



Be smart in a SNAP!



5th Day, data ingestion, Nov 2019, Florence

<https://www.snap4city.org/501>

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES



UNIVERSITÀ
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DINFO
DIPARTIMENTO DI
TECNOLOGIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS
AND INFRASTRUCTURE
TECHNOLOGIES LAB



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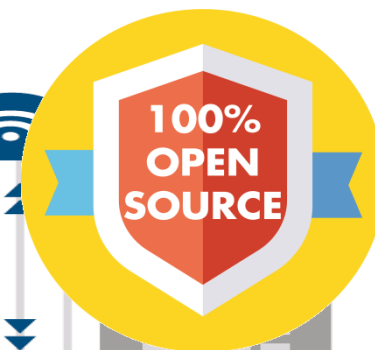
SNAP4city



Powered by

scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders

<https://www.Snap4City.org>



5th Day, data ingestion, Nov 2019, Florence

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Paolo Nesi, paolo.nesi@unifi.it

<https://www.Km4City.org>

<https://www.disit.org>



General Overview of the full Course

- **1st Day:** *General overview (1 day, 6 hours)*
- **2nd Day:** *Dashboards, how to build and manage them (4 hours)*
- **3rd Day:** *IOT Applications development, IOT Devices, IOT Networks (4 hours)*
- **4th Day:** *Data Analytics, in R Studio, In Python, how to integrate with IOT Applications (4 hours)*
- **5th Day:** *Data Ingestion, Data Warehouse, ETL Development, Data Gate, IOT Device Data ingestion, etc.. (5 hours)*
- **6th Day:** *Snap4City Architecture, How To Install Snap4City (3 hours)*
- **7th Day:** *Smart city API (internal and external) Web and Mobile App development tool kit (4 hours)*

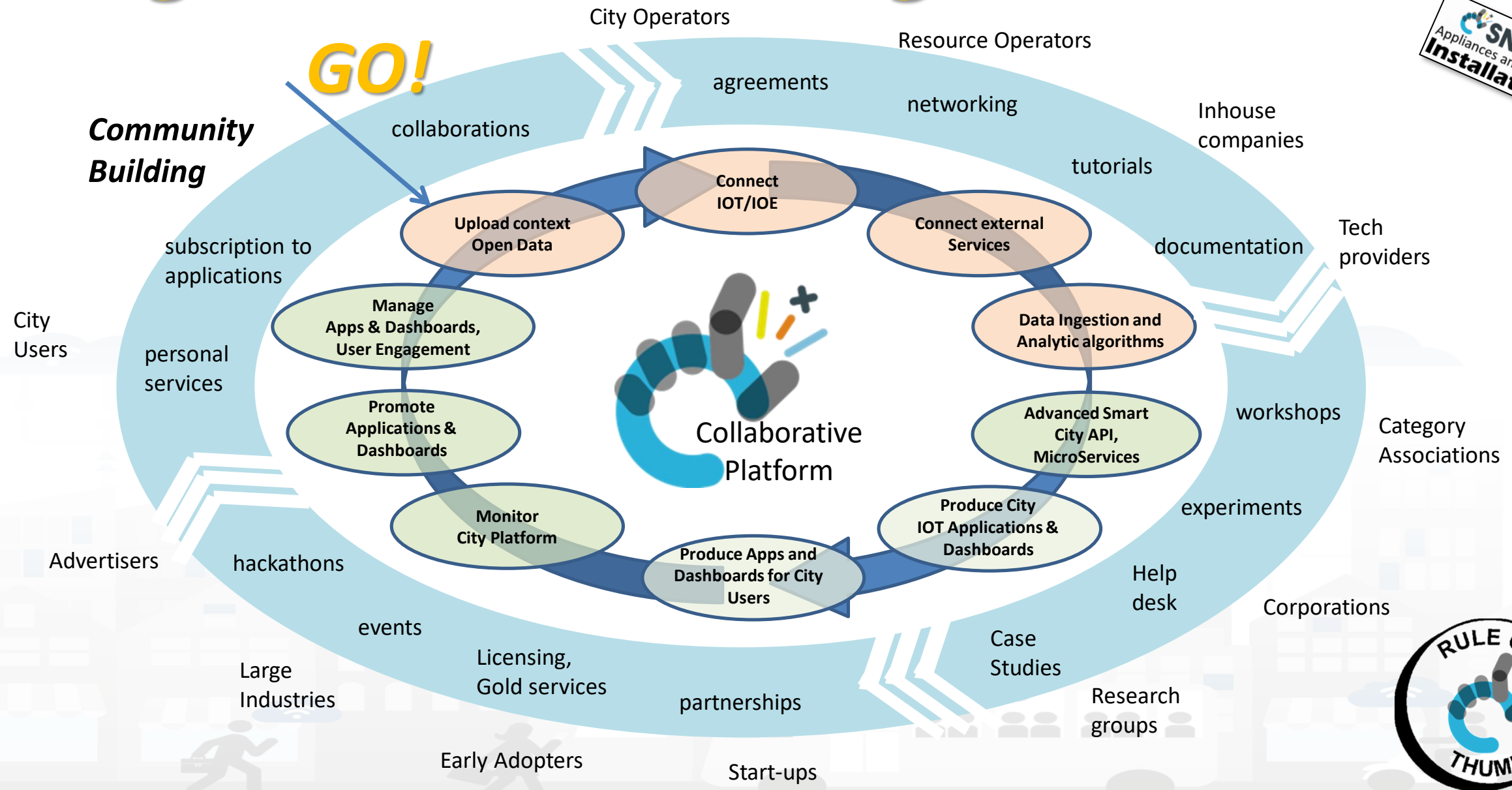
A number of the training sections include esercitazioni

Updated versions on: <https://www.snap4city.org/501>



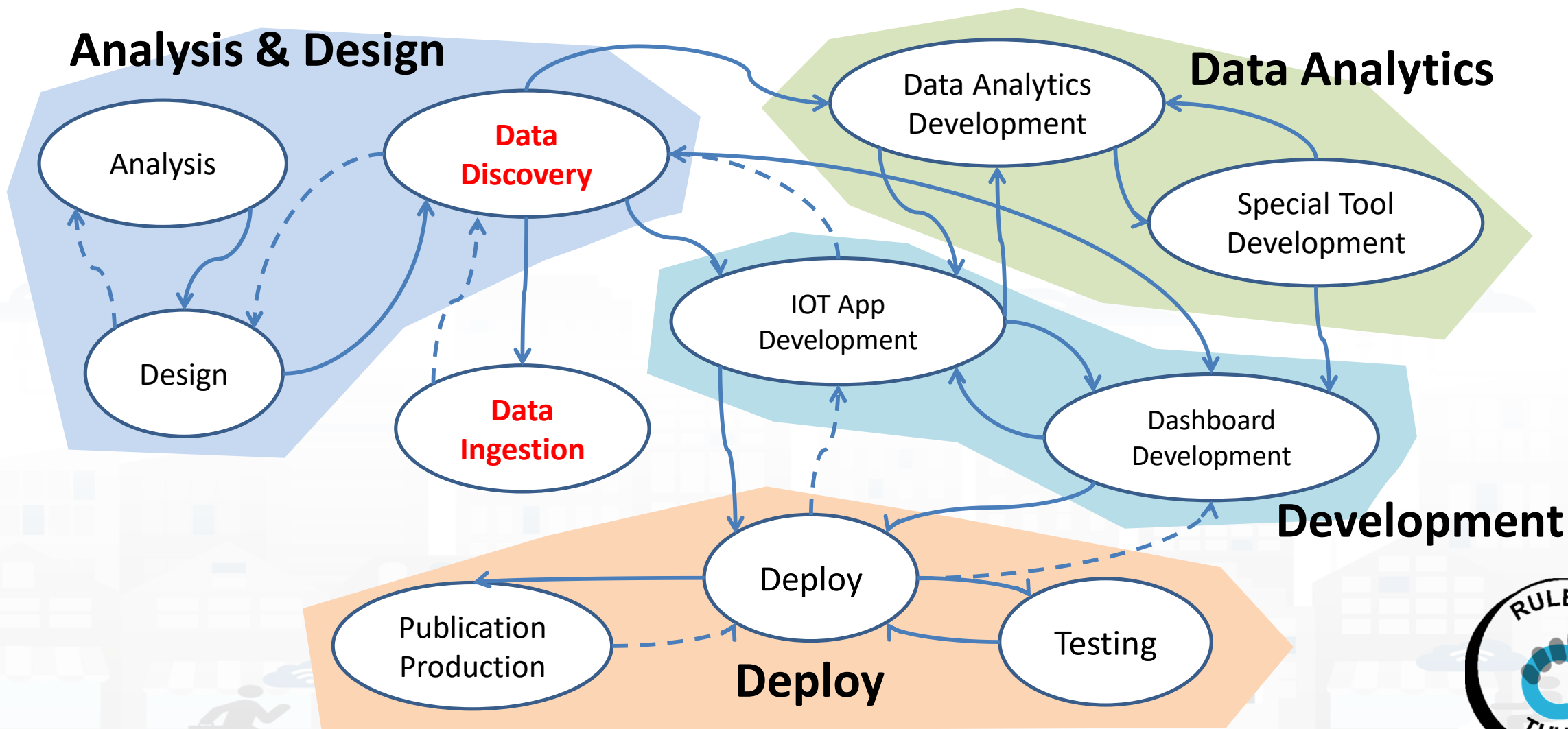
- GO • **Data Ingestion Capabilities**
- GO • **Data Ingestion Strategy (and process)**
- GO • **Setting Up the Road Graph on Knowledge Base**
- GO • **Data Set Load via Data Gate (plus how to load triples into Knowledge base)**
- GO • **Data Ingestion and Transformation via ETL Processes**
- GO • **Data Ingestion via IOT Brokers**
 - IOT Network: recall of basic concepts
- GO • **IOT Directory**
 - IOT Devices and IOT Brokers Registration
- GO • **Data Ingestion via IOT Applications**
- GO • **Data Ingestion from API, External Services, Custom MicroServices**
- GO • **Data Ingestion via Web Scraping**
- GO • **Data Streams from Smart City API, participatory**
- GO • **Data Streams from Mobile Devices, participatory**
- GO • **Data Streams from Dashboards**
- GO • **GIS Data Import and Export**
- GO • **Social Media data collection and exploitation**
- GO • **Acknowledgements**

Living Lab Accelerating



Development Life Cycle

Smart City Services



TOP

Data Ingestion Capabilities

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

IOT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADVANCED
SMART CITY API,
MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

DATA ANALYTICS
BUSINESS INTELLIGENCE
WHAT-IF AND
SIMULATION

SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM. OPENED
TO DEVELOPERS
AND STAKEHOLDERS

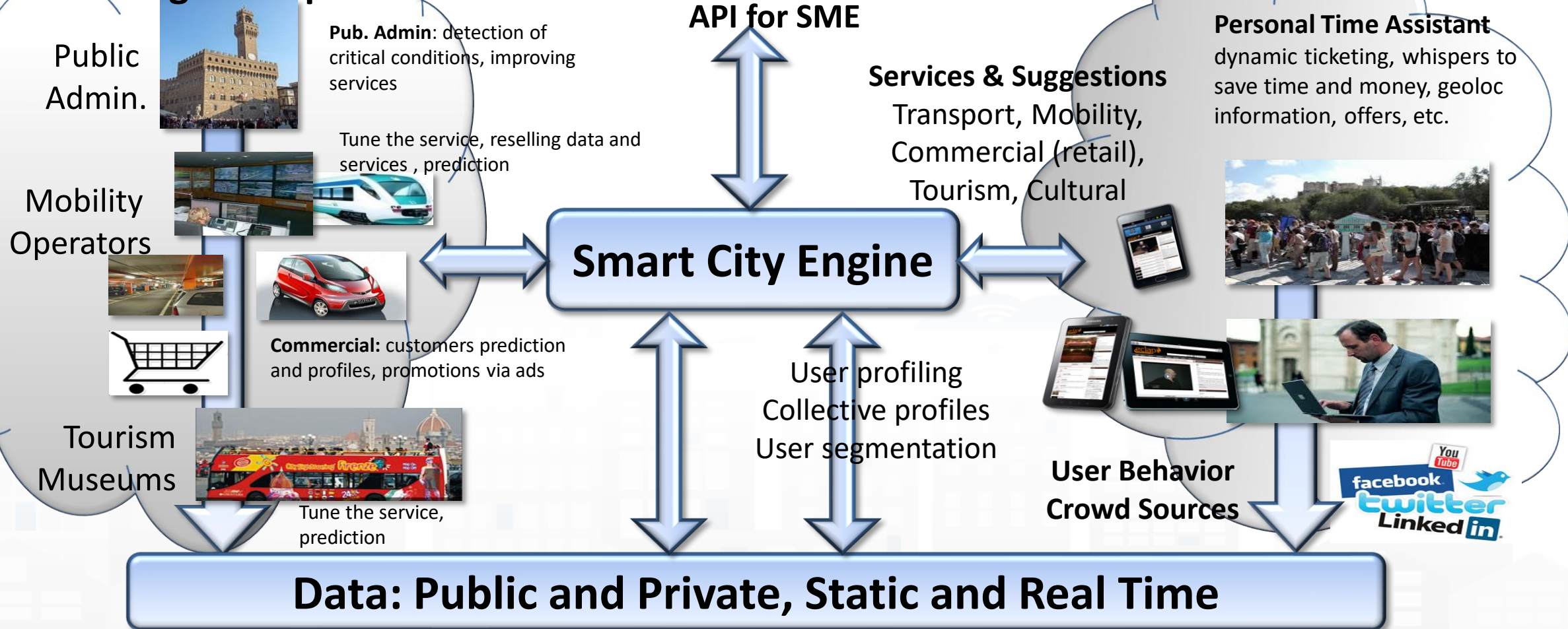
TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

Challenges: Requests and Deductions



Private: user movements, social media, crowd sources, commercial (retail)

Public: infomobility, traffic flow, TV cameras, flows, ambient, weather, statistic, accesses to LTZ, services, museums, point of interests, ...

Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

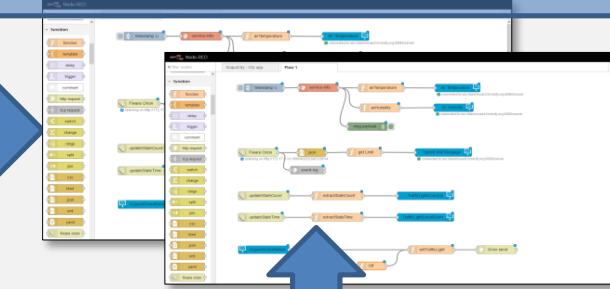
IOT and data World

IOT Applications

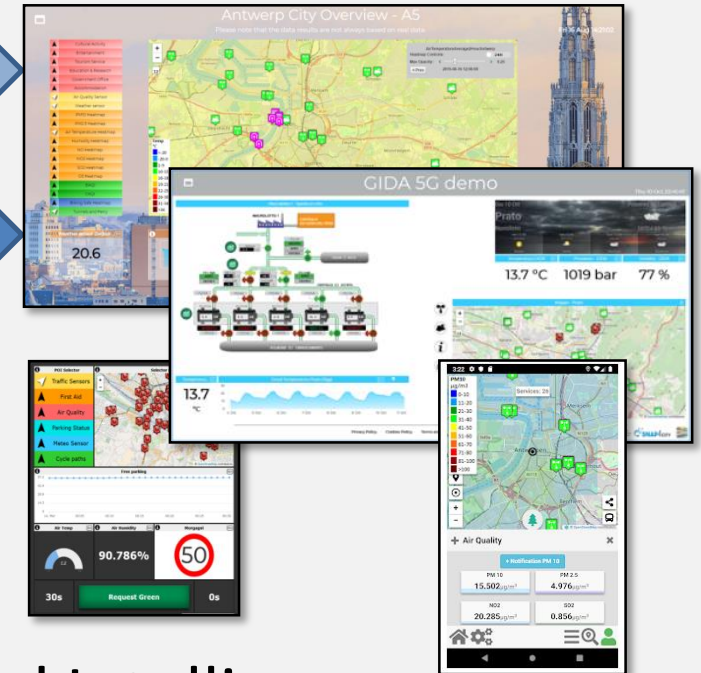
Dashboards and Apps



My IOT Devices



Big Data Analytics, Artificial Intelligence





APPLIANCES CONTAINERS

- LOCAL GOVERN
- STAKEHOLDERS
- CITY USERS
- IN-HOUSE
- ENERGY OPERATORS
- MOBILITY OPERATORS
- COMMERCIAL OPERATORS
- SECURITY OPERATORS
- INDUSTRIES
- RESEARCHERS
- START-UPS
- ASSOCIATIONS



- GDPR
- SECURITY
- PRIVACY
- ASSESSMENT
- AUDITING
- PENTESTED

- OPEN IOT DEVICES
- IOT EDGE
- IOT GATEWAY
- PAX COUNTERS
- IOT BUTTONS

- TEST CASES, SCENARIOS, VIDEOS, HACKATHONS
- OPEN SOURCES, COMMUNITY OF CITIES
- TRAINING TUTORIALS, COMMUNITY MANAGEMENT

IOT APPLICATIONS - INSTANT APPS



DATA DRIVEN APPLICATIONS • REAL TIME PROCESSING • BATCH PROCESSING • ANY PROTOCOL & FORMAT

DASHBOARDS & APPLICATIONS



CONTROL ROOM • SITUATION ROOM • OPERATOR DASHBOARDS • BUSINESS INTELLIGENCE • WHAT-IF ANALYSIS • DECISION SUPPORT • SIMULATIONS • RISK ANALYSIS • RESILIENCE ANALYSIS

MOBILE & WEB APPLICATIONS



DEVELOPMENT KIT • SUGGESTIONS • MOBILE APPS • MONITORING PANELS • PLATFORM UTILITIES • READY TO USE SMART APPLICATIONS

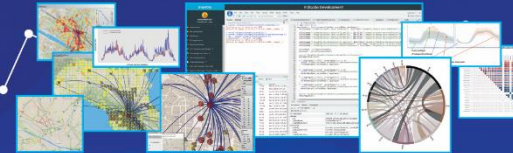
MICROSERVICES & ADVANCED SMART CITY API

LIVING LAB - DEV TOOLS - COWORKING



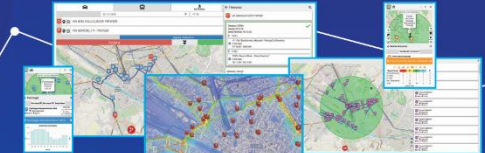
IOT DIRECTORY • SERVICE MAP • RESOURCE MANAGER • DATA GATE • R STUDIO • ETL

BIG DATA - DATA ANALYTICS



PREDICTIONS • ANOMALY DETECTION • WHAT-IF ANALYSIS • TRAFFIC FLOW RECONSTRUCTION • ORIGIN-DESTINATION MATRICES • SOCIAL MEDIA ANALYSIS • OFFER VS DEMAND ANALYSIS • ENVIRONMENTAL DATA ANALYSIS AND PREDICTIONS • REAL TIME HEATMAPS • ROUTING • ALERTING • EARLY WARNING • PERSONAL AND VIRTUAL ASSISTANTS • SMART SOLUTIONS • SMART SHARING • PARTICIPATORY

DATA ANALYTICS TOOLS - MICRO-APPLICATIONS



KM4CITY DATA AGGREGAT KNOWLEDGE BASE - EXPERT SYSTEM OF THE CITY - BIG DATA STORE

IOT MNG - DATA MNG - DATA INSPECTOR - PROCESS MNG - USER ENGAGEMENT - GDPR MNG ...

GIS

CITY UTILITIES

OPEN DATA

LEGACY &
EXTERNAL
SERVICES

PERSONAL
DATA

IOT / IOE

BROKERS

KPI

INDUSTRY 4.0

SOCIAL MEDIA



Standards and Interoperability

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, etc.



Snap4City vs Formats

- Snap4City is capable to ingest and work with any format:
 - Data **exchange**: JSON, GeoJSON, XML, HTML, HTML5, DATEX, GTFS, binary, etc.
 - **GIS formats**: WMF, WFS, heatmaps,
 - **Table**: CSV, XLSX, XLS, database, ...
 - **archive** file formats: zip, rar, 7z, tgz, ...
 - **image** formats: png, gif, tiff, ico, jpg, ...
 - **video** formats: mp4, avi, mov, ...
- Search the format you need to cope on the search box of Snap4City portal!: [Snap4City Supported Protocols, adding new protocols](#)

Data vs Smart Services enabling on Snap4City

- **Public Transportation and mobility activated services in some where with Snap4City**
 - **Smart parking** (parking locations and real time parking data) ... predictions
 - **Smart Fuel pricing** (fuel station locations and real time prices)
 - **Routing** (detailed GIS information, text indexing of streets, POI, etc.)
 - **Quite routing, perfect shopping, etc. etc.** (more data in needed....)
 - **multimodal routing** (detailed GIS information, Public transport time schedule)
 - **Info traffic** (traffic flow sensors, real time Traffic events, their localization, etc.)
 - **Dense info traffic** (traffic flow sensors and traffic flow reconstruction algorithm)
 - **Car/Bike/Scooter Sharing** (position and availability of Cars/Bikes, Scooters) ... predictions
 - **Smart Biking** (cycling paths, environmental data) ... predictions
 - **E-vehicles** (position, status of recharging stations,. ...) ... predictions vs booking
 - **Smart river crossing** (position and status of Underpass, Ferry) ... prediction
 - **Quality of Public Transport** (actual time of arrival at the bus stops, wrt planned time schedule)
 - **Early Warning vs Resilience** (combination of several data including mobility, events, Social to perform early warning...)

Data vs Smart Services enabling on Snap4City

- **Social and Users Behaviour**

- **Smart First Aid**
- **search for POI and public transport services**
- **Social Media Monitoring and acting**
- **Information to Tourists**
- **Early Warning, prediction of audience**
- **Improvement of services for Tourists**

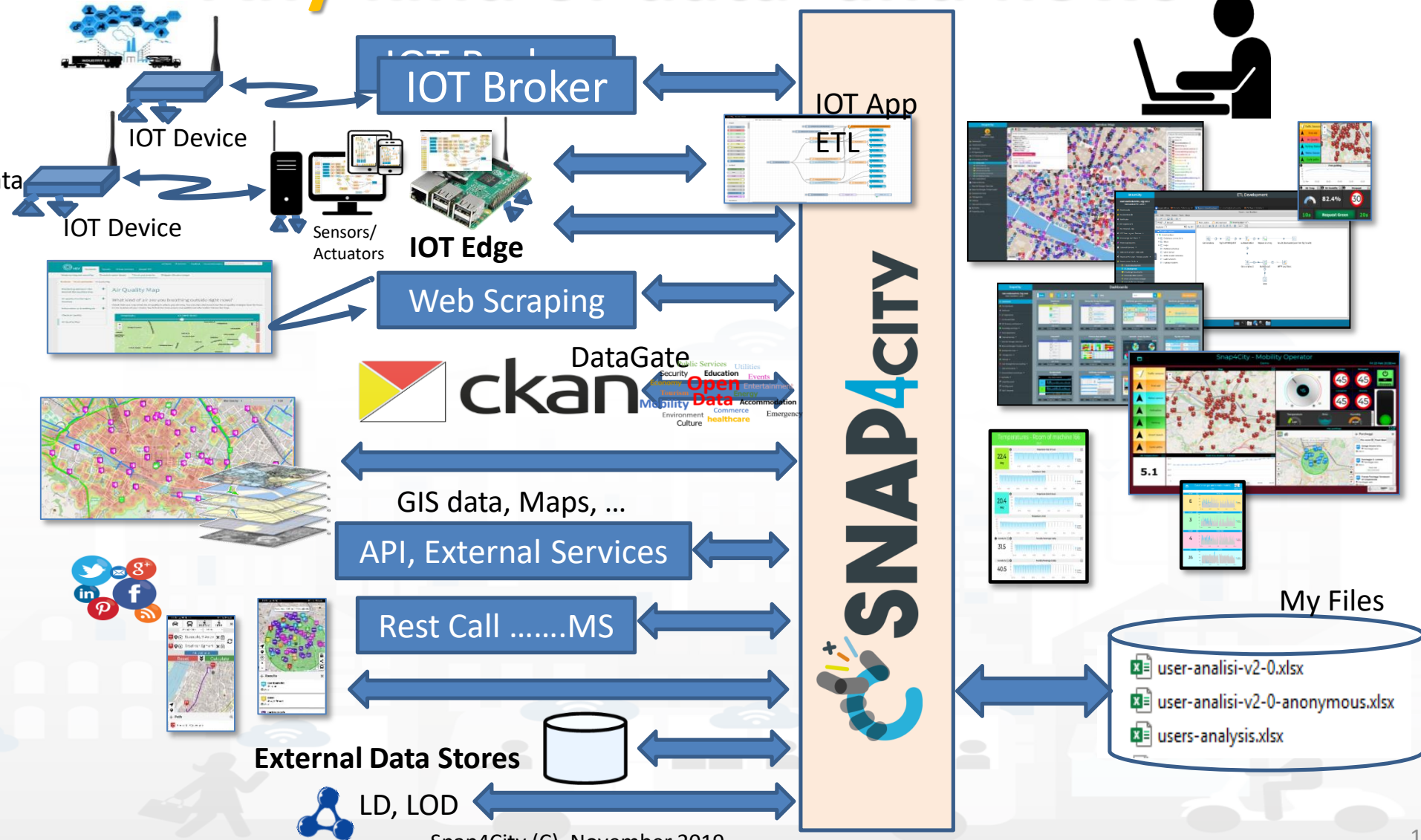
(Location of First AID, real time status of triage)
(POI geolocalized, spatial queries, along paths)
(Identif. of dysfunction, quality of service perceived)
(Entertainment Events)
(Twitter data, social media)
(people flow, usage of services)
(Origin Destination Matrices, trajectories, heatmaps)
(People Monitoring, via App, Wifi, PAX Counter)
(Twitter Data, social mea,....)

- **Weather and environment, quality of life**

- **Weather forecast/condition**
- **Air quality Pollution**
- **Pollination**
- **Alerting on Air quality for multiple parameters**
- **Information Heatmaps for weather and air quality**
- **Air quality indexes, and forecast**

(Weather forecast)
(pollution sensors, PM10, PM2.5, NOX, etc.)
(Pollination sensors)
(Prediction of parameters time slots, notification)
(air quality sensors, heatmaps, prediction)
(.....)

Any kind of data and flows



Private and static

- Fiscal Code, SSN
- Non shared pictures
- Level aspects
- Patient health record
- ..

- Personal movements
- GPS traces
- Relationships among people

- User Behaviour
- social media
- Contributions
- Consumption of energy, gas
- banking

Real time private

- Personal traffic
- Position of cars
- Position of taxi
- Position of CarSharing ...

- TV cameras

Static Public (open data)

statistics: accidents, census, votations

- # Accesses to RTZ ZTL
- Data from Public GOV

Position of commercial activities, POI

- Museums
- City services data, almost
- Active services

- Info traffico
- video camere
- Info weather
- Info environment
- Status of the queue at Museums
- earthquake data
- parking

- Stato accessi alla ZTL
- Stato dei servizi

Real time public (open data)

Further readings

- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)
- [HOW TO: add IOT Device data source from external broker to the platform.](#)
- [TC9.13: How to upload a local file into your IOT Application](#)
- [TC9.16 Web Scraping to get data from web pages](#)
- [TC6.3. Creating ETL processes for automated data ingestion and data transformation](#)
- [TC9.2. Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards](#)
- [TC6.1. Managing DataSets via DataGate: ingest, search, download, upload, annotate, share](#)
- [TC6.2. Search on DataGate for Data Sets](#)
- [TC2.25. Registering external MicroService calling RestCall services, using it on IOT applications](#)

Data Gathering and Knowledge Management

- Data ingestion can be performed by using multiple tools:
 - ETL processes, IOT Applications, Data Gate, WebScraping. We suggest:
 - ETL for static / periodic data in PULL
 - IOT App for real time data and flow, from IOT Brokers/Devices
 - DataGate for Static Data, upload them as files, or collected from other CKAN
 - WebScraper for scraping data from Web Pages, when authorized!
- See how to test cases:
 - [HOW TO: add data sources to the Snap4City Platform](#)
 - [HOW TO: define privacy rules for personal data, produced by the end-users own device](#)
 - [US6. Developing and using processes for data transformation](#)
 - [TC6.1 - Managing DataSets via DataGate: ingest, search, download, upload, annotate, share](#)
 - [TC6.3 - Creating ETL processes for automated data ingestion and data transformation](#)
 - [TC6.5 - Managing Heterogeneous File Ingestion via ETL processes](#)
 - [TC6.9 - ETL processes for multiprotocol and format data ingestion, see on GITHUB for library](#)
 - [TC9.2 - Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards](#)

TOP

Data Ingestion Strategy

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA OWNER
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

IoT/IOE DEVICES
AND NETWORKS

IOT APPLICATIONS,
THE LOGIC AND
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VIGILANCE: SOCIAL
MEDIA ANALYSIS

SNAP4CITY
AND KM4CITY
PROJECTS

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

Smart City Functional Architecture

Transport systems
Mobility, parking



Public Services,
Govern, events, ...



Sensors, IOT Cameras,
Wi-Fi



Environment, Water,
energy



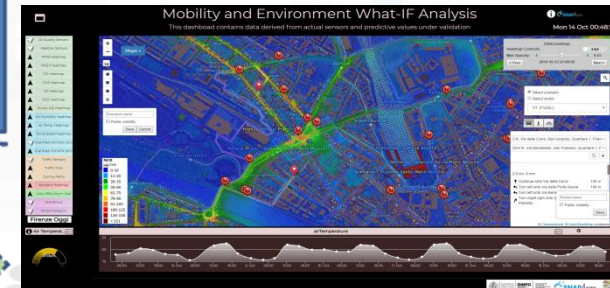
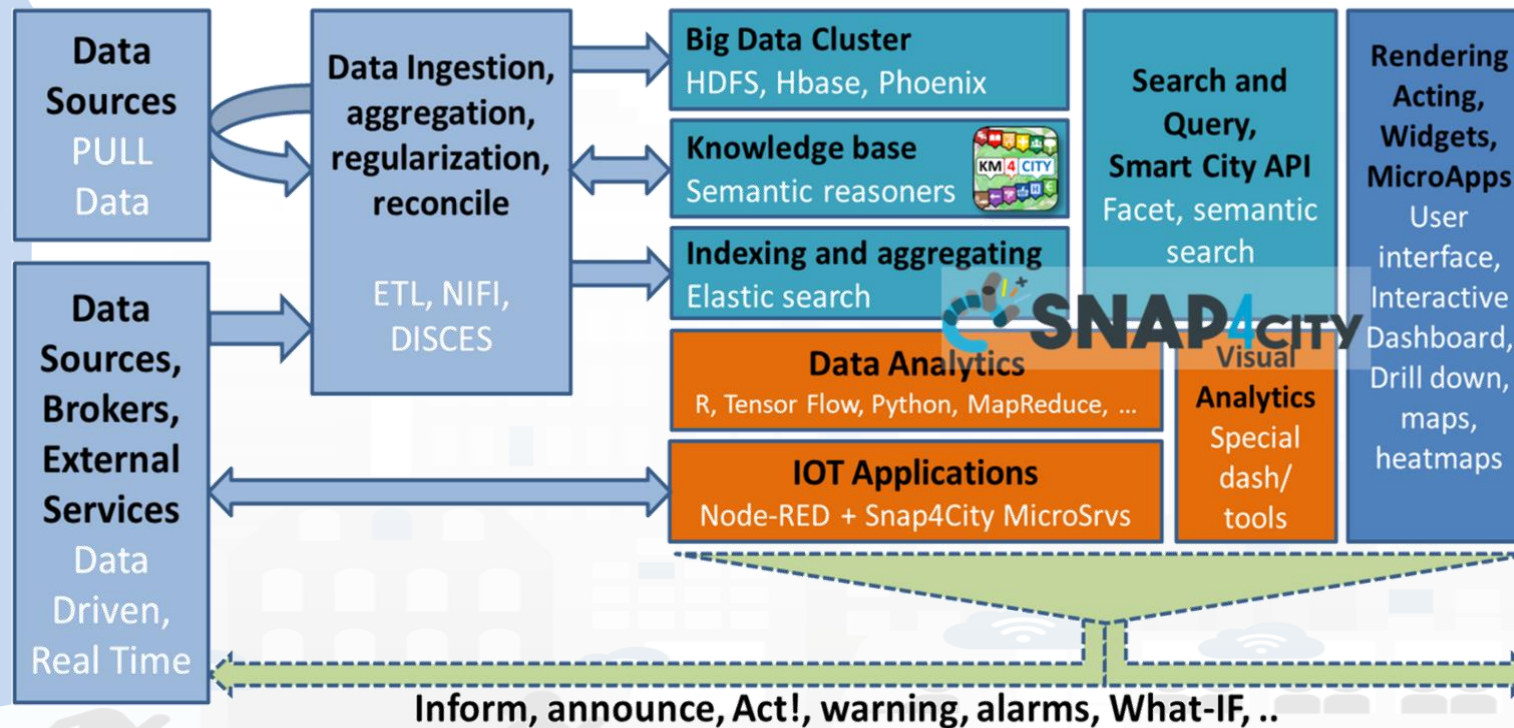
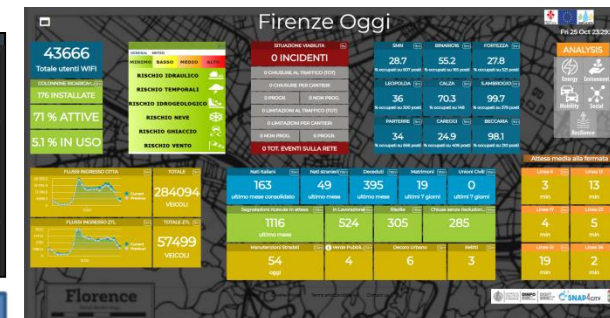
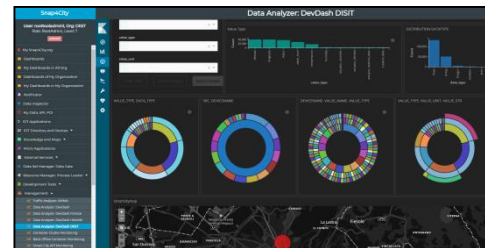
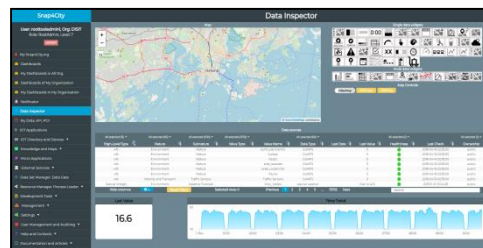
Shops, services,
operators



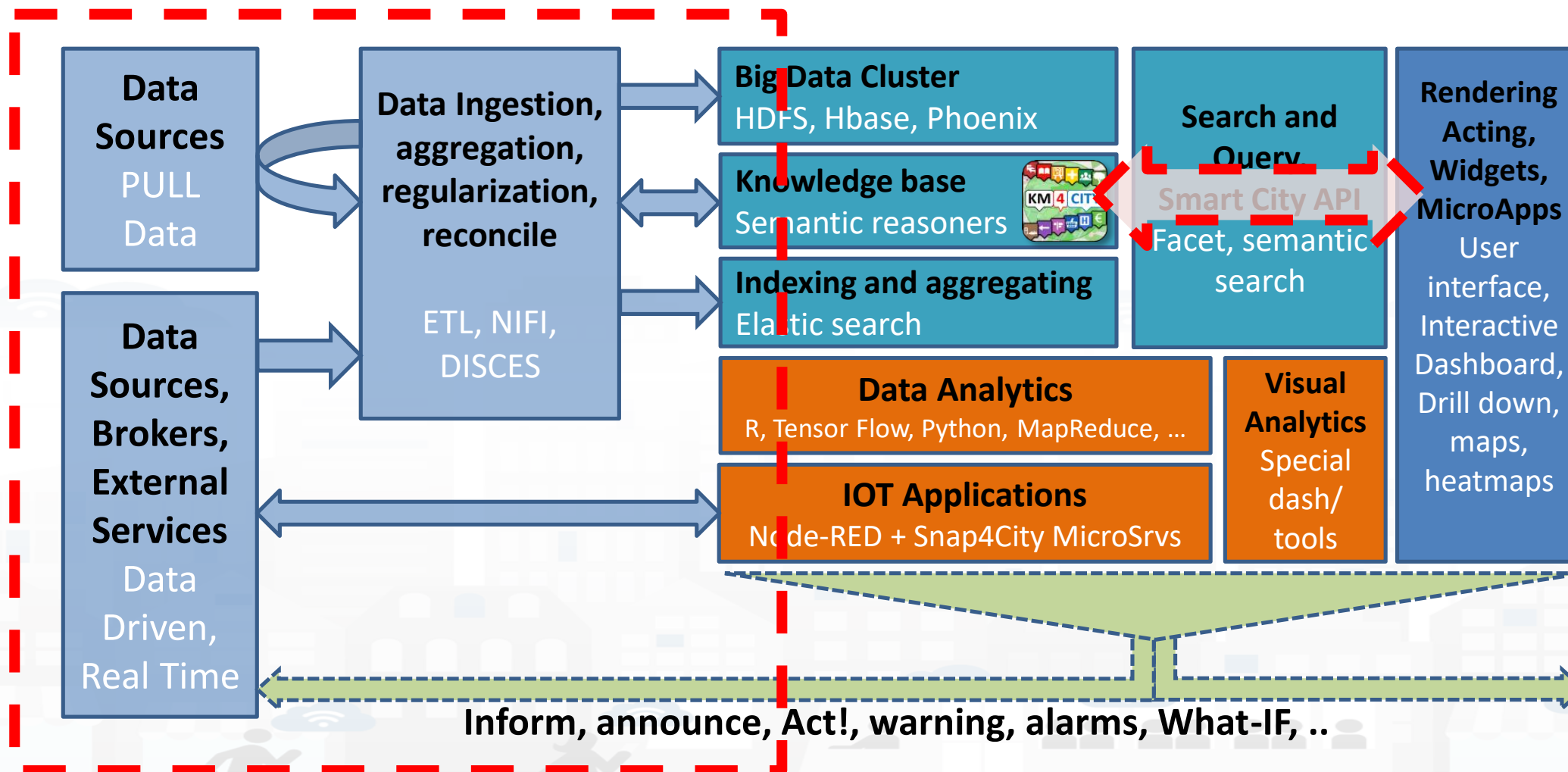
Social Media



**Social Media
Crawler and
Manager**



Snap4City Architecture vs Data Ingestion



Modalities and Strategies for data ingestion

- **Road Graphs:** from GIS, and/or OSM (see Snap4City tool for that), ...
- **Data** of any format via any protocol
- **Structured and non-structured** data (tables and free text, mixt)
- **Static data** and metadata descriptions:
 - typically ingested with DataGate for automated ingestion and you find it on the menu on left of Snap4City environment.
 - DataGate is a module of CKAN, it can be installed on any CKAN also.
 - ingested producing a process visually: ETL, Node-RED, NIFI, etc.
- **Simple data and complex data as:** GIS data, heatmaps, tracks, etc.
- **Real Time data** can be ingested by using:
 - Node-RED, NIFI, ETL, WebScraping, etc.
- **Event Driven** → Node-RED, NodeJS

Static vs Dynamic Information

- Most of the valuable data are Real Time/Dynamic data, based on Static info.
 - **For example**, data coming from Smart Park or a Smart Light solution
 - They are composed of a set of Devices,
 - each Device has **Static** information such as:
 - data structure: device ID, Current consumption, temperature,
 - GPS coordinates... (if the devices is not a moving one)
 - Classification: nature, subnature, Healthiness criteria, MTTF, etc.
 - each Collection of Devices has in addition common information such as: licensing, gateway access, gateway credentials, description of provider, time of update, etc.
 - Each Device produces a data package/message according to minimum data Structure as **Dynamic** information, in PUSH towards the Gateway. The Gateway in turn can be:
 - a sort of Broker sending data to other consumer in Push or
 - can provide also data in PULL when requested by some consumer.
 - This means that data fully describing the situation is composed by Static and Dynamic aspects that have to be described into the platform and reconnected when one access to the device...

Unified Data and Services Model/Classification

All selected (12) ▾	All selected (68) ▾	All selected (845) ▾	All selected (827) ▾	Data sources				All selected (2) ▾	All selected (2) ▾					
High-Level Type ▴ ▾	Nature ▴ ▾	Subnature ▴ ▾	Value Type ▴ ▾	Value Name ▴ ▾	Data Type ▴ ▾	Last Date ▴ ▾	Last Value ▴ ▾	Healthiness ▴ ▾	Last Check ▴ ▾	Ownership ▴ ▾				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Pian di scÒ	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Vernio	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Vergemoli	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Castelnuovo di garfagnana	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Pian di scÃ'	●	2018-10-11 09:00:21	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Montepulciano	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Isola del giglio	●	2019-06-29 17:04:05	public				
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather		Abbadia san salvatore	●	2019-06-29 17:04:05	public				
Hide columns		Reset filters	Selected rows: 1	Previous	1	2	3	4	5	...	4798	Next	Search	

High Level Types

Nature

SubNature

Semantic

Value Type

Value Name

Data Type

Technical

Last Date/Time

Last Value

RealTime

Healthiness

Last Check

Status

Ownership

What happen to data into the platforms

- **Static** information has to be collected in advance
- **Dynamic** information has to be connected to Static one at the ingestion time
- **PLUS:** when data enter into the platform a wide number of information is added/created such as:
 - Internal technical identification, modalities to access to the information
 - Historical data storage
 - Eventual derived data: date and time of ingestion, average, quality level, etc.
 - Rights to access at the data: who can access and to do what ?
 - Visual representation of data, may be an image of the Device how it has been installed and where, by who, telephone number for maintenance, etc.
 - Process ID used to ingest the data, possible IOT Applications that are using the data,
 - ...

Data are not as Simple as one can imagine

- Data to be managed into the Smart City IOT are not so simple as one may imagine, and not limited to take into account only IOT Devices.
- THUS, a large number of data TYPES and sources have also to be addressed:
 - E.g.: external services, heatmaps, trajectories, maps, OD matrices, actuators, personal data, KPI, API descriptors, special widgets, events, predictions, Tweets, posts, GIS, mobile devices, etc.
 - With their complexity of managing data, licensing, etc...
- THEY are called **High Level Types: how and which tool / process can cope with them into the Smart City Platform?... See next!**
 - Thus a unified model is needed.

How to Ingest



All of them can be shown on Dashboards, what about manipulate them!!!!

HLT, High Level Types++	GPS	Static	Dynamic	MacroCat	Single	Time Series	Trajectory	HTTP	How to ingest/change/manage
Complex Event	Yes		Yes	Yes	Yes	Yes			Dashboard, ETL, Special, IOT App
API (Ext. Srv., any prot.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ETL, Special, IOT App
External Service (web pag)								Yes	ETL, Special, IOT App, Web Scraper
KPI			Yes		Yes				Dashboard, IOT App, API
MicroApplication								Yes	Dashboard, IOT App, API
Dashboard-IOT App			Yes		Yes	Yes			Dashboard, IOT App, API
My Personal Data			Yes			Yes			Dashboard, IOT App, UserInterf, API
MyKPI	Yes		Yes		Yes	Yes	Yes		Dashboard, IOT App, UserInterf, API
MyPOI	Yes	Yes		Yes	Yes				Dashboard, IOT App, UserInterf, API
Heatmap	Yes		Yes		Yes	Yes			IOT App, MicroService, UserInterf, API
Sensor	Yes	Yes	Yes	Yes	Yes	Yes			IOT Directory, IOT App, UserInterf, API
Sensor Actuator	Yes	Yes	Yes	Yes	Yes	Yes			Dashboard, IOT App, UserInterf, API
POI (Point of Interest)	Yes	Yes		Yes	Yes				DataGate, ETL, IOT App, API
Special Widget								Yes	ETL, special, IOT App, API
Synoptics MyKPI (groups)			(Yes)		(Yes)	(Yes)		Yes	Special, API
Special Tools	(Yes)		(Yes)		(Yes)		(Yes)	Yes	As MyPersonalData
WFS/WMF (GIS)	Yes								From third party tools, ETL, IOT App, API

Legenda: How to ingest/change/manage

- **Dashboard:** by creating a Dashboard that can act/change the values with actuators (2nd Day Slides)
- **API:** you can use the Smart City API to change / provide the values (see 3rd Day Slides)
- **IOT App:** by developing an IOT Application on Node-RED exploiting Snap4City MicroServices (4th Day Slide, and in part in these slides)
- **DataGate:** you can use the DataGate tool to ingest the Static data (mainly Open), and publish them
- **ETL:** by developing an ETL process, and put it in execution via DISCES
- **IOT Directory:** you can use the IOT Directory tool to change the parameters, and set up the ingestion process, via IOT Brokers, IOT Devices, IOT Edge.
- **Special:** by using a special tool for developing a process, or for creating SVG Synoptics
- **UserInterf:** there is a number of Tools with Graphic User Interface that you can use to change the values, see in the menu on the left.
- **Web Scraper:** by creating a Web Scraping process and exploiting the results into an IOT Application
- **As MyPersonalData:** they are substantially MyPersonalData
- **From third party tools:** they can be manipulated by using third party tools

Data Sets, and Open Data

- **Data Sets as files coming from Open Data or private data** can be loaded into Snap4City by using:
 - **DataGate** tool and its automated process of ingestion, and they have to be compliant with a specific tabular format. The automated process is capable to ingest the data and store them into the HBASE Storage
 - **An ETL process** specifically developed to feed the ingested data into the storage. Which can be: HBASE or Elastic Search
 - **An IOT Application** specifically developed to feed the ingested data into the storage. Which can be: HBASE or Elastic Search

IOT App vs ETL

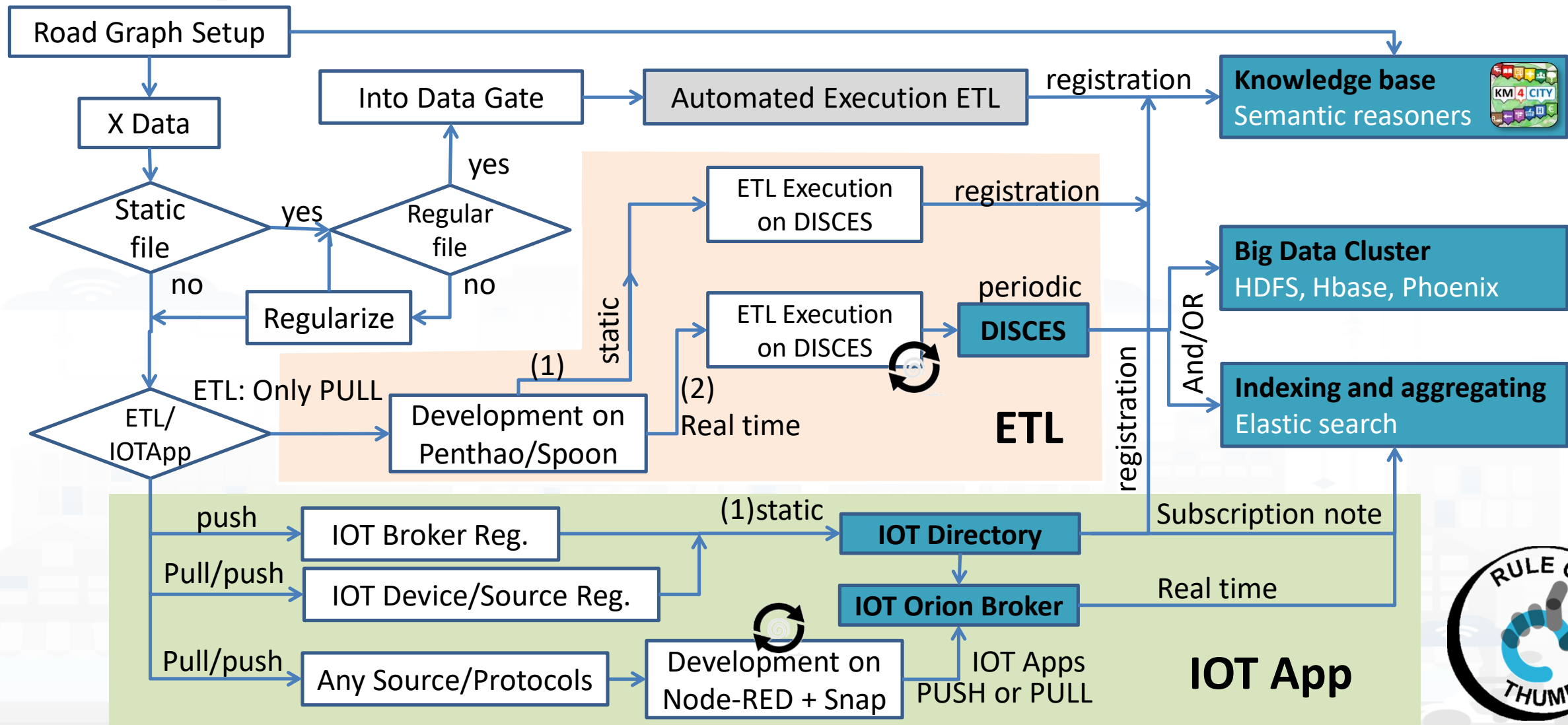
IOT Applications

- Created on browser
- A huge number of Protocols
<https://www.snap4city.org/65>
- Scheduled internally and managed as Container
- Less diffused approach
- Large number of Snap4City MicroServices, well documented
- PUSH and PULL models
- Simple mechanism to add new Features
- Very diffused in IOT
- Static and Dynamic data models depending on IOT Broker capabilities

ETL processes

- Created with Spoon editor on VM (on premise or via remote access to VM)
- A Large number of protocols
<https://www.snap4city.org/65>
- Scheduled by DISCES in the back office
- Well known data warehouse model
- Well documented for the process
- Only PUSH models
- Complex mechanism to add a new functionality
- Very diffused in Data transformation
- Static and Dynamic data models well linked ..

