

Sensors Integration into Heterogenous Services Platform and Domain Adaption

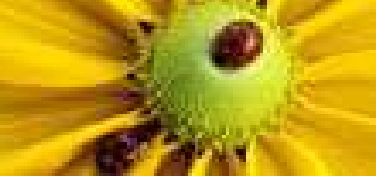
Master Thesis Presentation

by

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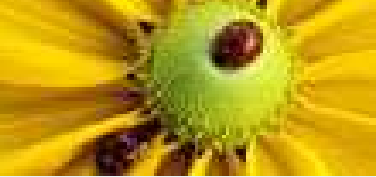




Topics

Goal: Demonstrate interoperability of Sensors in heterogeneous infrastructures, example JBV use-case with sensors to Telenor Objects platform

1. Background - Standard ETSI TS 102.690
2. Introduction
 - M2M
 - ETCMS/ETCS
 - GSM-R
3. Realization
 - Telenor Objects - Shepherd platform
 - Sensors - Sun SPOT
4. Demonstration
5. References



Tasks

Outline

● Topics

● Tasks

1. Introduction

2. Realization

3. Demonstration

1. Analyze the standard ETSI TS 102 690
2. Analyse the Shepherd platform
3. Propose a generic integration aproach
4. Implemetation and performance analysis

About the Machine-to-Machine (M2M)

Outline

1. Introduction

- About the Machine-to-Machine (M2M)
- M2M Specifications for the Railway
- What is ERTMS/ETCS?
- ERTMS components
- GSM → GSM-R
- GSM/ GSM-R architecture
- GSM/ GSM-R Properties
- ETSI TS 102.690 standard
- M2M high level system overview

2. Realization

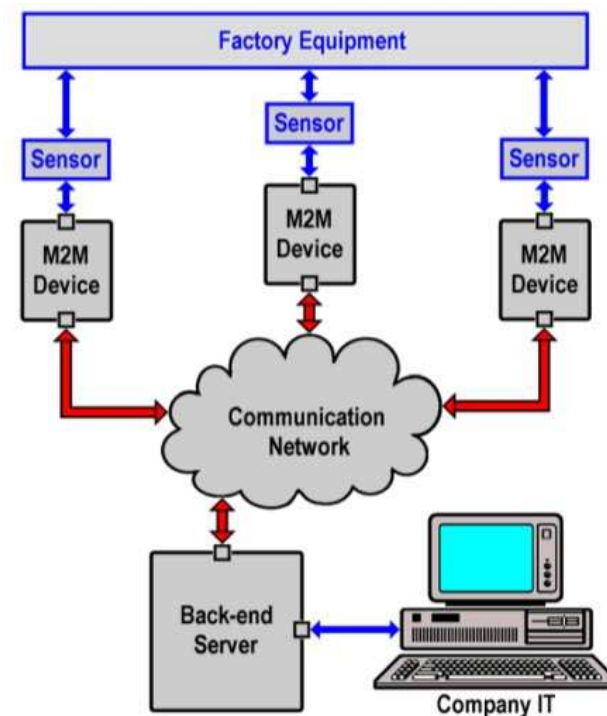
3. Demonstration

*The ability of a machine device to “communicate” with another machine devices + intelligent properties with the self-**

The elements in the concept

- M2M Device → two-fold properties: one with interfaces to the sensor, while another to the network interfaces
- Communication network → acts as connection point, and provides the accessibilities using different technologies such as LAN, Wi-Fi, ISDN, GSM etc.
- Back-end server → data collection point.

M2M for monitoring application



[Walter, 2005, Whitepaper]

