NINTH INTERNATIONAL I* WORKSHOP

Applying Tropos modeling for Smart mobility applications based on the FIWARE platform

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Outline

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4 Conclusions and future works

Context

Nowadays, the high density of vehicles in current cities has led to several complex issues, such as traffic congestion, pollution, longer trip time, decreasing public safety and increasing noise.

For instance, in Mexico City, with **20 million people**, there are **4 million vehicles** on the road and a total of **22 million trips every day**

Context

In this complex scenario, mobility concerns represent key challenges in smart cities design, where novel technologies such as **Internet of Things (IoT)** are required for developing systems that produce intelligent decisions based on data provided by objects connected to Internet.

FI-WARE
Open APIs for Open Minds

It is an open innovation ecosystem that allows creating new applications and Internet services.

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Context

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FIWARE Lab México
empowered by INFOTEC CONACYT

Mexico has an **instance** of the **FIWARE platform** called **Mexican FIWARE Lab Node** hosted in the **National Future Internet Laboratory** in INFOTEC.

Using the FIWARE platform and Mexican Node, we will deploy a smart mobility application.

Problem statement

In this sense, more than 100 European cities are already using FIWARE, most of them for mobility solutions…

… However

one of the main issues of FIWARE, as well as of most of current smart city platforms, is that they are using programming-based approaches, where solutions are generated starting from low design levels.

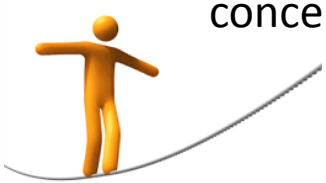
Sometimes, this kind of solution makes difficult to identify vulnerabilities of the system or bottle-necks, because of absence of a deep understanding of the organization (stakeholders, technologies, goals, the “to-be” of a system).

Our solution

We propose:

- The use of the **Tropos framework** to model the scenario and the operational environment of a smart mobility application based on FIWARE. Also, we propose the use of **Release Planning (RP)** approach for developing application.

As a result, we have identified some **challenges** in the use of Tropos concepts to represent **IoT components** of technological solutions for smart mobility applications.



