

- **An Integrated Architecture for Remote Healthcare Monitoring**
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Introduction

- **Remote healthcare monitoring** has attracted the interest of many research projects during last years
 - There is a need to address the issue of ageing population
 - In parallel, there are related technological evolutions (e.g. self organization of sensor networks)

Related projects

- **MobiHealth:** a platform allowing patients to be fully mobile whilst undergoing health monitoring [<http://www.mobihealth.org/>]
- **Hydra:** The Hydra middleware [<http://www.hydramiddleware.eu>] allows developers to incorporate heterogeneous physical devices into their applications by offering:
 - Easy-to-use web service interfaces for controlling any type of physical device irrespective of its network technology (Bluetooth, ZigBee etc)
 - Device and Service Discovery
 - Semantic Model Driven Architecture
 - P2P communication
 - Diagnostics
- **AAL** (Ambient Assisted Living), **CAALYX** (Complete Ambient Assisted Living Experiment): based on Hydra middleware

Overview of the proposed inCASA architecture (1)

- Previous approaches have not succeeded in integrating procedures capable of **profiling user habits** in order to implement customized **intelligent multilevel alerts/ communication services** for elderly people.
- inCASA architecture aims to accomplish the aforementioned goal.
- <http://www.incasa-project.eu>

Overview of the proposed inCASA architecture (2)

■ Utilize:

- Citizen-centric technologies
- Services network

■ In order to:

- Help and protect frail elderly people
- Prolong the time they can live well in their own home

■ **Basic architecture components**

- Telemonitoring system
- Smart Personal Platform (SPP)
- Hydra Middleware

The Telemonitoring system⁽¹⁾

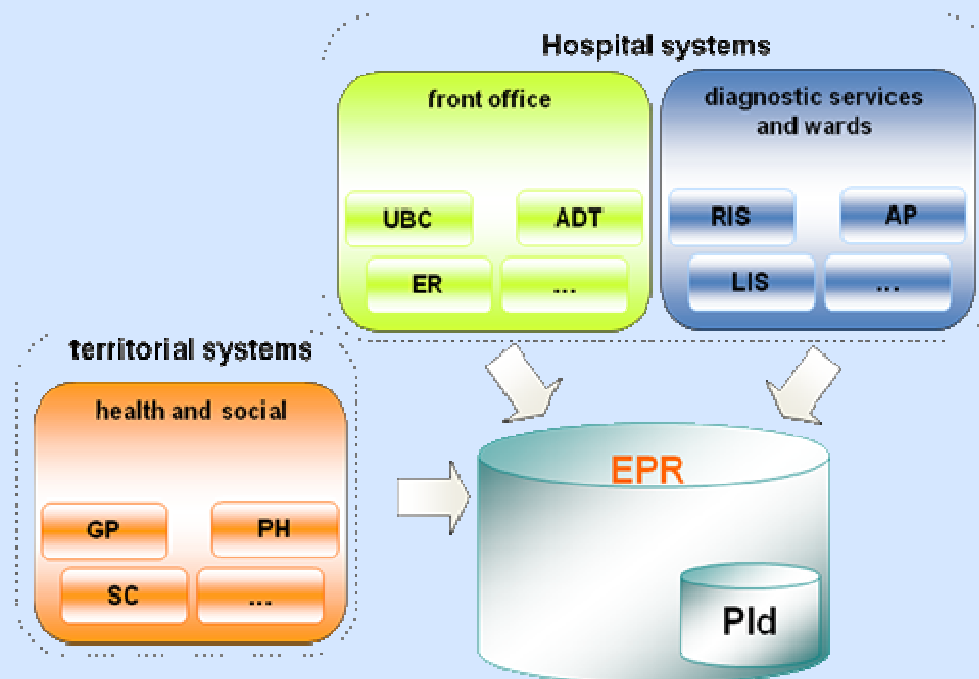
- Able to perform real-time measurements of critical metrics (e.g. pulse rate, heart rate)
- It communicates via radio waves with a Base Station located in elderly person's residence
 - The Base Station may identify abnormal situations (e.g. thermal disorder) and inform accordingly the headquarters
- It is consisted of the Body Sensor Network (BSN) and the Home Sensor Network (HSN)
 - BSN: portable wireless sensor devices
 - HSN: environmental sensors which have wireless interfaces