Data Ingestion Flow Guideline, thumb rules



Checking data ingestion results

Knowledge base
Semantic reasoners



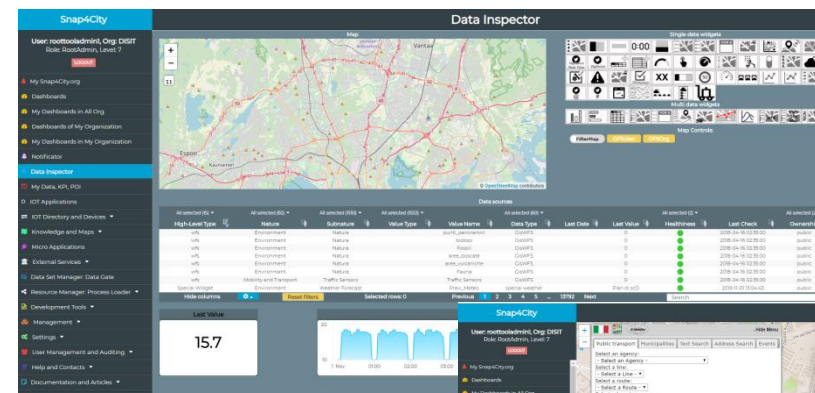
- Data Inspector
- ServiceMap, ASCAPI

Big Data Cluster
HDFS, Hbase, Phoenix

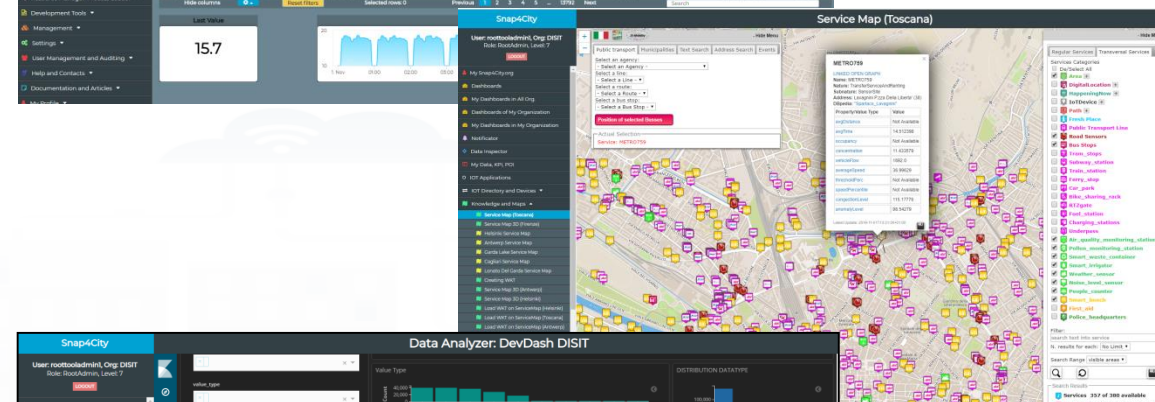
- Data Inspector
- ServiceMap, ASCAPI
- Hbase/Phoenix/Zeppelin

Indexing and aggregating
Elastic search

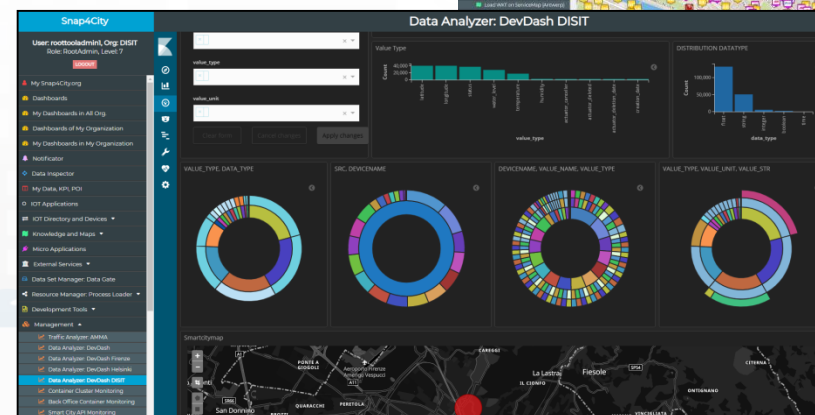
- Data Inspector
- ServiceMap, ASCAPI
- DevDash (Kibana)
- Elastic Search



Data Inspector



ServiceMap



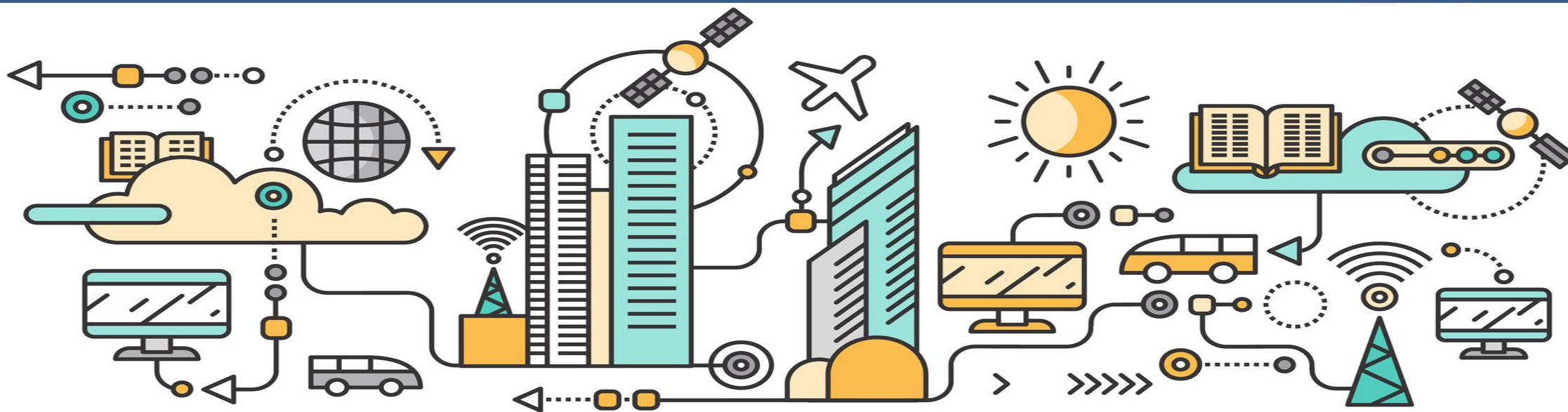
DevDash

A comment on the Flow Diagram

- The above flow diagram does not cover all cases, since it covers mainly
 - Static and dynamic data ingestion and integration
 - File ingestion provided form Open Data
 - Data ingestion from Data Bases, WS, IOT networks, FTP, IOT protocols, API, ...
 - etc.
- GIS Data can be ingested via ETL, IOT App, WFS API, WMS API
- Social media can be ingested via ETL, IOT App, etc.
- Etc.

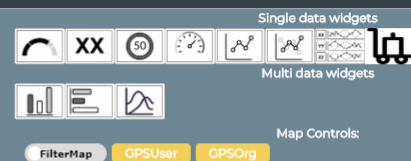
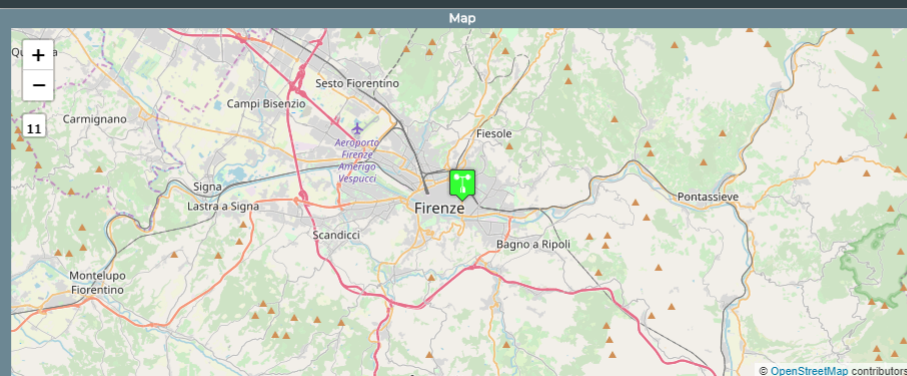
TOP

Data Inspector vs Data Processes Details



Advanced Features of the Data Inspector

- The data inspector has a number of feature accessible only for RootAdmin, such as:
 - Views on Detailed information on the basis of the the High Level Type
 - Values connected to the data (structure of the single data)
 - Details regarding the ingestion process
 - Eventual image representing the City Entity, for example the sensor
 - Ownership (licensing) details regarding the data owner
- So that you can access on the Snap4City version if you install on premise.
- A part of these features can be activate for the Organization Managers: «ToolAdmin» roles.



Map Controls:
FilterMap GPSUser GPSOrg

Sensor

All selected (7)

All selected (12)

All selected (658)

All selected (10)

All selected (2)

All selected (2)

High-Level Type

Nature

Subnature

Value Type

Value Name

Data Type

Last Date

Last Value

Healthiness

Last Check

Ownership

Sensor

Environment

Air_quality_monitoring_station

NO2

ARPAT_QA_FI-GRAMSCI

float

2019-06-24 00:00:00

●

2019-08-13 07:18:30

public

Sensor

Environment

Air_quality_monitoring_station

PM2_5

ARPAT_QA_FI-GRAMSCI

float

2019-06-24 00:00:00

13.0

●

2019-08-13 07:18:30

public

Sensor

Environment

Air_quality_monitoring_station

Benzene

ARPAT_QA_FI-GRAMSCI

float

2019-06-24 00:00:00

●

2019-08-13 07:18:30

public

Sensor

●

2019-08-13 07:18:30

public

Sensor

●

2019-08-13 07:18:30

public

Sensor

●

2019-08-13 07:17:27

public

Sensor

●

2019-08-13 07:17:27

public

Data sources Details

Device

Values

Process

Image

Ownership

GPS Coordinates:

43.7721, 11.2712

High-Level Type:

Sensor

Nature:

Environment

Search

18:00

20:00

22:00

Data sources Details

Device: GPS Coordinates: 43.7721, 11.2712

High-Level Type: Sensor

Nature: Environment

Subnature: Air_quality_monitoring_station

Value Name: ARPAT_QA_FI-GRAMSCI

Datasource: ETL

Ownership: public

Organizations: ['DISIT', 'Firenze', 'Toscana', 'Other']

[Link to Service Map](#)

Cancel

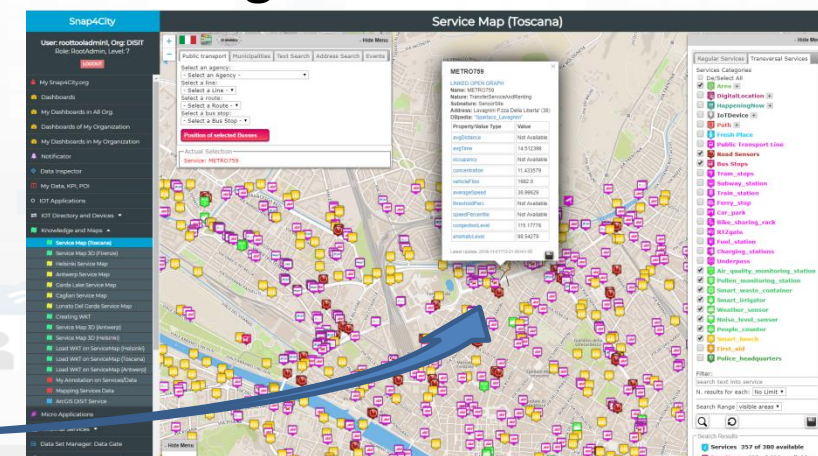
SNAP4CITY



- Click with the mouse

HLT: Sensor

Knowledge Base view: ServiceMAP



Data sources Details

Device Values Process Image Ownership

Value Type: annualPM10ExceedCount

Data Type: integer

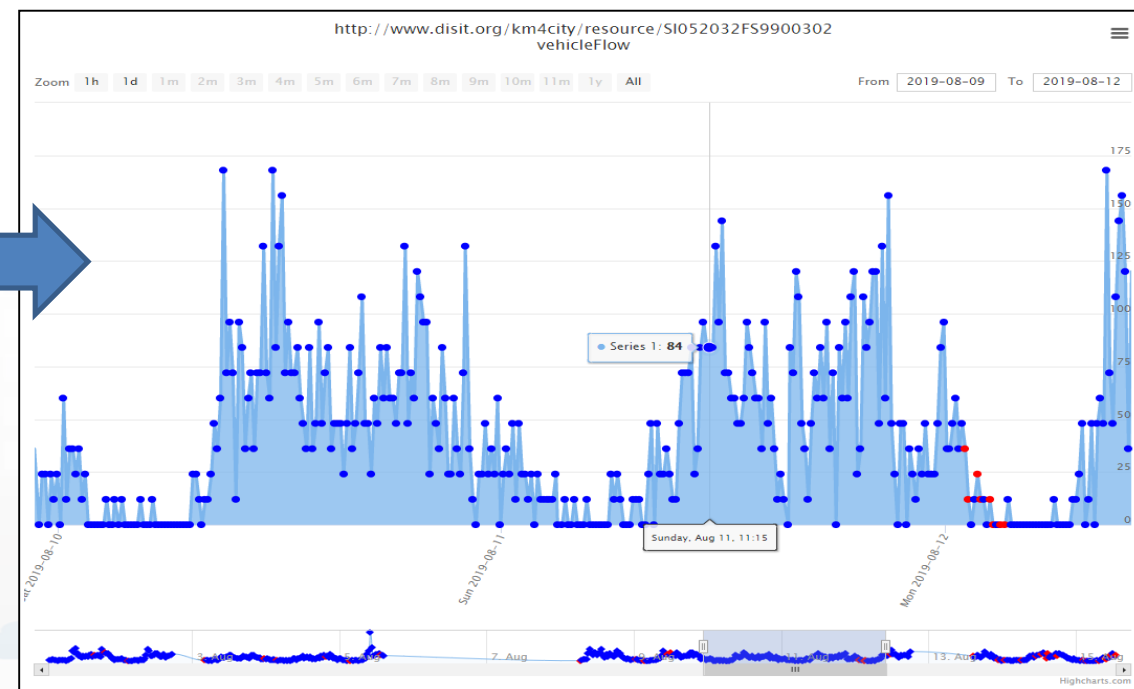
Last Date: 2019-06-24 00:00:00

Last Value: 13

Value Type	Healthy	Delay (s)	Reason	Healthiness Criteria	Refresh Rate (s)	Data type	Unit	Value	Time Trend
Benzene	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
annualPM10ExceedCount	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	integer	#		VIEW
SO2	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
hourO3Max	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	integer			VIEW
PM2_5	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
PM10	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
O3	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
NO2	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
H2S	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
CO	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	float	ppm		VIEW
dailyO3ExceedCount	false	8984804	too old data 8984804>=21600 and delay>=172800	refresh_rate	21600	integer	#		VIEW
airQualityNOxGraL3m	false	8984804	too old data 8984804>=3600 and delay>=172800	any	3600	float			VIEW
airQualityNOxGraL6m	false	8984804	too old data 8984804>=3600 and delay>=172800	any	3600	float			VIEW

Cancel

- Specific values of selected
- Information of the values of the other sensors on the same device
- Trends and marking of problems



Details regarding the Ingestion process

- For ETL processes
- Scheduling details and status: **DISCES**

DISCES Process Scheduler view

SCHEDULER NAME	ID	DATE	JOB NAME	JOB GROUP	STATUS	PROGRESS	TRIGGER NAME	TRIGGER GROUP	PREV FIRE TIME	NEXT FIRE TIME
TheThingsNet_PaxCo	9448	2019-10-26 23:58:00	TheThingsNet_PaxCo	TheThingsNet_PaxCo	RUNNING		TheThingsNet_PaxCo	TheThingsNet_PaxCo	2019-10-26 23:58:00	2019-10-27 00:03:00
Pronto_Soccorso_Phi	9447	2019-10-26 23:58:00	Pronto_Soccorso_Phi	Pronto_Soccorso_Phi	RUNNING		Pronto_Soccorso_Phi	Pronto_Soccorso_Phi	2019-10-26 23:58:00	2019-10-27 00:13:00
Pronto_Soccorso_Car	9446	2019-10-26 23:58:04	Pronto_Soccorso_Car	Pronto_Soccorso	FAILED		Pronto_Soccorso_Car	Pronto_Soccorso	2019-10-26 23:58:00	2019-10-27 00:13:00
CarPark_FirenzePac	9445	2019-10-26 23:58:00	CarPark_FirenzePac	CarPark_Firenze	RUNNING		CarPark_FirenzePac	CarPark_Firenze	2019-10-26 23:58:00	2019-10-27 00:13:00
AVM_delay_Firenze	9444	2019-10-26 23:58:00	AVM_delay_Firenze	AVM_delay_Firenze	RUNNING		AVM_delay_Firenze	AVM_delay_Firenze	2019-10-26 23:58:00	2019-10-27 00:13:00
sensori_FIRENZE_I	9443	2019-10-26 23:58:00	sensori_FIRENZE_I	sensori_FIRENZE_I	RUNNING		sensori_FIRENZE_I	sensori_FIRENZE_I	2019-10-26 23:57:59	2019-10-27 00:02:59
Prev_meteo_Poppl_x	9442	2019-10-26 23:58:03	Prev_meteo_Poppl_x	Prev_meteo_Poppl_x	SUCCESS	100%	MT_bccolli99dd51	DEFAULT	2019-10-26 23:57:29	1970-01-01 01:00:00
Prev_meteo_Badia_T	9441	2019-10-26 23:58:00	Prev_meteo_Badia_T	Prev_meteo_Badia_T	RUNNING		Prev_meteo_Badia_T	Prev_meteo_Badia_T	2019-10-26 23:57:05	2019-10-27 04:57:05
CarPark_MiC_160_P	9440	2019-10-26 23:57:14	CarPark_MiC_160_P	CarPark_Firenze	SUCCESS	100%	CarPark_MiC_160_P	CarPark_Firenze	2019-10-26 23:57:00	2019-10-27 00:17:00
sensori_PRATO_I	9439	2019-10-26 23:57:05	sensori_PRATO_I	sensori_PRATO_I	SUCCESS	100%	sensori_PRATO_I	sensori_PRATO_I	2019-10-26 23:56:59	2019-10-27 00:01:59
Prev_meteo_Poppl_x	9438	2019-10-26 23:57:29	Prev_meteo_Poppl_x	Prev_meteo_Poppl_x	SUCCESS	100%	Prev_meteo_Poppl_x	Prev_meteo_Poppl_x	2019-10-26 23:56:42	2019-10-27 04:56:42
TheThingsNet_PaxCo	9437	2019-10-26 23:57:40	TheThingsNet_PaxCo	TheThingsNet_PaxCo	FAILED		TheThingsNet_PaxCo	TheThingsNet_PaxCo	2019-10-26 23:56:00	2019-10-27 00:01:59
Pronto_Soccorso_US	9436	2019-10-26 23:56:12	Pronto_Soccorso_US	Pronto_Soccorso	SUCCESS	100%	Pronto_Soccorso_US	Pronto_Soccorso	2019-10-26 23:56:00	2019-10-27 00:11:00

Data sources Details

Device

Values

Process

Image

Ownership

Process Name Static:

ARPAT_QA_FI-GRAMSCI

Knowledge Base IP:

192.168.0.206

Disces IP:

192.168.0.20

Disces Process file path:

\\media\\Trasformazioni\\Phoenix_ETL\\QualitaAria\\Arpat_DailyDispatch_ARIA\\Ingestion\\

Phoenix table:

Graph Uri:

http://www.disit.org/km4city/resource/QualitaAria/Arpat_Stations

Job Name:

Arpat_DailyDispatch_ARIA

Link to Knowledge Base


Link to Disces

Cancel

Image of the Devices and Licensing

Data sources Details

Device Values Process **Image** Ownership



Data Inspector

Upload

No file chosen

Data sources Details

Device Values Process Image **Ownership**

Owner:

Licence:

Address:

Mail:

Data sources Details

Device	Values	Image	Ownership
GPS Coordinates:	51.222744, 4.405380		
High-Level Type:	External Service		
Nature:	Environment		
Subnature:	Antwerpen (park Spoor Noord) Air Pollution		
Value Name:	ExternalContent		
Datasource:	Special Process		
Ownership:	public		
Organizations:	['DISIT', 'Antwerp', 'Other']		

[Link to External Service](#)

Cancel

Data sources Details

Device	Values	Image	Ownership
Value Type:			
Data Type:	webpage		
Last Date:			
Last Value:	Antwerp		

Value Type	Healthy	Delay (s)	Reason	Healthiness

Data sources Details

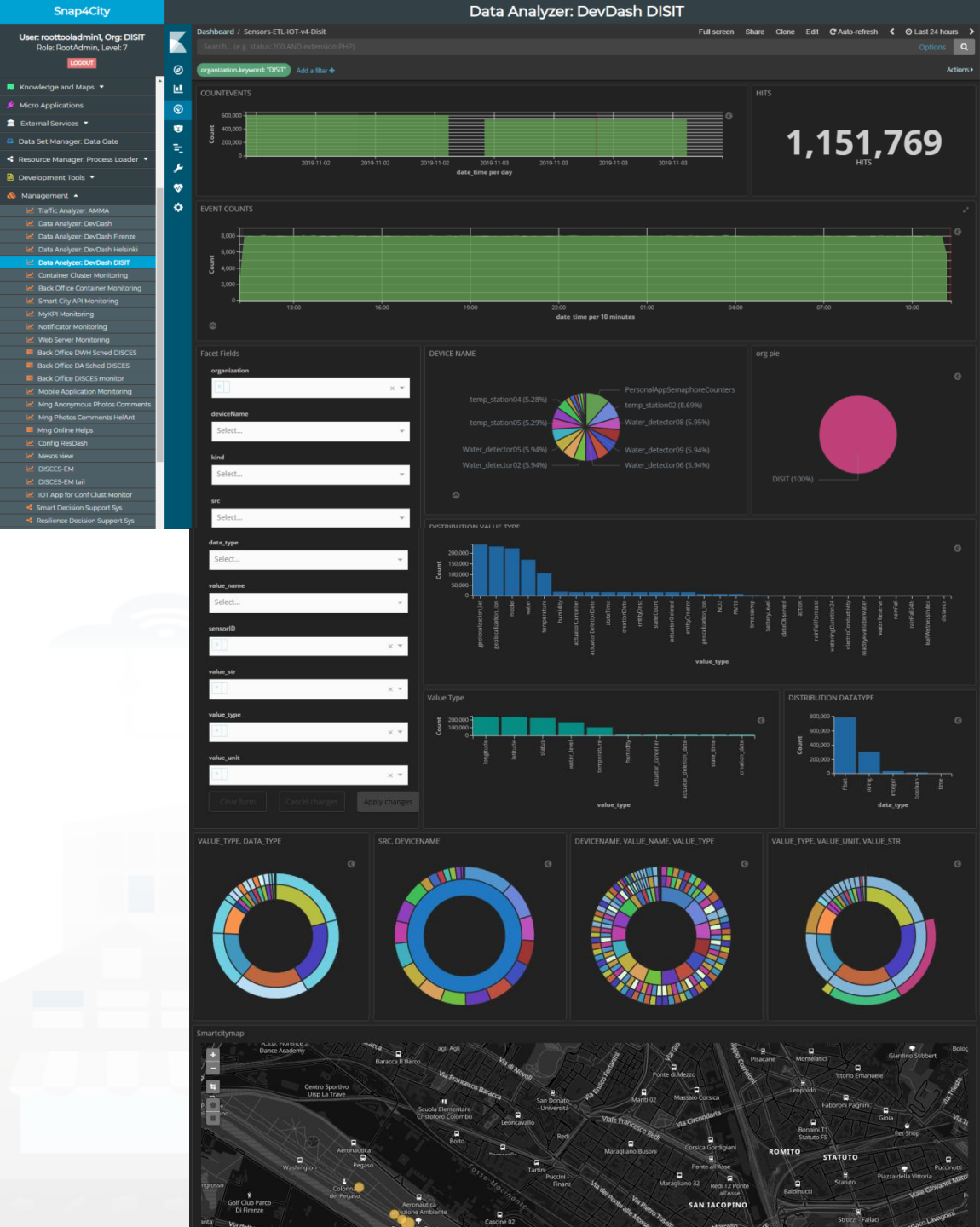
Device	Values	Image	Ownership

Data sources Details

Device	Values	Image	Ownership
Owner:			

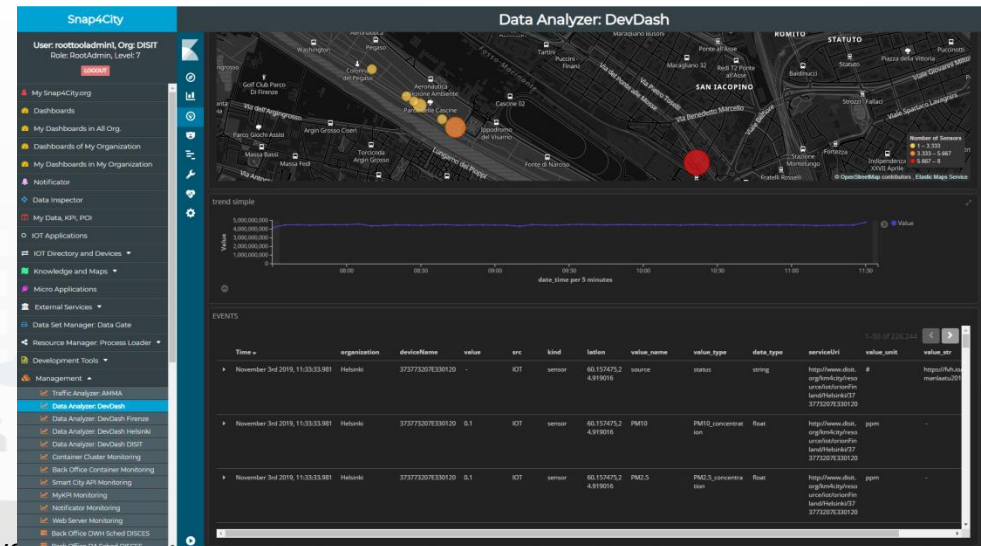
Cancel

The fields shown may be present or not depending on the HLT and on the information received



Operator Business Analysis Dashboards: DevDash, AMMA

- Dynamic Filtering, Adaptable, ...
- Full data details, drill down,...
- Synergic with **Data Inspector** which addresses data relationships, processing and information



TOP

Setting Up the Road Graph on Knowledge Base

FROM CITY DASHBOARDS TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

APPLICATIONS, THE LOGIC AND THE SMARTNESS

IOT/IOE DEVICES AND NETWORKS

APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART SERVICES, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF SIMULATION

SNAP4CITY ARCHITECTURE AND ECOSYSTEM, OPENED TO DEVELOPERS AND TAKERS

DECISION SUPPORT SYSTEMS AND CITY RESILIENCE

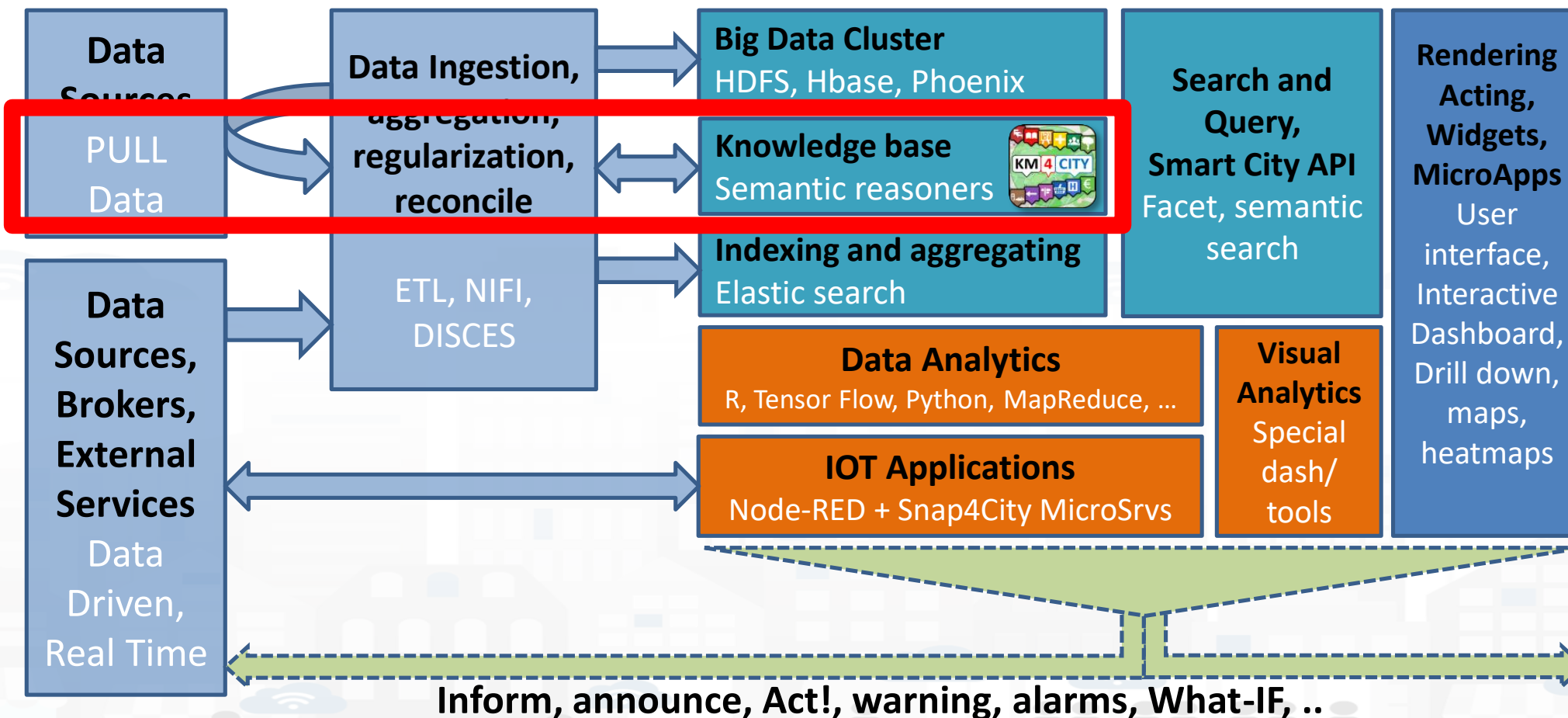
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

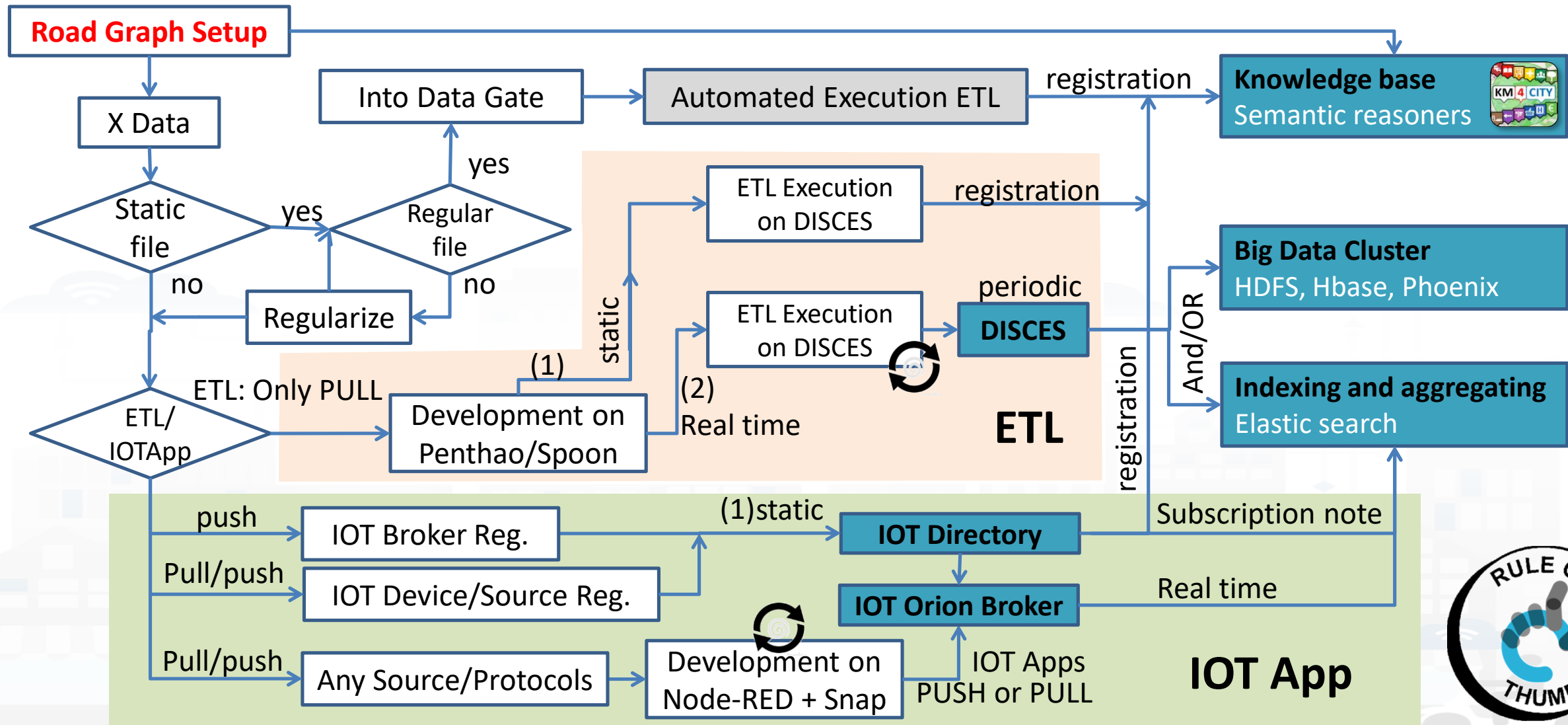
SNAP4CITY AND KM4CITY PROJECTS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

Snap4City as a Lambda Architecture



Data Ingestion Flow Guideline, thumb rules



Discovery

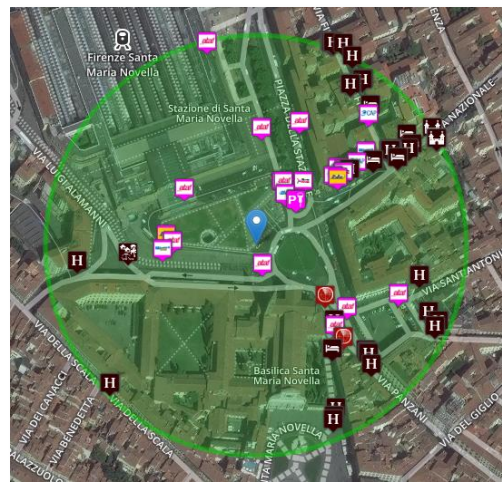


Search by Shape and Distance

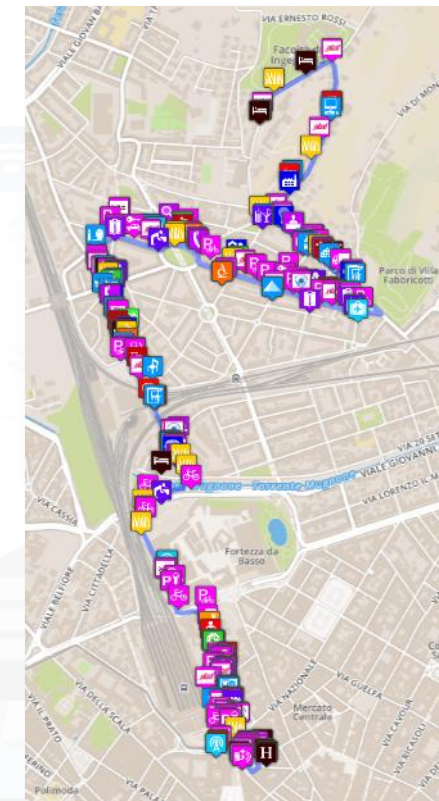
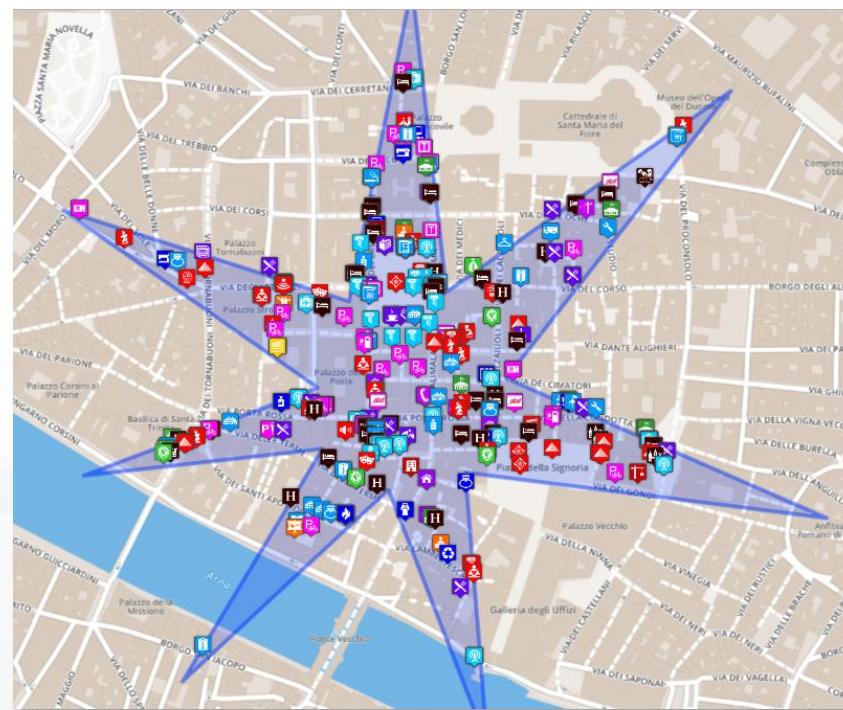
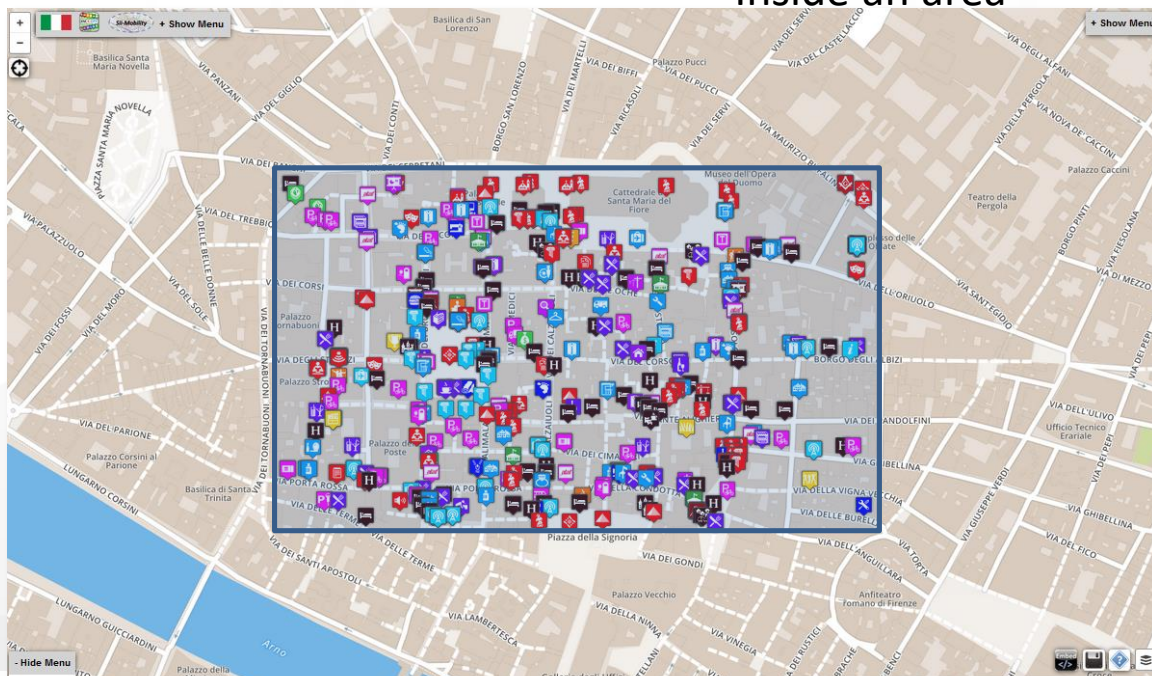
Each request or search in the Km4City model can be referred to a point and a ray, to an area, to a polyline

Inside a closed polyline

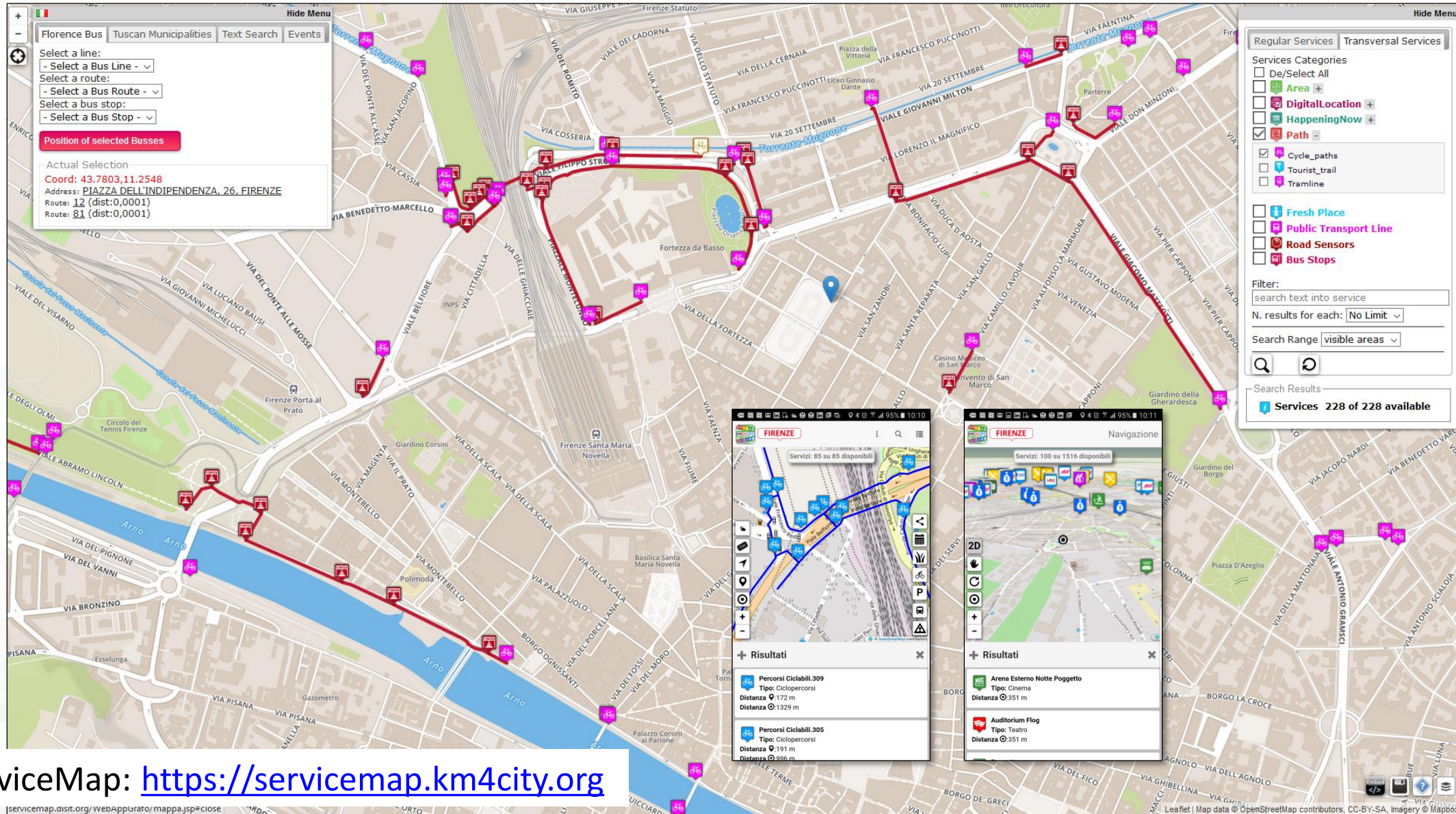
Along a polyline



Inside an area



Cycling Paths



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

Views of the Knowledge Base

Helsinki KB Service Map

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

Public transport Municipalities Text Search Address Search Events

Select an agency:
Select a line:
Select a route:
Select a bus stop:
Select a stop:
Position of selected Busses

Actual Selection
Service: 373773207E330127

Property	Value	Type
PM10	3	Integer
PM2.5	2	Integer
dateObserved	2019-10-22T02:59:42.930000+00:00	DateTime
reliability	0.5	Float
source	https://helsinki.fi/airquality/2019	URI
airQualityPM10Gral	0.2405 @2019-10-22T03:00:00+01:00	Text
airQualityPM10Enfuser	2.6207 @2019-10-22T03:00:00+01:00	Text
RealTimeDeltaAQI	-0.1793 @2019-10-22T03:00:00+01:00	Text
airQualityPM10RealTimeDeltaGral	2.2595 @2019-10-22T03:00:00+01:00	Text
EnfuserAQI	1.1793 @2019-10-22T03:00:00+01:00	Text
airQualityPM2_5Enfuser	0.7086 @2019-10-22T03:00:00+01:00	Text
airQualityPM10RealTimeDelta	-0.1207 @2019-10-22T03:00:00+01:00	Text
airQualityPM10AverageLastHour	2.5 @2019-10-22T03:00:00+01:00	Text
RealTimeAQI	1 @2019-10-22T03:00:00+01:00	Text
airQualityPM2_5AverageLastHour	1.9 @2019-10-22T03:00:00+01:00	Text
airQualityPM2_5RealTimeDelta	1.1914 @2019-10-22T03:00:00+01:00	Text

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

Linked Open Graph

Select a SPARQL endpoint:
Snap4City SmartCity Ontology (by DISIT)
no examples for this endpoint
View endpoint relation

Search for keyword:
Keywords:
Status:
Requests:
Multiple endpoint search

Type of relations

Select all:
Invert:
Show all inverse:
exposedBy:
hasAttribute:
implements:
owl:sameAs:
rdf:type:
hasSystemCapability:
observes:
rdf:type:
rdf:seeAlso

Linked Open Graph

373773207E330127

Identifier:
http://www.disit.org/km4city/resource/lot/orionFinland/373773207E330127

Image:
Info:
http://www.w3.org/2003/01/geo/wgs84_pos#lat 60.15858
http://www.w3.org/2003/01/geo/wgs84_pos#long 24.921349
http://schema.org/name 373773207E330127
http://www.disit.org/km4city/schema#format json
http://www.disit.org/km4city/schema#macaddress

Linked Open Data



Linked Open Graph

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

Linked Open Graph

SiiMobility (by DISIT)

Examples:

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

Choose a class:

Search for keyword

keyword:

uri: Request

Your data

sparql endpoint: (optional)

uri: Request

Status

Requests:

Remove Clear

Type of relations

Select all Deselect all Invert Hide all inverse

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

Linked Open Graph

museo ferragamo

DESCRIPTION

Relations of Museo Ferragamo with the road graph

Km4City: Knowledge Base



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

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

Big Data Tools



LOD and reasoners



Ontology Documentation:

<http://www.disit.org/6506>

<http://www.disit.org/6507>

<http://www.disit.org/5606>

<http://www.disit.org/6461>

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

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



Smart-city Ontology km4city



<https://www.snap4city.org/19>

Set up of the Knowledge Base, KB

- The **KB starts empty**, it has to be **initialized** with the Road Graph(s) of interest.
- **Road Graphs** can be obtained from:
 - GIS of the municipalities, regional govern, etc.
 - Open Street Map, OSM
 - Etc.
- See this note on KM vs OSM: <https://www.snap4city.org/397>
- Snap4City provides a tool for **feeding the KB with OSM**
 - [TC5.10- Open Street Map ingestion process](#)
 - OSM2KM4C tool is included into KBSM, VM and Docker
<https://www.snap4city.org/471>
 - Tool: <https://github.com/disit/osm2km4c>
- The load of city of 1 Million of inhabitants can be done in few hours.

