



Innovations in Clouds,
Internet and Networks

19th
ICIN
CONFERENCE

PARIS
MARCH 1 - 3, 2016

XMPP-based Network Management infrastructure for agile IoT application deployment and configuration

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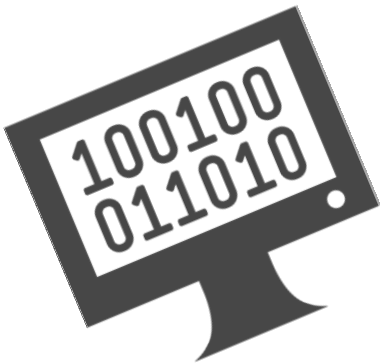
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The level of usability and the simplicity of current IoT platforms is quite low.

The amount of complexity can be usually afforded only by people having enough programming skills.



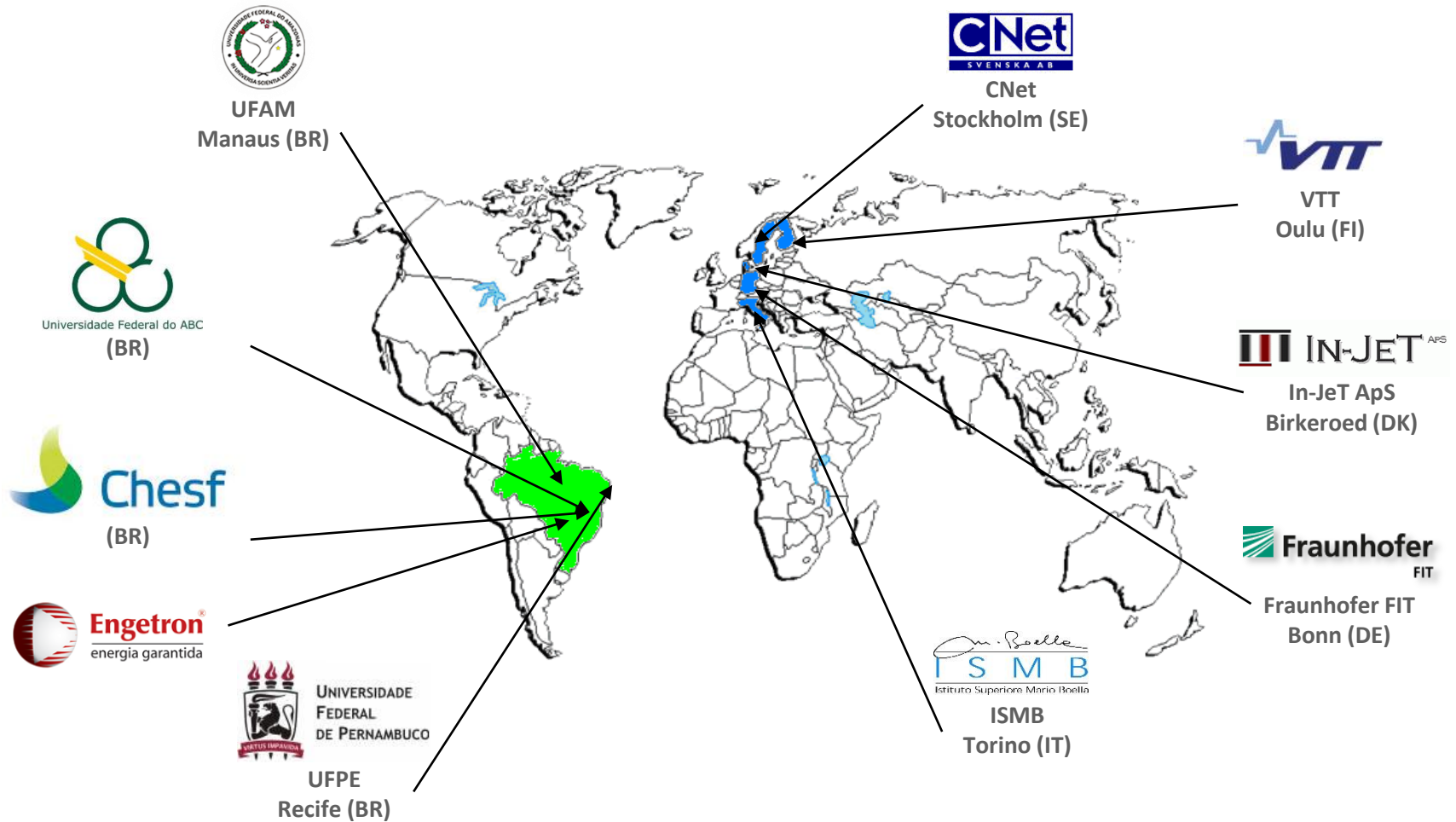


Intelligent System Development Platform for Intelligent and Sustainable Society

IMPreSS project is developing a Systems Development Platform allowing businesses to rapidly develop prototypes of Internet of Things (IoT) systems.

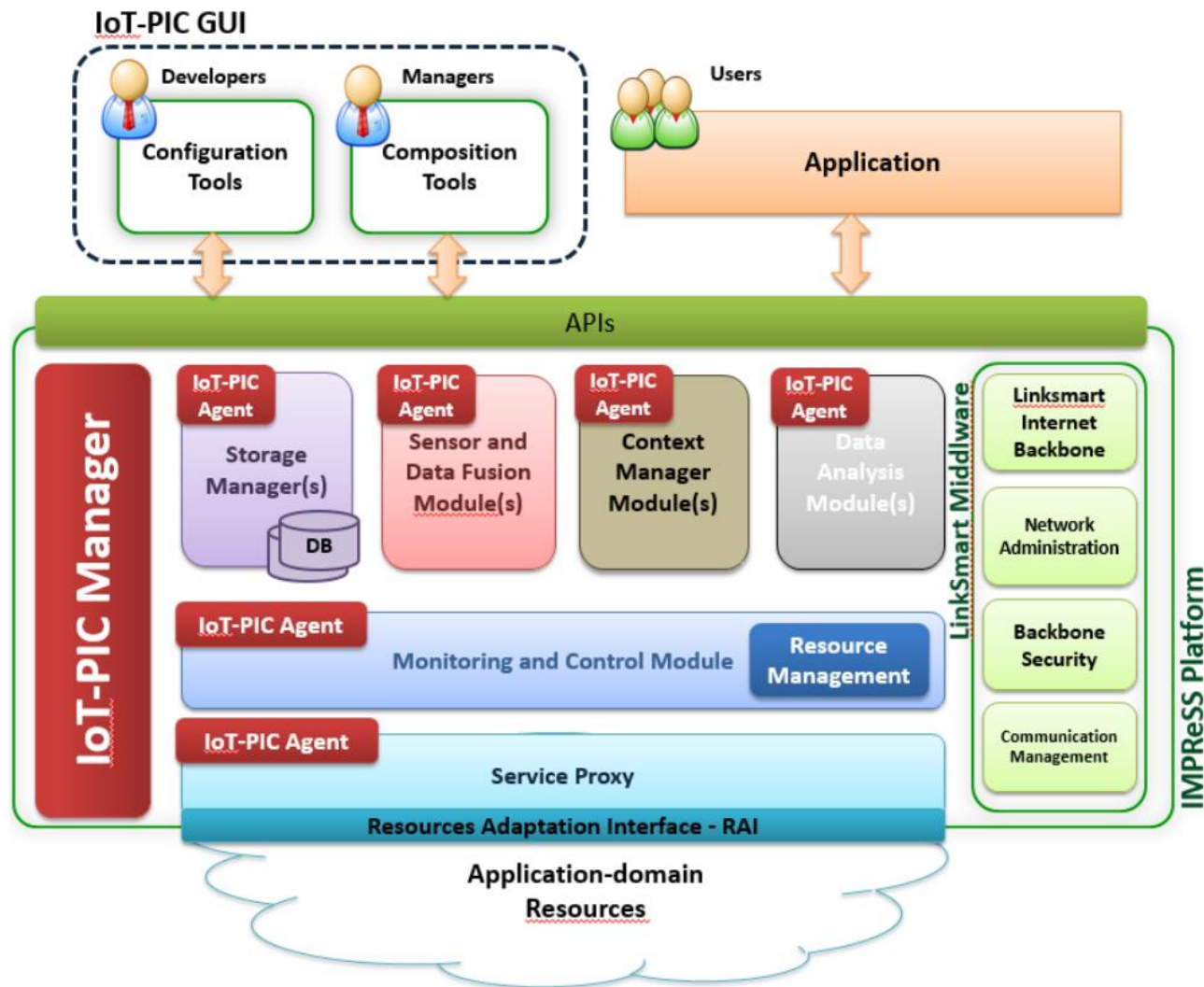
The project is partly funded by the [European Commission](#) under the [7th Framework Programme](#) in the area of EU-Brazil Research and Development cooperation under Grant Agreement no. 614100





