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Snap4City

KM4CITY

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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Issues

- 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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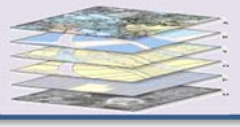
Open Data

GIS + Map Data



Personal Data

IoT/IoE

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

Km4City Ontology

Smart City Cloud Infrastructure

Km4City Smart City API

Final Users' Tools

Dashboards

IOT / IOE Apps

Mobile and Web Apps

Development and Management Tools

Management

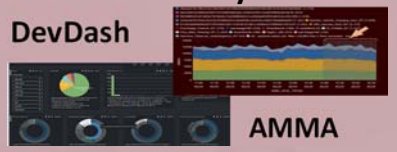
IOT Directory

ServiceMap

Linked Open Graph

Data Flow Analysis

DevDash



AMMA

DataGate/ CKAN

Resource Manager

Authentication, Authorization, GDPR, Security Assessment

Resources and the Architecture

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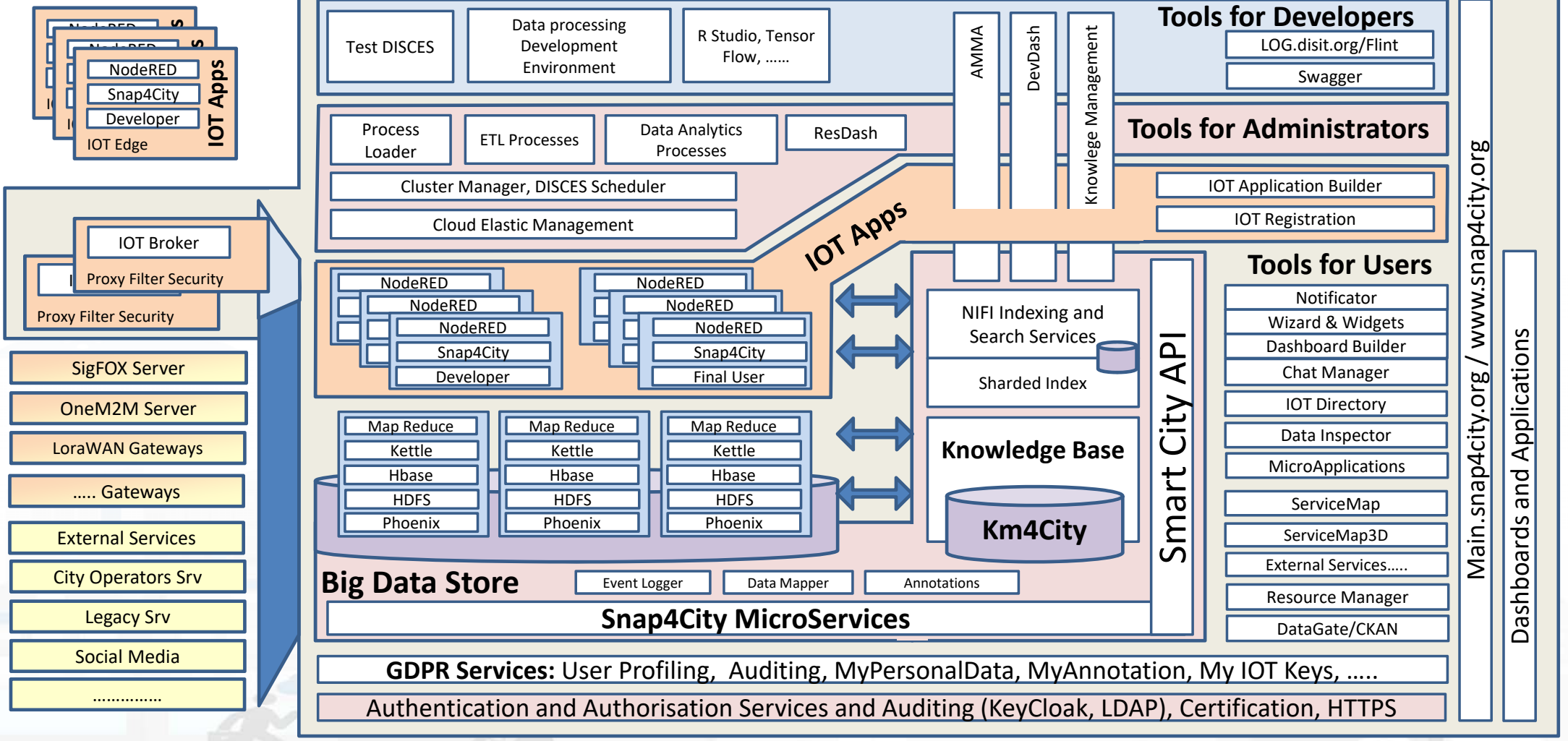

