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TECHNOLOGIES LAB

Snap4City



IOT/IOE Elastically Scalable Architecture for Smart City and Industry 4.0

Pierfrancesco Bellini, Daniele Cenni, Paolo Nesi

<https://www.snap4City.org>

<https://www.Km4City.org>



<https://www.disit.org/>

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4th Italian Conference on ICT for Smart Cities And Communities

19-21 September, 2018 | L'Aquila, Italy





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Issues

Snap4City



- IOT Applications are typically being executed on cloud and IOT edge devices; each of them may:
 - Be defined as applications (e.g., NodeJS) or simple rules, horn clauses, if-then-else rules, etc.
 - IOT App may be
 - more flexible and capable to respect requirements on protection, privacy, GDPR, user access and personalization, etc.
 - executed on Docker, VM, cloud
 - End to end Security, robustness, MicroServices, GDPR, etc.
 - Relevant problems **regarding scalability**: vertical and horizontal
 - Resources are: **CPU, Memory, Network, Storage**,
 - But also for each IOT App and User: IOT Devices, MicroServices, ExternalServices, DataAnalytics, MicroApplications, Dashboards, connections/traffic, etc.



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Open Data

Public Services, Utilities, Security, Education, Events, Economy, Open Data, Entertainment, Tourism, Energy, Accommodation, Mobility, Data, Commerce, Environment, Culture, healthcare, Emergency

GIS + Map Data

Personal Data

data, privacy, personal

IoT/IoE Sensors

Actuators

Industry 4.0

Social Media

Static, Quasi static and Real Time data flows

Data Processing Tools

ETL Processes, Data Analytic, R; IOT App; etc.

ETL Processes IoT/IoE Applications

Elastic Management of Containers

Big Data Storage Knowledge

Phoenix, Hbase + indexing Knowledge Base

Km4City Ontology

Smart City Cloud Infrastructure

Development and Management Tools

Management ServiceMap Data Flow Analysis DataGate/CKAN

IOT Directory Linked Open Graph DevDash AMMA Resource Manager

Authentication, Authorization, GDPR, Security Assessment

Km4City Smart City API

Final Users' Tools

Dashboards IOT / IOE Apps

Mobile and Web Apps

Resources and the Architecture

Snap4City scalability, i-Cities 2018, DISIT lab (C)

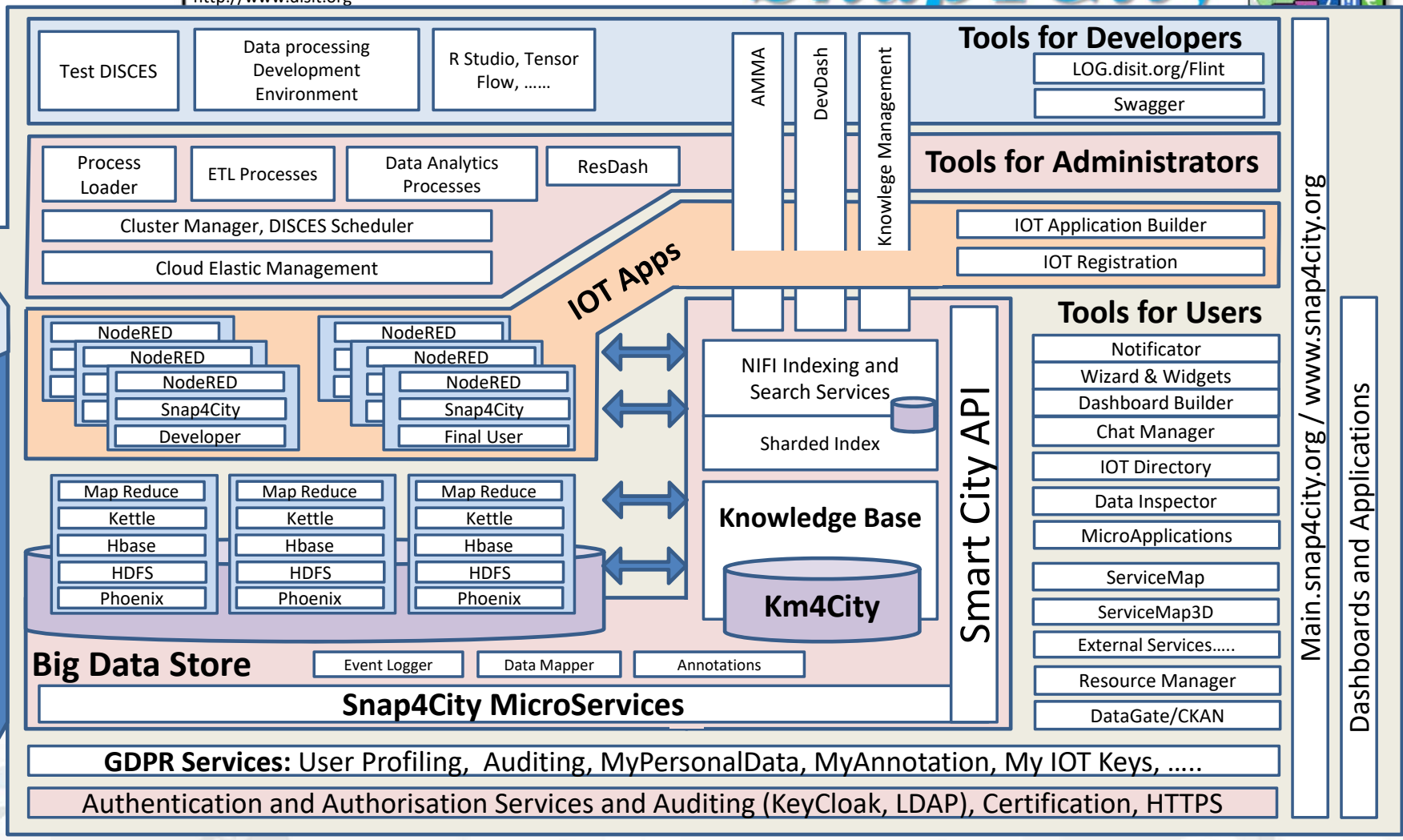
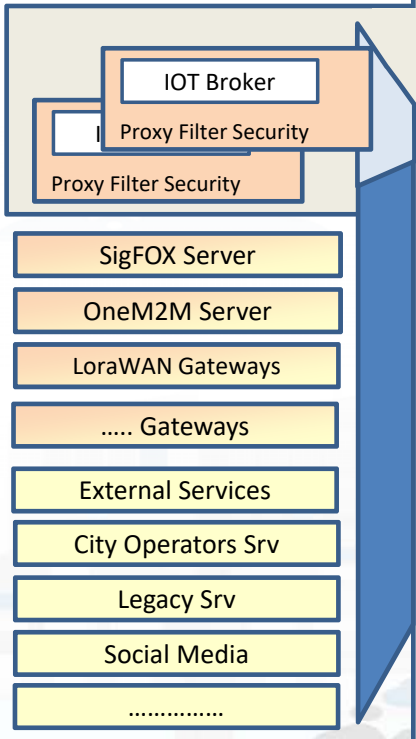
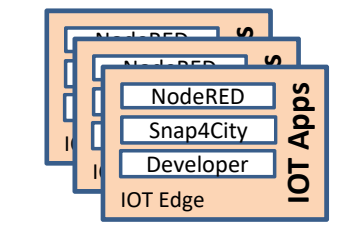


