

Software Defined Cities

Integrating the Cyber World with the Internet of Things by Leveraging on
Network Intelligence

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Consorzio Interuniversitario Nazionale per l'Informatica (CINI)



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- Director of the MDSLlab research group (mdslab.unime.it)
- Director of the CINI Italian lab on smart cities
<https://www.consortio-cini.it>
- Co-founder of Smartme (smartme.io)



A consortium of 47
Italian Universities that:

- do research in CS/CE
- deliver BS, MS, PhD degrees
- are public funded

Involves 1,300+
professors of CS or CE



Goals

- Pave the way to promote and stimulate **projects of national dimension**
- Develop a reference platform to manage smart cities with an *open* approach for software, data and hardware
- Create **Living Labs** to facilitate the development of new services for the citizens and strength the cooperation with PA and industries
- Adopt **re-using**, i.e. exchanging experiences and solutions among co-operating living labs

WHAT IS A SMART CITY?

A set of **Policies & Strategies** that leverage **technology** and **Data** to Deliver initiatives that:

- 1 Drive efficiency, sustainability and improved decision making for **cities**
- 2 Create a transparent, efficient and competitive environment for **businesses**
- 3 Improve inclusiveness, services and the quality of life for its **citizens**

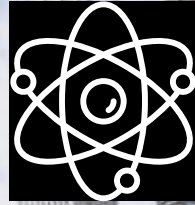


WHAT MAKES A SMART CITY



Monitor

Sense/Observe
Communicate/Connect



Model

Analyze/Optimize

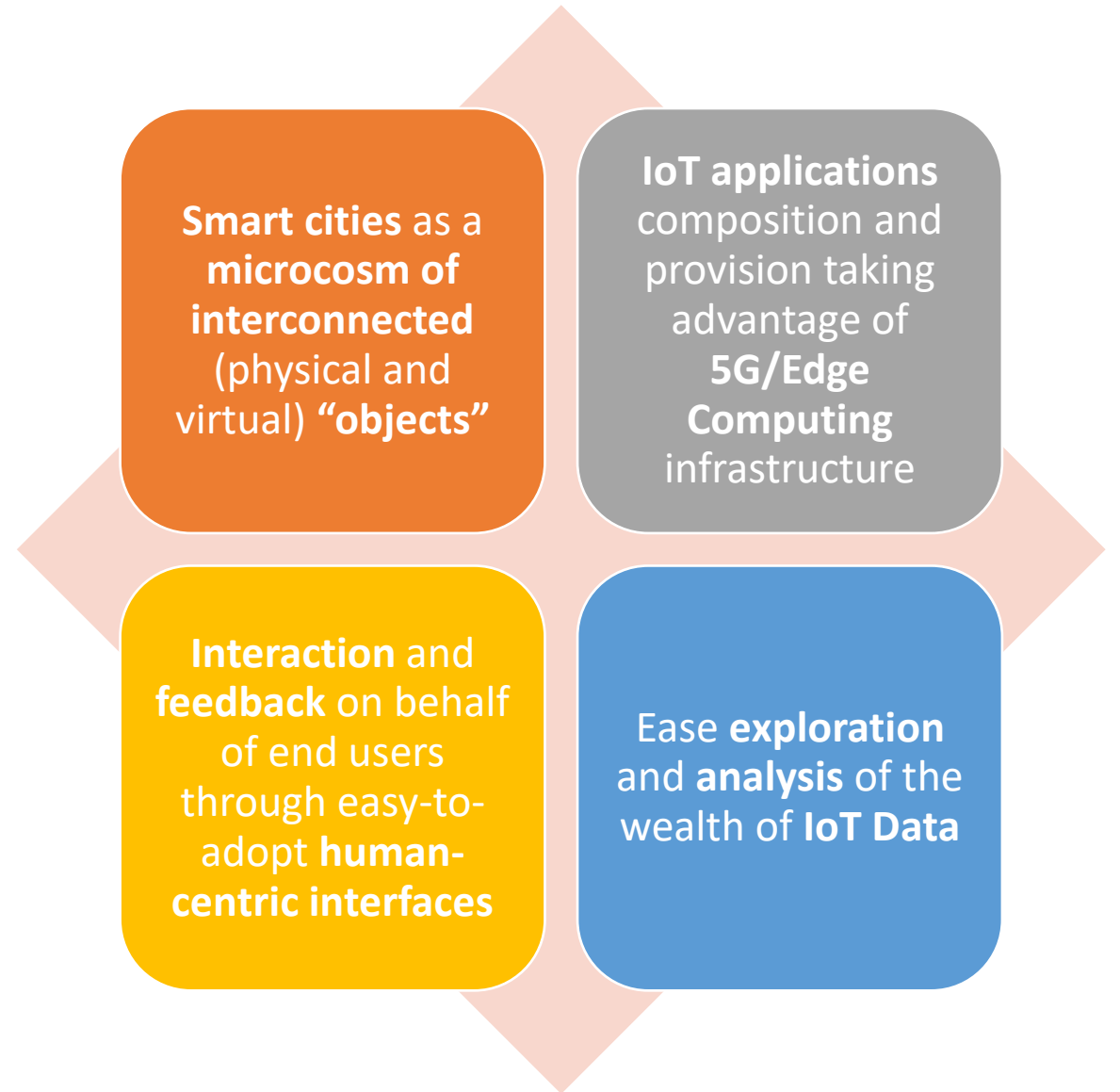


Manage

Present/Visualize,
Act

Data collection and analysis to **affect** the system
Act in Real-time @ City Scale
Drive learning algorithms and processing architecture

Smart Cities of the Future



SMART CITIES MEANS DIFFERENT THINGS TO DIFFERENT STAKEHOLDERS



- Traffic control
- Air quality monitoring
- Trash management
- Autonomous security systems

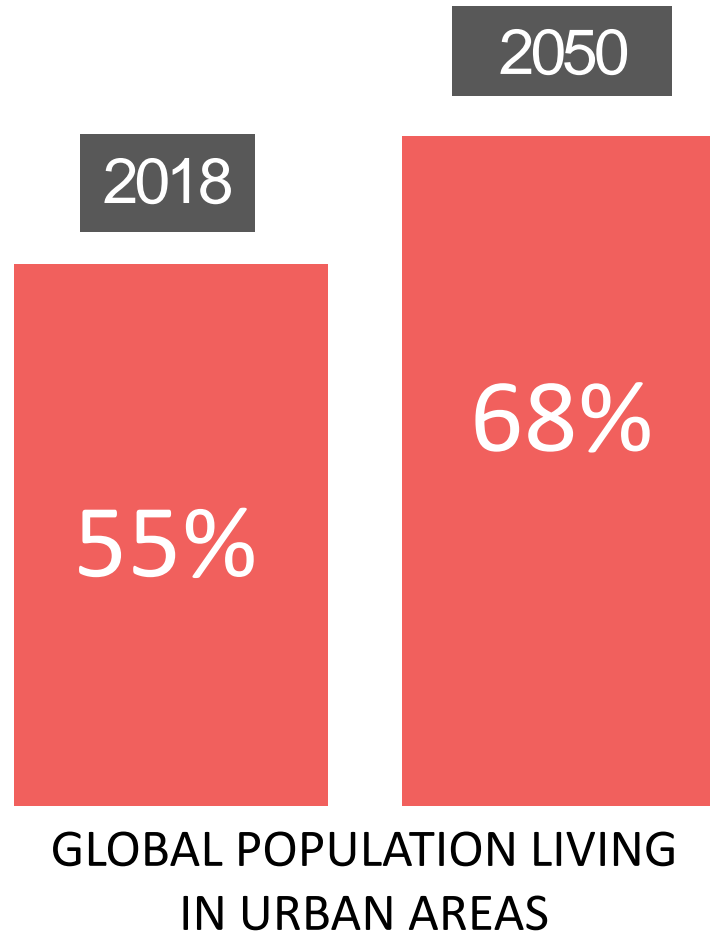


- Use the data being collected
- Driving Innovation
- Providing new services
- Money saving (transportation)



- Parking solutions
- Real-time traffic jam
- Predict trajectories timing
- Connected houses/offices

