

# TRESCIMO

Testbeds for Reliable Smart City Machine-to-Machine Communication

## Experiences in creating distributed experimental facilities



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# Challenges



- Smarter and greener cities are essential to address **economic, social, and environmental challenges due to the increase in urbanization** by allowing for informed decisions based on Internet of Things generated data.
- Focusing on two challenges:
  - Unstable **power supply of cities** in underdeveloped countries (e.g. South Africa), thus requiring smart energy management.
  - Deployment of **affordable smart sensors** (e.g. air sensors) and gathering information from nodes with **limited power or internet connectivity**.

# TRESCIMO



- Is a FIRE (Future Internet Research and Experimentation) project for the deployment and federation of testbeds across countries in Africa and Europe.
- Co-funded by the EU FP7 and the South African Department of Science and Technology

## Aim

To improve Future Internet Research Experimentation testbed capabilities in Europe and in South Africa through smart and green technologies and social innovation.



# Collaboration between Europe and South Africa



# Approach

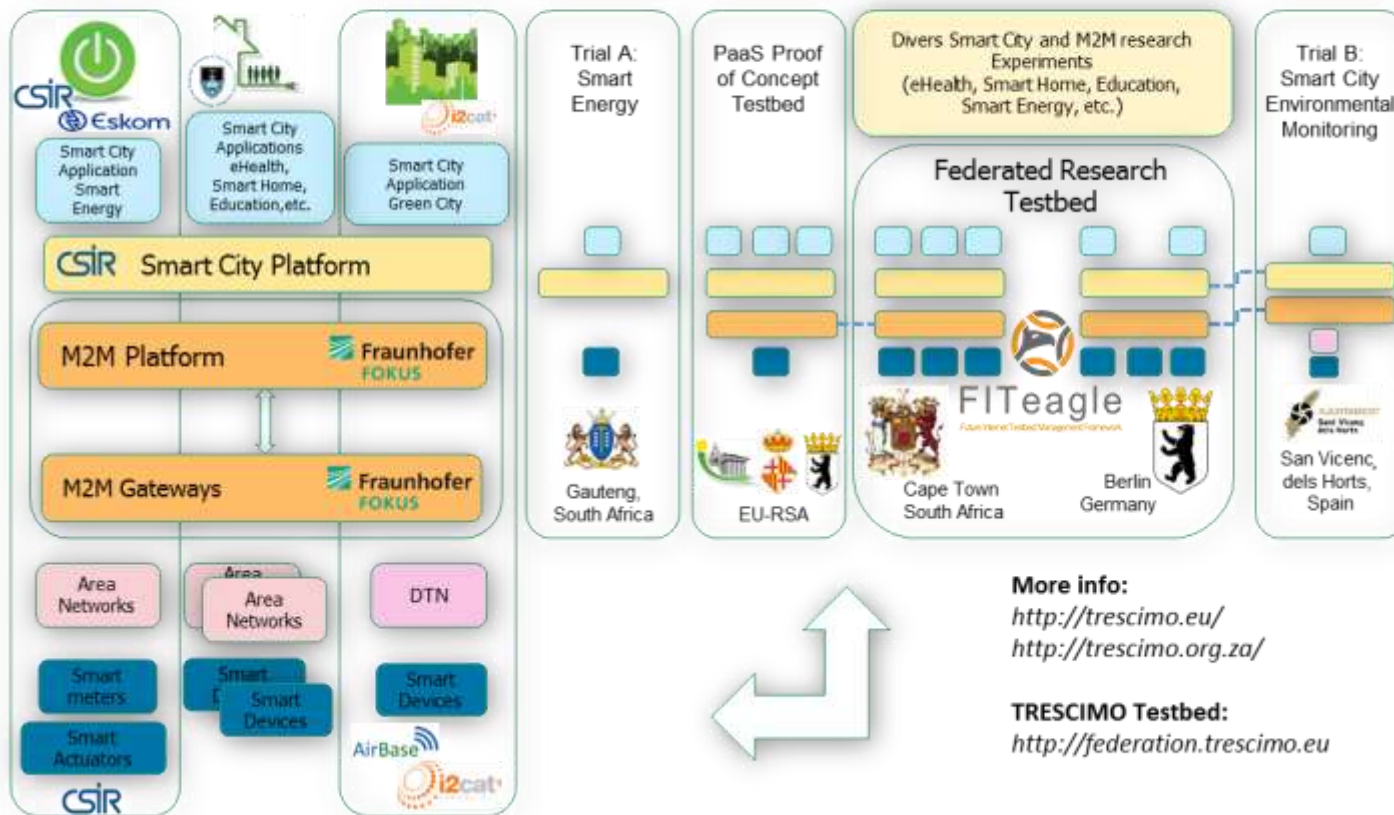


- Usage of autonomic communication methods for end-to-end M2M communication in Smart Cities focusing on **smart energy** management and smart city **environmental monitoring**
- Interweave a sophisticated Smart City platform and an ETSI/oneM2M compliant Machine-to-Machine (M2M) communication framework
- Combination of delay tolerant communication to support opportunistic information transmission

# TRESCIMO Architecture diagram



TRESCIMO Smart City Reference Architecture