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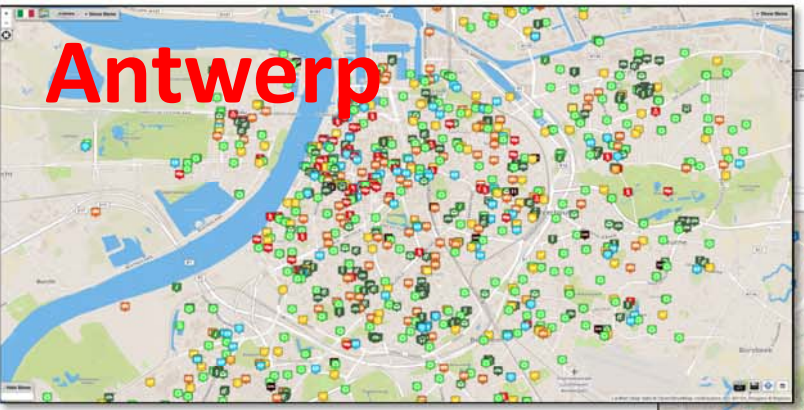
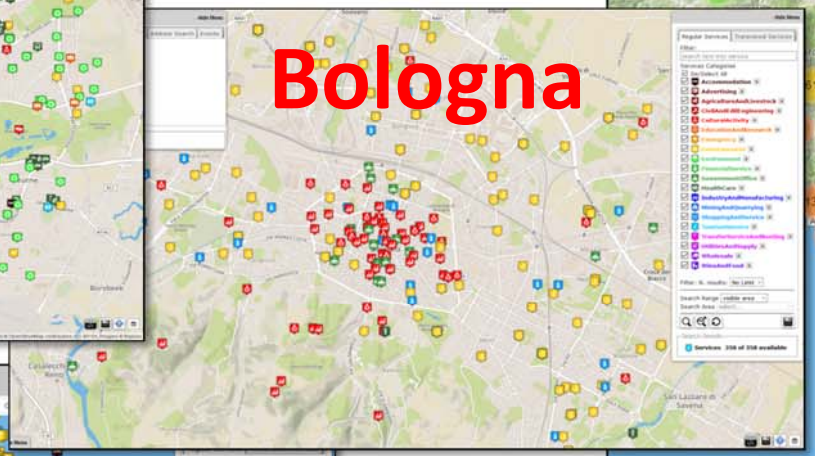
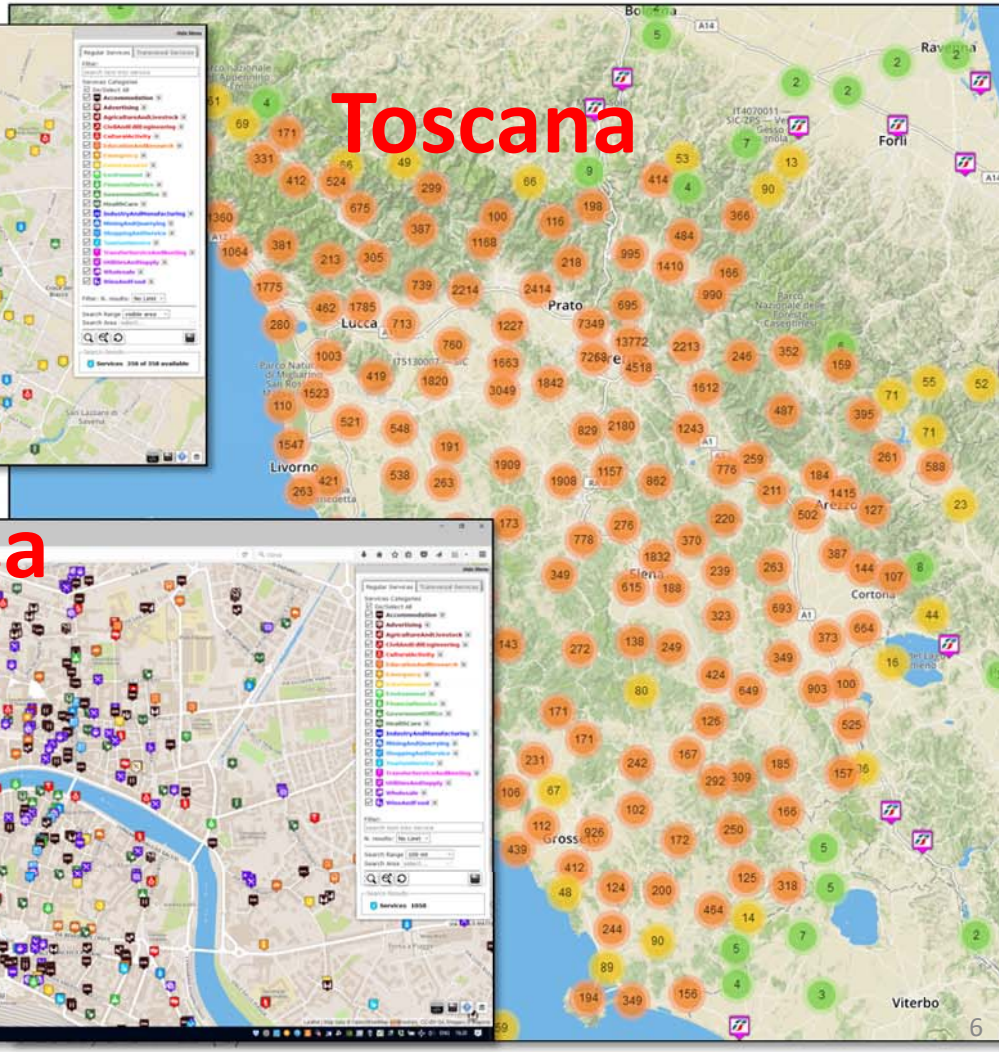
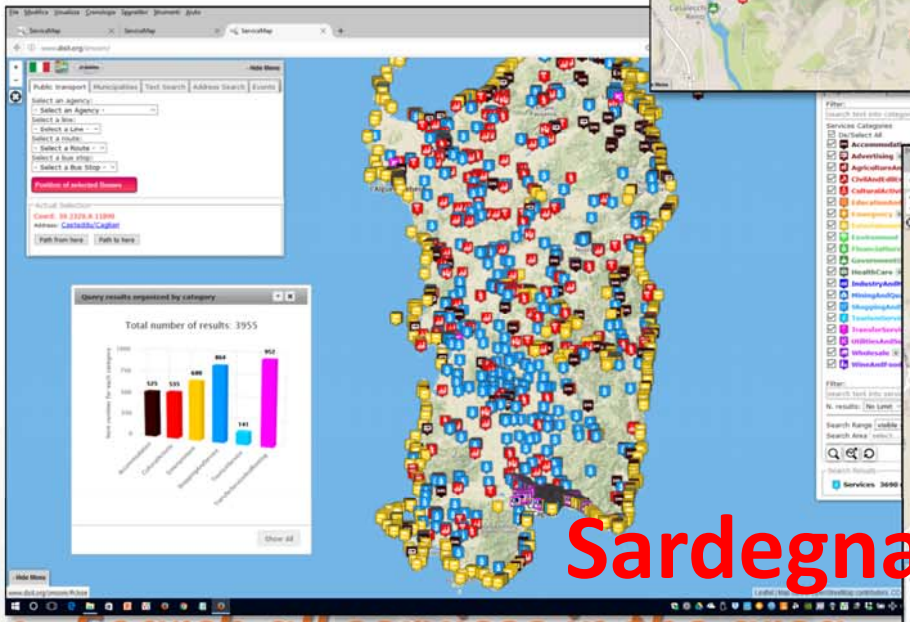
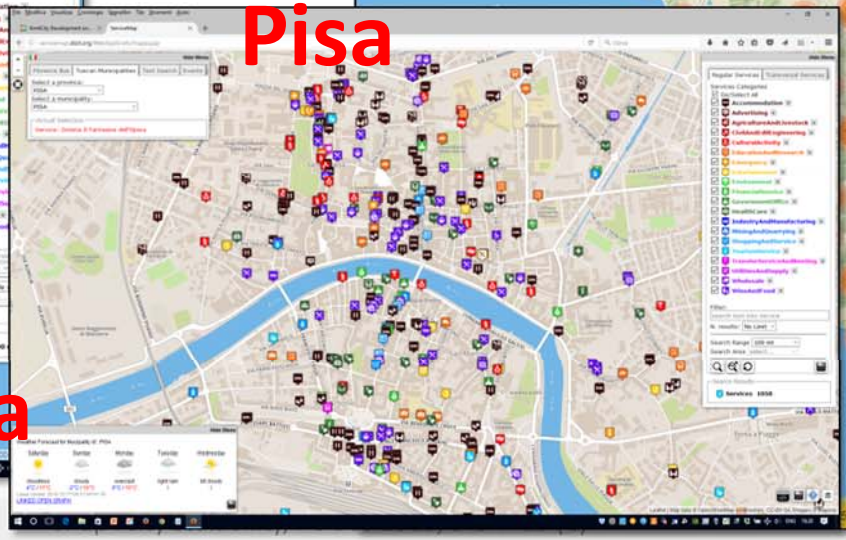
Coverage: examples