WHY SMARTER CITIES ARE NEEDED



90M

MOVE TO URBAN AREAS
IN **ASEAN** BY 2030

255M

MOVE TO URBAN AREAS
IN **CHINA** BY 2050

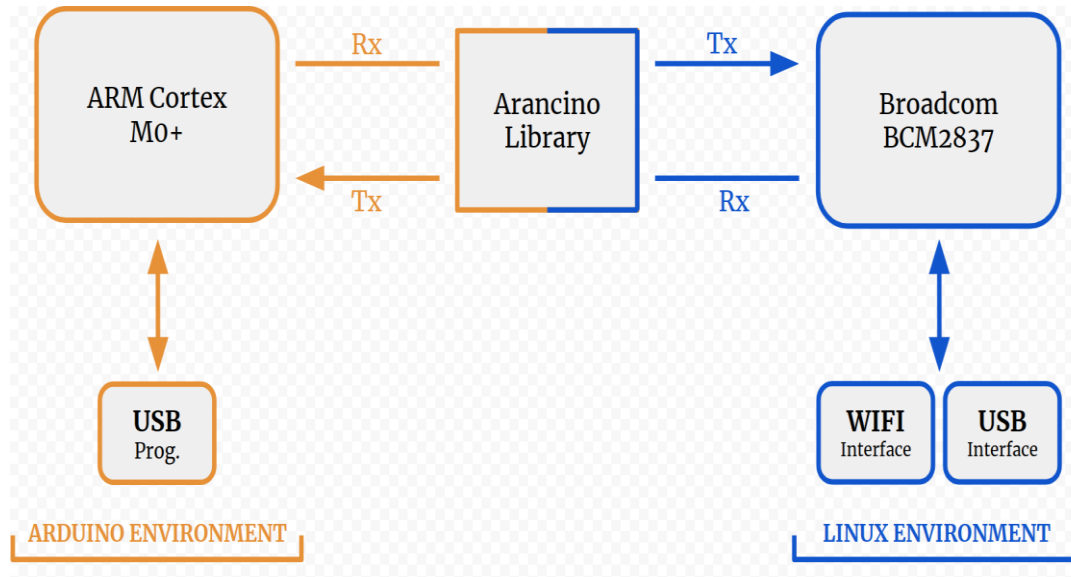
416M

MOVE TO URBAN AREAS
IN **INDIA** BY 2050

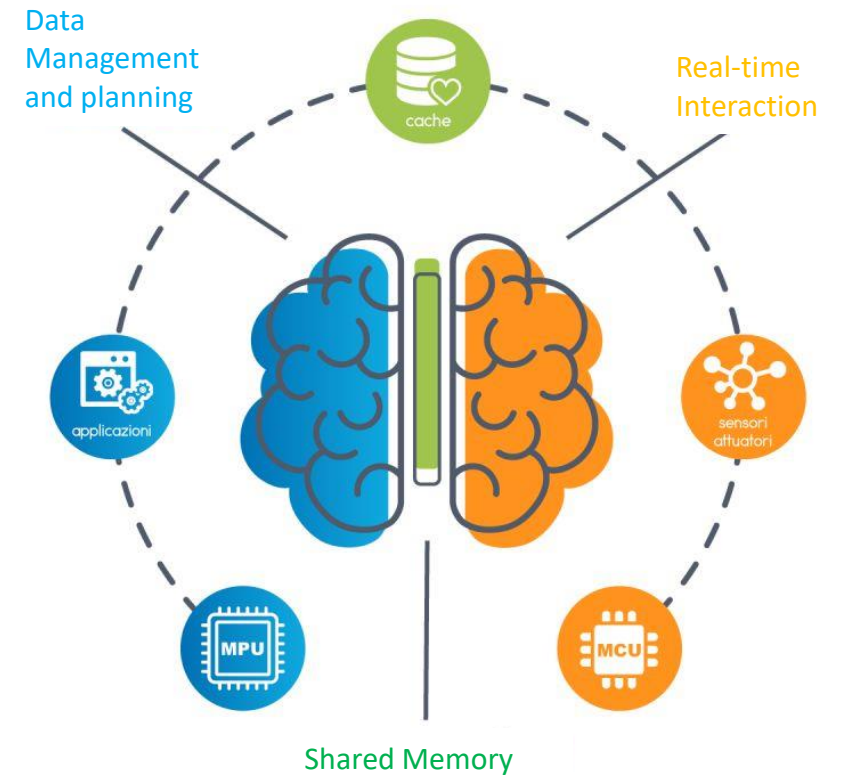
THE SMART CITY CHALLENGE



ARANCINO SMART BOARDS



Arancino.cc architecture

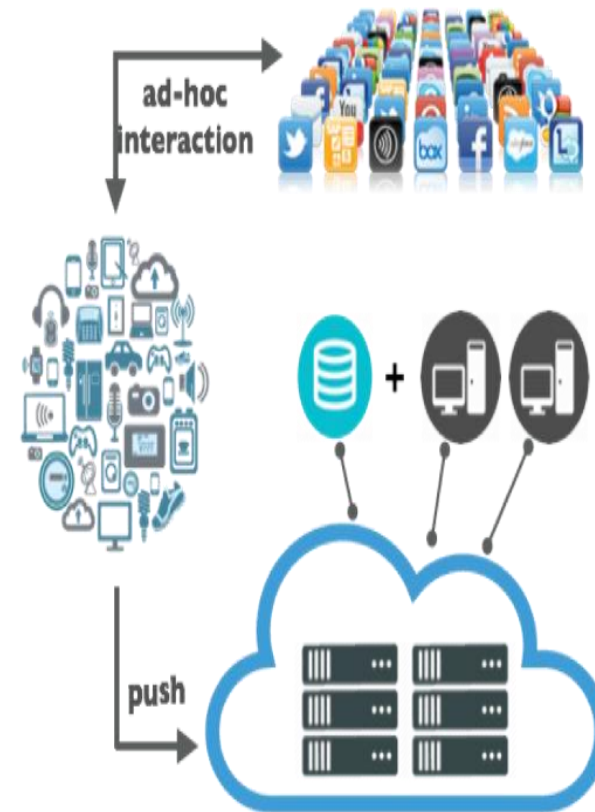


Stack4Things APPLICATION SPECIFIC (VERTICAL APPROACH)

The application uses ad-hoc mechanisms to interact with IoT devices.

No explicit interactions between Cloud components and IoT infrastructure.

Static infrastructure deployment.



I/Ocloud approach

IoT infrastructure as a natural extension of a datacenter

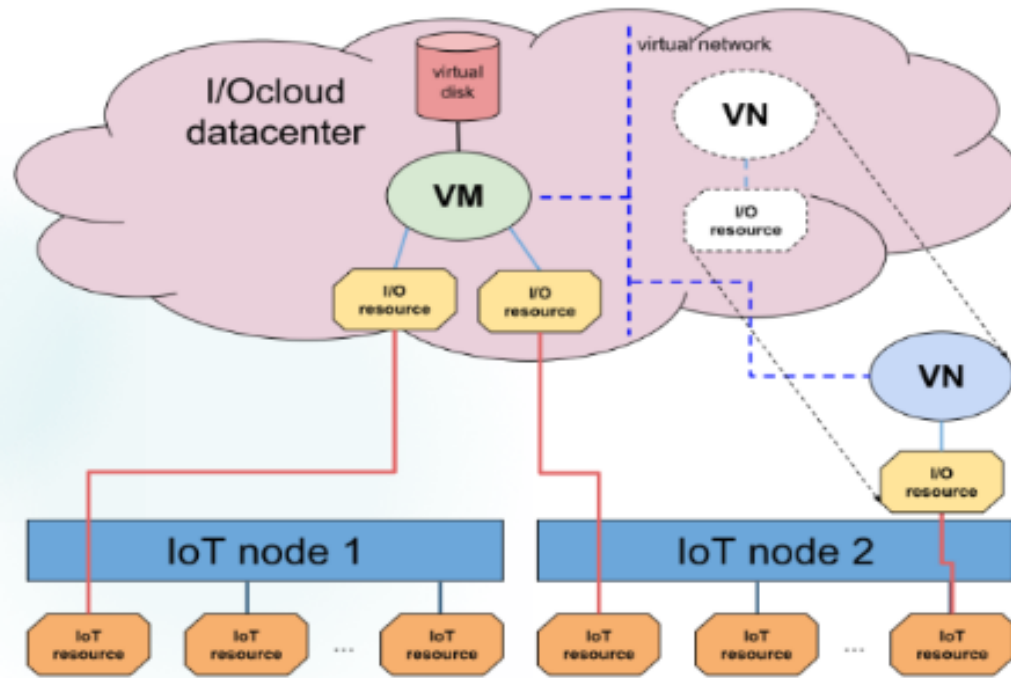
Well-defined Cloud API as a resource management interface

Separation of concerns between infrastructure and application (when needed)