M2M Specifications for the Railway

Outline

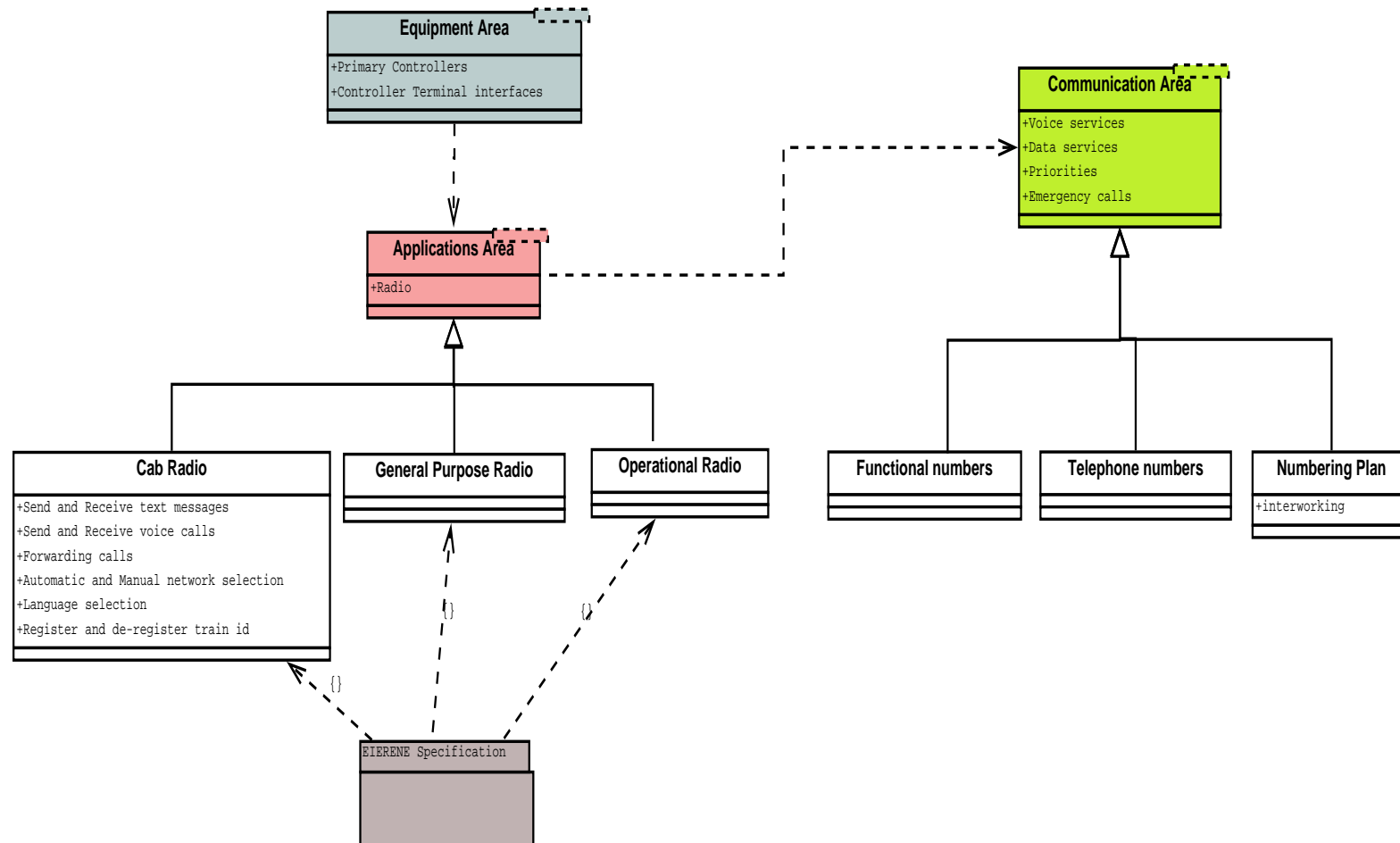
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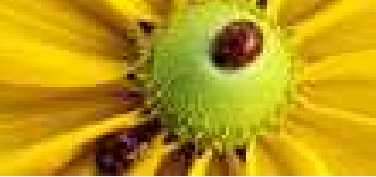
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Functional Requirements Specification:



[UIC, 2006, GSM-R Functional Group]



What is ERTMS/ETCS?

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ERTMS/ETCS (1989) → *A Command and Control system for traffic management to allow the interoperability of operation and exchangeability, and to ensure a high-speed rail system.*

- Why? To achieve a safety trans-European traffic management system, reduce the cost of maintenance.
- How? To introduce a GSM-R network with M2M in the ETCS.
- Concept is based on 3 levels of ERTMS:
 1. Level 1: existing signaling on rail lines with balise to transmit data between ETCS on-board equipment and the control center.
 2. Level 2: introduce GSM-R communication between the Radio Block Center and the on-board equipment. Allow continuous monitoring of correct speed with expected distance of travel.
 3. Level 3: a completely GSM-R network with continuous monitoring of train and its updated information.