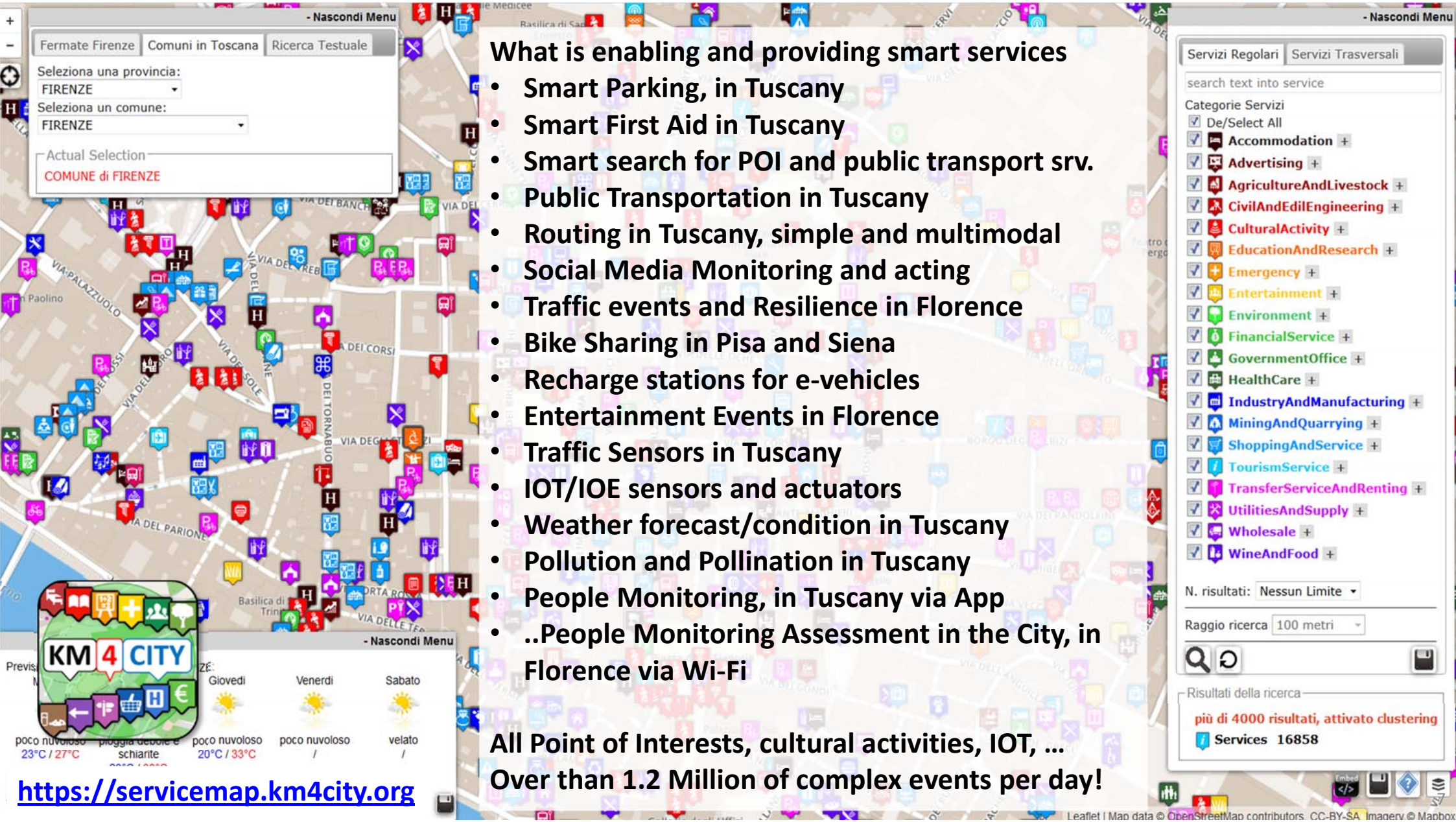








- Search all services in the area



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

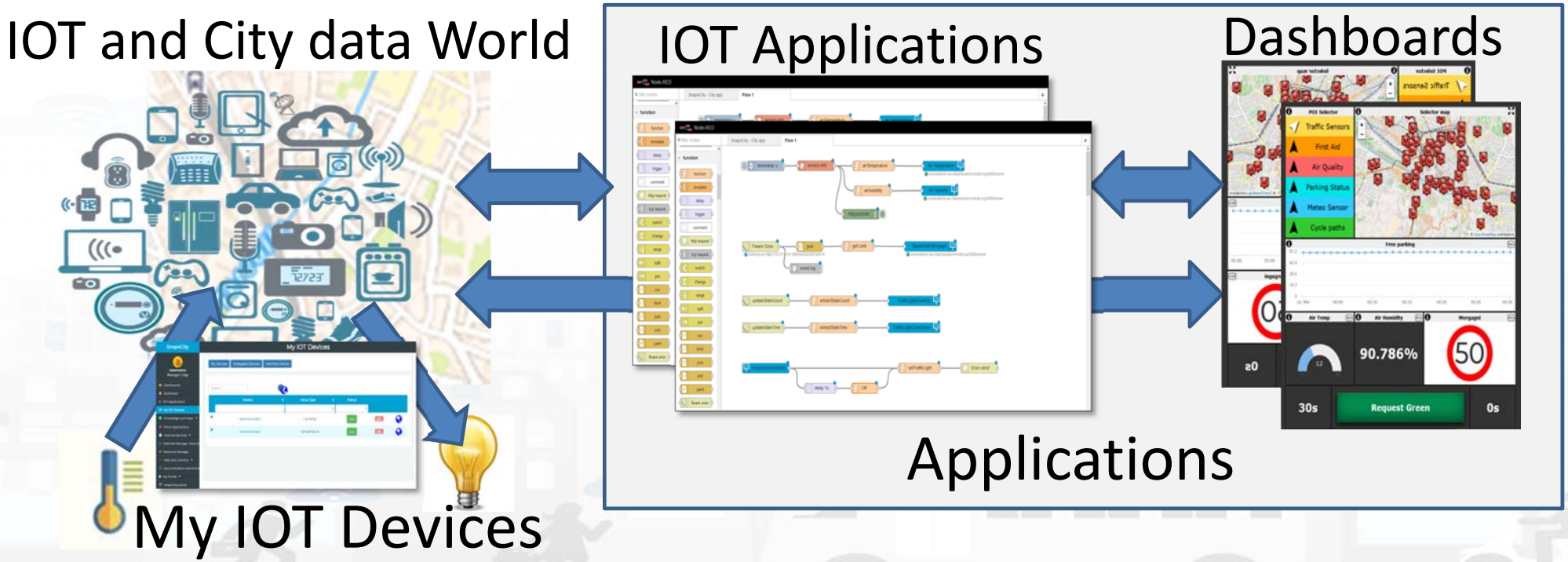
All Point of Interests, cultural activities, IOT, …
Over than 1.2 Million of complex events per day!

