Towards an IoT Ecosystem

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Agenda

- Introduction
- Requirements of IoT Middleware Platforms
- IoT Middleware Platforms
  - EcoDiF: Architecture and Implementation
  - Other Platforms
- Discussion

Introduction

- In the near future, it will be possible that every single object on Earth can be identifiable, addressable and accessed through the Internet
  - Wireless Communication
  - Sensing and acting upon the physical environments
- "Smart things" integrated in the Internet
  - Collaborate among them and with other physical and virtual web resources
  - Provide value added information for end users

Introduction

- Such emergent scenario constitutes the Internet of Things (IoT) paradigm

Definition

- A global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilities
  - Offering specific object identification, sensor and connection capability as the basis for the development of independent cooperative services and applications

Introduction

- Emergent IoT applications are characterized by being developed in an **opportunistic** and **ad hoc** way by potentially **lay users** on top of smart things
  - Web Mashup Approach
- The interaction model among the different services of an IoT application needs to be more relaxed than in traditional Web service compositions:
  1. The intermittent behavior of devices makes the interactions with them unpredictable
  2. The lifecycle of data streams in the IoT environment is also unpredictable
  3. The dependencies among application services are not fully known at design time

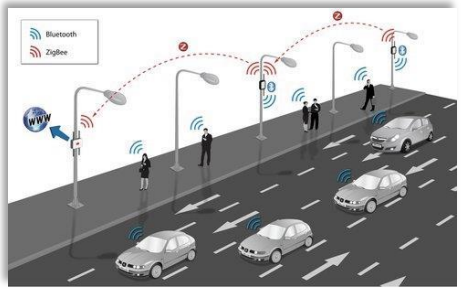
Introduction

- IoT as a System-of-Systems (SoS)
  - A composition of systems in which its constituent systems are individually discovered, selected, and composed possibly at run-time to build a more complex system

Introduction: Examples of IoT apps

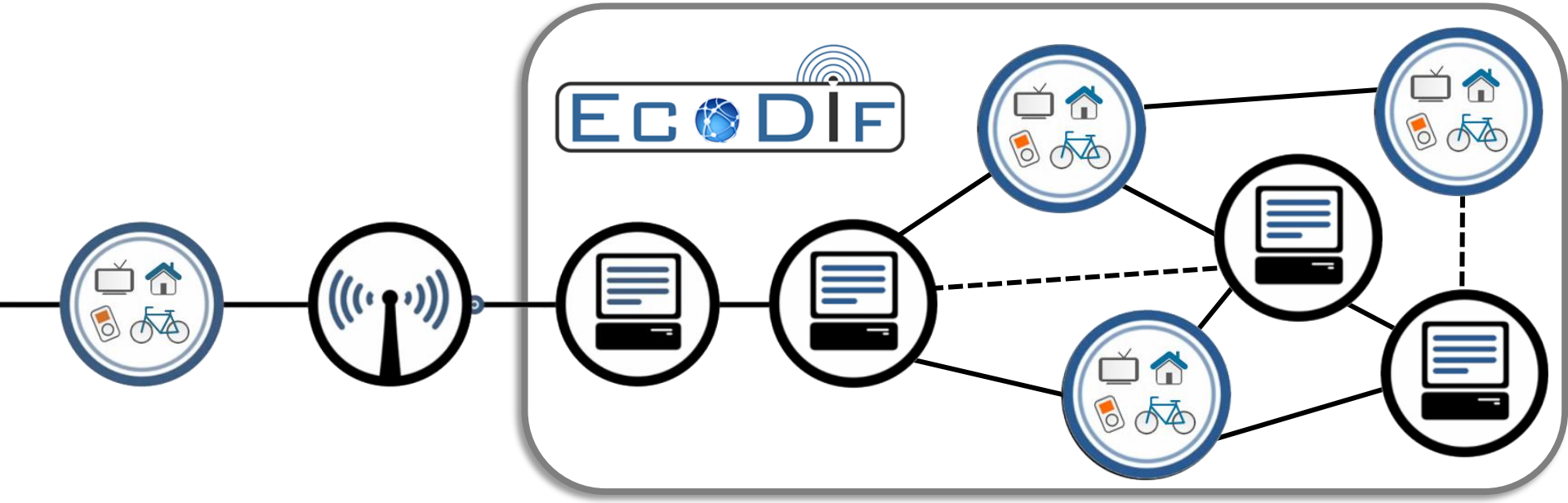
- Prevent global-scale catastrophes that may damage cities and affect the life of the people
  - Environmental monitoring

