The ebbits project: from the Internet of Things to Food Traceability

Smart AgriMatics2014

Contribution to session 5.2 Meat Information Provenance

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ebbits overview

enabling business-based Internet of Things and Services

An Interoperability platform for a Real-world populated Internet of Things domain

IP in the 7th framework Programme, theme ICT-2009.1.3 Internet of Things and Enterprise environments

August 2010 – August 2014 (February 2015)

SEVENTH FRAMEWORK PROGRAMME

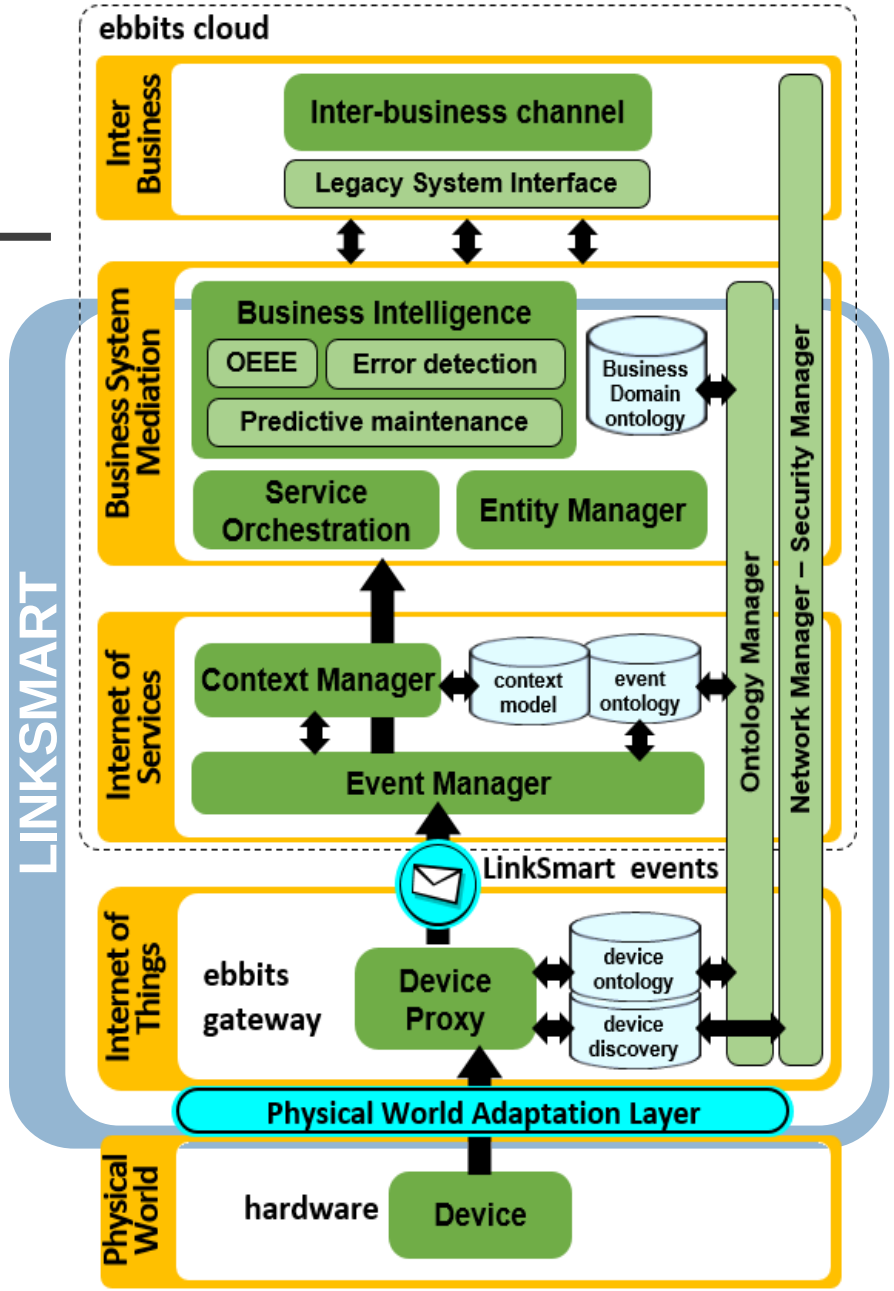
Fraunhofer FIT · ISMB Istituto Superiore Mario Boella · CNet Svenska AB · COMAU · IN-JET · InterSoft, a.s. Košice, Slovakia · SAP · tnm

ebbits aims & goals

- Allow businesses to integrate the **Internet of Things** into mainstream enterprise systems
  - Every device or subsystem can be represented by a **service** and can be integrated into an exiting enterprise systems
  - information generated by tags or sensors will feed directly and seamlessly the ERP systems
- Support multiple domains, like:
  - Automotive manufacturing
  - **Food traceability**
- Enable applications across **stakeholder boundaries**
  - Supporting interoperable end-to-end business applications, from sensors and products to real world people.
- Make developers' life easier

