time

get other activity on my data
save my data
get my annotation
get anonymous data
get other data

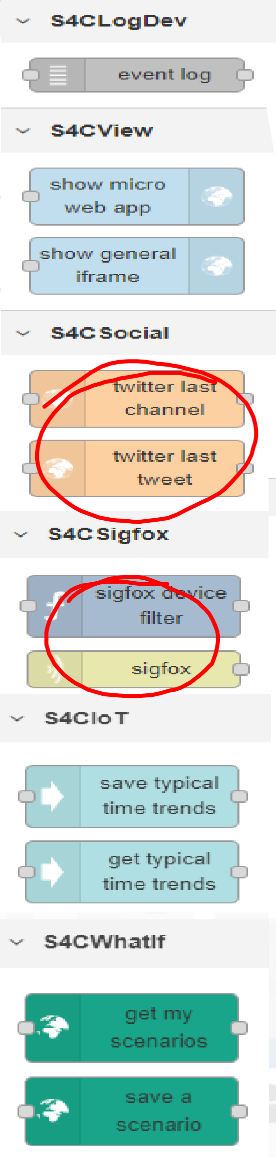
S4CKPIData
get my kpidata
get delegated kpidata
get public kpidata
get my kpidata values
get public kpidata values
get delegated kpidata values
delegate my kpidata
get iotapps using my kpidata
save my kpidata values

S4CDashboard
coordinates - from - map
impulse - button
numeric - keyboard
switch - button
dimmer
geolocator
dropdown
form
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
selector - to - map
dashboard - map
event - driven - my - kpi
synoptic - read
synoptic - write
synoptic - subscribe

S4COpenMaint
om get processes
om get teams
om get components
om get plants
om get status
om create new process
om advance process
om details process
om delete process

S4CIoT
iotdirectory new device from model
delegate my device
change ownership my device
iot directory
iot directory
iot directory link
iot directory link
iotdirectory get device
fiware orion subscribe v1
fiware orion query v1
fiware orion update v1
fiware orion out v1
fiware orion subscribe api v2
fiware orion query api v2
fiware orion update api v2
fiware orion out api v2
fiware orion in v2
fiware orion query v2
fiware orion out v2
fiware orion in v2(url syntax v1)
fiware orion query v2(url syntax v1)
fiware orion out v2(url syntax v1)
snap4all button



S4CLogDev
event log

S4CView
show micro web app
show general iframe

S4CSocial
twitter last channel
twitter last tweet

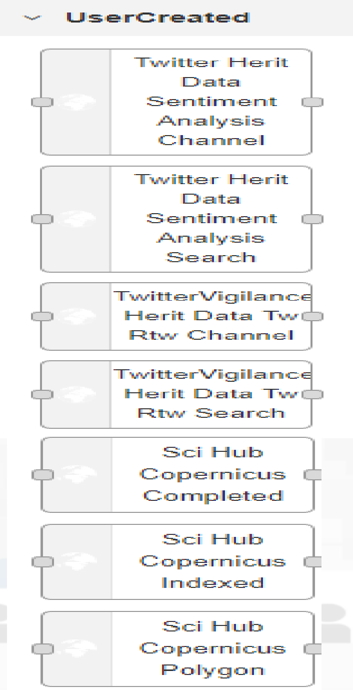
S4CSigfox
sigfox device filter
sigfox

S4CIoT
save typical time trends
get typical time trends

S4CWhatIf
get my scenarios
save a scenario

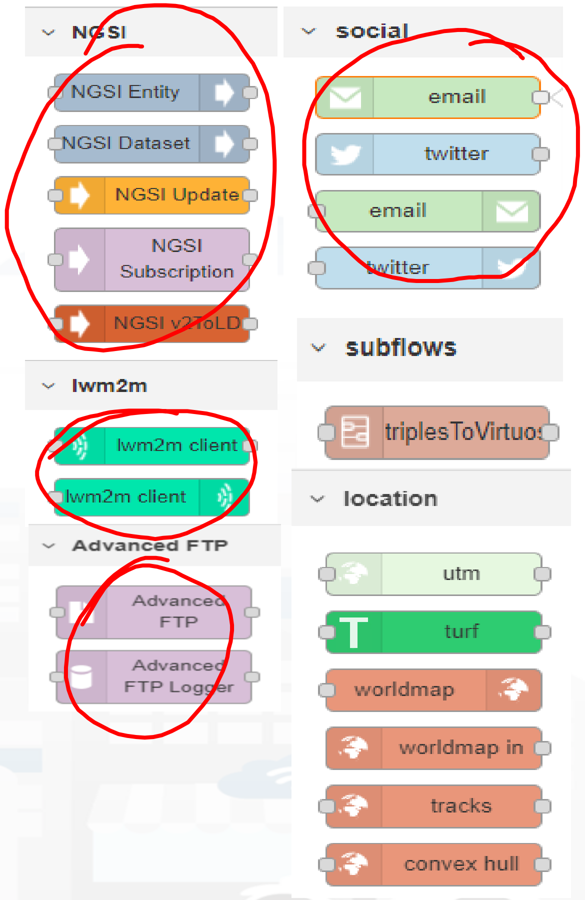
https://flows.nodered.org/search?term=snap4city

AND: From Resource Manager



UserCreated
Twitter Herit Data Sentiment Analysis Channel
Twitter Herit Data Sentiment Analysis Search
TwitterVigilance Herit Data Tw Rtw Channel
TwitterVigilance Herit Data Tw Rtw Search
Sci Hub Copernicus Completed
Sci Hub Copernicus Indexed
Sci Hub Copernicus Polygon

We suggest also to install:



NGSI
NGSI Entity
NGSI Dataset
NGSI Update
NGSI Subscription
NGSI v2ToLD

lwm2m
lwm2m client
lwm2m client

Advanced FTP
Advanced FTP
Advanced FTP Logger

social
email
twitter
email
twitter

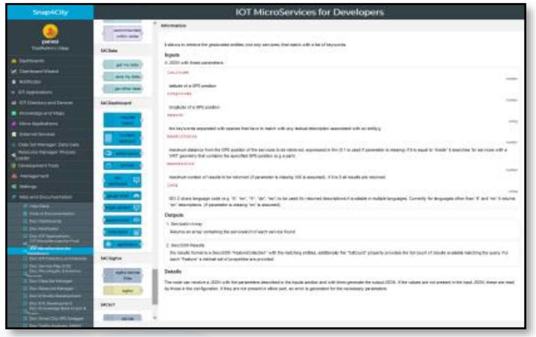
subflows
triplesToVirtuos

location
utm
turf
worldmap
worldmap in
tracks
convex hull

Proc.Logic / IoT App Development

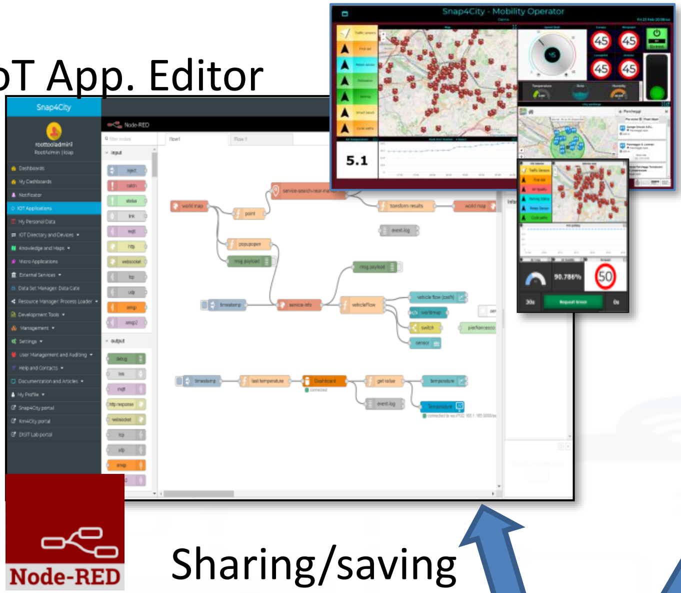
IOT Discovering

MicroServices collections

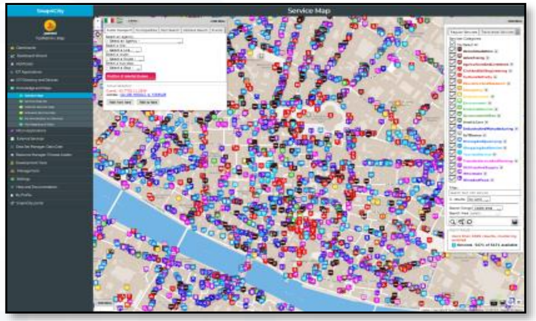


My IoT Applications

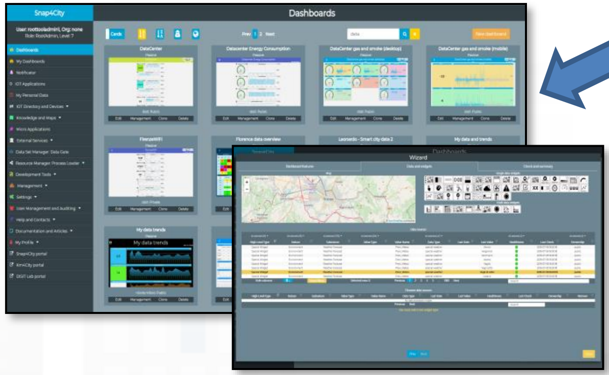
IoT App. Editor



Generating IoT App With Dashboard



ServiceMap Discovery

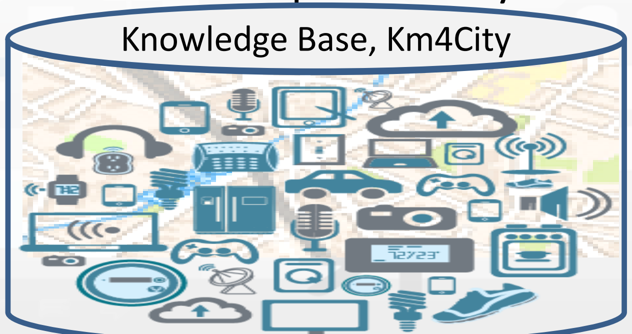


Dashboard Collection, Editor and Wizard

Sharing/saving reusing IoT App

Resource Manager

GitHub



JavaScript

- Nasce nel 1995 con il nome ‘Mocha’ grazie a Brendan Eich (fondatore di Netscape)
- Negli anni ‘90 si parla di Dinamic HTML (DHTML)
- Nel ‘97 nasce lo standard internazionale ECMA-262 (ECMAScript), per regolamentare le specifiche javascript, http://www.ecma-international.org
- Nel 2005 Jesse James Garrett rilascia un white paper in cui conia il nome ‘Ajax’ per descrivere una serie di tecnologie per creare applicazioni web, tra cui JavaScript
- Nel 2009 si ha la versione ECMAScript 5
- Giugno 2015 ECMAScript 6, attuale versione
- Riferimenti:
  - https://www.w3.org/community/webed/wiki/A_Short_History_of_JavaScript
  - https://www.w3.org/standards/webdesign/script

JavaScript

- E' un linguaggio di scripting open source orientato agli oggetti e agli **eventi**

- Usato per:
  - Programmazione web sia lato server che lato client
    - Oggi molto lato server, si veda per esempio **Node.JS**
  - Gestione azioni interattive e aggiunta di maggiore dinamicità alle pagine web

- Comunicazione sia sincrona che asincrona con il server

Concetto di script lato client

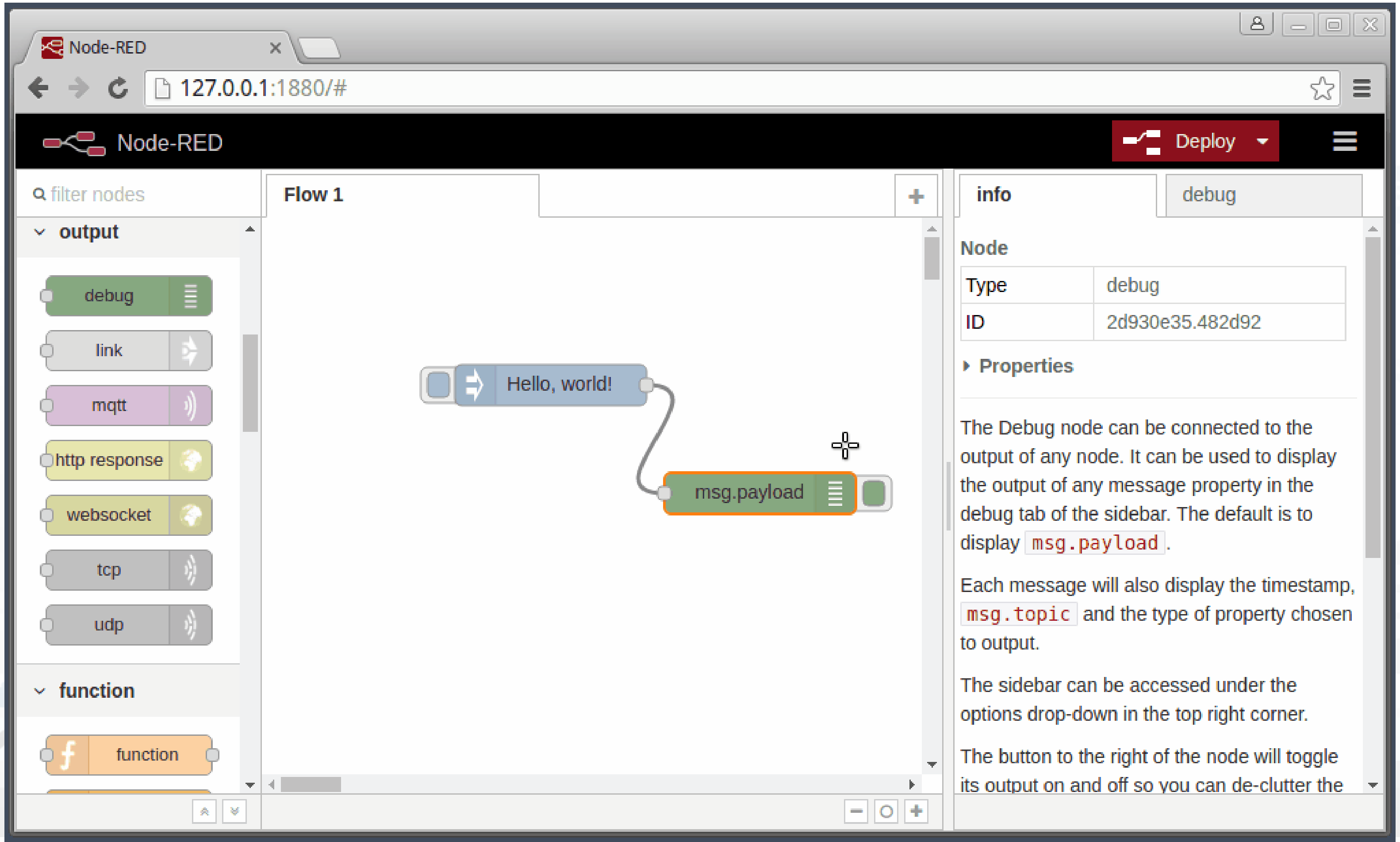
- Uno script lato client è un programma che affianca un documento HTML (embedded)
- Viene eseguito, sulla macchina del client, quando questo effettua il load della pagina HTML
- Azioni effettuate dagli script:
  - Modifica dinamica dei contenuti visualizzati
  - Controllo dinamico dei valori di input nei form
  - Possono essere attivati in base ad eventi effettuati dall'utente sulla pagina web (download, upload, movimenti del mouse, etc.)
  - Possono produrre elementi grafici
  - etc.
- Tipologie di Script:
  - Eseguiti una volta nel momento in cui l'utente carica la pagina
  - Eseguiti in base alle azioni effettuate dagli utenti (nel momento in cui si verificano)

JSON (Javascript Object Notation)

- Nasce per memorizzare dati, trasferire informazioni, rappresentare i dati in maniera da poterli trasferire tra programmi anche diversi
- Nasce dalla modalità di rappresentazioni degli oggetti in javascript
- E’ una alternativa a XML per la trasimissione delle informazioni
- E’ diventato uno standard: http://www.json.org
  - RFC: https://tools.ietf.org/html/draft-zyp-json-schema-03
- ESEMPIO :
  - **Javascript (oggetto)**: {nome: "Mario", cognome: "Rossi "}
  - **JSON (stringa di car. UNICODE)**: '{nome: "Mario", cognome: "Rossi"}‘
  - **XML:** <nome>Mario</nome><cognome>Rossi</cognome>