# TRESCIMO – a FIRE Testbed



The TRESCIMO federation of testbeds allows experimenters to :

- Access an implementation of a compliant M2M middleware platform based on ETSI M2M standards to be used for research activities in the areas of M2M, IoT and Smart Cities.
- Select connected M2M nodes and services in order to meet the requirements of an experiment.
- Use both integration of both physical and virtual M2M devices.
- Test and validate prototype smart devices and services.
- Access heterogeneous resources from the European and South African context.

# TRESCIMO – a FIRE Testbed



- TRESCIMO is integrated into the Fed4FIRE SFA client, powered by FITeagle2, running under the following URL: <https://federation.trescimo.eu>
- It is the first testbed based on the new semantic RSpec testing tool (valuable source of evaluation for this kind of resource description)
- It is one of the first completely virtualized testbeds with real use-case background (Smart Cities)
- It is the first and only testbed that offers a virtualized Smart City Software Stack as a Service to Experimenters
- It is a TOSCA (Topology and Orchestration Specification for Cloud Applications) based cloud federation testbed (valuable source of evaluation)
- Prospective experimenters will be able to access our testbeds through the use of FIRE tools



# TRESCIMO Trials



## San Vicenç dels Horts, Spain | Smart City Environmental Monitoring Trial

The trial consists of the deployment of a Delay Tolerant Networks (DTN) based system for Environmental Monitoring in Smart Cities with no need for an on-purpose infrastructure for interacting with the sensors distributed through the city. It is an energy efficient solution based on enhanced radio wake-up system mechanisms and bidirectional communication with the sensors.