From Cloud to Fog/Edge computing

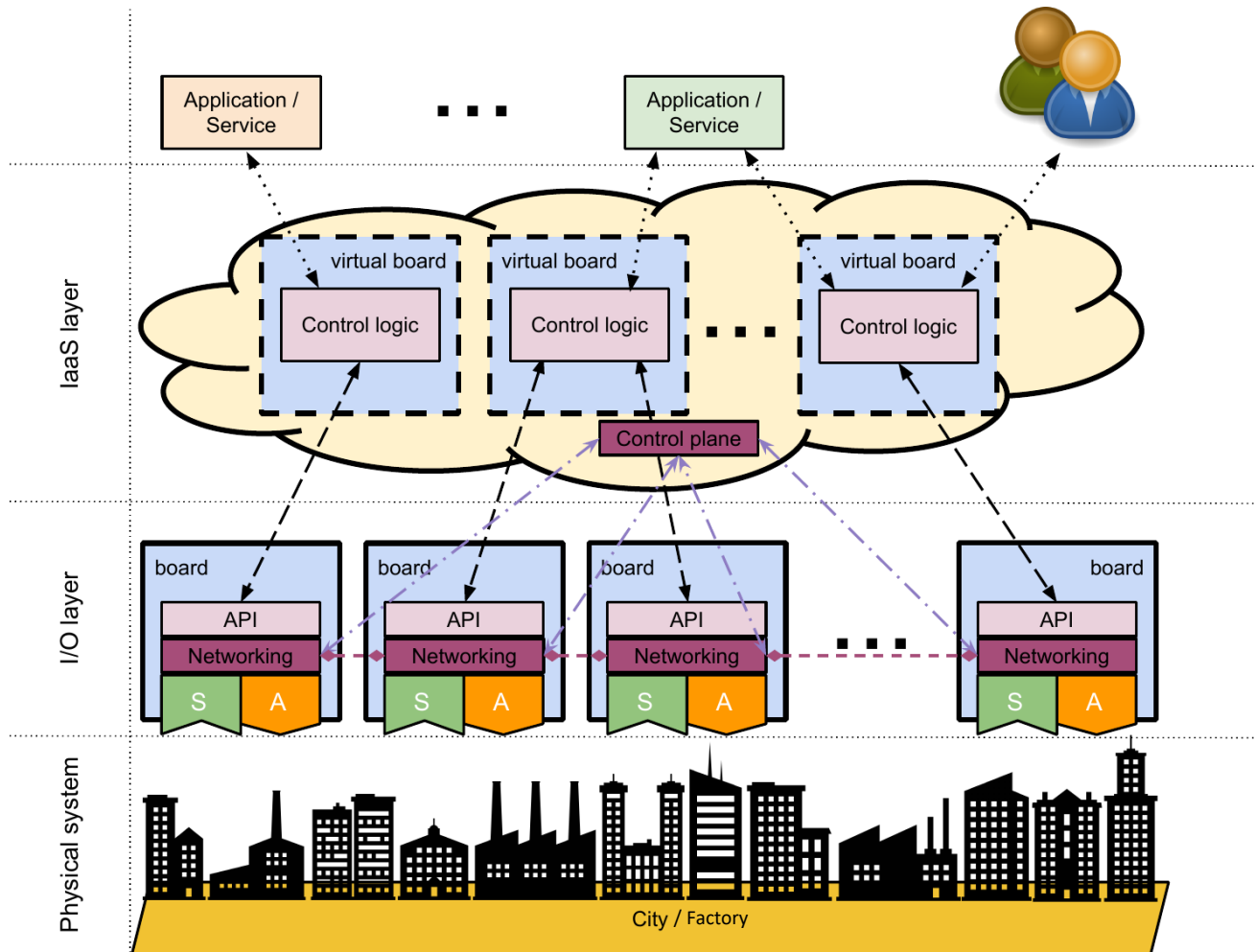
Device computation offloading





**Approaches
(to I/O extensions for the Cloud)**

Stack4Things SOFTWARE DEFINED CITIES/FACTORIES



Analogy with Software Defined Networking (SDN).

Extends the SD* approach to a cyber city system to enable the re-configuration of the underlying infrastructure.

Several controllers exploit and implement the requested node topologies through generalized rules and according to predefined policies.

Stack4Things S4T & OPENSTACK

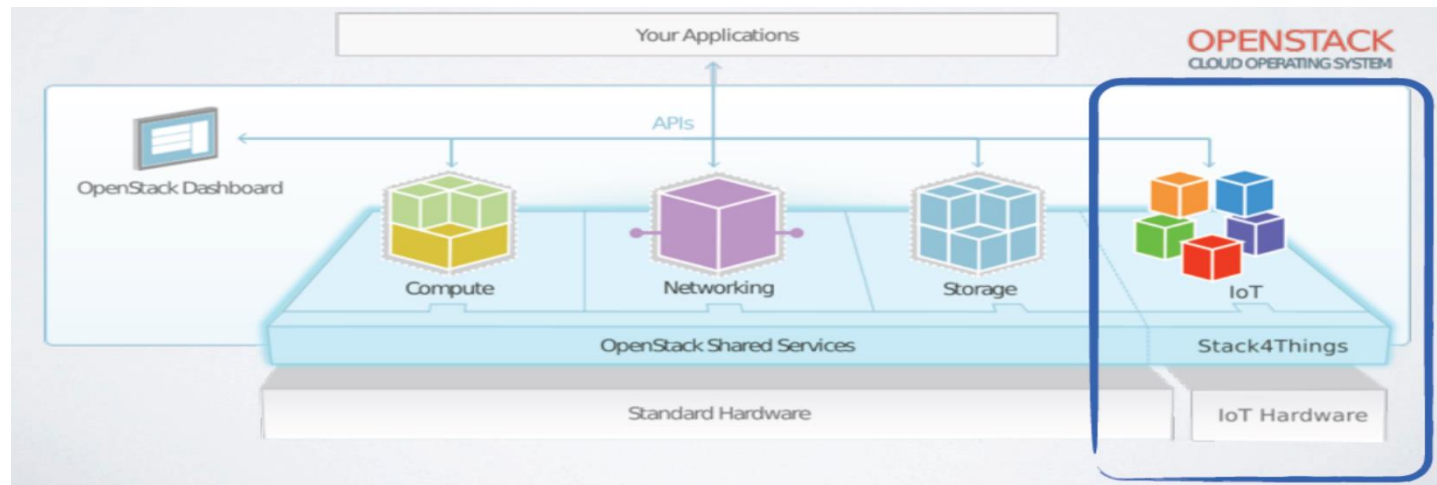
IoT resource management service for OpenStack Clouds

OpenStack (unofficial) project:

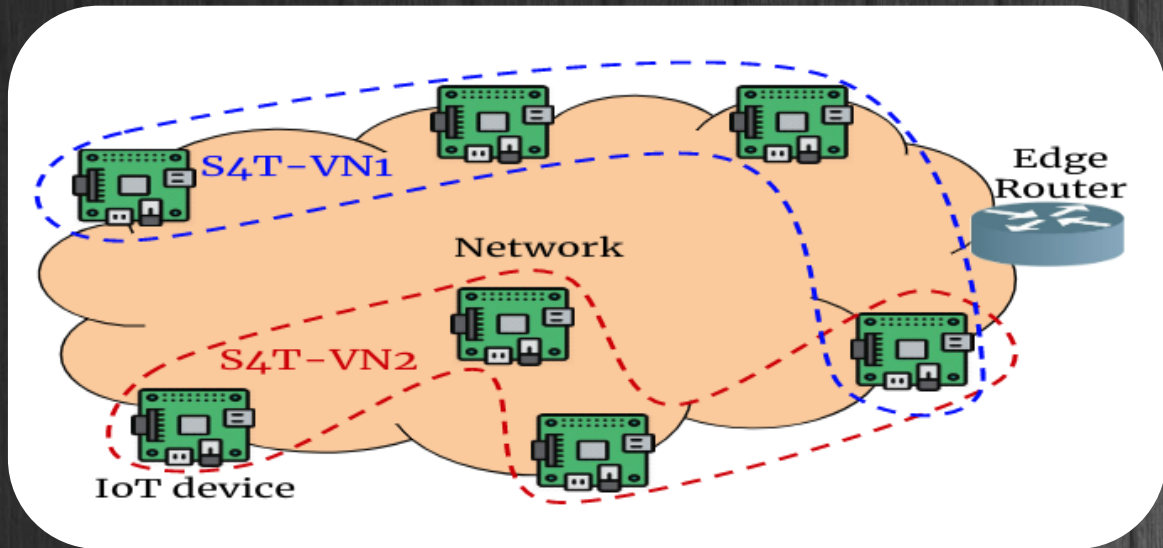
Member of the OpenStack Edge Computing group
(https://wiki.openstack.org/wiki/Edge_Computing_Group)