Hello World of Node-RED

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



Node

Type	debug
ID	2d930e35.482d92

Properties

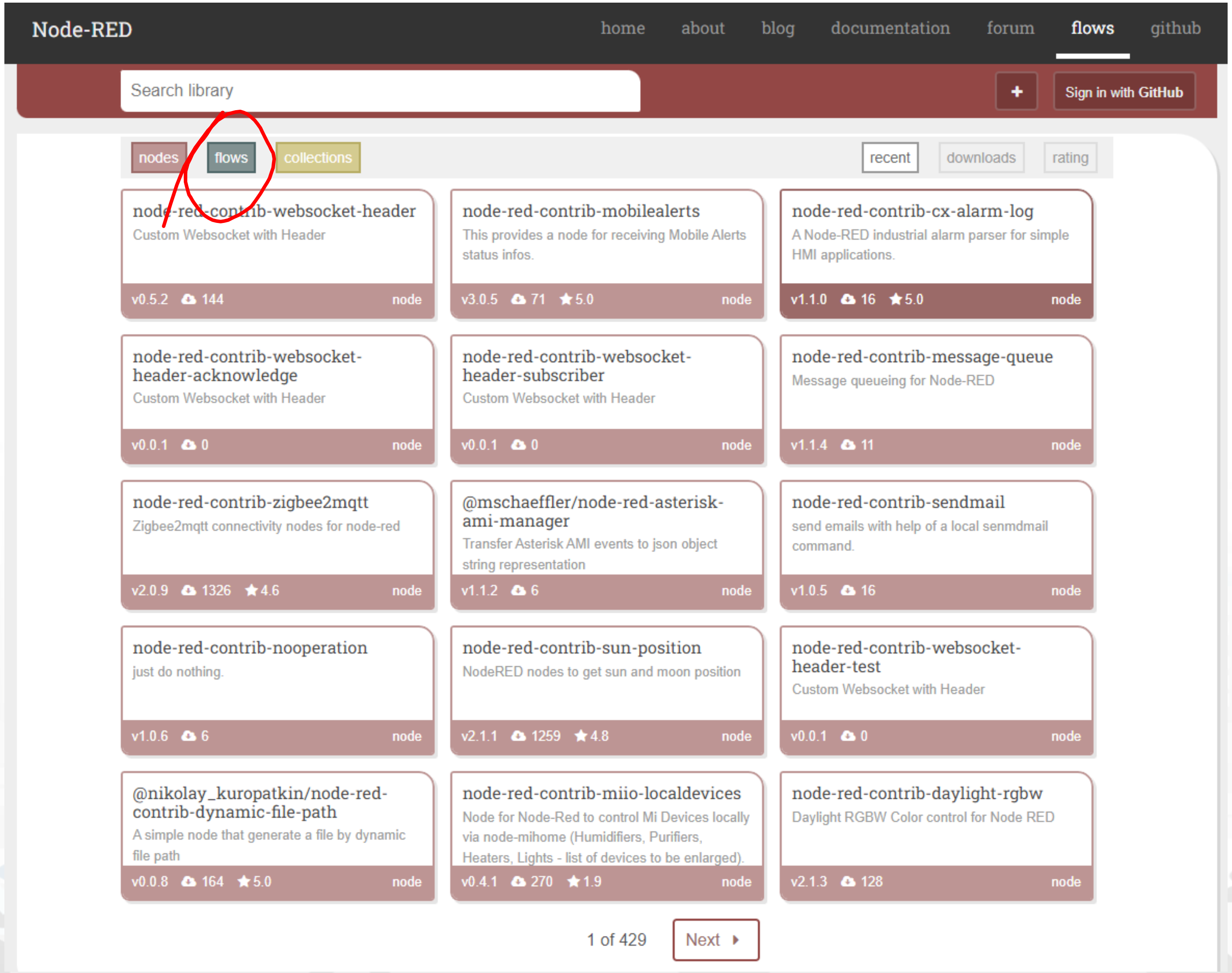
The Debug node can be connected to the output of any node. It can be used to display the output of any message property in the debug tab of the sidebar. The default is to display `msg.payload`.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

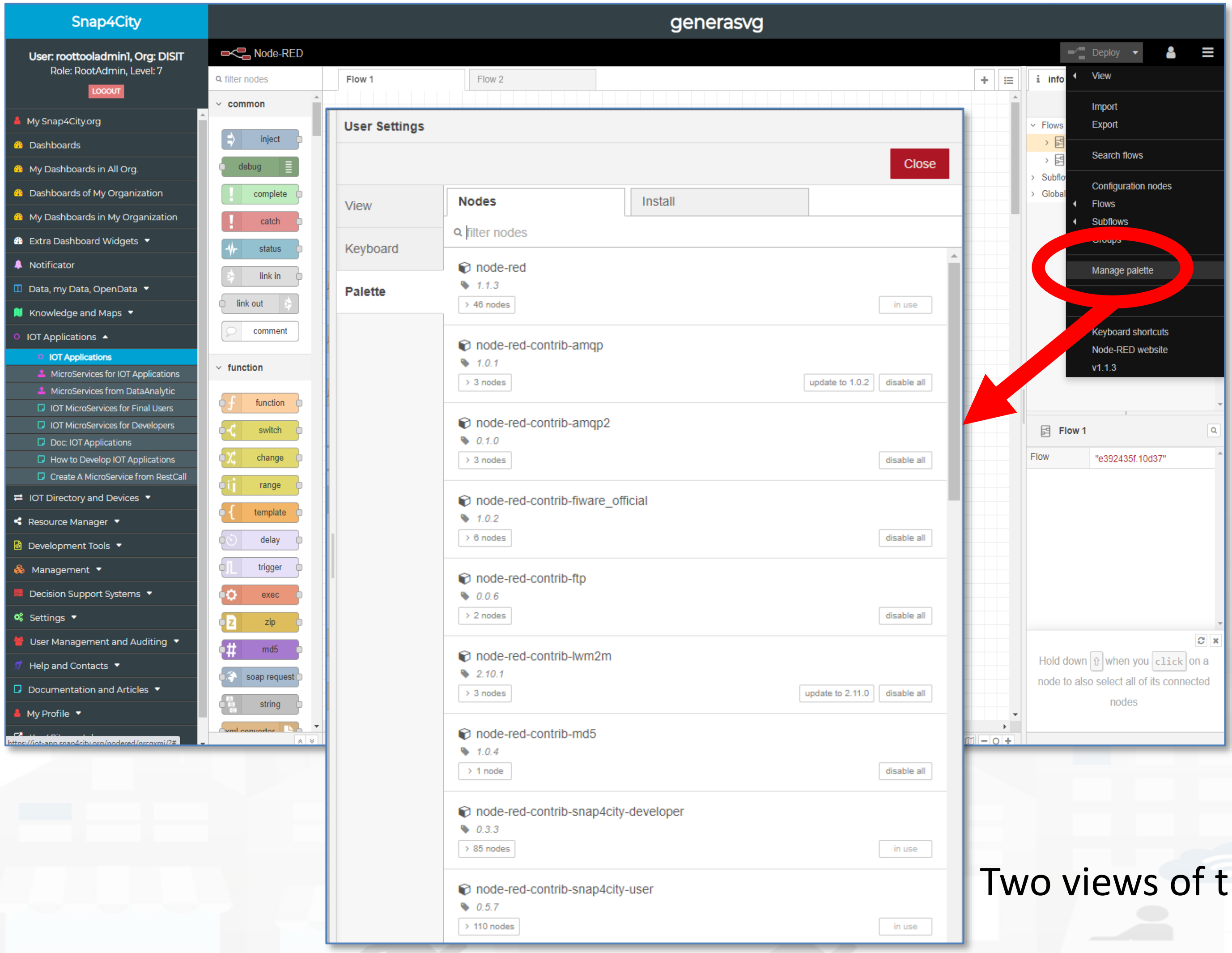
@nikolay_kuropatkin/node-red-contrib-dynamic-file-path
A simple node that generate a file by dynamic file path
v0.0.8 164 ★5.0 node

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

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

1 of 429 Next

Load Library from Palette



Snap4City

generasvg

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

User Settings

Close

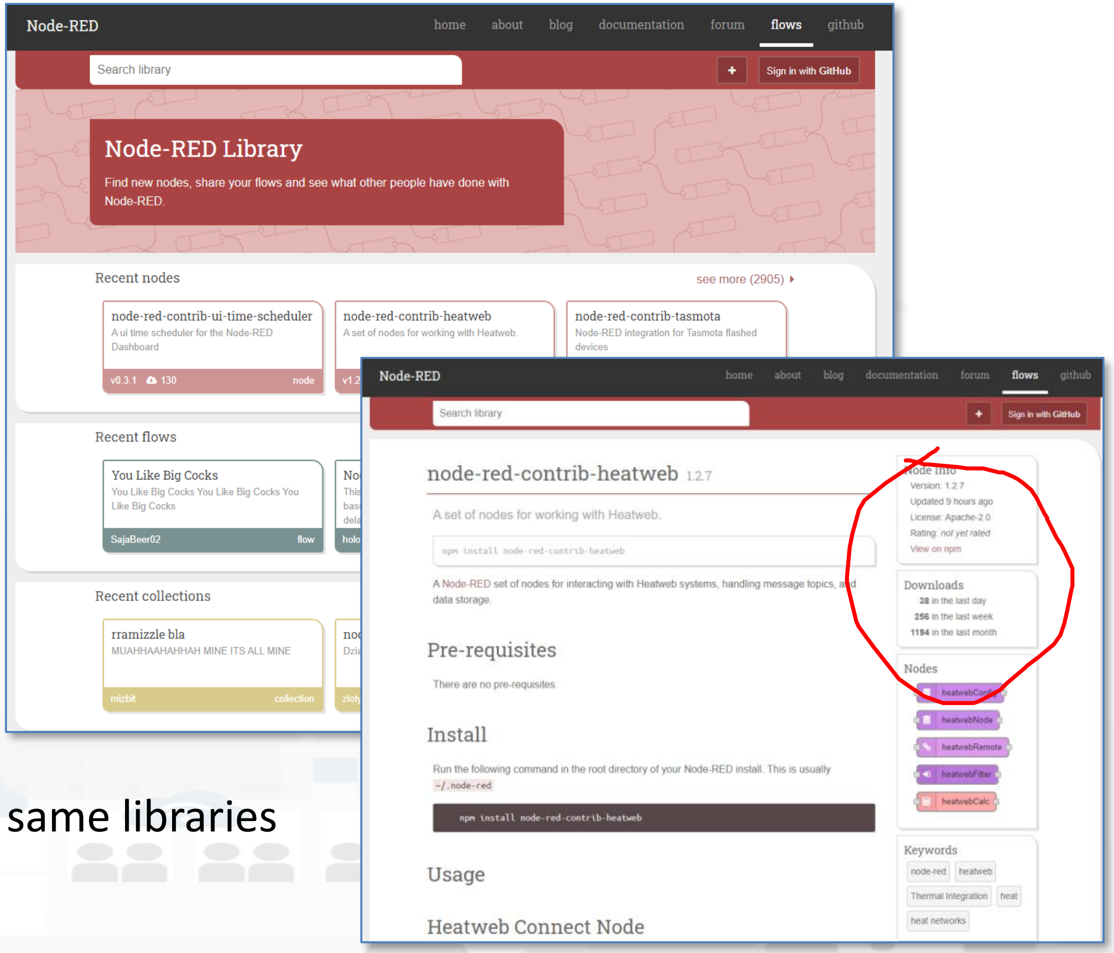
View | Keyboard | Palette

Nodes | Install

filter nodes

Node	Version	Nodes	Action
node-red	1.1.3	46 nodes	in use
node-red-contrib-amqp	1.0.1	3 nodes	update to 1.0.2 · disable all
node-red-contrib-amqp2	0.1.0	3 nodes	disable all
node-red-contrib-fiware_official	1.0.2	6 nodes	disable all
node-red-contrib-ftp	0.0.6	2 nodes	disable all
node-red-contrib-lwm2m	2.10.1	3 nodes	update to 2.11.0 · disable all
node-red-contrib-md5	1.0.4	1 node	disable all
node-red-contrib-snap4city-developer	0.3.3	85 nodes	in use
node-red-contrib-snap4city-user	0.5.7	110 nodes	in use

https://flows.nodered.org/



Node-RED Library

Find new nodes, share your flows and see what other people have done with Node-RED.

Recent nodes — see more (2905)

- node-red-contrib-ui-time-scheduler — A ui time scheduler for the Node-RED Dashboard — v0.3.1 · 130 · node
- node-red-contrib-heatweb — A set of nodes for working with Heatweb.
- node-red-contrib-tasmota — Node-RED integration for Tasmota flashed devices

Recent flows

- You Like Big Cocks — You Like Big Cocks You Like Big Cocks You Like Big Cocks — SajaBeer02 · flow

Recent collections

- rramizzle bla — MUAHHAAHAHHAH MINE ITS ALL MINE — mizbit · collection

node-red-contrib-heatweb 1.2.7

A set of nodes for working with Heatweb.

```
npm install node-red-contrib-heatweb
```

A Node-RED set of nodes for interacting with Heatweb systems, handling message topics, and data storage.

Pre-requisites

There are no pre-requisites

Install

Run the following command in the root directory of your Node-RED install. This is usually ~/.node-red

```
npm install node-red-contrib-heatweb
```

Usage

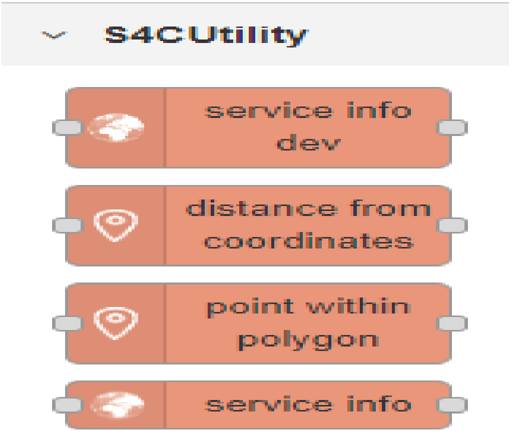
Heatweb Connect Node

Node Info
Version: 1.2.7
Updated 9 hours ago
License: Apache-2.0
Rating: not yet rated
View on npm

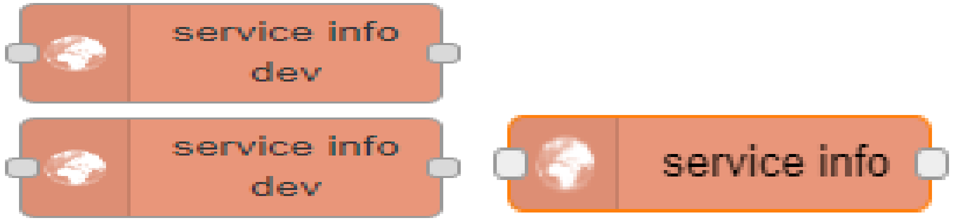
Downloads
38 in the last day
256 in the last week
1194 in the last month

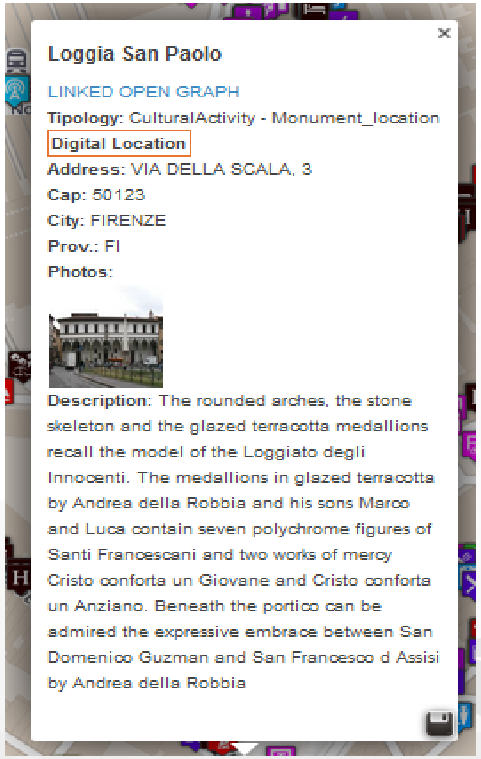
Two views of the same libraries

S4CSearch



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





Loggia San Paolo

LINKED OPEN GRAPH

Tipology: CulturalActivity - Monument_location

Digital Location

Address: VIA DELLA SCALA, 3

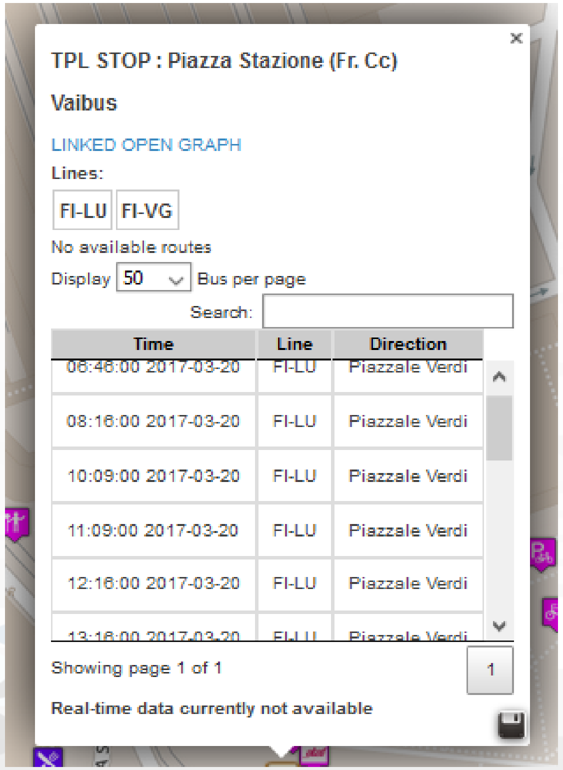
Cap: 50123

City: FIRENZE

Prov.: FI

Photos:

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



TPL STOP : Piazza Stazione (Fr. Cc)

Vaibus

LINKED OPEN GRAPH

Lines:

FI-LU FI-VG

No available routes

Display 50 Bus per page

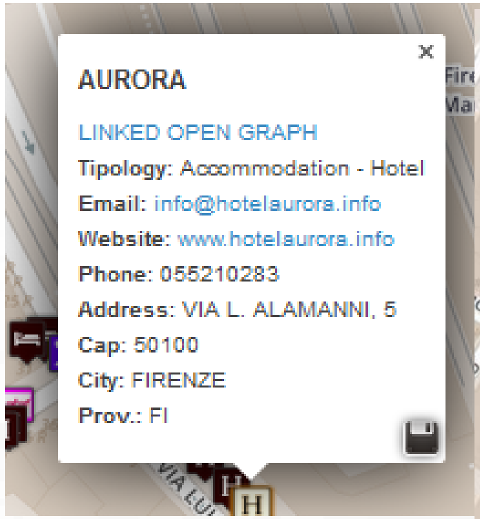
Search:

Time	Line	Direction
06:46:00 2017-03-20	FI-LU	Piazzale Verdi
08:16:00 2017-03-20	FI-LU	Piazzale Verdi
10:09:00 2017-03-20	FI-LU	Piazzale Verdi
11:09:00 2017-03-20	FI-LU	Piazzale Verdi
12:16:00 2017-03-20	FI-LU	Piazzale Verdi
13:16:00 2017-03-20	FI-LU	Piazzale Verdi