Federated ServiceMap and Smart City API

To improve scalability, fault tolerance and federation among cities:

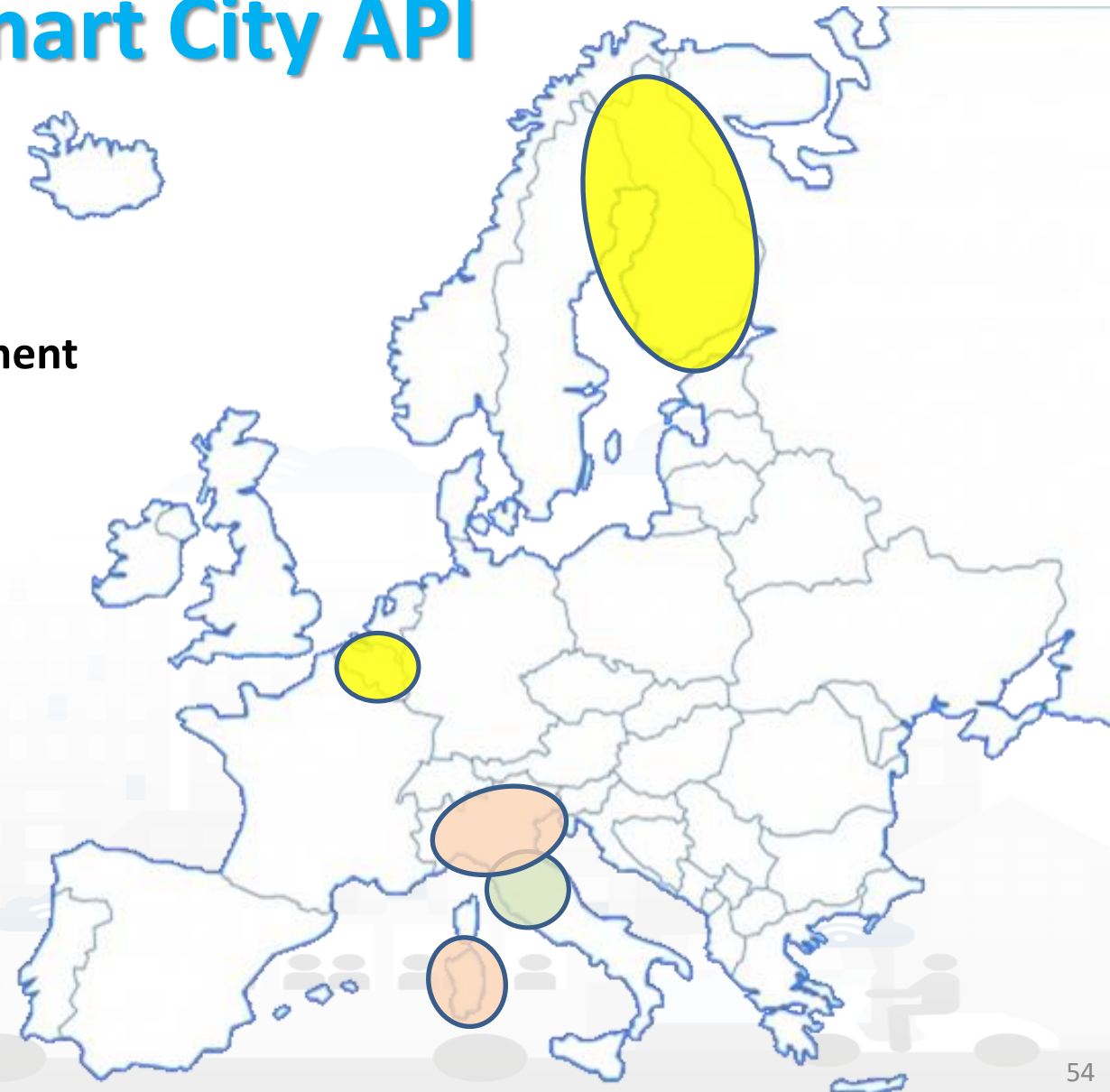
- One entry point Smart City API for all zones
- Multiple Knowledge base See performance assessment

At different levels:

- Among cities/regions
- Among data providers, Operators

By Means of:

- Smart City API → Apps
- Smart City Ontology
- Dashboards/data analytics
- Organization independent



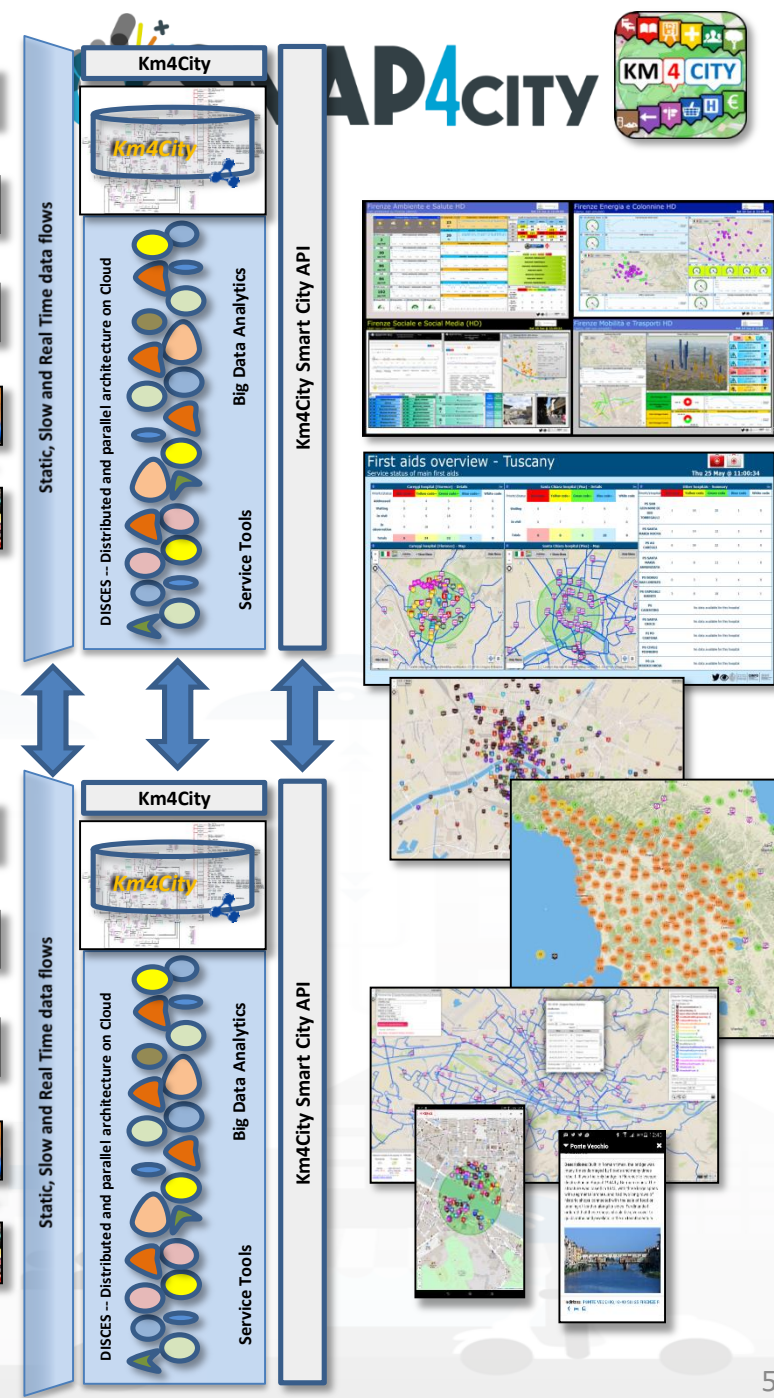
Km4City Federation

At different levels:

- Among cities/regions
- Among data providers
- Among Operators

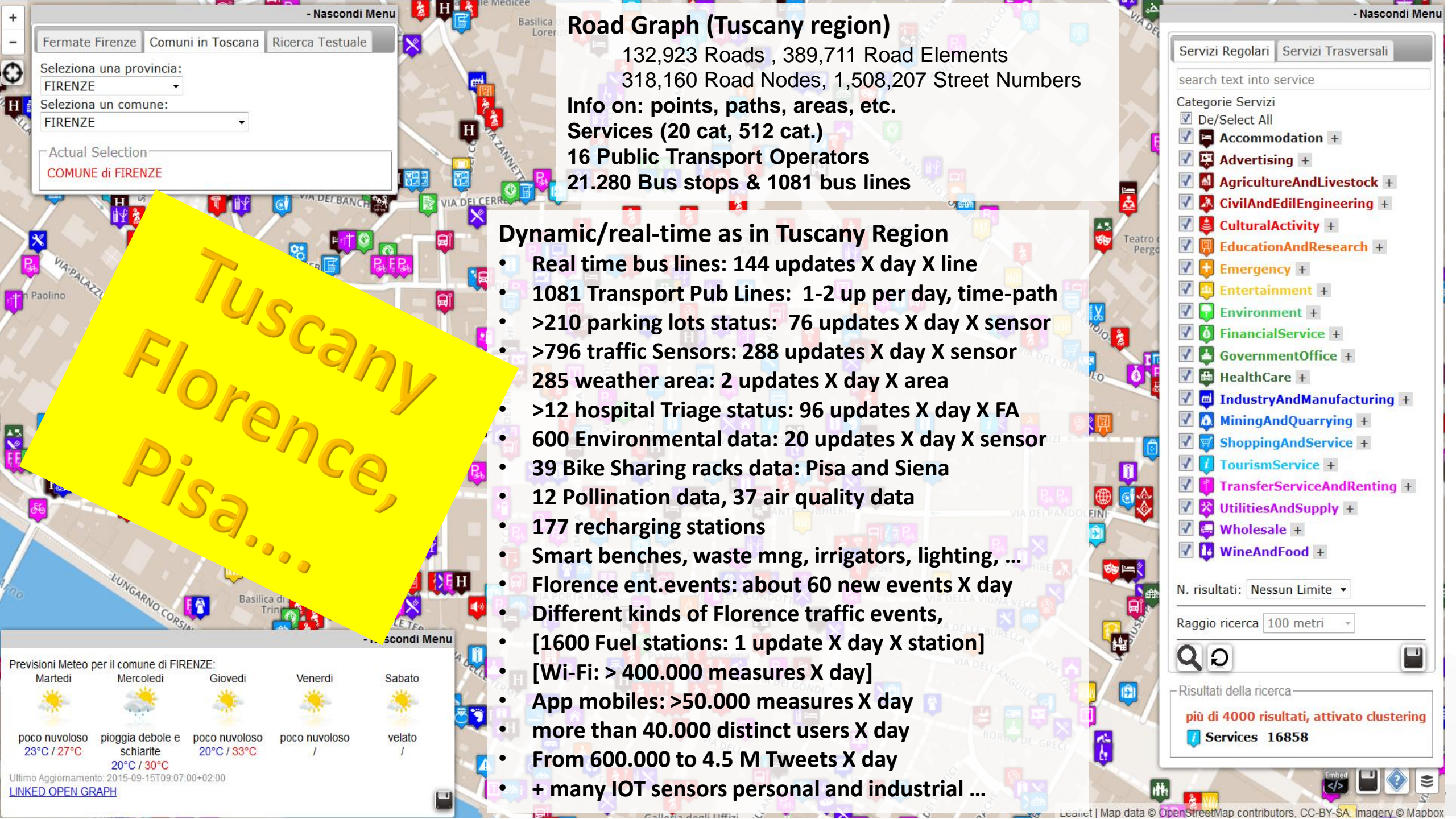
By Means of:

- Smart City API → Apps
- Km4City Smart City Ontology
- Dashboards/data analytics





- **Km4City is the reference ontology for Snap4City**, It allows to:
 - keep connected city entities each other:
 - Semantic Index, reticular
 - Perform spatial, geo graphic, and temporal reasoning
 - Discover city entities and their relationships,
 - IOT devices, IOT sensors, city elements, etc.
 - Provide access via Advanced Smart City API
 - Federate other Km4City Knowledge Bases, the approach allows to scale geographically and create redundancies, improving performances
- Documentation
 - [TC5.15 - Snap4City Smart City API Collection and overview, real time](#)
 - [ServiceMap and ServiceMap3D, Knowledge Model, Km4City Ontology](#)
 - [Knowledge Base Graphs and Queries: browsing and queries into the KB](#)



Road Graph (Tuscany region)

132,923 Roads , 389,711 Road Elements

318,160 Road Nodes, 1,508,207 Street Numbers

Info on: points, paths, areas, etc.

Services (20 cat, 512 cat.)

16 Public Transport Operators

21.280 Bus stops & 1081 bus lines

Dynamic/real-time as in Tuscany Region

- Real time bus lines: 144 updates X day X line
- 1081 Transport Pub Lines: 1-2 up per day, time-path
- >210 parking lots status: 76 updates X day X sensor
- >796 traffic Sensors: 288 updates X day X sensor
- 285 weather area: 2 updates X day X area
- >12 hospital Triage status: 96 updates X day X FA
- 600 Environmental data: 20 updates X day X sensor
- 39 Bike Sharing racks data: Pisa and Siena
- 12 Pollination data, 37 air quality data
- 177 recharging stations
- Smart benches, waste mng, irrigators, lighting, ...
- Florence ent.events: about 60 new events X day
- Different kinds of Florence traffic events,
- [1600 Fuel stations: 1 update X day X station]
- [Wi-Fi: > 400.000 measures X day]
- App mobiles: >50.000 measures X day
- more than 40.000 distinct users X day
- From 600.000 to 4.5 M Tweets X day
- + many IOT sensors personal and industrial ...

Tuscany
Florence,
Pisa....

Fermate Firenze Comuni in Toscana Ricerca Testuale

Seleziona una provincia:

FIRENZE

Seleziona un comune:

FIRENZE

Actual Selection

COMUNE di FIRENZE

Servizi Regolari Servizi Trasversali

search text into service

Categorie Servizi

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

N. risultati: Nessun Limite

Raggio ricerca 100 metri



Risultati della ricerca

più di 4000 risultati, attivato clustering

Services 16858

Previsioni Meteo per il comune di FIRENZE:

Martedì Mercoledì Giovedì Venerdì Sabato



poco nuvoloso pioggia debole e poco nuvoloso poco nuvoloso velato

23°C / 27°C 20°C / 33°C / 20°C / 30°C

Ultimo Aggiornamento: 2015-09-15T09:07:00+02:00

[LINKED OPEN GRAPH](#)



TOP

Data Set Load via Data Gate (plus how to load triples into Knowledge base)

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT APPLICATIONS VS IOT DEVICES

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IOT/IOE DEVICES AND NETWORKS

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

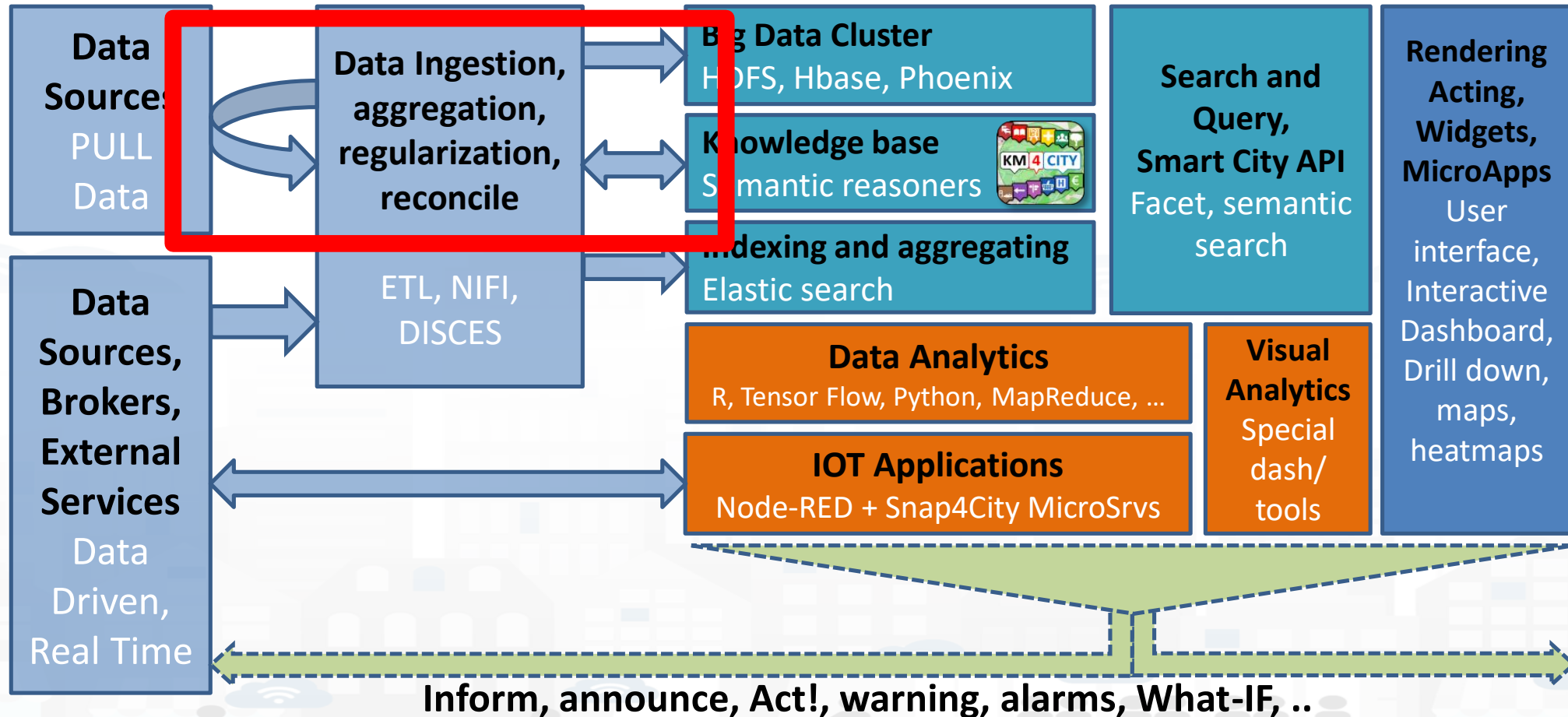
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

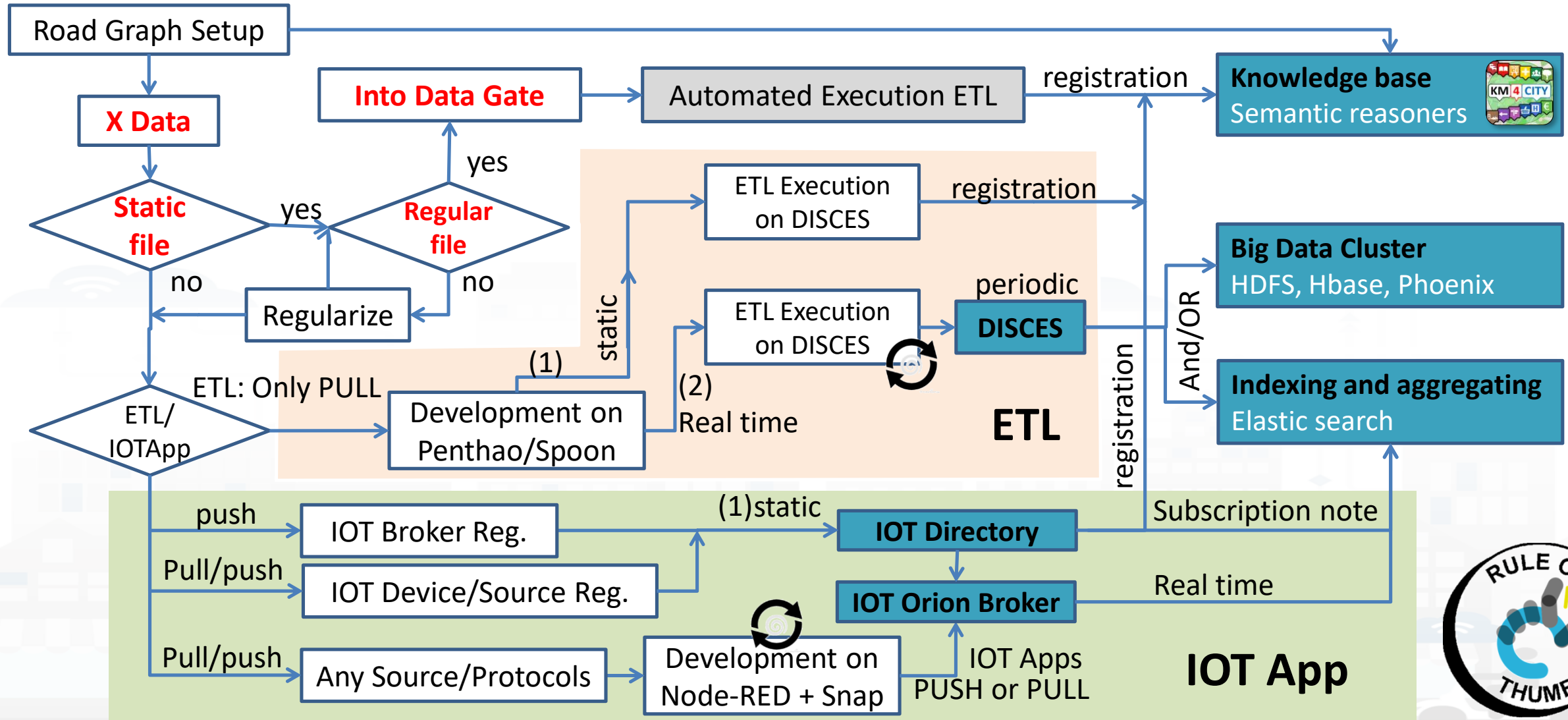


ckan

Snap4City as a Lambda Architecture



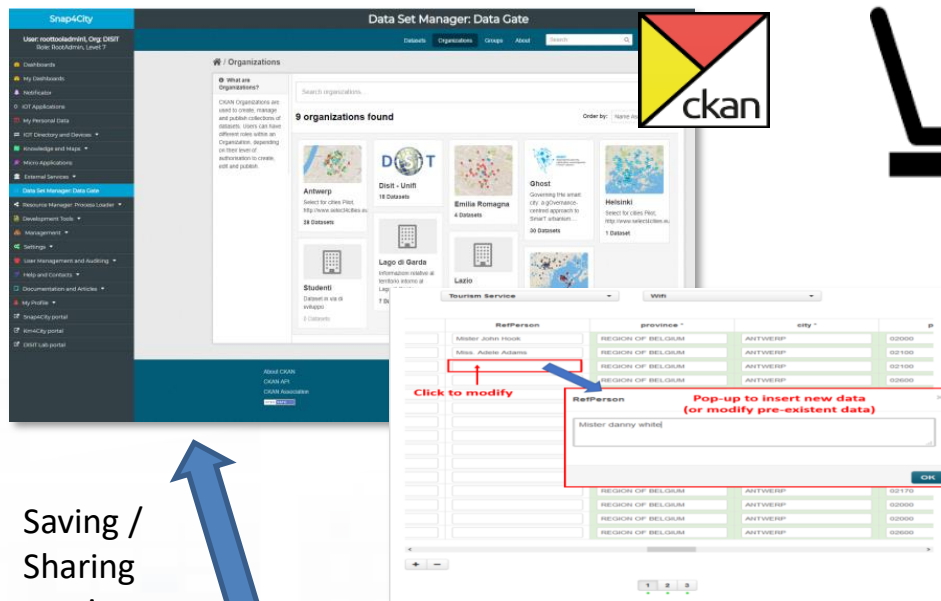
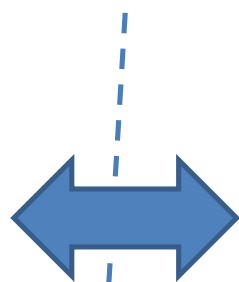
Data Ingestion Flow Guideline, thumb rules



Data Ingestion via Data Gate



Knowledge and Storage Data
from the Field and City



Saving /
Sharing
reusing



Federated Network



Data Set: sharing,
Harvesting, Loading/
Downloading



Data Set:

- Search
- Loading
- Download
- Share
- Publish
- Also automated

https://datagate.snap4city.org/ssologin_handler

Integrated DataGate/CKAN

Static open data ingestion

Federated Crawling
Federated Distribution

Data Set:

- Search
- Loading
- Download
- Share
- Publish
- Also automated



Snap4City

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

- 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

Data Set Manager: Data Gate

Datasets Organizations Groups About Search

/ Organizations

What are Organizations?

CKAN Organizations are used to create, manage and publish collections of datasets. Users can have different roles within an Organization, depending on their level of authorisation to create, edit and publish.

Search organizations...

9 organizations found Order by: Name Ascending

Antwerp
Select for cities Pilot,
<http://www.select4cities.eu>
28 Datasets

Disit - Unifi
18 Datasets

Emilia Romagna
4 Datasets

Ghost
Governing the smart city: a gOvernance-centred approach to Smart urbanism.....
30 Datasets

Helsinki
Select for cities Pilot,
<http://www.select4cities.eu>
1 Dataset

Lago di Garda
Informazioni relative al territorio intorno al Lago di Garda
7 Datasets

Lazio
0 Datasets

Studenti
Dataset in via di sviluppo
0 Datasets

Veneto
12 Datasets

About CKAN
CKAN API
CKAN Association
[Open Data](#)

Powered by **ckan**
Language: English

Tourism Service Wifi

RefPerson	province *	city *	p
Mister John Hook	REGION OF BELGIUM	ANTWERP	02000
Miss. Adele Adams	REGION OF BELGIUM	ANTWERP	02100
	REGION OF BELGIUM	ANTWERP	02100
	REGION OF BELGIUM	ANTWERP	02600

Click to modify

Pop-up to insert new data (or modify pre-existent data)

RefPerson

Mister danny white

OK

REGION OF BELGIUM	ANTWERP	02170
REGION OF BELGIUM	ANTWERP	02000
REGION OF BELGIUM	ANTWERP	02000
REGION OF BELGIUM	ANTWERP	02600

Automated data regularization

https://datagate.snap4city.org/ssologin_handler

Further readings on Datagate

- [Data Set Manager: Data Gate / CKAN federated](#)
- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)
- [TC6.1- Managing DataSets via DataGate: ingest, search, download, upload, annotate, share](#)
- [TC9.3- Managing data sets with IOT Applications, and exploiting DataGate](#)
- [TC6.2- Search on DataGate for Data Sets](#)
- [US6. Developing and using processes for data transformation](#)
-

TOP

Data Ingestion and Transformation via ETL Processes

FROM CITY DASHBOARD TO APPLICATIONS

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IoT APPLICATIONS VEST EDGE DEVICES

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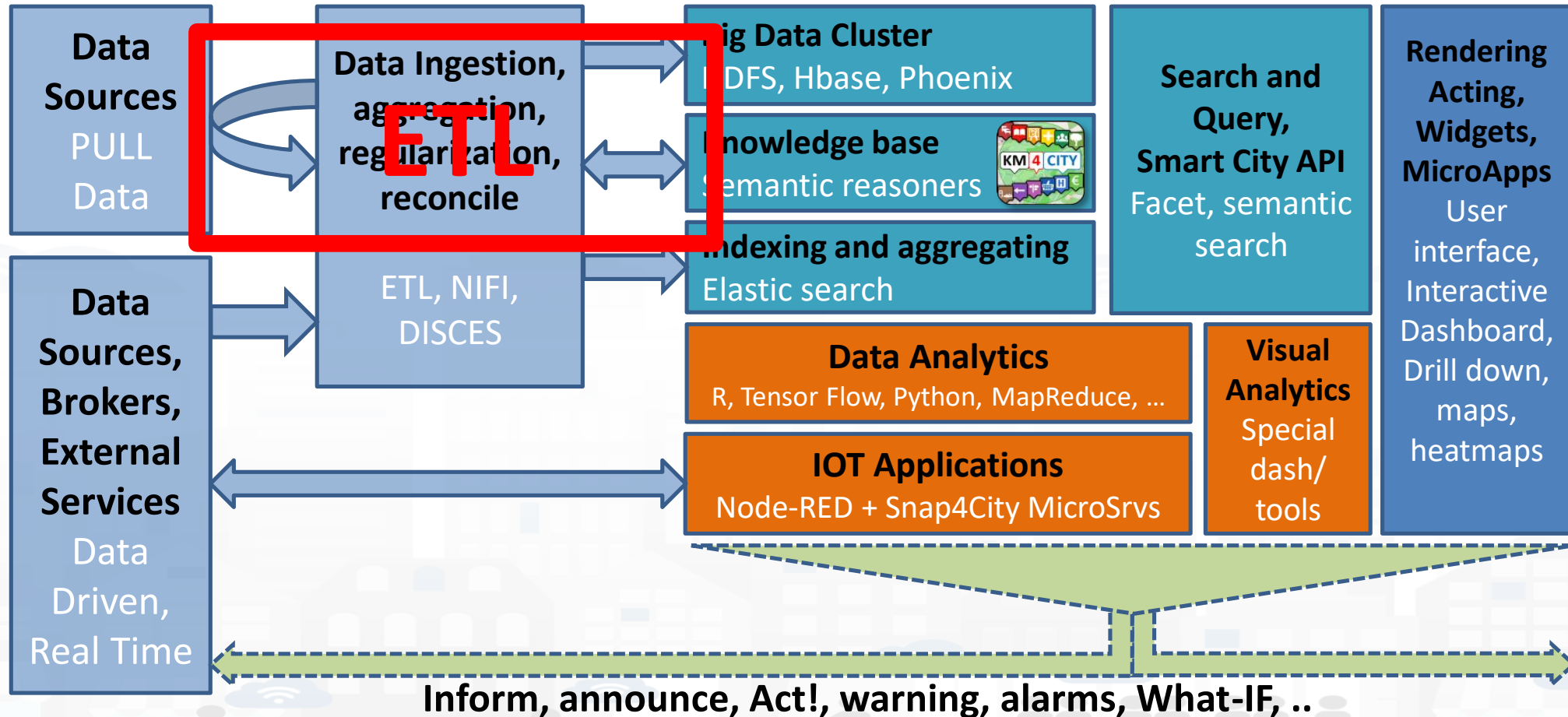
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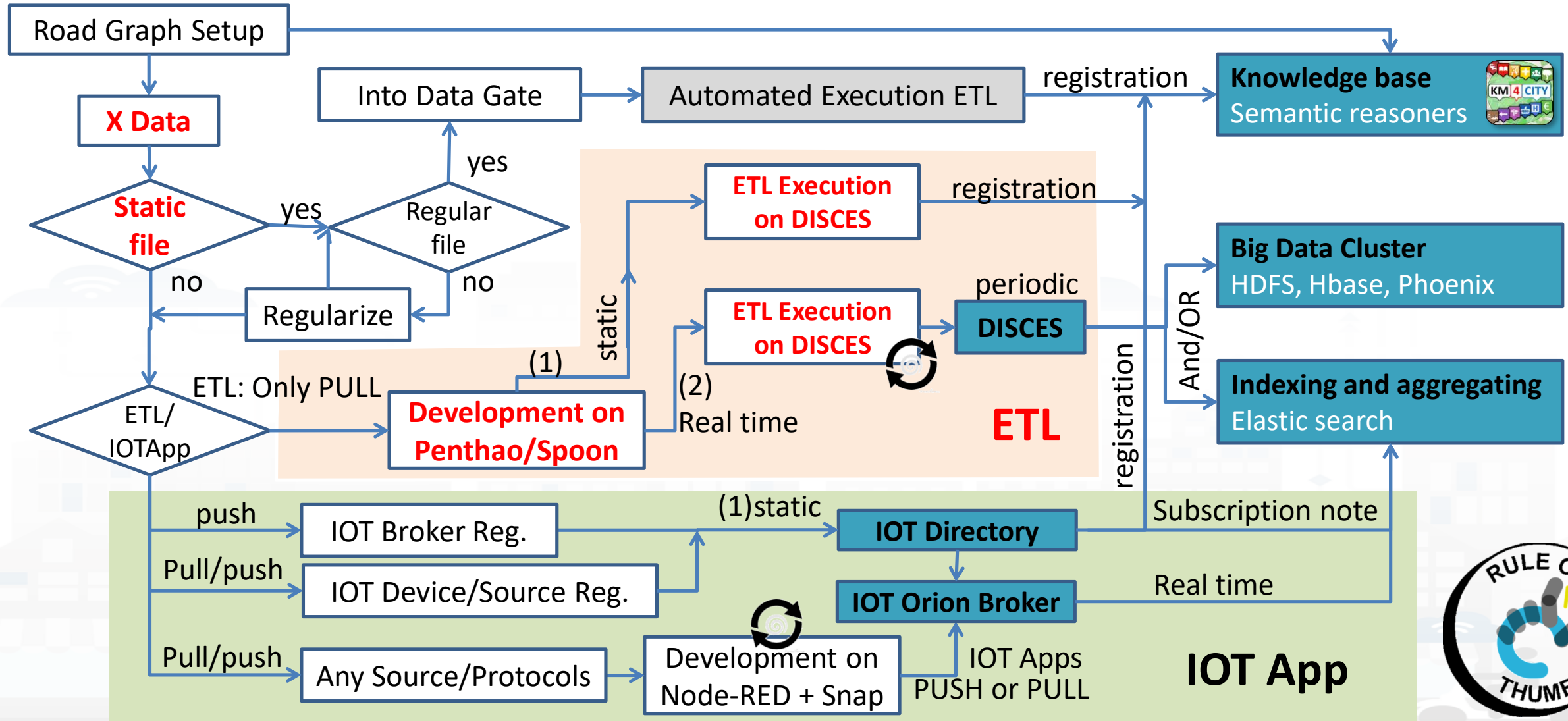
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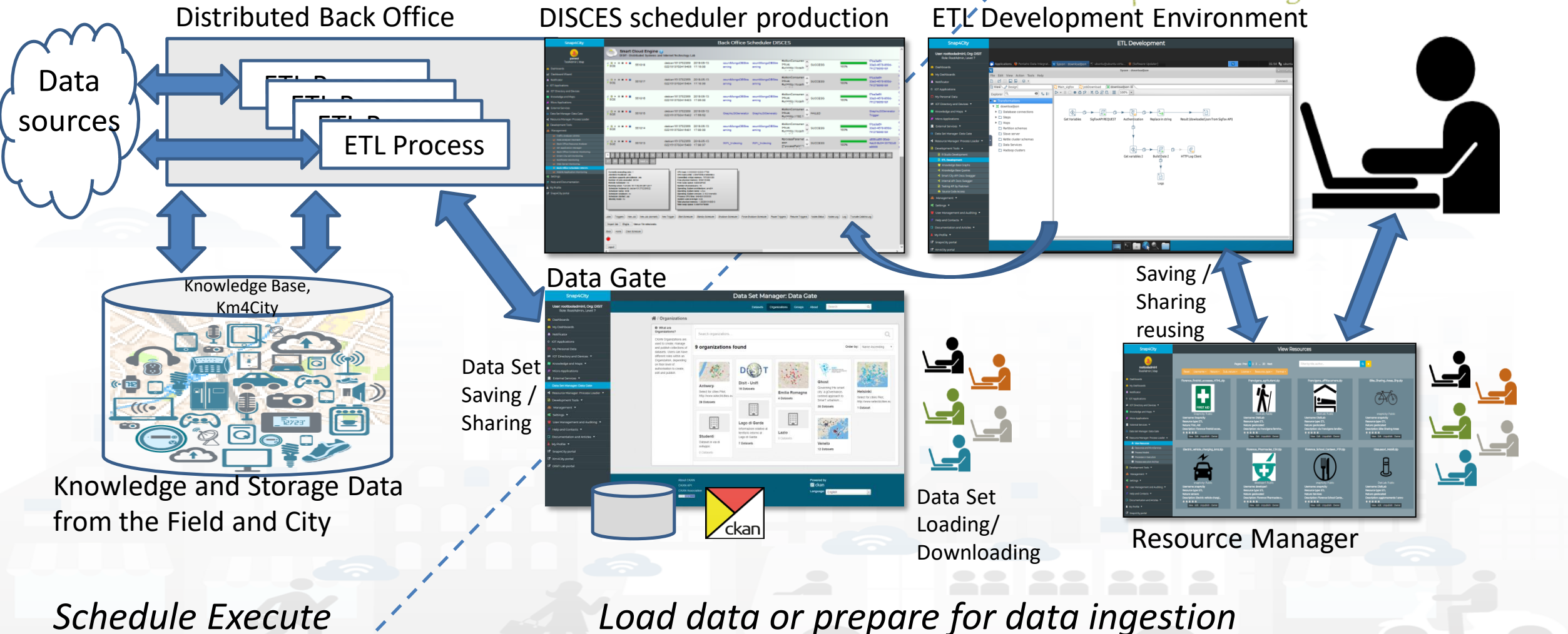
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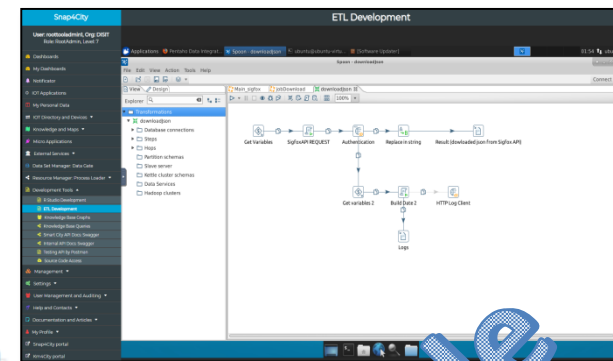
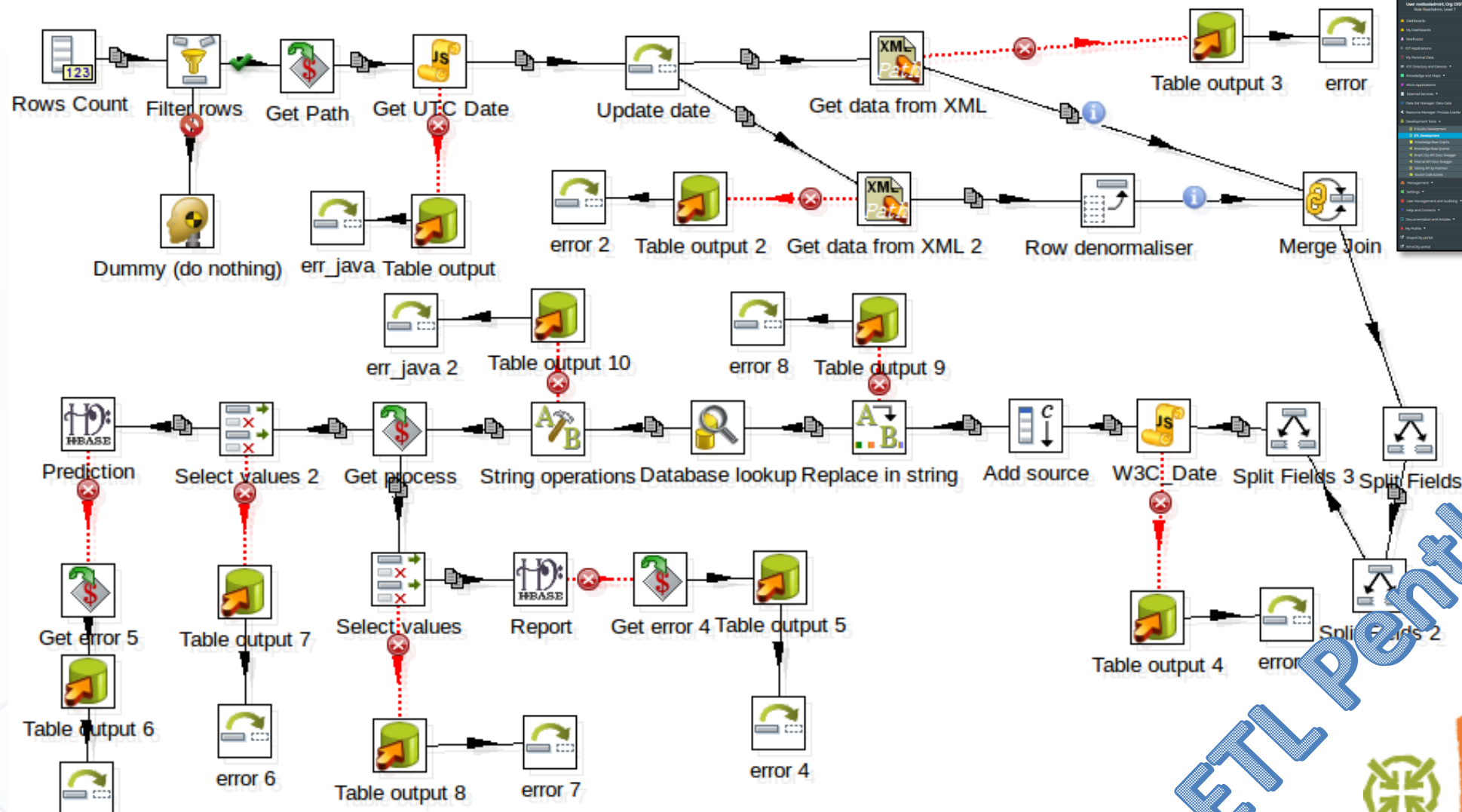
Data Ingestion Flow Guideline, thumb rules



Developers of ETL, Data Manager



Integrated ETL development

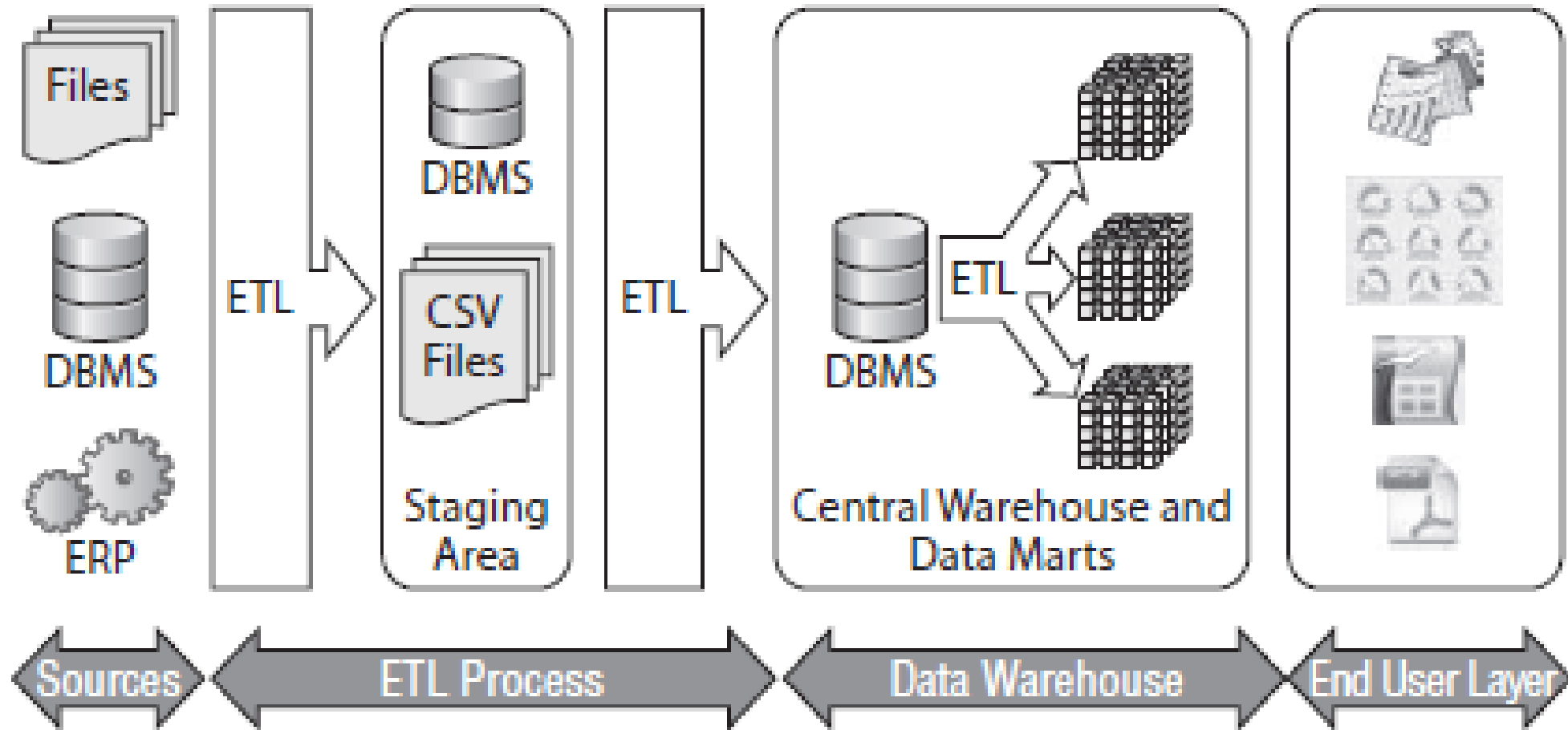


ETL Pentaho Kettle

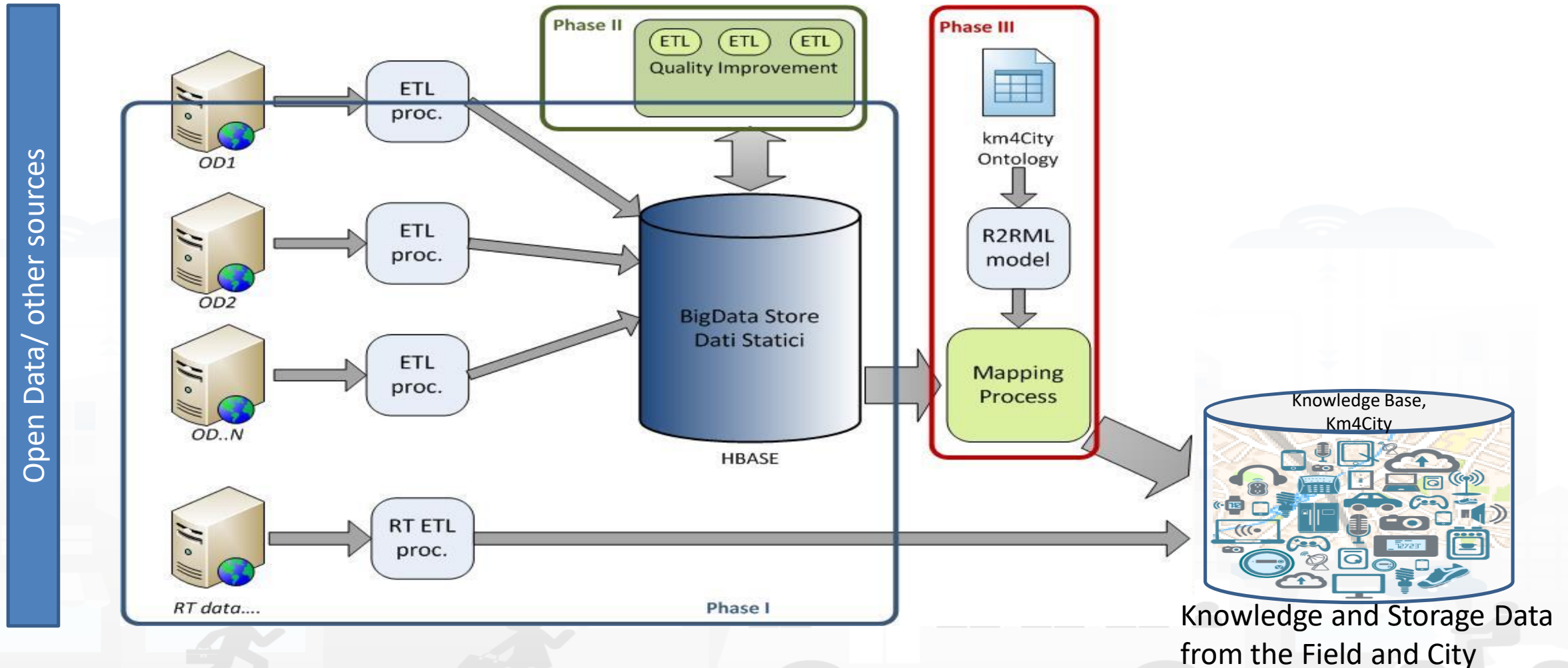


Batch Processing for dynamic data ingestion

Classic Data warehouse Architecture



The traditional Km4City Approach



ETL Processes

The three phases are:

- Extracting data from outside sources (**Ingestion** phase).
- Transforming data to fit operational needs which may include improvements of quality levels (**Data Quality Improvement** phase).
- Loading data into the end target (database, operational data store, data warehouse, data mart, etc.). So the data can be translated in **RDF triples using a specific ontology (Static/periodic datasets)** or on **NoSQL Databases (Dynamic datasets)**

Phase I: Data Ingestion

- **Purpose is to store data in HBase**
(Big Data NoSQL database).
- **Acquisition of wide range of OD/PD:** open and private data, static, quasi static and/or dynamic real time data.
- **Static and semi-static data** include: points of interests, geo-referenced services, maps, accidents statistics, etc.
 - files in several formats (SHP, KML, CVS, ZIP, XML, JSON, etc.)
- **Dynamic data** mainly data coming from sensors
 - parking, weather conditions, pollution measures, bus position, ...
 - using Web Services
- Using **Pentaho - Kettle** for data integration (Open Source tool)
 - using specific **ETL** Kettle transformation processes (one or more for each data source)

Phase II: Data Quality Improvement

- **Purpose:** add more information as possible and normalize data from ingestion
- **Problems kinds:**
 - Inconsistencies, incompleteness, typos, lack of standards, multiple standards, ...
- **Problems on:**
 - Place-name code
 - Street names (e.g., dividing names from numbers, normalize when possible)
 - Dates and Time: normalizing
 - Telephone numbers: normalizing
 - Web links and emails: normalizing

Phase III: Data mapping

- Purpose is to translate data from QI in RDF triples
- We use triples to do inference on data.
- Using **Karma Data Integration tool**, a **mapping model** from SQL to RDF on the basis of the ontology was created.
 - Data to be mapped first temporary passed from HBase to MySQL and then mapped using Karma (in batch mode)
- The mapped data in triples have to be uploaded (and indexed) to the **RDF Store** (Virtuoso).
- Triples are composed by a subject, a predicate and an object.

Pentaho Data Integration (Kettle)

Main strengths:

- Collect data from a **variety of sources** (extraction);
- Move and modify data (transport and transform) while cleansing, denormalizing, aggregating and enriching it in the process;
- Frequently (daily) store data (loading) in the final target destination, usually a **large dimensionally modeled database** (or **data warehouse**).
- **Spoon**: graphically oriented end-user tool to model the **flow of data** from input through transformation to output (**transformation**)
- **Pan** is a **command line tool** that executes transformations modeled with Spoon
- **Chef**: a graphically oriented **end-user tool** used to model **jobs** (transformations, FTP downloads etc. placed in a flow of control)
- **Kitchen** is a **command line tool** to execute jobs created with Chef.

Type of Steps in Spoon

Three different kinds of steps:

- **Input:** process some kind of 'raw' resource (file, database query or system variables) and create an output stream of records from it.
- **Output:** (the reverse of input steps): accept records, and store them in some external resource (file, database table, etc.).
- **Transforming:** process input streams and perform particular actions on them (adding new fields/new records); these actions produce one or more output streams.