System architecture

- **Built on the top of the LinkSmart Middleware**
  - **LinkSmart** it is an **open source** project, available at: sourceforge.net/p/linksmart
- **Physical World Sensors and Networks abstraction**
  - **Semantic** interoperability between heterogeneous physical world technologies
- **Device discovery manager**
  - Attribute-based **service descriptions**
- **Data and Event Management**
  - P2P based service management using a **publish-subscribe** communication paradigm
- **Centralized and Distributed Intelligence**
  - **Data fusion** & ontology-based **context** model
- **Frameworks for Business Process Life Cycle Management**
  - Process **taxonomy**



Entities and Services

Services

- The capabilities of smart or simple objects, sub-systems, people as well as applications are all exposed as ***services*** or a ***composition of services***
  - No need to have a direct link to any specific physical resource

Entities

- ***Static Resources*** which need to be monitored throughout their whole lifecycle:
  - ***Physical Entity*** - *any physical object* that is relevant from a user or application perspective
  - ***Virtual Entity*** - a computational or data element representing a Physical Entity
    - ***Active*** (any type of active code or software program)
    - ***Passive*** (digital representation of something stored in an IT-based system)

Entities and applications

- Different stakeholders can use ***different local names*** (according to different identification schemes) for the ***same entity***

- Building IoT applications across different stakeholders in the business process requires the knowledge of the relationship
  - between an ***entity*** and its ***relevant names/aliases***
  - among ***different entities***

Management of Entities

- IoT Application deal with Physical and Virtual Entities
- A clear **identification scheme** is required to enable **discovery, lookup** and **resolution** process

ebbits **Entity Manager** provides:

- World-Wide ***unique identifiers*** that are random generated
- ***Mapping functionalities*** between physical entities and virtual entities