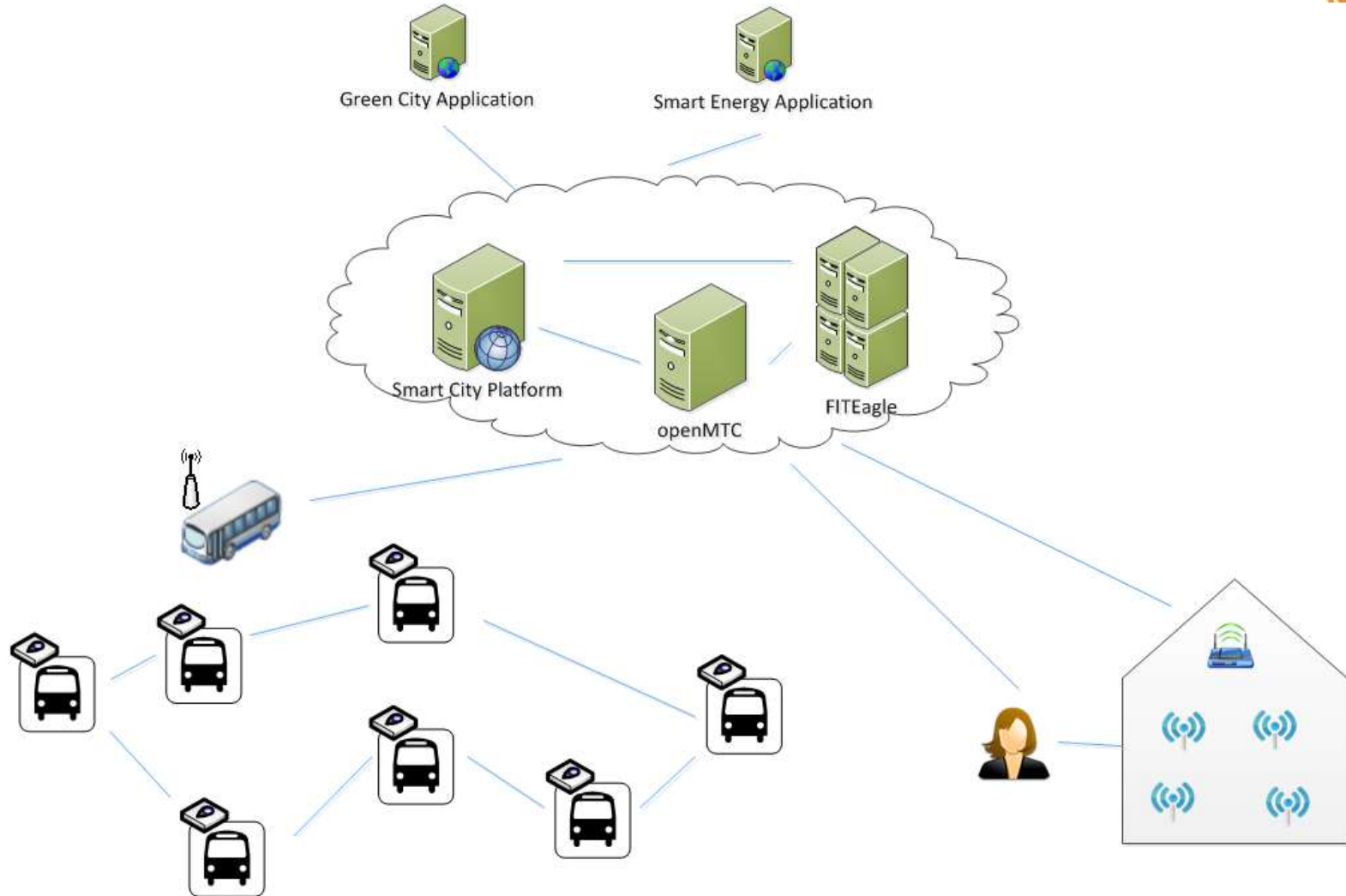
AJUNTAMENT  
San Vicenç dels Horts

## Gauteng, South Africa | Smart Energy System Trial

The platform used in this trial will be implemented in an end-to-end scenario linking a number of households to the Smart City Platform. The aim of the trial is to establish means for demand-side management and informative communication (i.e. data acquired, transferred, processed and the result communicated to a device or to a person). The interface to the person is provided by a mobile application.



# TRESCIMO EU and SA Trials



# TRESCIMO Key Innovations



- **Smart Environmental Monitoring Application:** Solution based on the combination of Delay Tolerant Networks and Radio Triggered Wake-up systems to avoid the deployment of a backhaul network
- **Smart City Platform as a Service:** Data visualization tool and big data analytics for Smart City services
- **Smart City/Smart Energy mobile application:** Smart energy monitoring and control application which allows energy consumers to remotely monitor and control nominated appliances in their homes
- **Eskom Smart Energy Devices:** IoT sensor and actuator devices installed in energy consumers homes
- **Smart Energy/eHealth/Education experimentation applications:** developed by students for teaching, experimentation and research purposes
- **M2M middleware enhancements:** OpenMTC oneM2M and LWM2M implementation

# TRESCIMO Research Capacity Building



- Organised **workshops in 2014 and 2015** at UCT. These were well attended by potential students from UCT and other universities in South Africa, as well as invited guests from local Industry.
- A **masters' level course** on the foundation of modern networking to be offered to Master of Science in Engineering and taught Masters' students in December 2015. Invitations will be extended to other universities, private industry in South Africa and the Department of Science and Technology.
- TRESCIMO testbed allows for experimentation towards a larger Future Internet Research Experimentation (FIRE) community.
- 11 PhD and MSc Researchers (5 in South Africa and 6 in Europe) are involved in the development.
- The TRESCIMO project also provided hands on training for undergraduate students to get experience working on an Internet of Things testbed.



# Thank you!



Photo of the TRECIMO consortium , taken during a plenary meeting in Berlin, Germany, from 24 - 26 September 2015