- Monitoring of urban infrastructures
  - Smart Cities



Introduction

- Following we briefly describe requirements and examples of existent IoT platforms
- An example of IoT middleware platform:
  - EcoDiF (Web Ecosystem of Physical Devices)



Requirements of IoT Platforms

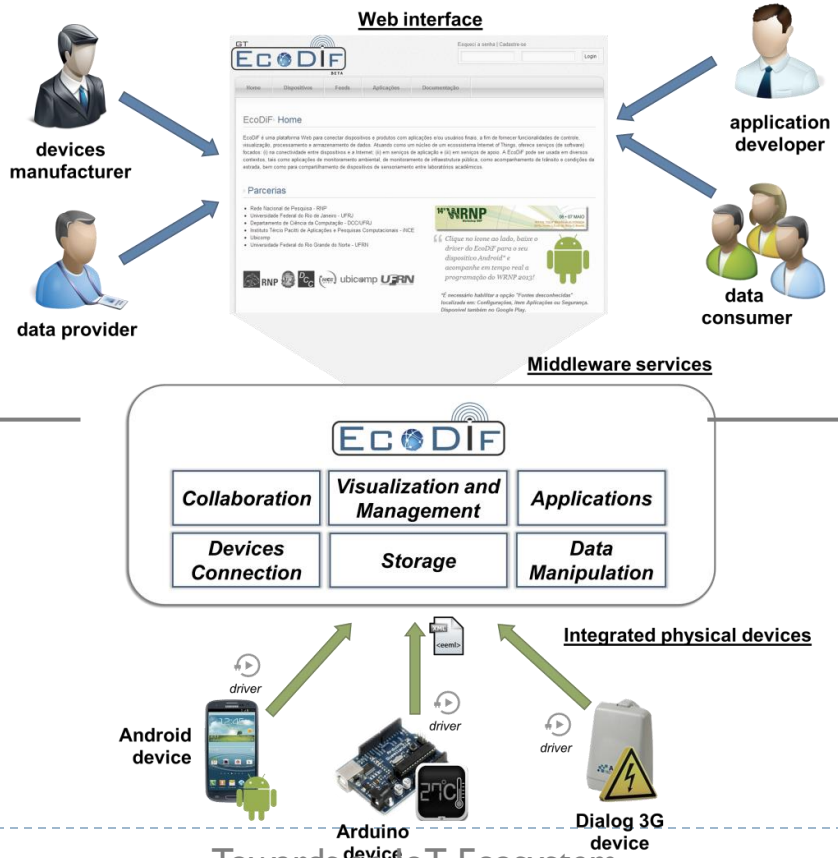
1. Scale
2. High degree of hardware and software heterogeneity
3. Uncertainties
    1. Wireless communication
    2. Device location, state
    3. Network topology
4. Conflict resolution
    1. Different apps requirements
5. Issues related to the management of massive data, privacy, and security in the IoT context