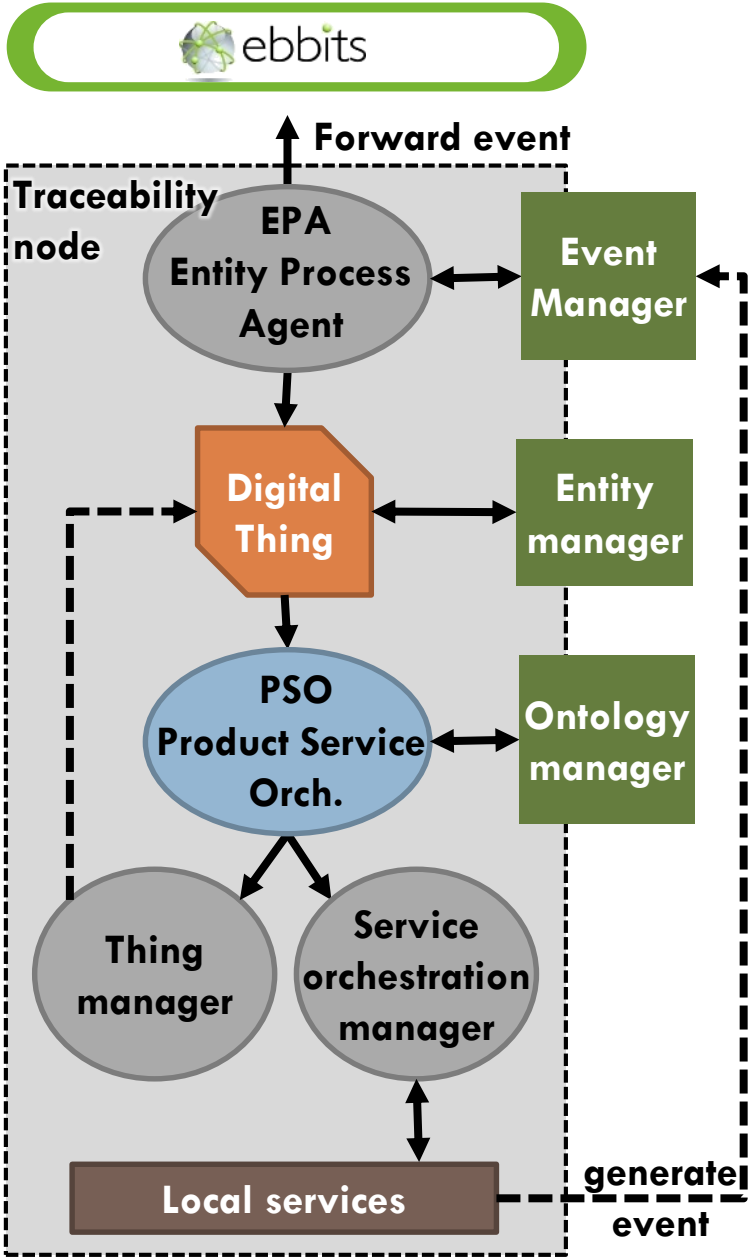
ebbits Entity Manager

Repository where each ***Entity*** is identified by

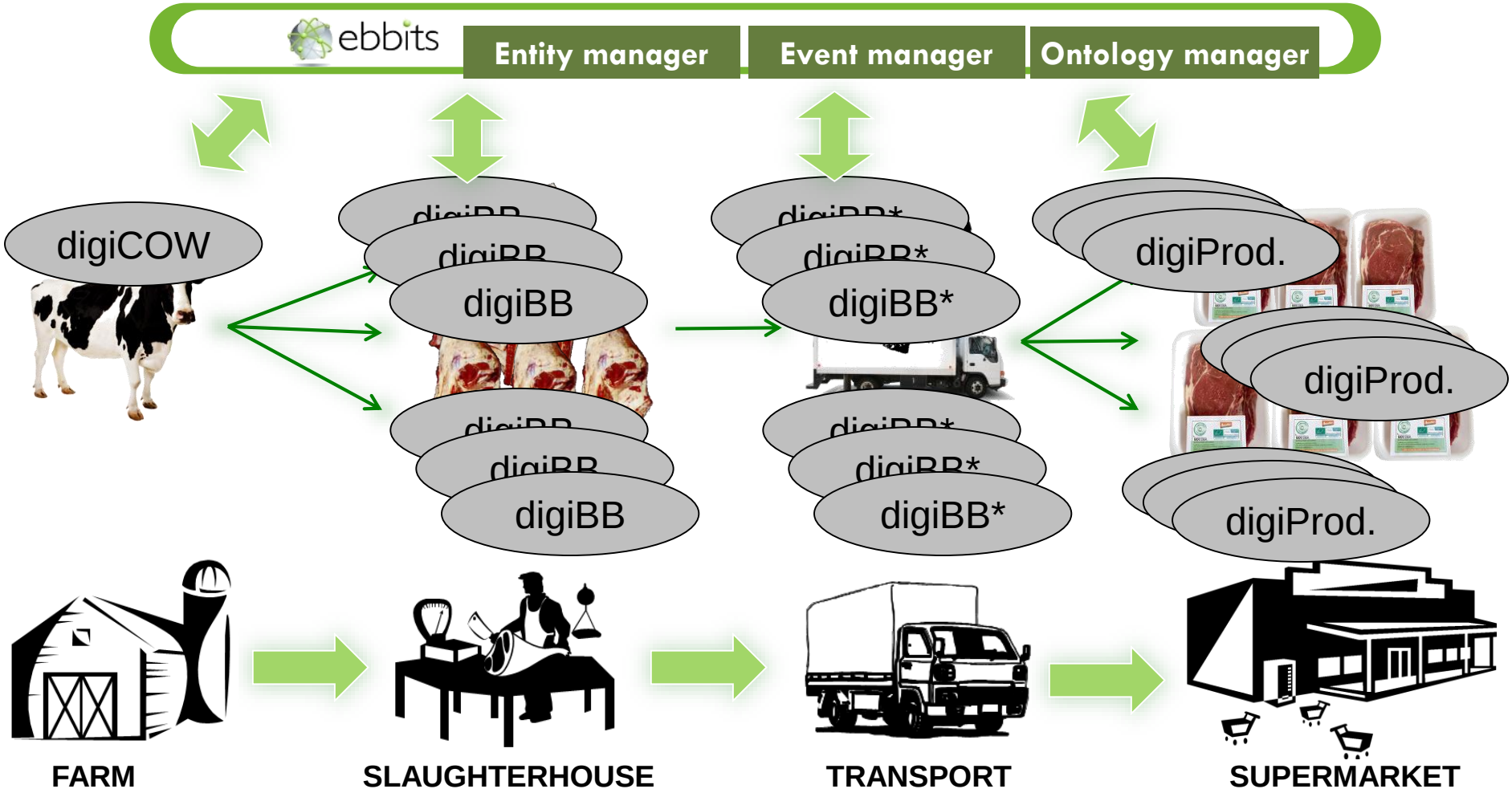
- **UUID** generated automatically (an **EPC** code can be used as initial local ID for a given Entity)
- ***Local ID*** that identifies the Entity in the local domain of the resource provider,
- ***List of aliases /local IDs*** that identify the same entity, but potentially stems from other stakeholders and uses other local identification scheme
- ***List of unique UUIDs*** related to resources which are in the ***part-of relation*** with the given Entity.
  - An Entity could have one or more parts (***Slave Entities***) and at the same time it could be part of one or more Entities (***Master Entities***).
  - An ***oriented acyclic graph structure*** is used to store such relationships
- The Entity Manager provide Support for ***resolution service***

Traceability node

- The *ebbits:DigitalThing* can represent any physical or digital entity.
- The traceability node acts as a hub for collecting product-relevant events and data and manages them locally



Reference Scenario
Food Traceability



Farm environment – Cows Information

- Registration of Birth
  - Parents
  - Race
  - Sex
- Registration of production conditions
  - Organic
  - Outdoor housing
  - Feed
- Medical treatment