The Telemonitoring system⁽²⁾

- HSN and BSN sensors may use different communication technologies / protocols (like Bluetooth, ZigBee etc) as they may be manufactured by various vendors
- **Solution:** Use of Hydra Middleware which allows sensors to work together in a single BSN/HSN through remote adaptation and reconfiguration

Smart Personal Platform (SPP)

- An EPR (Electronic Patient Record) system able to share, collect and analyze data extracted from hospital software and present them in a patient oriented view



Smart Personal Platform's Goals

- Build a continuous patient record
- **Particularly for the inCASA architecture, SPP will manage the user habits learning system**
 - The application will provide alerts related to significant changes in activities of daily life
 - Alerts will be produced through evaluation workflows that will decide the action's type (e.g. automated call, SMS to a relative, SMS to a doctor)

Hydra Middleware⁽¹⁾

- **A building block for the Socio-Medical platform in inCASA architecture**
- Supports the self discovery and self configuration of inter-connected devices
- On top of the middleware, developers may add inCASA related applications utilizing device and sensor networks.

Hydra Middleware⁽²⁾

- Hydra middleware offers **web service interfaces** for managing any type of connected physical device regardless of its physical layer technology such as Bluetooth, RF, ZigBee, RFID, WiFi.
- It takes care of selecting the appropriate software component, called **proxy**, which is able to perform low-level communication with each device