https://servicemap.km4city.org

Level 4 users: dashboard with intelligence App

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

Dashboard-IOT App

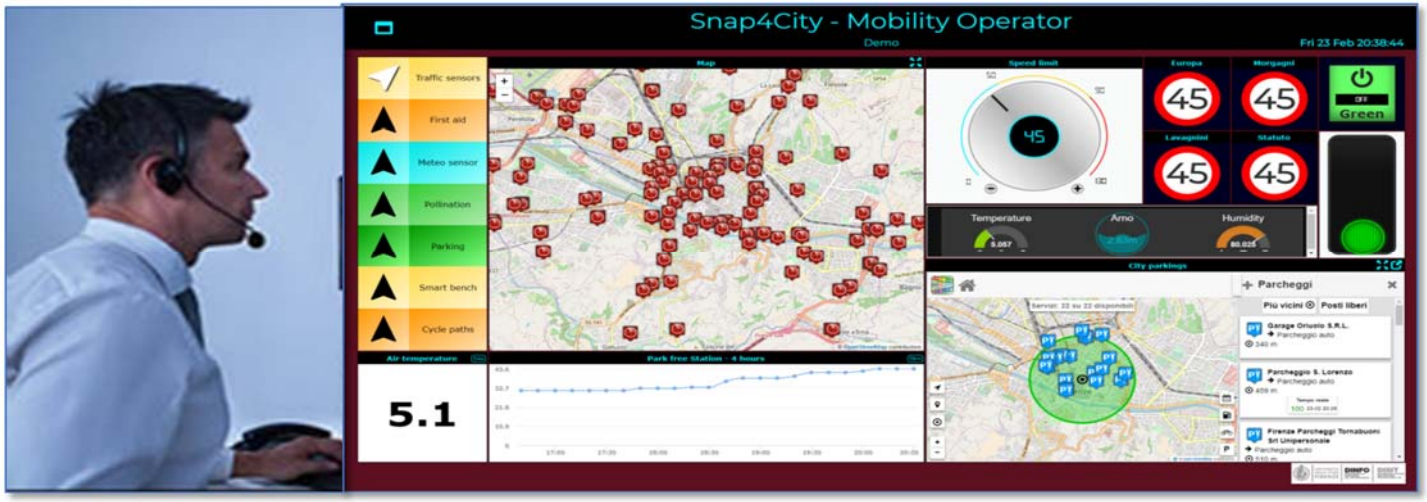


City Dashboard + IOT App

Control Room Operator

Would like to:

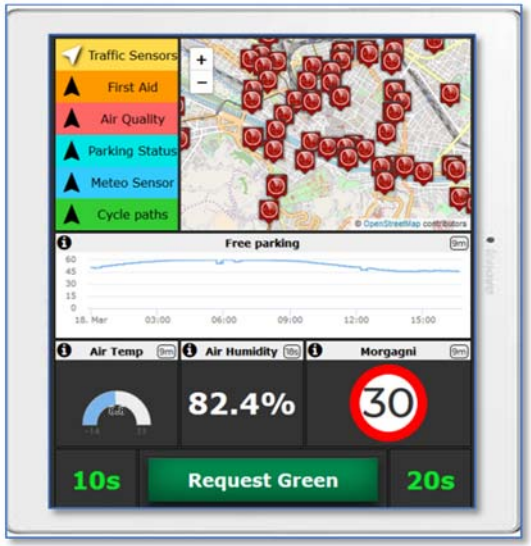
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., ..
- **Act and** monitor Dynamic Plates
- **Act and** monitor red lights