Type of Transformations in Spoon

- Input
 - Access Input
 - CSV file input
 - Data Grid
 - De-serialize from file
 - Email messages input
 - ESRI Shapefile Reader
 - Excel Input
 - Fixed file input
 - Generate random credit
 - Generate random value
 - Generate Rows
 - Get data from XML
 - Get File Names
 - Get Files Rows Count
 - Get SubFolder names
 - ...
 - Salesforce Input
 - SAP Input
 - Table input
 - Text file input
 - XBase input
 - Yaml Input

- Scripting
 - Execute row SQL script
 - Execute SQL script
 - Formula
 - Modified Java Script Value
 - Regex Evaluation
 - User Defined Java Class
 - User Defined Java Expression

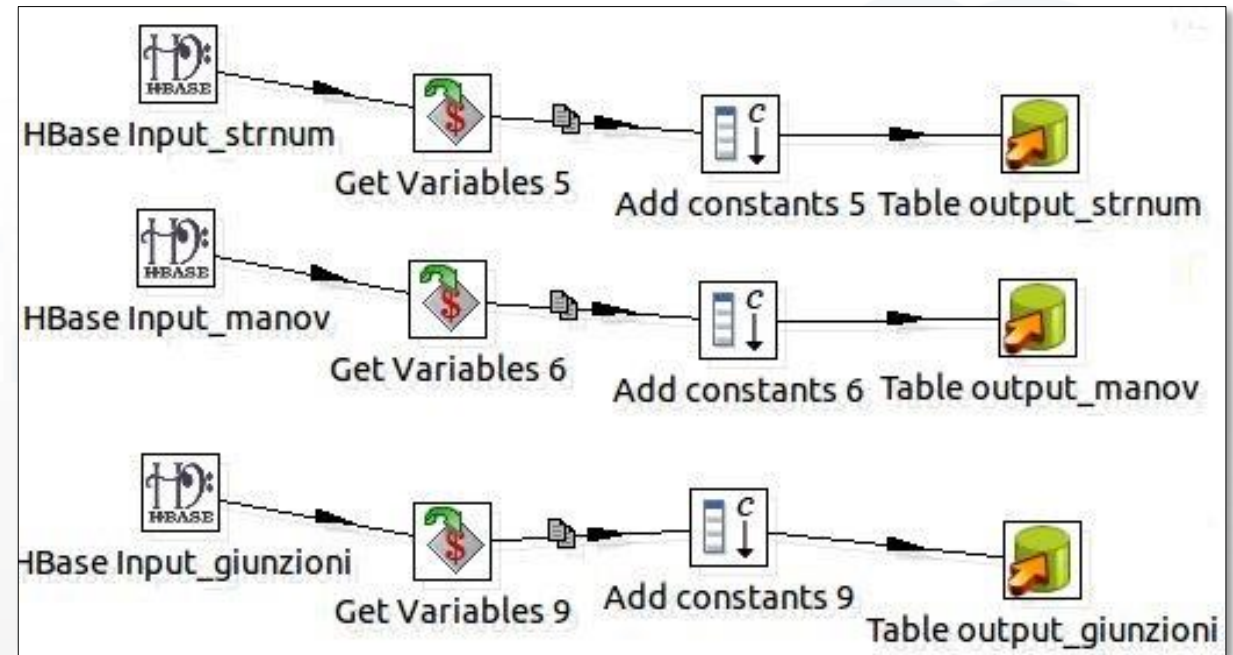
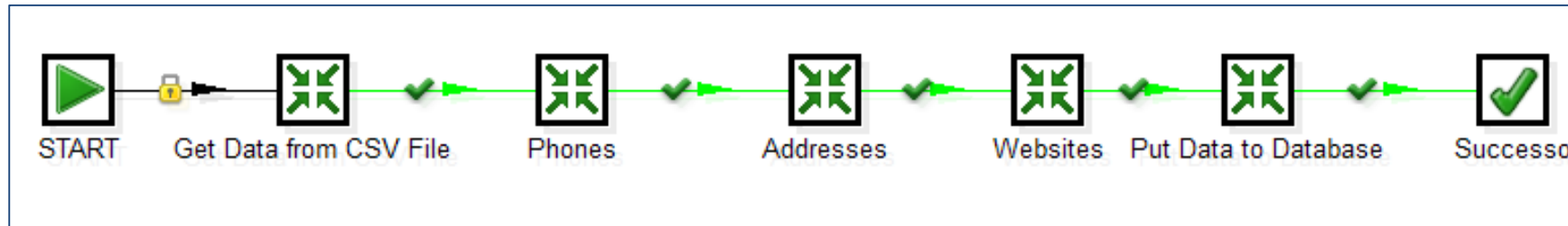
- Transform
 - Add a checksum
 - Add constants
 - Add sequence
 - Add value fields changing
 - Add XML
 - Calculator
 - Closure Generator
 - Example plugin
 - Number range
 - Replace in string
 - Row denormaliser
 - Row flattener
 - Row Normaliser
 - Select values
 - Sort rows
 - Split field to rows
 - Split Fields
 - String operations
 - Strings cut
 - Unique rows
 - Unique rows (HashSet)
 - Value Mapper
 - XSL Transformation

- Lookup
 - Call DB Procedure
 - Check if a column exists
 - Check if file is locked
 - Check if webservice is avail
 - Database join
 - Database lookup
 - Dynamic SQL row
 - File exists
 - Fuzzy match
 - HTTP client
 - HTTP Post
 - Stream lookup
 - Table exists
 - Web services lookup

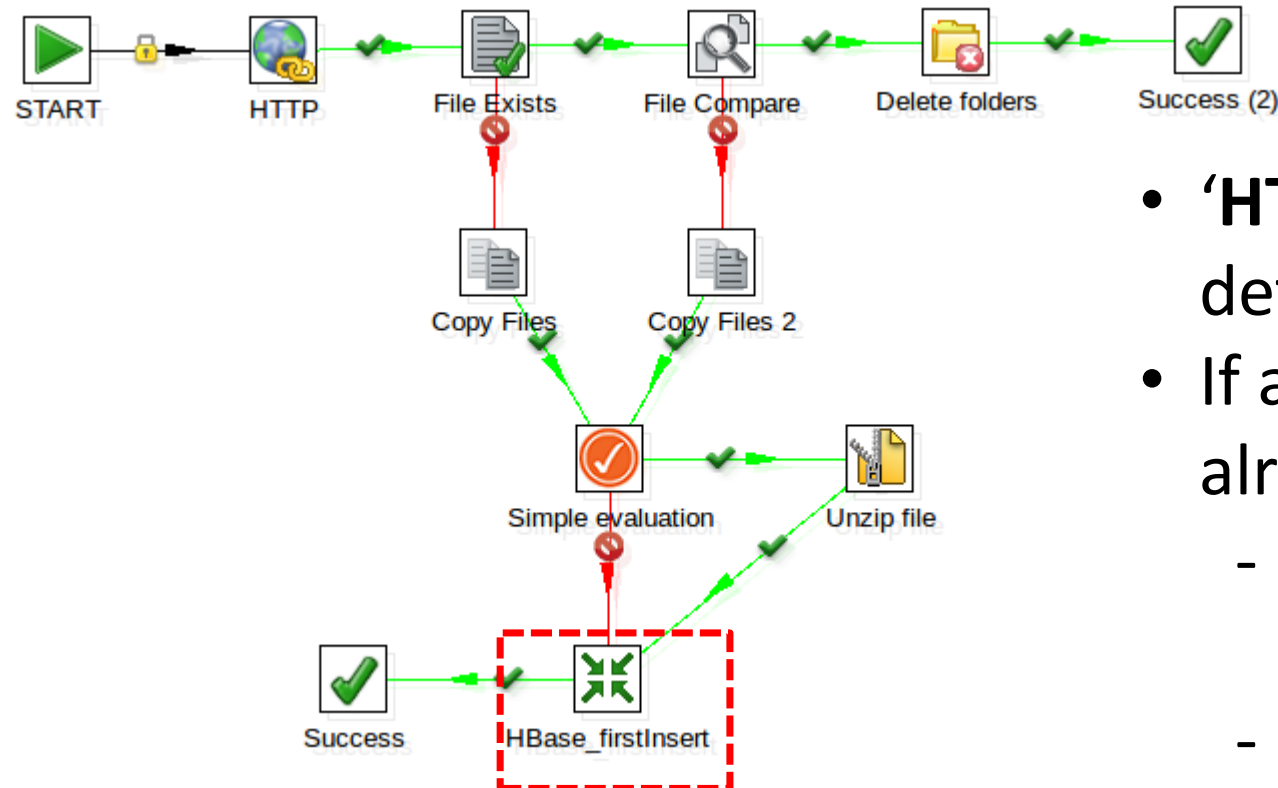
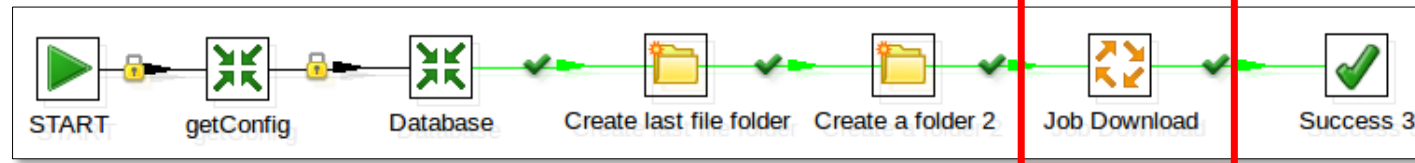
- Utility
 - Change file encoding
 - Clone row
 - Delay row
 - Execute a process
 - If field value is null
 - Mail
 - Metadata structure of str
 - Null if...
 - Process files
 - Run SSH commands
 - Send message to Syslog
 - Write to log

- Output
 - Access Output
 - Delete
 - Excel Output
 - Insert / Update
 - Json output
 - LDAP Output
 - Palo Cells Output
 - Palo Dimension Output
 - Properties Output
 - RSS Output
 - Salesforce Delete
 - Salesforce Insert
 - Salesforce Update
 - Salesforce Upsert
 - Serialize to file
 - SQL File Output
 - Synchronize after merge
 - Table output
 - Text file output
 - Update
 - XML Output

Sequential vs parallel



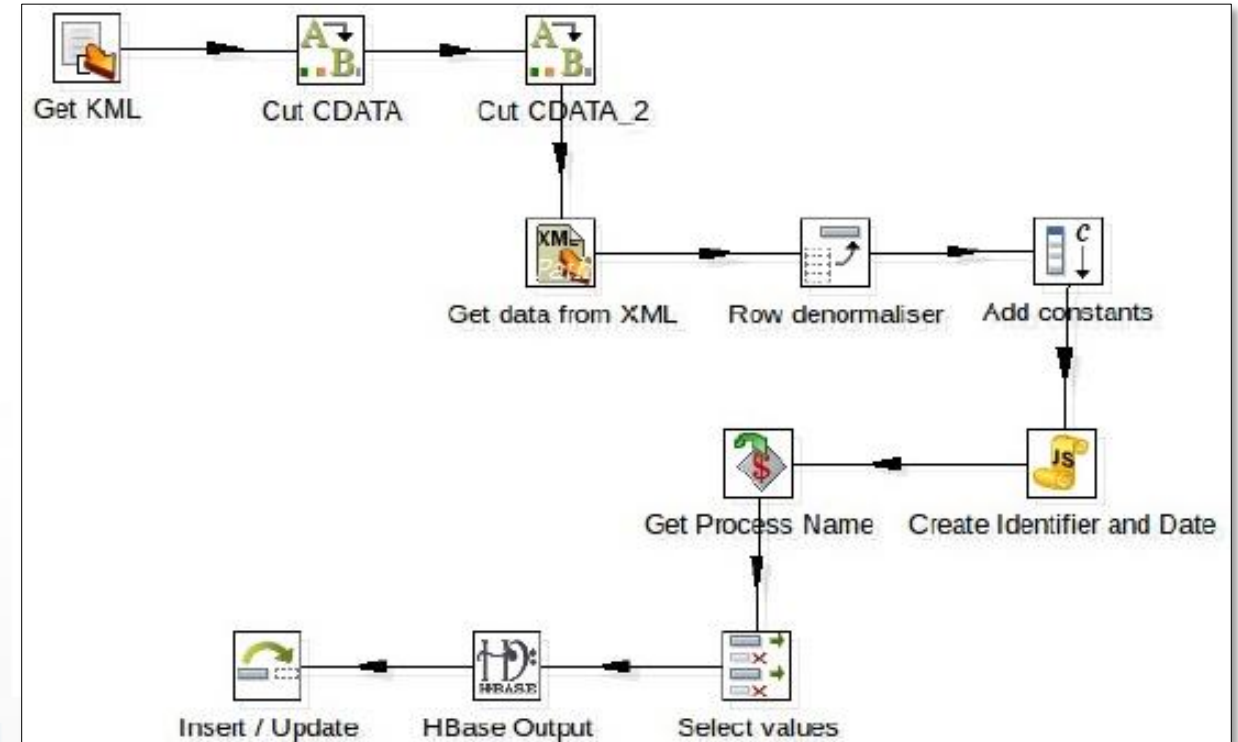
Job Download



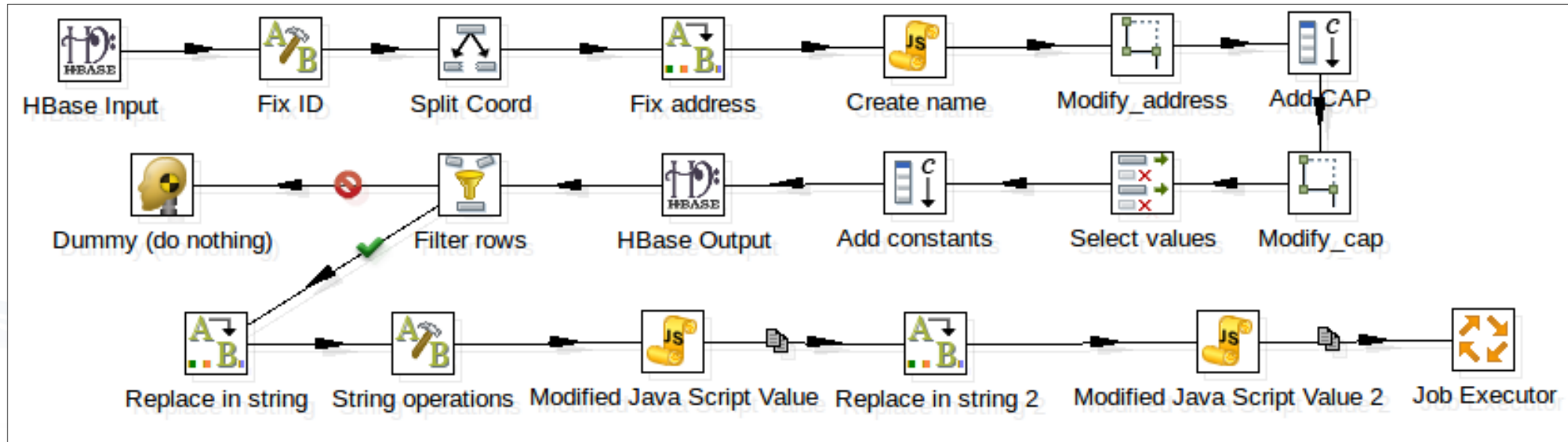
- ‘**HTTP**’ step downloads the dataset defined in *PARAM* (URL) field.
- If a file with the same name already exists, we compare them.
 - If they are the same, we delete the folders created before.
 - Otherwise we unzip the file and ‘**HBase_firstInsert**’ is called.

HBase_firstInsert

- **'Get KML'** loads the file just downloaded.
- **'Get data from XML'** and **'Row denormaliser'** extract fields from source file.
- In the JS step, we create an identifier (it will be use as key in HBase).
- **'HBase Output'** saves the information in a HBase table.
- **'Insert/Update'** updates the last ingestion date in MySQL table *process_manager2*.

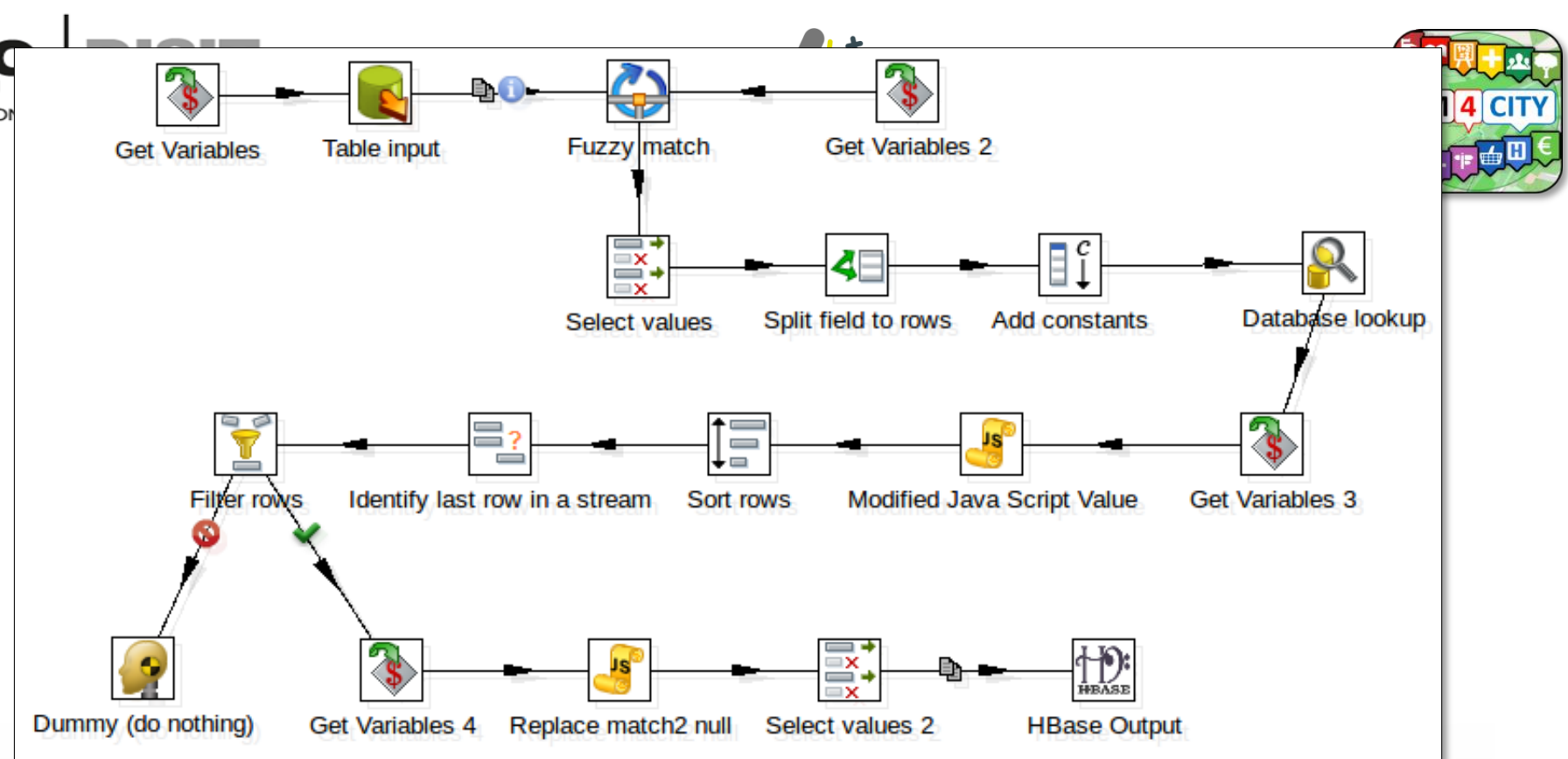


Quality Improvement



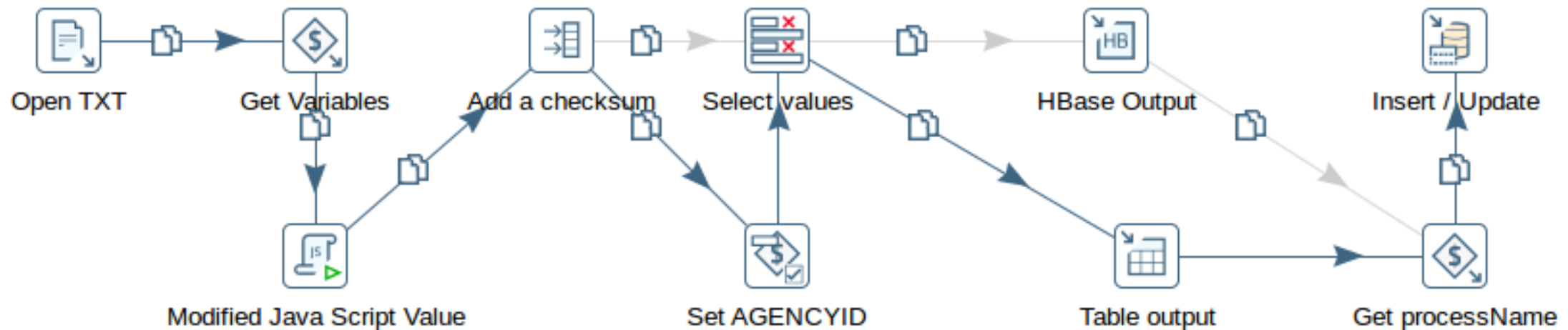
- **'HBase Input'** gets back data saved at the ingestion end.
- **'Fix address'** is used to correct typing error (e.g. Giovambattista instead of Giovanbattista) or to simplify search of right toponym code.
- **'Modify_*** transformations normalize address, CAP, website, e-mail, phone number, ...
- **'Add constants'** adds two fields (address_syn, codice_tponimo) which we will use in the next job.
- **'HBase Output'** saves in a new HBase table the quality improvement result.
- For the rows which have an un-empty *streetAddress*, the steps below extract a word from *streetAddress* which we will use to find the right toponym code.

Job Executor



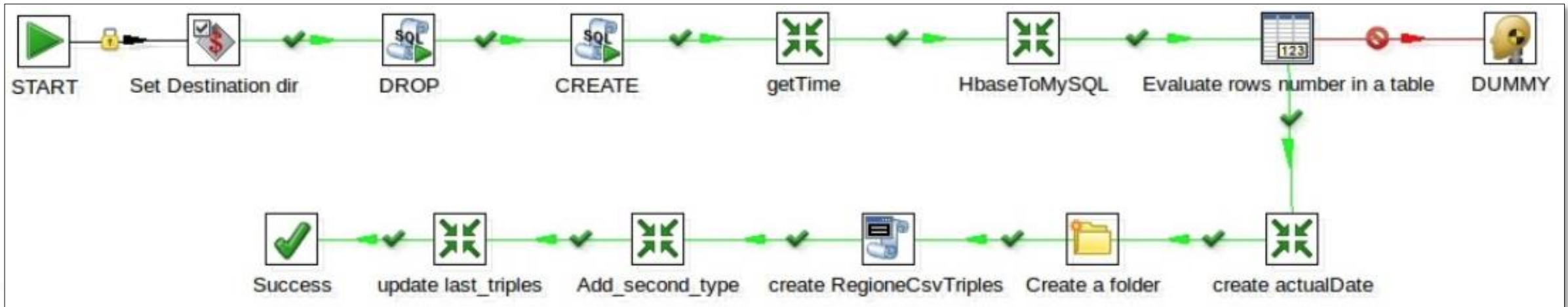
- To get toponym codes we use *tbl_toponimo_bis* MySQL table. It contains road names, toponym codes, town codes, Each road has his center coordinates (lat, long).
- **'Table input'** does the query on that table using the word created before.
- **'Fuzzy match'** calculates similarity (from 0.2 up to 1) between the query result and the address acquired during ingestion phase.
- Following steps calculate distance from ingestion coordinates and query ones and select the closest.
- **'HBase Output'** fills *address_syn* and *codice_toponimo* in QI HBase table.

QI Problems



- The method used for toponym code extraction sometimes produces wrong results.
- Given a word, might be impossible to determine right toponym code (e.g., query using '*Brunelleschi*' returns '*Via dei Brunelleschi*', '*Piazza Brunelleschi*').
- Summarize roads with their centers and calculate distances could not return right results (if the point of interest is far from his road center, it could be closer to another road center).

Triplification
















- Since we use Karma to generate models, we have to move data from HBase to MySQL.
- **'DROP'** and **'CREATE'** respectively deletes MySQL table if already exists and creates a new one.
- **'getTime'** returns last triple generation timestamp for a specific process (using MySQL *process_manager2* table).
- **'HBaseToMySQL'** moves data from HBase to MySQL only if timestamp just calculated is older than the date of last ingestion (it prevents to generate triples based on the same data).
- **'create RegioneCSVTriples'** calls Karma script to generate triples based on the model.
- **'update last_triples'** updates last triple generation timestamp in *process_manager2*.

Scheduling Real Time Ingestions

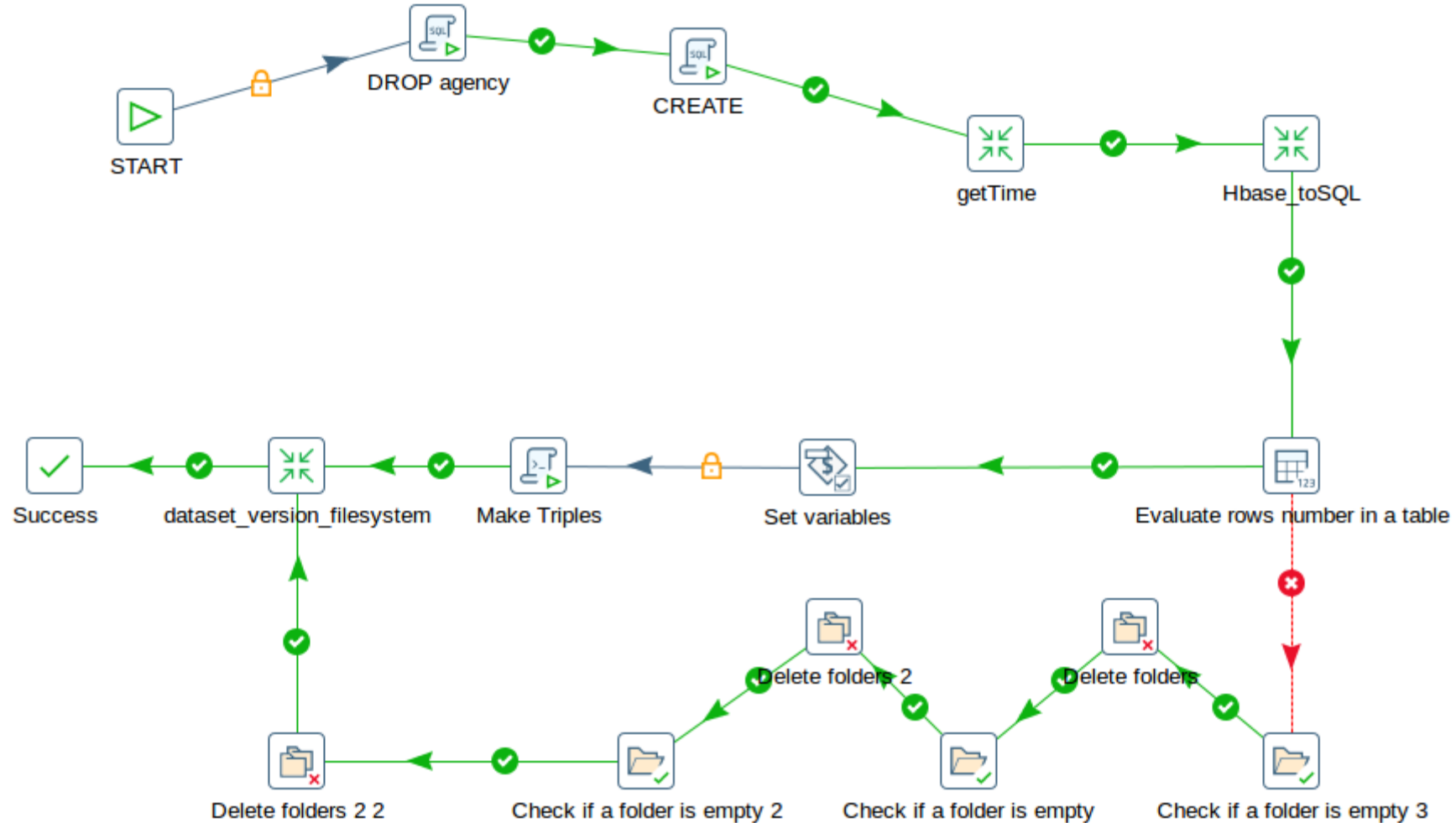
- For **Real Time data** (car parks, road sensors, etc.), the ingestion and triple generation processes should be performed periodically (no for **static data**).
- A scheduler is used to manage the periodic execution of ingestion and triple generation processes;
 - this tool throws the processes with a predefined interval determined in phase of configuration.



Scheduler: DISCES

 Smart Cloud Engine DISIT - Distributed Systems and Internet Technology Lab												
SCHEDULER NAME	ID ↓	FIRE INSTANCE ID	DATE	JOB NAME	JOB GROUP	JOB DATA	STATUS	PROGRESS	TRIGGER NAME	TRIGGER GROUP	PREV FIRE TIME	NEXT FIRE
 SCE	183652	hadoopnode0715265 676204441526567620 531	2018-05-17 19:52:04	sensore_Demidoff_per iferia	sensori_traffico_veicol are	#processParameter s= [{"processPath":"/u	SUCCESS	100%	sensore_Demidoff_per iferia_trigger	sensori_traffico_veicol are_trigger	2018-05-17 19:52:00	2018-05-17
 SCE	183651	hadoopnode0415265 553660711526555366 283	2018-05-17 19:50:02	Sensori_MeteoSIR_P hoenix	Sensori_Phoenix	#processParameter s= [{"processPath":"/h	FAILED		Sensori_MeteoSIR_P hoenix_trigger	Sensori_Phoenix	2018-05-17 19:50:00	2018-05-17
 SCE	183650	hadoopnode0715265 676204441526567620 530	2018-05-17 19:50:32	CarPark_MLIC_160_P hoenix	CarPark_Phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	CarPark_MLIC_160_P hoenix_trigger	CarPark_Phoenix_trig ger	2018-05-17 19:50:00	2018-05-17
 SCE	183649	hadoopnode04c1526 555081135152655508 1132	2018-05-17 19:49:19	Bike_Siena_Phoenix	Bike_Phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	Bike_Siena_Phoenix_ trigger	Bike_Phoenix_trigger	2018-05-17 19:49:00	2018-05-17
 SCE	183648	hadoopnode0415265 553660711526555366 281	2018-05-17 19:49:38	smart_waste_FI_phoe nix	smart_waste_phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	8b095cf2- d5b3-4c93-890a- b6544d950542	137efde2-25b6-4b7c- 95ef-1aaff2f8ea51	2018-05-17 19:49:00	2018-05-17
 SCE	183647	hadoopnode0715265 676204441526567620 528	2018-05-17 19:49:36	Bike_Pisa_Phoenix	Bike_Phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	Bike_Pisa_Phoenix_tr igger	Bike_Phoenix_trigger	2018-05-17 19:49:00	2018-05-17
 SCE	183646	hadoopnode0715265 676204441526567620 527	2018-05-17 19:49:05	Sensore_Senese_peri feria	sensori_traffico_veicol are	#processParameter s= [{"processPath":"/u	SUCCESS	100%	Sensore_Senese_peri feria_trigger	sensori_traffico_veicol are_trigger	2018-05-17 19:49:00	2018-05-17
 SCE	183645	hadoopnode04c1526 555081135152655508 1131	2018-05-17 19:48:06	Sensore_Senese_Ce ntro	sensori_traffico_veicol are	#processParameter s= [{"processPath":"/u	SUCCESS	100%	Sensore_Senese_Ce ntro_trigger	sensori_traffico_veicol are_trigger	2018-05-17 19:48:00	2018-05-17
 SCE	183644	hadoopnode0415265 553660711526555366 280	2018-05-17 19:49:38	charging_stations_FI_ phoenix	charging_stations_ph oenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	charging_stations_FI_ phoenix_trigger	charging_stations_ph oenix_trigger	2018-05-17 19:47:00	2018-05-17
 SCE	183643	hadoopnode0715265 676204441526567620 526	2018-05-17 19:48:10	weather_sensor_Sant aMarta_FI_phoenix	weather_sensor_phoe nix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	weather_sensor_Sant aMarta_FI_phoenix_tr igger	weather_sensor_phoe nix_trigger	2018-05-17 19:46:00	2018-05-17
 SCE	183642	hadoopnode0415265 553660711526555366 278	2018-05-17 19:46:58	CarPark_SienaParche ggi_Phoenix	CarPark_Phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	CarPark_SienaParche ggi_Phoenix_trigger	CarPark_Phoenix_trig ger	2018-05-17 19:45:00	2018-05-17
 SCE	183641	hadoopnode0715265 676204441526567620 520	2018-05-17 19:47:58	CarPark_MLIC_164_P hoenix	CarPark_Phoenix	#processParameter s= [{"processPath":"/h	SUCCESS	100%	CarPark_MLIC_164_P hoenix_trigger	CarPark_Phoenix_trig ger	2018-05-17 19:45:00	2018-05-17

Triplification Overview



Triplification Overview

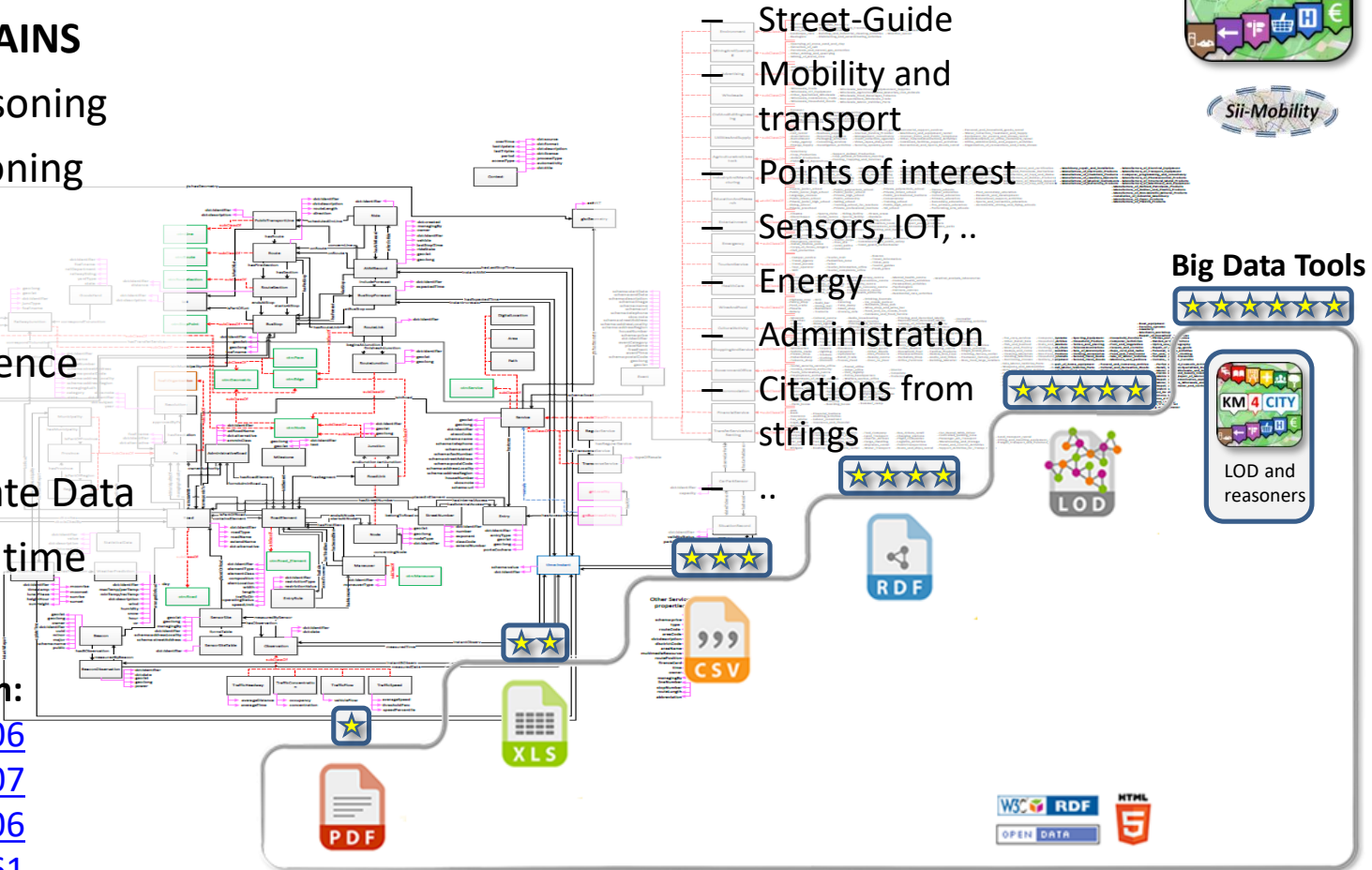
```
java -cp target/karma-offline-0.0.1-SNAPSHOT-shaded.jar edu.isi.karma.rdf.OfflineRdfGenerator  
--sourcetype DB  
--modelfilepath "${MODELPATH}/${processName}_agency.ttl"  
--outputfile ${TRIPLESDESTDIRECT}/agency.n3  
--dbtype MySQL  
--hostname ${IPADDRESSMASTER}  
--username ${USERNAMEMYSQL}  
--password ${PSWMYSQL}  
--portnumber ${PORTMYSQL}  
--dbname ${DATABASEMYSQL}  
--tablename ${processName}_agency
```


Km4City: Knowledge Base

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

Ontology Documentation:

<http://www.disit.org/6506>
<http://www.disit.org/6507>
<http://www.disit.org/5606>
<http://www.disit.org/6461>



Smart-city Ontology km4city

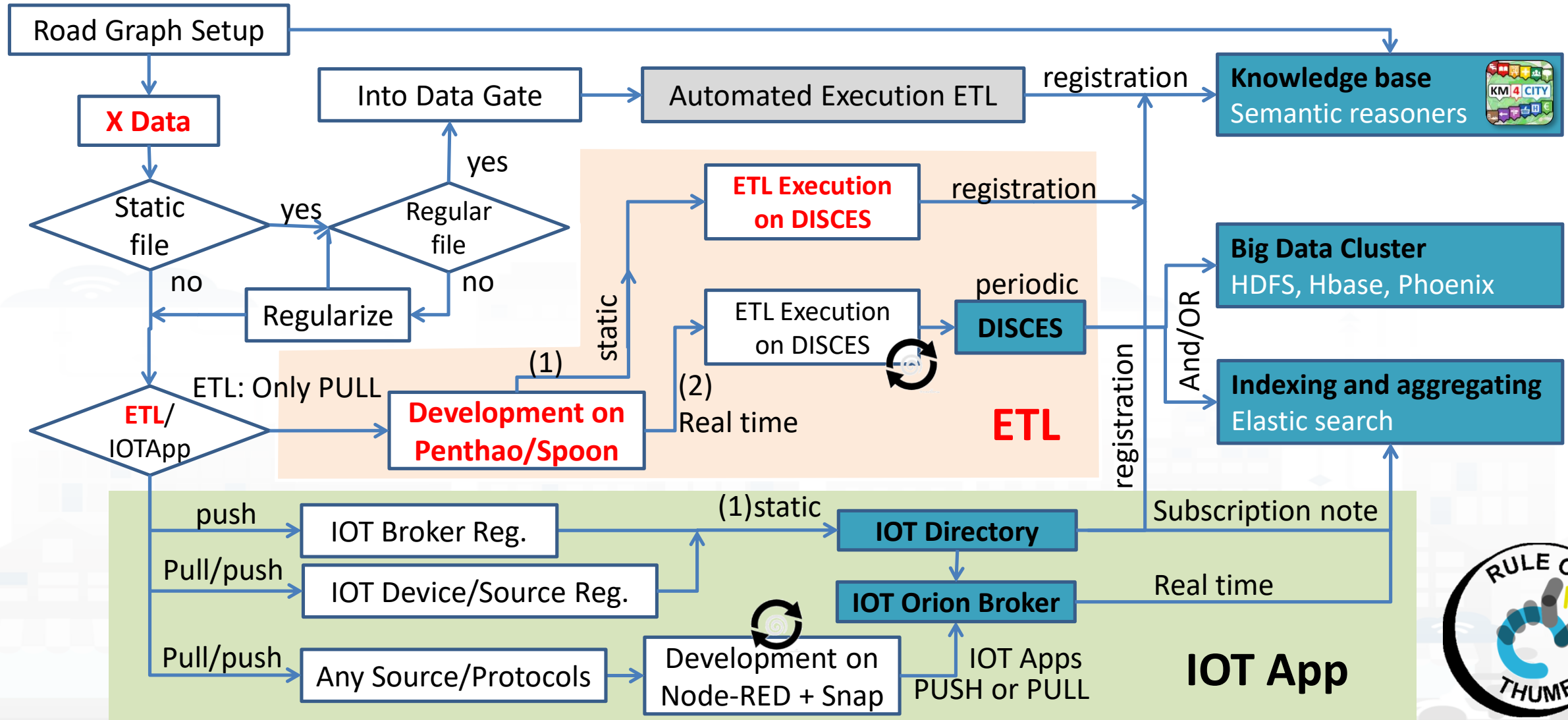


Karma

An introductory guide for generating RDF triples from relational data in minutes

Karma (<http://usc-isi-i2.github.io/karma/>) is a data integration tool developed at the Center of Knowledge Graphs of the Information Science Institute at the University of Southern California. Here at DISIT, we exploit Karma for triplifying relational data.

Data Ingestion Flow Guideline, thumb rules



- Karma is a mapping model based on ontology (**km4city**) from MySQL tables to RDF.
- Triples are uploaded to **Virtuoso**, an RDF Store.
- It can import MySQL tables but no HBase ones.

Here are the steps to have your triples in your pocket in minutes:

1. Get one of the ready-to-use DISIT VMs
2. Launch the Karma server
3. Build your own model:
 1. Load vocabularies
 2. Load relational tables
 3. (Optional) Load R2RML models
4. Define mappings
4. Export your model
5. Launch the command-line tool
6. Enjoy!

Karma v2.024 Import Manage Models Reset ...

Command History

- Import Ontology: km4c Virtuoso 1.6.2.owl
- Import Ontology: schema-org.rdf
- Import Ontology: skos.rdf
- Import Ontology: dcterms.rdf
- Import Ontology: foaf.rdf
- Import Ontology: wgs84_pos.rdf
- Set Worksheet Properties: Code_corsa_test
- Import Database Table:

Arte_e_cultura_csv

Prefix: s | Base URI: http://localhost:8080/source/ | Graph Name: http://localhost/worksheets/Arte_e_cultura_csv

FinalKey	address	cap	category	categoryEng	city	email	
002aac4104a...	VIA DELLA SAPIENZA	53100	biblioteca	Library	SIENA	biblioteca@c...	05
004656618eb...	VIA SAN GIOVANNI	55036	biblioteca	Library	PIEVE FOSCIANA	Empty	05

Get one of the ready-to-use DISIT VMs

The DISIT Lab makes available through its Drupal portal a set of ready-to-use virtual machines specifically oriented to data integration. Here is how you can get one of them:

1. Connect to <http://www.disit.org/drupal/?q=node/6690> and scroll down to the section “MACCHINA VIRTUALE, VMSDETL, GIA' PRONTA”
2. Get the “Versione del 2017/2018 0.8 con Phoenix” at <http://www.disit.org/vmsdetl/VMSDETL-2017-v0-8.rar>, or the “Versione del 2017/2018 0.8 con Phoenix per Virtualbox” at <http://www.disit.org/vmsdetl/VMSDETL-2017-v0-8-ovf.rar>, unless you have a good reason for picking a different one
3. Wait for the download to complete, and extract the archive
4. Launch the VM player of your choice
5. Open the VM
6. Run it
7. https://www.snap4city.org/download/video/ETL_and_Console_of_the_Virtual_Machine_-_User_Manual.pdf
8. https://www.snap4city.org/download/video/Snap4city_VM_Quick_guide.pdf

Karma

Launch the Karma server

Do the following to run the Karma server:

1. Open a shell
2. Move to `~/programs/Web-Karma-master/karma-web`
3. Run `mvn -Djetty.port=9999 jetty:run`
4. Wait while the Jetty server comes up
5. Connect to `localhost:9999` where you will find the Web application for building your model

Karma




Build the model

For that Karma could produce the RDF triples for you, it is required that you instruct it about how relational data should be mapped to semantic data. Documents that describe such a mapping are called R2RML models. Models are built operating a dedicated Karma Web application, and they are exported as ttl files.

Steps:

1. Load Vocabularies
2. Load Relational Tables
3. Load R2RML Models
4. Define Mappings

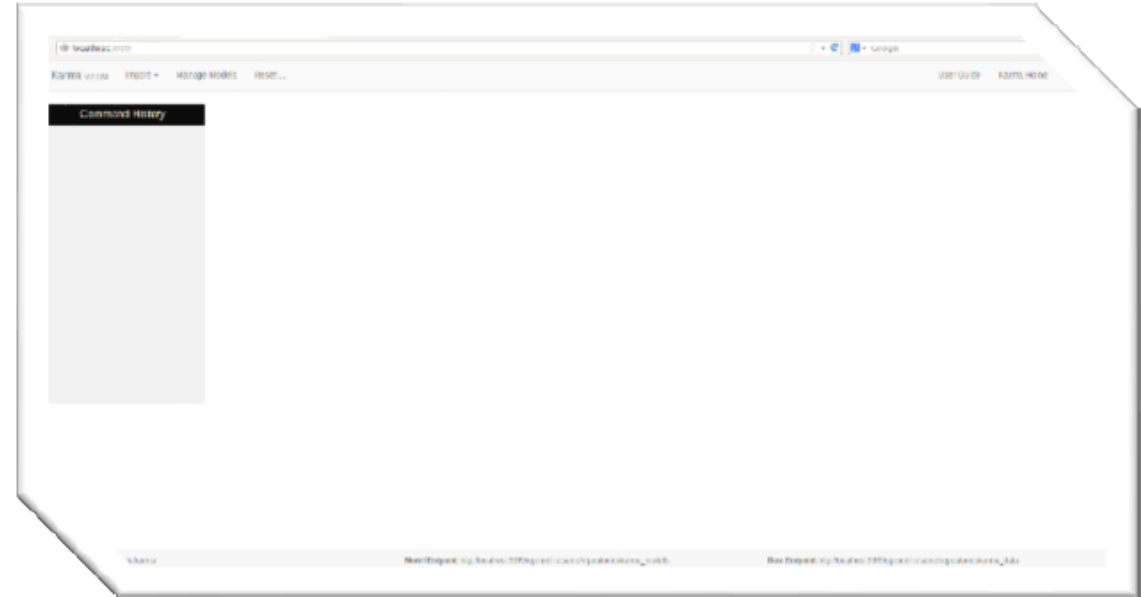
Load Vocabularies

Have you connected to <http://localhost:9999>? Are you displaying something similar to this?  Right, you are ready to load your vocabularies.

Identify classes and properties that you wish to appear in RDF triples that will be the result of the whole process. Identify vocabularies where such classes and properties are defined. Load them.

Below here is how you load a vocabulary:

1. Hit **Import**, at the top left corner of the Web page
2. Hit **From File**
3. Select the vocabulary file (it can be an OWL, RDF/XML, or TTL file)
4. Leave **OWL Ontology** selected, and hit **Next**
5. Indicate the correct file encoding if the proposed one is not, and hit **Import**



You should now see your newly imported vocabulary displayed in the Command History (left column).

Load Relational Tables

Identify tables in your RDB where source data can be found. Load them in your model.

Below here is how you load a table:

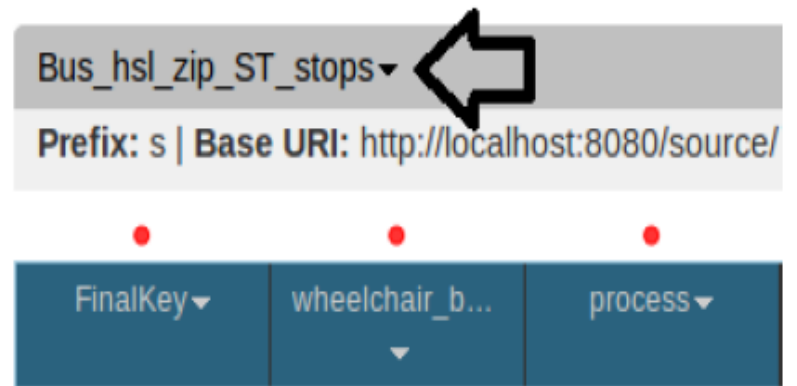
1. Hit `Import`, at the top left corner of the Web page
2. Hit `Database Table`. The `Import Database Table` dialog should open.
3. Fill in the form with authentication data and RDB name, and hit `OK`
4. A table listing should appear below the form
5. Put the mouse pointer over the table of your interest
6. Buttons `Import` and `Preview` should appear at the right of the table name. Hit `Import`.
7. Confirmation message “Table imported in the workspace!” should appear. Hit `OK`.
8. Repeat steps 5 – 8 for each table where source data are found
9. Hit `Close` at the bottom right corner of the `Import Database Table` dialog to dismiss it

Load R2RML Models

If you already have built and exported a model in the past, and you now just need to make a modification over it, you can start loading and applying your existing model, instead of rebuilding it from scratch.

Below here is how you apply an existing model:

1. Identify the table to which the model has to be applied, and hit the triangle that is displayed next to the table name ➡
2. Select `Apply R2RML Model`, and then `From File`
3. Select the ttl file that contains your model, and hit `Open`
4. Done. Classes and links should appear in the workspace.



Define Mappings

Below here is how you specify that a **column** of an **RDB table** maps to a **data property** of a **semantic class**, and how to specify that a **column** contains an identifier that can be used for building the URIs of instances of the **semantic class**:

1. Below **RDB table** name, identify the blue box that contains the **column** name written in white
2. Hit the white triangle that you can see next to the **column** name
3. Hit Set Semantic Type
4. Pick the checkbox at left of *property* of Class
5. Hit the Edit button at right of *property* of Class
6. Select the **semantic class** from the All Classes list. Use the Class textbox for filtering.
7. Select the **property** from the All Properties list. Use the Property textbox for filtering.
8. If the **column** is a key, pick the Mark as key for the class checkbox
9. You can map the **column** to a *typed* literal, filling the textbox below the label Literal type
10. When you are done, hit Save. Repeat the procedure for each of the **columns** to be mapped.

Define Mappings

Below here is how you specify instead that a foreign key of a table in a relational database corresponds to an object property of a semantic class. Scenario: a relational table **stops**, that corresponds to a semantic class **Stop**, has a column **agency_id** where the unique identifier of the agency that manages the stop can be found. Each value in **agency_id** corresponds to one and only one value in a column, let's say *id*, that can be found in the relational table **agencies**. Table **agencies** corresponds to the semantic class **Agency**. We wish resources of class **Stop** to be linked each to the appropriate resource of class **Agency**, through the property **gtfs:agency**. For such a purpose, we will do the following:

1. Load relational table **stops** to workspace
2. Map data properties, linking columns in table **stops**, to the class **Stop**, through appropriate properties, as outlined above
3. Identify the grey box with rounded angles that has the name of the class **Stop** written within. It should locate in the workspace. Identify the black triangle that should locate near the right margin of the box. Click it.
4. Select **Add Outgoing Link**. A popup window should open.
5. Type **gtfs:agency** in the box labelled **Property**, and **gtfs:Agency** in the box labelled **To Class**
6. Click **Save** in the bottom right corner of the popup window to dismiss it.
7. A new grey box, related to class **Agency**, will appear in the workspace, linked to the grey box related to class **Stop** through a link labelled **agency** for brevity
8. Map column **agency_id** as a data property of class **Agency**, also specifying that it is a unique identifier, as described in the above paragraph
9. Repeat for all foreign keys to be mapped, then go to next step (*Export your model*).

Once you have defined all needed mappings, you have to export your model to a ttl file, so that you can provide it as a parameter to the command-line Karma tool that performs the triplification. Here is how you can export your model:

1. Identify the RDB table whose model you wish to export
2. Hit the black triangle at the right of the table name
3. Select Publish, and then Model
4. A popup should appear at the top right corner of the window, saying “R2RML Model published”
5. Hit Manage Models, in the menu bar at the top of the page
6. A listing should appear of all models that you have exported in the current session
7. Identify the row corresponding to the last model exported, based on the File Name (the name of the RDB table) and the Publish Time.
8. Cut the URL that you can find in the rightmost column of the prospect, and open it in a new tab
9. Save As... the page that you have opened at step 8.
10. Done. The file that you have saved at step 9 is your ready-to-use R2RML model.