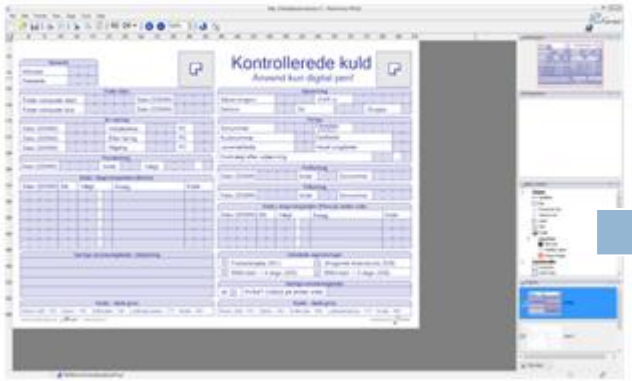
Interaction with Danish National Cattle Database/FMS

- Live sensor data (temperature/humidity)

Farm environment – the Digital Pen & Paper

- A way to collect structured data while working in the field
- Data written with a pen on paper forms ends up as digital data on a server

Design tool



Digital Paper Sheets

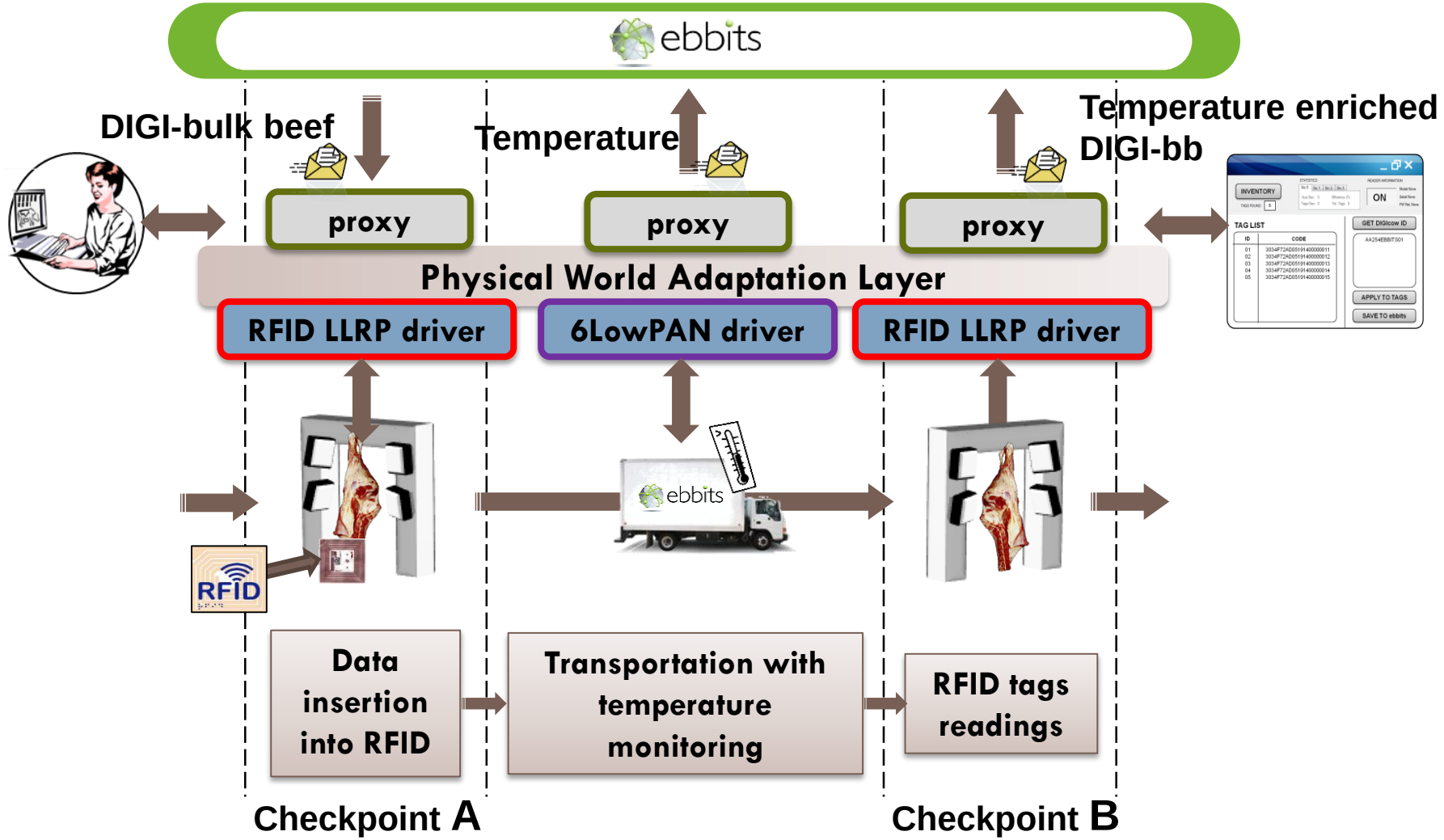
Client Router Software
Handwriting Recognition