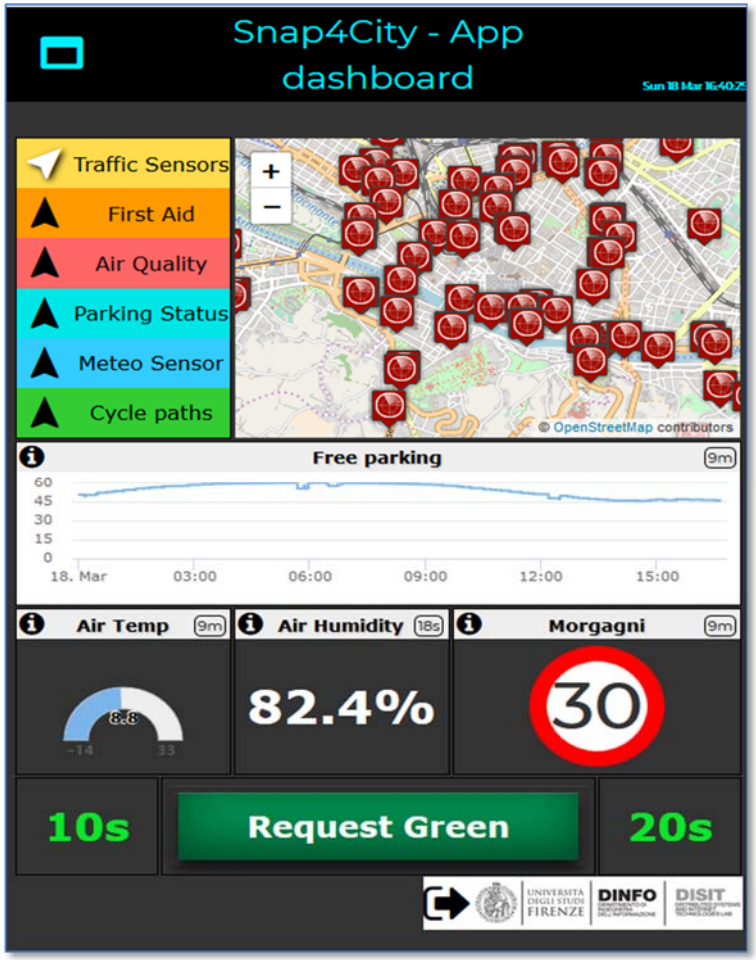
Driver, Policeman

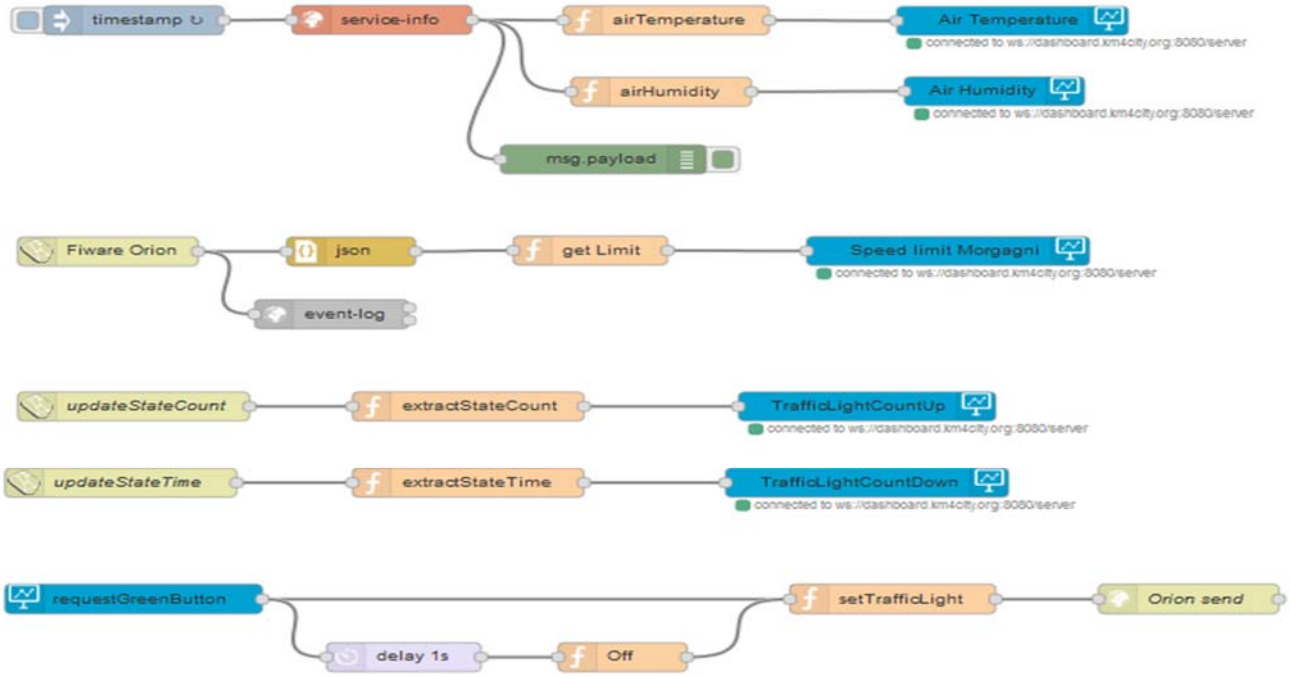
Would like to:

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



IOT Application with City Dash simpler development





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IOT Applications

roottooladmin1
RootAdmin | ldap

- 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
owner: tester14
Management