Showing page 1 of 1

1

Real-time data currently not available



AURORA

LINKED OPEN GRAPH

Tipology: Accommodation - Hotel

Email: info@hotelaurora.info

Website: www.hotelaurora.info

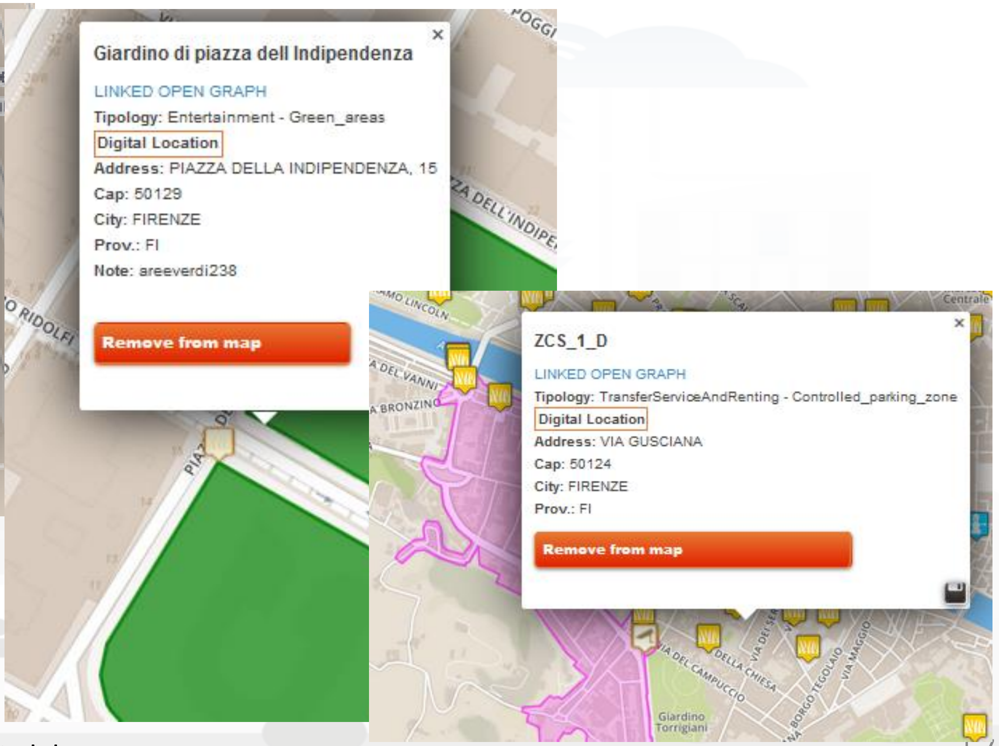
Phone: 055210283

Address: VIA L. ALAMANNI, 5

Cap: 50100

City: FIRENZE

Prov.: FI



Giardino di piazza dell Indipendenza

LINKED OPEN GRAPH

Tipology: Entertainment - Green_areas

Digital Location

Address: PIAZZA DELLA INDIPENDENZA, 15

Cap: 50129

City: FIRENZE

Prov.: FI

Note: areeverdi238

Remove from map

ZCS_1_D

LINKED OPEN GRAPH

Tipology: TransferServiceAndRenting - Controlled_parking_zone

Digital Location

Address: VIA GUSCIANA

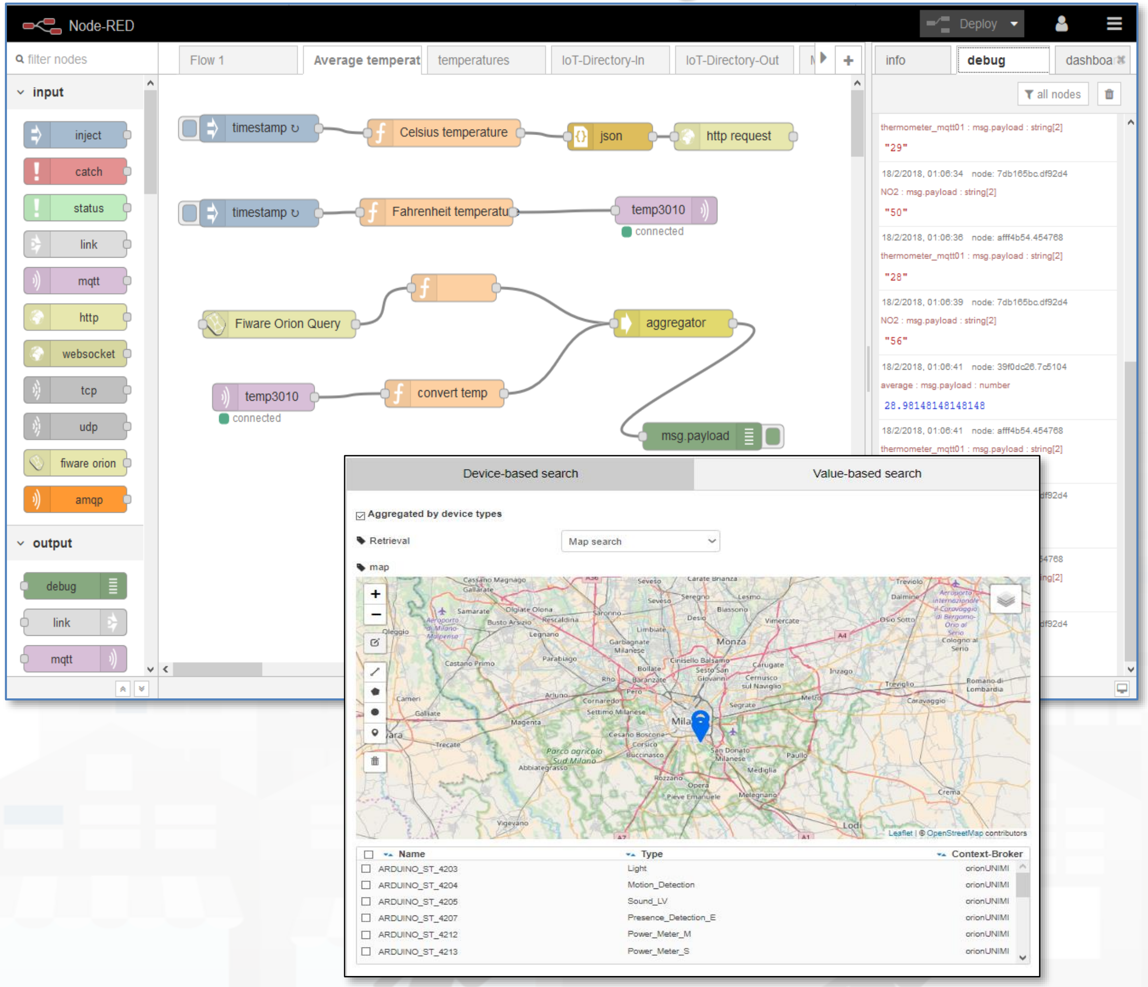
Cap: 50124

City: FIRENZE

Prov.: FI

Remove from map

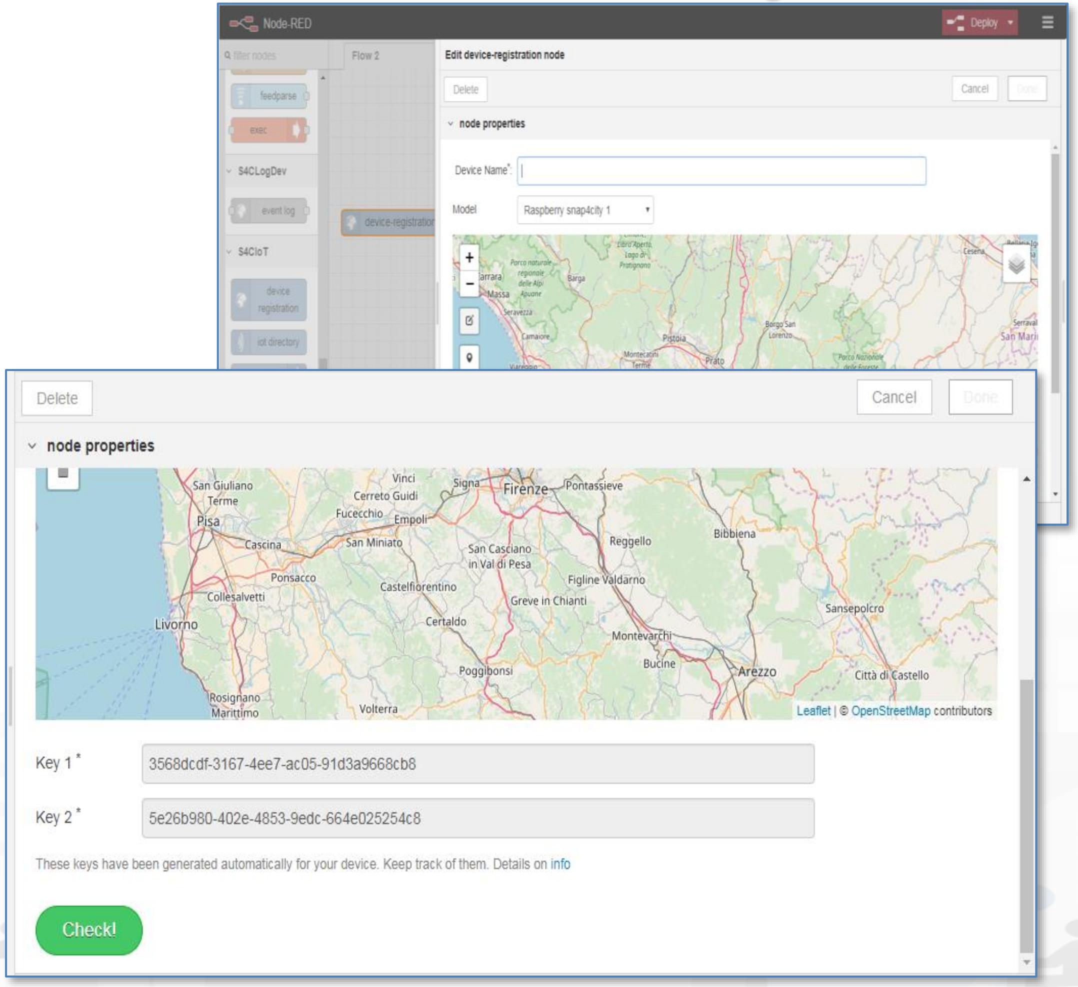
IOT Discovery on IOT Application Development



```
thermometer_mqtt01 : msg.payload : string[2]
 "29"
18/2/2018, 01:06:34   node: 7db165bc.df92d4
NO2 : msg.payload : string[2]
 "50"
18/2/2018, 01:06:36   node: afff4b54.454768
thermometer_mqtt01 : msg.payload : string[2]
 "28"
18/2/2018, 01:06:39   node: 7db165bc.df92d4
NO2 : msg.payload : string[2]
 "56"
18/2/2018, 01:06:41   node: 39f0dc26.7c5104
average : msg.payload : number
 28.98148148148148
18/2/2018, 01:06:41   node: afff4b54.454768
thermometer_mqtt01 : msg.payload : string[2]
```

☑ Aggregated by device types

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



Edit device-registration node

node properties

Device Name*:

Model: Raspberry snap4city 1

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

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

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

Check!

Agenda

- Architetture IoT/IoE, reti, formati e protocolli, pattern
- Protocolli tipi IoT vs protocolli industriali
- Interoperabilità, protocolli push e pull
- Concetti di broker, gateway, adapter
- JSON, JavaScript, Node-RED
- **Esercitazione on Node-RED JavaScript**
- Data Ingestion processing
- Test

TOP

Node-RED Demo 1

Node-RED

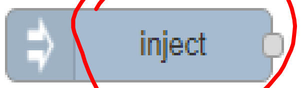
Node-RED

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)

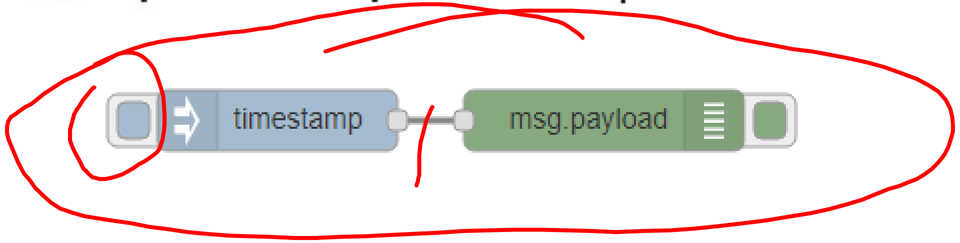
Generates a random number. You can configure the number generation interval and the type (integer or float).

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

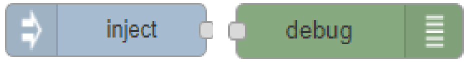
Shows a number inside a gauge counter.

Shows a text inside the local dashboard

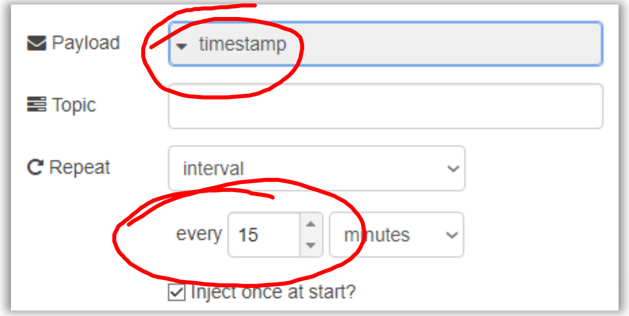
Step 1



- Inject and Debug



- Connect
- Configure



Payload: timestamp

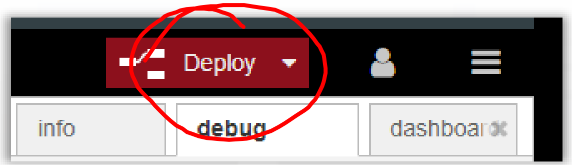
Topic:

Repeat: interval

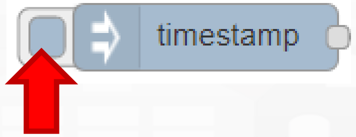
every 15 minutes

☑ Inject once at start?

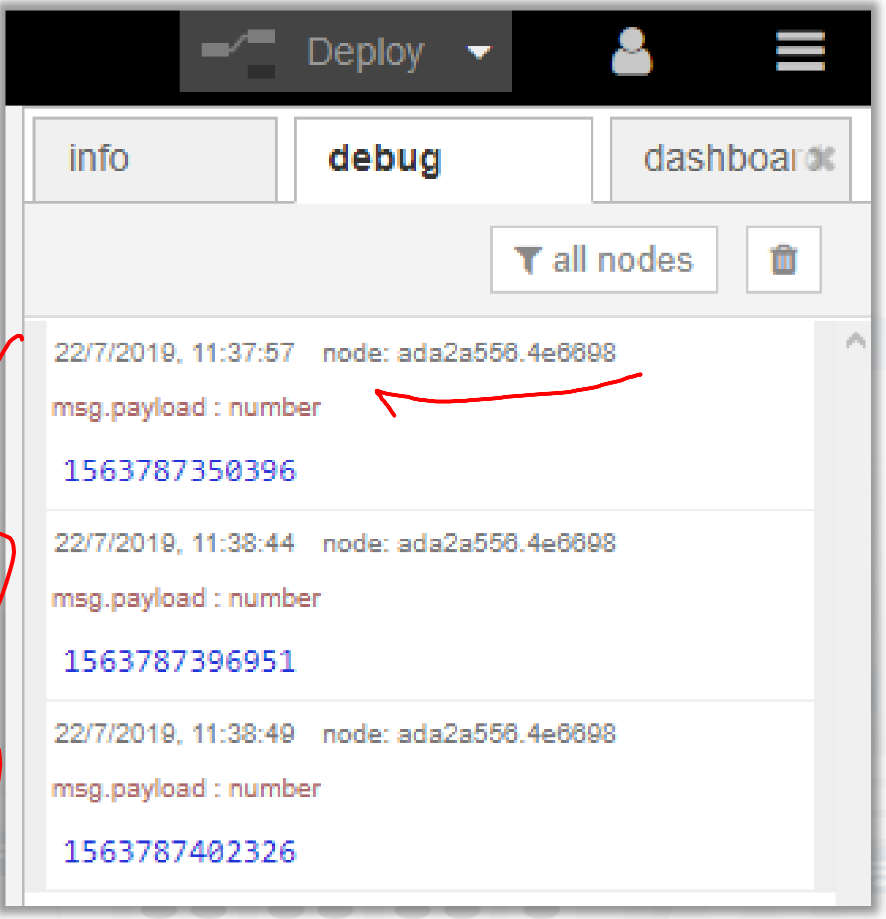
- Deploy



- Click

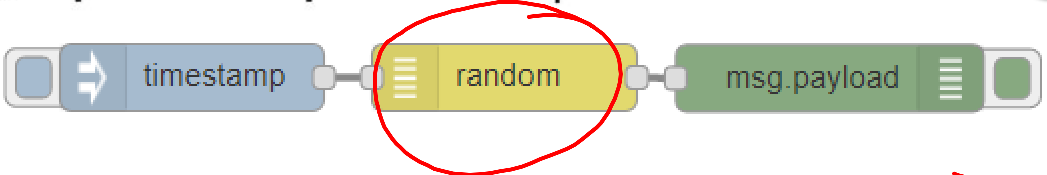


- Observe

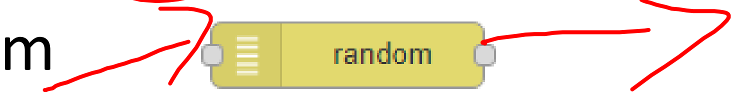


```
22/7/2019, 11:37:57   node: ada2a558.4e6898
msg.payload : number
 1563787350396

22/7/2019, 11:38:44   node: ada2a558.4e6898
msg.payload : number
 1563787396951

22/7/2019, 11:38:49   node: ada2a558.4e6898
msg.payload : number
 1563787402326
```