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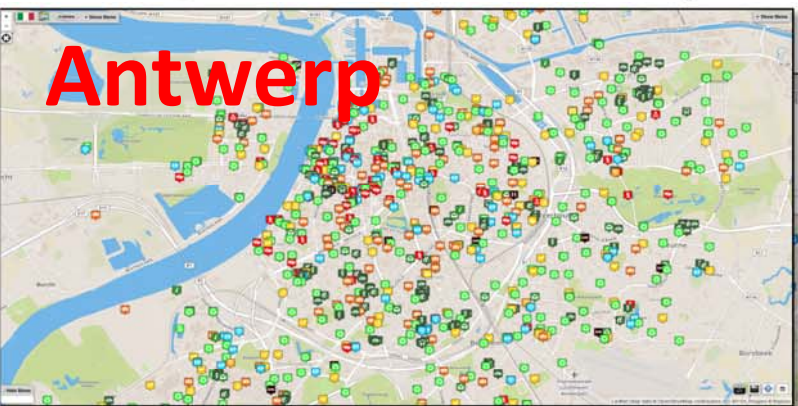
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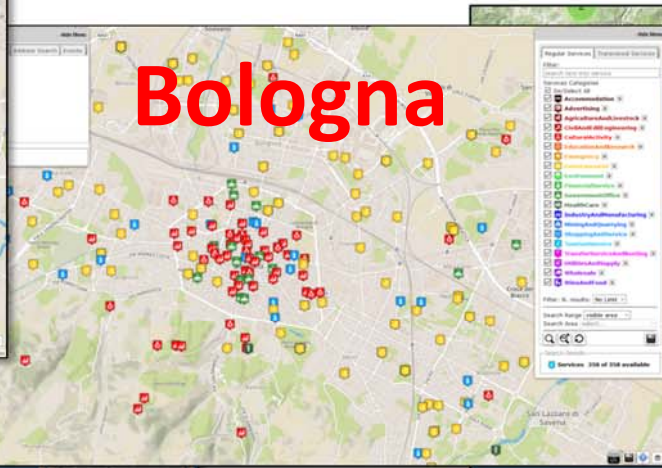
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Coverage: examples