<https://launchpad.net/iotronic>

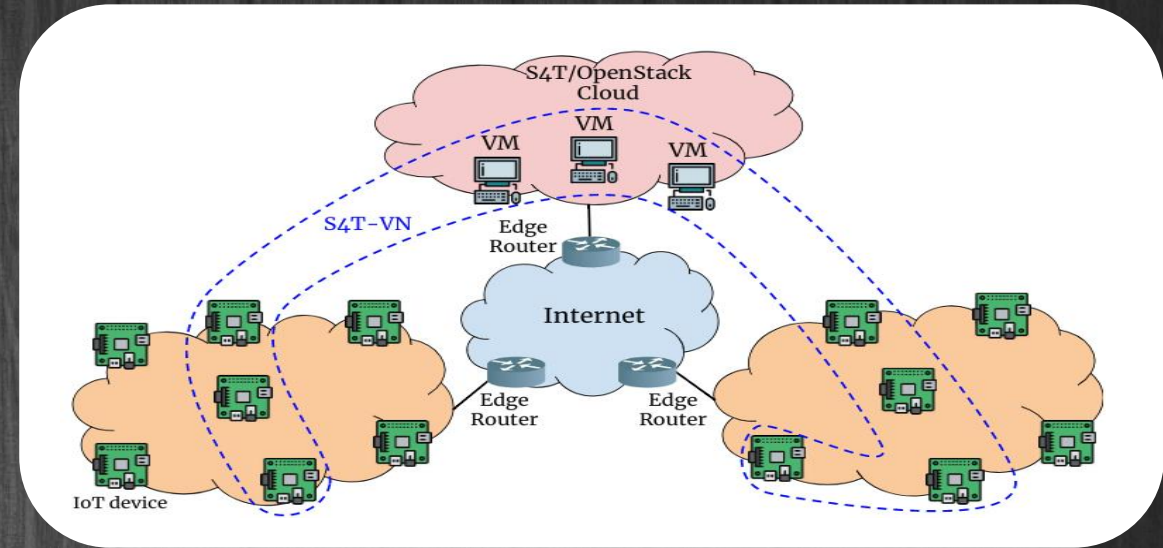
<https://opendev.org/x/iotronic>



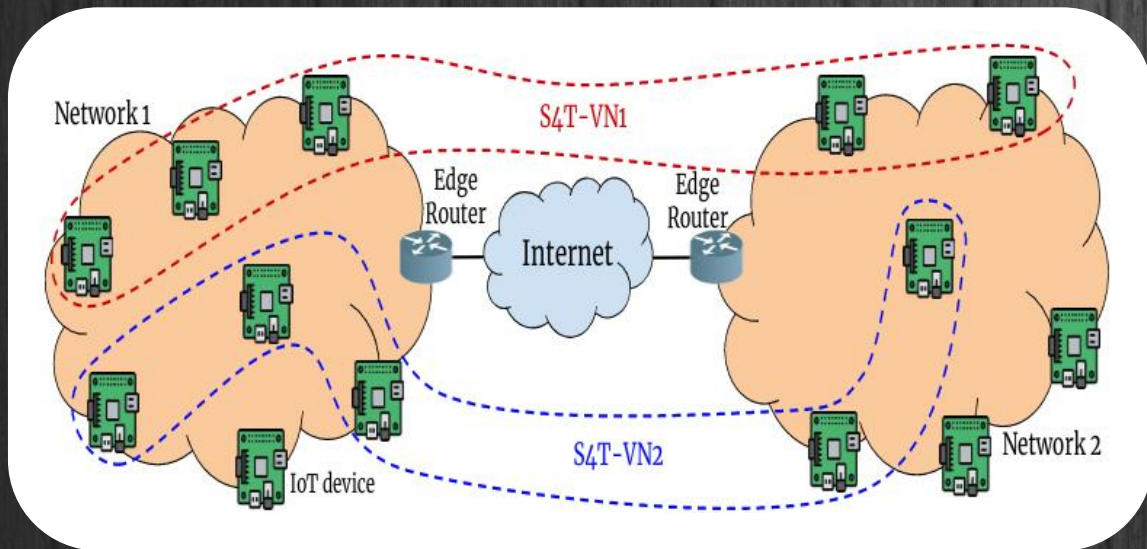
Stack4Things VIRTUAL NETWORKING IN IOT



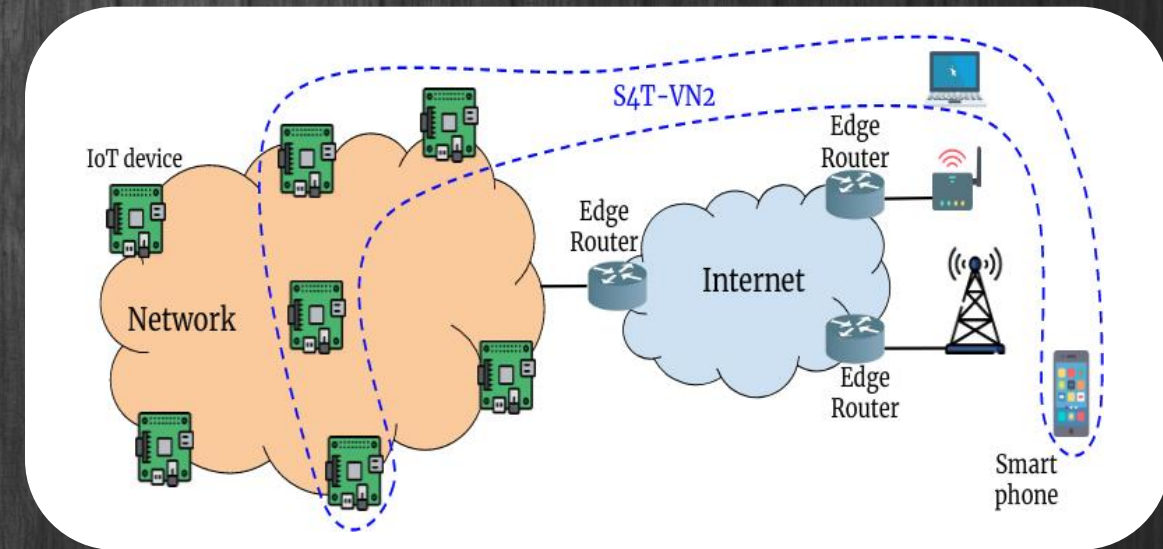
USE CASE 1



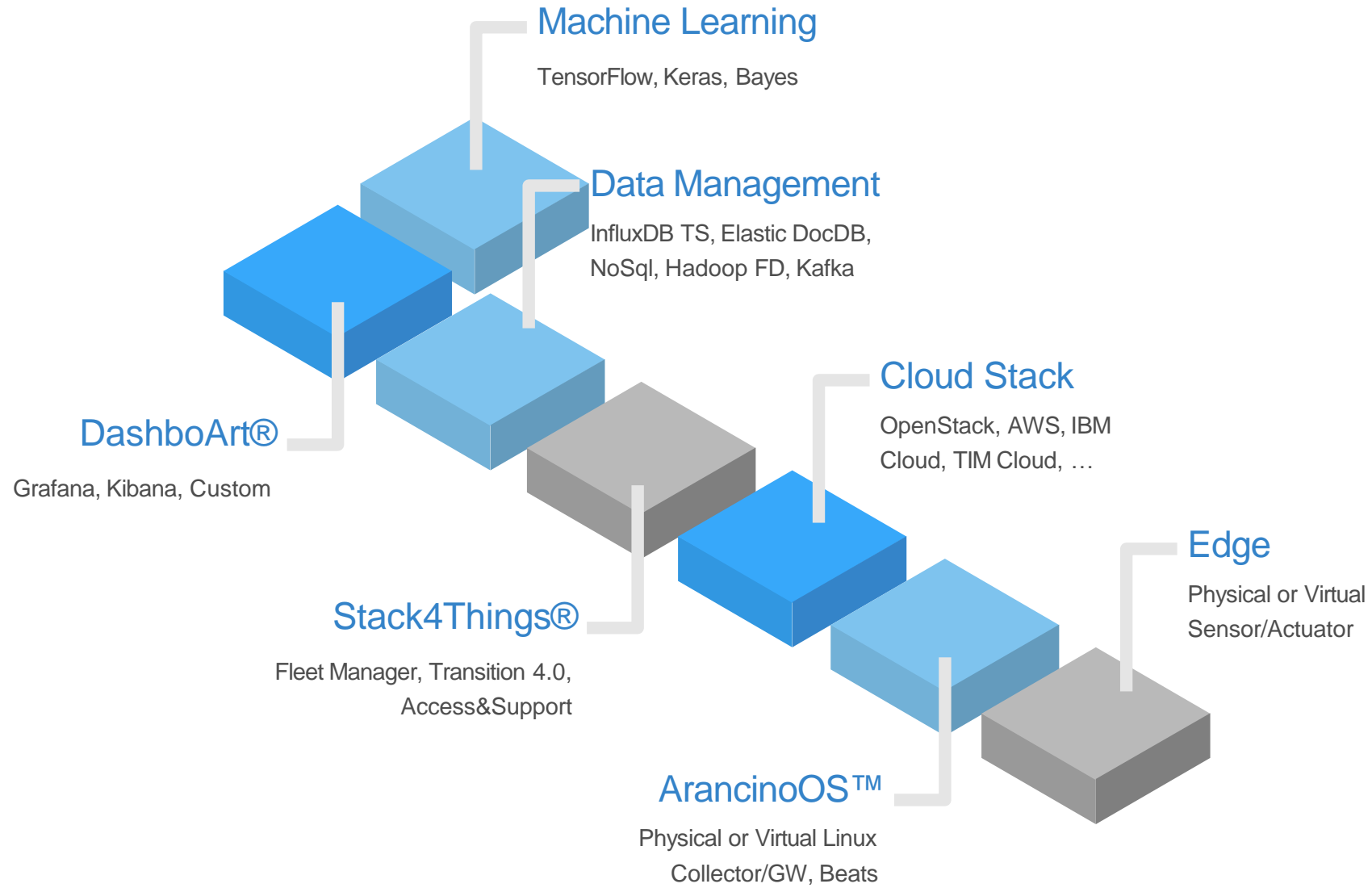
USE CASE 3



USE CASE 2



USE CASE 4



Challenges and Enabling Technologies

- **Convergence** of IoT technologies (heterogeneity, interoperability, openness)
- Emergence of **5G and beyond-5G networks**: provision of high-data rates, dense deployments, accurate localization
- **5G/Edge Computing orchestration platforms** for efficient, reliable and secure applications provision
- **Intelligence and automation** in the edge and cloud part through **Machine Learning (ML)** techniques
- IoT Data storage, representation and management through IoT **Data Lakes** and **Knowledge Graphs**
- **Internet of Skills** evolution by involving the human in the decision-making loop



Reusing *and* best practices adoption