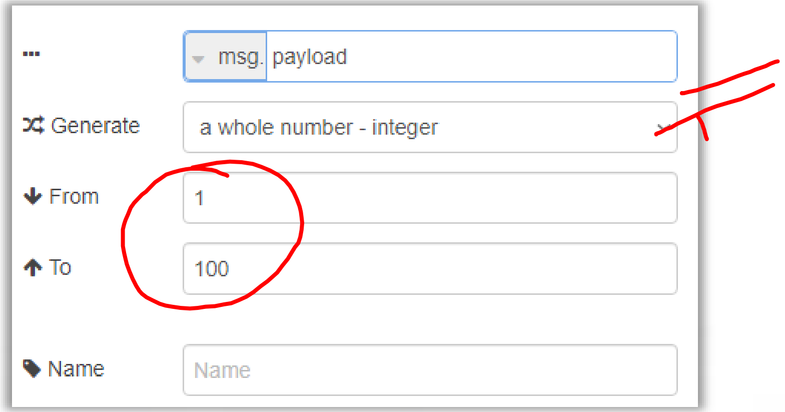
Step 2



- Random

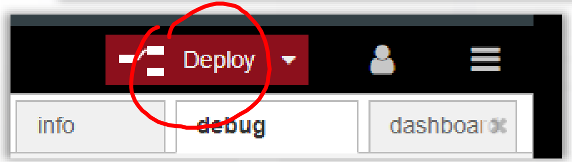


- Connect
- Configure

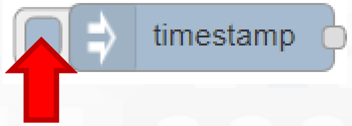


... msg. payload
Generate: a whole number - integer
From: 1
To: 100
Name: Name

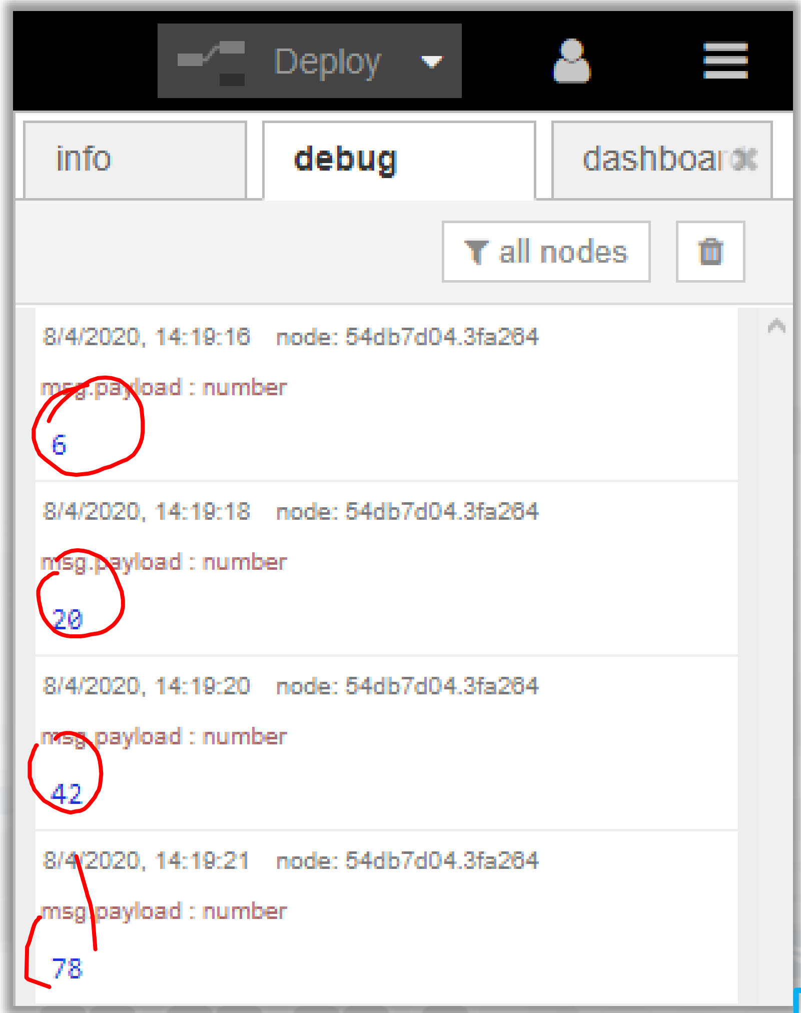
- Deploy



- Click

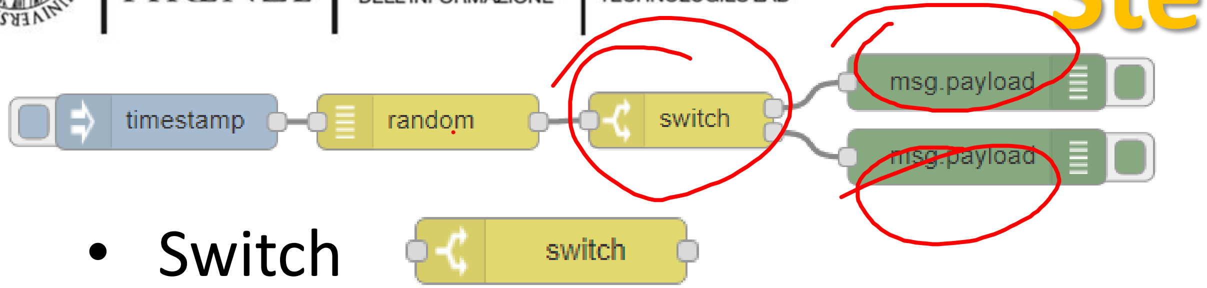


- Observe



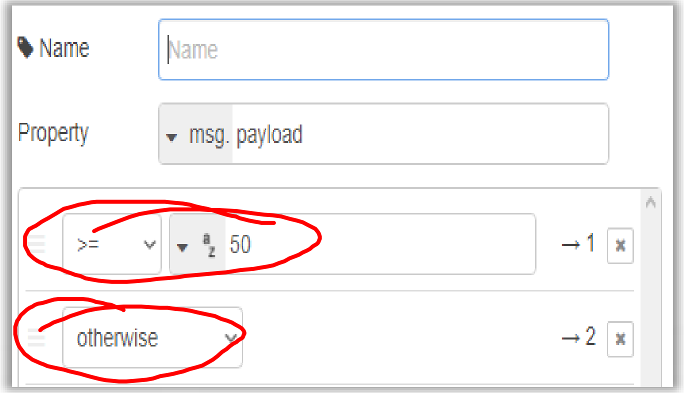
```
8/4/2020, 14:19:16   node: 54db7d04.3fa264
msg.payload : number
6

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

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

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

Step 3



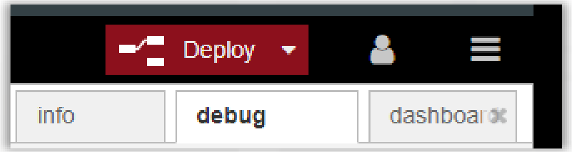
- Switch

- Connect
- Configure

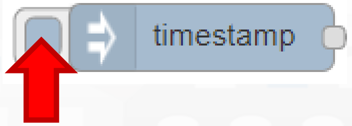


Name: Name
Property: msg. payload
>= 50 → 1
otherwise → 2

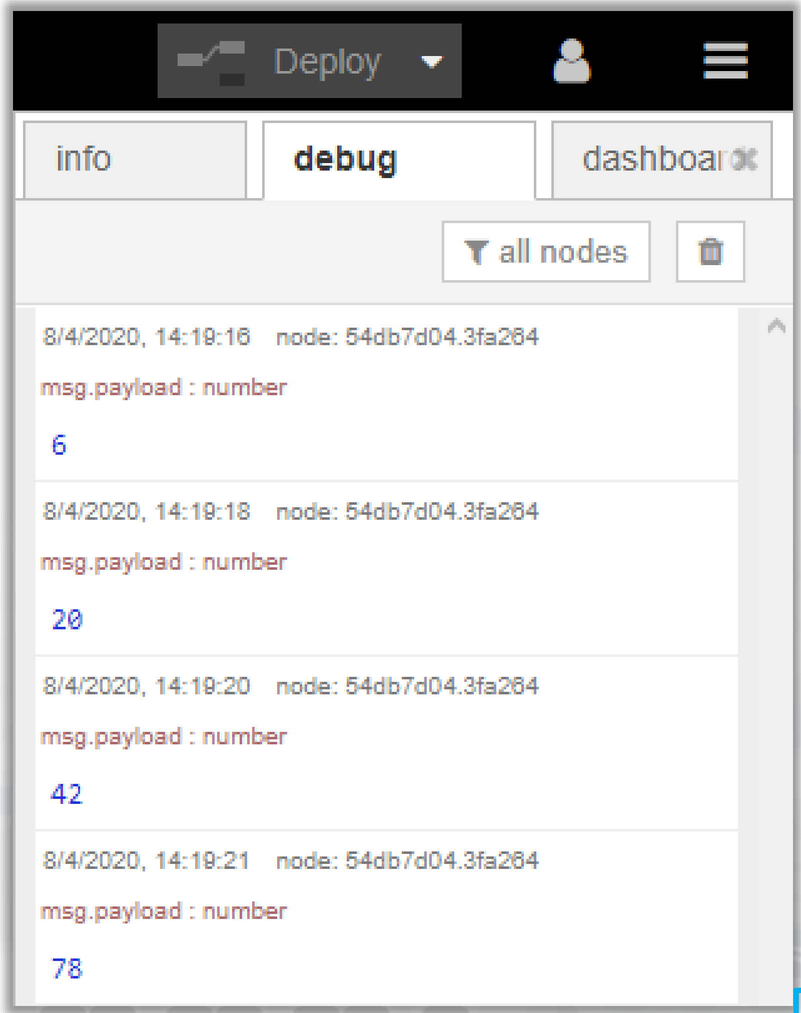
- Deploy



- Click

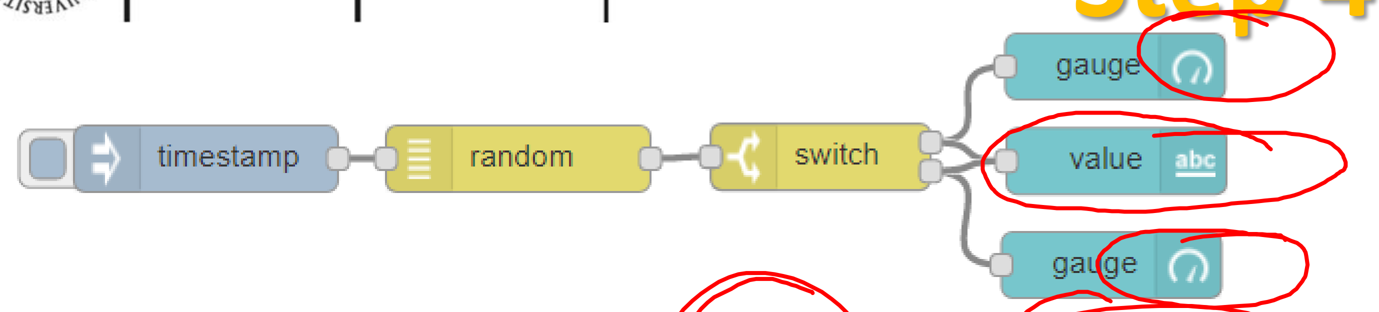


- Observe

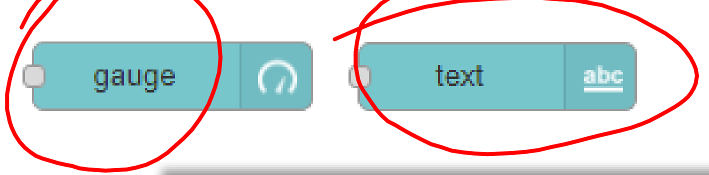