IoT Platforms

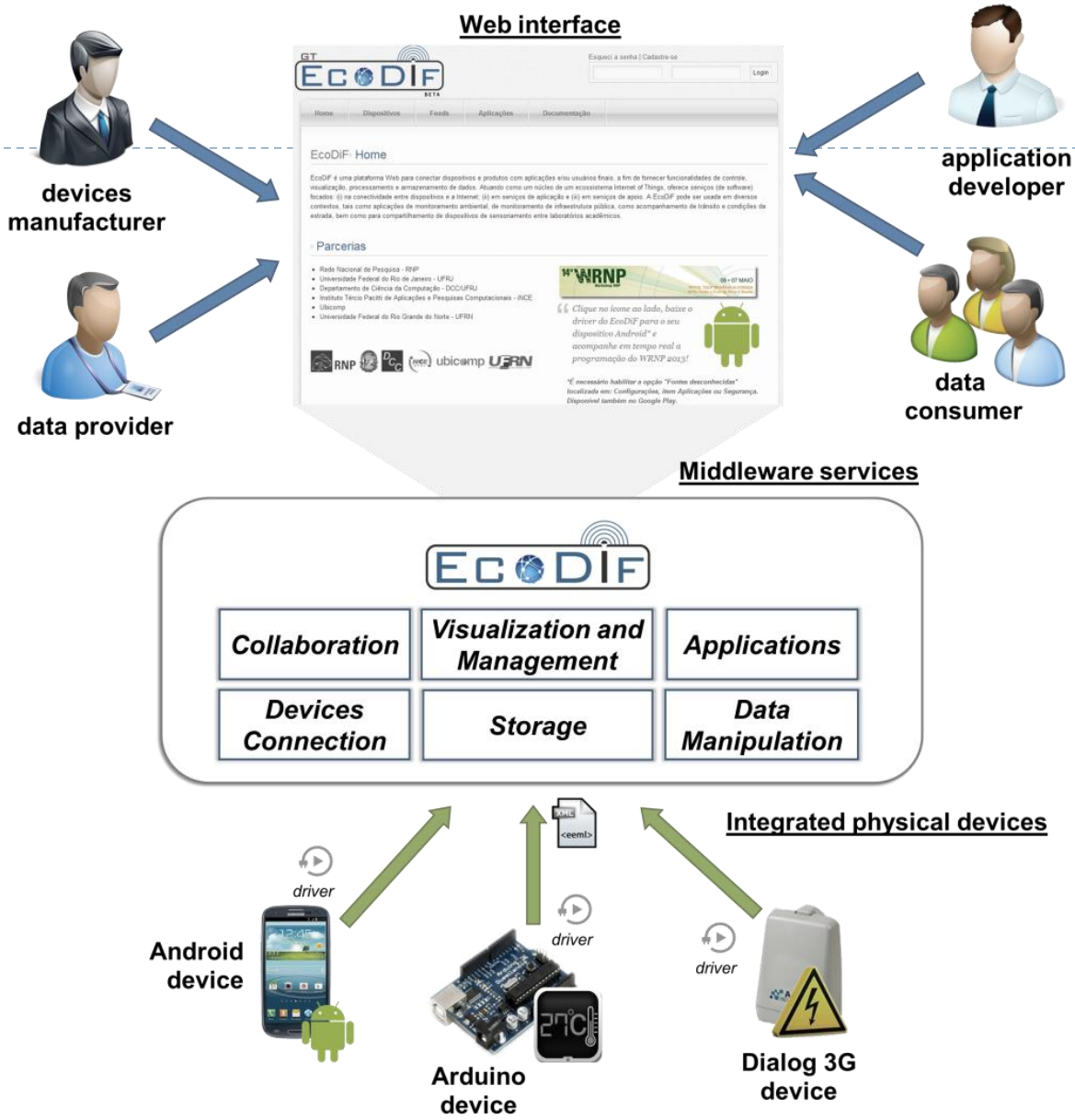
- An IoT middleware should address all the aforementioned requirements and it is typically arranged as an SoS composed of 3 different subsystems:
  - The subsystem composed of smart things
  - The subsystem composed of applications that run on top of the objects
  - The socio-technical subsystem composed of users and interfaces

EcoDiF

- In this context EcoDiF is a platform that enables the integration of devices, information, users, and apps, creating an IoT EcoSystem



EcoDiF


Web interface
devices manufacturer
data provider
application developer
data consumer
Middleware services
Collaboration
Visualization and Management
Applications
Devices Connection
Storage
Data Manipulation
Integrated physical devices
driver
Android device
driver
Arduino device
driver
Dialog 3G device

Discussion

- Current IoT platforms have several limitations, and lack mainly to tackle aspects of SoS
  - Lack of mechanisms to deal with uncertainty of sensor data and metadata and with conflicting applications
  - Need for new architectural approaches for building applications
- Traditional Software Engineering approach: focus is on breaking down the individual pieces of what is being analyzed
  - not suitable to study dynamic and complex systems such as SoS
- Systems Thinking: how the object of study interacts with the other constituent parts

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