la mia app
owner: finaluser1
Management

la mia app fi finauser1
owner: finaluser1
Management

Localhost
owner: badii
Management

MarazziniTest4
owner: mmarazzini2
Management

MarazziniTest5
owner: mmarazzini2
Management

MarazziniTest6
owner: mmarazzini2
Management

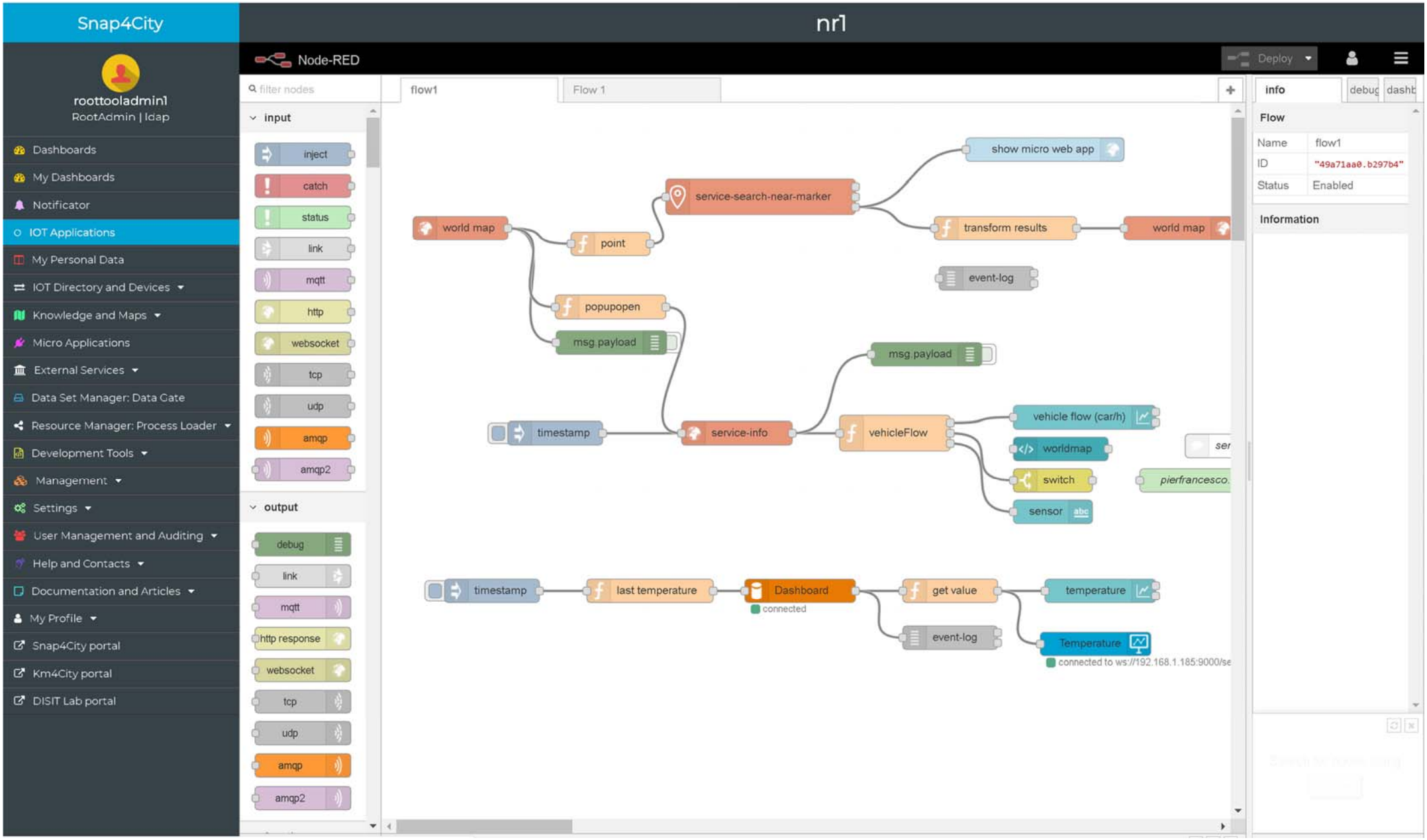
marconewappa
owner: newmarco
Management

media
owner: tester11

mia solo
owner: disit

my app
owner: pb3

my first app
owner: newpiero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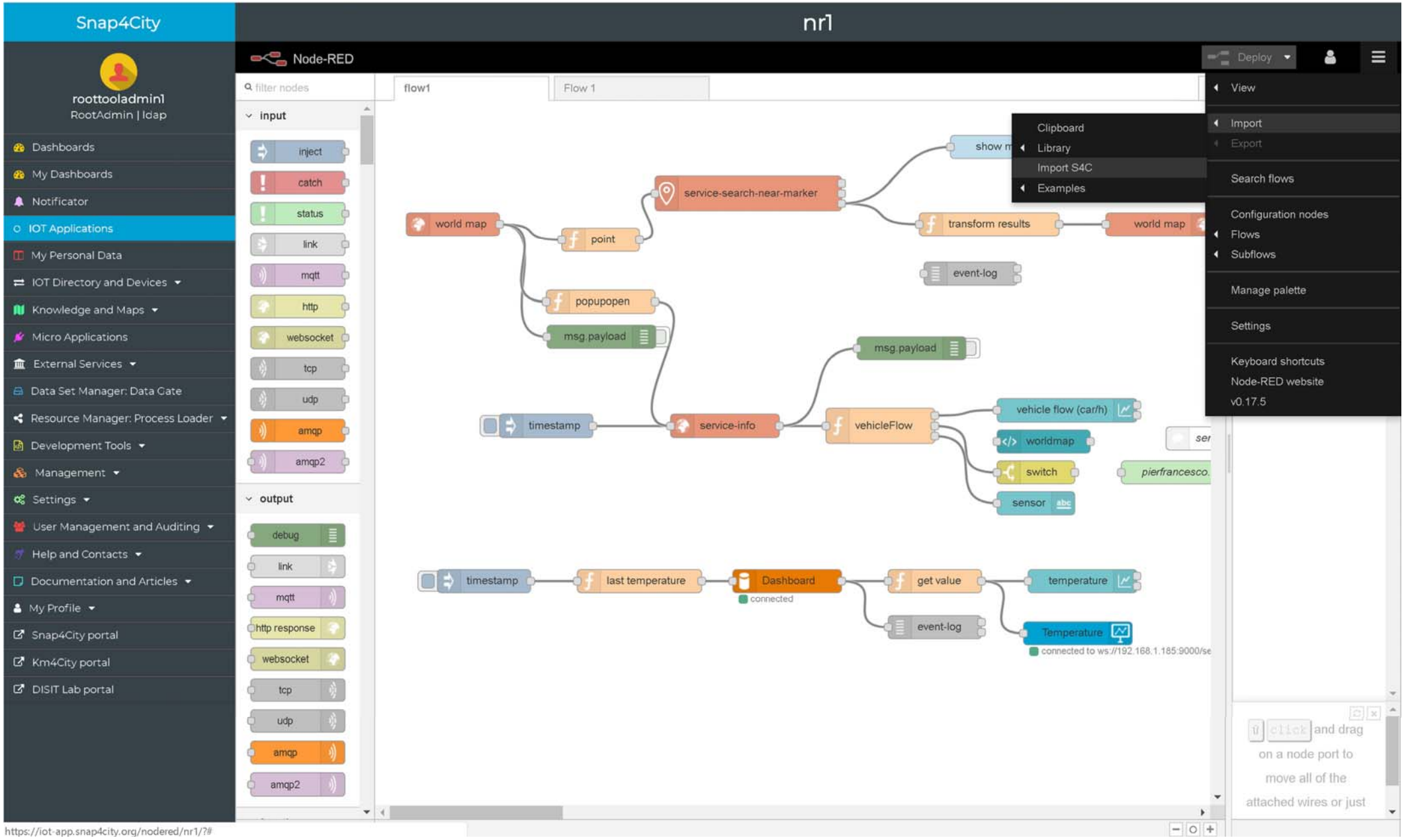
Km4City portal
DISIT Lab portal
Node-RED
Deploy
filter nodes
input
inject
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
flow1
Flow 1
show micro web app
service-search-near-marker
world map
point
transform results
world map
event-log
popupopen
msg.payload
msg.payload
timestamp
service-info
vehicleFlow
vehicle flow (car/h)
worldmap
switch
sensor
timestamp
last temperature
Dashboard
connected
get value
temperature
event-log
Temperature
connected to ws://192.168.1.185:9000/se