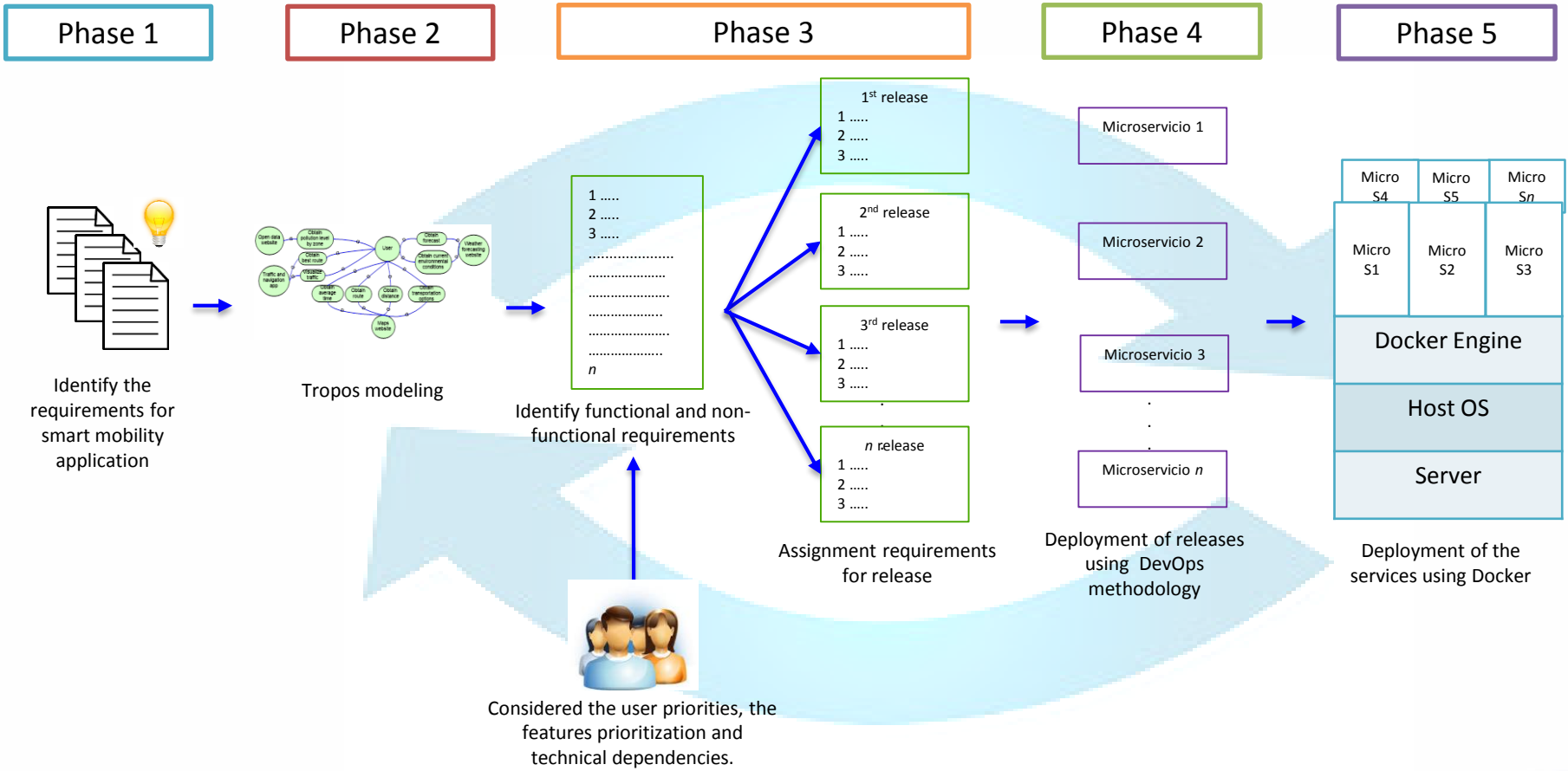
Our contributions

The core of our contribution is to **explore** the use of Tropos **to model the complex scenario** of a smart mobility application to be developed, called ***Green Route***, representing smart technology components as intentional actors since they have the ability to make decisions by themselves.

It will be a smart application to help the final user to determine **the best route** to follow to reach a destination, taking into account the user profile and the user preferences.

It will propose the **ideal route** for the user, avoiding routes with high levels of pollution, floods or pollen, etc.

