



Towards the Smart City concept let's discover

Summary

Why do we need Smart Cities?

Is the IoT enough?

CACHACA - let's discover

1

Why do we need Smart Cities?

New challenges to face



New challenges to face

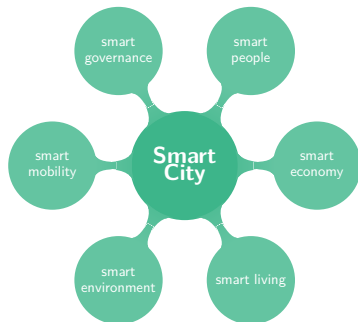


New challenges to face



A Smart City¹ needs integration

- ▶ efficiency and sustainability.
- ▶ integrate all the infrastructures and services.
- ▶ monitor and control via intelligent devices.



¹G. P. Hancke and B. d. C. E. Silva. "The role of advanced sensing in smart cities". In: *Sensors* 13.1 (2013).

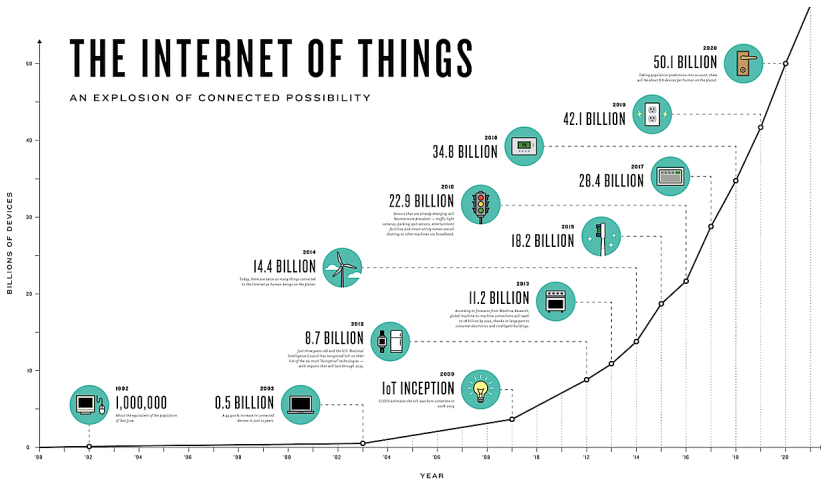
The Internet of Things (IoT), **connectivity** for anything

“from ***anytime*** and ***anyplace***, ***anyone*** will now have connectivity for ***anything***”²

²ITU Internet Reports. *The Internet of Things*. 2005.

THE INTERNET OF THINGS

AN EXPLOSION OF CONNECTED POSSIBILITY



Credit: www.i-scoop.eu - based on Cisco data.

First takeaways

- ▶ Cities need to be *smarter*.
- ▶ A Smart City needs integration.
- ▶ IoT is called to play a key role.



2

Is the IoT enough?

Libelium Smart World

Air Pollution

Control of CO₂ emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest Fire Detection

Monitoring of combustion gases and preemptive fire conditions to define alert zones.

Wine Quality Enhancing

Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

Offspring Care

Control of growing conditions of the offspring in animal farms to ensure its survival and health.

Sportsmen Care

Vital signs monitoring in high performance centers and fields.

Structural Health

Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

Smartphones Detection

Detect iPhone and Android devices and in general any device which works with WiB or Bluetooth interfaces.

Perimeter Access Control

Access control to restricted areas and detection of people in non-authorized areas.

Radiation Levels

Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

Traffic Congestion

Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Lighting

Intelligent and weather adaptive lighting in street lights.

Intelligent Shopping

Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

Noise Urban Maps

Sound monitoring in bar areas and centric zones in real time.

Water Leakages

Detection of sound pressures outside tanks and pressure variations along pipes.

Vehicle Auto-diagnosis

Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Item Location

Search of individual items in big surfaces like warehouses or harbours.

Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

Smart Parking

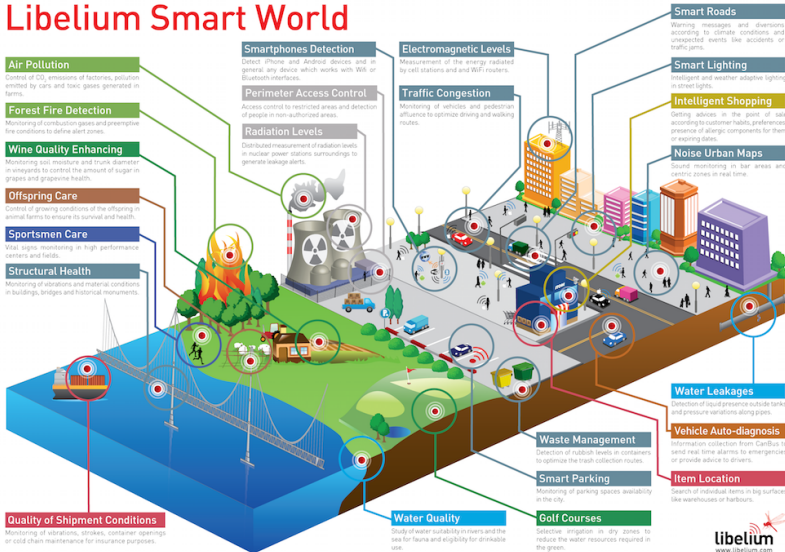
Monitoring of parking spaces availability in the city.