Launch the command-line tool

Once you have exported your R2RML model as a **ttl file**, you are ready to perform the triplification:

1. Open a shell
2. Move to `/home/ubuntu/programs/Web-Karma-master/karma-offline`
3. Launch the following as a single line command, customizing parameter values in bold:

```
mvn exec:java
-Dexec.mainClass="edu.isi.karma.rdf.OfflineRdfGenerator"
-Dexec.args=" --sourcetype DB --modelfilepath /path/to/model.ttl
--outputfile /path/to/output_triples_file.n3 --dbtype MySQL
--hostname mysql_srv_hostname_or_ip_address --username mysql_user
--password mysql_pwd --portnumber 3306 --dbname mysql_dbname
--tablename mysql_table_name -Dexec.classpathScope=compile
```


ETL SDK Virtual machine

- [https://www.snap4city.org/download/video/ETL and Console of the Virtual Machine - User Manual.pdf](https://www.snap4city.org/download/video/ETL%20and%20Console%20of%20the%20Virtual%20Machine%20-%20User%20Manual.pdf)
- [https://www.snap4city.org/download/video/Snap4city VM Quick guide.pdf](https://www.snap4city.org/download/video/Snap4city%20VM%20Quick%20guide.pdf)
- videos: <https://www.snap4city.org/drupal/node/139>
- example on Github: <https://github.com/disit/smart-city-etl>
- <https://www.snap4city.org/download/video/Snap4City-ETL-VM.rar>
- “Versione del 2017/2018 0.8 con Phoenix” at <http://www.disit.org/vmsdetl/VMSDETL-2017-v0-8.rar>, or the “Versione del 2017/2018 0.8 con Phoenix per Virtualbox” at <http://www.disit.org/vmsdetl/VMSDETL-2017-v0-8-ovf.rar>, unless you have a good reason for picking a different one

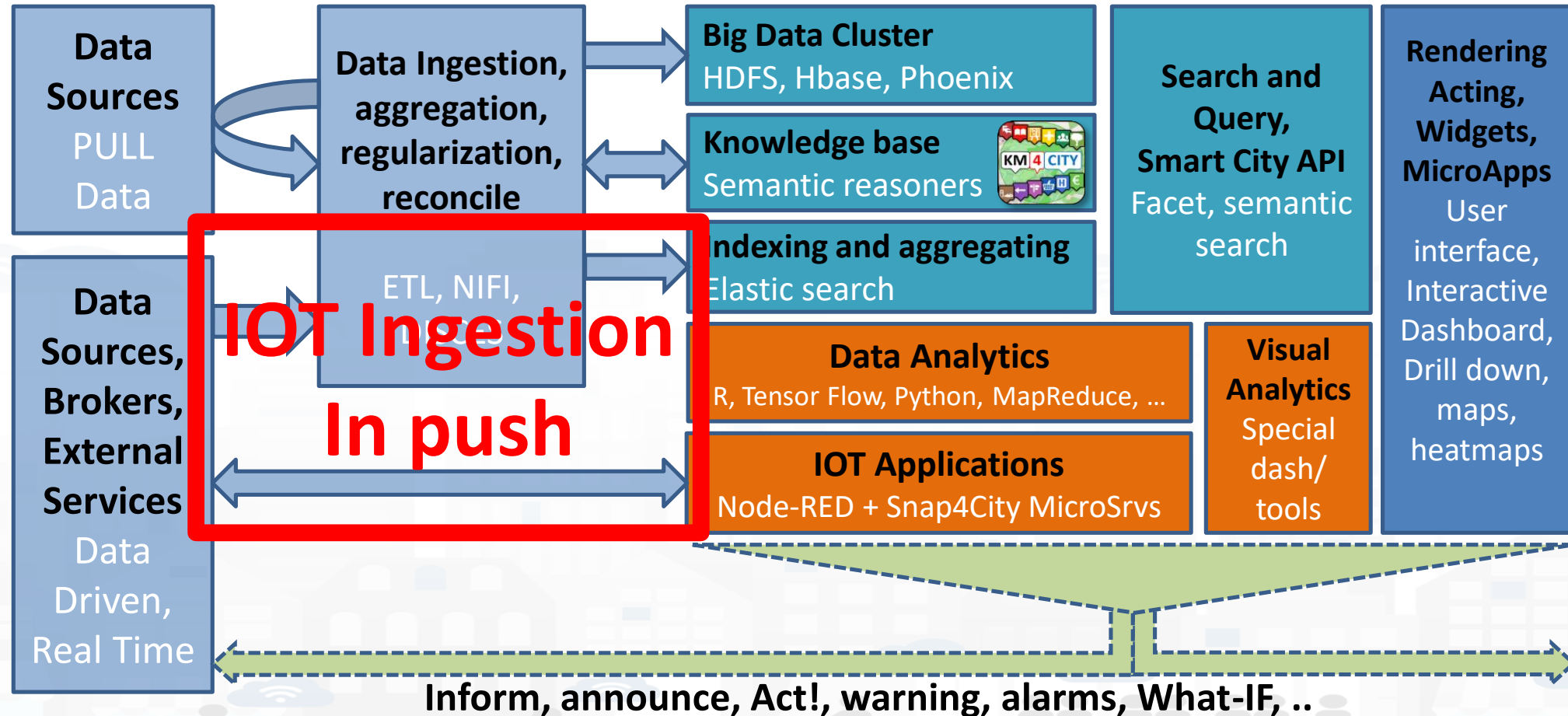
Further readings on ETL

- ETL Development: <https://www.snap4city.org/drupal/node/24>
- [US6. Developing and using processes for data transformation](#)
- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)
- [TC6.3. Creating ETL processes for automated data ingestion and data transformation](#)
- [TC6.4- Managing ETL processes via Resource Manager, upload, execute, monitor](#)
- [TC6.5- Managing Heterogeneous File Ingestion via ETL processes](#)
- [TC6.6- Producing data-sets in Bundle via ETL](#)
- [TC6.8- ETL processes for data transformation, and exploiting MicroServices/API/RestCall](#)
- [TC6.9- ETL processes for multiprotocol and format data ingestion, see on GITHUB for library](#)
- [TC6.10- ETL Applications using multiple protocols, and formats for files and to calling services using REST and WS](#)
- [TC6.11- Add a new ETL coping with a new Protocol](#)
- [ETL processes for massive Data Ingestion and Transformation](#)

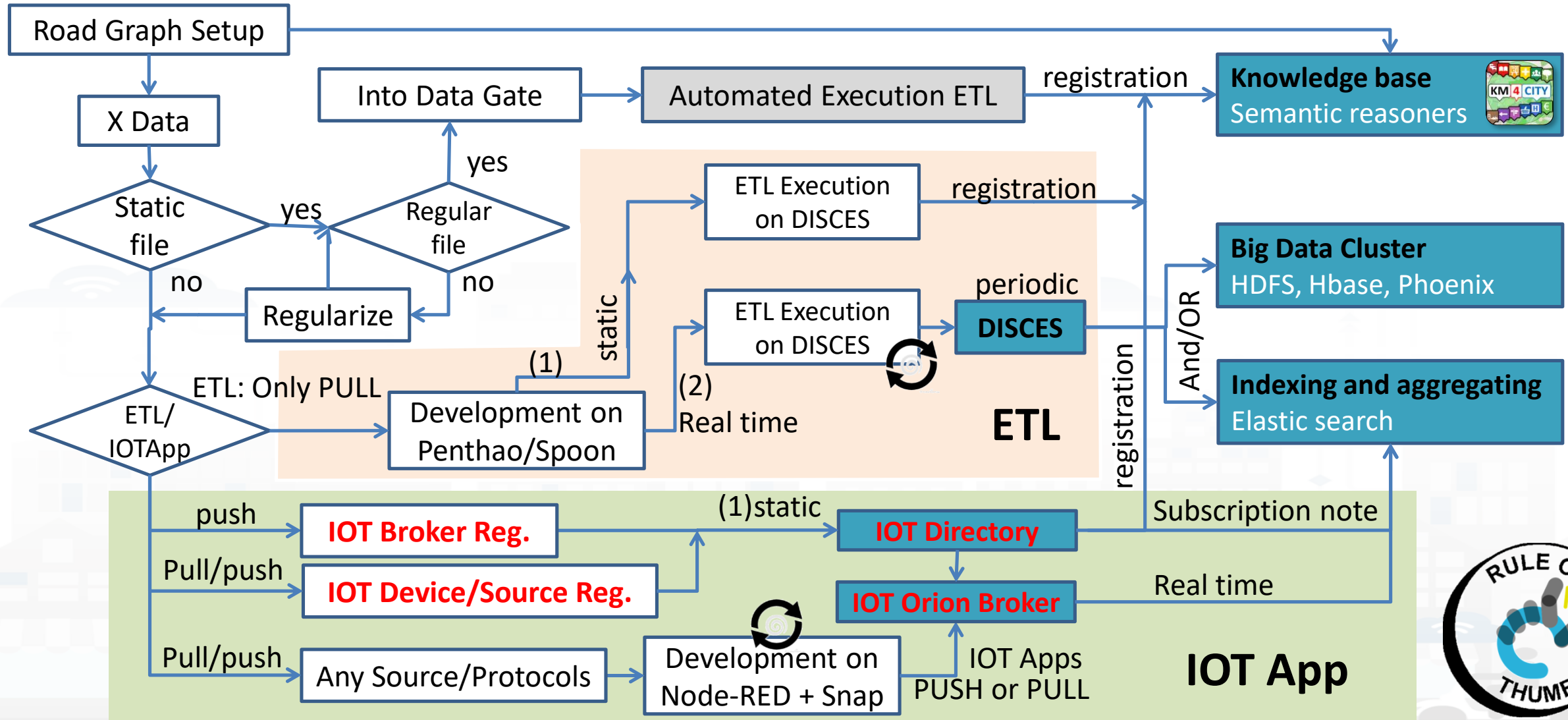
Data Ingestion via IOT Brokers

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

Snap4City as a Lambda Architecture



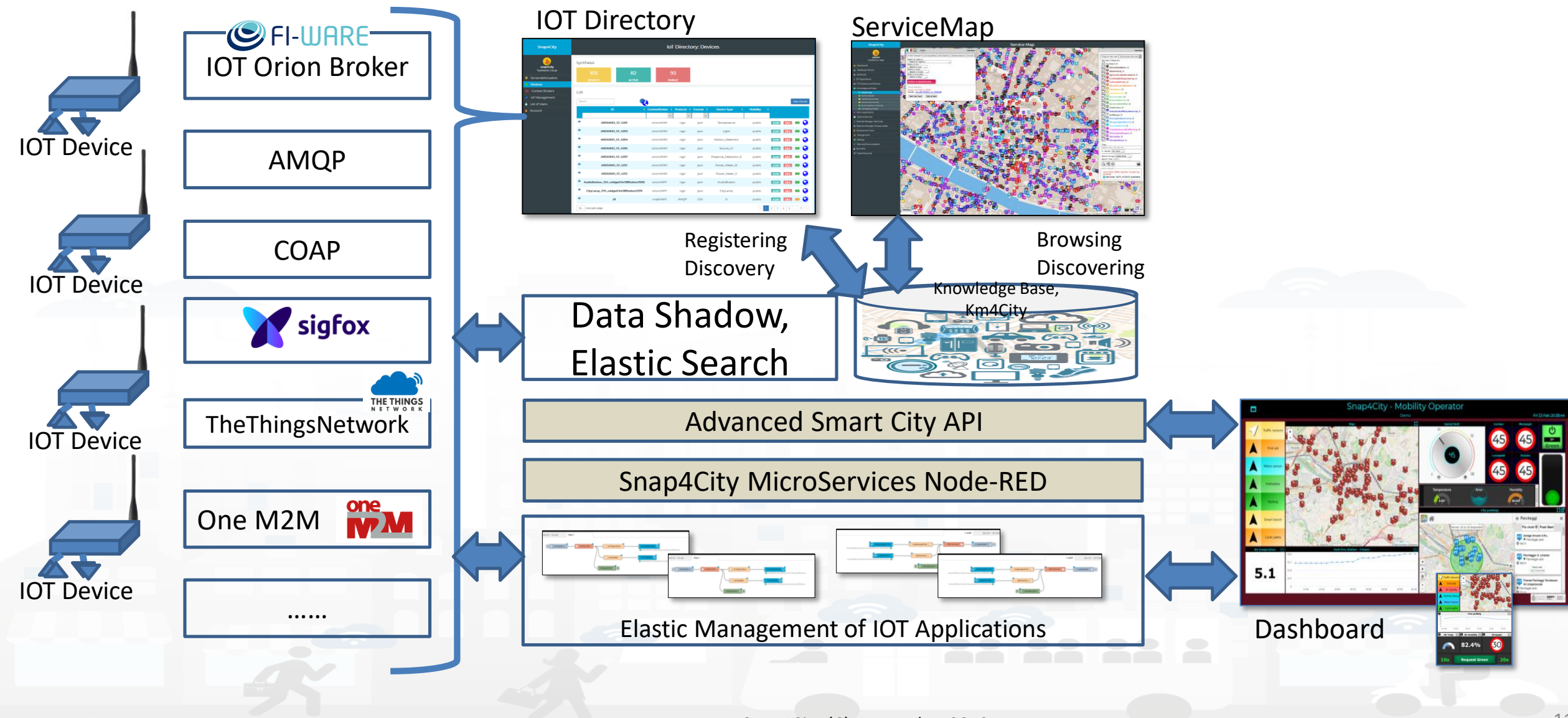
Data Ingestion Flow Guideline, thumb rules



IOT ingestion process

- The condition at which one may target is:
 - Using a registered IOT Broker on IOT Directory
 - one could call also non registered IOT Brokers directly from IOT App, but in this manner the sending of data to DataShadow has to be performed by the User/developer
 - Using IOT Devices, they have to be registered
 - One could even get data from a non registered device, for example calling it directly or setting a Gateway to send data in push to the IOT Application

IOT Architecture

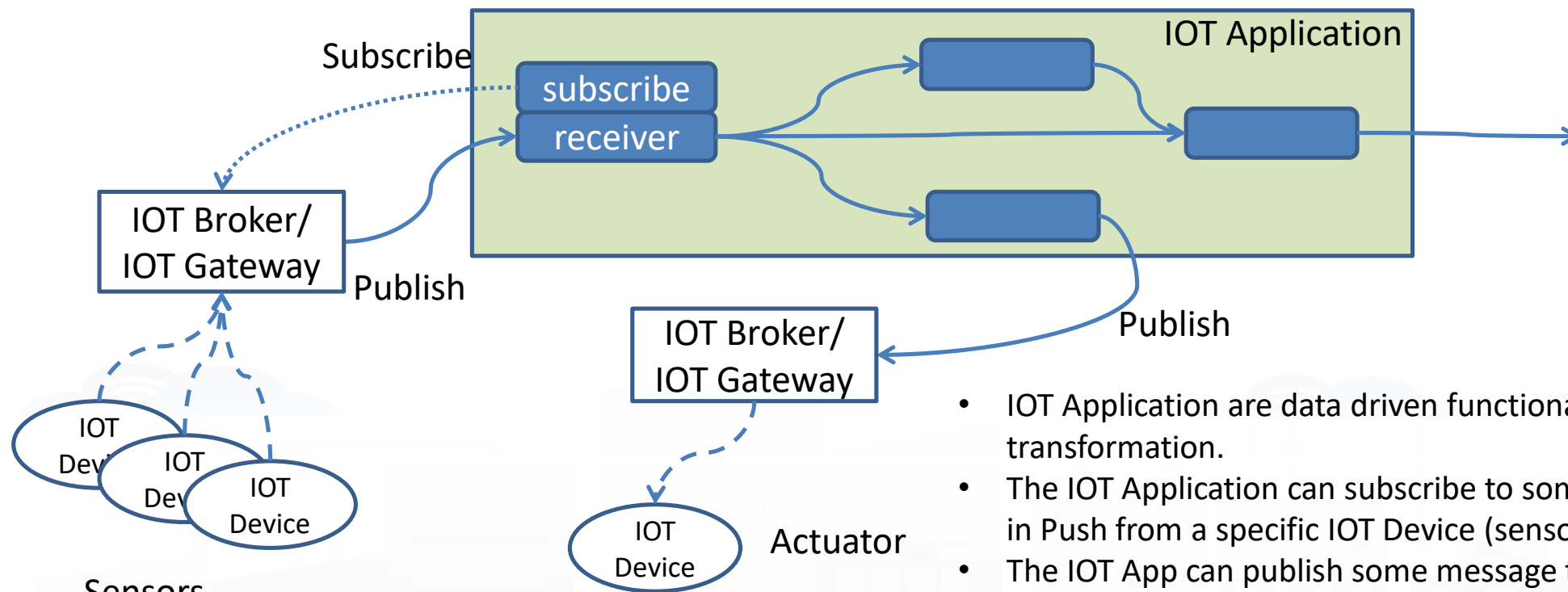


TOP

IOT Networks: recall of basic concepts



IOT Basic

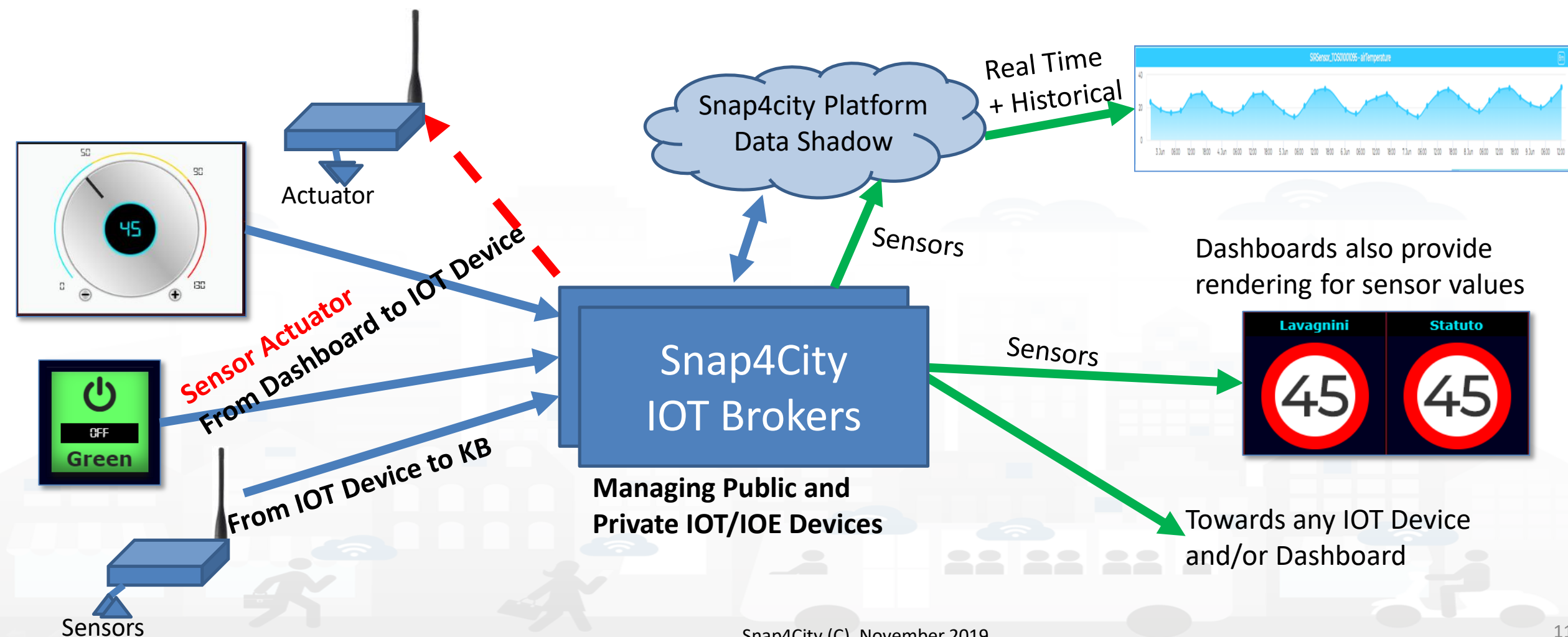


Sensors

- 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.

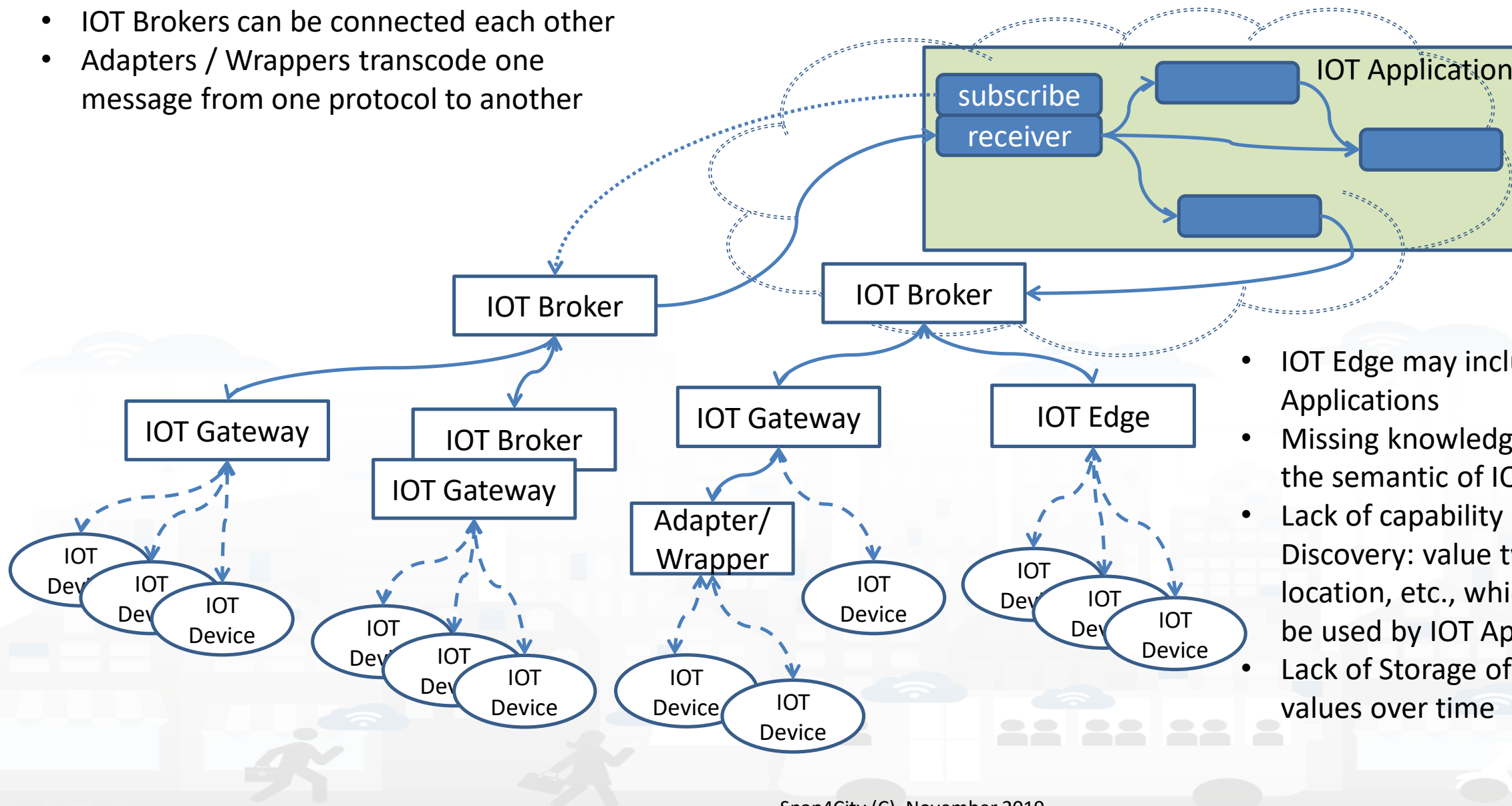
- IOT Application are data driven functional programs for data transformation.
- The IOT Application can subscribe to some IOT Brokers to receive data in Push from a specific IOT Device (sensor)
- The IOT App can publish some message toward some IOT Device (Actuator), passing via an IOT Broker.
- Continuous 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

IOT Data Driven



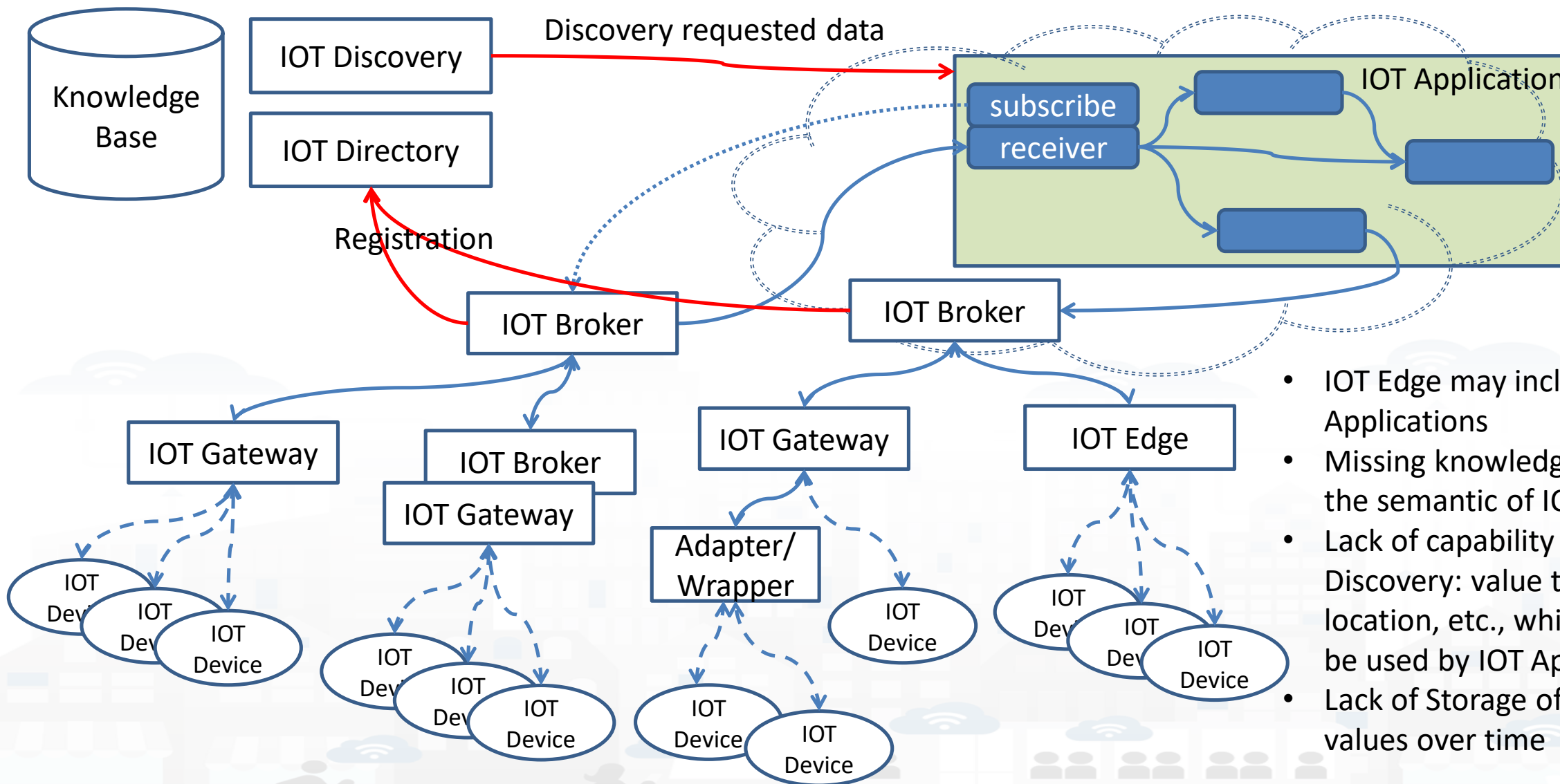
Definitions

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



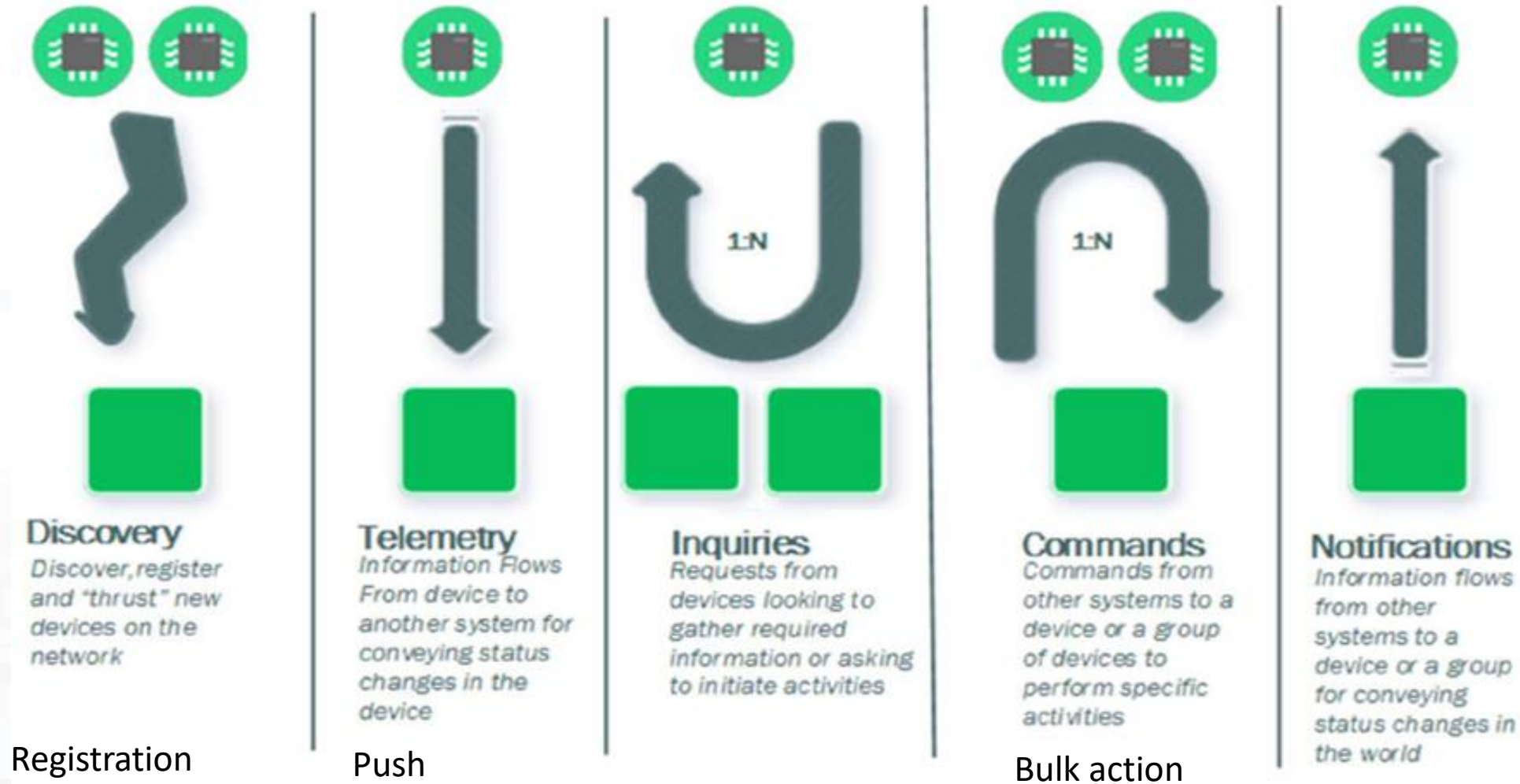
- IOT Edge may include IOT Applications
- Missing knowledge about the semantic of IOT devices
- Lack of capability for IOT Discovery: value type, location, etc., which could be used by IOT App
- Lack of Storage of data values over time

Definitions



- 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

Communication Patterns



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

Note on Communication patterns

- Not all Communication Patterns are supported by all Protocols
- 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,

TOP

IOT Directory



IOT Network Manager vs Final User

Network of IOT Brokers

IOT Directory

My IOT Device

IOT Network
Manager

Register

Registering

Discovering

Discovering

Final user
Manager

Knowledge Base,
Km4City

Browsing

ServiceMap
Knowledge Base

IOT Application

Knowledge and Storage
Data from the Field and
City

Dashboard Wizard

Main Features of the IOT Directory

- **Registers IOT Brokers**
 - Different kind of Brokers, different kinds of authentications and protocols
 - Registered IOT Orion Brokers can be queried for collecting their managed devices, so that those IOT Devices are registered
- **Registers IOT Devices:** singularly or at groups (in Bulk)
 - Registration can be custom or based on IOT Device Model
 - IOT Edge are registered as special IOT Devices
 - Registered IOT Devices are saved into local Data base and Knowledge Base
- **Provides support for security aspects:**
 - Generation of Certificates, Keys, etc.
 - Collection of keys when IOT devices are on some IOT Gateway or Second Level IOT Broker.
- **Manages Ownership and Delegation** for
 - IOT brokers, IOT devices, IOT Device Values

IOT Directory Features vs Users Roles

Entities	what	By using	Manager	AreaManager	ToolAdmin/RootAdmin
IOT Sensor/Actuator	Browse, use	Several Tools	X	X	X
	Delegate	IOT Directory	X	X	X
	Discovery	KB, API, MicroServices	X	X	X
IOT Devices	Browse, use	Several Tools	X	X	X
	Add/change/Delete	IOT Directory, API, ..	X	X	X
	Add in Bulk	IOT Directory, API, ..			X
	Delegate	IOT Directory	X	X	X
	Discovery	KB, API, MicroServices (MS)	X	X	X
IOT Device Model	use	IOT Directory	X	X	X
	create	IOT Directory		X	X
IOT Broker	Browse, use	IOT Directory	use	Browse, use	X
	Add/change/Delete	IOT Directory			X
	Delegate	IOT Directory			X
	Periodic Update	IOT Directory			X

Privacy vs IOT Directory features

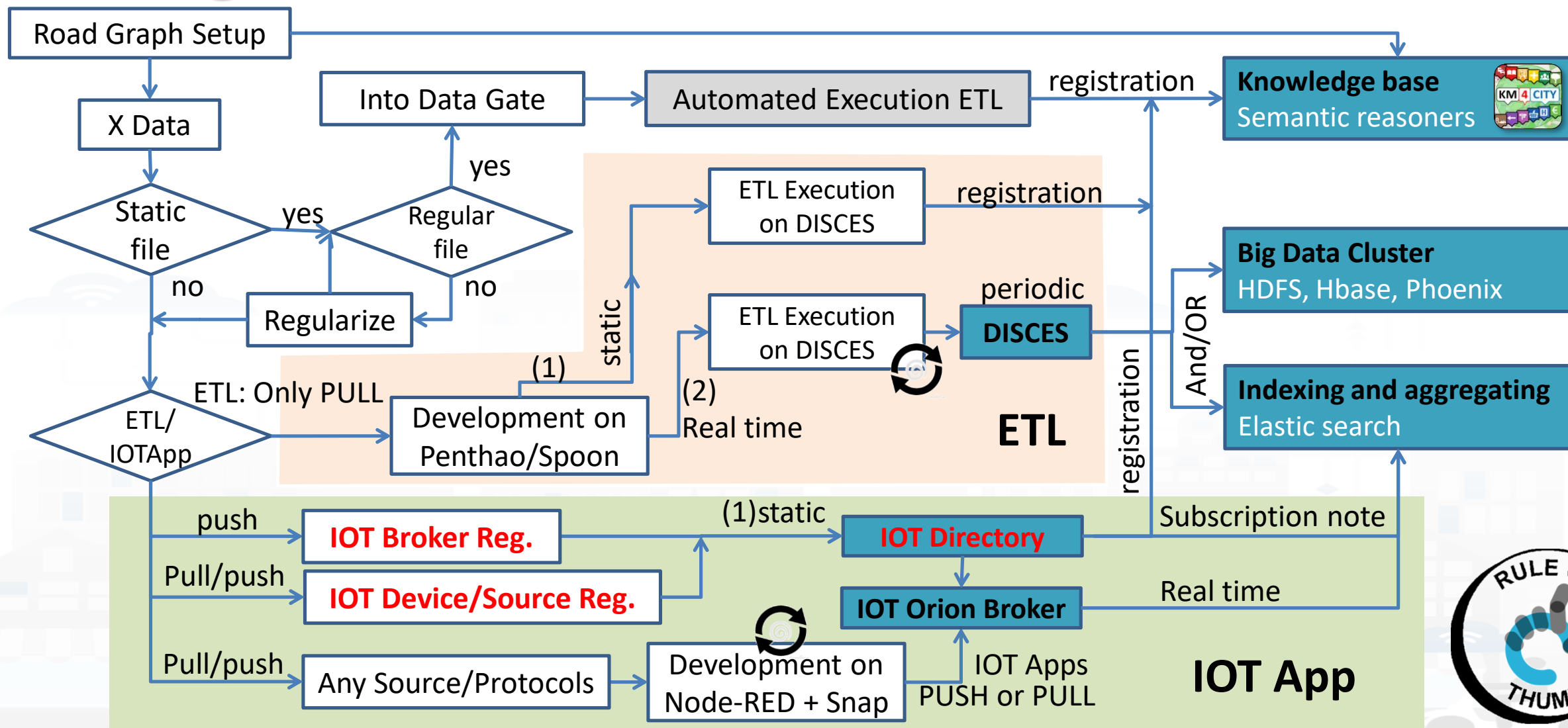
- In IOT Directory of Snap4City:
 - Each Sensor Value, IOT Device, IOT broker can be private or public
 - Private Entities
 - Are accessible only for the Owner in edit/change/delete
 - can be delegated in access to: single user, group, or to organizations

TOP

IOT Device and IOT Brokers Registration

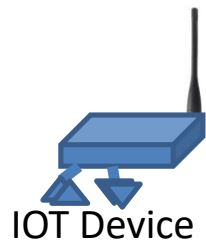


Data Ingestion Flow Guideline, thumb rules



In which case you are?

<https://www.snap4city.org/drupal/node/474>

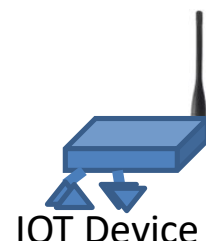


IOT Device

IOT Broker

SNAP4CITY

Case B2



IOT Device

IOT Broker

SNAP4CITY

Case B1

i) Registered IOT Broker
on Snap4City



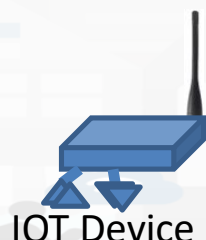
IOT Device

IOT Broker

SNAP4CITY

Case A1.2

a) Registered
IOT Device on Broker



IOT Device

IOT Broker

SNAP4CITY

Case A2

a) Registered
IOT Device on Broker

i) Registered IOT Broker on Snap
ii) Registered IOT Device on Snap

- A. Already registered on an IOT Broker** of your/city organization. In this case, who provided you the IOT Device may have provided also at least: an IOT Device Identifier, a description of the data produced by the Device, the protocol kind and the IOT Broker in which it is registered, etc. **For example:** device ID: es286481295, temperature and humidity, NGSI, the “orionFinland” IOT Broker on <https://ngsi.fvh.fi> or the “Antwerp” IOT Broker on <https://ext-api-gw-p.antwerpen.be>. **In order to** exploit the data of your IOT Device in the Platform, you
1. have an **IOT Device which is registered** on an **IOT Broker** (for example, you received with the IOT Device the name of the IOT Broker) that is registered to Snap4City. You have two cases:
 1. **the IOT Device has been **already registered** on Snap4City by the organization/city.** This case can be verified by using the steps described in:
 - See in this case: [HOW TO: verify if an IOT device is registered and accessible for me.](#)
 - if the IOT device is registered please note that you are in case A3, if not, go at case A1.2
 2. **the IOT Device is **not yet registered** on Snap4City** (for example when a IOT Broker is managed by a third organization for security aspects, for example the FHV or DIGIPOLIS, or IMEC, ...), they given to your the device to test on different platforms.
 - See in this case: [HOW TO: Add an IOT Device on Snap4City platform that is already registered on an external IOT Broker](#)
 3. need to access IOT Device data **without registering the IOT Device in the Snap4City platform and Broker**, you need to know some configuration parameter of the IOT Broker and IOT Device, and Snap4City IOT App can get data directly from the IOT broker of your device without the need of having the Broker officially registered on snap4City.
 - See in this case: [HOW TO: add IOT Device data source from external broker to the platform.](#)
 2. have an **IOT Device which is already registered to an internal Snap4City IOT Broker** (a IOT Broker managed by Snap4City for security aspects). In this case, the IOT Device and corresponding data are immediately accessible, and you can find them into the list of your data in the Data Inspector view, for Dashboards, etc., go in the Data Inspector to search your data by GPS location, name, nature as you like.
- B. Not registered to an IOT Broker.** In this case, you need to know, at least, how the IOT Device works and how it can be internally configured to communicate with an IOT Broker: to authenticate, register, etc. So that you need to know: an IOT Device Identifier, a description of the data produced by the device, the protocol, etc. For example: device ID: 286481295, temperature and humidity, [NGSI](#) with basic authentication,
1. **In this case**, the first step is to register the IOT Device to an IOT Broker. Snap4City offers you a number of **Snap4City IOT Brokers** compliant with different protocols to which you can connect your device. To this end, please follow this tutorial:
 - See in this case: [HOW TO: Add an IOT Device on Snap4City platform by registering it on an Internal Snap4City IOT Broker](#)
 2. in alternative you can find some other brokers in your area according to the protocol of your device.
 3. **Once registered the IOT Device to an IOT Broker please restart from case (A); if you registered with a Snap4City IOT Broker it will be easy an (A2).**

How to setup and IOT Data Stream

Managers/AreaManagers:

1. Register the IOT Broker you want to use.
 - If you do not have one, you can ask one to Snap4City
2. Register the IOT Device you want to use.
 - If it is only one Device to reg, you can do it manually,
 - if they are many, we suggest you to create an IOT Device Model, then register the device (only AreaManagers)
3. Use IT

Administrators:

1. Register the IOT Broker you want to use, or use one already registered.
 - If the IOT Orion Broker has IOT Devices registered in you can use the procedure for automated registration (from your Broker to the IOT Directory and KB), with rule for transformation, etc.
 - If not see points 2 and/or 3
2. Register a single IOT Device manually
3. Register a group of IOT Devices
 - create a IOT Device Model
 - Create a CVS file for Registering devices in Bulk
4. Use IT

Register IOT Broker

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
 - My IOT Devices
 - IOT Sensors and Actuators
 - IOT Devices
 - IOT Devices Management
- IOT Brokers**
 - IOT Device Models
 - IOT Devices Bulk Registration
 - IOT Broker Periodic Update setting
 - IOT Orion Broker Mapping Rules
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools

IOT Brokers

Show 10 entries

	IOT Broker	Access Link		Owner	Created	Edit	Delete
+	Antwerp	https://ext-api-gw-p.antwerpen.be/digipolis/aov		iotdirectory.antwerp	2019-03-13 14:57:17	EDIT	DELETE
+	Antwerp2	https://ext-api-gw-p.antwerpen.be/imec/smartz		iotdirectory.antwerp	2019-01-01	EDIT	DELETE
+	mqttUNIFI	192.168.1.10				DELETE	
+	mqttUNIMI	159.149.129.184				DELETE	
+	orionAntwerp-UNIFI	broker3.snap4city.org				DELETE	
+	orionFinland	https://ngsi.fvh.fi				DELETE	
+	orionHelsinki-UNIFI	broker2.snap4city.org				DELETE	
+	orionUNIFI	https://broker1.snap4city.org				DELETE	
+	orionUNIFIProxyHelsinki	https://www.snap4city.org/iot_ingestion/	ngsi	PRIVATE			
+	orionUNIMI	159.149.129.184	1026	ngsi	DELEGATED		

Showing 1 to 10 of 12 entries

Add new context broker

Info Geo-Position Security

Kind
Context Broker name is mandatory

IP
IP is mandatory

amqp
Protocol

Access Link

Private
Ownership

Name
Context Broker name is mandatory

Port
Port is mandatory

Version

Access Port

Add new context broker

Info Geo-Position Security

Latitude
Latitude is mandatory

Longitude
Longitude is mandatory

Cancel Confirm

Add IOT/IOE Devices

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

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

Create your own devices:

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

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

IOT Devices/Sensors

AreaManager | ldap

- Dashboards
- Notifier
- IOT Applications
- IOT Directory and Devices
 - IOT Sensors and Actuator
 - IOT Devices**
 - IOT Brokers
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Load
- Development Tools
- Management
 - Lente di ingr.
 - 100%
 - Visualizzazioni
- My Profile
- Snap4City portal

IOT Devices

Name	IOT Broker	Protocol	Format	Device Type	Ownership	Status	
+	ARDUINO_ST_4203	orionUNIMI	ngsi	json	Light	public	active EDIT DEL
+	ARDUINO_ST_4204	orionUNIMI	ngsi	json	Motion_Detection	public	active EDIT DEL
+	ARDUINO_ST_4205	orionUNIMI	ngsi	json	Sound_LV	public	active EDIT DEL
+	ARDUINO_ST_4207	orionUNIMI	ngsi	json	Presence_Detection_E	public	active EDIT DEL
+	ARDUINO_ST_4212	orionUNIMI	ngsi	json	Power_Meter_M	public	active EDIT DEL
+	ARDUINO_ST_4213	orionUNIMI	ngsi	json	Power_Meter_S	public	active EDIT DEL
+	AudioButton_254_widgetOnOffButton2930	orionUNIFI	ngsi	json	AudioButton	public	active EDIT DEL
+	CityLamp_274_widgetOnOffButton3379	orionUNIFI	ngsi	json	CityLamp	public	active EDIT DEL
+	fan02	mqttUNIFI	mqtt	csv	fancoil	public	active EDIT DEL
+	Impulset					public	active EDIT DEL

Search Device Location on Map

10 rows per page

Add new device

Info

IOT Broker

Position

Values

Name

custom

Type

Model

Producer

Mac Address

Public

0

Visibility

Frequency

KEY1

KEY 2

Cancel

Confirm

AreaManager | ldap

- Dashboards
- Notifier
- IOT Applications
- IOT Directory and Devices
 - IOT Sensors and Actuator**
 - IOT Devices
 - IOT Brokers
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Load
- Development Tools
- Management
 - Lente di ingr.
 - 100%
 - Visualizzazioni
- My Profile
- Snap4City portal

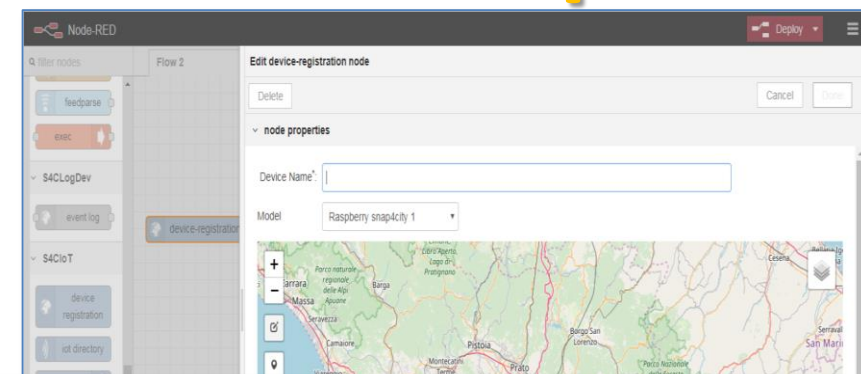
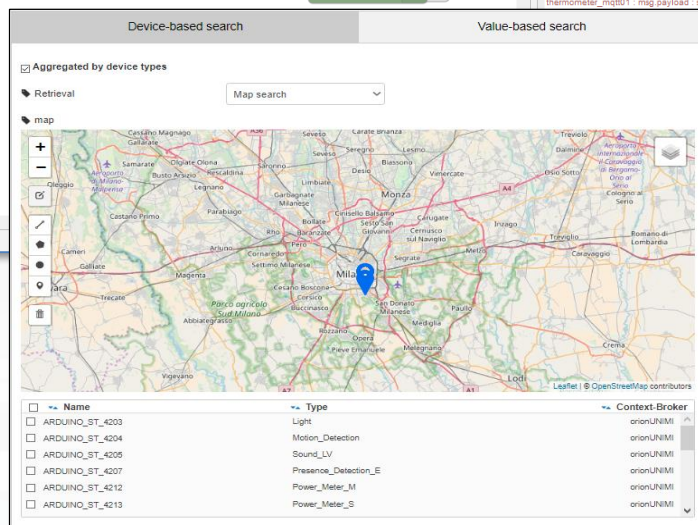
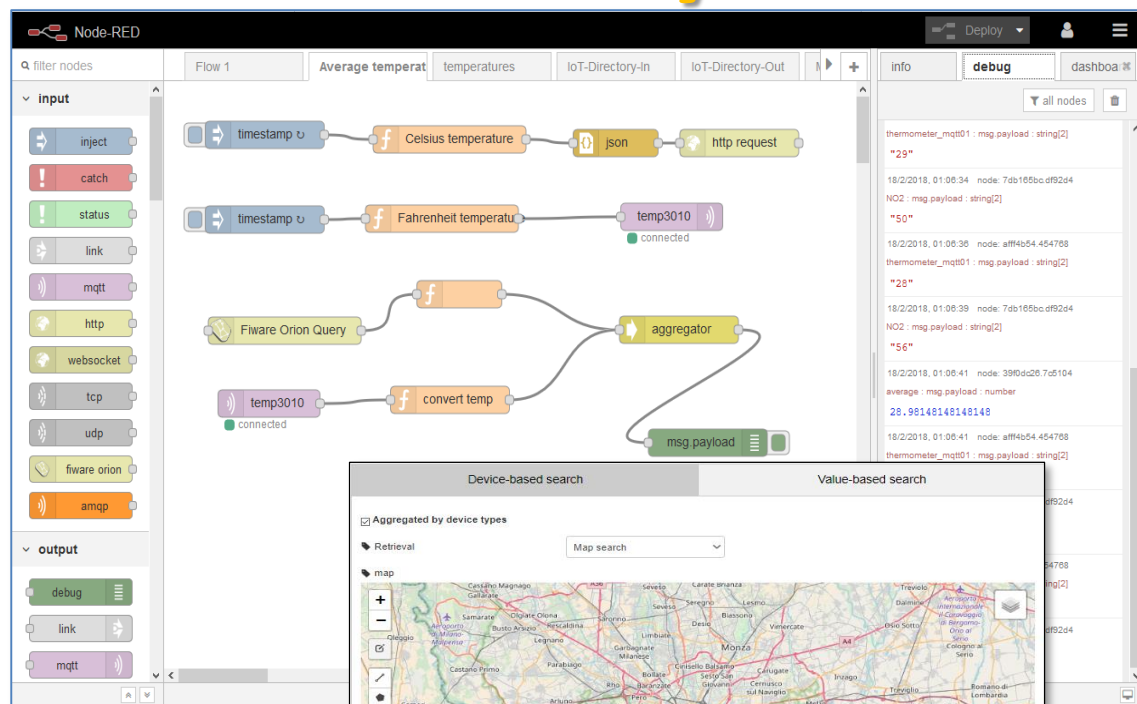
IOT Sensors and Actuators

IOT Broker	Device	Value Name	Value Type	Healthiness Criteria	Refresh Rate	Status	
+	orionUNIMI	ARDUINO_ST_4203	latitude	latitude	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4203	light	light	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4203	longitude	longitude	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4203	measure_units	-	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4203	timestamp	timestamp	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4204	latitude	latitude	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4204	longitude	longitude	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4204	measure_units	actuator_canceller	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4204	motion_detection	motion_detection	refresh_rate	300	active EDIT DEL
+	orionUNIMI	ARDUINO_ST_4204	timestamp	timestamp	refresh_rate	300	active EDIT DEL

Search Device Location on Map

10 rows per page

IOT Discovery on IOT Application Development



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!