Proposed schema to *Green Route*

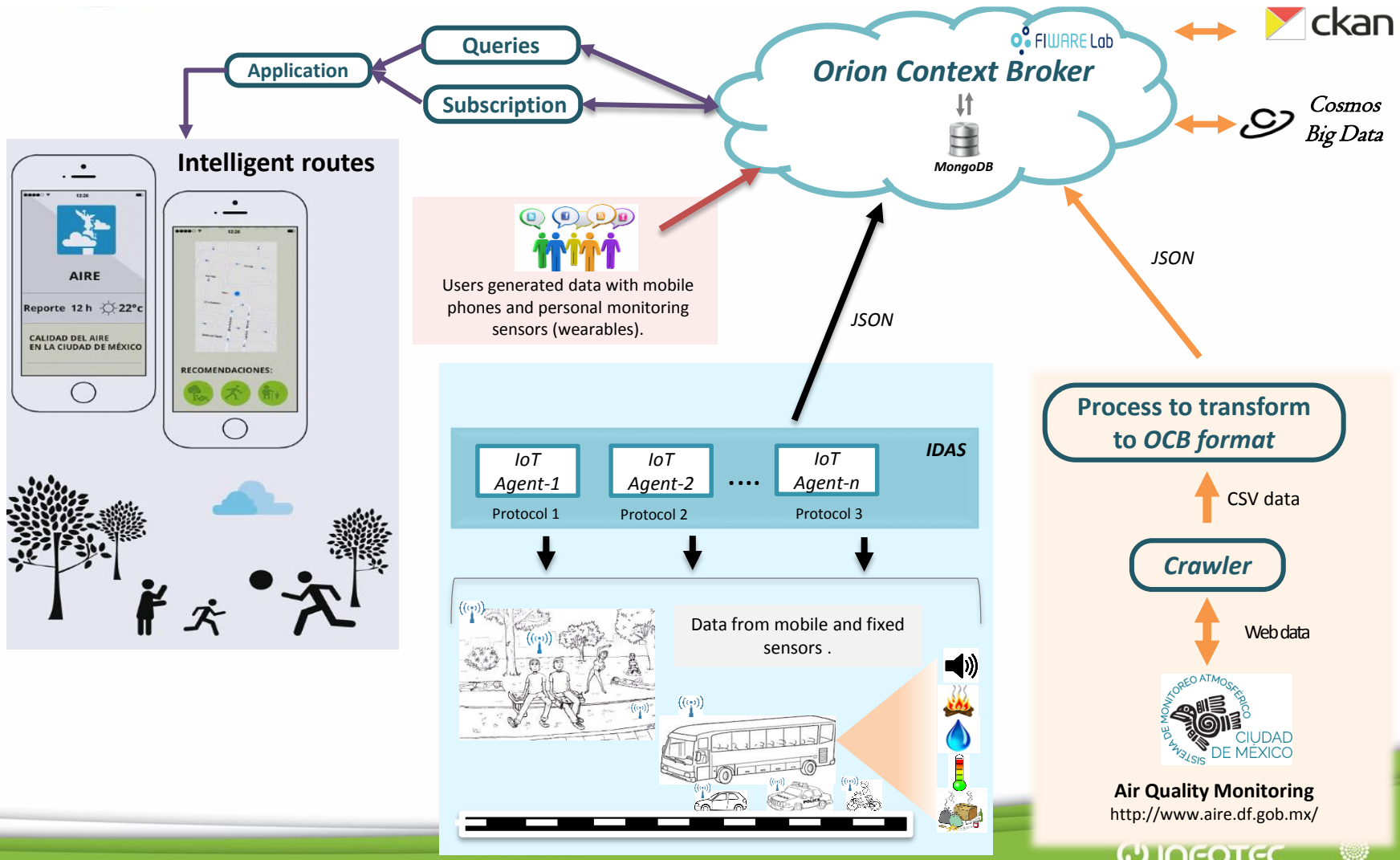


We are using the **Release Planning (RP)** approach for developing Green Route.

Green Route: a smart mobility application

Phase 1

The objective of this phase is to identify the requirements for smart mobility application



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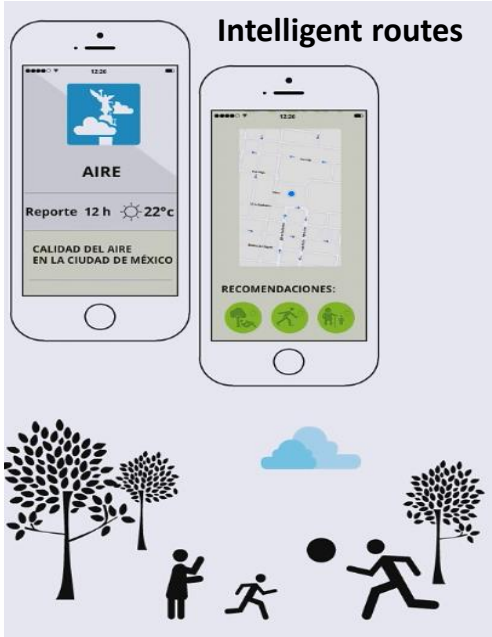


Some examples of requirements of *Green Route*

Manage data in the cloud

- Send data to the cloud
- Save user favourite routes
- Subscribe to data changes

Get environmental data from different data sources

- Get data from mobile units
- Get data from fixed units
- Get data from open data web sites

Get user information

- Get and save user position
- Capture user profile
- Get user satisfaction about proposed route
- Get user type of transport
- Get user feedback
- Get historical data

Determine best user route

- Cross information
- Data analysis
- User behavior prediction
- Historical data analysis
- Define alerts pattern
- Provide real time environmental conditions

Non-functional requirements

- Reliability
- Accurate
- Secure
- Accesible data
- Real time

Tropos modeling of a smart mobility application

Phase 2

The goal of this phase is to model the requirements of *Green Route*, which mainly focuses on:

a) the representation of all the elements: data acquisition and infrastructure and platform as a service for data storage, processing, analysis and consumption of data in the cloud.
b) the representation of all the required functionalities of *Green Route* to answer user needs.