[Curzon, ERTMS, 1999], [UNIFE, Factsheet]

ERTMS components

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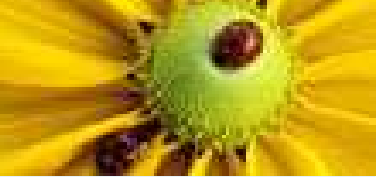
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[Pictures from Youtube video]



GSM → GSM-R

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GSM → Technology for digital cellular of transmitting mobile voice and data services^a. GSM operates in Europe between 900 – 1.8GHz bands.

1. UIC documents for specifications:

- EIRENE Functional Requirements Specification
- GSM-R Procurement Guide
- Interoperability Directives → Technical Specification and Control and Command System.

2. GSM-R network is based on existing GSM networks.

3. Depending on the “National” implementation of GSM-R: Public, Private, Hybrid network.

^a<http://www.gsmworld.com/technology/gsm/index.htm>

GSM/ GSM-R architecture

Outline

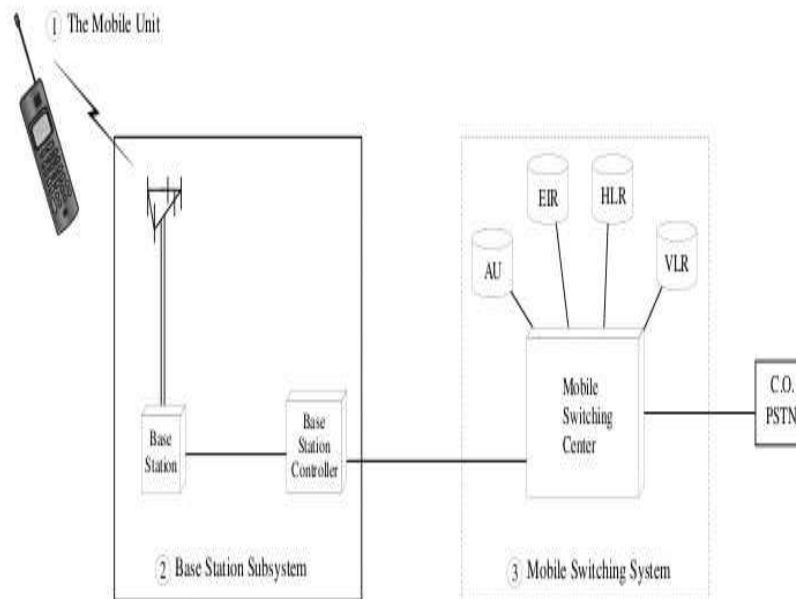
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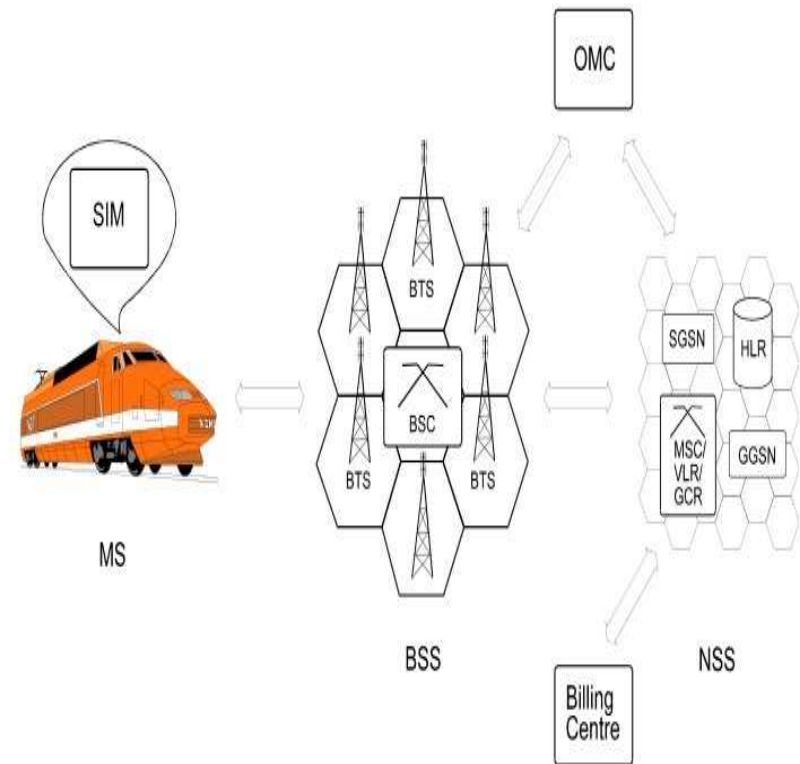
2. Realization