```
8/4/2020, 14:19:16   node: 54db7d04.3fa264
msg.payload : number
6
8/4/2020, 14:19:18   node: 54db7d04.3fa264
msg.payload : number
20
8/4/2020, 14:19:20   node: 54db7d04.3fa264
msg.payload : number
42
8/4/2020, 14:19:21   node: 54db7d04.3fa264
msg.payload : number
78
```

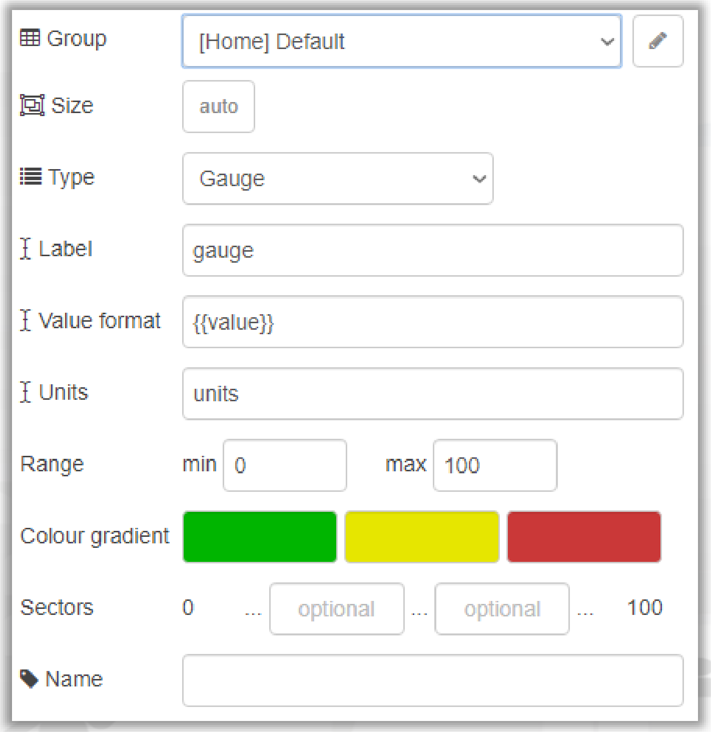
Step 4



- Gauge and text

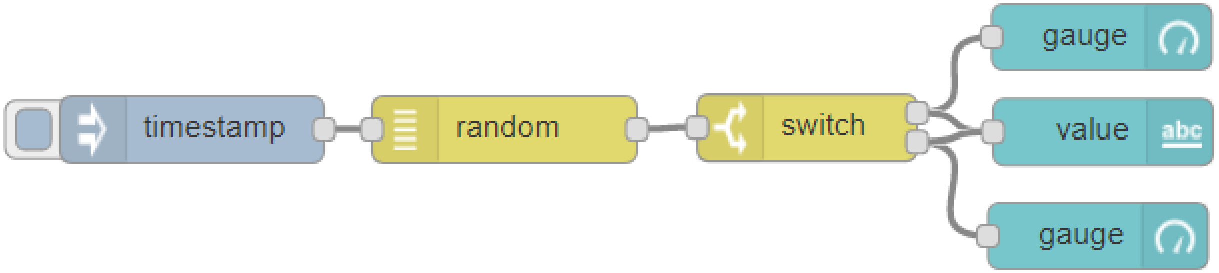


- Connect
- Configure gauge

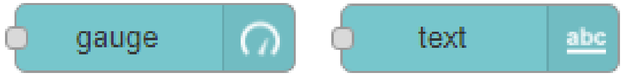


Group	[Home] Default
Size	auto
Type	Gauge
Label	gauge
Value format	{{value}}
Units	units
Range	min 0 max 100
Colour gradient	🟩 🟨 🟥
Sectors	0 ... optional ... optional ... 100
Name	

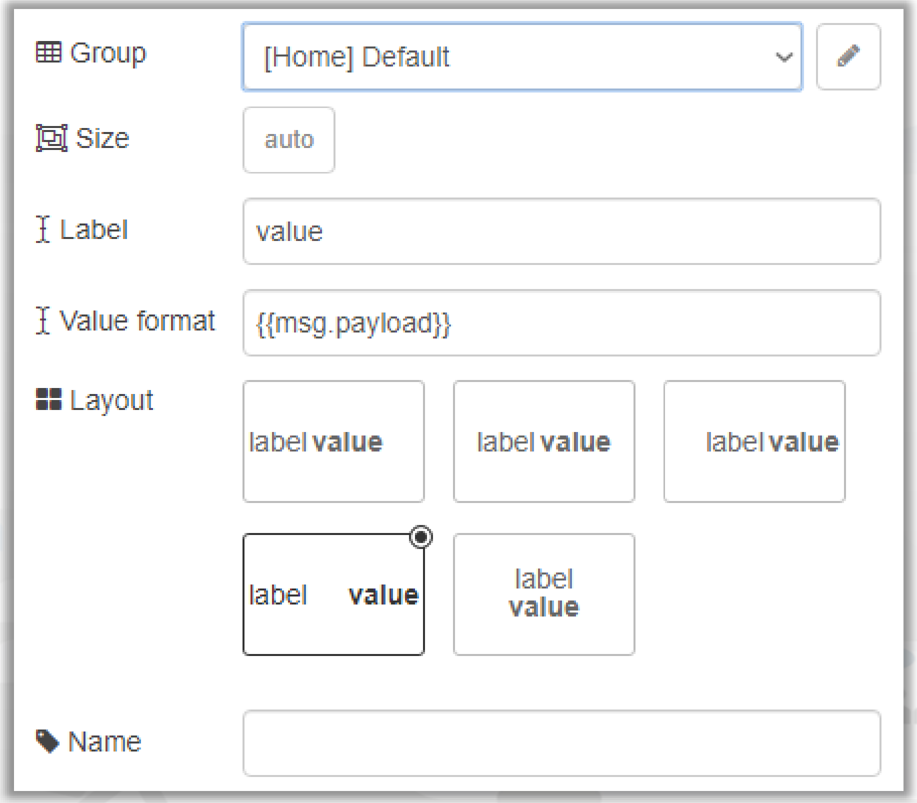
Step 4 Bis



- Gauge and text



- Connect
- Configure text



Group: [Home] Default

Size: auto

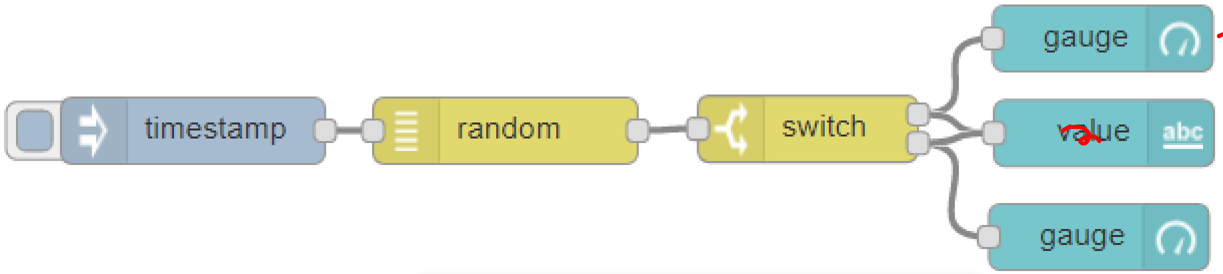
Label: value

Value format: {{msg.payload}}

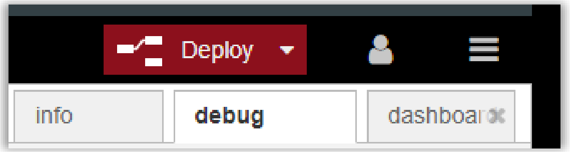
Layout:
○ label value
○ label value
○ label value
● label value
○ label value

Name:

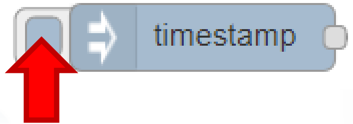
Step 5



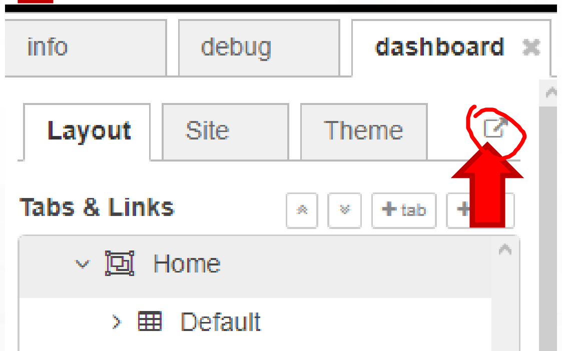
- Deploy



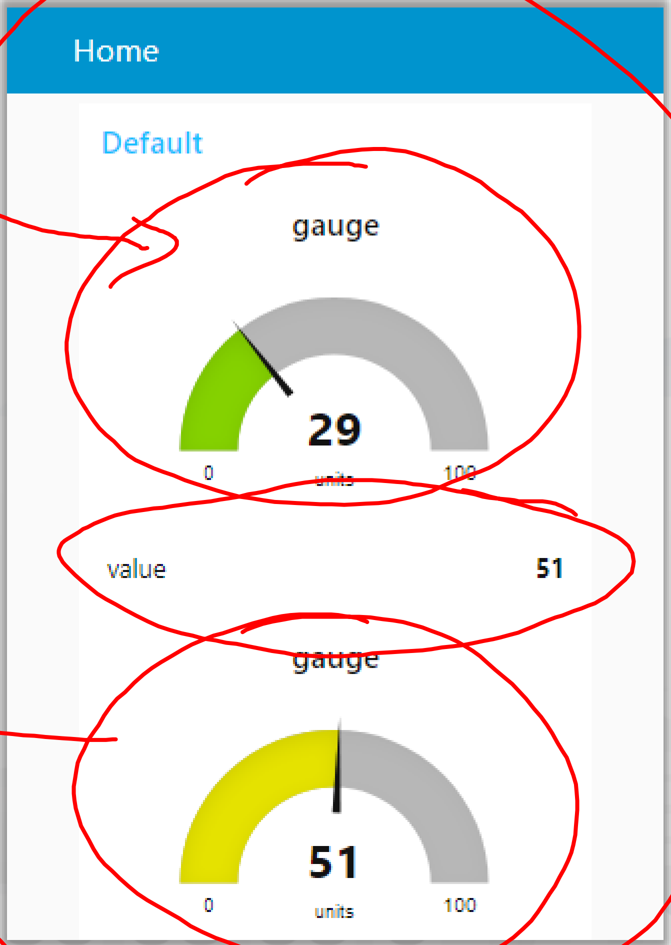
- Click



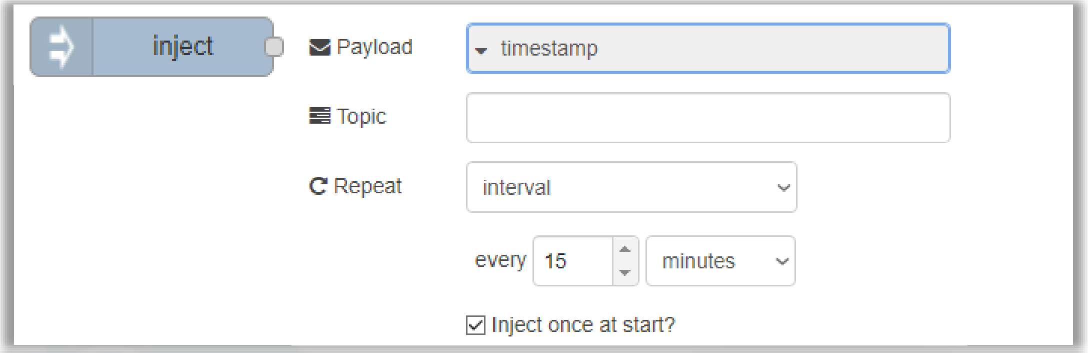
- Click



- Observe



Nodes configuration 1/2


inject

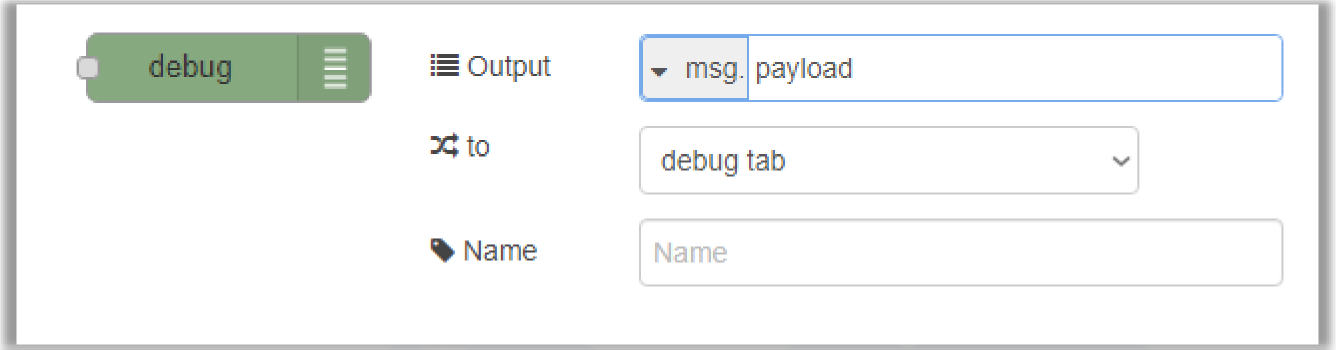
Payload: timestamp

Topic:

Repeat: interval

every 15 minutes

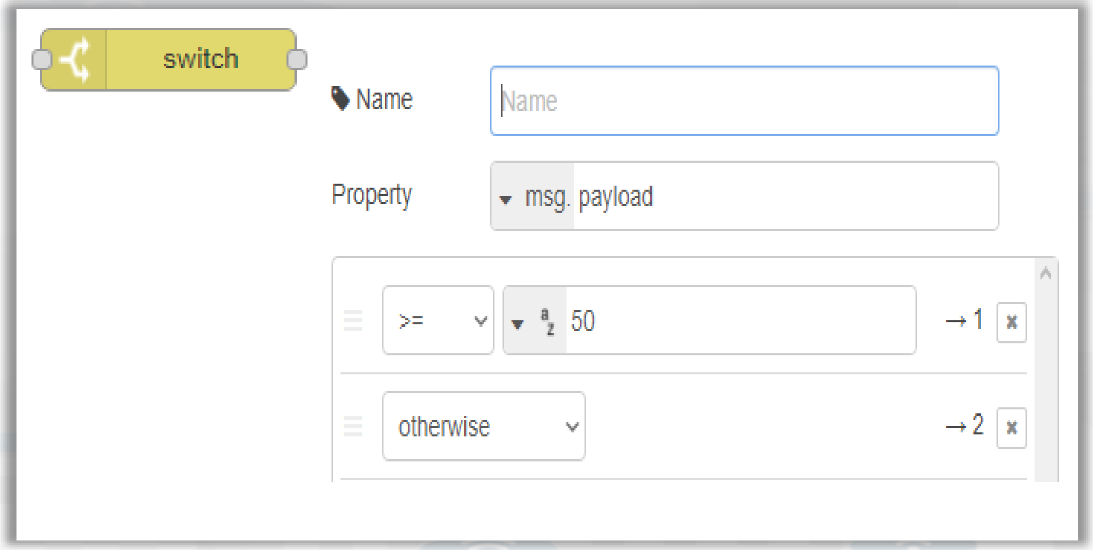
☑ Inject once at start?


debug

Output: msg. payload

to: debug tab

Name: Name

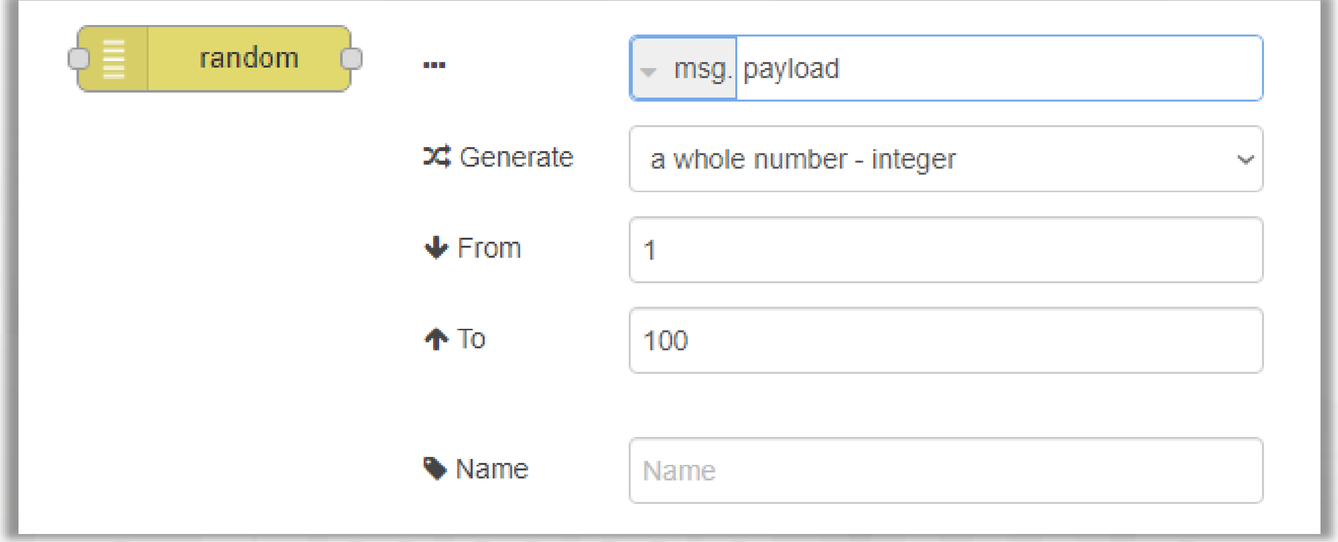

switch

Name: Name

Property: msg. payload

>= 50 → 1

otherwise → 2


random

... msg. payload

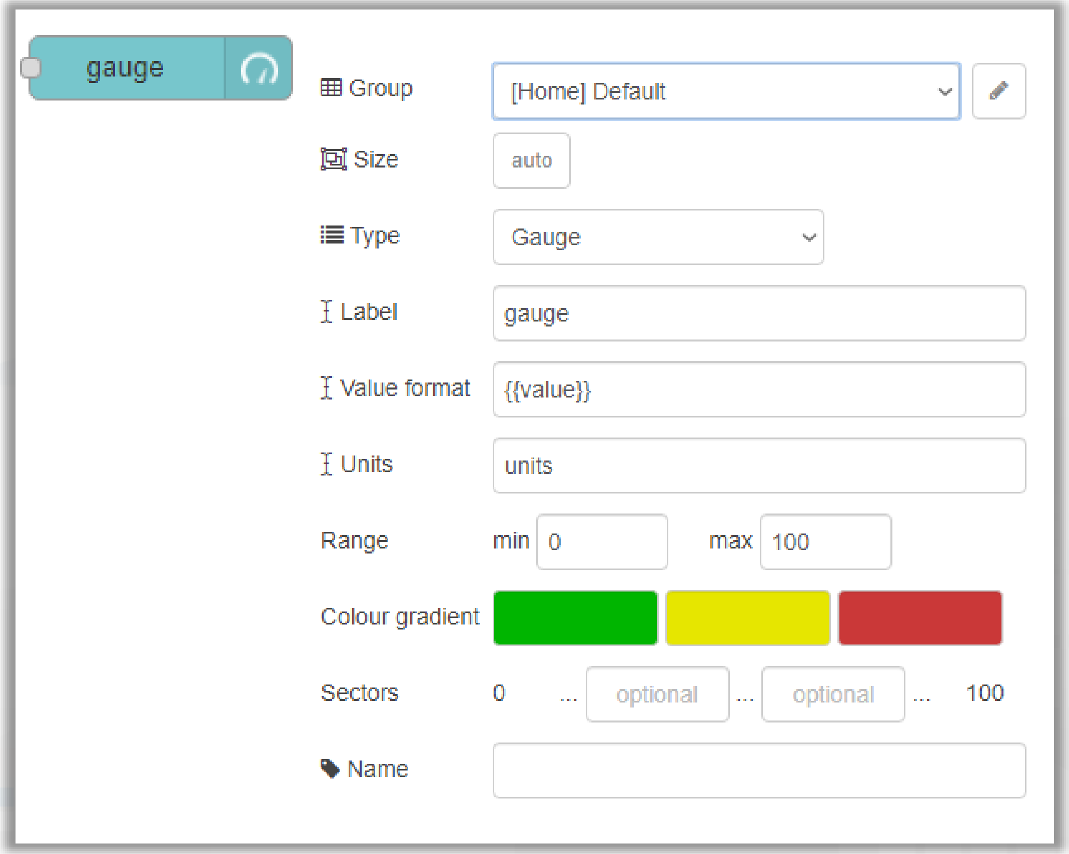
Generate: a whole number - integer

From: 1

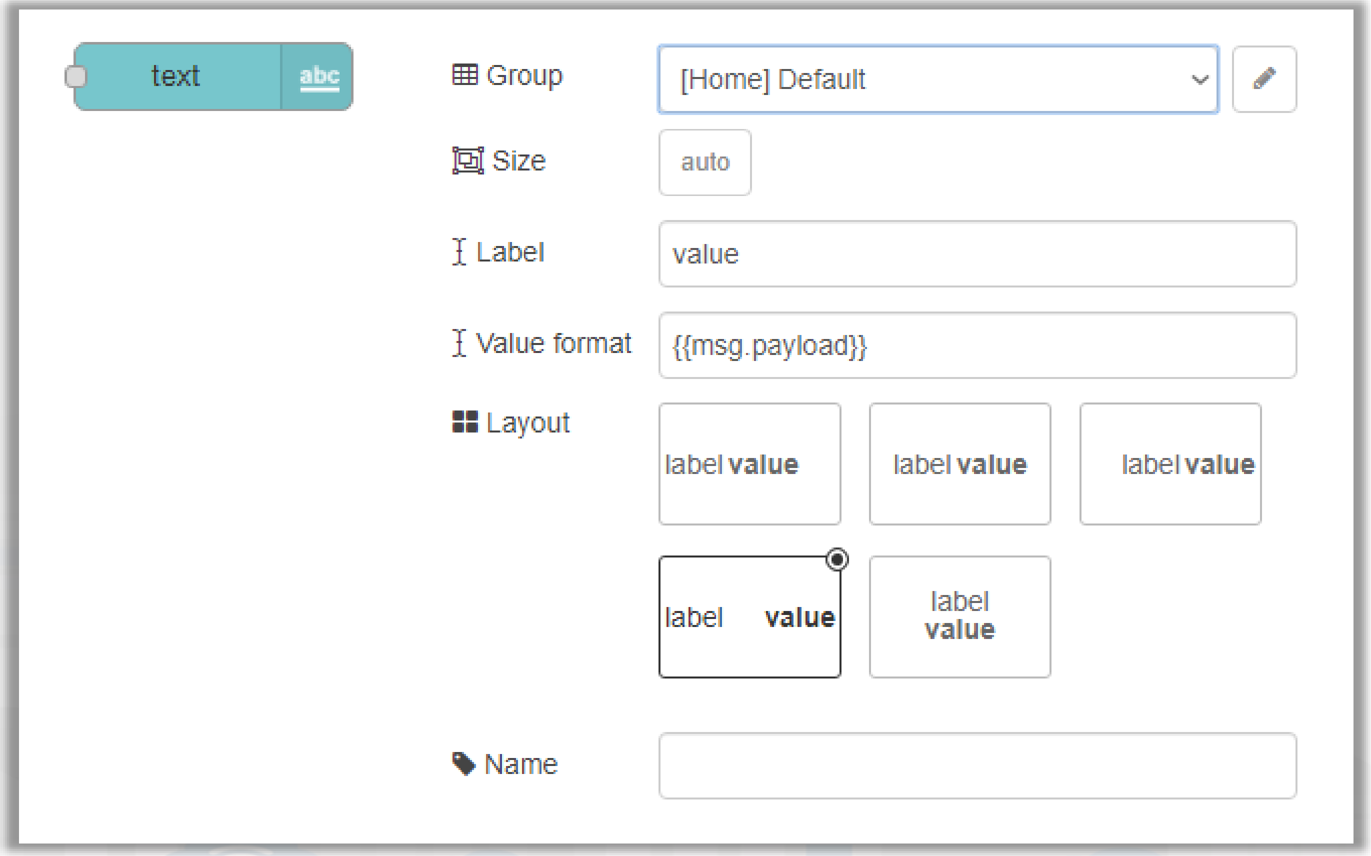
To: 100

Name: Name

Nodes configuration 2/2

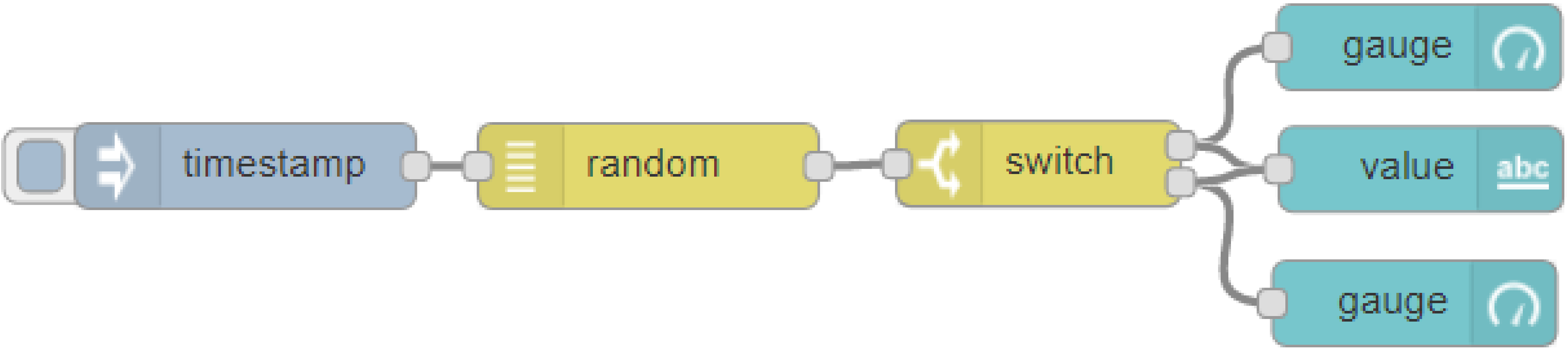


Group: [Home] Default
Size: auto
Type: Gauge
Label: gauge
Value format: {{value}}
Units: units
Range: min 0 max 100
Colour gradient: 🟩 🟨 🟥
Sectors: 0 ... optional ... optional ... 100
Name:

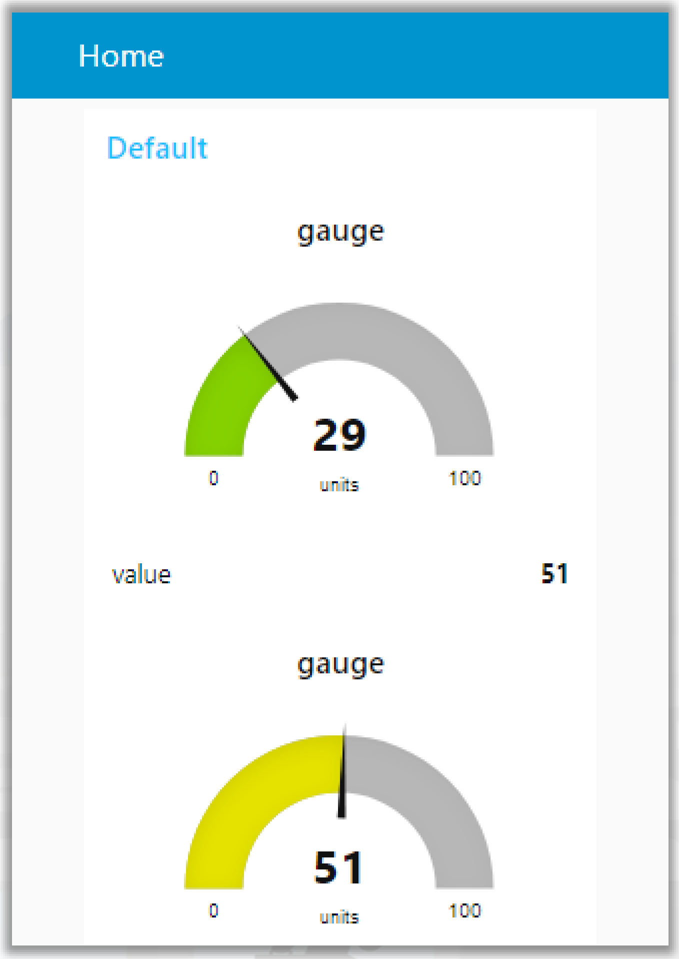


Group: [Home] Default
Size: auto
Label: value
Value format: {{msg.payload}}
Layout: label value | label value | label value | ● label value | label value
Name:

Nodes connections



Resulting Dashboard



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

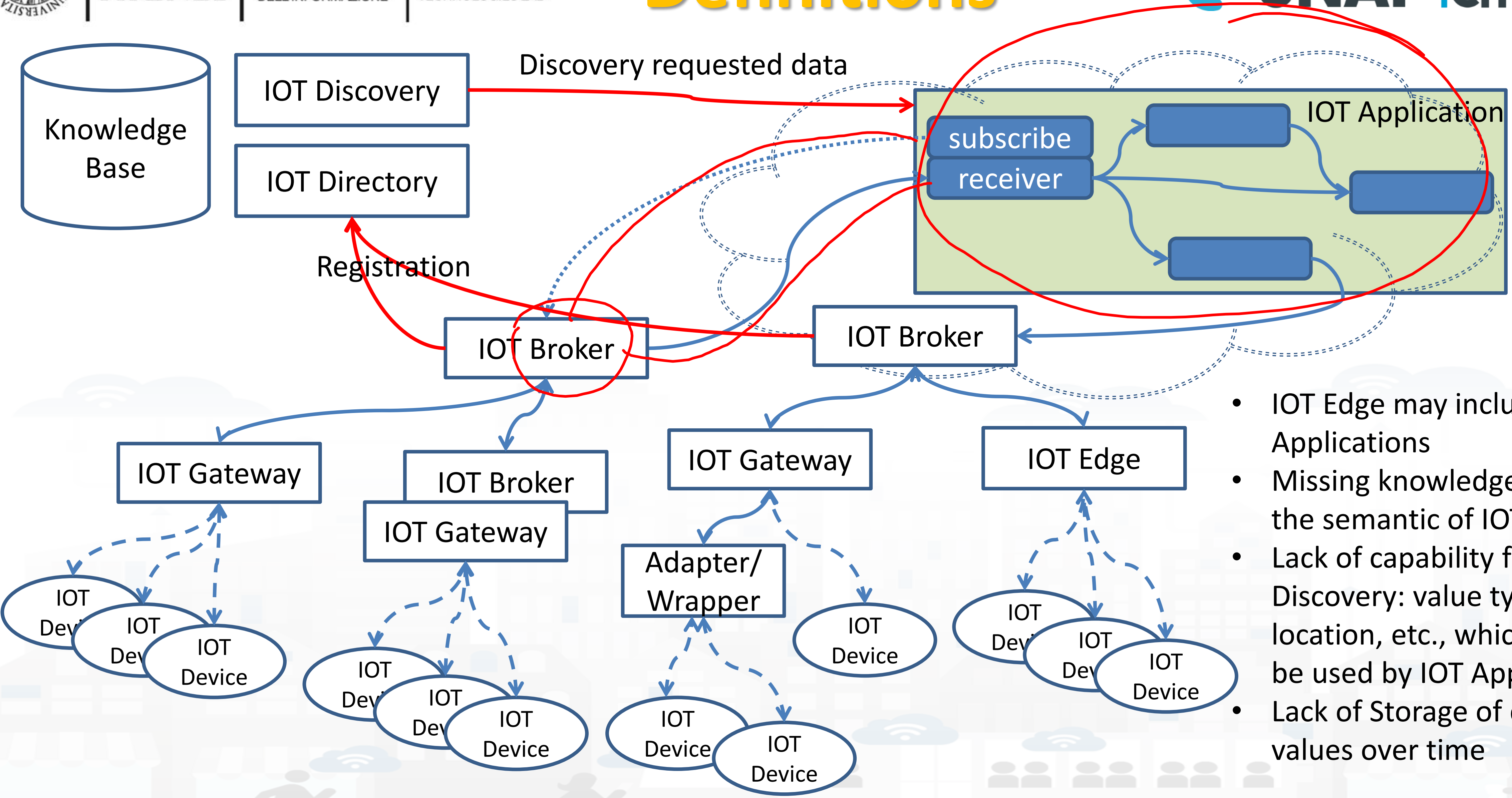
Snap4city dashboards are more :

- Powerful
- Flexible
- Secure
- nicer

Agenda

- Architetture IoT/IoE, reti, formati e protocolli, pattern
- Protocolli tipi IoT vs protocolli industriali
- Interoperabilità, protocolli push e pull
- Concetti di broker, gateway, adapter
- JSON, JavaScript, Node-RED
- **Esercitazione on Node-RED JavaScript**
- Data Ingestion processing
- Test

Definitions



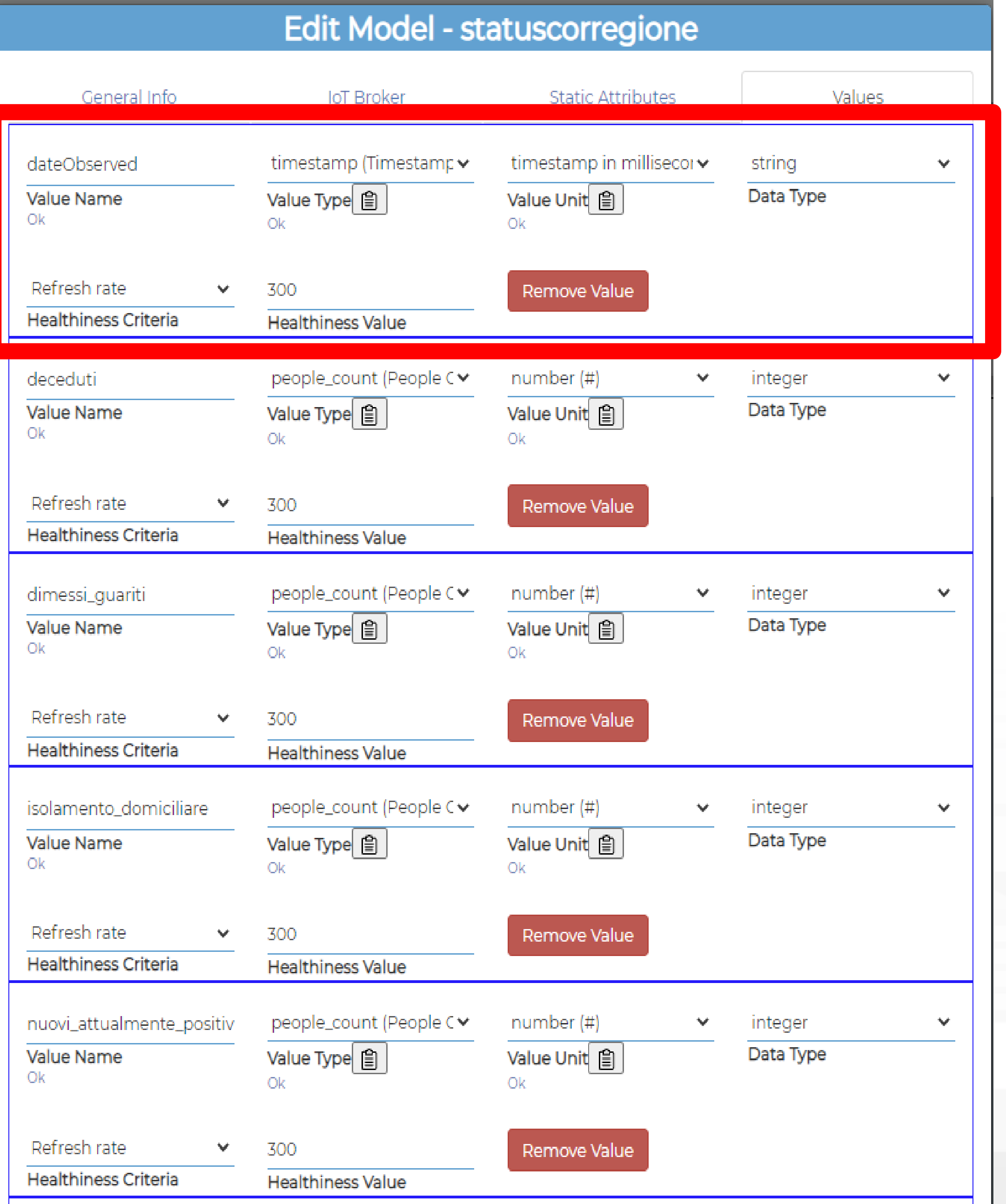
- IOT Edge may include IOT Applications
- Missing knowledge about the semantic of IOT devices
- Lack of capability for IOT Discovery: value type, location, etc., which could be used by IOT App
- Lack of Storage of data values over time

Activities for Registration on Directory

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

1 **Entity/IoT Directory**

Manual or automated Registration
of Entities/Devices

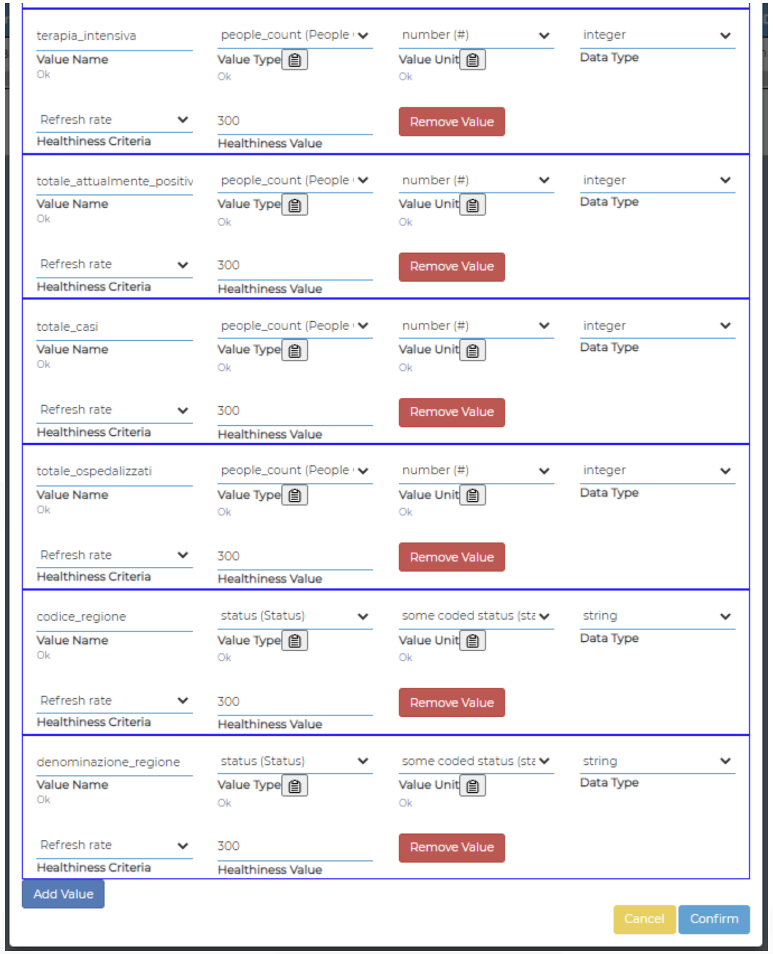


Edit Model - statuscorregione

Value Name	Value Type	Value Unit	Data Type	Healthiness Criteria	Healthiness Value
dateObserved	timestamp (Timestamp	timestamp in millisecoı	string	Refresh rate	300
deceduti	people_count (People C	number (#)	integer	Refresh rate	300
dimessi_guariti	people_count (People C	number (#)	integer	Refresh rate	300
isolamento_domiciliare	people_count (People C	number (#)	integer	Refresh rate	300
nuovi_attualmente_positiv	people_count (People C	number (#)	integer	Refresh rate	300

For Time Series

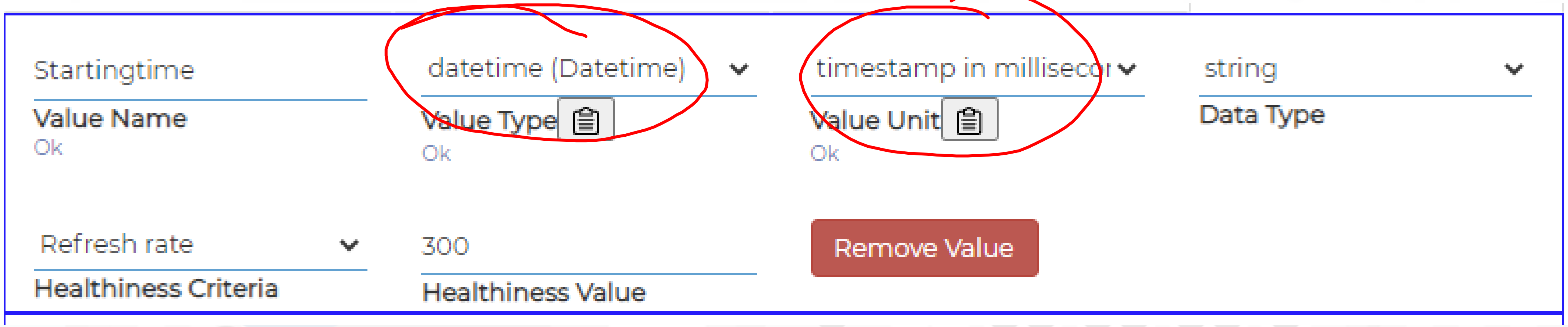
- ValueName: dateObserved
- ValueType: timestamp
- ValueUnit: timestamp in millisecond
- DataType: string
- E.g.: ISO string of the date-time



Value Name	Value Type	Value Unit	Data Type	Healthiness Criteria	Healthiness Value
terapia_intensiva	people_count (People (	number (#)	integer	Refresh rate	300
totale_attualmente_positiv	people_count (People (	number (#)	integer	Refresh rate	300
totale_casi	people_count (People (	number (#)	integer	Refresh rate	300
totale_ospedalizzati	people_count (People (	number (#)	integer	Refresh rate	300
codice_regione	status (Status)	some coded status (sta	string	Refresh rate	300
denominazione_regione	status (Status)	some coded status (sta	string	Refresh rate	300

Please note for Time Series of IoT Devices

- Snap4City engine recognizes as time basis for the TimeSerie only 1 Varible with
  - ValueType as TimeStamp (in milliseconds)
- **If you need more than one timestamp** in milliseconds use:
  - ValueType as ***DateTime*** (in milliseconds)



Value Name: Startingtime
Ok

Value Type: datetime (Datetime)
Ok

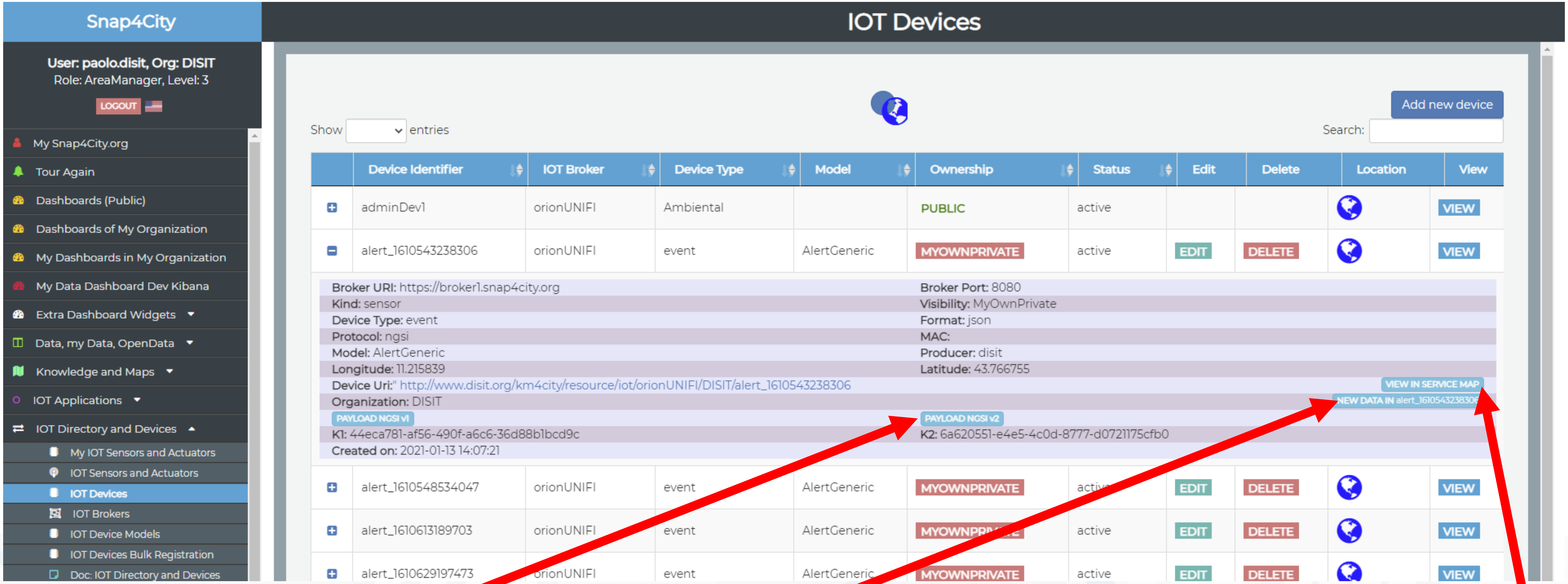
Value Unit: timestamp in millisecoı
Ok

Data Type: string

Healthiness Criteria: Refresh rate

Healthiness Value: 300

Once Created, I may send a new data to it


Snap4City
User: paolo.disit, Org: DISIT
Role: AreaManager, Level: 3
LOGOUT
My Snap4City.org
Tour Again
Dashboards (Public)
Dashboards of My Organization
My Dashboards in My Organization
My Data Dashboard Dev Kibana