info
debug
dashb
Flow
Name
flow1
ID
"49a71aa0.b297b4"
Status
Enabled
Information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Flow 1
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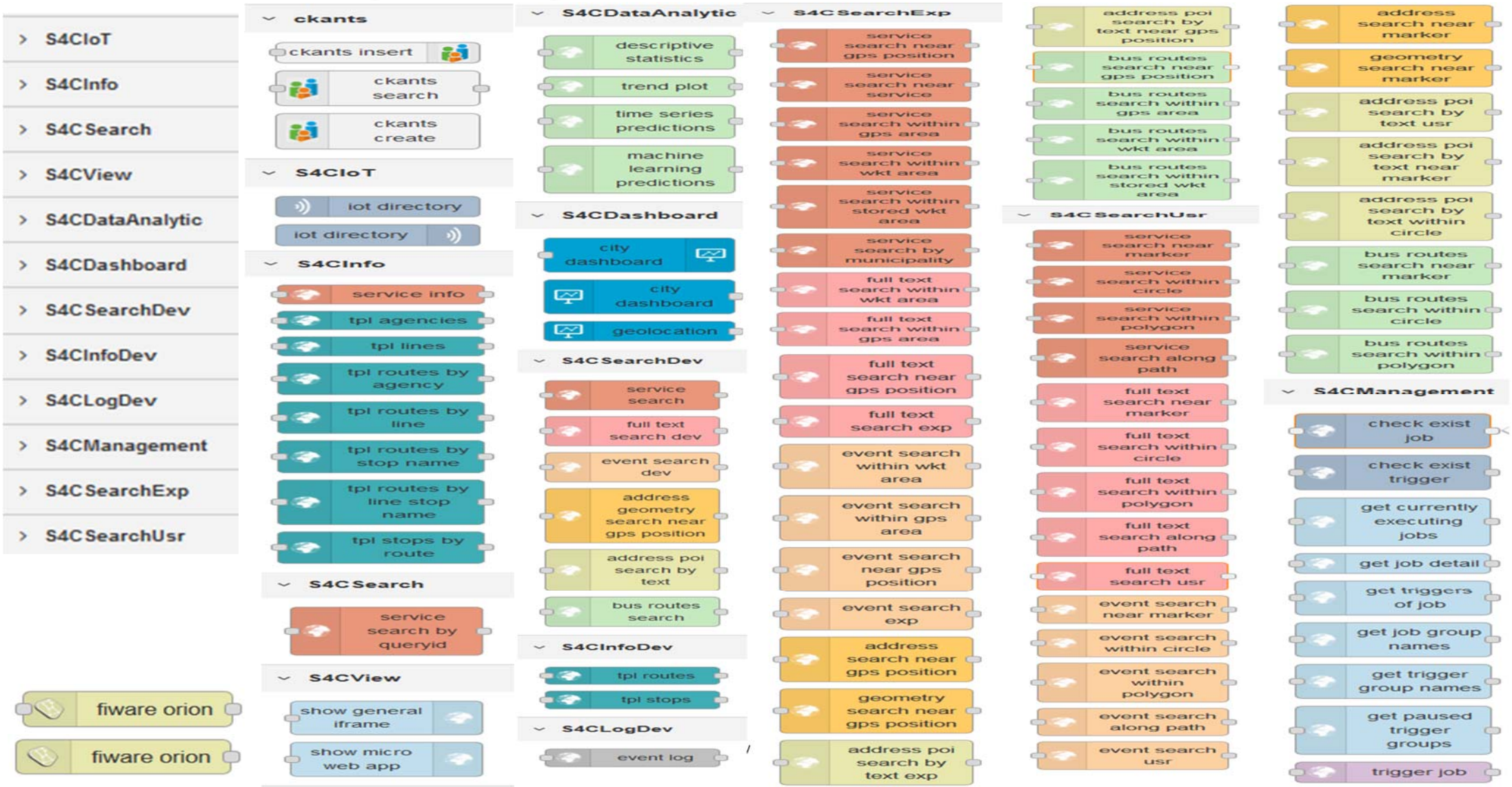
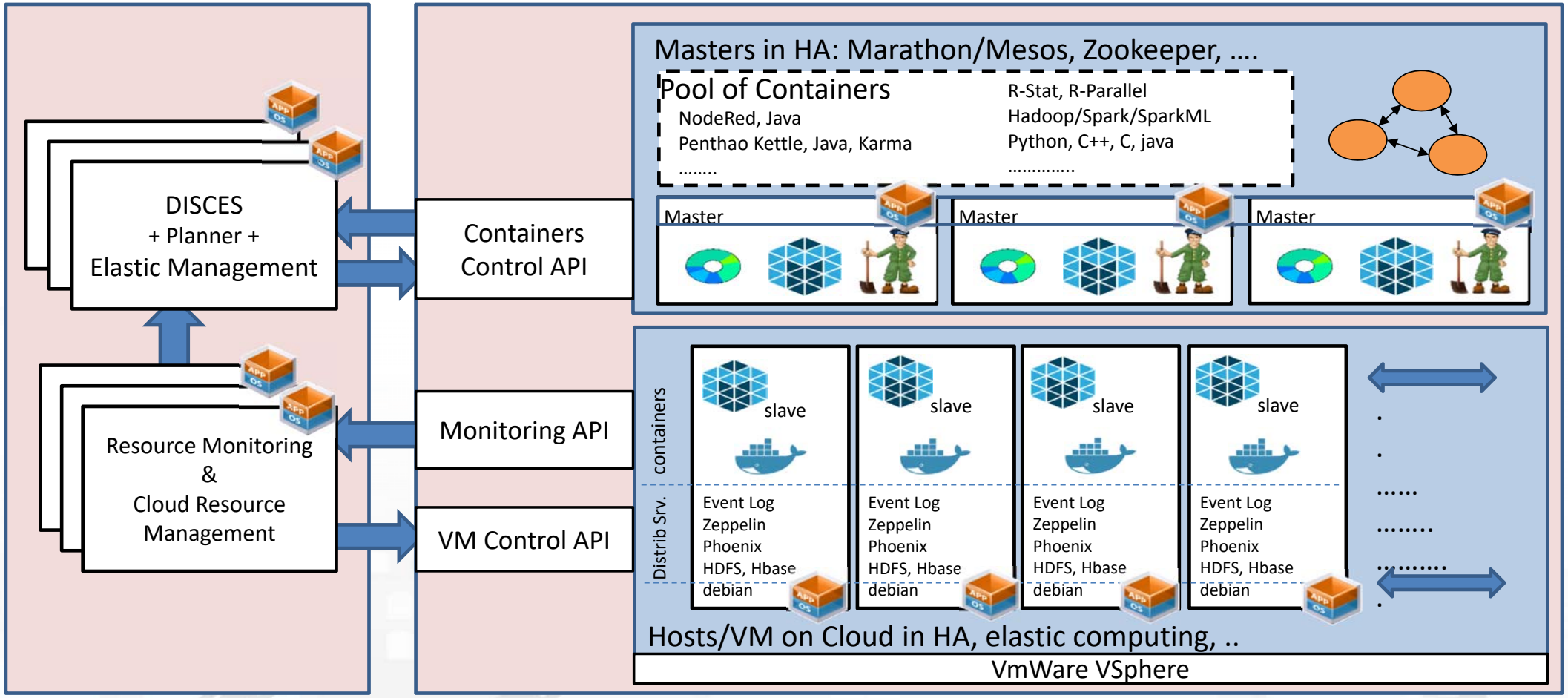
catch
status
link
mqtt
http
websocket
tcp
udp
amqp
amqp2
output
debug
link
mqtt
http response
websocket
tcp
udp
amqp
amqp2
world map
point
service-search-near-marker
transform results
world map
event-log
popupopen
msg.payload
msg.payload
timestamp
service-info
vehicleFlow
vehicle flow (car/h)
worldmap
switch
sensor
timestamp
last temperature
Dashboard
connected
get value
temperature
event-log
Temperature
connected to ws://192.168.1.185:9000/se
View
Import
Export
Search flows
Configuration nodes
Flows
Subflows
Manage palette
Settings
Keyboard shortcuts
Node-RED website
v0.17.5
Clipboard
Library
Import S4C
Examples
click and drag
on a node port to
move all of the
attached wires or just
https://iot-app.snap4city.org/nodered/nr1/?#