Sensors/
Actuators

IOT Devices

IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI

Arduino,
Wi-Fi, NGSI

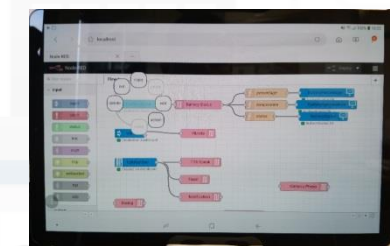
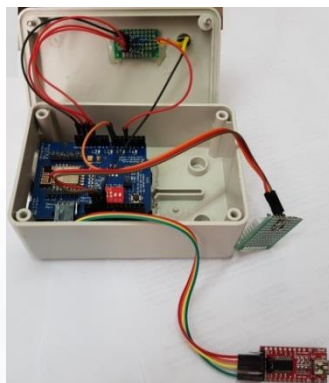
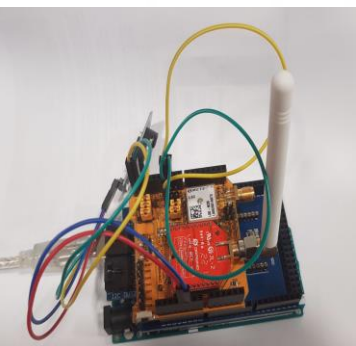
Snap4All
IOT Button
ESP, NGSI,
Wi-Fi, BT

Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

IOT Edge
NodeRED:
Raspberry Pi,
NGSI, WiFi,
RJ45,..

IOT Edge
NodeRED:
Android, LINUX,
Windows, ...

LoraWan
Gateway:
IOT Edge, NGSI,
WIFI, RJ45, GPS



Any Sensor / Actuator
Open to other protocols

Activities for IOT data ingestion

- **Registration of**
 - an IOT Device
 - a Set of IOT Devices with the same model: loading in Bulk
- The registration implies the **automated production of the model into the Knowledge Base**, which implies:
 - Activation of the DataShadow memory for historical data access
 - Activation of Discovery mechanisms
 - Activation of Dashboard Wizard

Further readings

- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)
- [HOW TO: add IOT Device data source from external broker to the platform.](#)
- [TC9.13: How to upload a local file into your IOT Application](#)
- [TC9.2. Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards](#)
- [TC2.25. Registering external MicroService calling RestCall services, using it on IOT applications](#)

- If you need more on IOT Applications, please see slides of Day 3
 - <https://www.snap4city.org/download/video/barc19/iot/>
- If you need more on Data Analytics, please see slides of Day 4
 - <https://www.snap4city.org/download/video/barc19/da/>

TOP

Data Ingestion via IOT Applications

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
CITY API
MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

DATA ANALYTICS,
BUSINESS
INTELLIGENCE,
WHAT-IF AND
SIMULATION

SNAP4CITY
ARCHITECTURE AND
ECOSYSTEM
FOR DEVELOPERS
AND STAKEHOLDERS

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

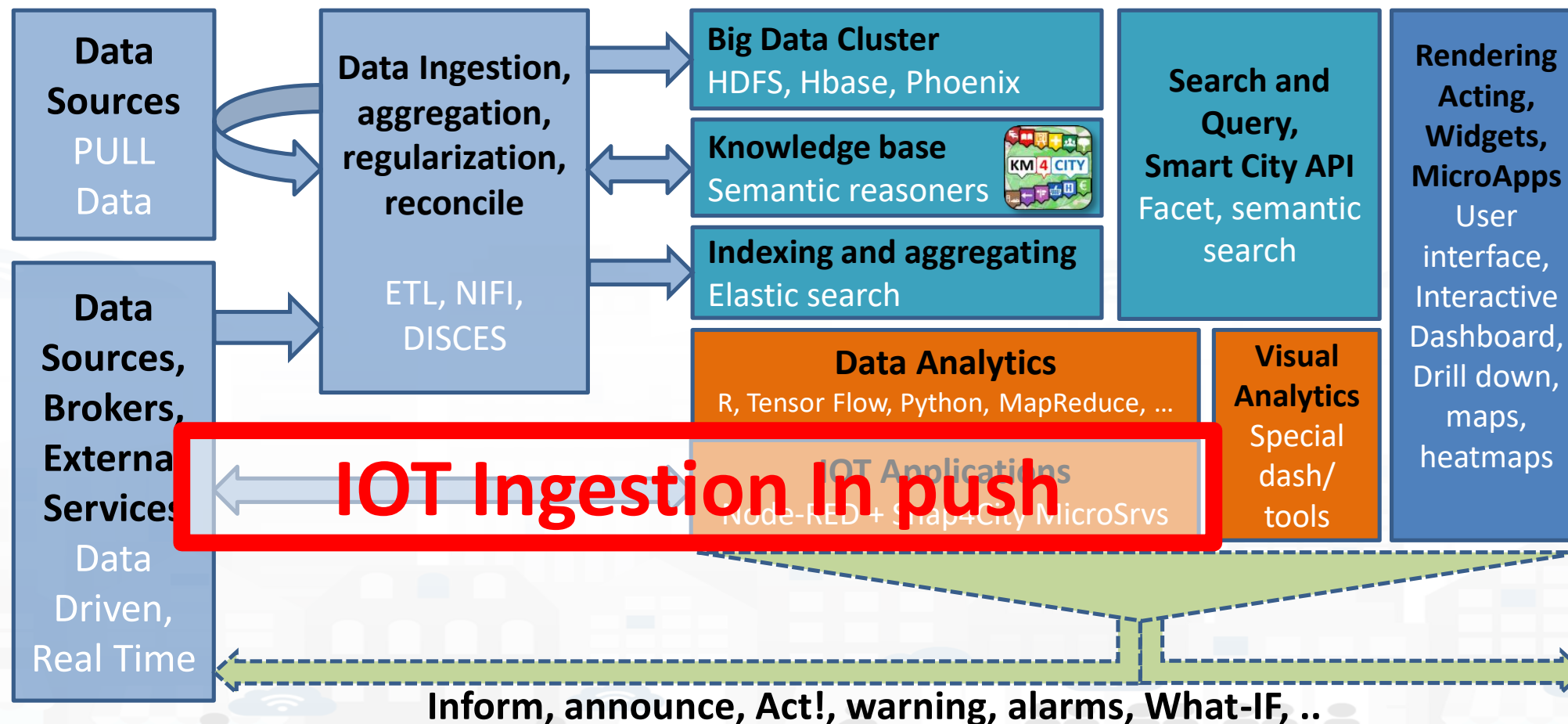
DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

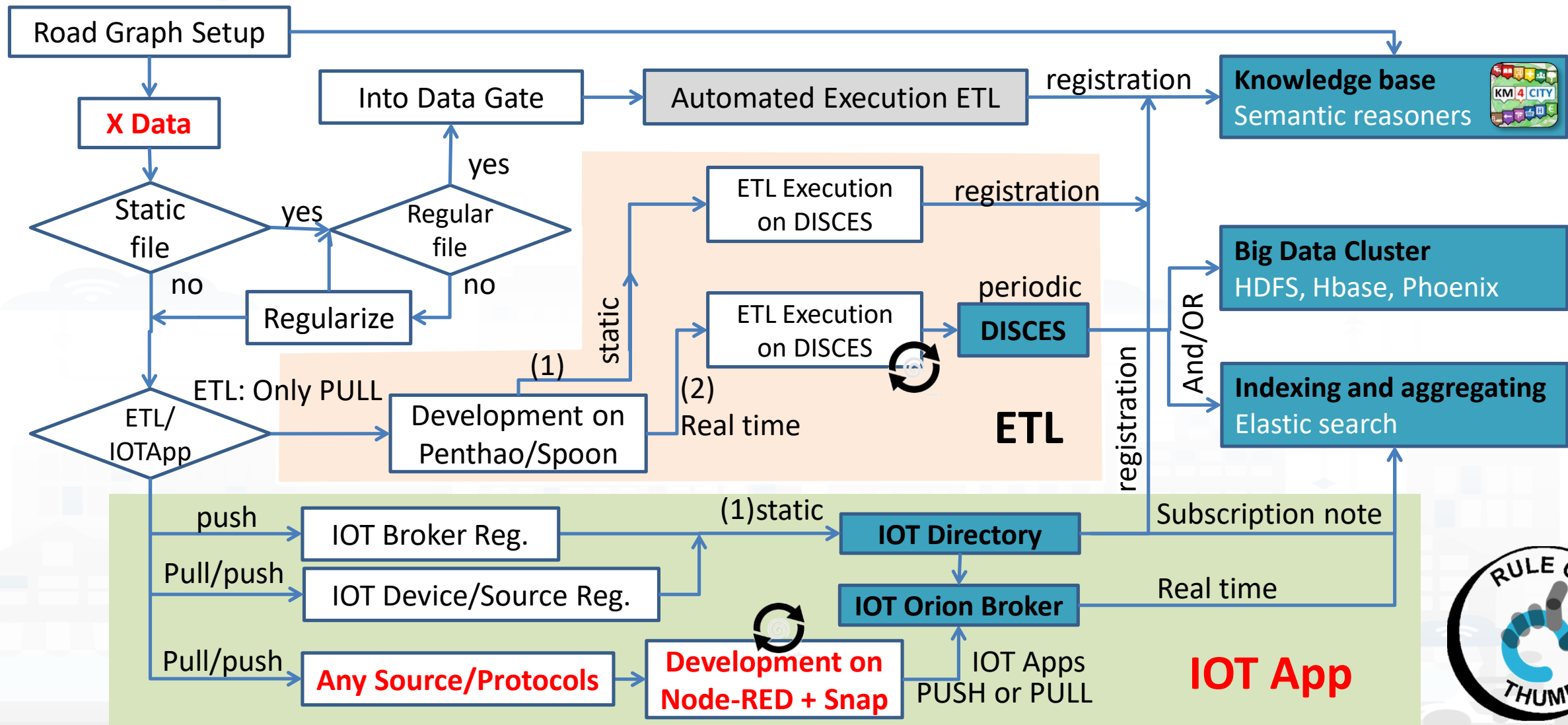
SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

Snap4City as a Lambda Architecture



Data Ingestion Flow Guideline, thumb rules



Snap4City: Builder of Sentient Cities Solutions

Dashboards with data driven IOT Applications enforcing intelligence

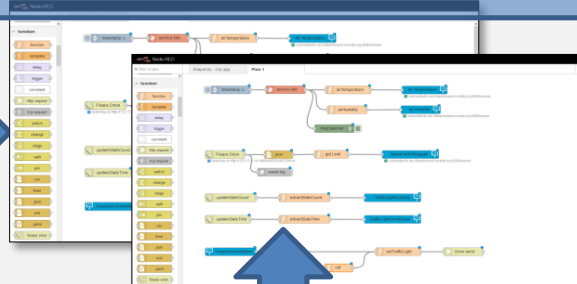
IOT and data World

IOT Applications

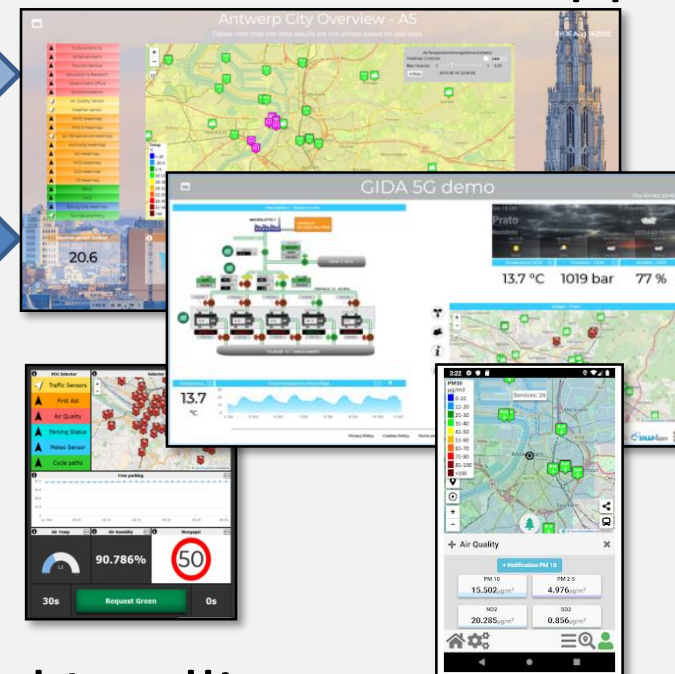
Dashboards and Apps



My IOT Devices



Big Data Analytics, Artificial Intelligence



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 - SliMobilityControlRoom

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



rootooladmin1
RootAdmin | Idap

- 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
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- My Profile
- Snap4City portal
- Km4City portal
- DISIT Lab portal

Node-RED

Deploy

filter nodes

flow1

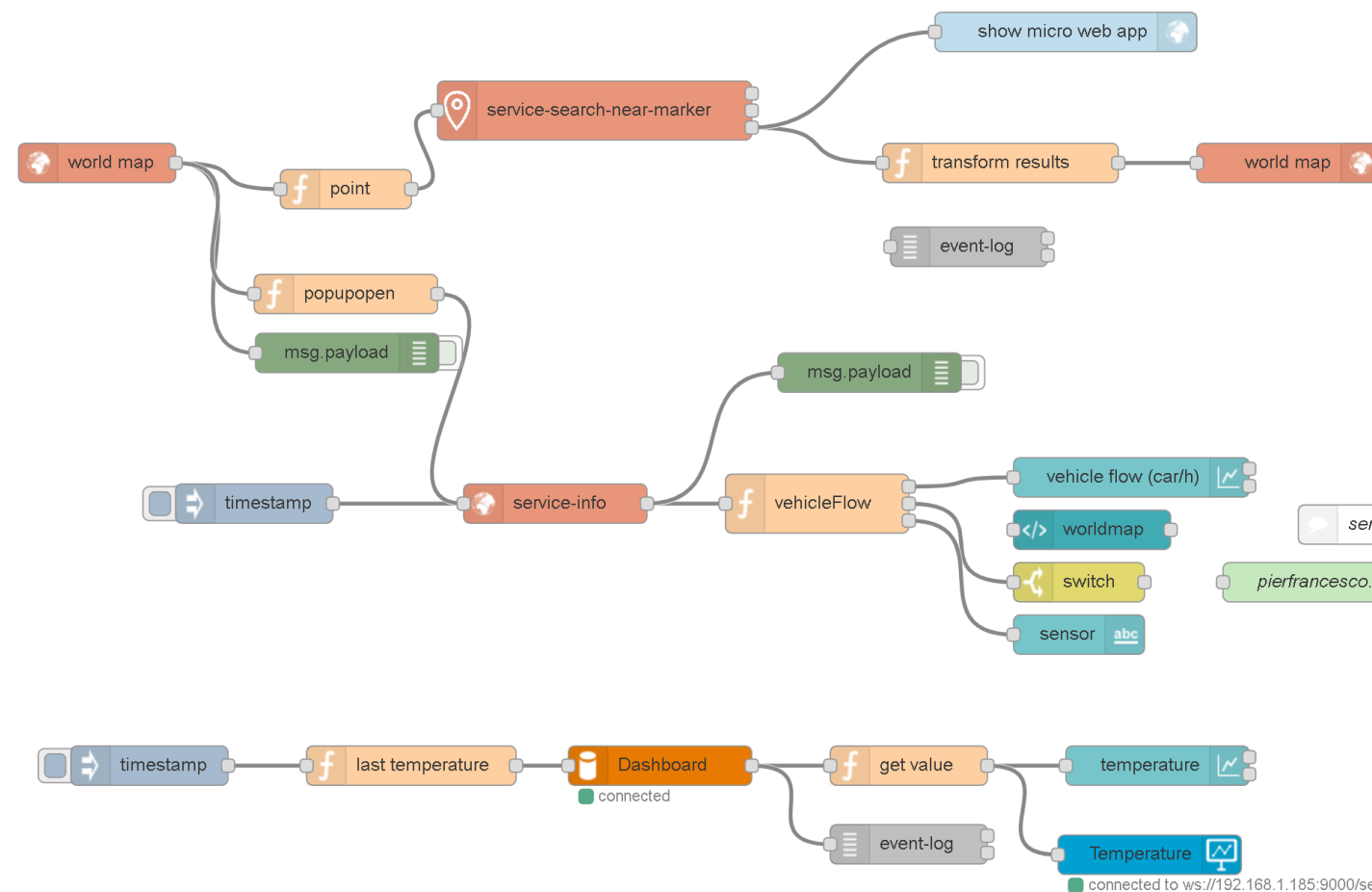
Flow 1

input

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

output

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



info debug dashb

Flow

Name	flow1
ID	"49a71aa0.b297b4"
Status	Enabled

Information

Search for nodes using

ctrl-f

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

Distributed Data Intelligence
Distributed Systems and In
Department of Information E
http://www



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

- input**: inject, catch, status, link, mqtt, http, websocket, tcp, udp, amqp, amqp2, stomp.
- output**: debug, link, mqtt, http response, websocket, tcp, udp, amqp, amqp2, stomp.
- function**: function, template, delay, trigger, comment, http request, tcp request, switch, change, range, split, join, csv, html, json, xml, yaml, soap request, base64, msgpack, random, rbe.
- social**: e mail, twitter, e mail, twitter.
- storage**: tail, file, ftp, mysql, file.
- analysis**: sentiment.
- advanced**: watch, feedparse, sunrise, exec.
- dashboard**: button, dropdown, switch, slider, numeric, text input, date picker, colour picker, form, text, gauge, chart, audio out, notification, ui control, template.
- lwm2m**: lwm2m client, lwm2m client.
- location**: turf, worldmap, worldmap, tracks.

+ on IOT Edge Raspberry

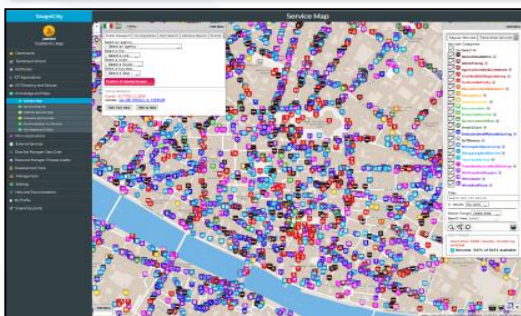
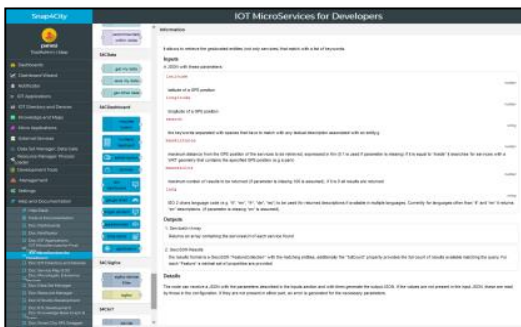
The screenshot displays the Node-RED block palette with the following categories and blocks:

- 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.

IOT Applications Development

IOT Discovering

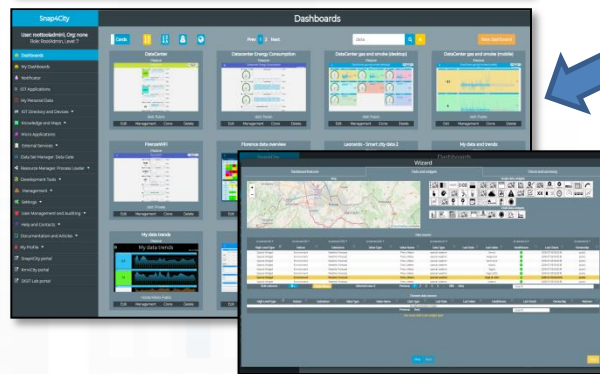
MicroServices collections



ServiceMap Discovery

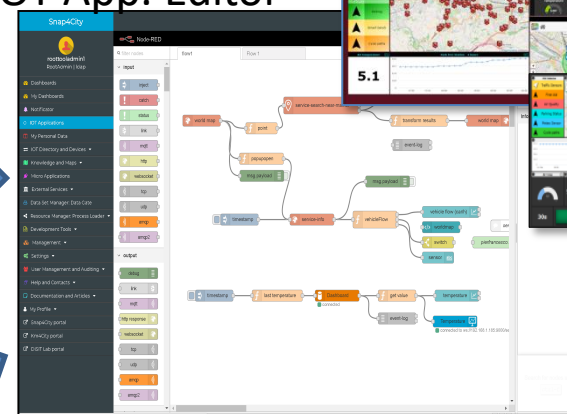
Knowledge Base, Km4City

My IOT Applications



Dashboard Collection,
Editor and Wizard

IOT App. Editor



Sharing/saving
reusing IOT App



Resource Manager

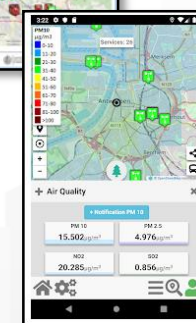
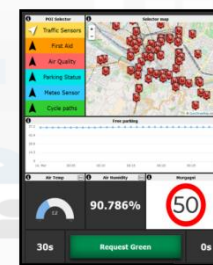
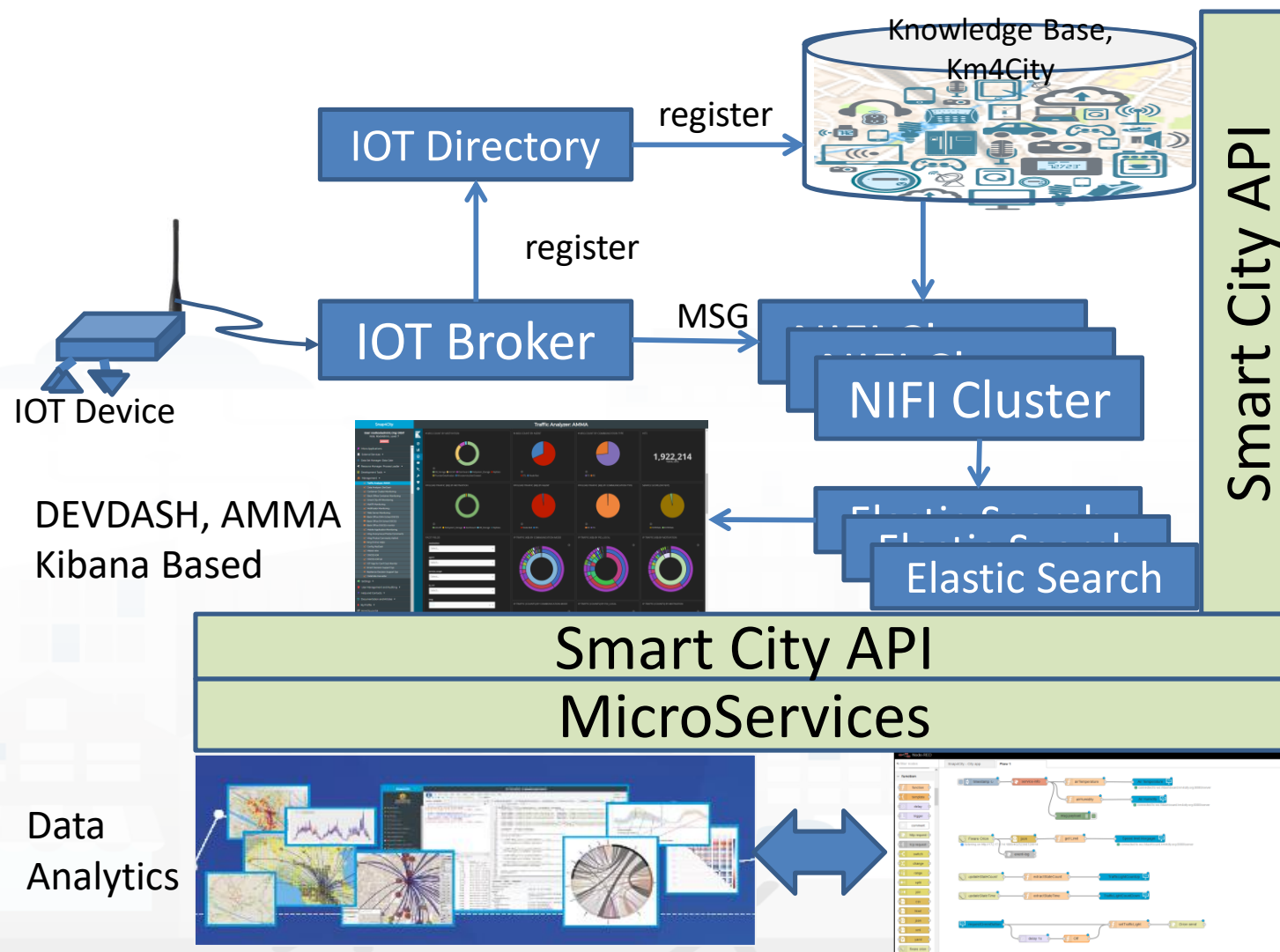
Generating IOT App
With Dashboard



From Data Ingestion toward DataShadow

- The main workflow for data ingestion via IOT Applications consists of a set of phases into the IOT flow:
 1. **Data/MSG collection** from some external services. This action can be done in PULL or PUSH depending on the protocol and by using several approaches
 2. **Data Transformation** if needed
 3. **Data Save** on Data Shadow by sending a Message to one of the registered IOT Orion Broker with the data in JSON format. Before sending the data, the corresponding IOT device with the same model has to be registered.
 1. Single and registration in BULK are possible.
 2. In alternative, the interrogation of an IOT Broker NGSI from the IOT Directory for the automated registration of IOT Devices which are already present in the IOT Broker is also possible.
- Snap4City provides a NIFI cluster that is registered to all the registered IOT Brokers (NGSI, MQTT, etc.) and thus any data/MSG entering in those Brokers is sent to NIFI that performs the reconciliation from dynamic and static data (exploiting the KB), and sent the information to the Elastic Search indexing and thus into the DataShadow.

From Data Ingestion towards DataShadow



Further readings

- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)
- [HOW TO: add IOT Device data source from external broker to the platform.](#)
- [TC9.13: How to upload a local file into your IOT Application](#)
- [TC9.2. Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards](#)
- [TC2.25. Registering external MicroService calling RestCall services, using it on IOT applications](#)

- If you need more on IOT Applications, please see slides of Day 3
 - <https://www.snap4city.org/download/video/barc19/iot/>
- If you need more on Data Analytics, please see slides of Day 4
 - <https://www.snap4city.org/download/video/barc19/da/>

TOP

Data Ingestion via API: External services, Custom MicroService

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GAT
AND CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
IMAGING OPEN
ANALYTICS
ANALYTICS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

IOT/EDGE DEVICES
AND NETWORKS

IOT/EDGE DEVICES
AND NETWORKS

ADVANCED
SMART CITY API,
MICROSERVICES
SNAP4CITY

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

DATA ANALYTICS
INTELLIGENCE,
WHAT-IF AND
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SNAP4CITY
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TO DEVELOPERS
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SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

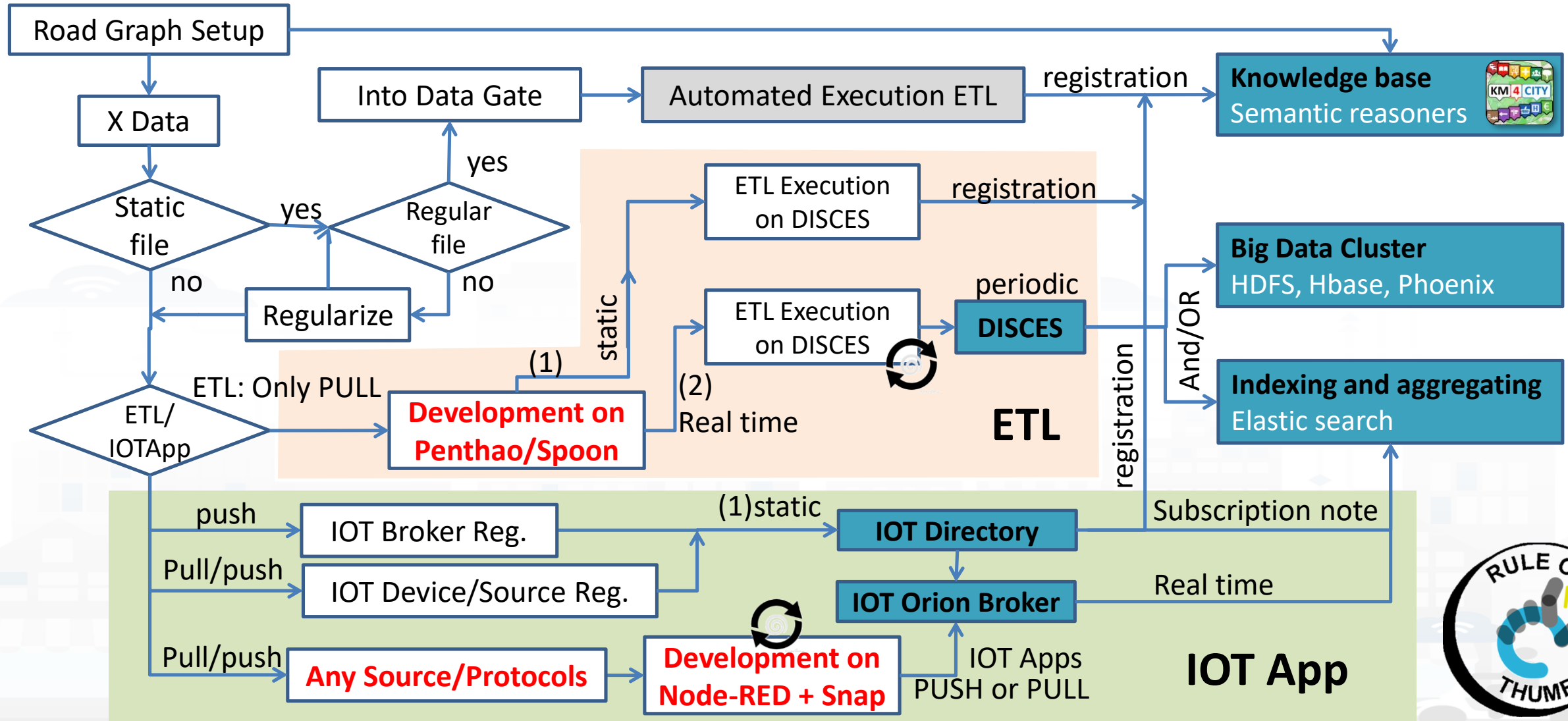
General solution, bring data from API to Dashboards

- The **simplest manner** is to create an IOT Application that exploits the REST API and in the IOT App you can decide to:
 - send data directly event driven in Dashboard using the **Snap4City Dashboard MicroServices**
 - send data on some registered **IOT Broker** registered on IOT Directory of Snap4City using IOT Orion Broker MicroService in the IOT Application, and this will post automatically on KB and Elastic Search (data shadow) etc. wizards and dashboards (please note that you need to have registered the device into the IOT Directory before)
 - send data on Snap4City **MyKPI MicroService**, and this will post make them available for wizards and dashboards (you need to have registered the MyKPI before)
- You can **save/consolidate your rest API** transforming it in a MicroService usable for many colleagues into IOT Applications:
 - TC2.25- Registering external MicroService calling RestCall services, using it on IOT applications
<https://www.snap4city.org/drupal/node/129>
- IF your REST API is going to use credentials as username and password, we suggest you to save them into MyPersonalData of Snap4City
 - so that the code will not provide clear credentials and you can update from user interface on your personal data profile.
 - The IOT App can retrieve the Username and Password at the moment in which they are used with the security shield of Snap4City

Alternative Solutions Using ETL

- You can use an ETL process to send data on (i) Hbase storage, or on (ii) DataShadow via some IOT Broker.
- The ETL can
 - send/save data on a registered **IOT Orion Broker** on IOT Directory as MSG. The MSG as IOT Device has to be registered.
 - Then you can send the MSG to the IOT Orion Broker, which will post the MSG automatically on KB and Elastic Search (data shadow) etc. etc. wizards and dashboards
 - use Snap4City API of **MyKPI to send their values (once registered the MyKPI)** and this will provide the values on storage wizards and dashboards
 - save data on Hbase/Phoenix for long term storage, if needed see specific section on these slides.

Data Ingestion Flow Guideline, thumb rules



TOP

Data Ingestion via Web Scrapping

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

IC APPLICATIONS
THE LOGIC AND
THE SMARTNESS

MAINTAINED
BY MICROSERVICES,
SNAP4CITY API

SNAP4CITY
LIVING LAB FOR
COLLABORATIVE
WORK

SNAP4CITY FOR
BEGINNERS

DATA ANALYTICS,
BUSINESS
INTELLIGENCE,
WHAT-IF AND
SIMULATION

SNAP4CITY
ARCHITECTURE AND
SYSTEMS
FOR DEVELOPERS
AND STAKEHOLDERS

TWITTER
VIGILANCE: SOCIAL
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DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

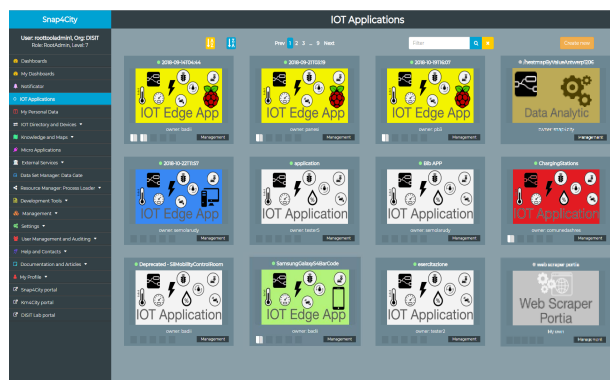
SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

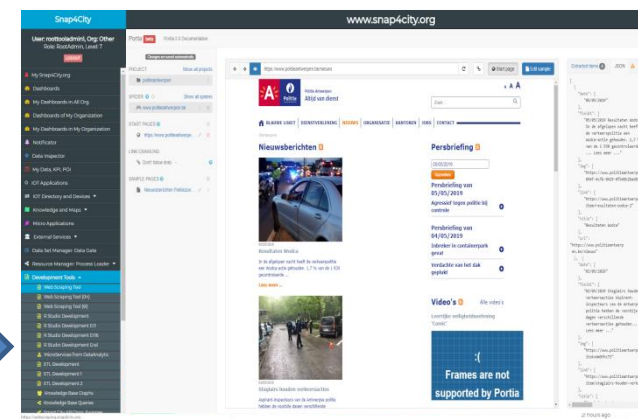


Web Scraping

My Scraping process



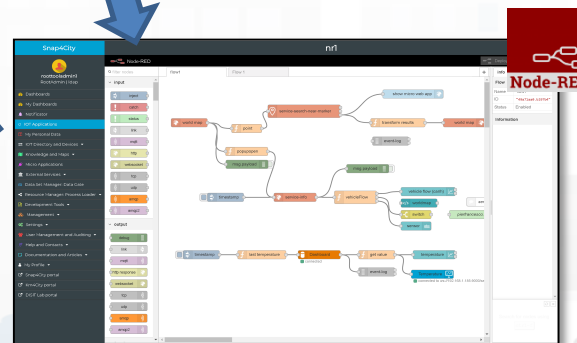
Web Scraper PORTIA



Generating
WEB Scraping



Knowledge Base, Km4City



IOT App. Editor

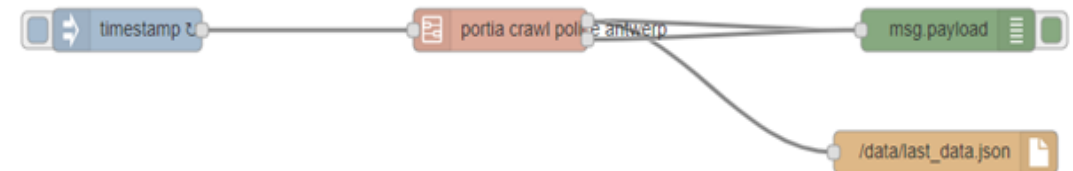
Sharing/saving
reusing Scraping



Resource Manager



Web scraping



- TC9.16 – Web Scrapping to get data from web pages

Web Scrapping

SNAP4CITY



Snap4City

User: roottooladmin!, Org: Other
Role: RootAdmin, Level: 7
LOGOUT

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notifier
- Data Inspector
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools**
 - Web Scrapping Tool
 - Web Scrapping Tool (0n)
 - Web Scrapping Tool (6l)
 - R Studio Development
 - R Studio Development 0.11
 - R Studio Development 0.116
 - R Studio Development Gral
 - MicroServices from DataAnalytic
 - ETL Development
 - ETL Development 1
 - ETL Development 2
 - Knowledge Base Graphs
 - Knowledge Base Queries
 - Smart City API Docs: Swagger

Portia **beta** Portia 2.0 Documentation

Changes are saved automatically

PROJECT **Show all projects**

politeantwerpen

SPIDER **Show all spiders**

www.politeantwerpen.be

START PAGES **Show all start pages**

https://www.politeantwerpen.be

LINK CRAWLING

Don't follow links

SAMPLE PAGES **Show all sample pages**

Nieuwsberichten Politezon

https://www.politeantwerpen.be/nieuws

Polite Antwerpen
Altijd van dienst

BLAUWE LOKET | DIENSTVERLENING | **NIEUWS** | ORGANISATIE | KANTOREN | JOBS | CONTACT

Startpagina

Nieuwsberichten

05/05/2019
Resultaten Wodca

In de afgelopen nacht heeft de verkeerspolitie een Wodca-actie gehouden. 1,7 % van de 1 930 gecontroleerde ...
Lees meer ...

03/05/2019
Stagiairs houden verkeersacties

Aspirant-inspecteurs van de Antwerpse politie hebben de voorbije dagen verschillende ...

Persbriefing

05/05/2019
Oproepen

Persbriefing van 05/05/2019

Agressief tegen politie bij controle

Persbriefing van 04/05/2019

Inbreker in containerpark gevat

Verdachte van het dak geplukt

Video's Alle video's

Leerrijke veiligheidsopleiding 'Comic'

Frames are not supported by Portia

Extracted items JSON

```
[
  {
    "date": [
      "05/05/2019"
    ],
    "title": [
      "Resultaten Wodca"
    ],
    "img": [
      "https://www.politeantwerpen.be/894f-4cfb-8419-8f046b2bad65.jp"
    ],
    "link": [
      "https://www.politeantwerpen.be/item/resultaten-wodca-2"
    ],
    "title": [
      "Resultaten Wodca"
    ],
    "url": [
      "https://www.politeantwerpen.be/nieuws"
    ]
  },
  {
    "date": [
      "03/05/2019"
    ],
    "title": [
      "Stagiairs houden"
    ],
    "img": [
      "https://www.politeantwerpen.be/894f-4cfb-8419-8f046b2bad65.jp"
    ],
    "link": [
      "https://www.politeantwerpen.be/item/stagiairs-houden"
    ],
    "title": [
      "Stagiairs houden"
    ],
    "url": [
      "https://www.politeantwerpen.be/nieuws"
    ]
  }
]
```

portia crawl police antwerp

Snap4City

User: roottooladmin!, Org: Other
Role: RootAdmin, Level: 7
LOGOUT

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
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- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services

portia-crawler-police-antwerp

Node-RED

Flow 1

```
graph LR
    timestamp[timestamp] --> portia[portia crawl police antwerp]
    portia --> msg[msg payload]
    portia --> last_data[last_data.json]
    portia --> http[http]
    last_data --> json[json]
    json --> http
```


TOP

Data Streams from Smart City API, participatory

FROM CITY
DASHBOARD TO
APPLICATIONS

FORGING &
MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

DATA GATHERING
AND CITY DATA
KNOWLEDGE
MANAGEMENT

IOT/IOE DEVICES
AND NETWORKS

IOT APPLICATION
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
FOR PARTNERS
AND TAKEHOLDERS

DATA ANALYTICS,
BUSINESS
INTELLIGENCE,
WHAT-IF AND
PREDICTIONS

TWITTER
VIGILANCE: SOCIAL
MEDIA ANALYSIS

HOW TO ADOPT
SNAP4CITY, AND
OUR ROADMAP

SNAP4CITY
AND KM4CITY
PROJECTS

SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

- We intend in this cases the data that can be posted on the infrastructure by using the Smart City API, such as:
 - MyPersonalData, MyKPI, data from IOT App on mobile, etc.
 - please see slides of Day 7
- Next section discusses those that are automatically collected from Mobile Phone and sent to the infrastructure on cloud via the Smart City API. For example:
 - Clicks on App
 - Post of images on POI
 - Post of comments on POI
 - Post of raking on POI
 - Questionnaires, and reactions
 - Trajectories taken from the mobile phone positions and clicks
 - OBD2 data and positions
 - Etc.

TOP

Data Streams from Mobile Devices

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 APPLICATION, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

SNAP4CITY ARCHITECTURE AND ECOSYSTEM, RESEARCH, DEVELOPMENT AND STAKEHOLDERS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

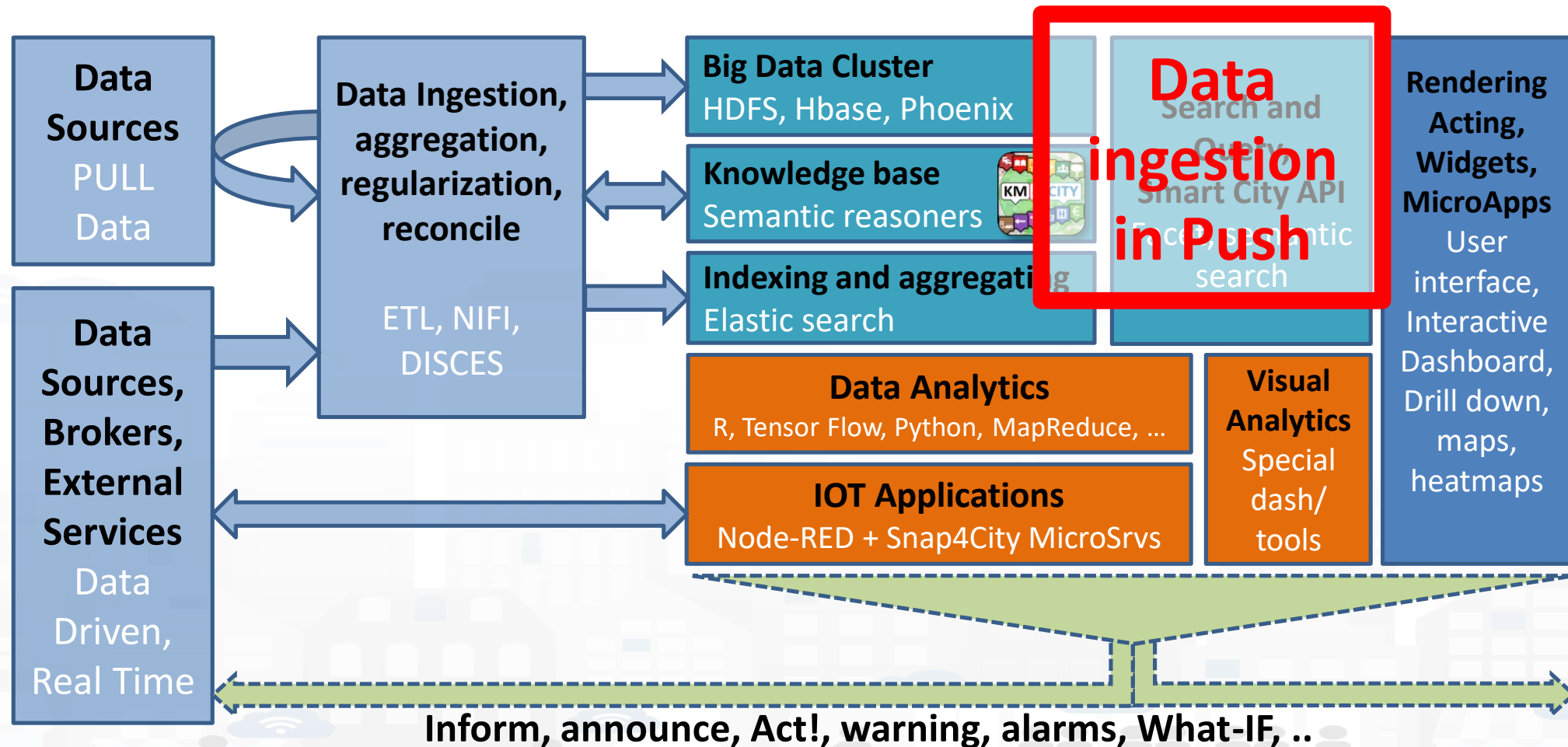
TWITTER VIGILANCE, SOCIAL MEDIA ANALYSIS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY AND KM4CITY PROJECTS

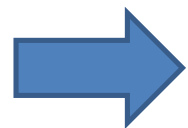
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

Snap4City as a Lambda Architecture



The App is a Bidirectional Device

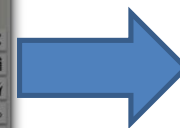
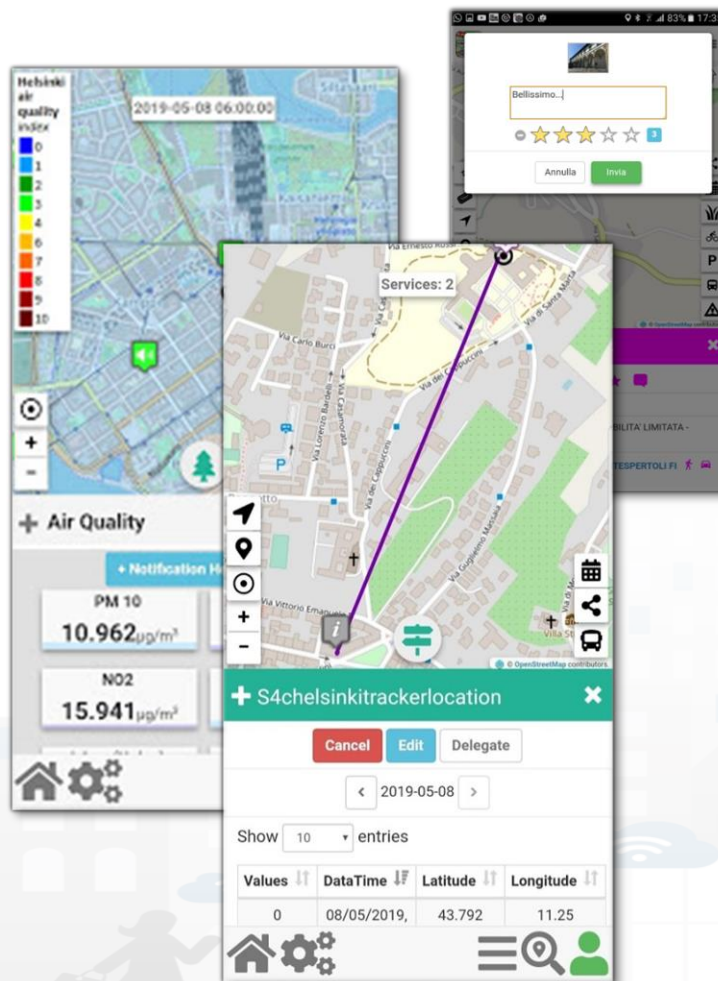
- GPS Positions
- Selections on menus
- Views of POI
- Access to Dashboards
- searched information
- Routing
- Ranks, votes
- Comments
- Images
- Subscriptions to notifications
-



Produced information

- Accepted ?
- Performed ?
- ...

Users



Derived information

- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- Requested information
- Routing performed
-

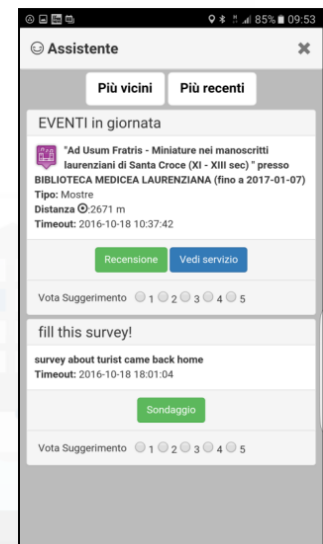
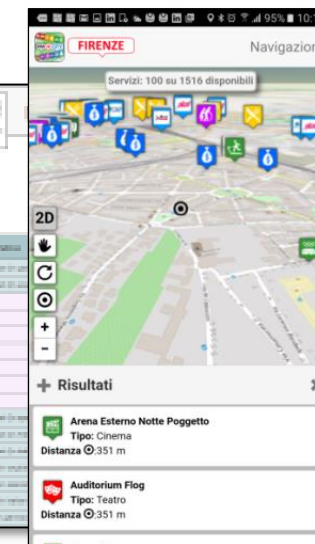
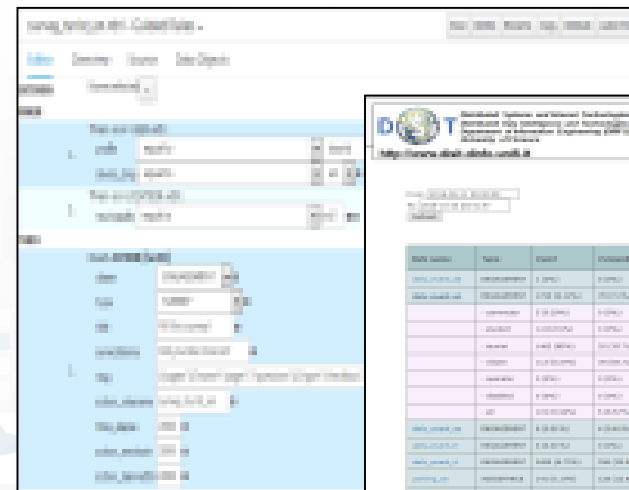
Produced information

- Suggestions
- Engagements
- Notifications
- ...

