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LDR-LT platform (H/W/S/W) provision to activity clusters (initial)

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Abstract

This document provides a short description of LDR-LT platforms that are provided to clusters. The platforms specification as well as the user guide are available in other deliverables that are indicated in this report.

Keywords

Low Data Rate, Location and Tracking, Physical Layer, MAC layer, Network layer, Application layer, Ranging procedure, Positioning, Relaying, Mesh Networking.

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Abbreviations

ADC	Analog to Digital Converter
AF	Application Framework
ALOHA	
API	Application Programming Interface
APPL	Application layer
APS	Application Support layer
ASIC	Application-Specific Integrated Circuit
BB	BaseBand
BI	Beacon Interval
BO	Beacon Order
BP	Beacon Period
CAP	Contention Access Period
CFP	Contention Free Period
CRC	Cyclic Redundancy Check
DDR	Double Data Rate
DO	Device Object
EUWB	coExisting short range radio by advanced Ultra-WideBand radio technology
FIFO	First In First Out
FPGA	Field Programmable Gate Array
GUI	Graphical User Interface
GTS	Guaranteed Time Slot
HMI	Human-Machine Interface
HW	HardWare
IEEE	Institute of Electrical and Electronics Engineers
IP	Inactive Period / Internet Protocol
IR	Impulse Radio
LDR	Low Data Rate
LNA	Low Noise Amplifier
LQI	Link Quality Indicator
LT	Location and Tracking
LUT	Look Up Table

MAC	Medium Access Control layer
NWK	NetWork layer
OS	Operating System
PAN	Personal Area Network
PC	Personal Computer
PHY	PHYSical layer
PIB	PAN Information Database
PLL	Phase Locked Loop
POSIX	Portable Operating System Interface (uniX)
PPDU	Physical layer Protocol Data Unit
PN	Pseudo Noise
PRI	Pulse Repetition Interval
PRP	Pulse Repetition Period
PUI	PUBlic Interface
PULSERS 2	Pervasive Ultra-wideband Low Spectral Energy Radio Systems
QFN	Quad Flat No leads package
QoS	Quality of Service
RAM	Random Access Memory
RF	Radio Frequency
RX	Receiver
SD	Super-frame Duration
SDRAM	Synchronous Dynamic RAM
SO	Super-frame Order
SOC	System On Chip
STL	
SW	SoftWare
TDMA	Time Division Multiple Access
TP	Topology management Period
TX	Transmitter
UWB	Ultra Wide Band
ZDO	Zigbee Device Object

1 Executive summary

One of the main objectives of EUWB WP7 is to provide a representative Ultra Wide Band Low Data Rate – Location and Tracking (UWB LDR-LT) platform to application-oriented Work Packages at an early stage in the project (M12). Since PULSERS II project members successfully designed a complete functional LDR-LT platform in the frame of WP3a, it was decided to use it as a starting point in EUWB. This platform provides a complete protocol stack from the physical layer up to the application layer. Several functionalities are implemented on the platform to illustrate potential applications envisioned for this technology (sensors, actuators, localisation engine, MAC-level relaying).

This document is linked to the delivery of the platforms in M12 and provides links to the necessary documents in order to run the Graphical User interface and to use the platforms. If other information are requested by the users when they will receive the platforms, all the necessary documents and explanations will be provided. CEA, THA and ACO will follow the use of the platforms by the users inside EUWB and will provide the needed assistance.

2 Introduction

The purpose of this report is to give a very short physical description of the LDR-LT platform and to give to the readers the necessary references in which they can find all necessary information to run the platforms.