Extra Dashboard Widgets
Data, my Data, OpenData
Knowledge and Maps
IOT Applications
IOT Directory and Devices
My IOT Sensors and Actuators
IOT Sensors and Actuators
IOT Devices
IOT Brokers
IOT Device Models
IOT Devices Bulk Registration
Doc: IOT Directory and Devices
IOT Devices
Add new device
Show entries
Search:

	Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Edit	Delete	Location	View
⊞	adminDev1	orionUNIFI	Ambiental		PUBLIC	active			🌐	VIEW
⊟	alert_1610543238306	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE	🌐	VIEW

Broker URI: https://broker1.snap4city.org | **Broker Port:** 8080

Kind: sensor | **Visibility:** MyOwnPrivate

Device Type: event | **Format:** json

Protocol: ngsi | **MAC:**

Model: AlertGeneric | **Producer:** disit

Longitude: 11.215839 | **Latitude:** 43.766755

Device Uri:" http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/alert_1610543238306

VIEW IN SERVICE MAP

Organization: DISIT

NEW DATA IN alert_1610543238306

PAYLOAD NGSI v1 | PAYLOAD NGSI v2

K1: 44eca781-af56-490f-a6c6-36d88b1bcd9c | **K2:** 6a620551-e4e5-4c0d-8777-d0721175cfb0

Created on: 2021-01-13 14:07:21

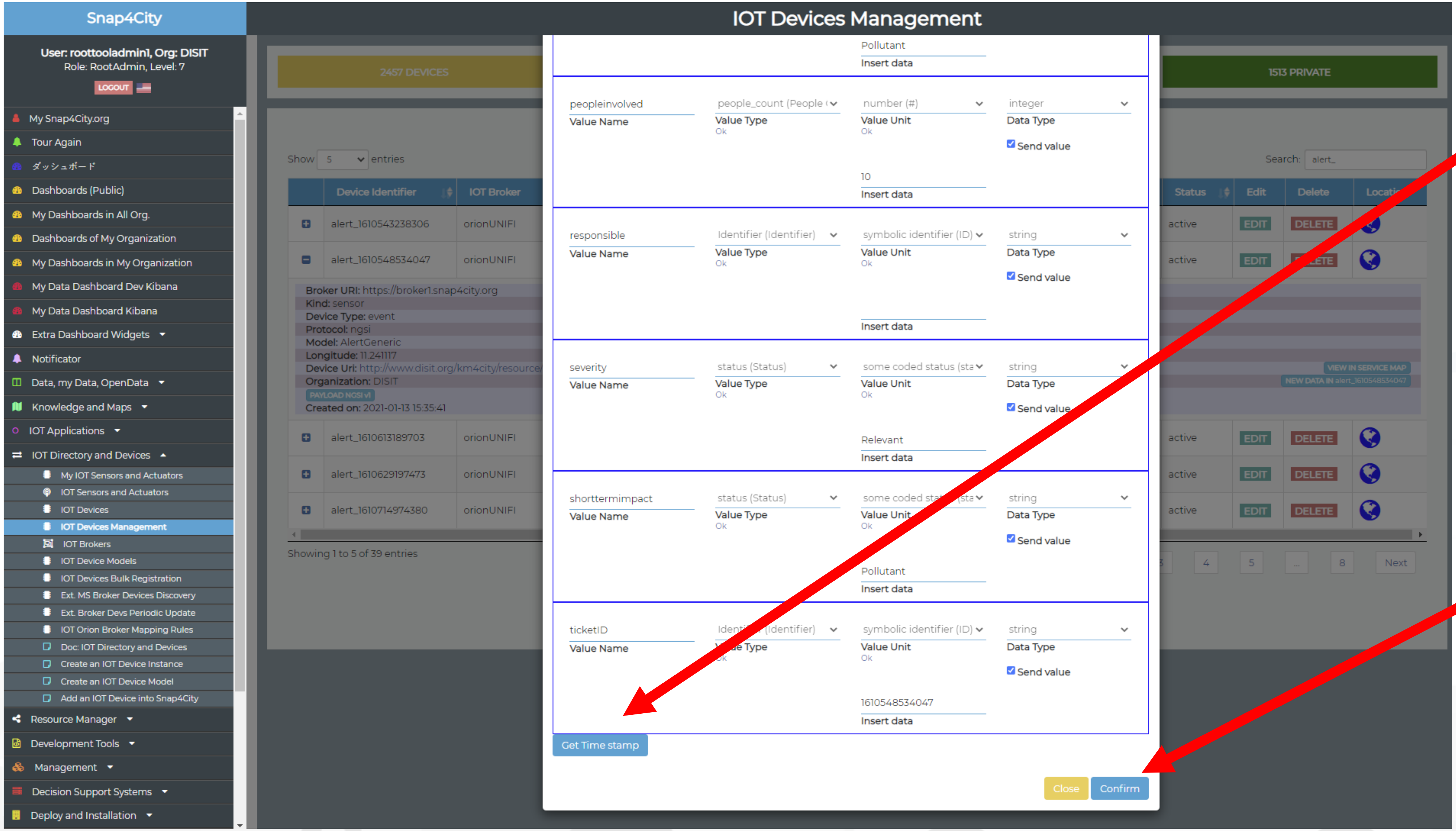
	Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Edit	Delete	Location	View
⊞	alert_1610548534047	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE	🌐	VIEW
⊞	alert_1610613189703	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE	🌐	VIEW
⊞	alert_1610629197473	orionUNIFI	event	AlertGeneric	MYOWNPRIVATE	active	EDIT	DELETE	🌐	VIEW

Get/See last message from Broker

Generate a New Message towards the Device, Storage

View IoT Device on map and its last value

Edit Message



Snap4City

IOT Devices Management

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

LOGOUT

- My Snap4City.org
- Tour Again
- ダッシュボード
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- My Data Dashboard Kibana
- Extra Dashboard Widgets
- Notificator
- Data, my Data, OpenData
- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
  - My IOT Sensors and Actuators
  - IOT Sensors and Actuators
  - IOT Devices
  - IOT Devices Management
  - IOT Brokers
  - IOT Device Models
  - IOT Devices Bulk Registration
  - Ext. MS Broker Devices Discovery
  - Ext. Broker Devs Periodic Update
  - 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
- Development Tools
- Management
- Decision Support Systems
- Deploy and Installation

2457 DEVICES — 1513 PRIVATE

Show 5 entries — Search: alert_

	Device Identifier	IOT Broker	Status	Edit	Delete	Locati
+	alert_1610543238306	orionUNIFI	active	EDIT	DELETE	
−	alert_1610548534047	orionUNIFI	active	EDIT	DELETE	
+	alert_1610613189703	orionUNIFI	active	EDIT	DELETE	
+	alert_1610629197473	orionUNIFI	active	EDIT	DELETE	
+	alert_1610714974380	orionUNIFI	active	EDIT	DELETE	

Broker URI: https://broker1.snap4city.org
Kind: sensor
Device Type: event
Protocol: ngsi
Model: AlertGeneric
Longitude: 11.241117
Device Uri: http://www.disit.org/km4city/resource
Organization: DISIT
PAYLOAD NGSI V1
Created on: 2021-01-13 15:35:41

VIEW IN SERVICE MAP
NEW DATA IN alert_1610548534047

Showing 1 to 5 of 39 entries — 4 5 ... 8 Next

Pollutant
Insert data

Value Name	Value Type	Value Unit	Data Type	Send value	Insert data
peopleinvolved	people_count (People (	number (#)	integer	☑	10
responsible	Identifier (Identifier)	symbolic identifier (ID)	string	☑	
severity	status (Status)	some coded status (sta	string	☑	Relevant
shorttermimpact	status (Status)	some coded st (sta	string	☑	Pollutant
ticketID	Identifier (Identifier)	symbolic identifier (ID)	string	☑	1610548534047

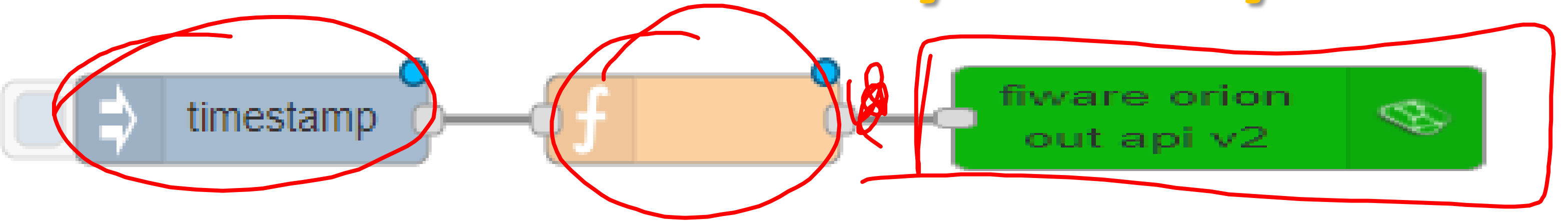
Get Time stamp

Close — Confirm

Impose current date time on dateObserved

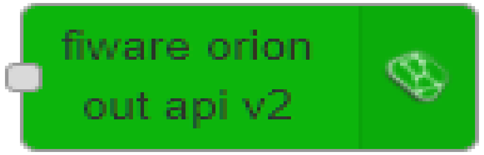
Send the Message to the Device, Storage

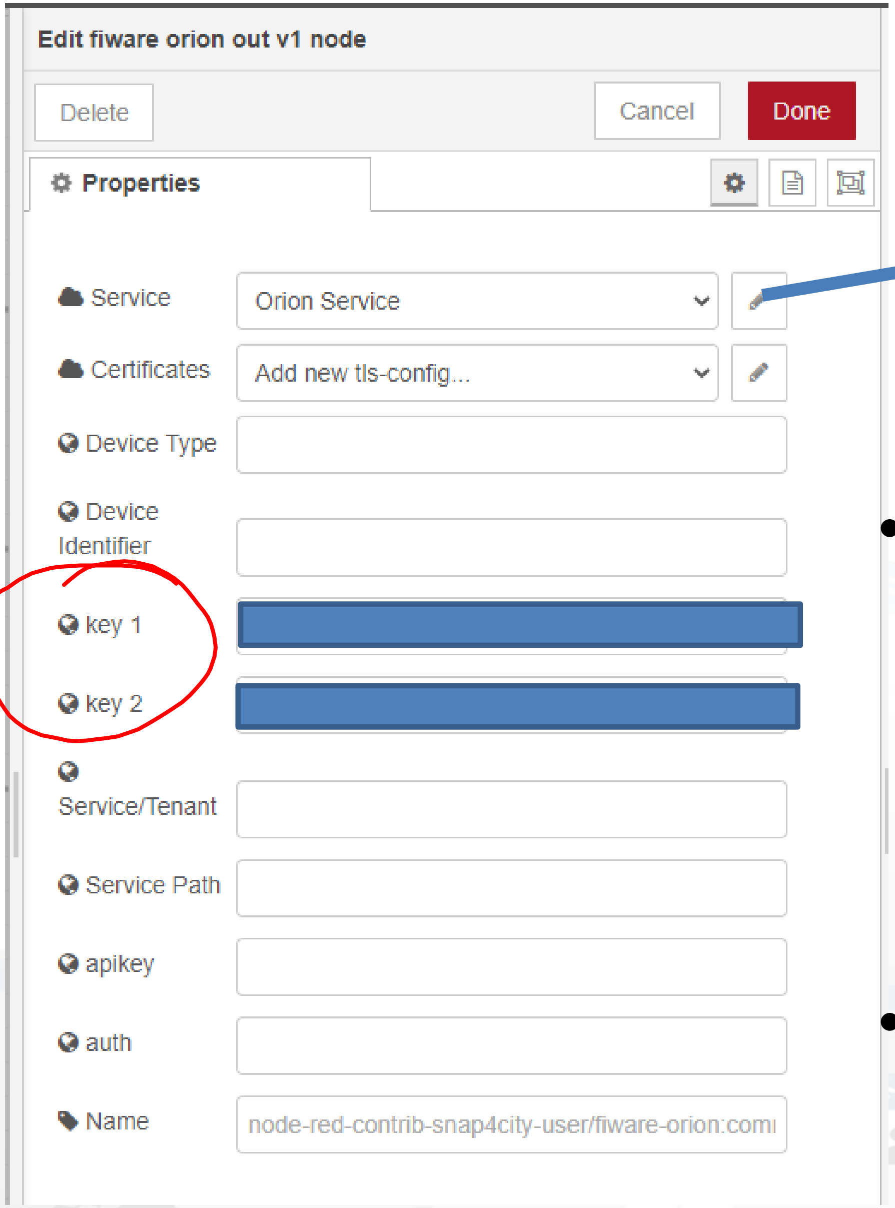
Once created the Device you may send data on it



- You may create a Proc.Logic / IOT App, where:
  - Function: is preparing the JSON package
  - Block «FIWARE Orion OUT V2» is sending the data to the Orion Broker. Namely: «OrionUNIFI»
  - Please note that several version of ORION Brokers and protocols exists:
    - So that you have to know which protocols you need to use for your broker

Settings ?

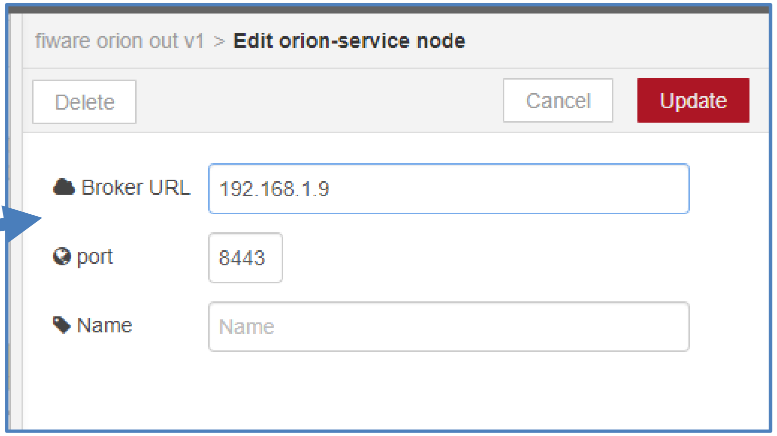




Edit fiware orion out v1 node

- Service: Orion Service
- Certificates: Add new tls-config...
- Device Type:
- Device Identifier:
- key 1: [redacted]
- key 2: [redacted]
- Service/Tenant:
- Service Path:
- apikey:
- auth:
- Name: node-red-contrib-snap4city-user/fiware-orion:comı

- Certificates are automatically loaded at the first authentication
- Done!!



fiware orion out v1 > Edit orion-service node

- Broker URL: 192.168.1.9
- port: 8443
- Name: Name

- IP if the Broker is in cloud (internal)
  - List of brokers is automatically provides
  - The K1, K2 is automatically provided if you are authenticated
- Symbolic address of Broker can be taken from Directory

- A Json from the IOT App
  - NGSI V1
- **ID**: The Name of the IOT Device: «corveneto»
- **Type** as that define in the IOT Device when you created
- The **Time stamp**: “dateObserved” to have a time series data
  - “str” is a string with the date and time in standard ISO, such as ,
  - “2020-08-04T04:00:00+02:00”,
  - “2020-08-03T00:00:00.000Z”
- And the **vector** of **“attributes”**