Slaughterhouse level

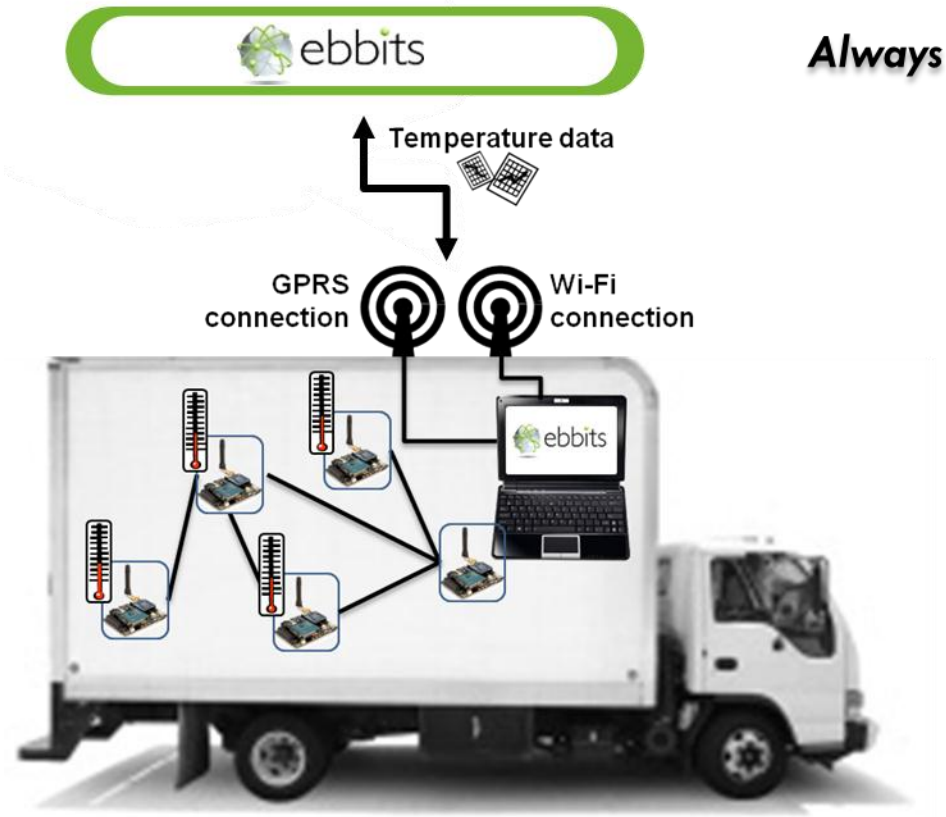
- Classification of meat
  - Colour
  - Fat content
  - Muscle volume