Snap4City MicroServices

Snap4City



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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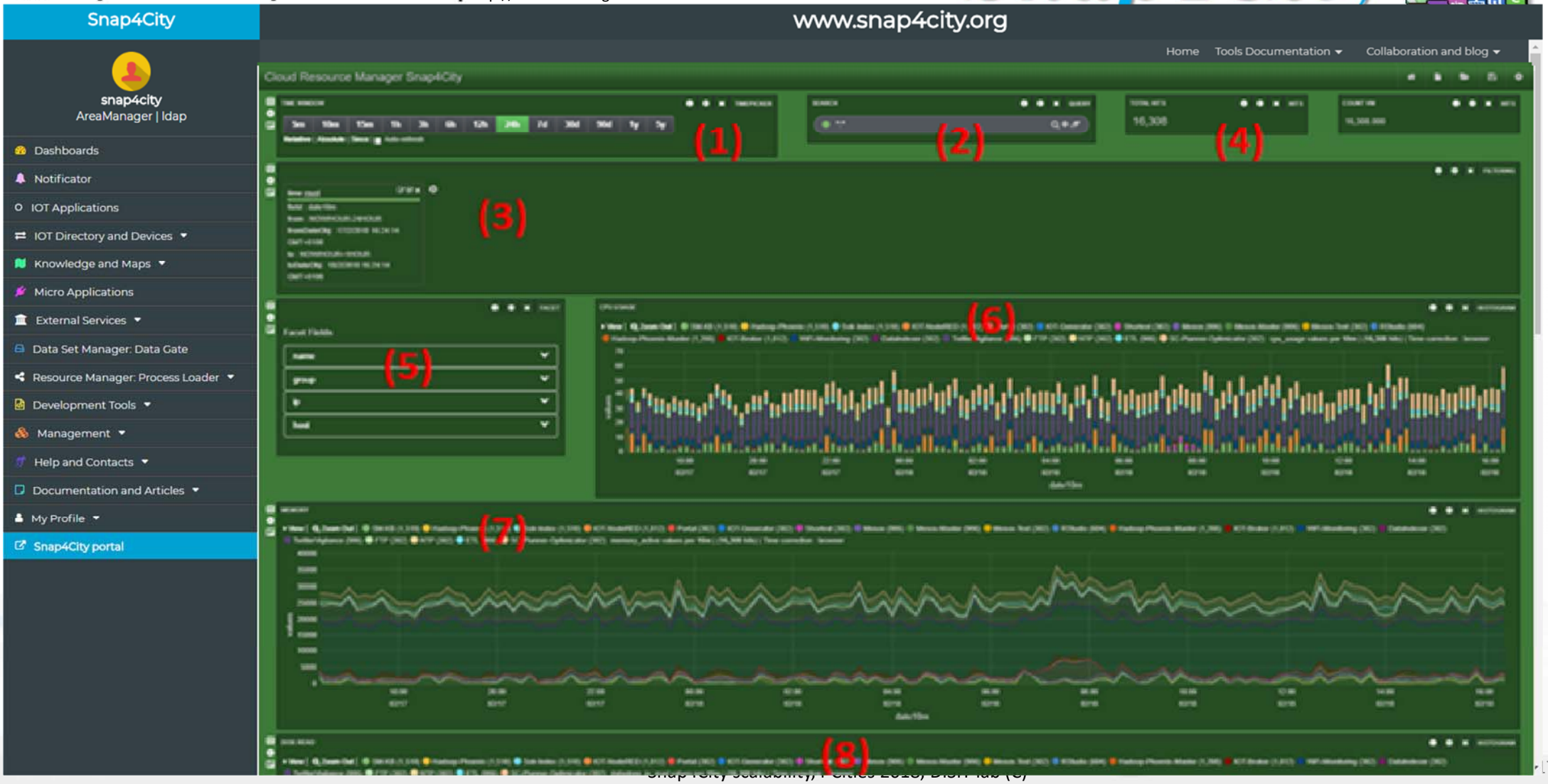

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Container Cluster Monitoring
panesi
ToolAdmin | ldap
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Data Analyzer: DevDash
Back Office Res. Analyzer: ResDash
Container Cluster Monitoring
Back Office Container Monitoring
Smart City API Monitoring
Notificator 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
Cluster status
Containers
850
Tasks
850
#Healthy
850
#Unhealthy
0
CPU trend
#VMs running
15
#VMs up
15
CPU
76.87
Memory
86.63
memory trend
Memory usage %
CPU usage %
#Containers
Total
Healthy
RESET GRAPH CPU/MEM USAGE
RESET GRAPH TASKS

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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
Help and Contacts
Documentation and Articles
My Profile
Snap4City portal
#mqtt msg recvd/min
#mqtt msg sent/min
#msg in output/min
1185305.07
1072894.99
808999
Total MSG: 1.054.566.71
RESET TOTAL
RESET CHART
START 100 TEST APPS
test apps 837
STOP 100 TEST APPS
START MQTT MSGS /2
START MQTT MSGS
#mqtt gens: 22
STOP LAST MQTT GEN
STOP ALL MQTT MSGS
#VMs
#mqtt msgs
Containers per VM
Unhealthy Containers per VM
Docker Containers per VM

Note

- **Https://www.snap4city.org**
- **Registratevi se lo volete provare o se volete saperne di piu'**