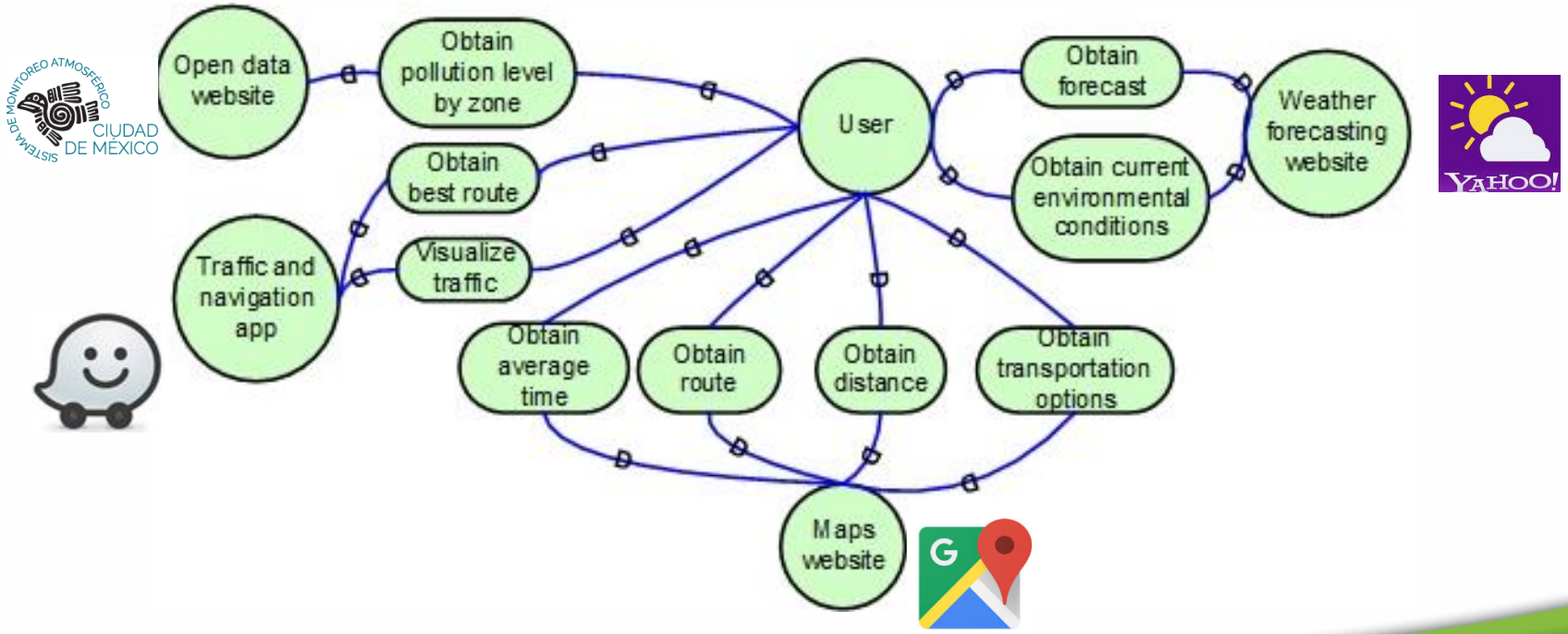
The **actor concept** has been used to represent the hardware and software involved in the solution, since they **communicate** among them **without human intervention.**

Additionally, these components have skills to independently take decisions based on its context, making use of **mechanisms** of the **artificial intelligence**.