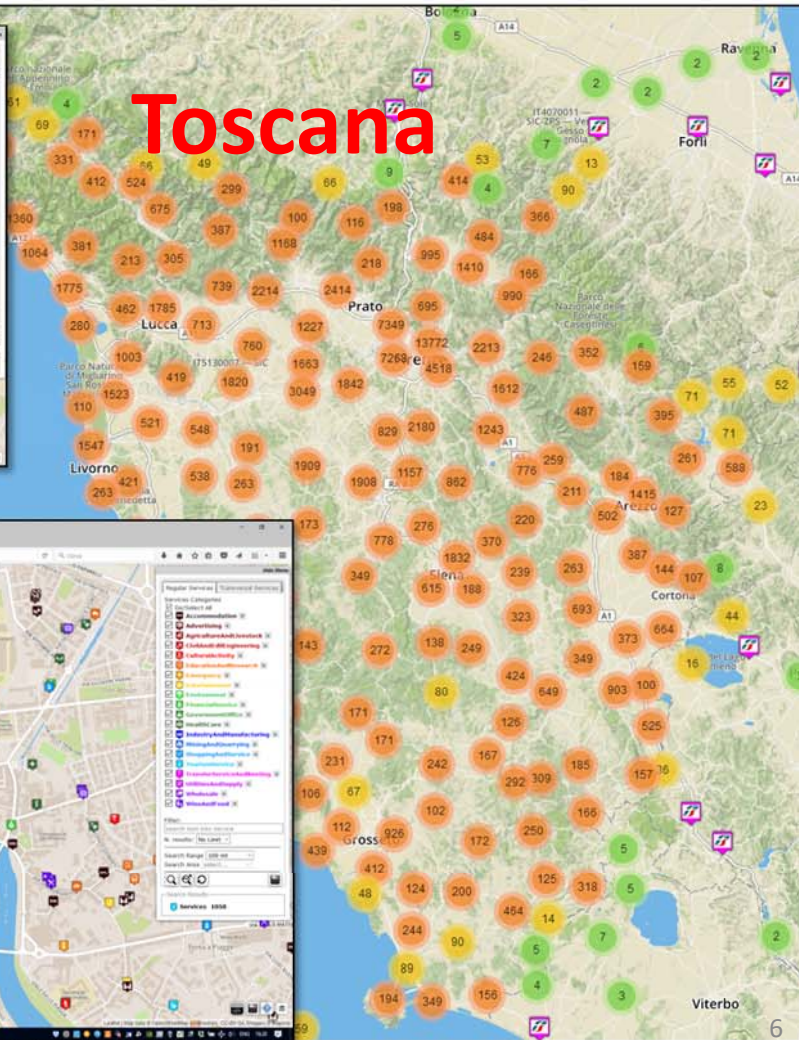
Antwerp



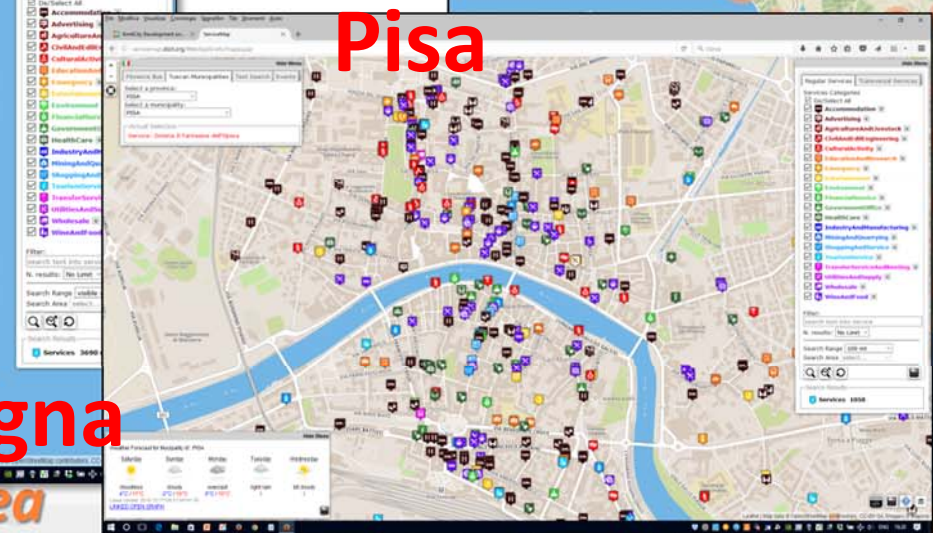
Bologna



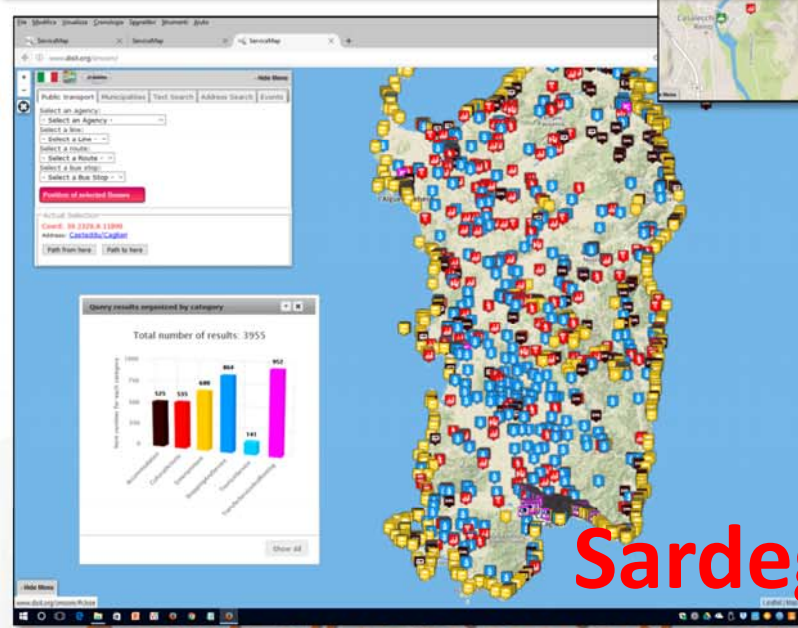
Toscana



Pisa



Sardegna



• Search all services in the area

- Nascondi Menu

Fermate Firenze Comuni in Toscana Ricerca Testuale

Seleziona una provincia:
FIRENZE

Seleziona un comune:
FIRENZE

Actual Selection
COMUNE di FIRENZE

Previsi
Glovedi Venerdì Sabato
poco nuvoloso 23°C / 27°C pioggia debole e schiarite poco nuvoloso 20°C / 33°C velato

KM4CITY

What is enabling and providing smart services

- Smart Parking, in Tuscany
- Smart First Aid in Tuscany
- Smart search for POI and public transport srv.
- Public Transportation in Tuscany
- Routing in Tuscany, simple and multimodal
- Social Media Monitoring and acting
- Traffic events and Resilience in Florence
- Bike Sharing in Pisa and Siena
- Recharge stations for e-vehicles
- Entertainment Events in Florence
- Traffic Sensors in Tuscany
- IOT/IOE sensors and actuators
- Weather forecast/condition in Tuscany
- Pollution and Pollination in Tuscany
- People Monitoring, in Tuscany via App
- ..People Monitoring Assessment in the City, in Florence via Wi-Fi

All Point of Interests, cultural activities, IOT, ...
Over than 1.2 Million of complex events per day!

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

<https://servicemap.km4city.org>



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Level 4 users: dashboard with intelligence App

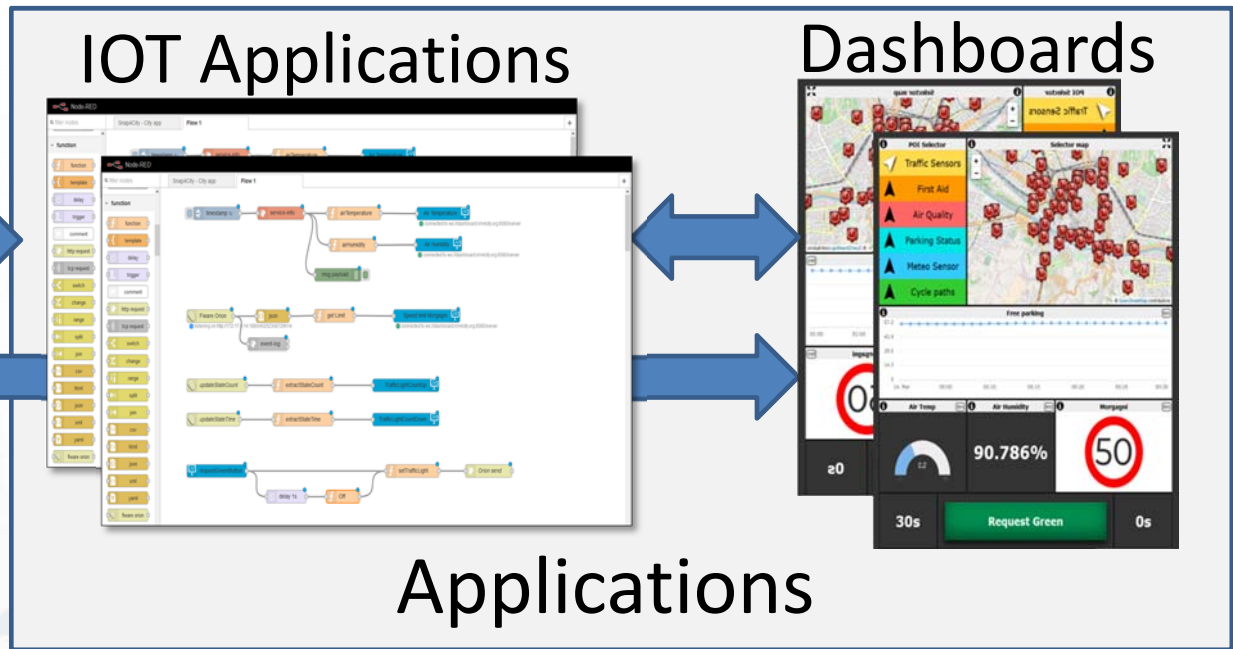
- Dashboards with IOT Applications for enforcing smart and intelligence into them.