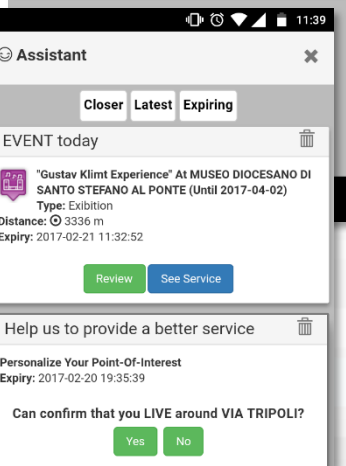
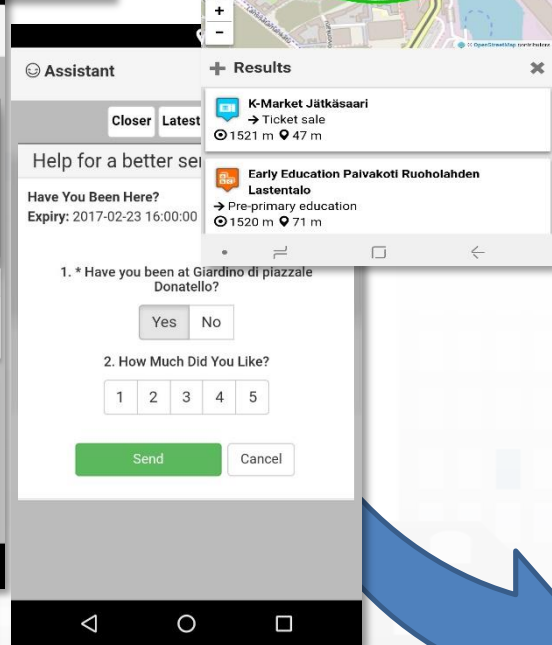
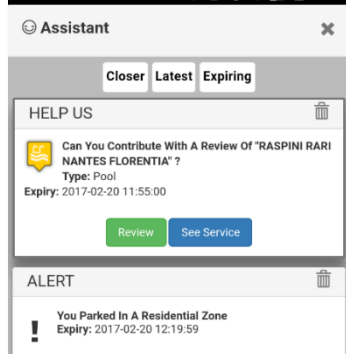
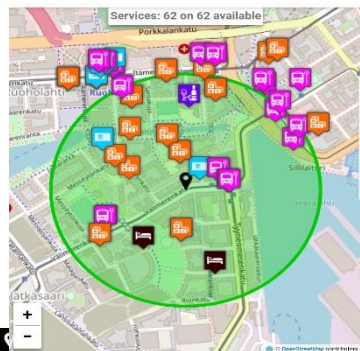
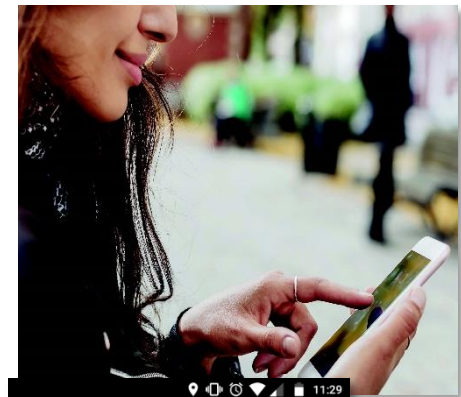
System

Profiled Engagements to City Users

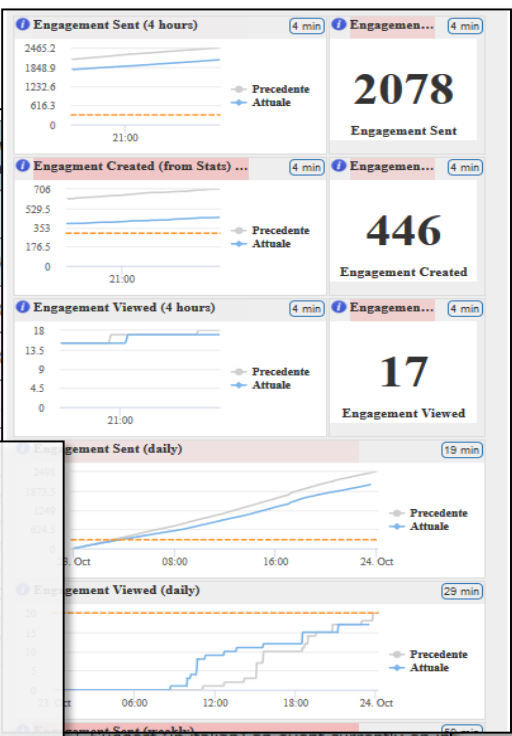
- The users are profiled to learn habits:
 - Personal POI, paths, Mobility habits
- Information and engagements sent to the users are programmed according to the context and user behavior to:
 - Stimulate virtuous habits
 - More sustainable habits
 - More healthy habits, etc.
 - Get feedbacks
 - Provide bonus and prices,
 - Send alerts,



Users' Engagement



Rule name	Type	#sent	#viewed	#viewed / #sent
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%
- commuter		5 (0.29%)	0 (0%)	0 (0%)
- student		14 (0.81%)	0 (0%)	0 (0%)
- tourist		1462 (85%)	25 (35.71%)	25 (17.2%)



Inform

- Air Quality forecast is not very nice
- You have parked out of your residential parking zone
- The Road cleaning is this night
- The waste in S.Andreas Road is full

Engage

- Provide a comment, a score, etc.

Stimulate / recommend

- Events in the city, services you may be interested, etc..

Provide Bonus, rewards if needed

- you get a bonus since you parked here
- We suggest: leave the car out of the city, this bonus can be used to by a bus ticket

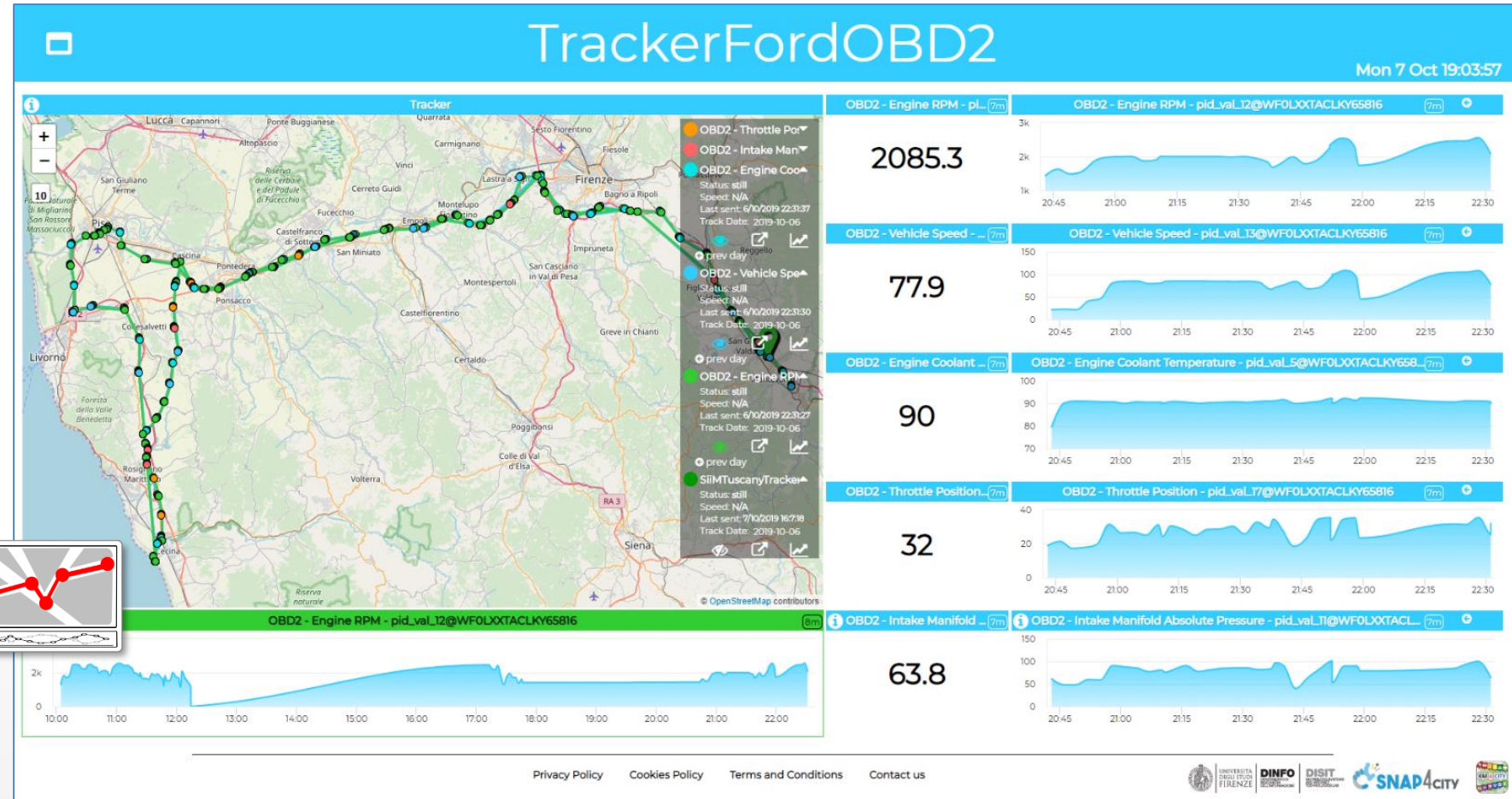


User
context

City
context

MyKPI: Tracking of Devices and Mobiles

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



Apps



OBU



Mobile
PAX Counter



OBD2

Load and change data via Smart City API

- Data regarding Mobile Phones:
 - Clicks on App
 - Post of images on POI
 - Post of comments on POI
 - Post of raking on POI
 - Questionnaires, and reactions
 - Trajectories taken from the mobile phone positions and clicks
 - OBD2 data and positions
 - etc.
- They are automatically collected and can be inspected by the user via special tools as presented in the following.

My KPI data view and manipulation

Snap4City

User: paolo.tos2, Org: Toscana
Role: Manager, Level: 2
[Logout](#)

- My Snap4City.org
- Dashboards (Public)
- Dashboards of My Organization
- My Dashboards in My Organization
- 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
- Help and Contacts
- Documentation and Articles
- My Profile
- Km4City portal
- DISIT Lab portal

My Data, KPI, POI

10 ☐ My ☐ Organization ☐ Delegated ☐ Public [Add My KPI](#) [Add My POI](#) [Add My Data](#)

No. +	High Level Type	Nature	Sub Nature	Value Name	Value Type	Data Type	Last Date	Last Value	Ownership	Username	Controls	Data	Visibility
17056991	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Throttle Position	pid_val_17@WBA3A11000J283814	percentage	5/10/2019, 15:36:03	15.25	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056990	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_val_13@WBA3A11000J283814	integer	5/10/2019, 15:36:02	10.75	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056989	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Engine RPM	pid_val_12@WBA3A11000J283814	integer	5/10/2019, 15:36:01	1168	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056582	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Run Time Since Engine Start	pid_val_31@50:8C:B1:63:C4:57	integer	15/8/2019, 16:33:49	2818.0476190476193	public	paolo.tos2	VIEW MAKE PRIVATE EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056581	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Vehicle Speed	pid_val_13@50:8C:B1:63:C4:57	integer	15/8/2019, 16:33:47	18.714285714285715	public	paolo.tos2	VIEW MAKE PRIVATE EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056580	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Engine RPM	pid_val_12@50:8C:B1:63:C4:57	integer	15/8/2019, 16:33:46	1420.3809523809523	public	paolo.tos2	VIEW MAKE PRIVATE EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056579	MyKPI	TransferServiceAndRenting	SensorSite	OBD2 - Intake Air Temperature	pid_val_15@50:8C:B1:63:C4:57	integer	15/8/2019, 16:33:48	36.333333333333336	public	paolo.tos2	VIEW MAKE PRIVATE EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056359	MyKPI	UtilitiesAndSupply	Agents	SiimTuscanyAppUsage	App Usage Information Saved From The App	string	11/10/2019, 13:50:09	EcoGuidaNew	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056358	MyKPI	UtilitiesAndSupply	Agents	SiimTuscanyTrackerLocation	GPS Information Saved From The App	float	15/10/2019, 12:19:21	0	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP
17056261	MyKPI	Accommodation	Agritourism	Numero Camere Libere	Singolo valore	integer	28/7/2019, 22:43:50	75	private	paolo.tos2	VIEW MAKE PUBLIC EDIT DELETE	VALUES METADATA	DELEGATE USERS CHANGE OWNERSHIP

Showing 1 to 10 of 12 My KPI Data

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

Further reading on MyKPI

- [TC1.17. Object tracking, widget tracker, personal tracking/trajectories, moving sensors](#)
- [TC 2.35- How manage My KPI with Dashboard](#)
- [Solution: using PAX Counters, monitoring museum and events](#)
- [HOW TO: define privacy rules for personal data, produced by the end-users own device](#)
- [TC9.13: How to upload a local file into the platform \(IoT Application and MyKPI\)](#)

TOP

Data Streams from Dashboards

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

APPLICATIONS THE LOGIC AND THE SMARTNESS

ADVANCED SERVICES, AP, MICROSERVICES, SNAP4CITY API

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SNAP4CITY THE VIEW OF THE ADMINISTRATORS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

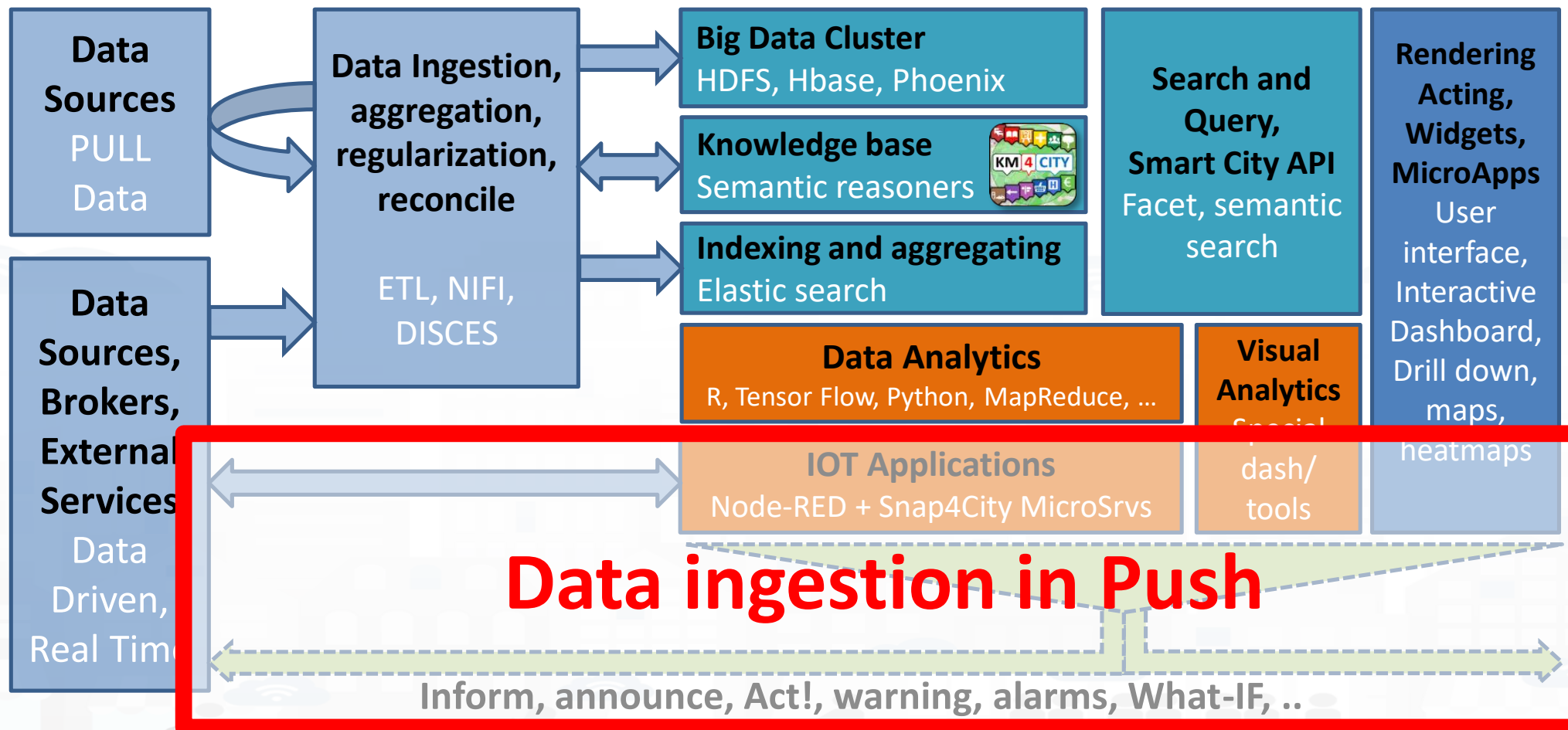
DISIT
DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB



SNAP4CITY



Snap4City as a Lambda Architecture



Snap4City: Builder of Sentient Cities Solutions

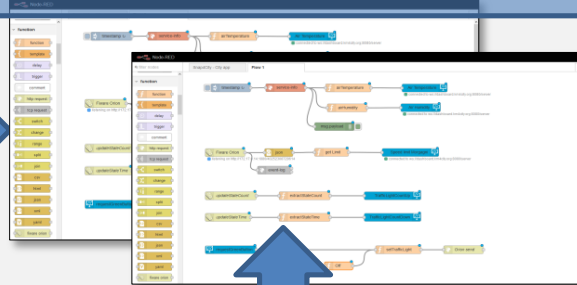
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World



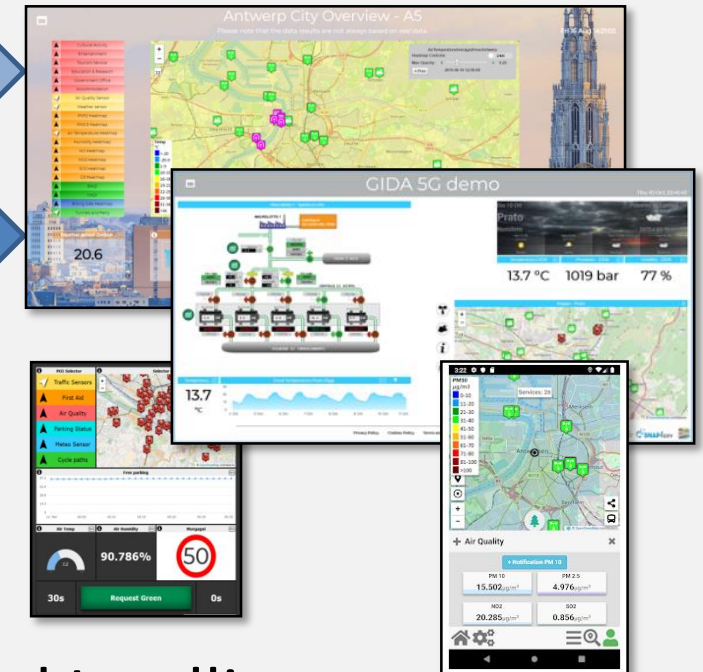
My IOT Devices

IOT Applications

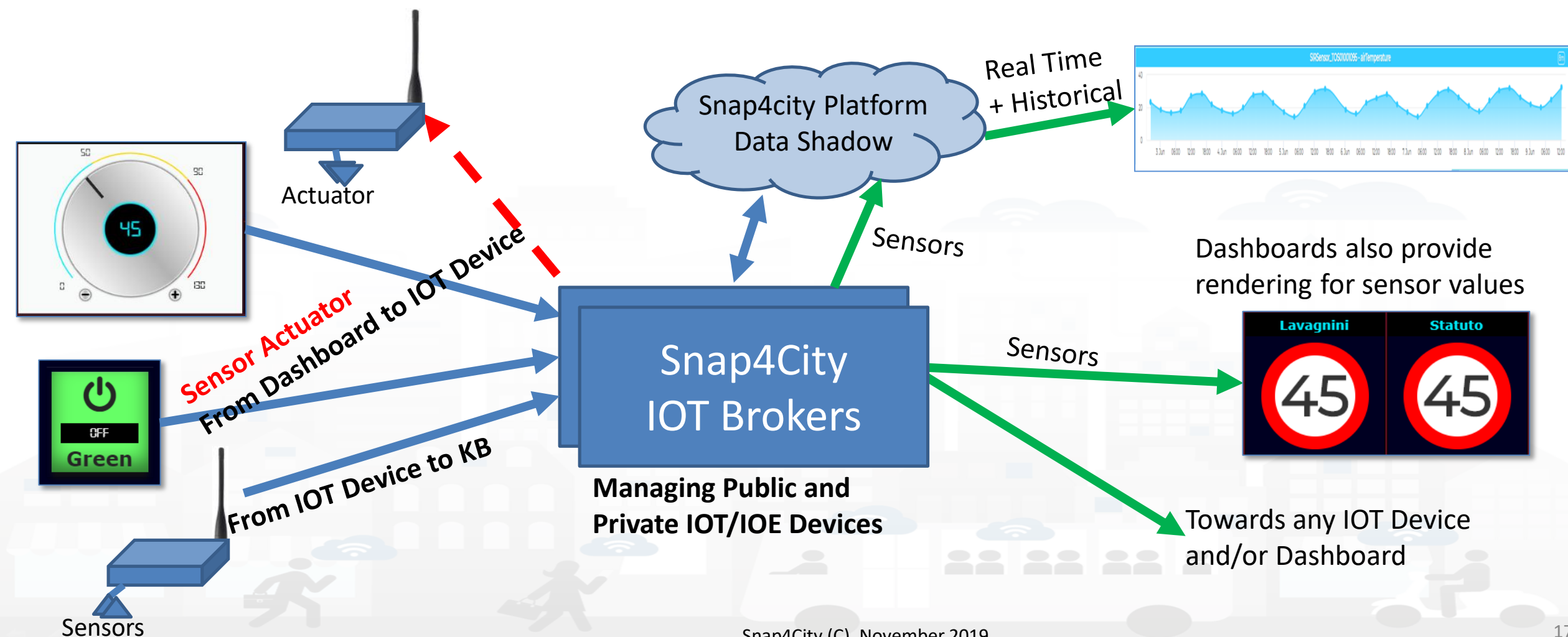


Big Data Analytics, Artificial Intelligence

Dashboards and Apps



IOT Data Driven

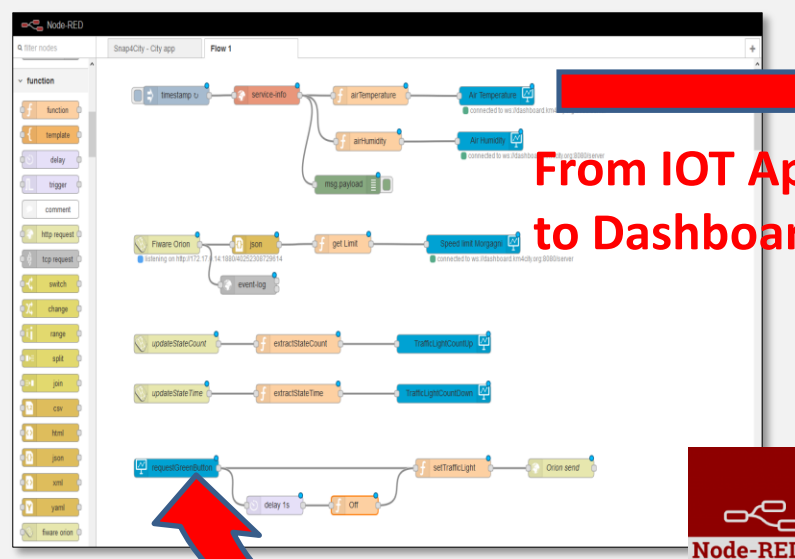


HLT: Sensors-Actuators

High Level Types

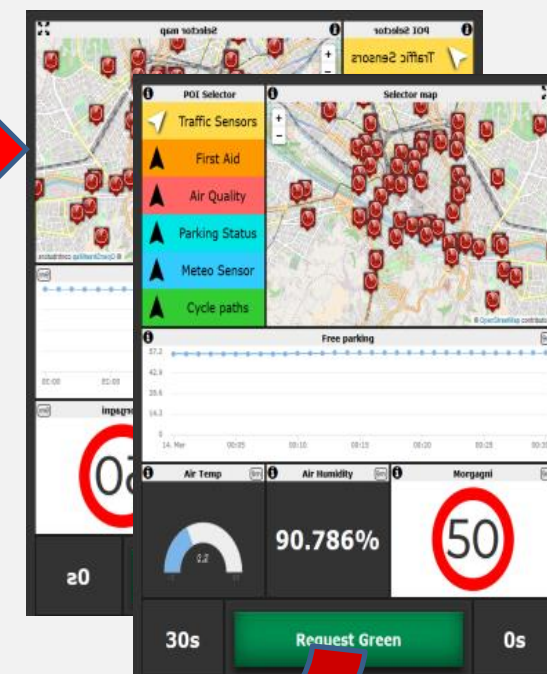
- Complex Event
- **Dashboard-IOT App**
- External Service
- Heatmap
- KPI (Key Performance Indicator)
- MicroApplication
- My Personal Data
- MyKPI
- MyPOI
- POI (Point of Interest)
- Sensor
- Sensor Actuator
- Special Widget
- Wfs (GIS)

IOT Application



From IOT App
to Dashboard

Dashboards



From Dashboard to
IOT App

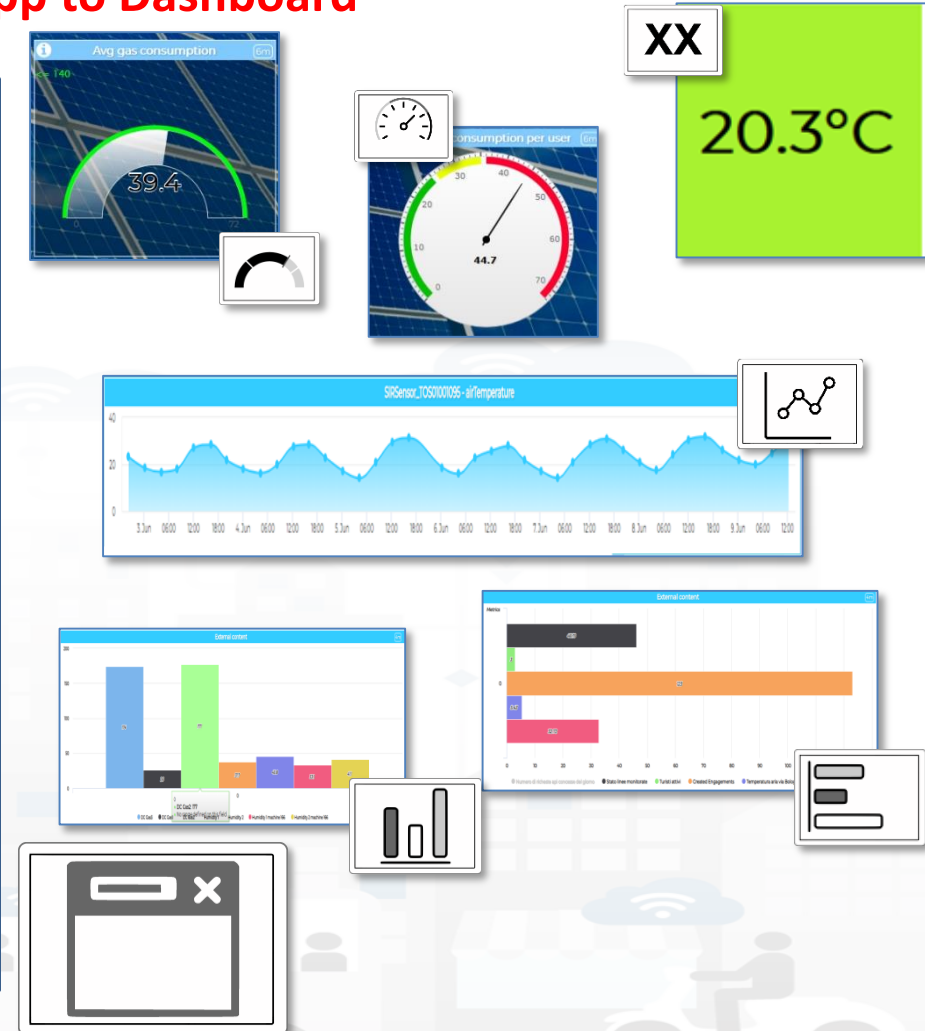
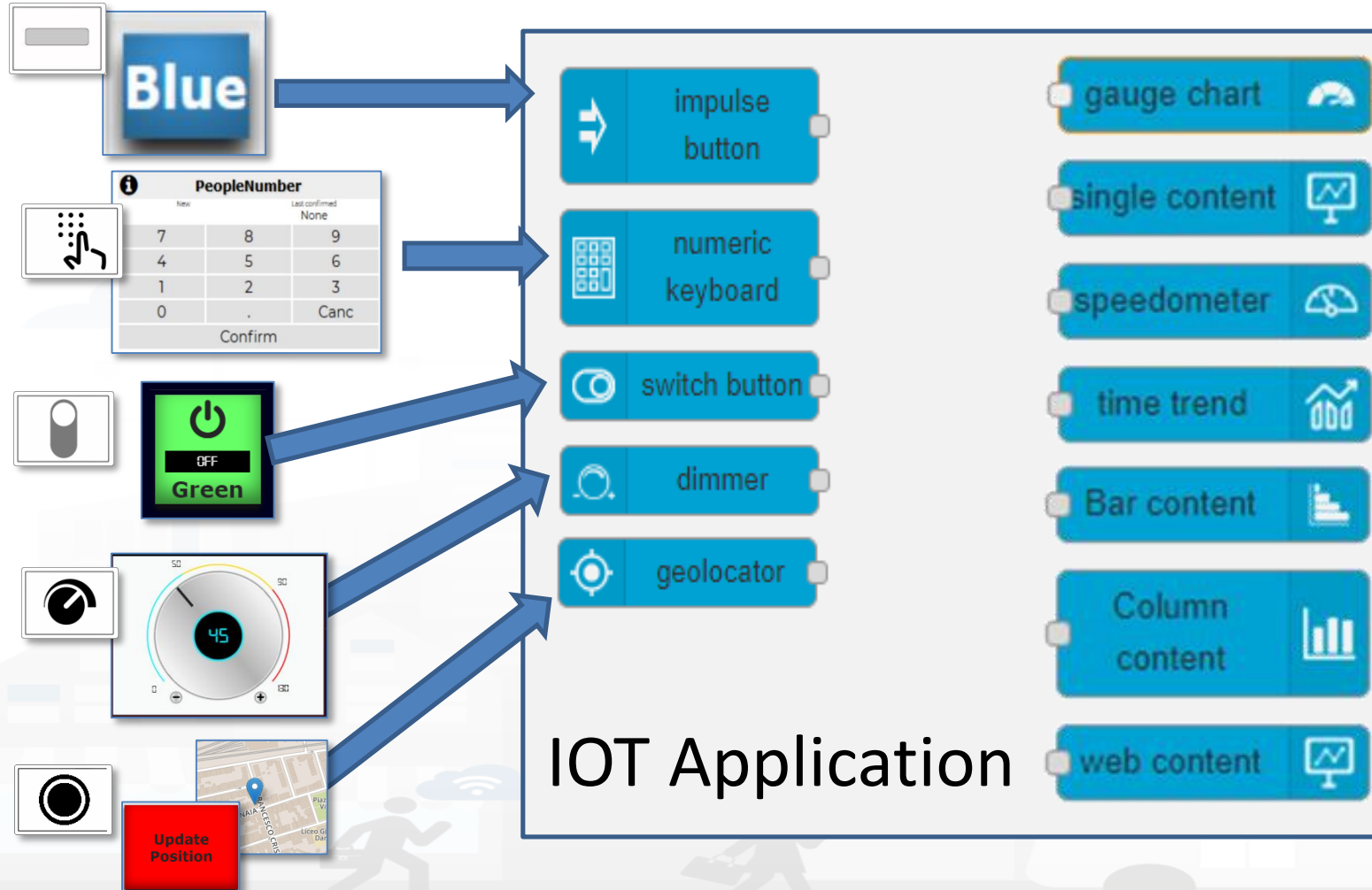
Nature

Dashboard-IOT App

Nature

From Dashboard to IOT App

From IOT App to Dashboard

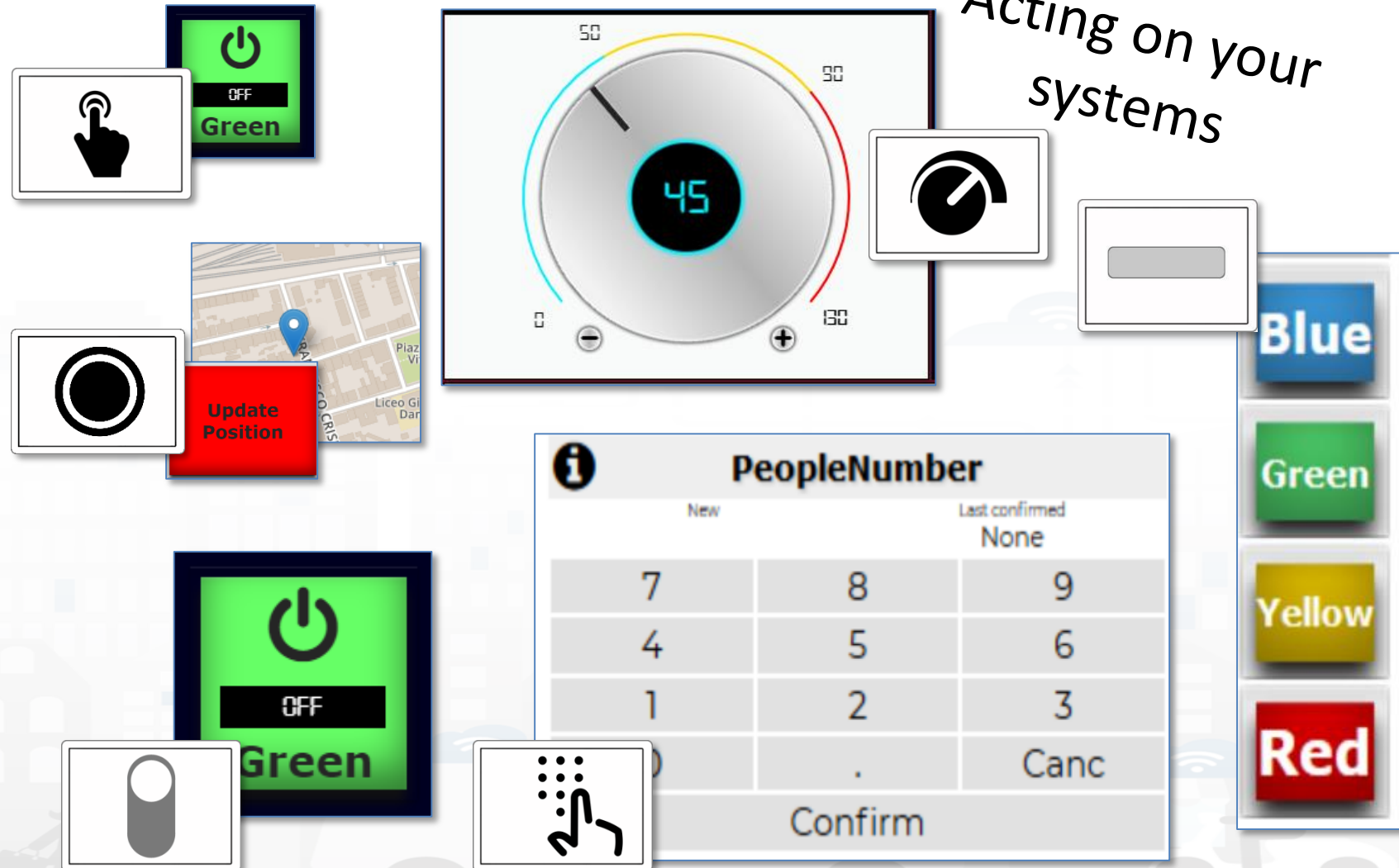


From Dashboard to IOT Devices

- **Widgets:**

- Impulse Button
- Button
- Switch
- Dimer/Slider
- Keypad
- geolocator

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



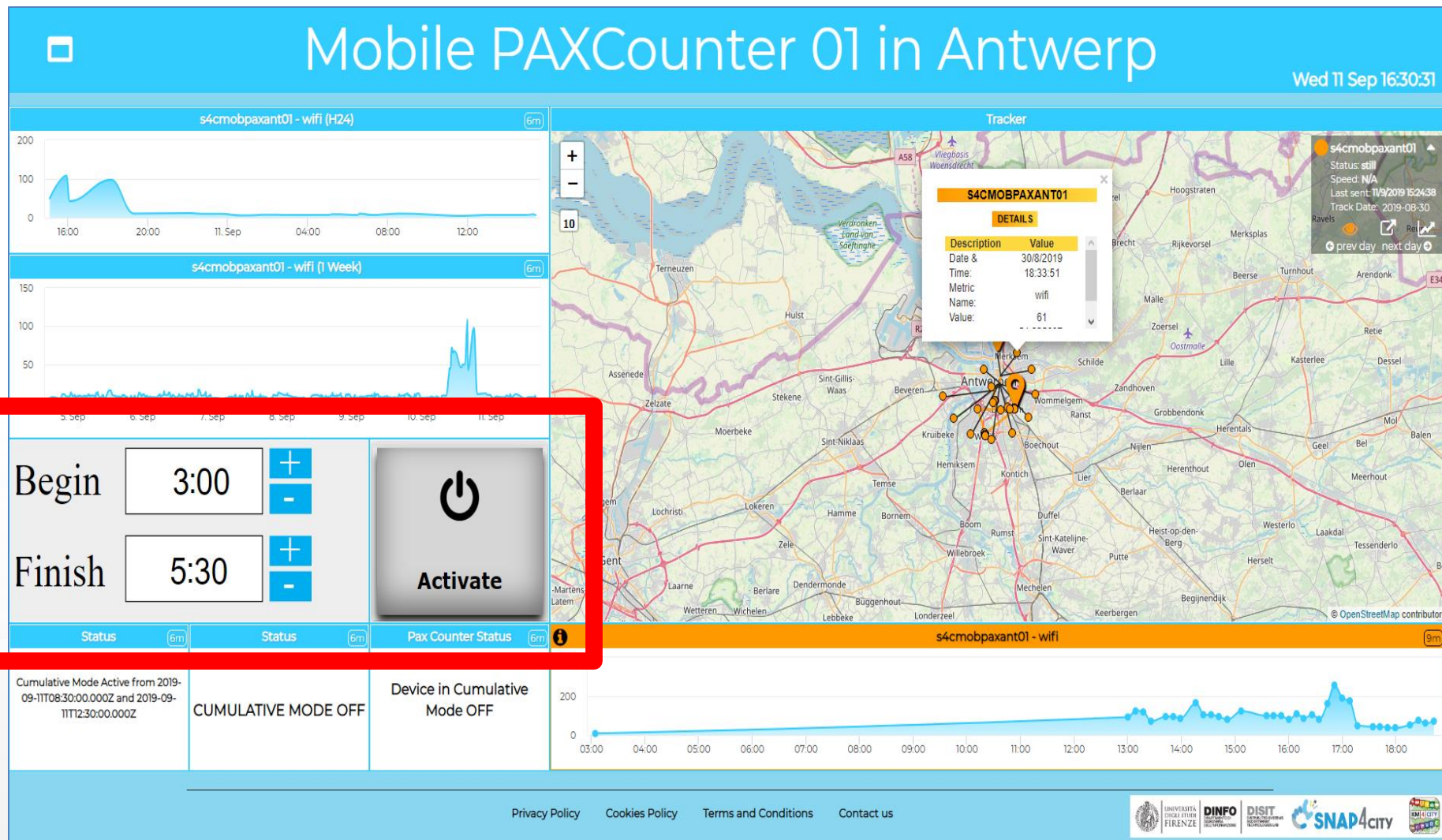
From Dashboards to MyKPI

- It is possible to pass from Dashboard to IOT App, IOT Devices, and MyKPI
- The user actions can be exploited for:
 - Changing IOT Application parameters
 - As input event driven for IOT Applications
 - Changing MyKPI values
 - Creating Events: see for example Dashboard for Operators

Controlling Personal Mobile PAX Counter

In this example, the **interaction with IOT Devices** counting people by using Wi-Fi and Bluetooth sniffing in its vicinity (according to GDPR)

Changing parameters via Custom Widget created in SVG and acting on IOT App



- If you need more, please see slides of Day 2
- <https://www.snap4city.org/download/video/barc19/dash/>

TOP

GIS Data Import and Export

FROM CITY
DASHBOARD TO
APPLICATIONS

DATA GATHERING
CITY DATA
KNOWLEDGE
MANAGEMENT

FORGING &
MANAGING OPEN
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AND MOBILE APPS

IOT APPLICATIONS
VS IOT EDGE
DEVICES

IOT APPLICATIONS,
THE LOGIC AND
THE SMARTNESS

ADVANCED
SMART CITY API,
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ECOSYSTEM. OPENED
TO DEVELOPERS
AND STAKEHOLDERS

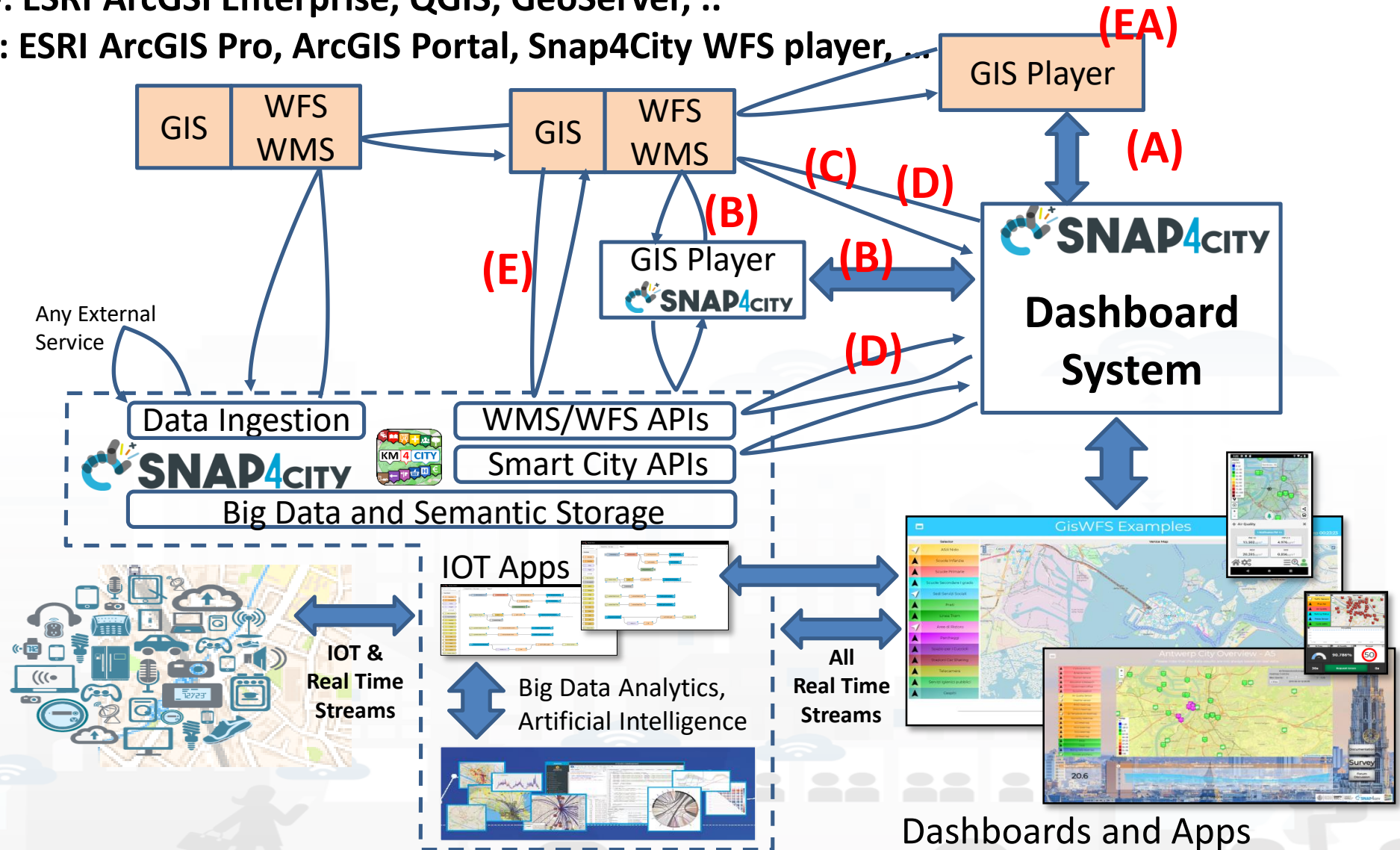
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DECISION SUPPORT
SYSTEM AND CITY
RESILIENCE

SNAP4CITY
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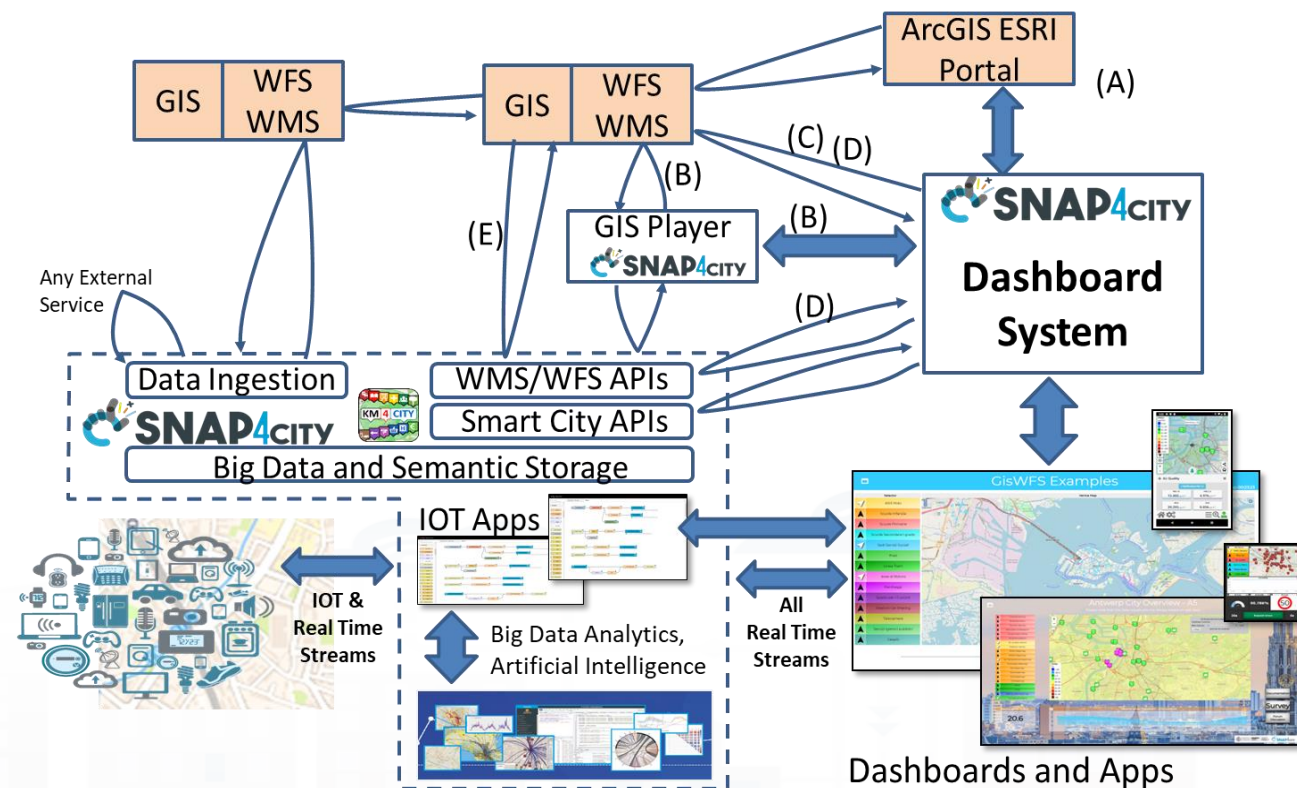
SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

GIS Player can be: ESRI ArcGIS Pro, ArcGIS Portal, Snap4City WFS player, ...