The *as-is setting model*

Phase 2

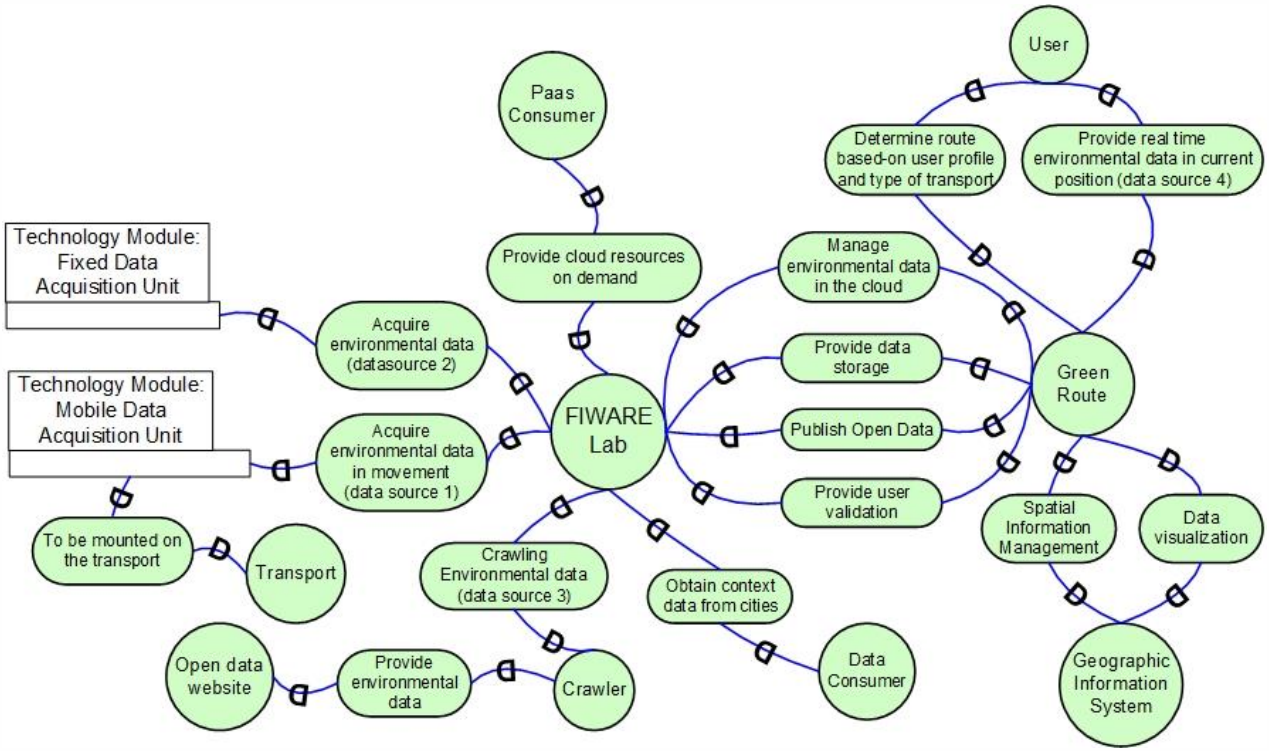
This model describes, in a high level view, the current scenario to determine the **best route** to follow to reach a destination (<u>without using a smart application</u>), where the user needs to **access** to **different data sources** to consolidate the information.



Goal model

Phase 2

This model represents the goal dependencies of the key actors of the *Green Route* in a high level view. In order to represent the sources to acquire environmental data, the model contains two units: *Mobile Data Acquisition Unit* (*Mobile Unit*) and *Fixed Data Acquisition Unit* (*Fixed Unit*).