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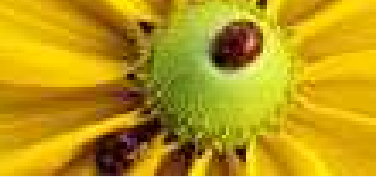
GSM elements



GSM-R



[The International Engineering Consortium, Tutorial]



GSM/ GSM-R Properties

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2. Realization

3. Demonstration

1. Analog voice is converted to digital before transmission over-the-air
2. Transparent roaming
3. Digital transmission rate = 270kbps (GSM), [Global System for Mobile Communication (GSM), Tutorials] (!!!)
4. Frequencies
 - Uplink = 890-915MHz(GSM), 876-915MHz(GSM-R)
 - Downlink = 935-960MHz(GSM), 921-960MHz(GSM-R)
5. Data frame format (access methods): Time Division Multiple Access(TDMA) & Frequency Division Multiple Access(FDMA):
120 ms, 26 frames, 8 burst periods per frame

ETSI TS 102.690 standard

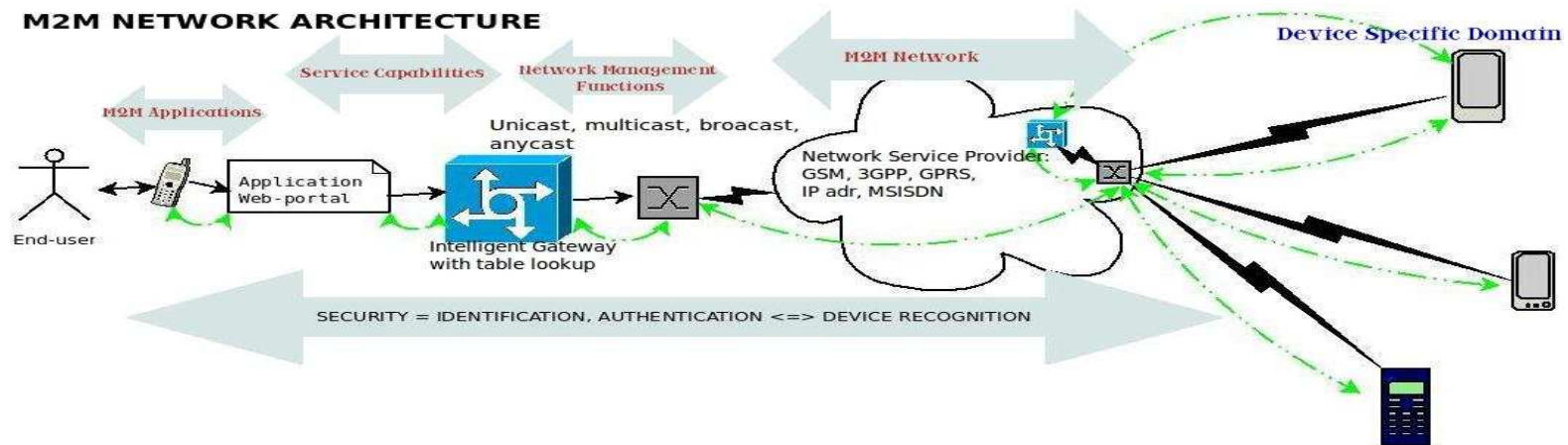
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What are the relations? The architecture is based on standard ETSI TS 102.690:

- Device is designed for a specific domain
- Device has an M2M application
- Device needs a SIM-card (Telenor SIM card) in order to enter the M2M network
- Device has an antenna to communicate with the Base Station via a Controller using GSM/ GSM-R (here: JBV use-case)
- Telenor provides M2M network, while the Shepherd platform provides data storage from different devices's applications → Heterogeneity.