- Carcass cut into minor pieces
  - Identified with barcode

Transportation level RFID for the cold chain

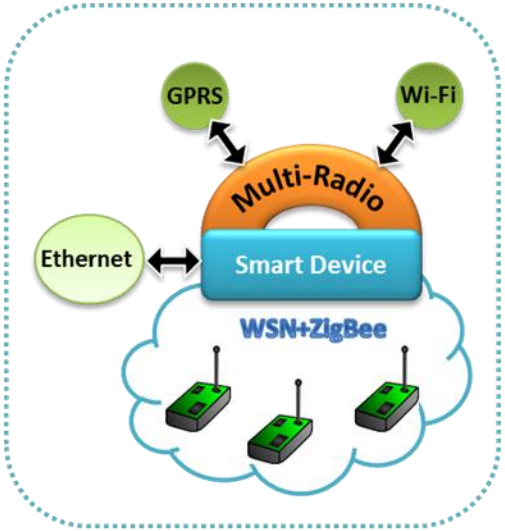


Transportation level Temperature monitoring

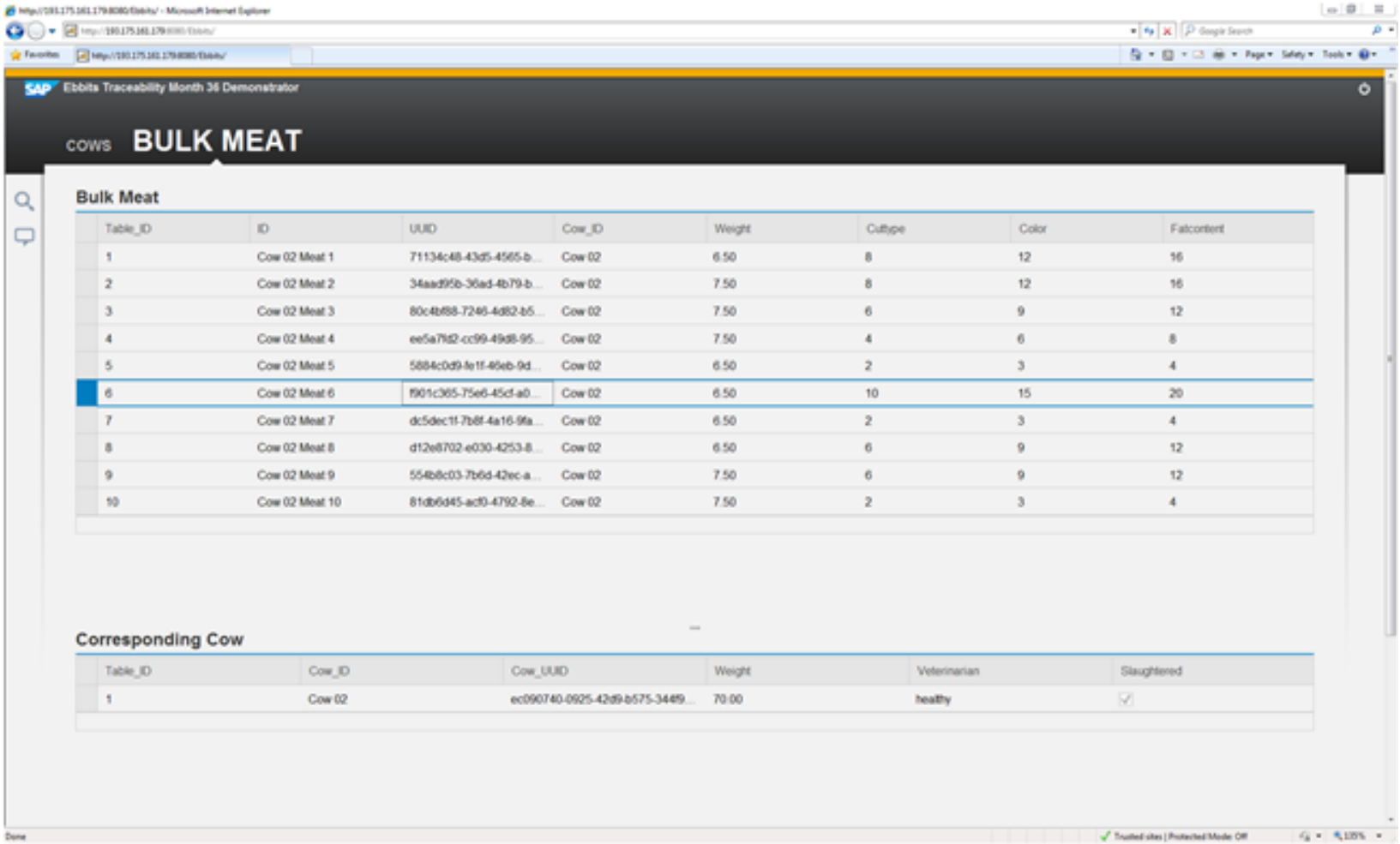


Combined use of multiple radio access technologies

***Always Best Connected* (ABC) to suit the user needs**

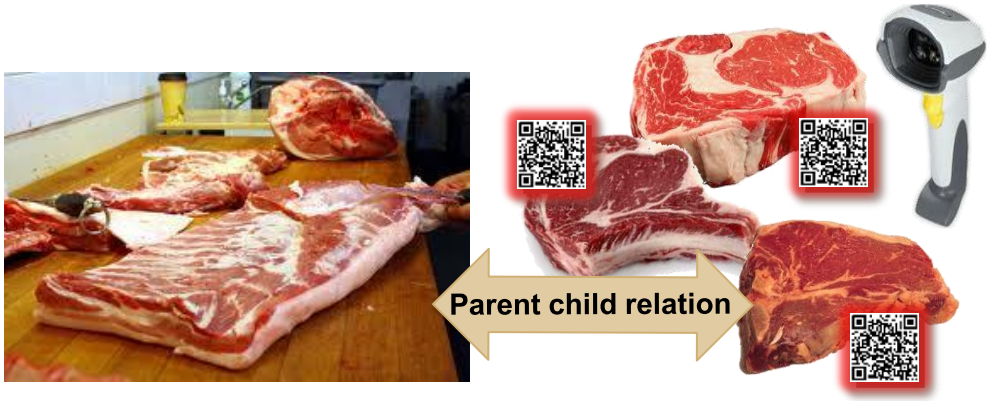


Retailer level
Bulk meat into SAP system



Retailer level
Field Trial in the supermarket

- Evaluation in one supermarket (Super Best)
- Test setup in the butchers department
- Demonstration and evaluation in shop



- Meat cuts arrives from slaughterhouse
- ID: Meat cut and packaged
- Parent child relations are created (through barcodes)

Consumer environment

- Aggregation of information from the traceability chain
- Cutting information
- Best before date
- Data available by app's

Conclusion and next steps

- **Conclusions:**
  - Several traceability relevant achievements:
    - Heterogeneous physical devices virtualization using a common interface
    - Product Service Orchestration Management
    - Integration of real world "things" as software objects.
    - Standard interface to control RFID reader in the traceability scenario
    - 6LoWPAN sensor nodes compliances
  - IoT-enabled meat traceability has been prototypically implemented
  - The prototype gathers a real world data from selected farms in Denmark
- **Next Step:**
  - Deployment of the solution to a production environment is planned for the next phase of the ebbits project
  - **People manager**
  - Traceability **many2many**