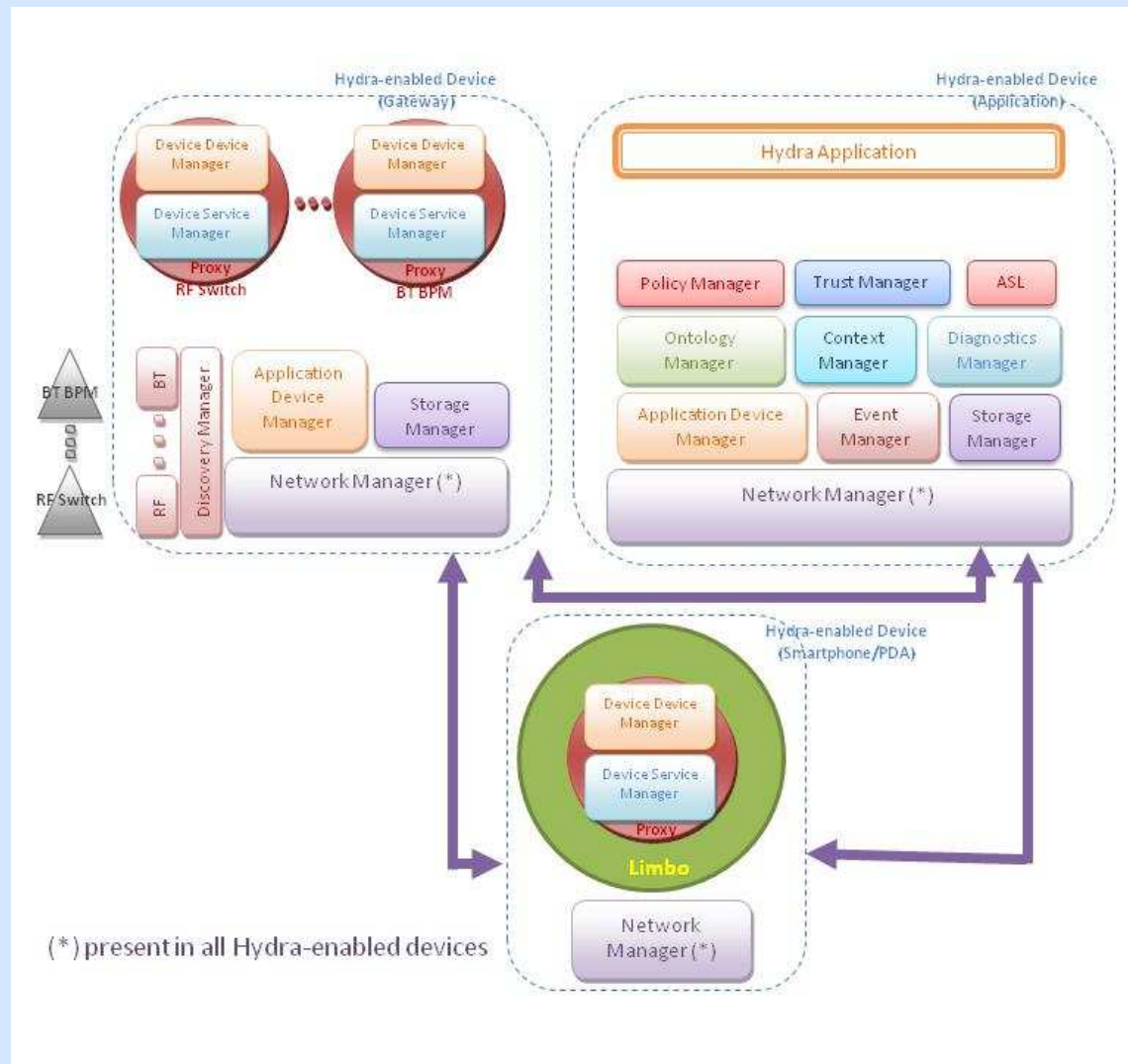
Hydra Middleware⁽³⁾

- One of Hydra middleware's basic characteristics is that it **exposes** device's available services as **web services** with respect to the relevant standards
- This characteristic facilitates the service discovery at the local network
- After local service discovery is achieved, device's services are exposed to the overall Hydra network, a P2P network, where anyone having the appropriate rights can discover and consume them

Hydra Middleware⁽⁴⁾

- The middleware is built of many software entities (called **managers**) which make possible the cost-effective development of intelligent applications for networked embedded systems.
- Next figure shows how the different middleware managers are **embedded** in gateways and devices to create the **SOA** in which devices' services appear as web services and UPnP services