```
msg = { payload : {
  "id": "corveneto",
  "type": "misura",
  "attributes":[
 {  "name": "dateObserved", "value": str, "type": "timestamp"  },
 {  "name": "stato",   "value": “active”,   "type": "string"  },
 {  "name": "ricoverati_con_sintomi",   "value": 12,   "type": "integer"  },
 {  "name": "terapia_intensiva",   "value": 34,   "type": "integer"  },
 {  "name": "totale_ospedalizzati", "value": 34,  "type": "integer"  },
 {  "name": "isolamento_domiciliare",  "value": 334,  "type": "integer"  },
 {  "name": "totale_attualmente_positivi",   "value": 12,   "type": "integer"  },
 {  "name": "nuovi_attualmente_positivi", "value": 33,   "type": "integer"  },
 {  "name": "dimessi_guariti",   "value": 22222,  "type": "integer"  },
 {  "name": "deceduti",    "value": 2,  "type": "integer"   },
 {  "name": "totale_casi",    "value": 2222,    "type": "integer"   },
 {  "name": "tamponi",    "value": 222222344,    "type": "integer"   }
 ]
 }
}
return msg;
```

NGSI V2

```
{"id":"corveneto",
"type":"misura",
"codice_regione":{"type":"integer","value":""},
"dateObserved":{"type":"time","value":"2021-01-18T17:00:00.000Z"},
"deceduti":{"type":"integer","value":"8025"},
"denominazione_regione":{"type":"string","value":""},
"dimessi_guariti":{"type":"integer","value":"222062"},
"isolamento_domiciliare":{"type":"integer","value":"66514"},
"latitude":{"type":"float","value":"45.43490"},
"longitude":{"type":"float","value":"12.33845"},
"nuovi_attualmente_positivi":{"type":"integer","value":"-1557"},
"ricoverati_con_sintomi":{"type":"integer","value":"2233"},
"stato":{"type":"string","value":"ITA"},
"tamponi":{"type":"integer","value":"3663538"},
"terapia_intensiva":{"type":"integer","value":"336"},
"totale_attualmente_positivi":{"type":"integer","value":"69083"},
"totale_casi":{"type":"integer","value":"299170"},
"totale_ospedalizzati":{"type":"integer","value":"2569"}
}
```

NGSI V2

The differences are mainly on how the variable are provided:

```
{
"id":"MyMobileDeviceTest",
"type":"misura",
"dateObserved":{"type":"timestamp","value":"2021-06-11T16:17:23.425Z"},
"status":{"type":"float","value":25}
"mydescription":{"type":"string","value":"see below the note for the forbidden characters"}
}
```

- **NOTE for:**
  - **names/IDs**: Spaces or strange characters are not allowed in the. Please use simple alfphanumeric strings, it is a limitation of many solutions including Orion Broker and increase interoperability of your data.
  - **Values of attributes and variables**: can be UTF8, but similarly, they do not accept: () <> “ ‘ ; = into values
  - https://fiware-orion.readthedocs.io/en/master/user/forbidden_characters/index.html

DateObserved

- The **Timestamp**: “dateObserved” to have a time series data
  - “str” is a string with the date and time in standard ISO, such as ,
  - “2020-08-04T04:00:00+02:00”,
  - “2020-08-03T00:00:00.000Z”
- In JavaScript you can obtain by using:
  - Var str = new Date().toISOString();
  - **Str** has to be the ISO date string of today-now (at the current time).

From date to ISOString with fuse aligned time

```
var todaynow = new Date();
dateCET2Z(todaynow).toISOString();
----
function dateCET2Z(date) {
    d = new Date(date).toLocaleString('nl-BE', {timeZone: 'Europe/Brussels'});
    offset = new Date(d).getTime() - new Date(date).getTime();
    return new Date(new Date(date).getTime() - offset);
}
```

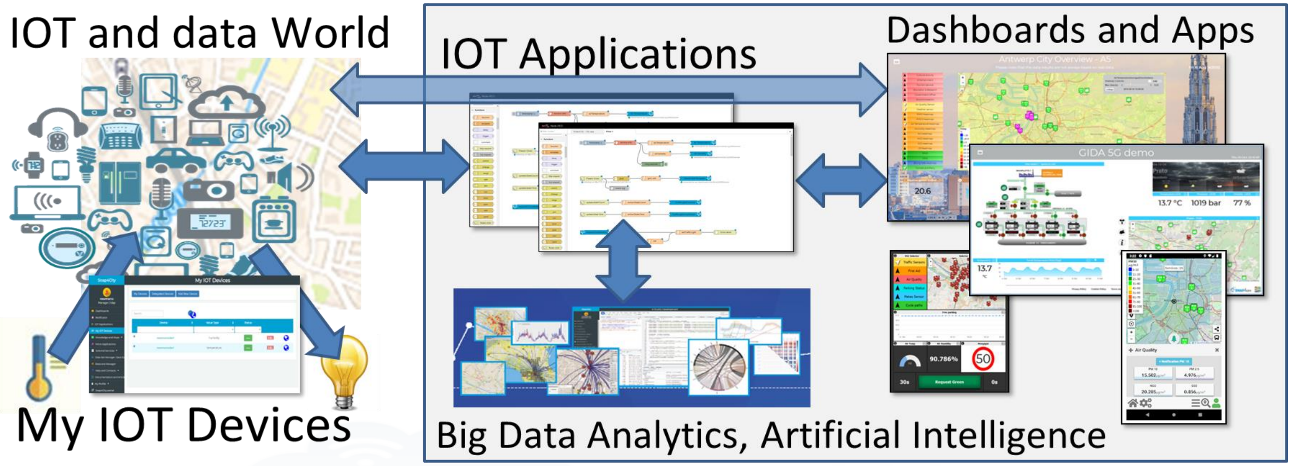
Test

- https://docs.google.com/forms/d/e/1FAIpQLSdvUSBpEkBvbvtqyNRxMNkB2D342il_rODqSt2Ab-7EV6JB1Q/viewform

Free Trial

- Register on [WWW.snap4city.org](http://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

DISIT



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.

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

▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube
▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube
▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube	▶ You Tube

booklets

- Smart City

SNAP4CITY
www.snap4city.org
www.snap4solutions.org
DIGITAL TWIN SOLUTIONS TO SETUP SUSTAINABLE DECISION SUPPORT SYSTEMS AND BUSINESS INTELLIGENCE

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

- Industry

SNAP4INDUSTRY
www.snap4industry.org
SMART DATA HUBS, BUSINESS INTELLIGENCE APPLICATIONS AND SERVICES

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

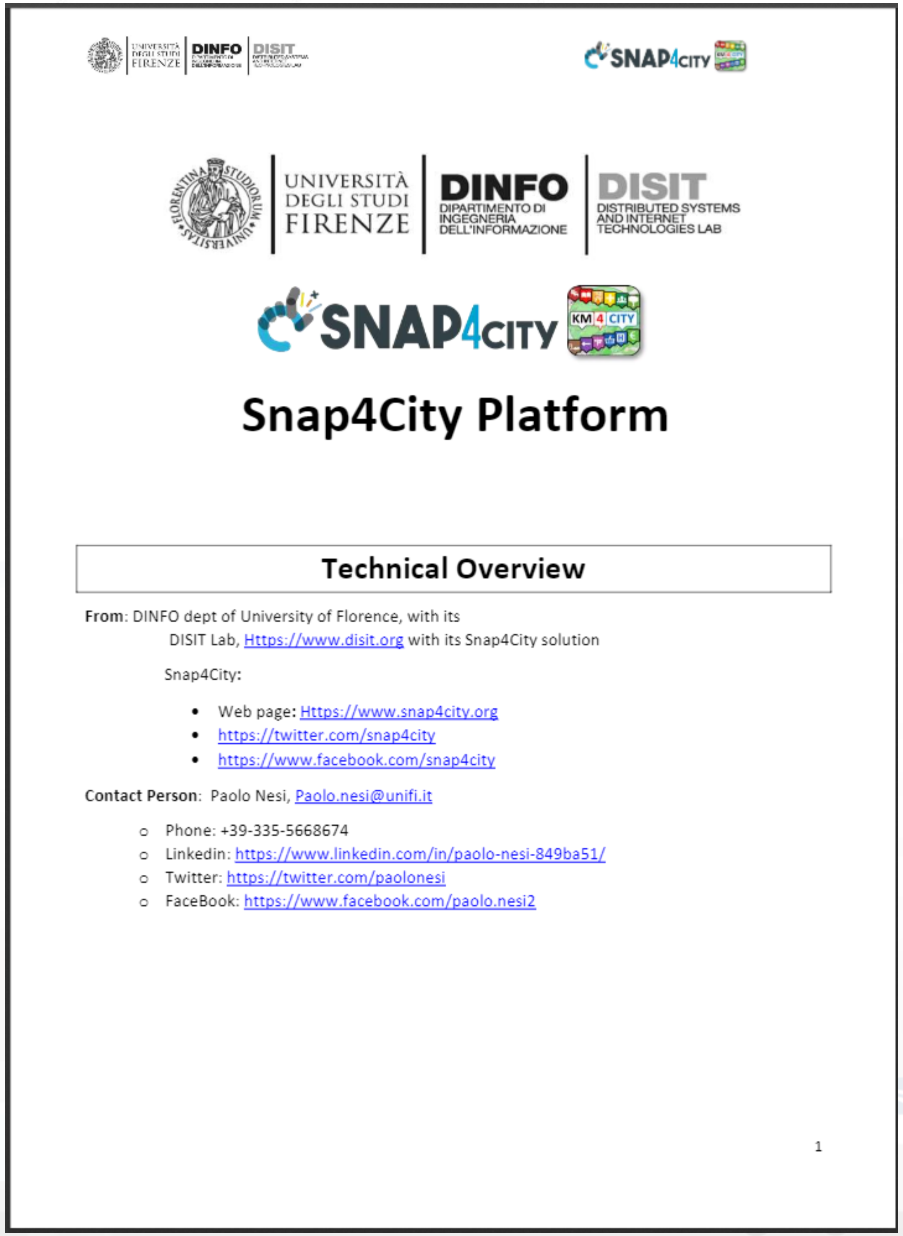
- Artificial Intelligence

SNAP4SOLUTIONS
ARTIFICIAL INTELLIGENCE
SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

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

Tech. Overview

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



Snap4City Platform

Technical Overview

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

Snap4City:

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

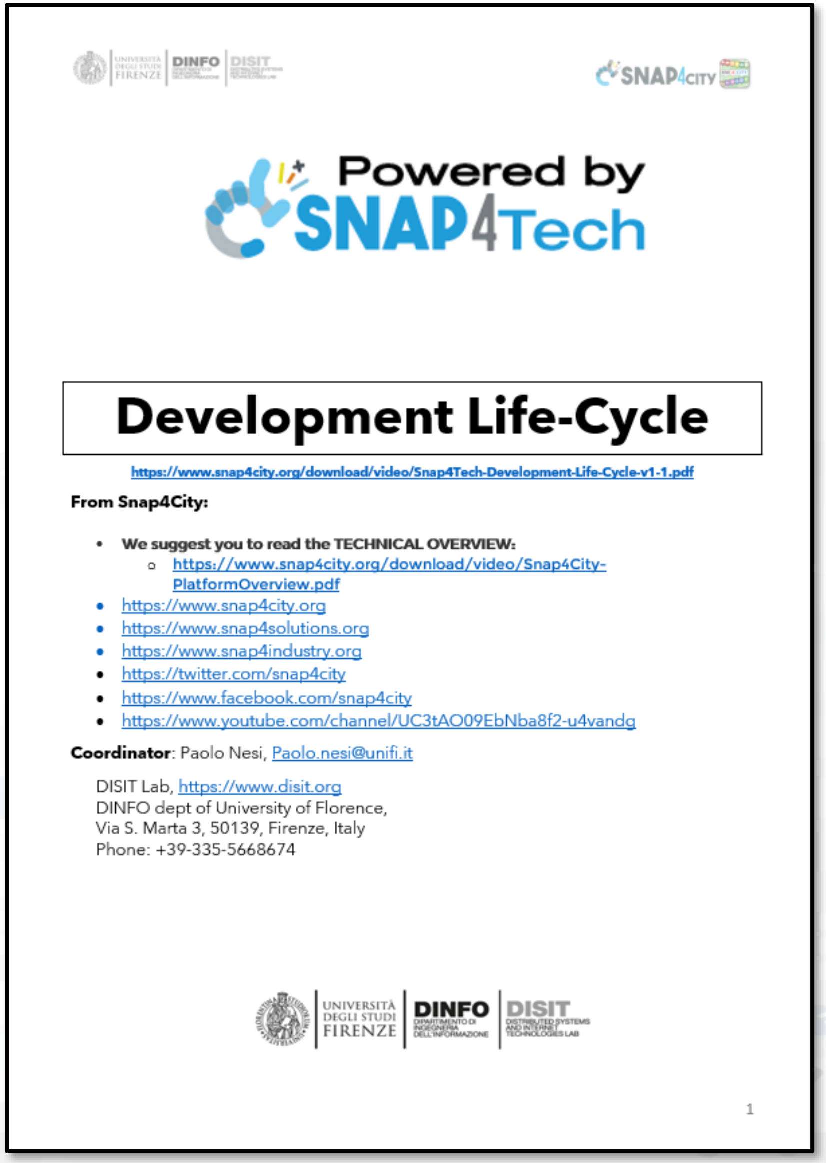
Contact Person: Paolo Nesi, Paolo.nesi@unifi.it

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

1

Development

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



Powered by SNAP4Tech

Development Life-Cycle

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

From Snap4City:

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

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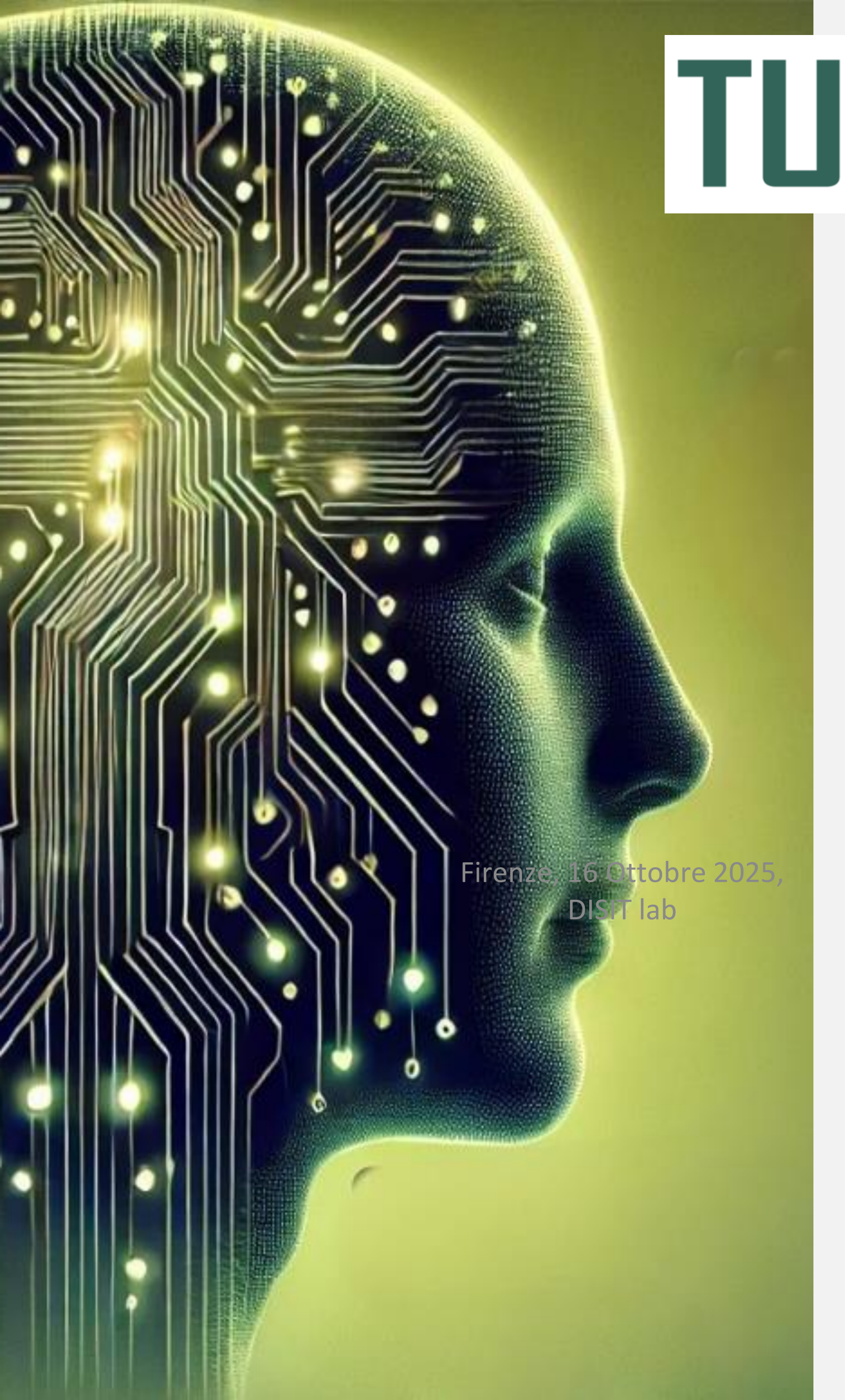

Grazie per l’attenzione!

? Q&A !

Firenze, 16 Ottobre 2025, DISIT lab

CONTATTI

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https://www.snap4city.org
https://www.snap4industry.org

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