- *Significantly **reduces the complexity and cost of developing intelligent systems.***
- *Enables system developers and integrators to **co-create and experiment** with new smart services and the Internet of Things.*
- *Provides developers with a **SOA based middleware which operates on cost-efficient and resource-constrained hardware platforms.***
- ***Enables mixed criticality applications** accessing resources on the heterogeneous Internet of Things and Services.*
- *Enables developers to **rapidly design, generate & extend** their applications*
- *Allows them to **deploy** their **system in a dynamic environment** without having to know the details of the environment in advance.*
- *Provides **non-expert developers with self- and community-guided development tools** that help them co-creating the necessary modules for smart applications.*

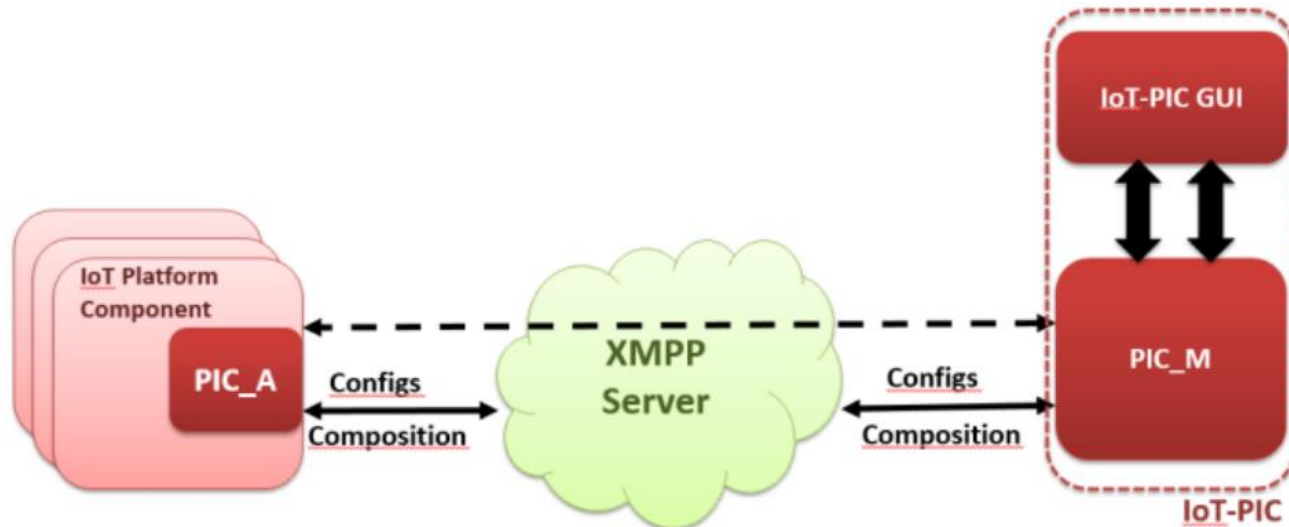
- Developing an **Integrated Development Environment (IDE)** to facilitate Model-Driven Development of Smarter Society Services.
- Providing a Service-Oriented **Middleware to support Mixed Criticality Applications on Resource-Constrained Platforms.**
- Developing easy-to-use and configurable tools for **Cloud-based Data Analysis and Context Management.**
- Managing the heterogeneity of Internet of Things through Network and **Communication Management.**
- Creating efficient **Deployment Tools for Internet of Things applications.**