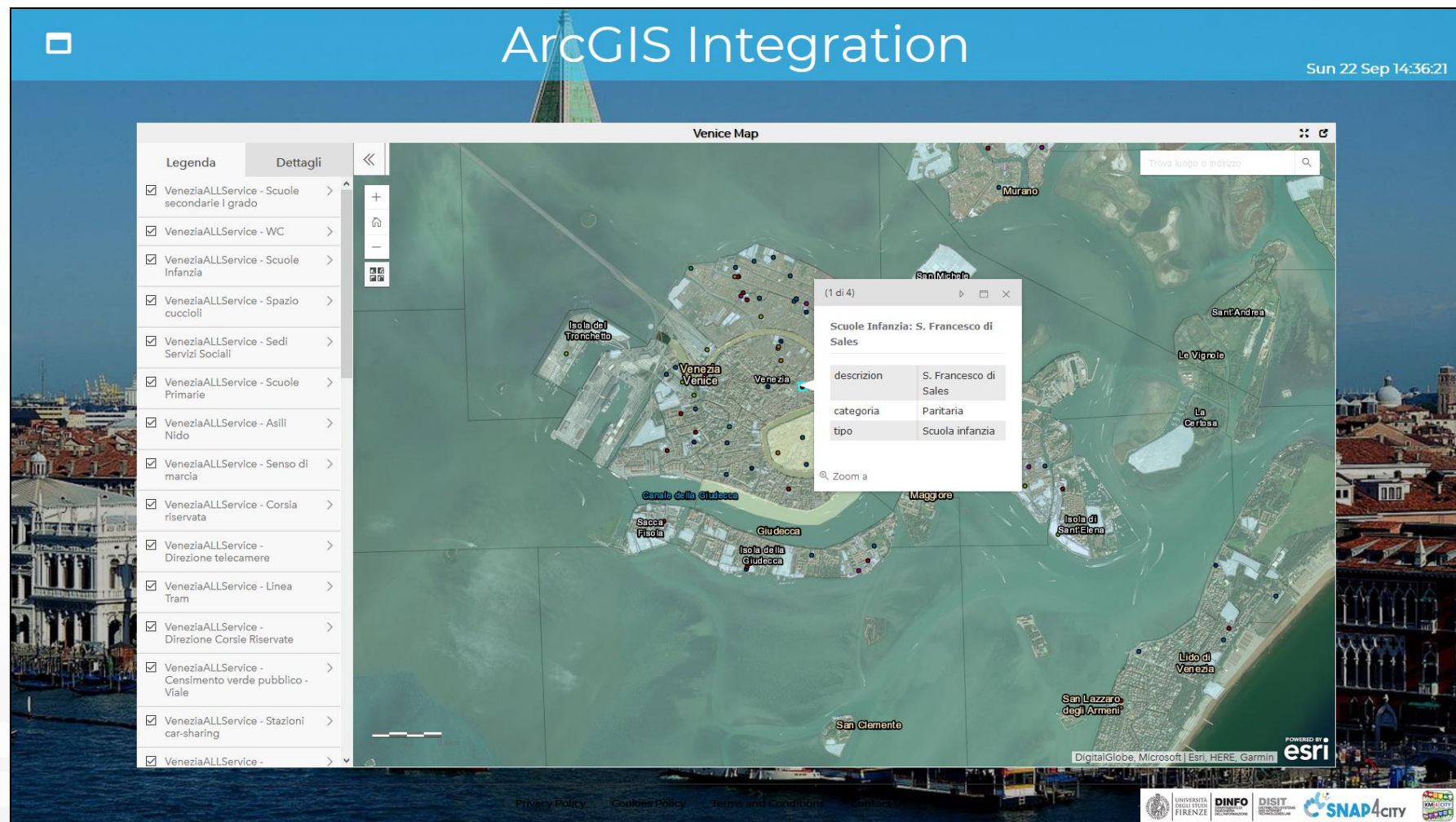
- **GIS:**
 - Geographic Information System
- **WMS:**
 - Web Map Service
- **WFS:**
 - Web Feature Services

- **Snap4City is interoperable with**
 - ESRI ArcGIS Enterprise, Portal, Pro/MAP, ...
 - other GIS tools supporting WFS, WMS, GeoJSON, GML
- **Snap4City is interoperable since:**
 - **Provides** info/data in WFS, WMS
 - **Exploits** data/info from WFS, WMS
 - **Import** data/info from WFS/WMS
- The Snap4City platform can be installed on premise using **Snap4City Appliance**
<https://www.snap4city.org/drupal/node/471>
 - **StartSNAP4CITYVM** includes the Dashboard Builder that is capable to work with WFS WMS protocols for the integration with GIS platforms as ESRI ArcGIS, QGIS, directly or using **Snap4City GIS player**.
 - **KBSSMVM** includes the Smart City API and WFS API which can be used to data harvest from any GIS servers and GIS desktop tool



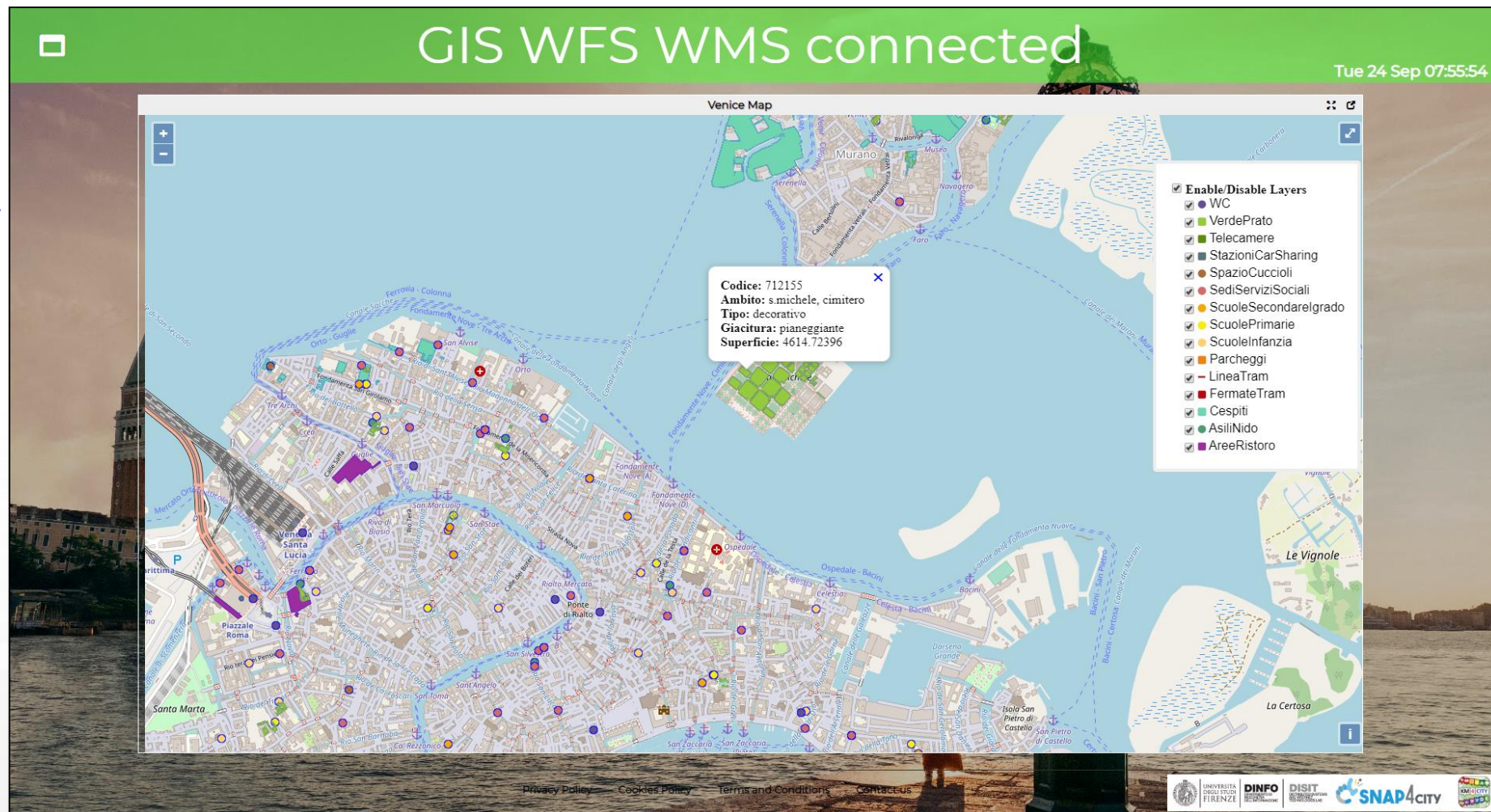
(A) ArcGIS ESRI as External Service

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- ArcGIS Portal accesses to ArcGIS Enterprise server
 - https://arcgis.km4city.org/arcgisportal/apps/Embed/index.html?webmap=5774fa9d0f7f4a2fb2d7cd52dffcd8c9&extent=12.3144,45.4276,12.3461,45.4419&home=true&zoom=true&previewImage=false&scale=true&search=true&searchextent=true&details=true&legendlayers=true&active_panel=details&basemap_gallery=true&disable_scroll=true&theme=light
- Snap4City Dashboard uses as External Service: ArcGIS ESRI Portal
- <https://main.snap4city.org/view/index.php?iddashboard=OTkw>



(B) GIS data on Dashboard via Snap4City GIS Player

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- Snap4City has its WFS Player
<https://main.snap4city.org/widgets/venezia/index.php>
- Snap4City Dashboard uses as External Service: Snap4City GIS viewer via WFS/WMS:
<https://main.snap4city.org/view/index.php?iddashboard=MTIxNg>



(C) Dash with Snap4City GIS widget and Selector

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- Snap4City has its WFS / WMS widget / Player
- Snap4City Dashboard shows WFS/WMS data via Special GIS Widget Map:
 - <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTQwMw==>
- Snap4City can use **Selector** to select WFS / WMS sources to be shown from ESRI ArcGIS (as well as from any other WFS service) on Widget map

Selector

ASili Nido

Suole Infanzia

Suole Primarie

Suole Secondare I grado

Sedi Servizi Sociali

Prati

Linea Tram

Aree di Ristoro

Parcheggi

Spazio per i Cuccioli

Stazioni Car Sharing

Telecamere

Servizi Igienici pubblici

Cespiti

Venice Map

URP - UFFICIO RELAZIONI CON IL PUBBLICO - MESTRE

DETAILS

DESCRIPTION

Description	Value
id_sede	170
indirizzo	PIAZZALE LUIGI CANDIANI (Mestre Centro), 5
sub_codice	2720
num_civico	5
barra	1
id_ente	1
ente	Comune di Venezia
pk_id	170

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SNAP4CITY

KM4CITY

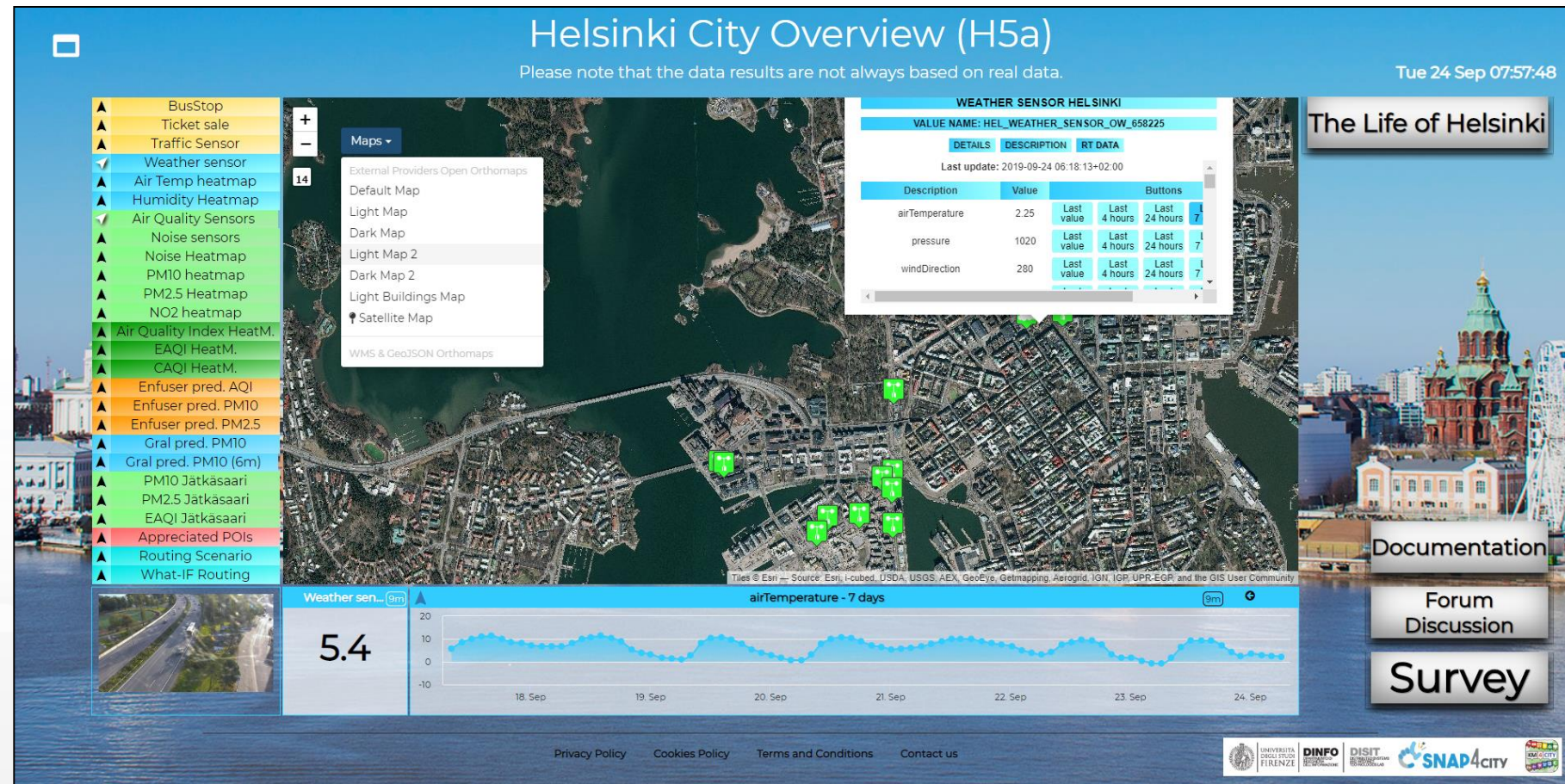
The Snap4City Widget Map allows to mix WFS GIS sources with Smart City API
<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTM5NA==>

Snap4City (C), November 2019

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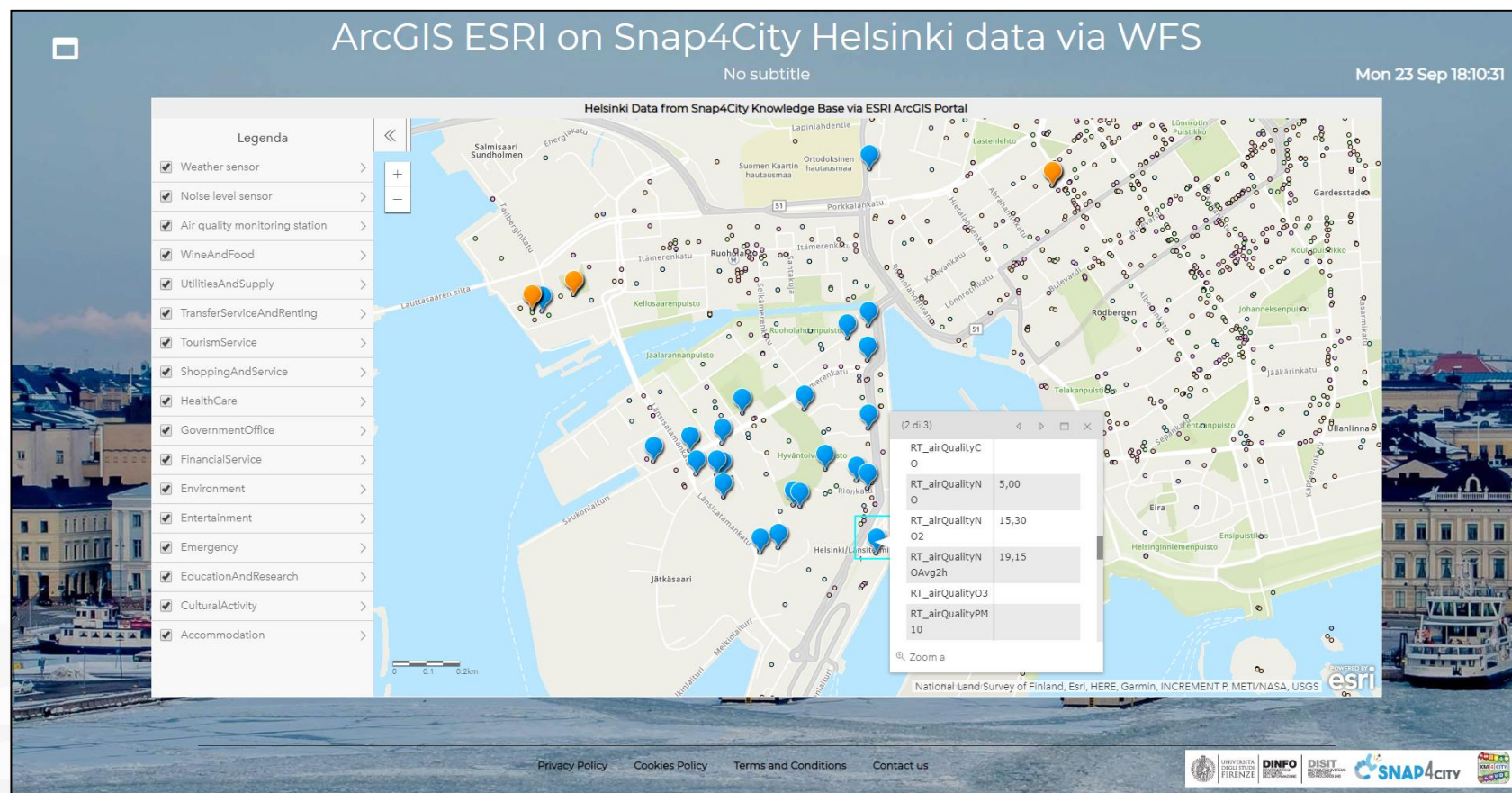
(D) Dashboard with Orthomaps and shapes layers based on WMS, GeoJSON

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed, and GeoServer
- Snap4City main MultidataMap Widget can load WMS background images and shapes, the Orthomaps
- Also Heatmaps calibrated are provided from GeoServer using WMS protocol
- Maps in this case are directly taken from ESRI Server, free of charge
- <https://www.snap4city.org/dashboardSmartCity/view/index.php?idashboard=MTQwNg==#>



(E) Snap4City via WFS on top of Smart City API provide data to ESRI ArcGIS Enterprise or ArcGIS Pro, and thus the data become accessible on ArcGIS ESRI Portal

- Snap4City provides a WFS service on top of SmartCity API. Thus providing data to any GIS/WFS client, including ESRI ArcGIS Enterprise, ArcGIS Pro, QGIS, etc.
- In the example, our ingested Helsinki Data have been harvested from ESRI ArcGIS via WFS.
- Once ingested on ESRI ArcGIS can be visualized, by using ArcGIS Portal
 - https://arcgis.km4city.org/arcgisportal/apps/Embed/index.html?webmap=fbcec7055a3446e29fc1e9c55cb53d79&extent=24.8335,60.1465,25.013,60.1965&zoom=true&previewImage=false&scale=true&legendlayers=true&disable_scroll=false&theme=light
- Snap4City Dashboard can show ESRI ArcGIS Portal (A) as External Services in a dashboard.
 - <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjIwNg==>

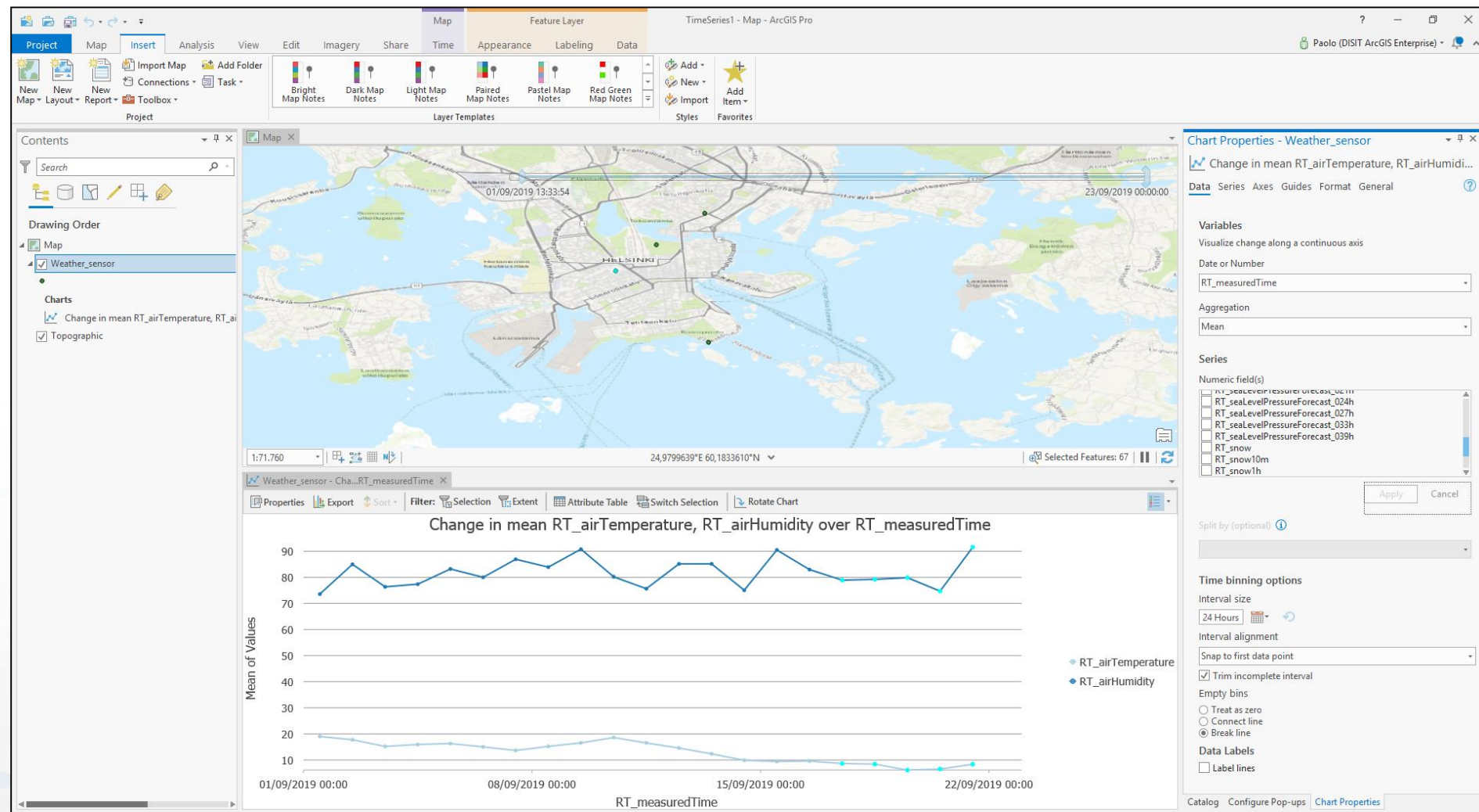


(EA) ArcGIS ESRI Pro as GIS / WFS play

To test you need to have installed ArcGIS pro on your pc and connect with Snap4City WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

On PC:

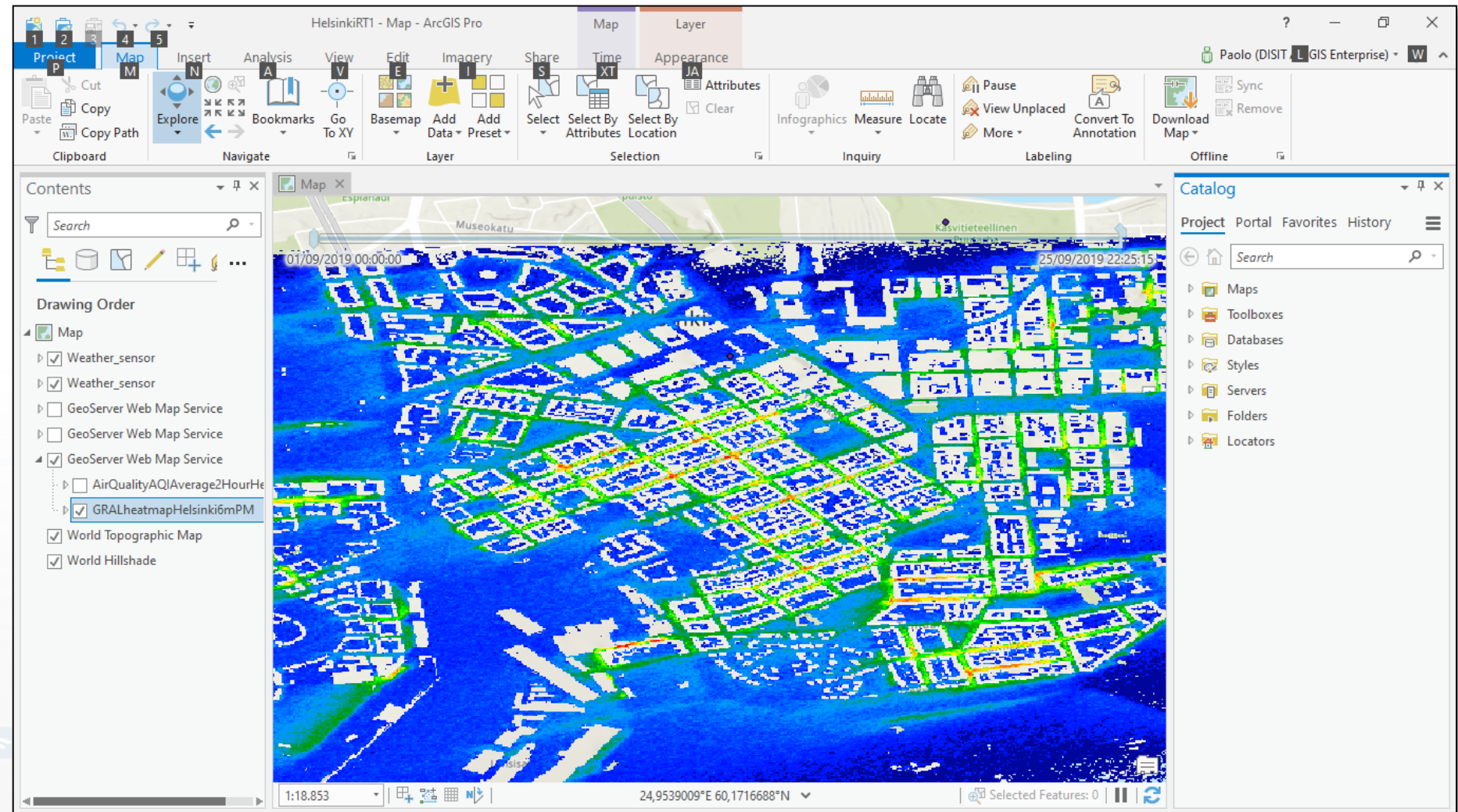
- (i) Get data via WFS connected to ESRI ArcGIS Enterprise or other sources
- (ii) Download data via WFS ... from...



(EA) ArcGIS ESRI Pro as GIS / WMS play

To test it you need to have installed ArcGIS pro on your pc and connect with our WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

Heatmap taken from Snap4City GeoServer via WMS protocol



Snap4City vs GIS, WFS/WMS

- GIS data:
 - Ingested via WFS/WMS protocols, and then managed as the other data. Data ingestion from GIS server can be performed via ETL processes, or directly from Dashboards
 - Shown on Dashboards via third party GIS tools as External Services
 - Shown on Dashboards using Special GIS Widget Map which directly access to GIS data via WFS/WMS
 - Heatmaps and Maps are distributed via a GeoServer
- Snap4City can interact with ArcGIS Real Time Events via MQTT protocol as well
- [Snap4City vs GIS solutions and connections](#)

TOP

Social Media data collection and exploitation

FROM CITY
DASHBOARD TO
APPLICATIONS

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MANAGING OPEN
AND FLEXIBLE WEB
AND MOBILE APPS

IOT APPLICATIONS
VS IOT
DEVICES

DATA GATHERING
AND CITY DATA
MANAGEMENT

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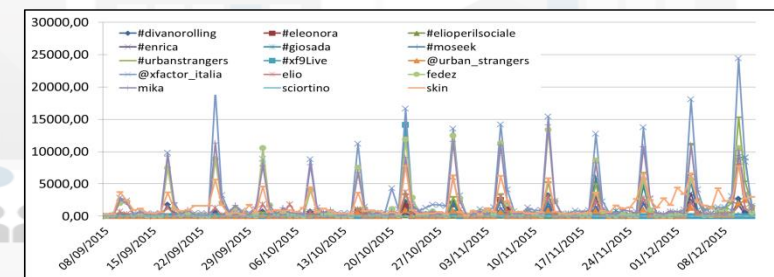
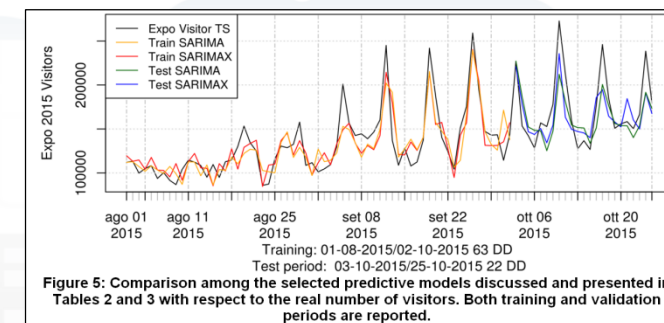
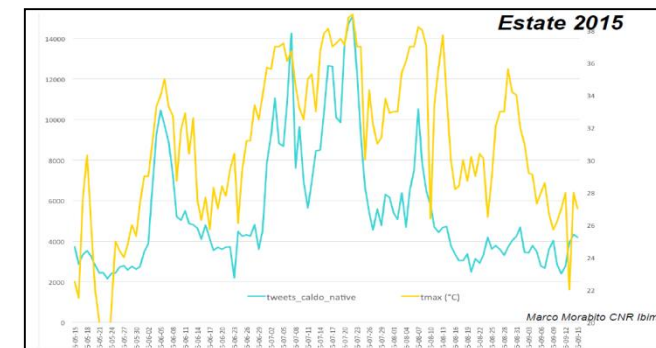
SNAP4CITY THE
VIEW OF THE
ADMINISTRATORS

Social Media Data

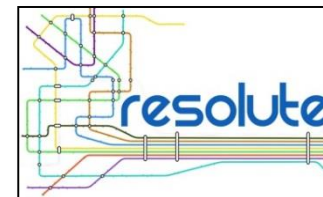
- Data from Social Media can be ingested in different manners:
- Twitter Data can be:
 - Collected via Twitter Vigilance programming keywords.
 - Collected in real time via IOT Applications
 - Once collected the Metrics (number of Tweets, reTweets, NLP, Sentiment Analysis, etc. can be:
 - Shown, exploited in IOT Applications
 - Exploited for early warning
- FaceBook data:
 - Can be generated by using IOT App
- Telegram data:
 - Can be generated by using IOT App

Prediction/Assessment

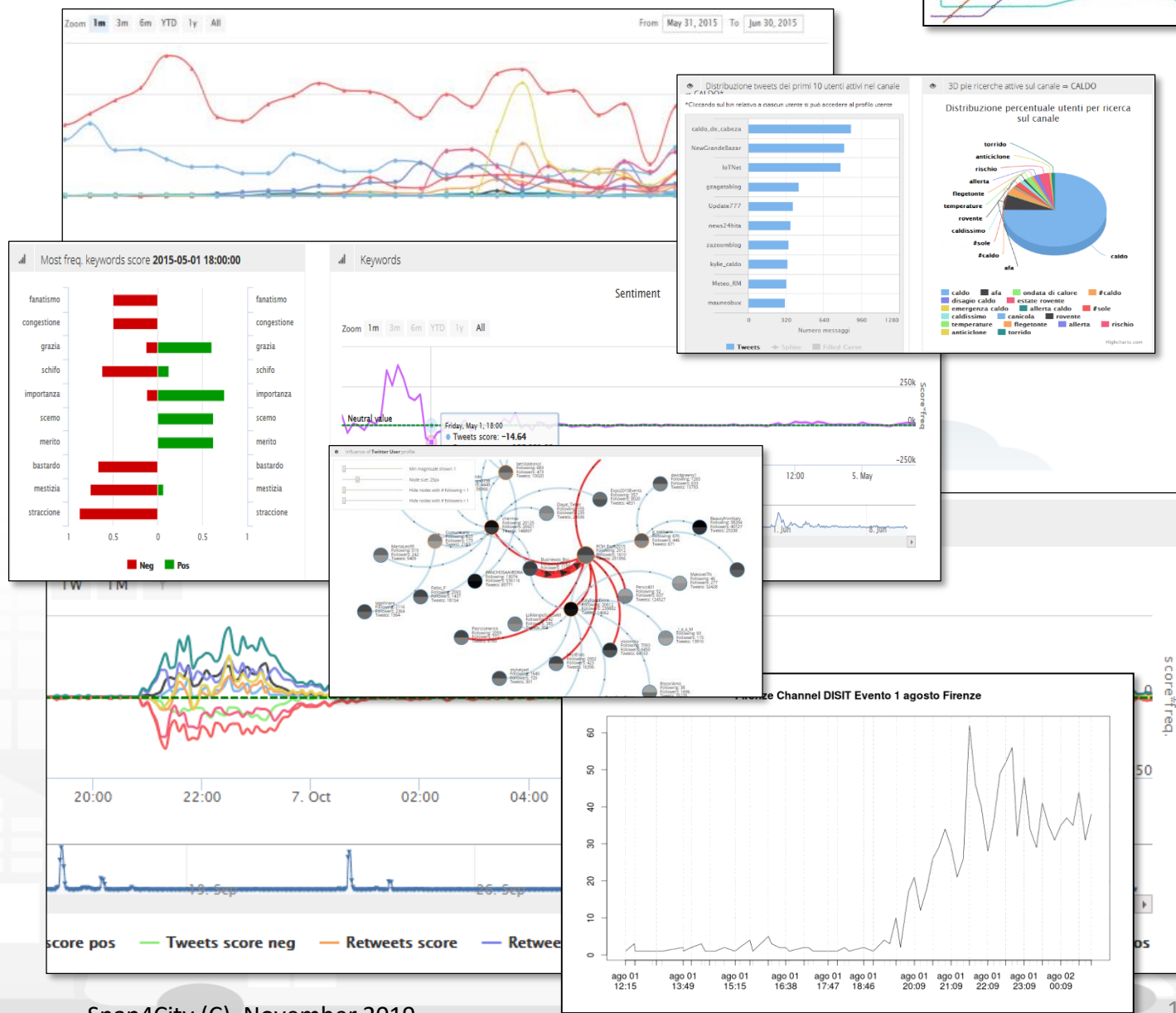
- Football game results as related to the volume of Tweets
- Number of votes on political elections, via sentiment analysis, SA
- Size and inception of contagious diseases
- marketability of consumer goods
- public health seasonal flu
- box-office revenues for movies
- places to be visited, most visited
- number of people in locations like airports
- audience of TV programmes, political TV shows
- weather forecast information
- Appreciation of services



Twitter Vigilance

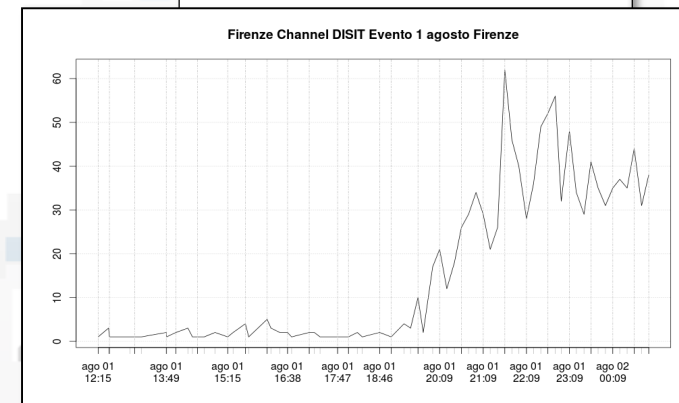
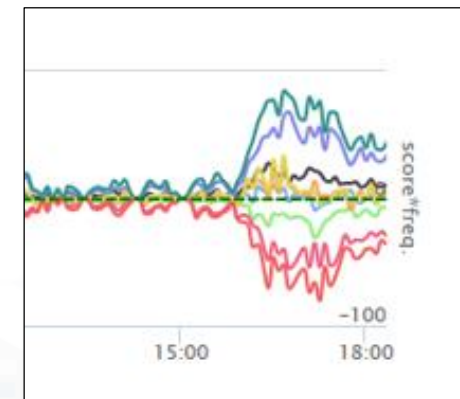
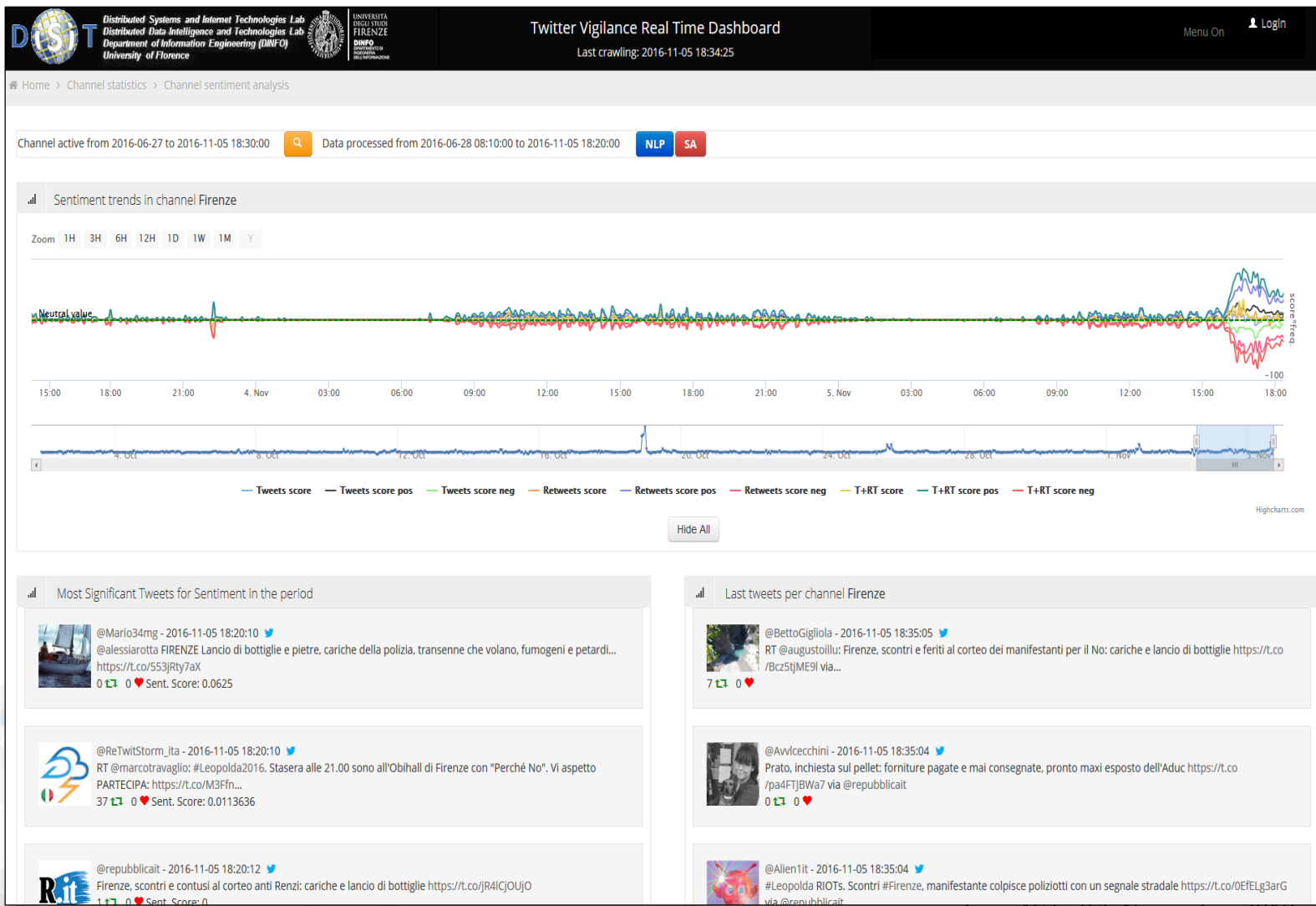


- <http://www.disit.org/tv>
- <http://www.disit.org/rttv>
- Citizens as sensors to
 - Assess sentiment on services, events, ...
 - Response of consumers wrt, ...
 - Early detection of critical conditions
 - Information channel
 - Opinion leaders
 - Communities
 - Formation
 - Predicting volume of visitors for tuning the services

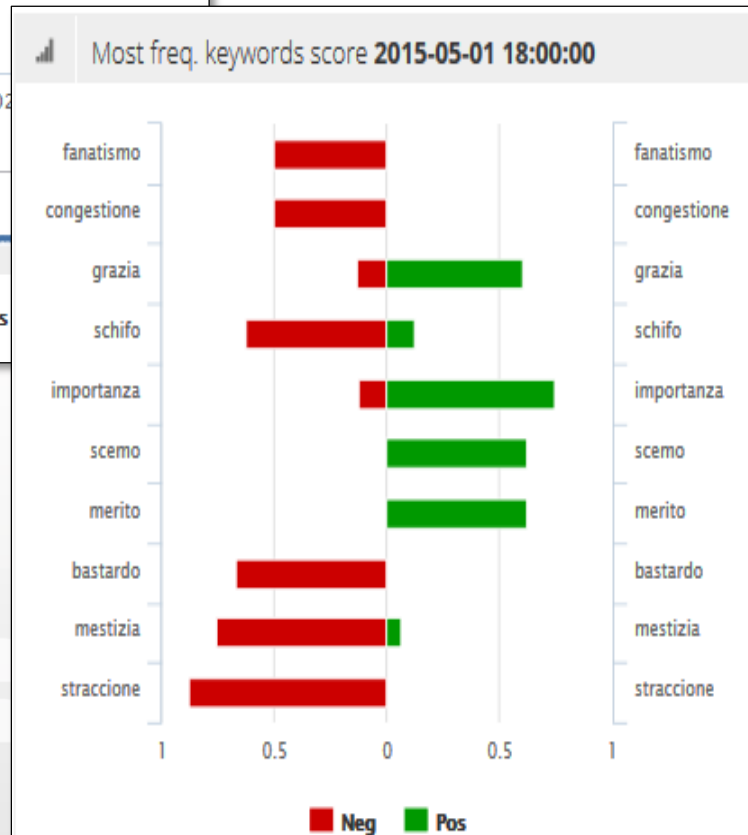
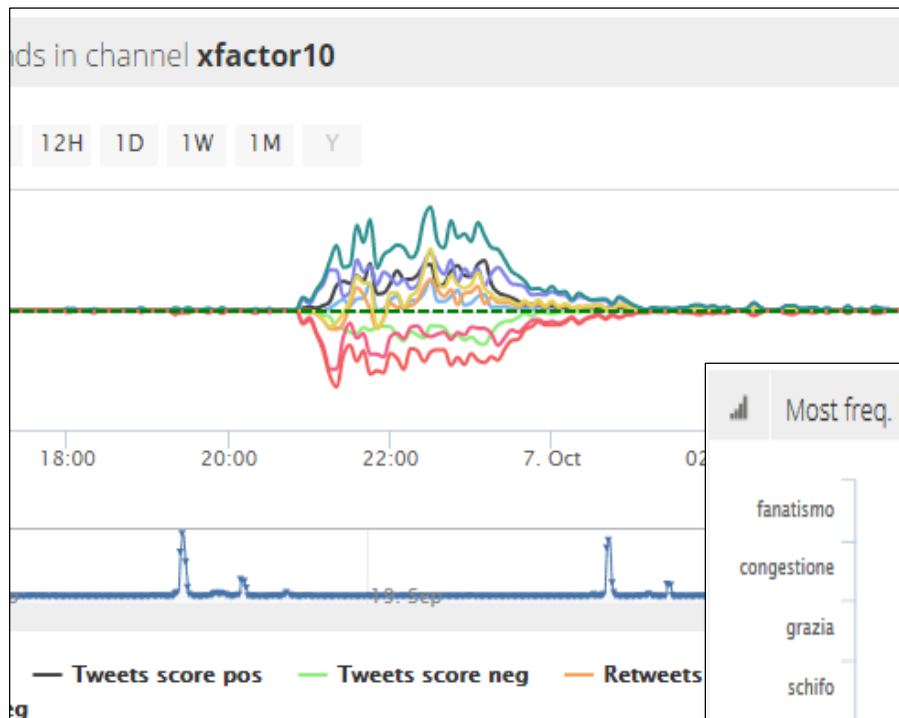


Twitter Vigilance RT: sentiment analysis

Real time
Early Warning



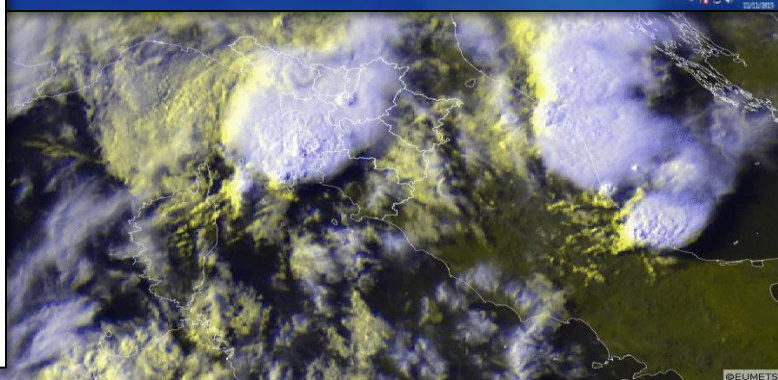
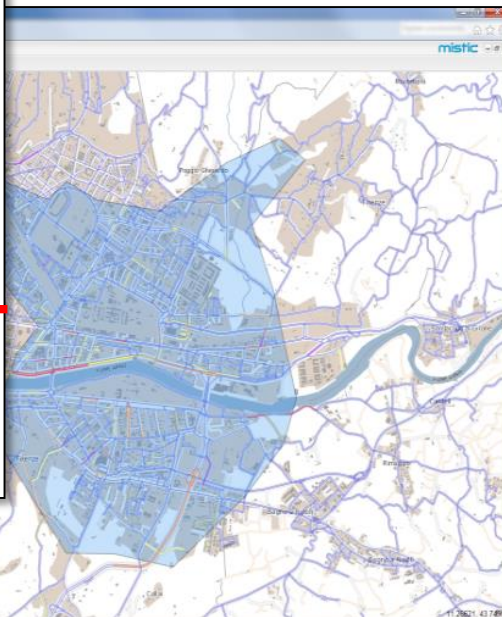
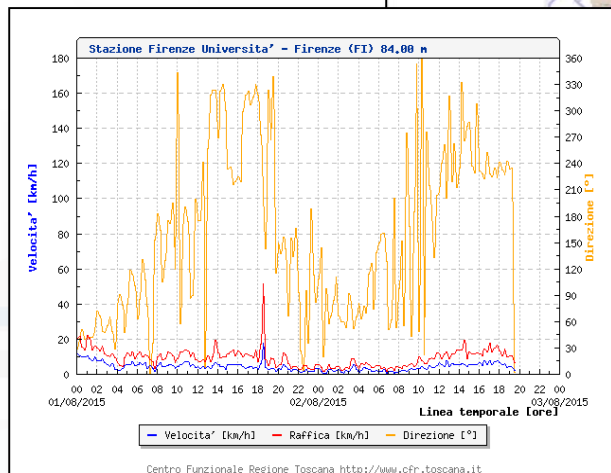
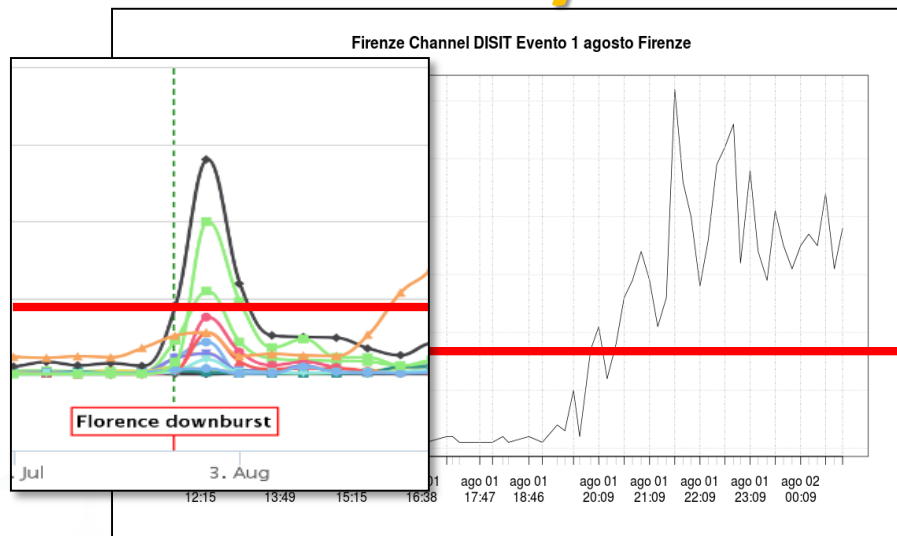
Sentiment Analysis



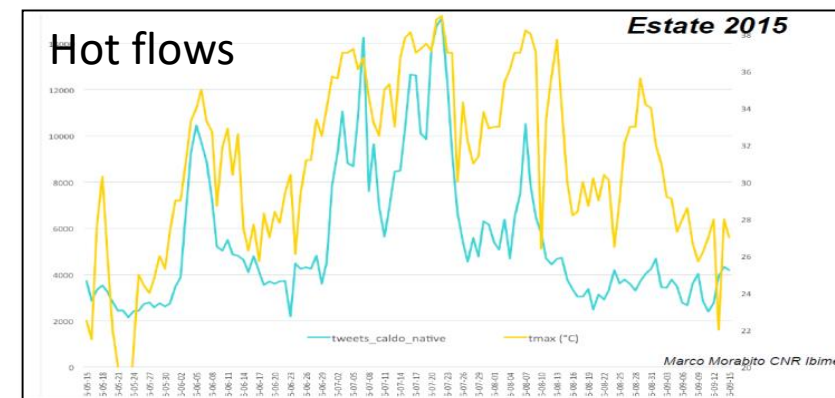


Twitter Vigilance

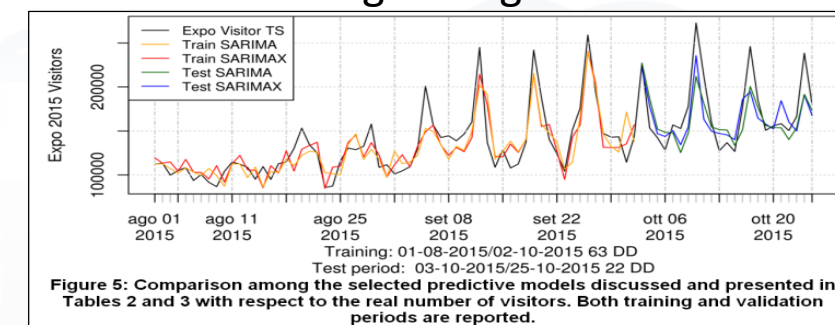
Early Warning



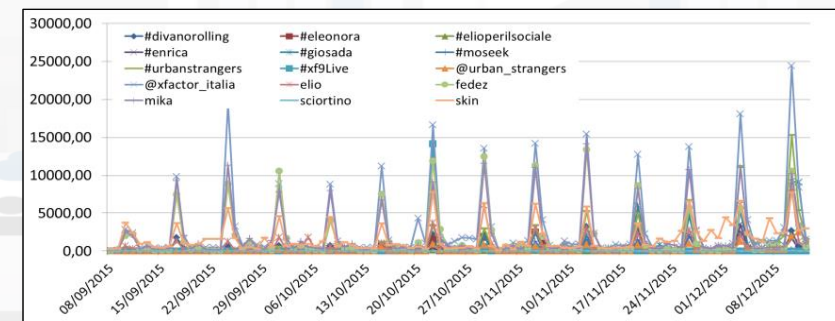
Predictive models



Attendance at long lasting events: EXPO2015



Attendance at recurrent events: TV, football





Twitter Vigilance

Further reading on Social Media

- [TC2.22- Exploiting Twitter Vigilance as External Service, in Dashboard, and as RestCall as MicroService in IOT applications](#)
- [TC2.21- IOT Applications with Social Media Actions, and cultural scenarious](#)
- [External Services](#)
- [TC2.21- IOT Applications with Social Media Actions, and cultural scenarious](#)

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- Km4City** is an open technology and research line of DISIT Lab exploited by a number of projects. Some of the innovative solutions and research issues developed into projects are also compliant and contributing to the Km4City approach and thus are released as open sources and are interoperable, scalable, modular, standard compliant, etc.



TOP



Be smart in a SNAP!

CONTACT

DISIT Lab, DINFO: Department of Information Engineering
Università degli Studi di Firenze - School of Engineering

Via S. Marta, 3 - 50139 Firenze, ITALY
<https://www.disit.org>

www.snap4city.org



Email: snap4city@disit.org

Office: +39-055-2758-515 / 517
Cell: +39-335-566-86-74
Fax.: +39-055-2758570



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