Golf Courses

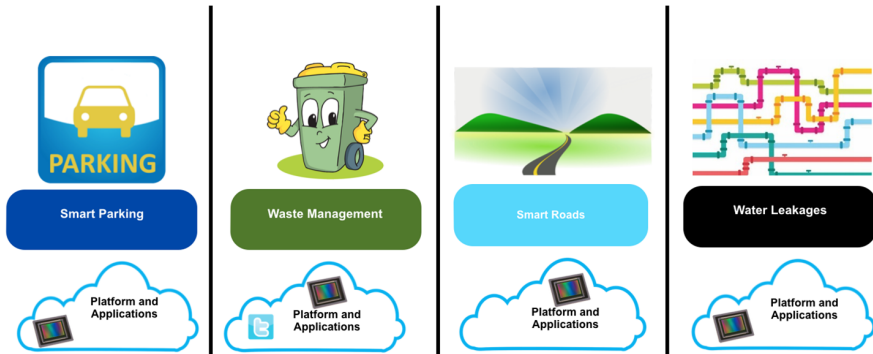
Selective irrigation in dry zones to reduce the water resources required in the green.

Water Quality

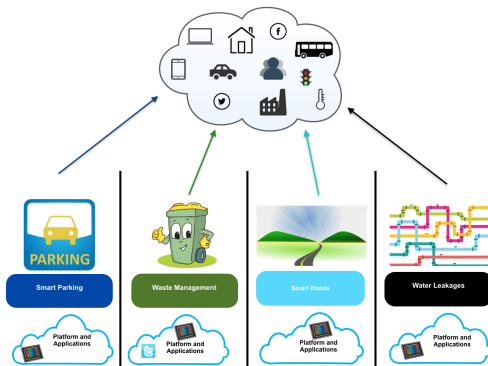
Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.



IoT applications are based on different architectures, standards, and platforms



The Cloud of Things (CoT)³



- ▶ Sensing-as-a-service model
- ▶ Semantic web technologies (i.e., Linked-Data)

³R. Petrolo, V. Loscri, and N. Mitton. "Towards a Smart City based on Cloud of Things, a survey on the smart city vision and paradigms". In: *Transactions on Emerging Telecom. Technologies* (2015).

...takeaways...

- ▶ CoT overcomes IoT's limitations in the Smart City context.
- ▶ Discovery of “appropriate” resources is a challenge.



3

CACHACA - let's discover

Confident-based Adaptable Connected objects discovery
to HARmonize smart City Applications

CACHACA's context

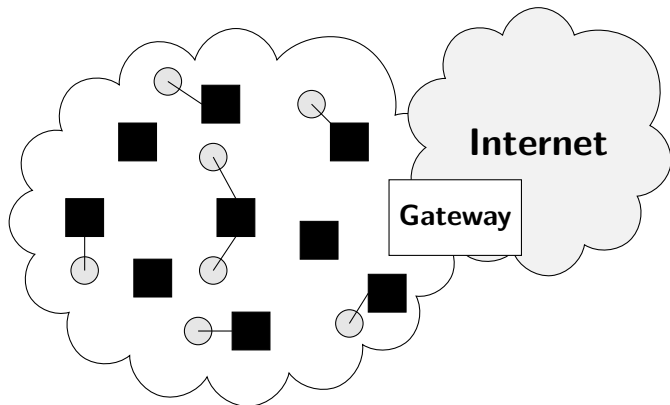


Figure: *node* (square), *sensor* (circle).

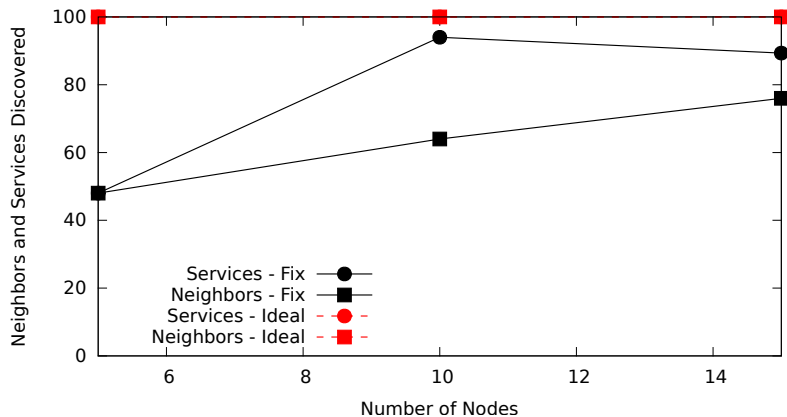
CACHACA evaluates and classifies neighborhood and services for each node

- ▶ existing Neighbor Discovery protocol
- ▶ adding info about “service(s)” offered by each node
- ▶ using Fuzzy logic
- ▶ introducing 2 metrics (physical and service confidence)

CACHACA's Neighbors Table

<i>ID</i>	<i>Service</i>	ω	φ	...
1	temp	excellent	good	...
30	light	good	good	
2	temp	excellent	excellent	
...				

CACHACA discovers almost all the services available



CACHACA for Smart Buildings



...takeaways

- ▶ Cities need to be smarter.
- ▶ IoT is not enough to enable the Smart City vision.
- ▶ Discovering “appropriate” service(s) is a challenge.





THANKS!

informatics mathematics
inria

Riccardo PETROLO

riccardo.petrolo@inria.fr

<http://chercheurs.lille.inria.fr/petrolo>