- ⦿ Environmental monitoring
- ⦿ Parking
- ⦿ Smart lighting
- ⦿ Energy management
- ⦿ Fleet monitoring
- ⦿ Car sharing
- ⦿ Smart cameras
- ⦿ Critical infrastructures

The screenshot shows the #SmartME project website. The header includes the project name and navigation links for Technologies, Timeline, and Community. The main content area is divided into three sections:

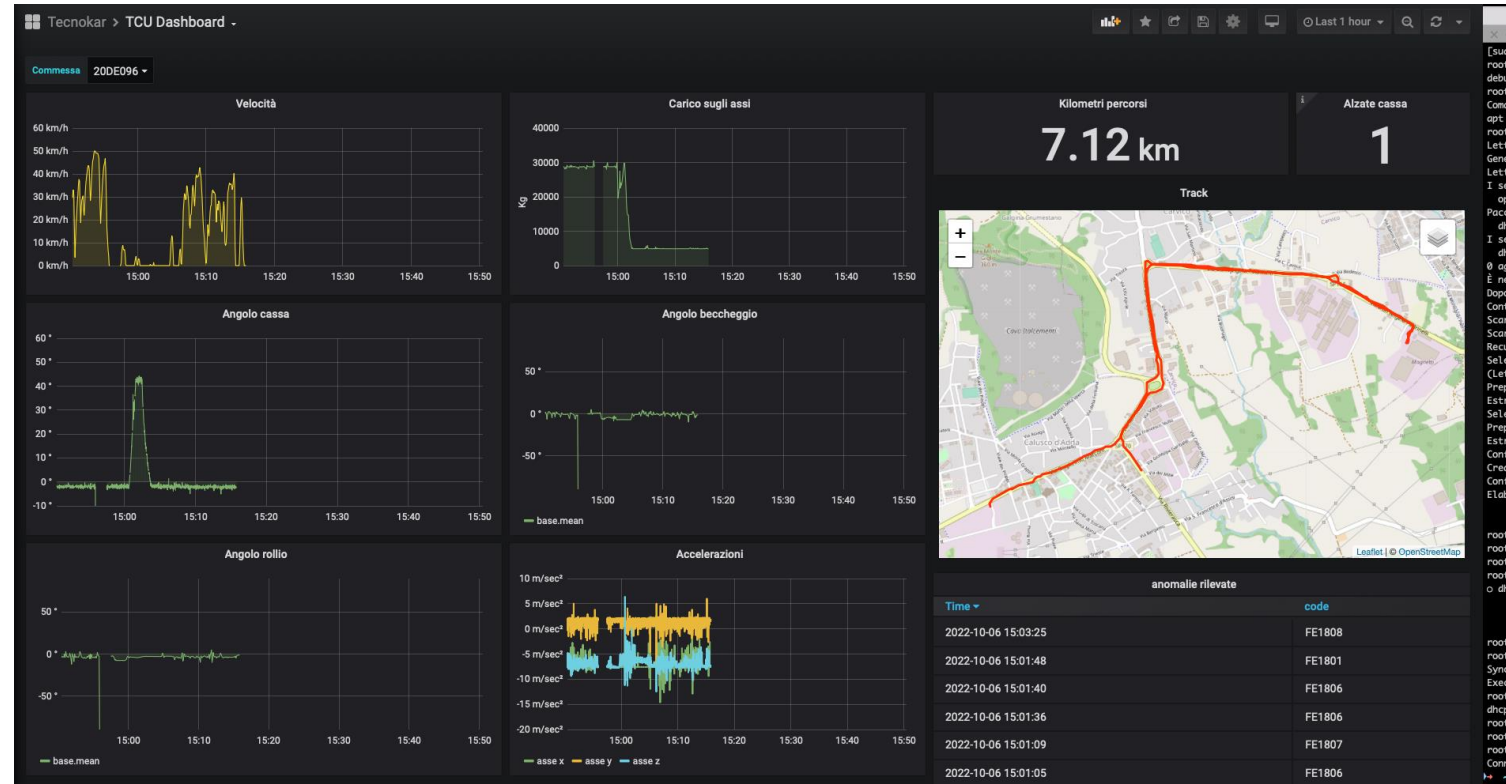
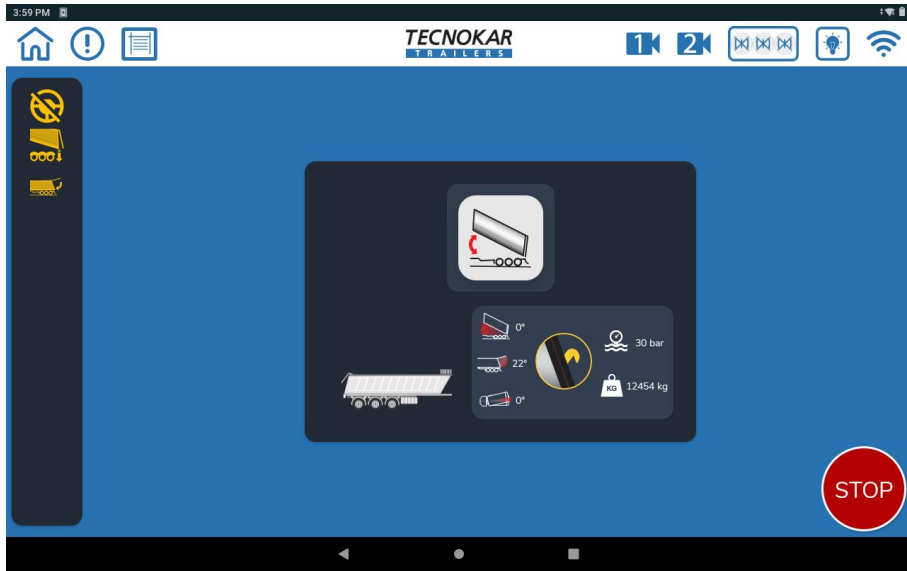
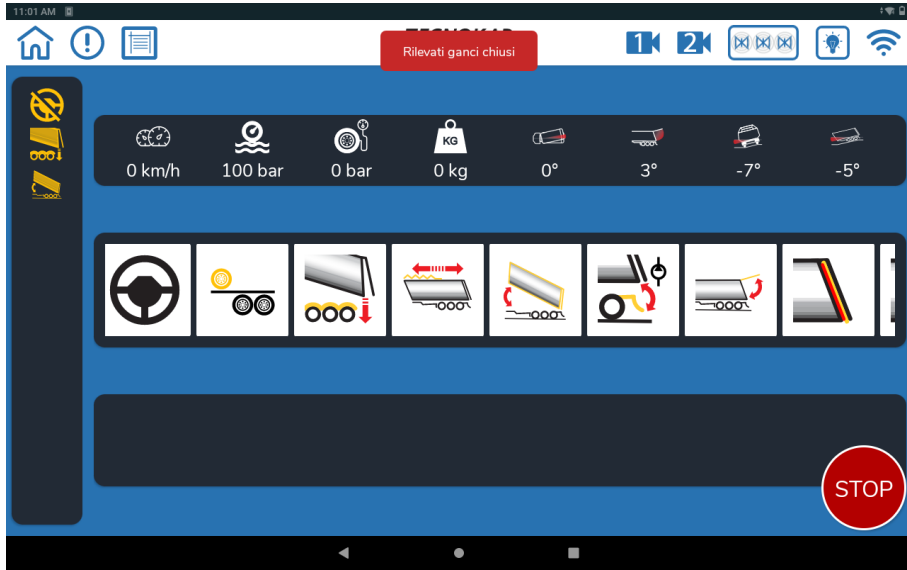
- The Project:** A text block describing the project as a crowd-funded initiative from researchers at the University of Messina, aimed at creating a virtual ecosystem based on the Internet of Things (IoT) to transform Messina into a smart city.
- Latest News:** A list of recent events, including "March 17, 2015 Deployment" and "April 28, 2015 Deployment", with "Read more" links.
- The Map:** A map of Messina, Sicily, showing the city's layout and various sensor locations marked with colored dots.