Dashboard-IOT App

IOT and City data World



My IOT Devices



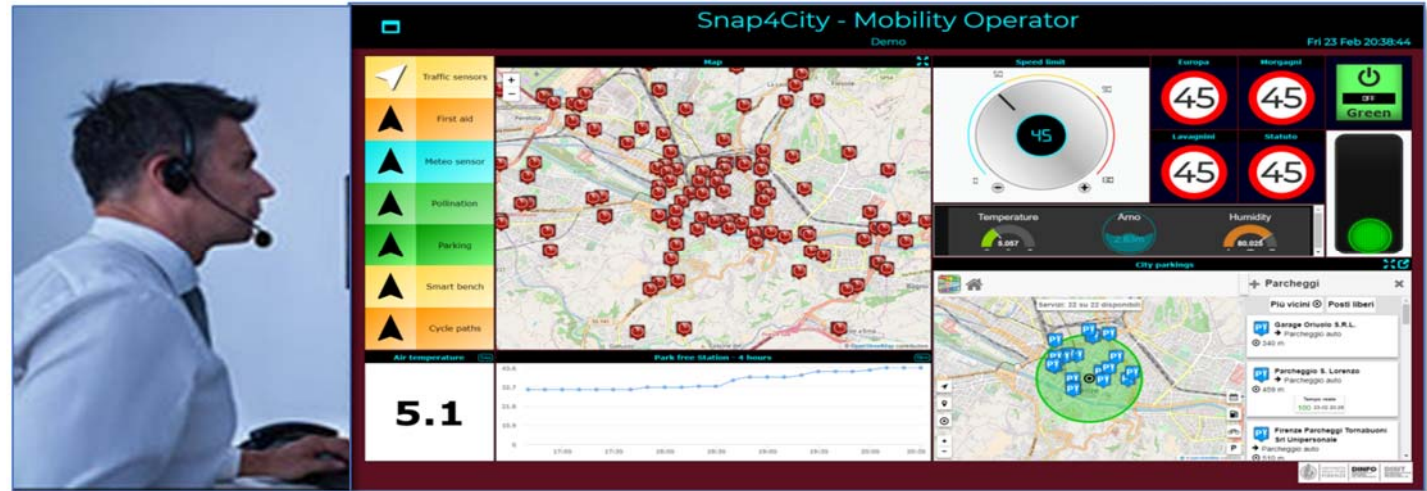
Applications

City Dashboard + IOT App

Control Room Operator

Would like to:

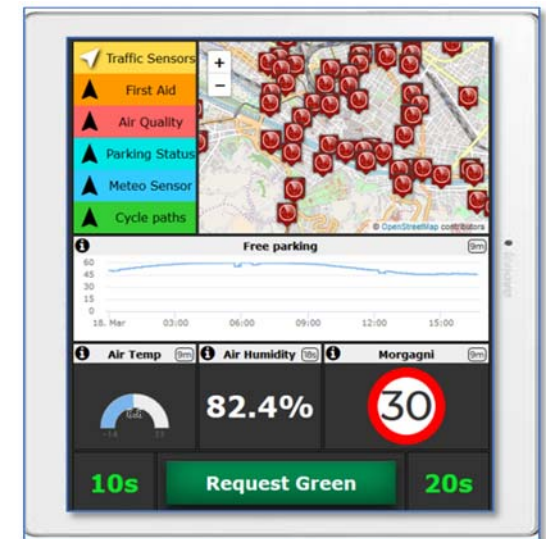
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., ..
- **Act and** monitor Dynamic Plates
- **Act and** monitor red lights