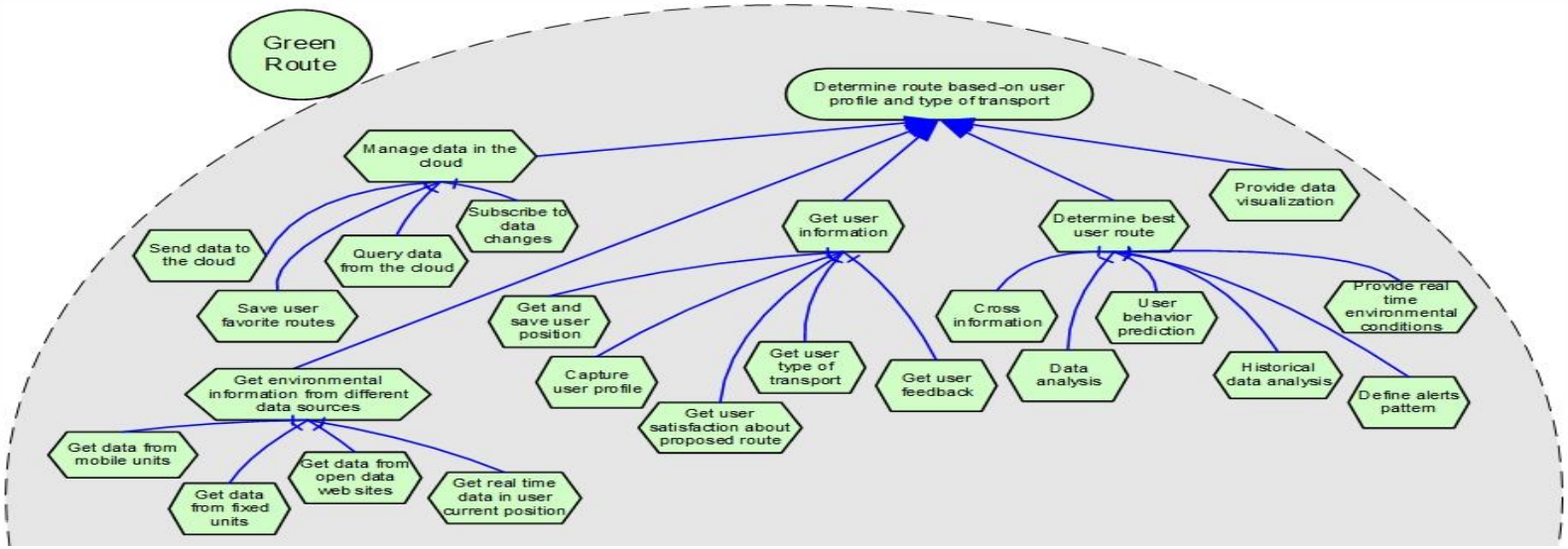


This model was generated as a first approximation to automate the *as-is setting model.*

Strategic rationale model

Phase 2

This model represents the social and intentional relationships mainly of IoT technologies and the final user.

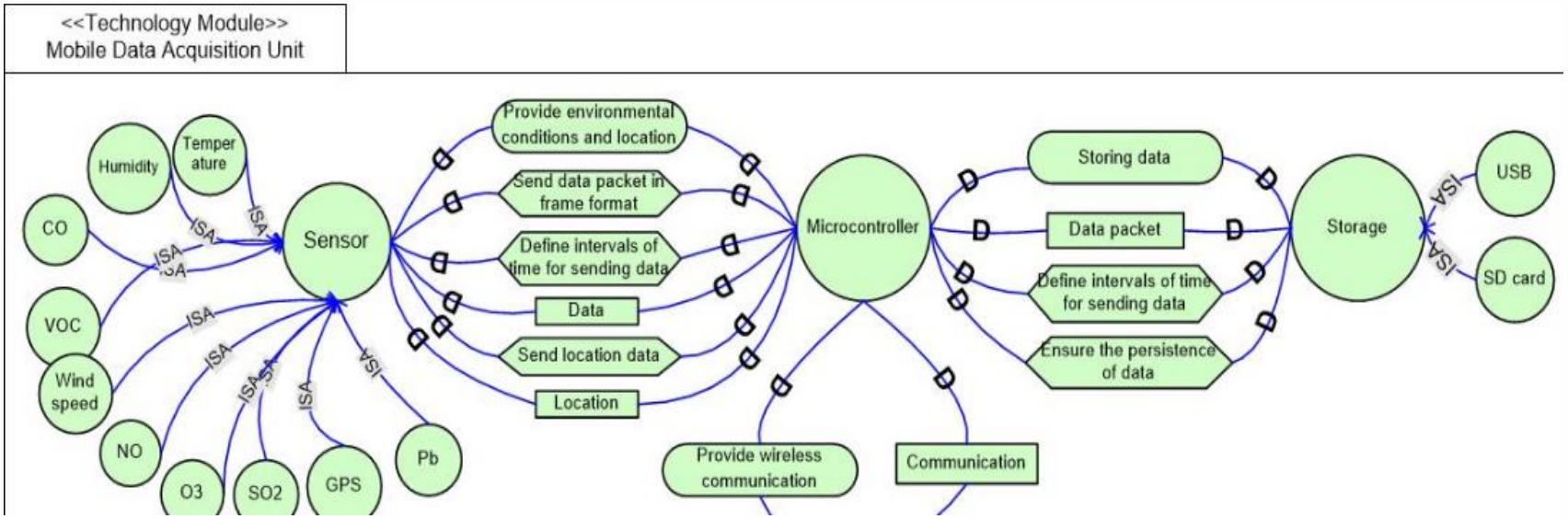


In order to achieve the goal “Determine route based-on user profile and type of transport”, the Green Route **has to accomplish five main tasks**: a) “Manage data in the cloud”, b) “Get environmental information from different data sources”, c) “Get user information”, d) “Determine best user route” and e) “Provide data visualization.