On the left side, there is a sidebar with the #SmartME logo, a list of credits (University of Messina, CIAM, CIAM, CIAM, MDS LAB MESSINA), location information (Messina - Sicily, Italy), and skills tags (Open Data, Smart City, Analytics, Sensors, Internet of Things (IoT)).

TRAILERS

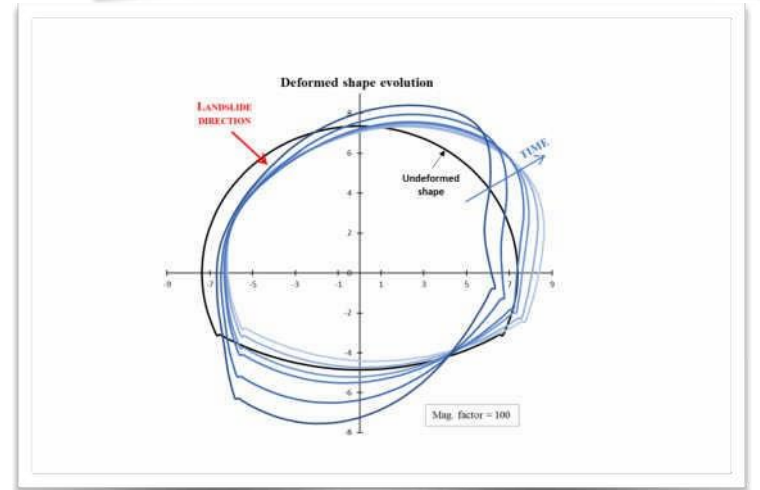
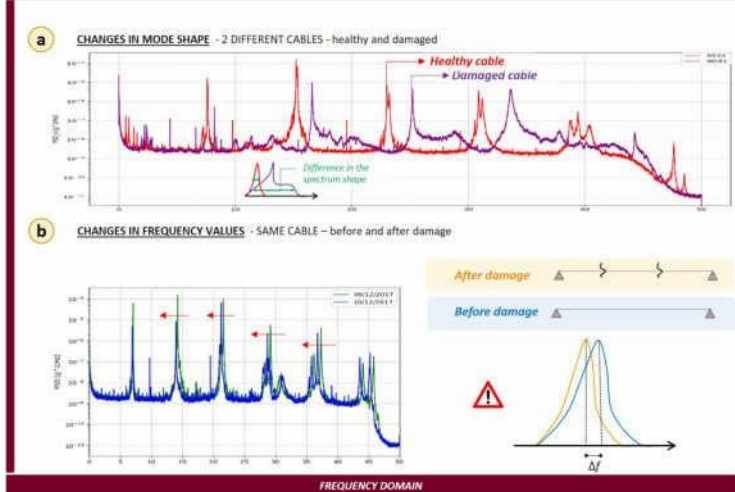
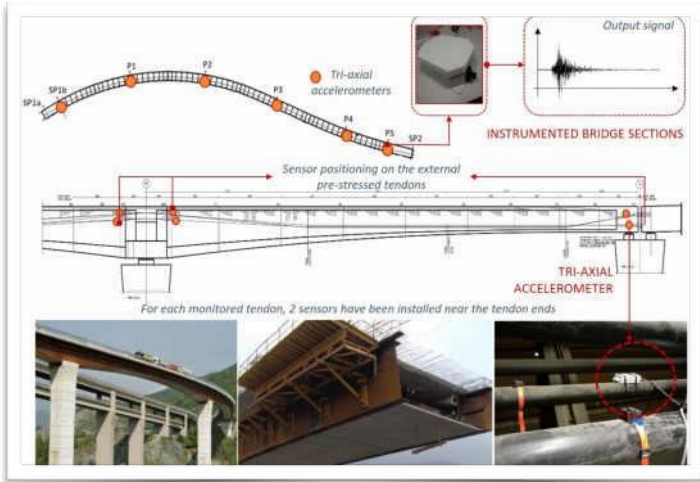
FIRMWARE + HARDWARE + MGMT CLOUD





INFRASTRUCTURES MONITORING

MGMT



#SmartME services TOO(L) SMART



TOO(L) smart is a **reuse** and evolution of the #SmartMe “good practice” that involves **TORINO** **PADOVA** **MESSINA** **LECCE** and **SIRACUSA**

The goal of project is to transform urban systems into a network of objects capable of taking an active role, interacting with each other, with citizens and with the PAs thanks to the paradigms of the Internet of Things and Cloud Computing.



#SmartME services TOO(L) SMART

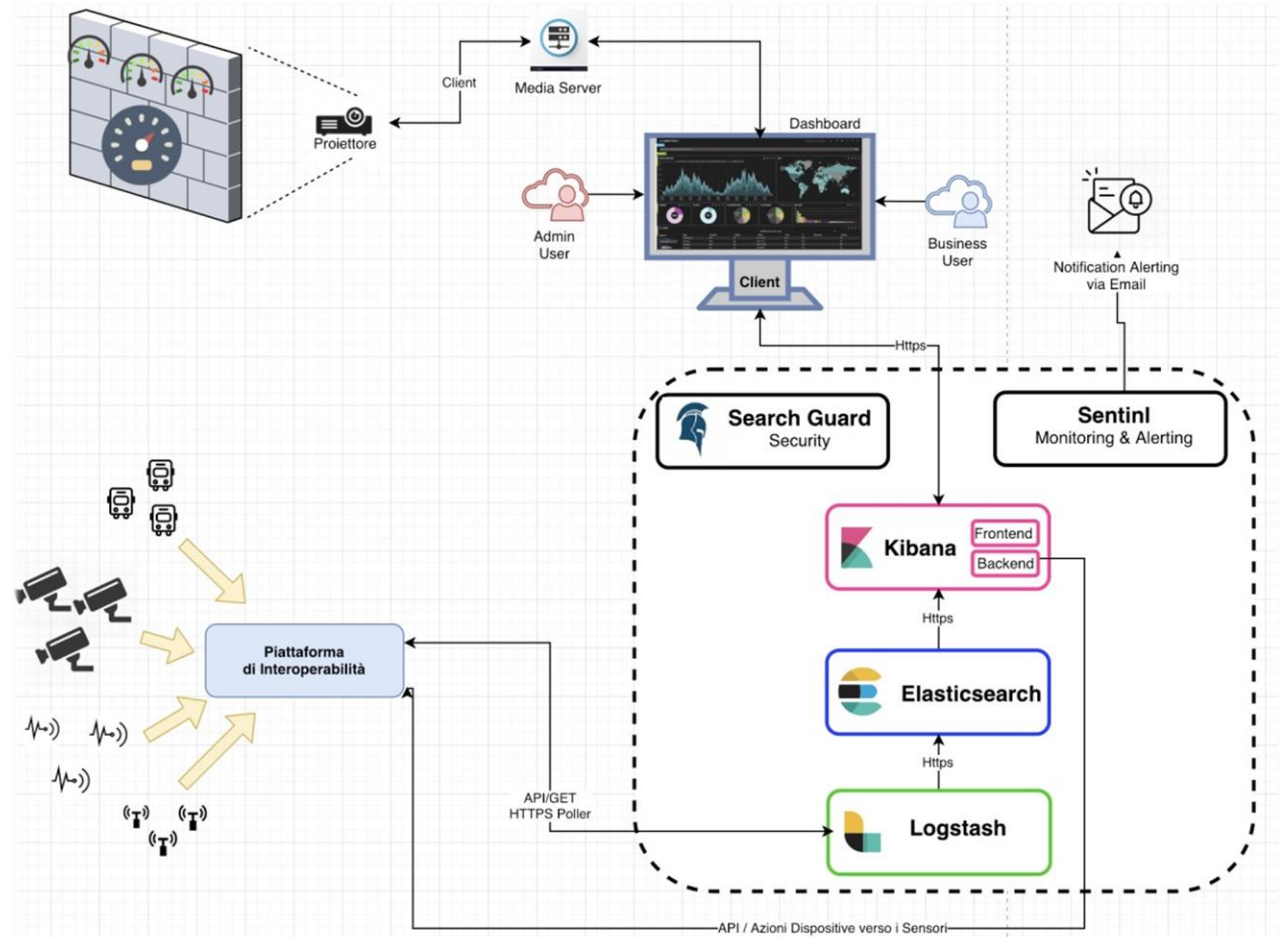


Budget: € 684,450.00

- CINI coordinates the dissemination of good practice at national level.
- Technical support is provided by the startup *smartme.io*
- Evolution: Benevento, Montechiarugolo, Bari, Tangier