Infrastructure for Configurations (IoT-PIC)

- Extends the concepts of traditional network planning and management to IoT networks
- Provides basic means for arranging, configuring and monitoring sub-components of an IoT platform
- Provides an easy-to-use model-based approach for the commissioning of general-purpose IoT platforms
- Allows the composition of the different available modules in order to connect them and to realize desired applications
- Allows the management of the status of both the entire platform and the single modules
- Allows dealing with the main aspects of commissioning and network management

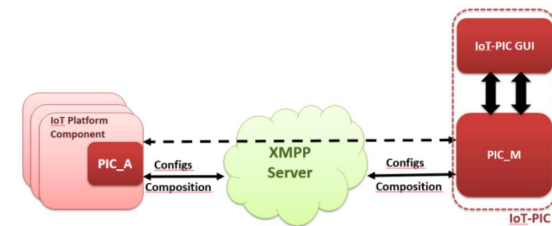
- *IoT Platform sub-components Discovery*
 - detects automatically devices joining the IoT platform and the services they provide
- *IoT Platform sub-components composition*
 - interconnect different available components of the platform (e.g. service proxies, data filtering and aggregation modules, decision support systems, etc.)
- *IoT Platform sub-components Configuration*
 - provides to each platform component involved in the realization of the application (i.e. the ones interconnected through the composition stage) the values for the correct behavior of the applications.



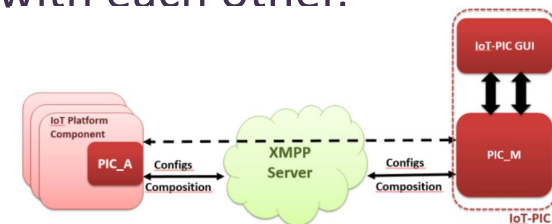
- PIC_M is a global component acting as a manager
- PIC_A is a local component associated with each component of the platform
- XMPP-based infrastructure
- High-level data security using TLS encryption and SASL authentication

PIC_M module

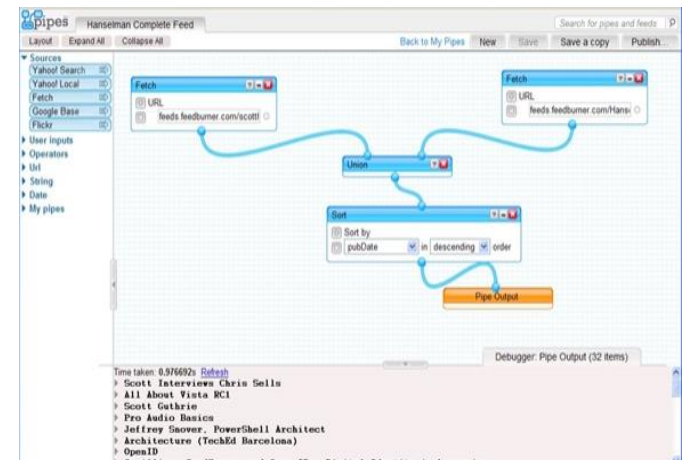
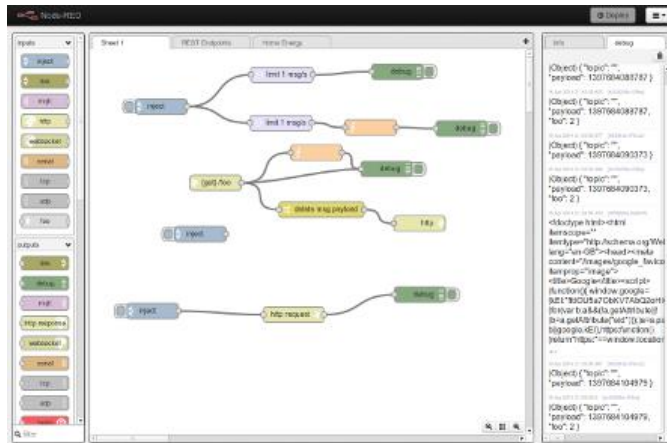
- It is in charge of managing the configuration and composition processes of the other modules belonging to the platform
- it works as an interface between the applications and the various components of the platform
- Leverages on publish-subscribe paradigm
- The functionalities of PIC_M are:
 - Notifies the applications on the status of the components available in the middleware
 - Retrieves the configuration from the PIC_A, when required through a XMPP ad-hoc command
 - Updates the configuration of the components through the PIC_A via XMPP