Mobile data acquisition unit

Phase 2

The mobile and fixed units have been represented using the ***technology module concept***, which allows to represent technology in a high abstraction level including information about functionalities, specific requirements and quality features.



Models are available in: http://www.tagoon.semanticbuilder.com/Troposmodels/

Experiences

Challenges

In general, Tropos enable analysts representing most of elements of smart mobility scenario: actors of different nature, technology, software and people, for instance, actors involved in cloud computing, sensor networks, crawling and user interfaces. Some issues identified are:

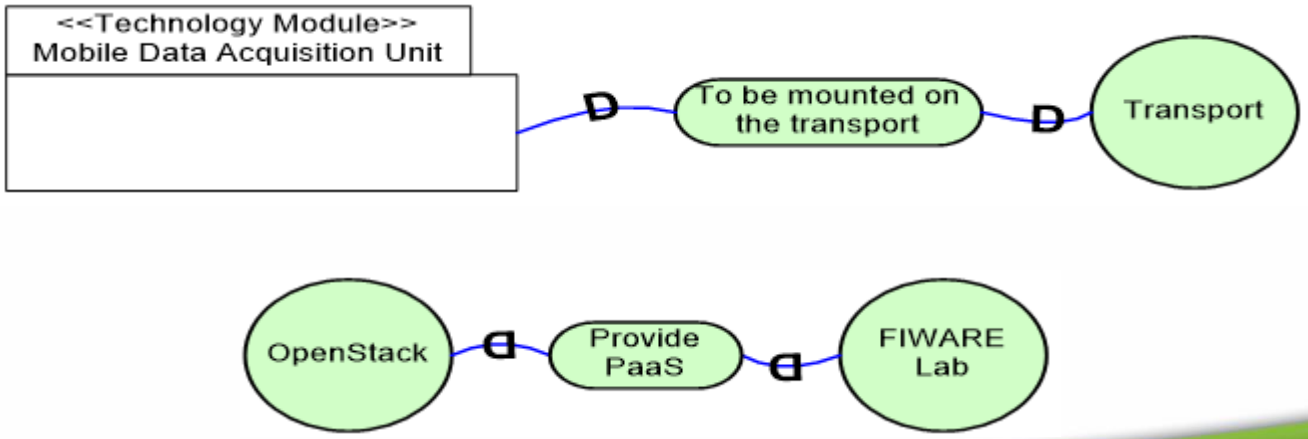
- The **crawler** actor obtains environmental data directly from a website in an automatic way. In this case, there is not goal, task or resource delegation between actors, since **the website is not aware of the crawler**. This has been represented in the model as a goal dependency where the crawler is the depender and the website is the dependee, however, the crawler does not delegate the website the responsibility to provide the data.

Challenges

- Two examples of **challenges** representing dependency between two actors have been identified, since the **delegation is not about a task execution or a resource provisioning**:

  a) The Mobile Unit **depends on** the transport to be mounted on it,

  b) The FIWARE Lab **depends on** OpenStack to provide Platform as a Service (PaaS). In these cases, a goal dependency has been used to indicate a **physical dependency between two actors**, however, these dependencies do not have the semantic of goal delegation.



Conclusions

The advantages of using Tropos for modeling smart mobility applications can be summarized in its **effectiveness** to cover a deeper understanding of a complex environment.

We consider that representing a smart mobility scenario, without a formal language to present intentional social relations, will difficult to:

- Obtain a high level view of the system to be developed.
- Clarify the role of each actor in the fulfillment of the goals of the system.
- Could not be determined the vulnerability level of the system.

We achieved represented complex relationships among actors of different nature, such as: smart software applications, cloud platforms, crawlers, sensor networks, human users, etc. It is important to point out that the development of mobility applications is highly dependent on technology.

Ongoing and future work

- For modeling activity is needed to **extend** Tropos concepts for the representation and interaction of IoT technologies.
- We believe that the Tropos semantic (delegation of responsibilities, the vulnerability associated to dependency, the role of depender and dependee) does not **comply** the semantic of these new ways of interacting.
- New modeling concepts are been developed to properly represent the needed semantics.
- **As future work**, we will use of the generated model **as starting point** of a semi-automatic process to develop the initial implementation of the system to-be. This is possible because the interaction with FIWARE components are standardized and they have well-defined functionalities.

Thank you
for your attention.

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http://fiware.org
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