M2M high level system overview

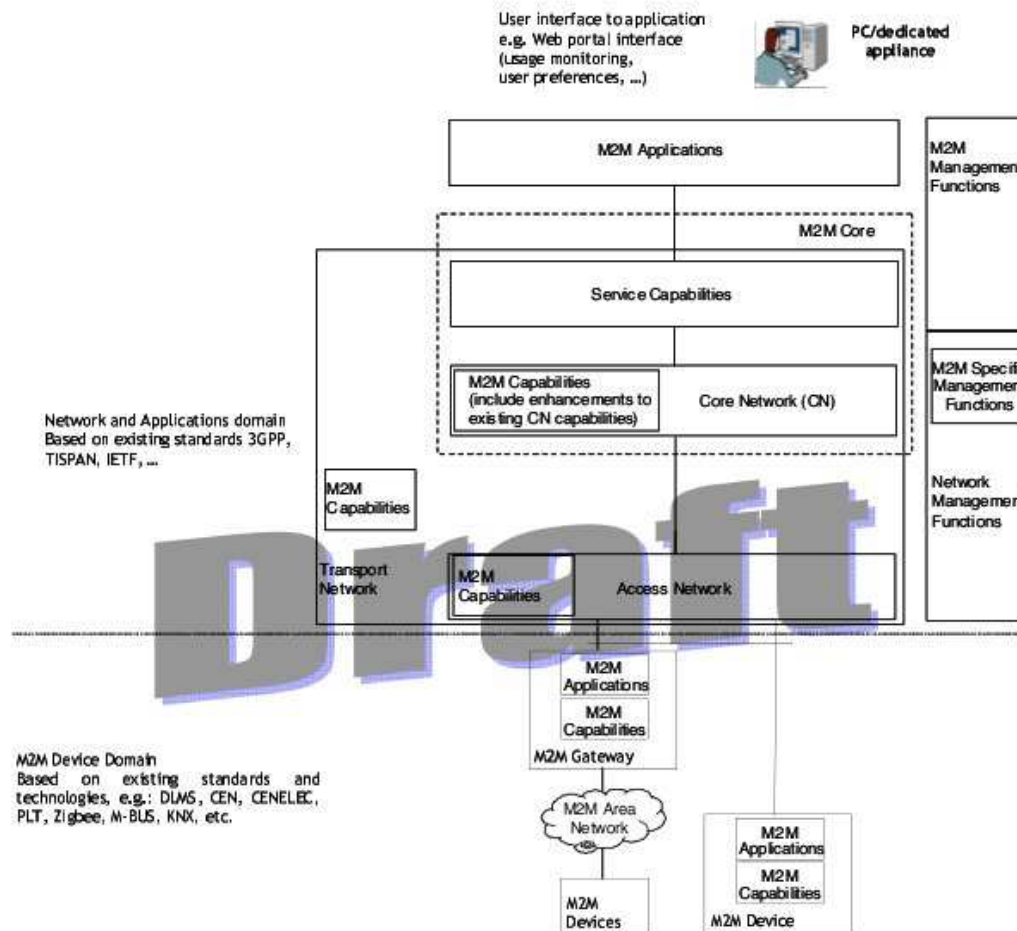
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[Standard ETSI, 2010]