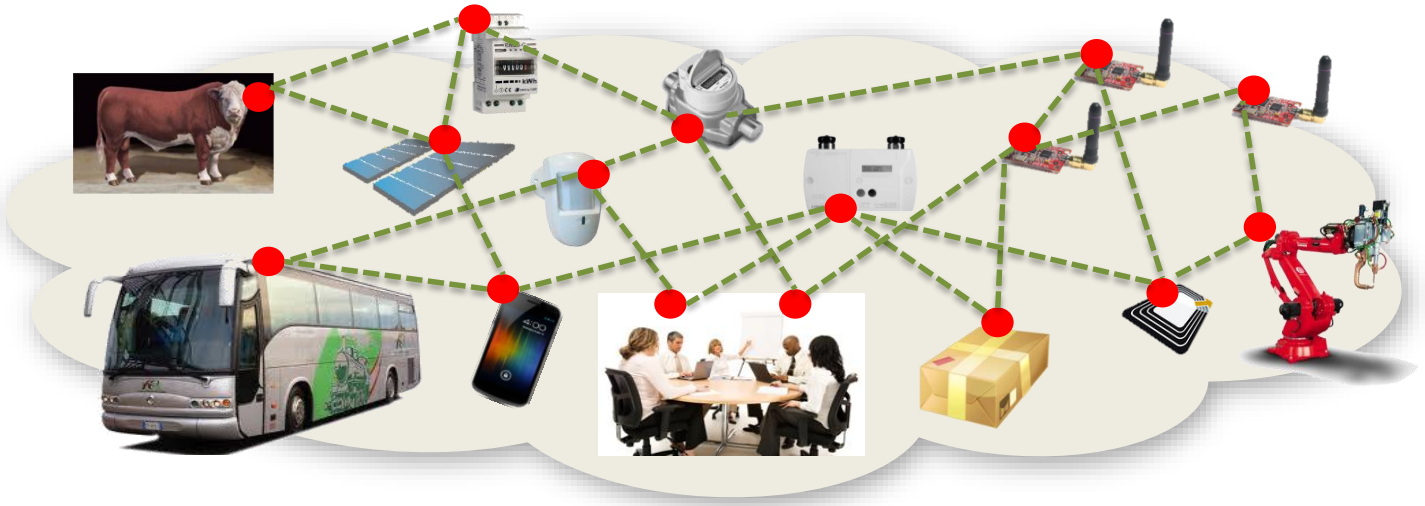
Thanks for your attention

Question?