- It extends each component of the platform with composition and configuration features
- It exposes “get” and “set” ad-hoc commands, to manage configuration parameters of a specific component to the PIC_M.
- It actually operates configuration commands coordinated by PIC_M
- PIC_A is responsible for:
 - Register the component in the PIC_M
 - Handling the configuration parameters of the component
 - Handling the interconnection of the components with each other. adding and removing input sources



- Aims at achieving fast and error-free application development
- Enables end-user programming / inexperienced developer
- High level of abstraction
 - Flow Based Programming (FBP)
 - Networks of "black box" processes
 - Yahoo! Pipe, DERI Pipe, Node-RED (IoT)



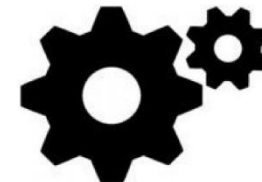
Discovery and composition operations



- Every discovered resource is registered to IoT_M
- IoT_M creates an XMPP account on the local XMPP server for each resources
- pub-sub nodes are created by PIC_M for managing events generated by resources
- XMPP Ad-hoc commands are created by PIC_M for managing actuations and synchronous commands offered by resources
- Resource node collects info about discovered resources type (e.g. temperatureSensor, humiditySensor)
- Function node collects info about operations allowed for each resource type
- A graphical connection between two modules reflect in a pub-sub node subscription