The Shepherd platform

Outline

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2. Realization

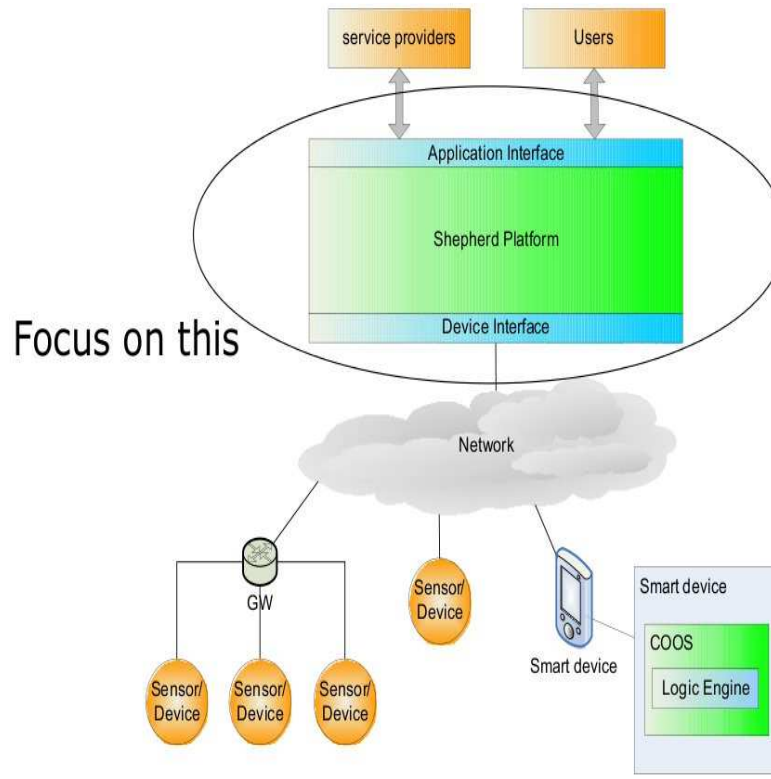
● The Shepherd platform

● Shepherd properties

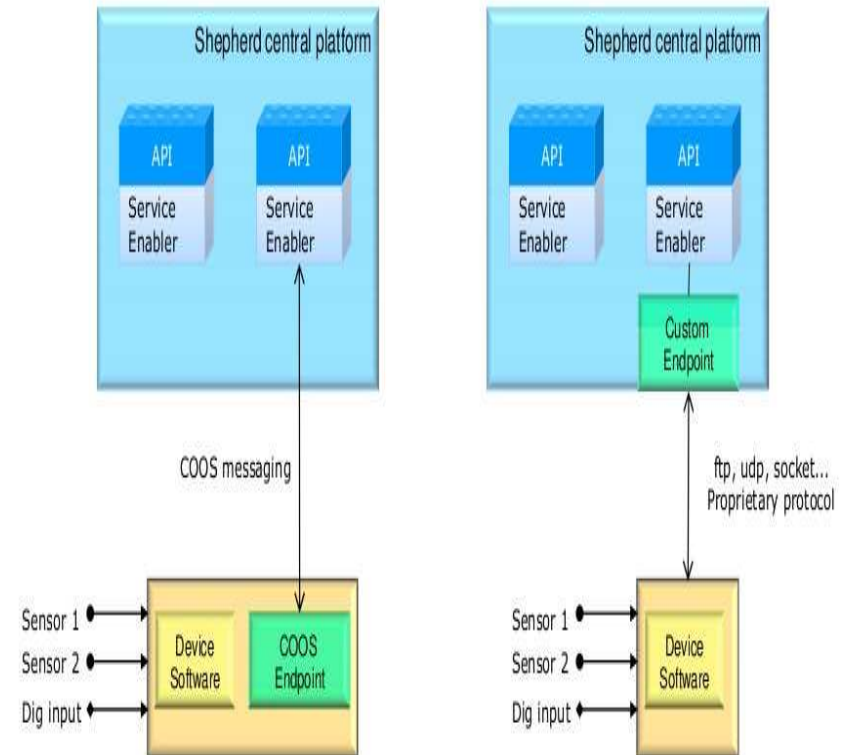
● Sun SPOT

3. Demonstration

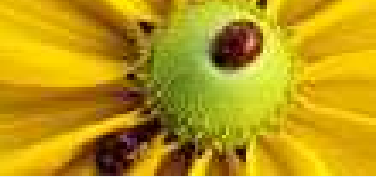
Connected components



Access methods



[Herstad, Telenor], [Nersveen, Telenor, 2010]



Shepherd properties

Outline

1. Introduction

2. Realization

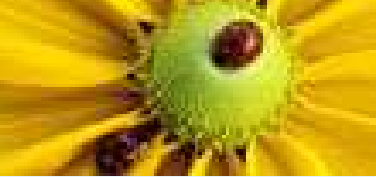
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● Sun SPOT