http://www.ebbits-project.eu/

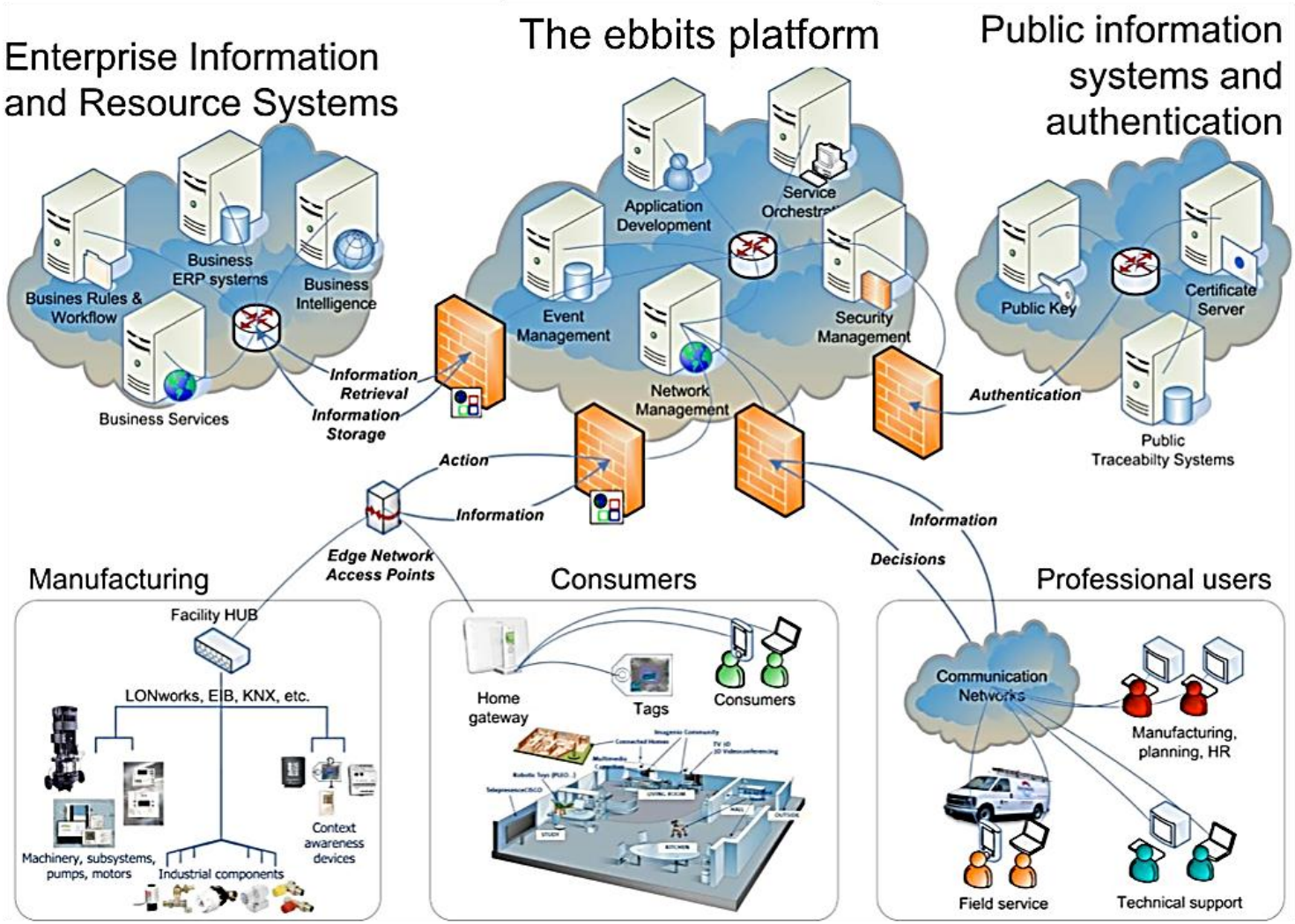
Internet of Things - IoT

- Definition: “IoT is a concept in which the real world is made by a large populations of intelligent objects able to be seamlessly integrated in a virtual world of information



- Today, wireless embedded technologies allow ubiquitous communications, pervasive computing and ambient intelligence, making the trend towards always-on devices really possible”

ebbits Platform

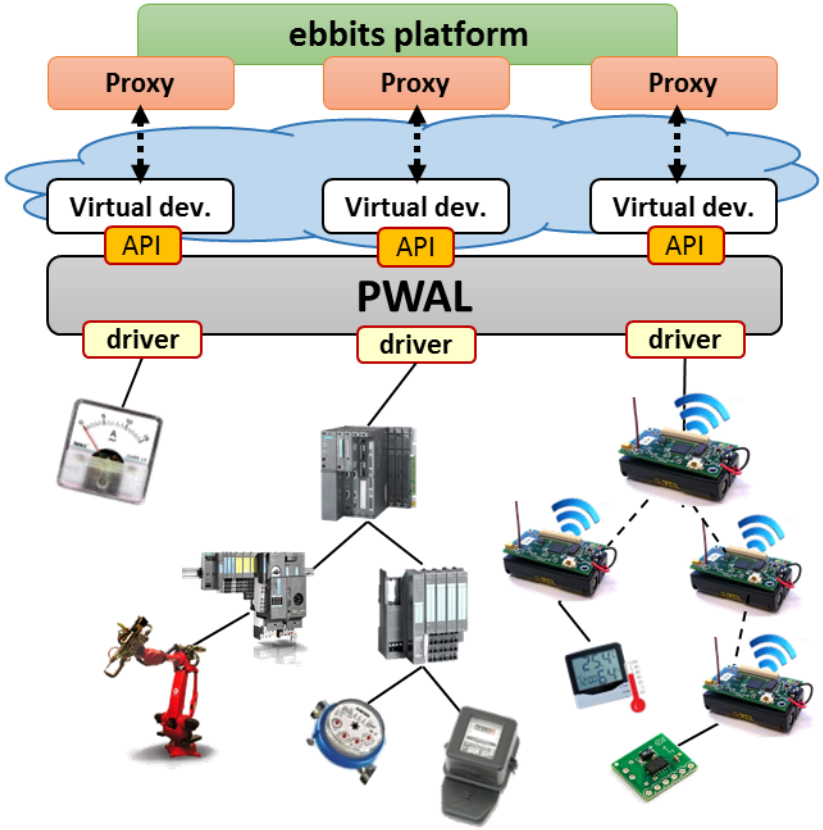


LinkSmart and PWAL

- LinkSmart is an IoT middleware, developed within the Hydra EU project. It aims at allowing developers to incorporate heterogeneous physical devices into their applications through easy-to-use web services.
  - LinkSmart has obtained during years a great success, and has been re-used by several EU project. Today it is an open source project, available at: http://sourceforge.net/p/linksmart
- ebbits fully leverages on LinkSmart, but introduce a further device abstraction level, the so called **PWAL – Physical World Adaptation Layer**

Physical World Adaptation Layer

- Connection with physical devices through PWAL **driver**
  - Communicates with the physical device using device technology
- Interaction with the ebbits platform through the Device **proxy**
  - Represents the physical device as a virtual device
  - Exposes an interface to the ebbits platform with the offered services and hardware resources



Ontology schema for the traceability scenario