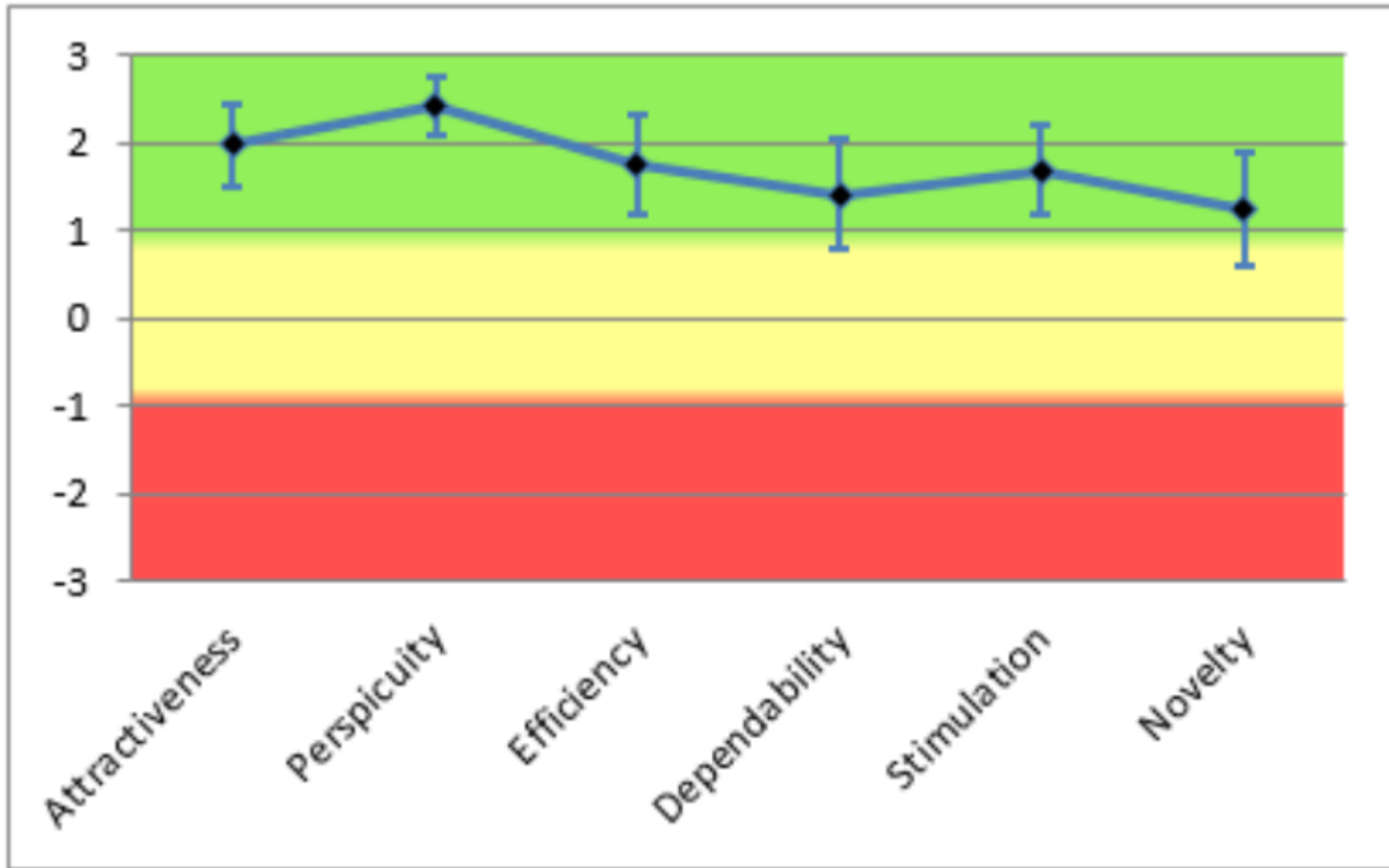
Configuration operations

- PIC_A exposes two ad-hoc commands for components configuration:
 - One provides an XML describing types, current values and a list of possible values to assign (if range is limited).
 - One allows updating the configuration variables
- ad-hoc commands are called to update variables
 - XML is passed with new values
- PIC_M provides two ad-hoc commands to read and write the configurations probing PIC_A(s)



- Evaluated by ten people among students and ICT technicians at University of Pernambuco
- A user experience has been filled out
- The following aspects have been evaluated:
 - *attractiveness* – general impression towards the component;
 - *efficiency* – how fast and efficient the component is and how the user interface look organized;
 - *perspicuity* – how much is easy to understand how to use the component and how does it work;
 - *dependability* – how much the user feels while using the component (i.e. is the interaction with the product secure and predicable?);
 - *stimulation*: how much interesting and exciting people perceived the component;
 - *novelty* – how much the design of the component is innovative and creative.





Future works

- To enhance the IoT-PIC with some useful features typical of Network Management solution
 - Evaluate the quality-of-service and the round trip time or other parameters used to monitor the status of a network.
- Pub-Sub nodes and ad-hoc commands will be generated on ontology descriptions basis
- As XMPP foundation members, current solutions will be discussed for taking part of XMPP-IoT extension.





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Thank you!

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March 3rd, 2016

Track D – INTERNET OF THINGS