3. Demonstration

1. Open source platform for the M2M services: *a middleware platform that connects the service and device objects through messaging communication*
2. Services management consist of Service Enabler
 - RFID Enabler → handle messages and Subscriptions
 - Location Enabler → handle location and notification
 - SMS Enabler → handle SMS to MSISDN
 - Generic Data Enabler → handle Object, message of application, and message subscription
3. Enable interoperability and inteconnectivity
4. Enable monitoring and management of services and devices
5. Independent device/ equipment suppliers
6. Heterogenous application developments
7. Require: COOS instance install on device



Sun SPOT

Outline

1. Introduction

2. Realization

- The Shepherd platform
- Shepherd properties
- Sun SPOT

3. Demonstration

1. All SPOT has a rechargeable battery, but not the base station
2. device consists of:
 - CPU
 - Memory
 - Power management circuit
 - Radio transceiver
 - Antenna
 - 3 sensing units: Accelerometer, Light and Temperature
 - 8 tri-color LEDs board
 - Battery lifetime:
 - (a) Active CPU = 7 hours
 - (b) Deep sleep = 37 hours
 - (c) Active CPU + all sensors are used = 3 hours

Prototype implementation

Outline

1. Introduction

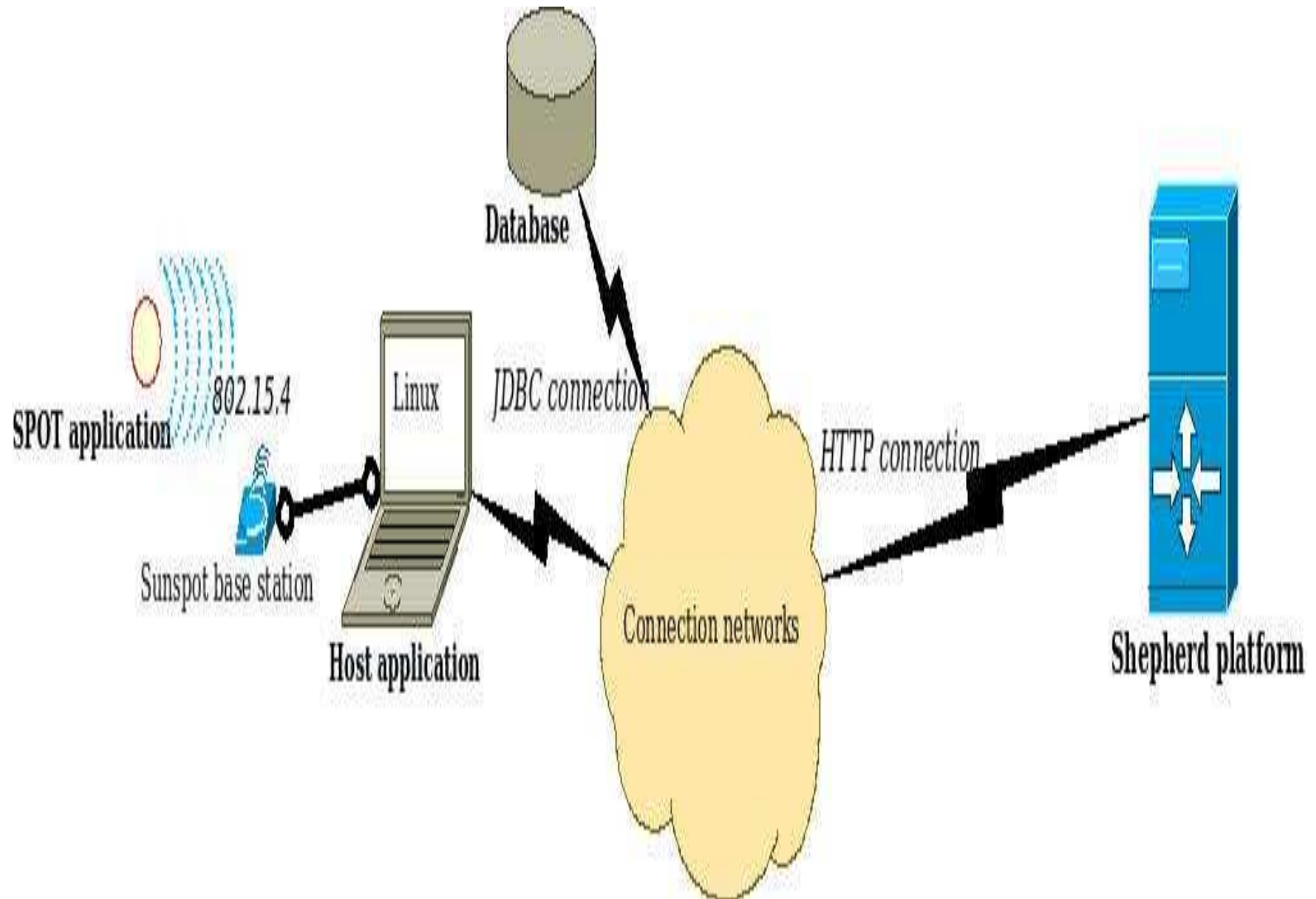
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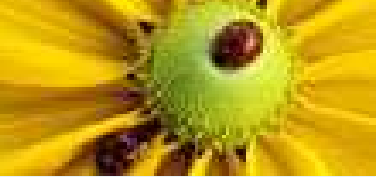
3. Demonstration