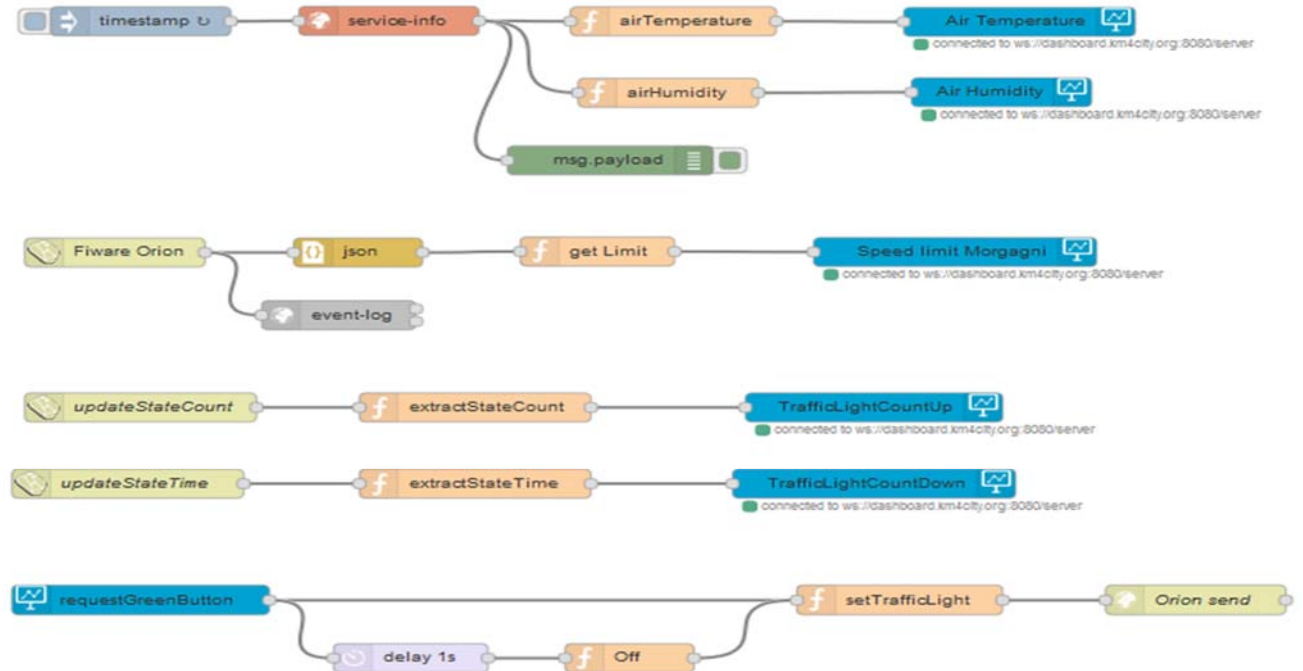
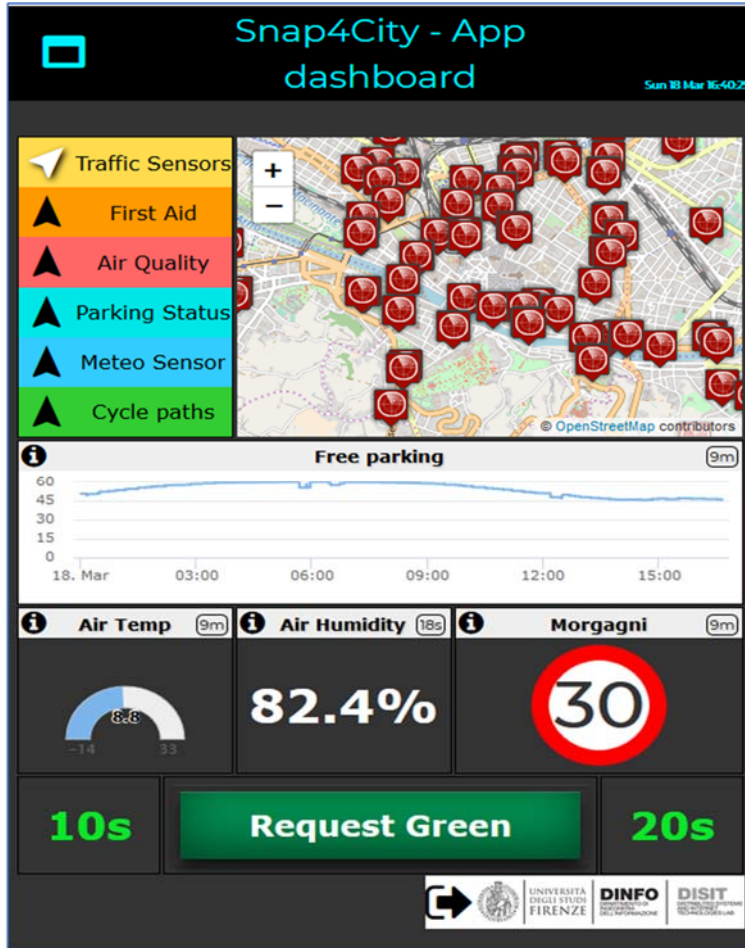
Driver, Policeman

Would like to:

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



IOT Application with City Dash simpler development





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
- 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



Prev 1 2 3 4 ... 9 Next

Filter

[Create new](#)

● Iot-App

IOT Application

owner: tester14

Management

● la mia app

IOT Application

owner: finaluser1

Management

● la mia app fi finuser1

IOT Application

owner: finaluser1

Management

● Localhost

IOT Application

owner: badii

Management

● MarazziniTest4

IOT Application

owner: mmarazzini2

Management

● MarazziniTest5

IOT Application

owner: mmarazzini2

Management

● MarazziniTest6

IOT Application

owner: mmarazzini2

Management

● marconewappa

IOT Application

owner: newmarco

Management

● media

IOT Application

owner: tester11

Management

● mia solo

IOT Application

owner: disit

Management

● my app

IOT Application

owner: pb3

Management

● my first app

IOT Application

owner: newpiro

Management

- roottooladmin1
RootAdmin | Idap
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Node-RED