3 LDR-LT Platform Overview

3.1 Platform overview

The overall architecture of the LDR-LT platform is shown on Figure 3-1 (physical view), Figure 3-2 (hardware perspective) and Figure 3-3 (software perspective). This platform includes a complete protocol stack:

Application layer (APPL)

Network layer (NWK)

Medium Access Control layer (MAC), split into SoftWare MAC (SW-MAC) and HardWare MAC (HW-MAC)

Physical layer (PHY)

The platform is based on PULSERS II platform and during the first period in EUWB, the work has been to take into account all the remaining bugs in the platform and to do some system tests. Furthermore, the platform that is given in M12 to EUWB partners is different from the PULSERS II one as the antenna has been changed, the Physical layer has been modified (mainly channel coding has been added) and the MAC layer has also evolved. Indeed due to the channel coding and remaining bugs, the MAC layer has been adapted and some tests at system level have been performed. Platform with RF step 2 is the one provided in M12 to EUWB partners whereas the one with RF step 1 is the one that was provided at the end of PULSERS II.

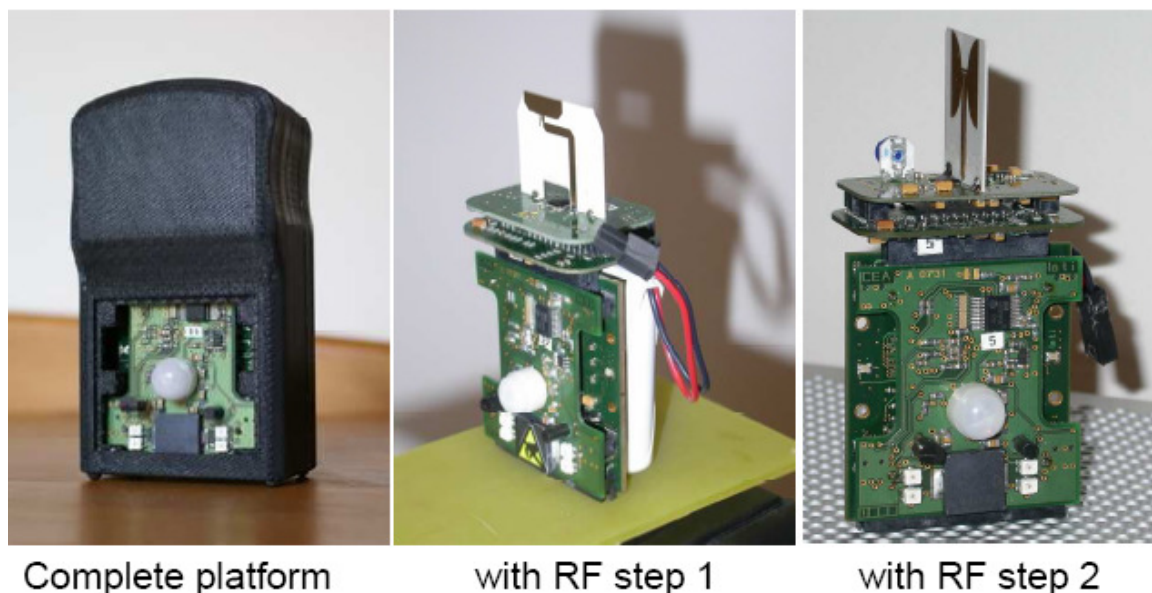


Figure 3-1 : Physical view of the IR-UWB LDR-LT platform (profile / front / packaged)

From the implementation point of view, note that the Application, Network, and SW-MAC layers are part of a software package whereas the HW-MAC and PHY layers are part of a hardware package.

The complete stack is implemented into each physical node, including the part of the application in charge of local elementary computations (e.g. for positioning purposes), all except but the part of the application that is hosted on a PC and responsible of advanced tasks (e.g. the Graphical User Interface).