Hydra Middleware⁽⁵⁾



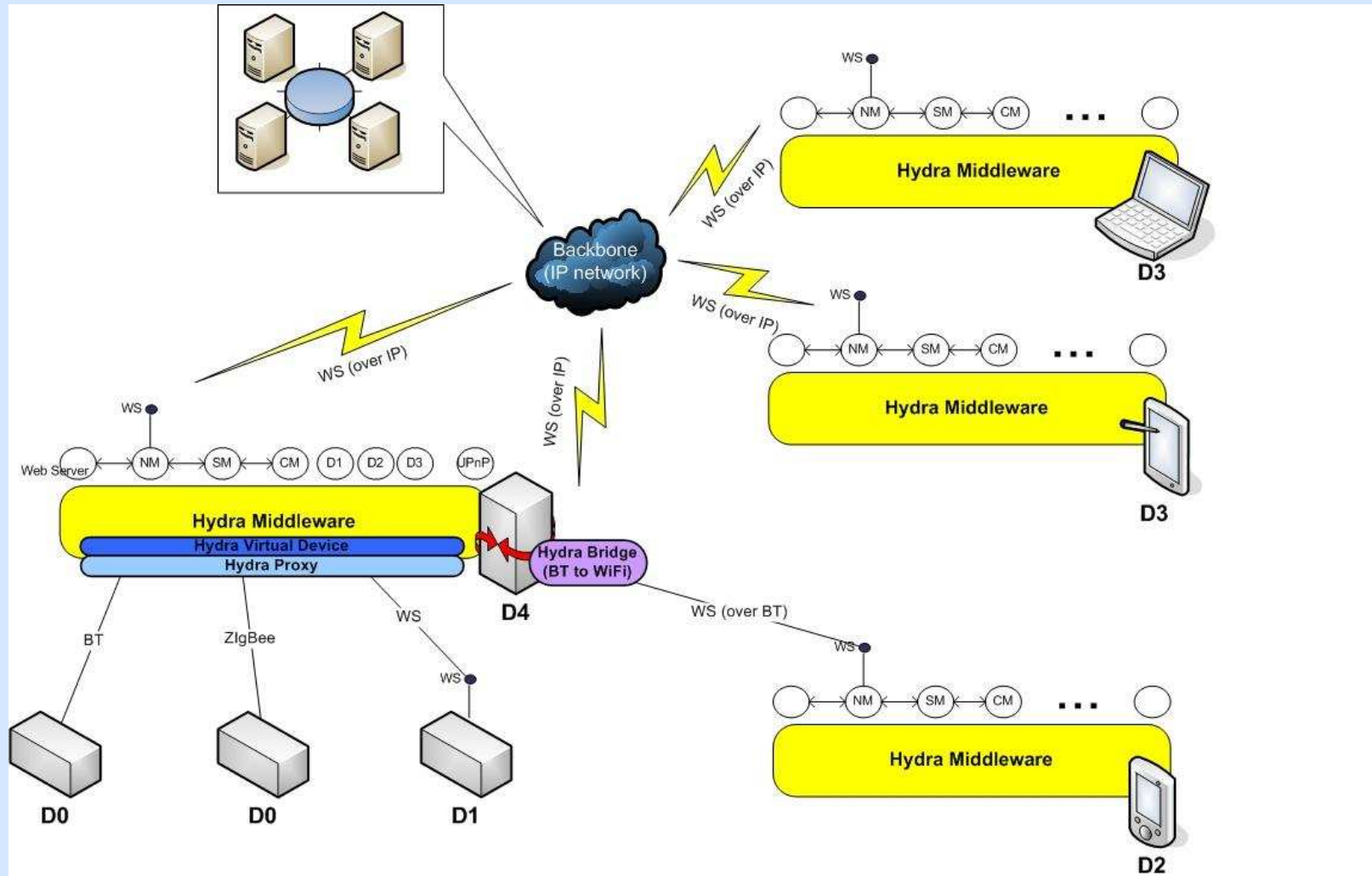
Hydra Middleware⁽⁶⁾

- **Key characteristic:** Each participating entity (e.g. physical device, sensor, subsystem) can be represented as a unique web service.
- The middleware takes care of handling device-dependent and network-dependent details allowing developers **not** to get involved with such low-level issues.

Hydra Middleware⁽⁷⁾

- **Novelty:** the use of peer-to-peer (P2P) network technologies to identify and utilize the services available in the network
- P2P pipes are used as an alternative to Web Service communication between Hydra-enabled devices.
- Next figure illustrates the Hydra P2P network and presents the overall Hydra connections

Hydra Middleware⁽⁸⁾



inCASA platform overview



inCASA platform synopsis

- Composed by a home infrastructure and a remote service provider infrastructure

- Home infrastructure:
 - ❖ A Home Base Station enriched with the Hydra middleware
 - ❖ A user habit / healthcare monitoring system

- Remote infrastructure:
 - ❖ Smart Personal Platform (SPP) able to store, retrieve and analyze the available personal data
 - ❖ Web services interface for consumer applications like clinical applications
 - ❖ Integrated Hydra middleware component for easy access to monitor data in case of need

Open related issues

- Compare the effectiveness, concerning inCASA architecture, of the different wireless communication technologies, like Bluetooth, WiFi, ZigBee
- Propose other sectors that specified architecture could be used apart from the healthcare monitoring sector
- Privacy issues while collecting data

Questions - Discussion