filter nodes

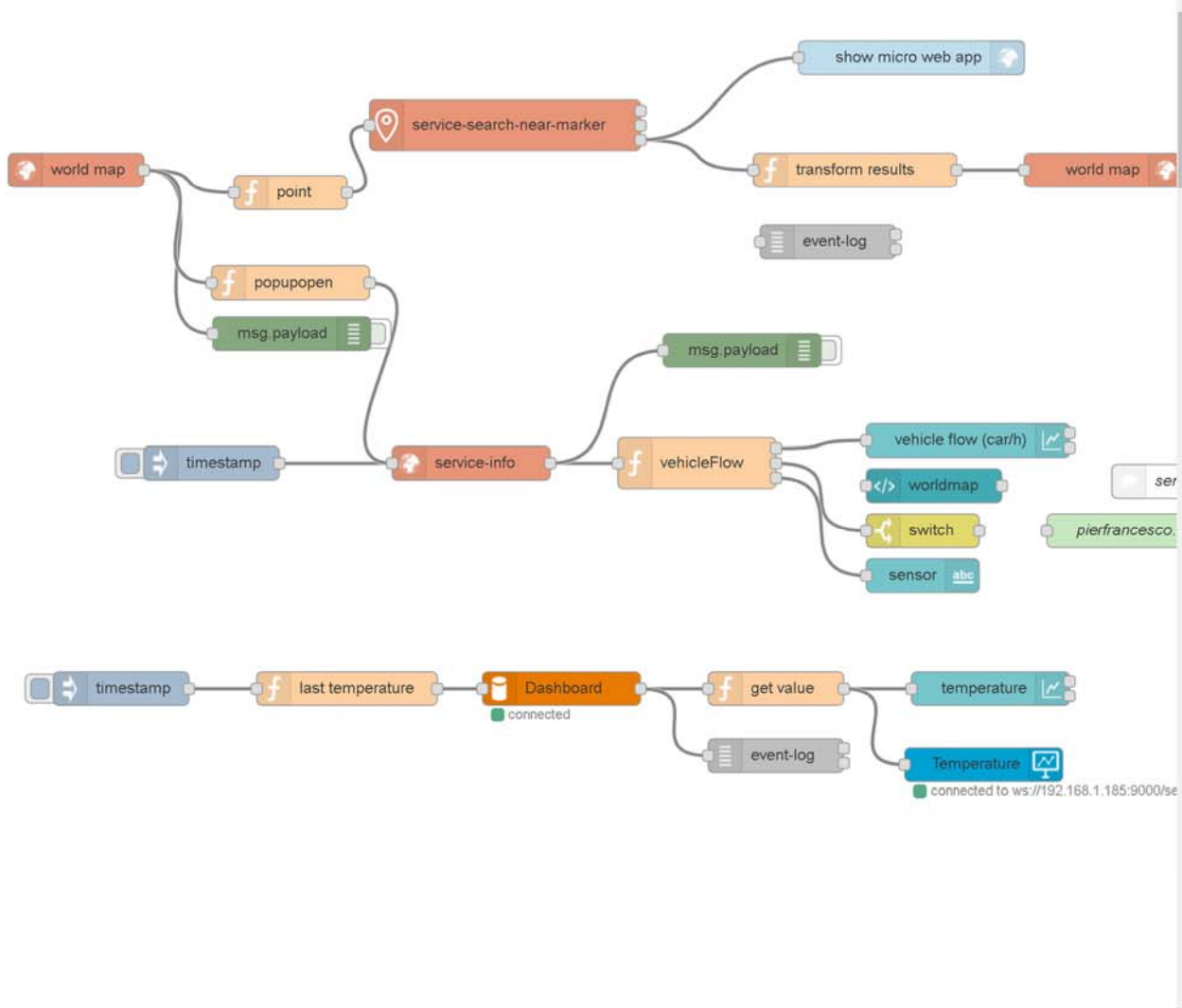
input

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

output

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

flow1 Flow 1



info debug dashb

Flow

Name	flow1
ID	"49a71aa0-b297b4"
Status	Enabled

Information

Information section with a search box and a button.



roottooladmin1
RootAdmin | ldap

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Node-RED

filter nodes

input

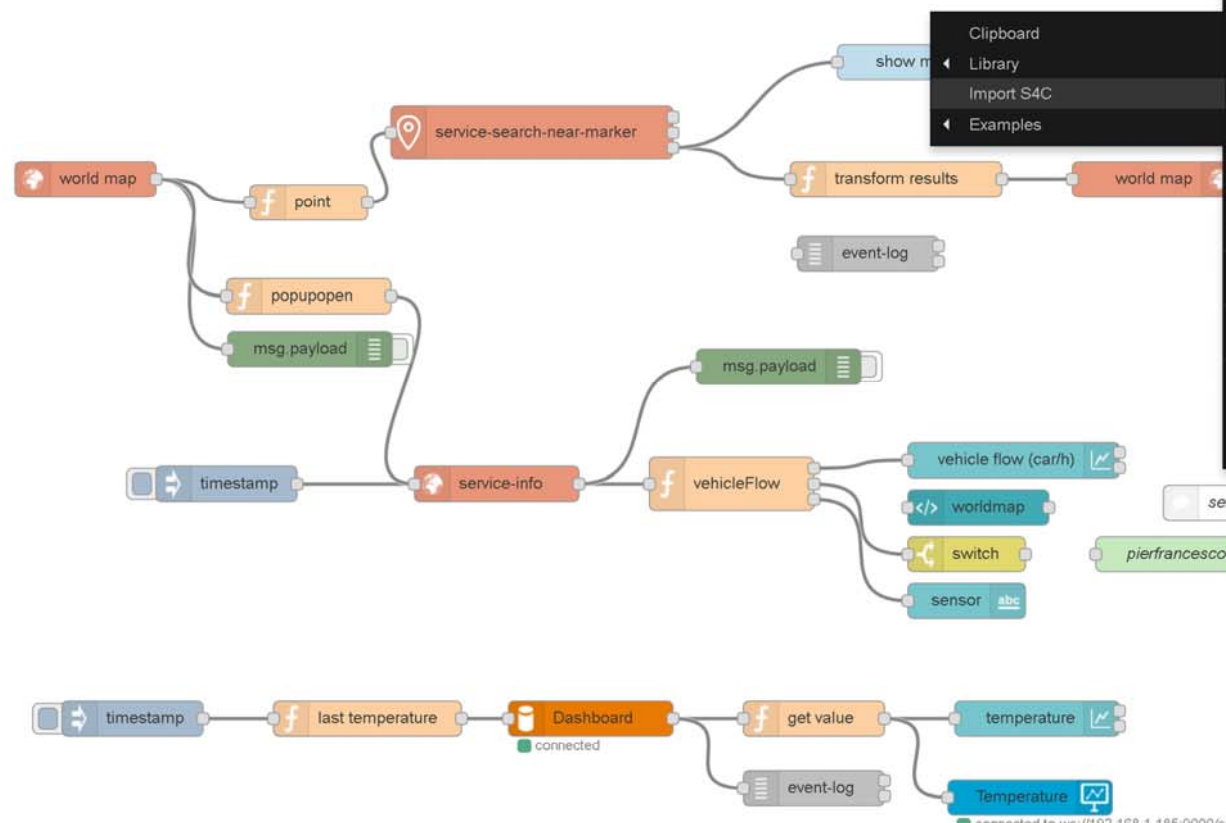
- inject
- catch
- status
- link
- mqtt
- http
- websocket
- tcp
- udp
- amqp
- amqp2

output

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

flow1

Flow 1



- Clipboard
- Library
- Import S4C
- Examples

- Deploy
- View
- Import
- Export
- Search flows
- Configuration nodes
- Flows
- Subflows
- Manage palette
- Settings
- Keyboard shortcuts
- Node-RED website
- v0.17.5

click and drag
on a node port to
move all of the
attached wires or just

Snap4City MicroServices



- > S4CIoT
- > S4CInfo
- > S4C Search
- > S4CView
- > S4CDataAnalytic
- > S4CDashboard
- > S4C SearchDev
- > S4CInfoDev
- > S4CLogDev
- > S4CManagement
- > S4C SearchExp
- > S4C SearchUsr

ckants

- ckants insert
- ckants search
- ckants create

S4CIoT

- iot directory
- iot directory

S4CInfo

- service info
- tpl agencies
- tpl lines
- tpl routes by agency
- tpl routes by line
- tpl routes by stop name
- tpl routes by line stop name
- tpl stops by route