- TOO(L) smart is based on (and evolves) the #SmartMe IoT Platform
- #SmartME was born as a crowdfunding project for the construction of an infrastructure of smart services within the city of Messina.
- The basic technological requirements are based on the "open source" paradigm therefore, "open" solutions have been adopted for software, hardware and data.
- Stack4Things is the framework used for IoT devices management. it constitutes an evolution of OpenStack.
- The reference hardware adopted is based on the Arancino board, which integrates the Raspberry PI compute module and the Arduino control module in a single device.

Lorenteggio area - Milan



SMART CAMERA FOR OBJECTS COUNTING 1/2

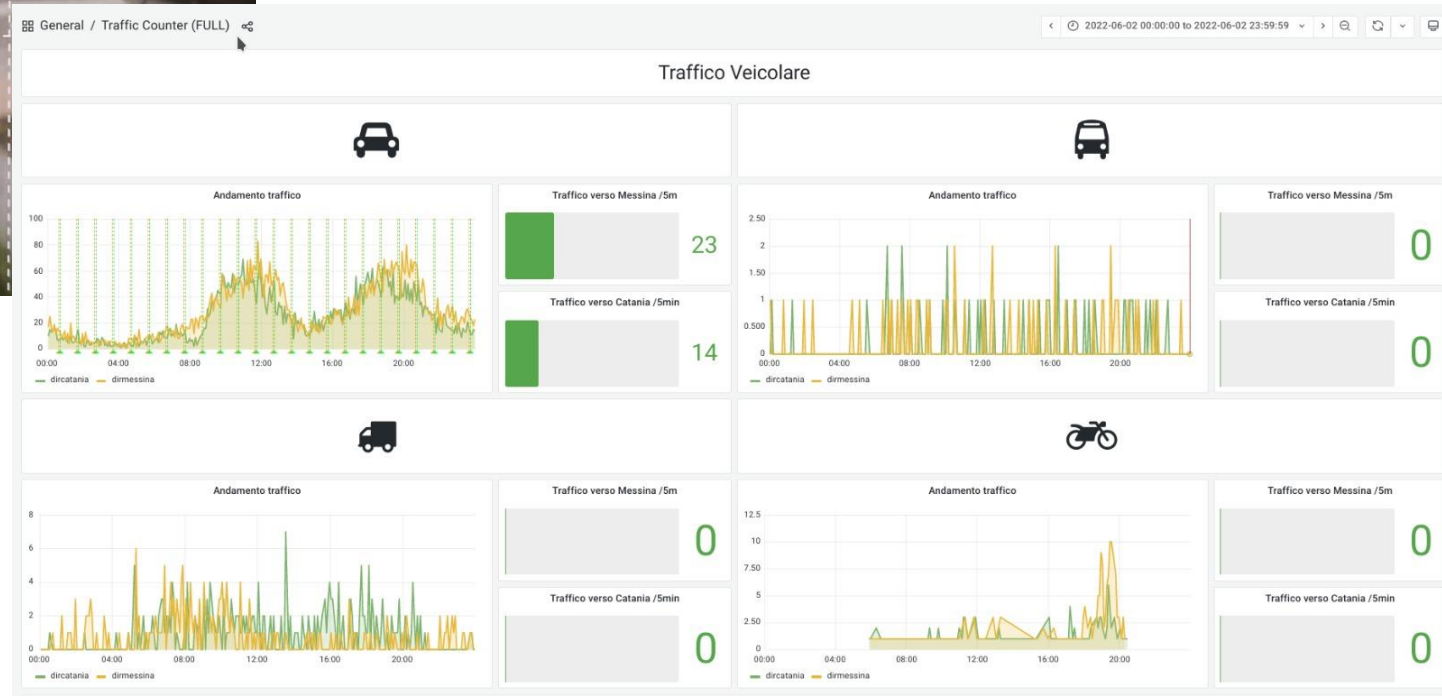
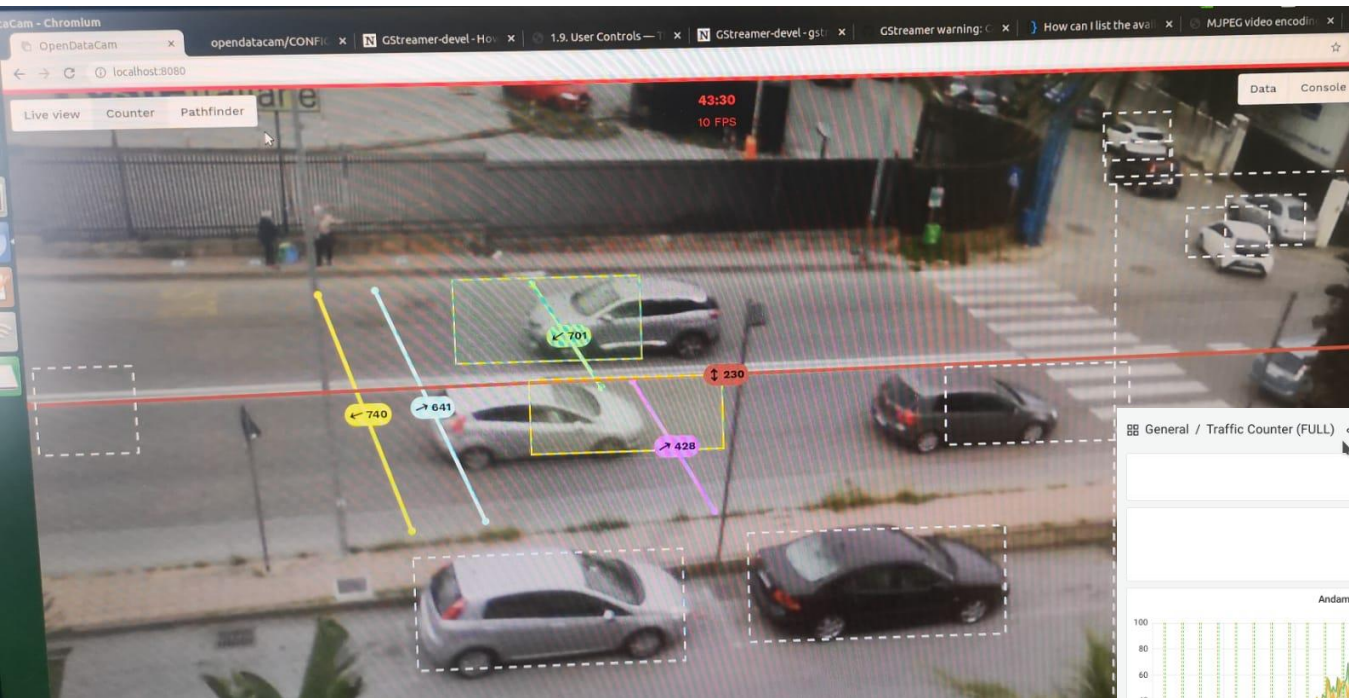
The AI Smart Camera (SME-AI-01) is a device equipped by the Arancino.AI technology for artificial intelligence applications, including indoor minibox or housing with IP protection rating for outdoor applications. It works "On the Edge": all processing takes place on the smart device and no images are recorded or transferred.

It has a vision system for the recognition of classes of objects. Each class of objects is recognized by its software package.

- Arancino.AI technology
- Crowd detecting
- Object Virtualization
- Overlay networks of things
- Remote control and customization
- Device Fleet management and delegation
- Fog orchestration
- Software-defined
- Customizable case



SMART CAMERA FOR OBJECTS COUNTING 2/2



Fleet Manager

https://fleets.smartme.io/accounts/login/?next=/

Fleet Manager

Username

Password

Login

Lost your password?