● Prototype implementation

● Achievements

● Performance Measurement





Achievements

Outline

1. Introduction

2. Realization

3. Demonstration

● Prototype implementation

● **Achievements**

● Performance Measurement

Adopted standard ETSI TS 102.690 to M2M application using Sun SPOT sensors to the M2M platform of heterogeneity:

- Base station sends broadcast every 15 sec.
- Sun SPOT sends values to base station every 30 sec.
- Host receives every 1 minute the values, and stores them temporary to an ArrayList
- The Host sends the values to the Shepherd platform

Performance Measurement

Outline

1. Introduction

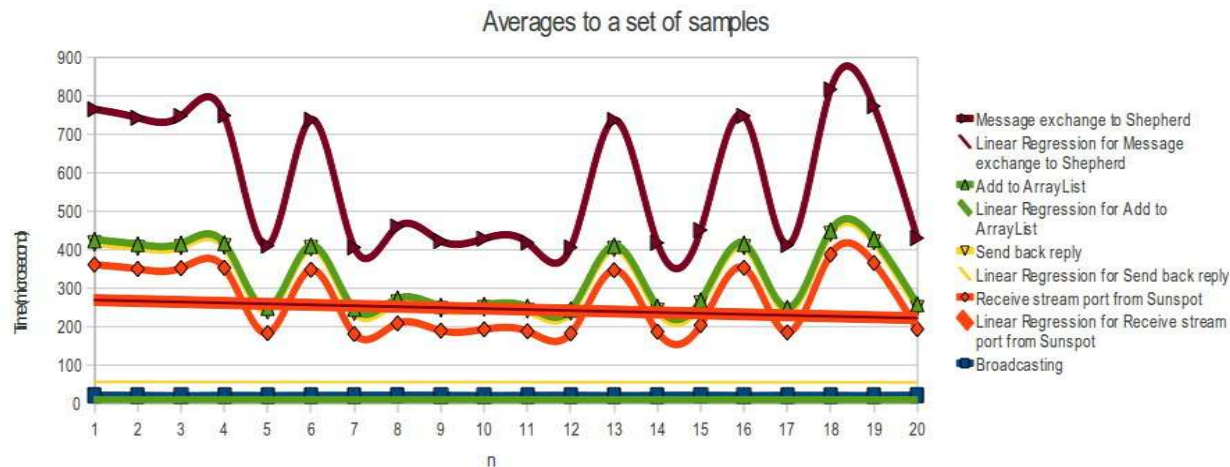
2. Realization

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● Prototype implementation

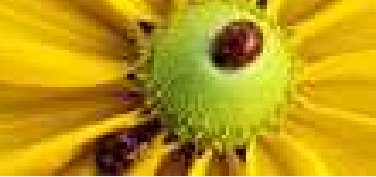
● Achievements

● Performance Measurement



Impacts on wireless communication:

- Device in shaking and movement did not affect the communication to the base station
- Plaster wall did not has an impact
- Poor battery affects the communication on longer distance
- Node load balancing might have impact for the peak when sending values to Shepherd
- The bandwidth can have impact for the HTTP communication to Shepherd
- Distance more than 10 metres leads to loss the wireless connection.



Biographies

Outline

1. Introduction

2. Realization

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4. References

● Biographies

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