S4C Search

- service search by queryid

S4CView

- show general iframe
- show micro web app

S4CDataAnalytic

- descriptive statistics
- trend plot
- time series predictions
- machine learning predictions

S4CDashboard

- city dashboard
- city dashboard
- geolocation

S4C SearchDev

- service search
- full text search dev
- event search dev
- address geometry search near gps position
- address poi search by text
- bus routes search

S4CInfoDev

- tpl routes
- tpl stops

S4CLogDev

- event log

S4C SearchExp

- service search near gps position
- service search near service
- service search within gps area
- service search within wkt area
- service search within stored wkt area
- service search by municipality
- full text search within wkt area
- full text search within gps area
- full text search near gps position
- full text search exp
- event search within wkt area
- event search within gps area
- event search near gps position
- event search exp
- address search near gps position
- geometry search near gps position
- address poi search by text exp

S4C SearchUsr

- address poi search by text near gps position
- bus routes search near gps position
- bus routes search within gps area
- bus routes search within wkt area
- bus routes search within stored wkt area
- service search near marker
- service search within circle
- service search within polygon
- service search along path
- full text search near marker
- full text search within circle
- full text search within polygon
- full text search along path
- full text search usr
- event search near marker
- event search within circle
- event search within polygon
- event search along path
- event search usr

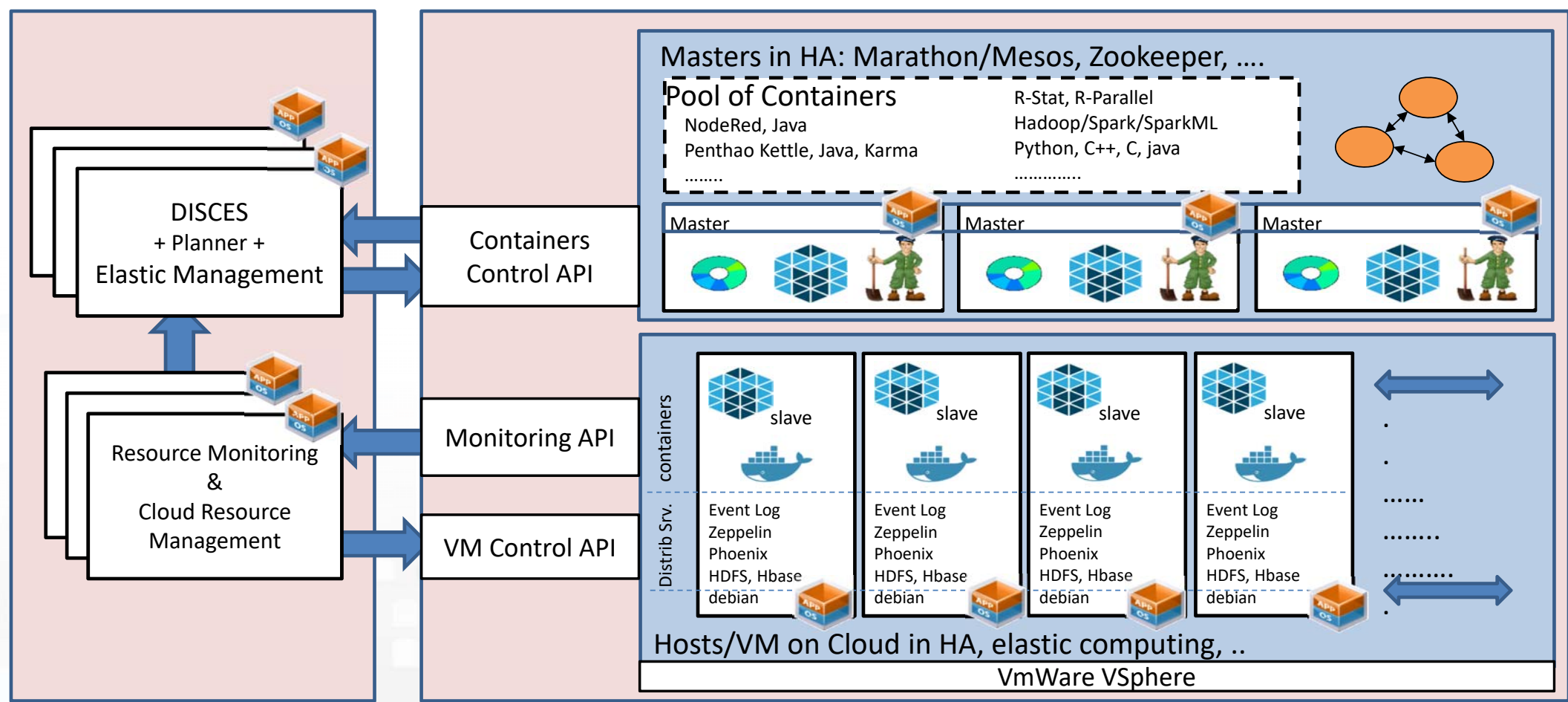
S4CManagement

- address search near marker
- geometry search near marker
- address poi search by text usr
- address poi search by text near marker
- address poi search by text within circle
- bus routes search near marker
- bus routes search within circle
- bus routes search within polygon
- check exist job
- check exist trigger
- get currently executing jobs
- get job detail
- get triggers of job
- get job group names
- get trigger group names
- get paused trigger groups
- trigger job