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Macchina ws-arancino

Azioni

Dettagli

Id: 1
 Codename: ws-arancino
 Serial: e9380315-be46-4876-9d83-9ed5c6d6bbf3
 Reg.Token: ws01
 Project: Smartme Weather Stations
 Fleet: ws_aris
 State: operative
 Model: arancino
 Sim: -
 Mac: -
 Hostname: ws-arancino
 First connection: -
 Production date: -
 Metadata: -
 Configuration: -
 Description: -
 QR Code: -

Dispositivi connessi

No devices connected

Powered by Smartme.IO

Info Weather Station

Name: ws-arancino

Temperature: 17.9 °C

Humidity: 75.0 %H

Precipitation: 15.0 mm

Console Azionamenti

Pole: smartpole_01

Interval 1: enable, dimmer, Output 1, Output 2

Interval 2: enable, dimmer, Output 1, Output 2

Interval 3: enable, dimmer, Output 1, Output 2

Last transmission: 10/05/2022 14:06:19

Firmware: tw10_v1_1-71

MAC: AC67B2DC187C

SAVE, CANCEL

Blockchain

Distributed: it uses peer-to-peer technology;

Open: anyone can download it from the web and becomes a network's node;

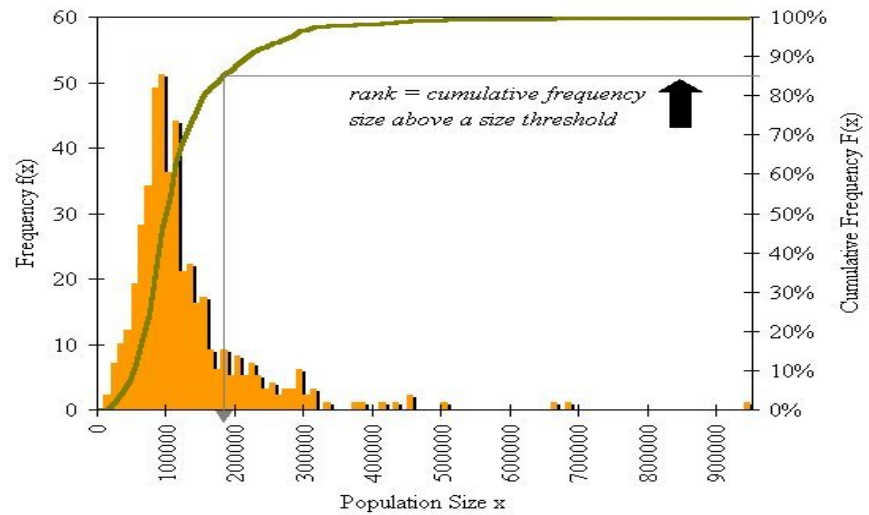
Encrypted: it is based on cryptographic protocols.

Each block contains the fingerprint (hash-code) of the previous block.

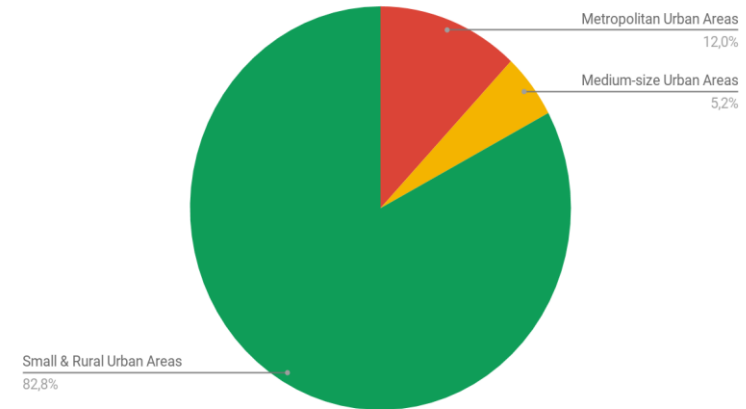


A Blockchain protects the integrity, authenticity, verifiability, and consistency of all recorded transactions. Transactions are made possible by the approval of 50% + 1 of the nodes and such digital data remains unchanged over time thanks to the massive use of cryptographic protocols. Therefore, Blockchain is an open verification system that does not need the approval of a central entity to transact.

Urban population by city size



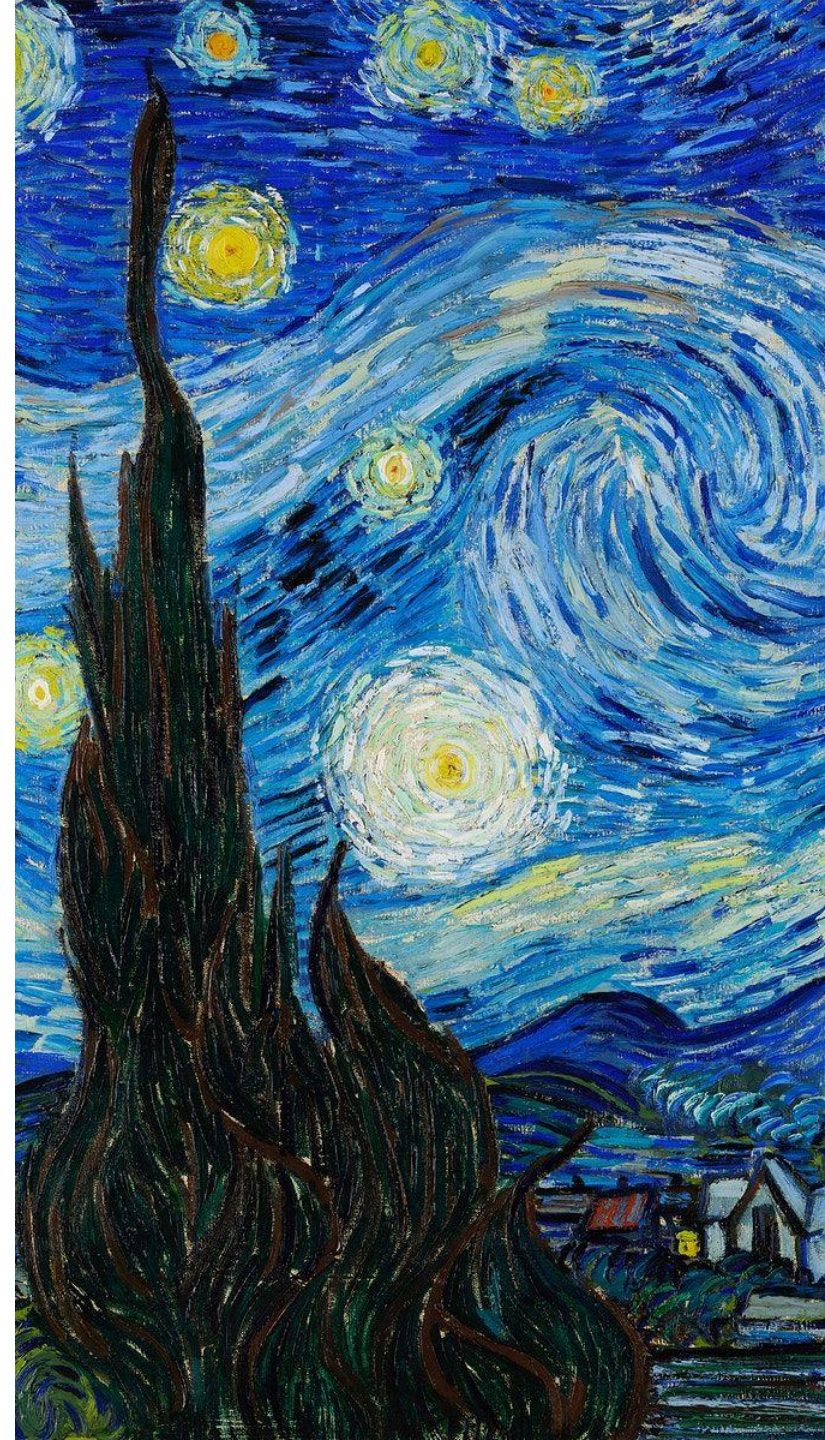
Italy



Do not overlook the small villages!

Some tips to take away

- Adopt **Openness** (SW, HW, Data)
- Support **reusing** and sharing of the results
- **Blockchain** for data certification and access control
- Fostering a **unifying vision** for the whole country (Cloud, IoT, Blockchain, Artificial Intelligence, 5G, Big Data)
- Spreading the **good practices** in Smart Cities
- Federate **Living Labs** with a citizen-centered view, and promote local competences and PMI
- Activate dedicated **training actions** on new technologies in cooperation with high schools and Universities



THANK YOU FOR YOUR ATTENTION

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Useful links:

- <https://www.consorzio-cini.it/>
- <https://smartme.io>
- <https://arancino.cc>
- <https://git.openstack.org/cgit/openstack/iotronic>