- fiware orion
- fiware orion



Hosts with VM on Cloud HA, DRS, FT





Elastic Scaling: allocare / deallocare

- Allocazione / deallocazione, Rebalancing vs compacting
 - Verticale delle risorse Docker e/o VM: CPU, Mem
 - NodeJS multiflusso per ogni Docker, l'utente richiede i flussi e le IOT App, il sistema le alloca in modo dinamico e ottimizza il carico
 - VM: gestione risorse Mem, CPU; trasparente ed automatica in DRS VmWare
 - Orizzontale delle risorse Docker e/o VM e/o [Host]:
 - Docker: aggiunta, spostamento (per clonazione) di IOT App
 - VM: on/off
- Monitoraggio risorse:
 - VM via VmWare API, Docker via Marathon and Mesos API
- Algoritmo in Python: azioni via API: VmWare, Marathon



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AreaManager | Idap

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- My Profile
- Snap4City portal**

www.snap4city.org

Home Tools Documentation Collaboration and blog

Cloud Resource Manager Snap4City

16,308 16,308,000

(1) (2) (4)

(3)

Facet Filter

(5)

UP-Processor

(6)

(7)

(8)



Snap4City

panesi
ToolAdmin | Idap

- Dashboards
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- Data Set Manager: Data Gate
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- Development Tools
- Management
 - Traffic Analyzer: AMMA
 - Data Analyzer: DevDash
 - Back Office Res. Analyzer: ResDash
 - Container Cluster Monitoring**
 - Back Office Container Monitoring
 - Smart City API Monitoring
 - Notifier Monitoring
 - Web Server Monitoring
 - Back Office Scheduler DISCES
 - Mobile Application Monitoring
 - Auditing Elements vs Ownership
 - Auditing Personal Data
 - Auditing Data Access: Try-out
 - Auditing Accesses
- Settings

Container Cluster Monitoring

Cluster status

Containers

850 units

Tasks

850 units

#Healthy

850 #tasks

#Unhealthy

0 #tasks

CPU trend

#VMs running

15 units

#VMs up

15 units

CPU

76.87 %

Memory

86.63 %

memory trend

Memory usage %

CPU usage %

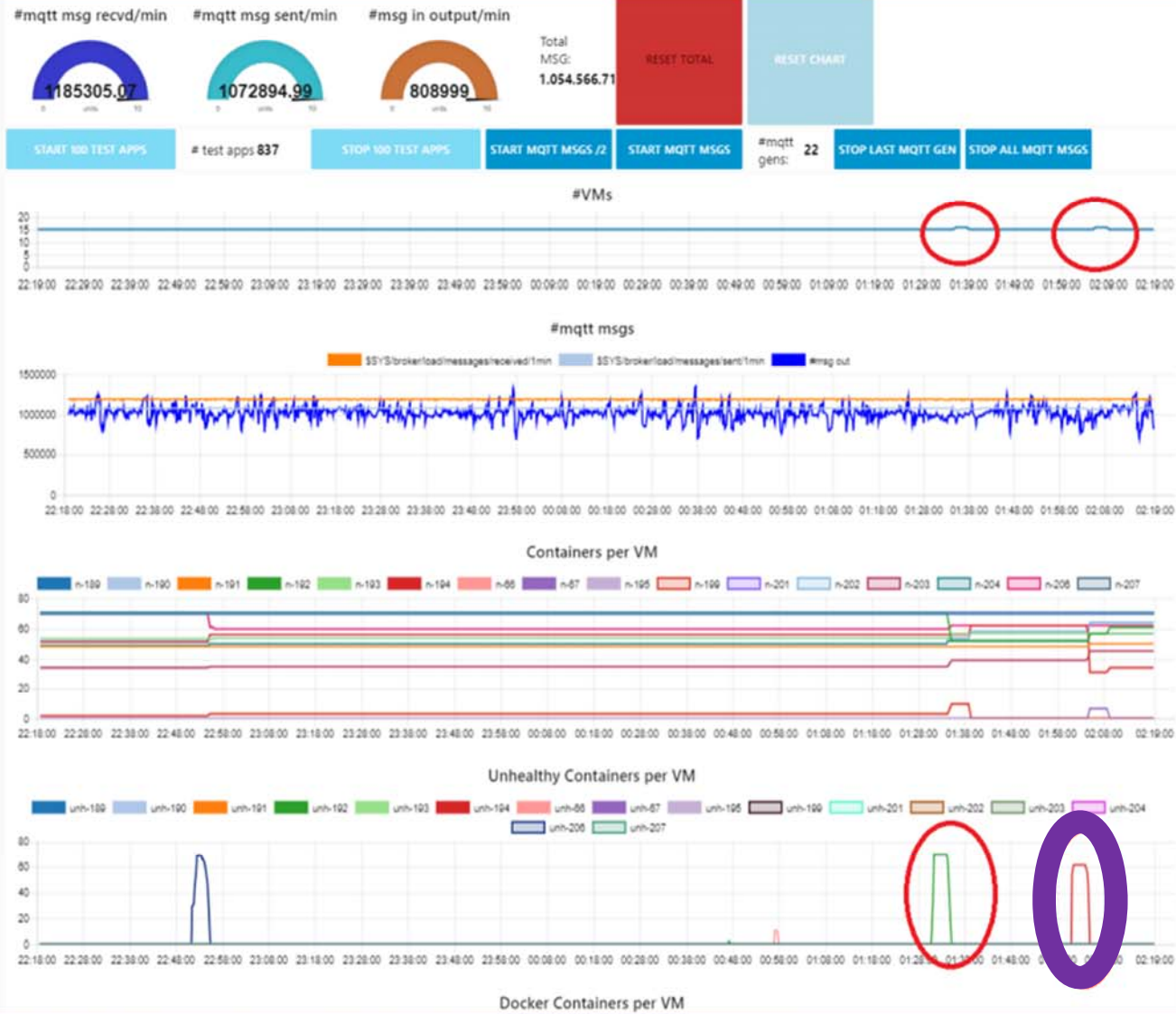
#Containers

RESET GRAPH CPU/MEM USAGE
RESET GRAPH TASKS

Testing



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Note

- <https://www.snap4city.org>
- Registratevi se lo volete provare o se volete saperne di piu'