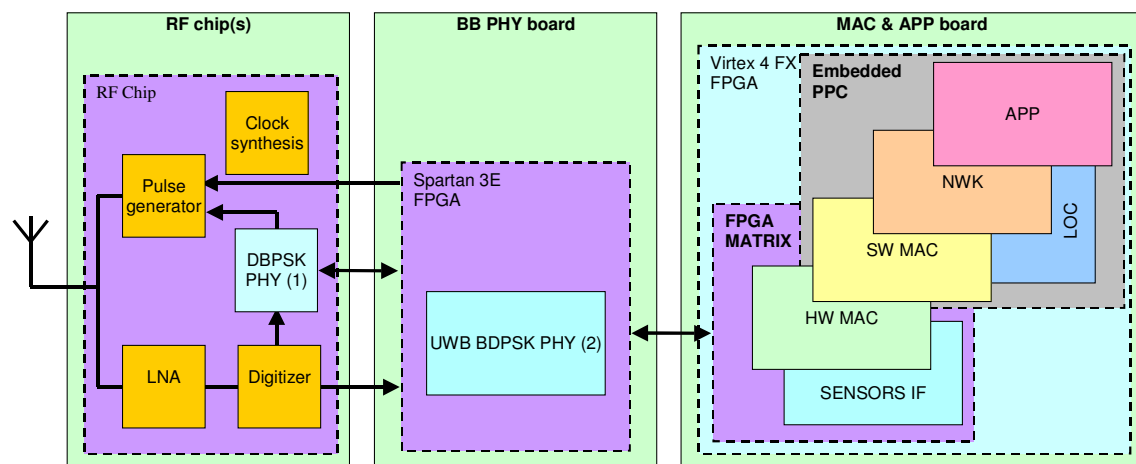


Figure 3-2 : Overall Synoptic of the LDR-LT platform

The software package is hosted on a Linux file system running on Random Access Memory (RAM). Each software layer is an independent Linux process running in the user memory space. All drivers reaching the hardware platform are running in the kernel memory space.

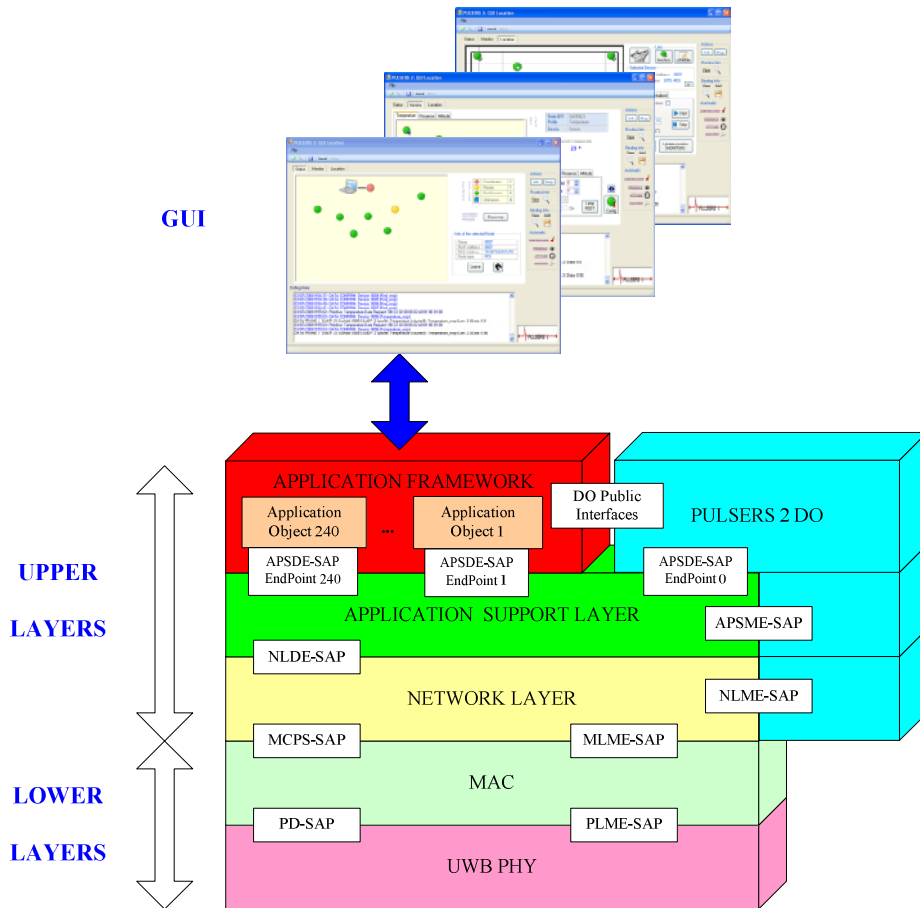


Figure 3-3 : Overall layer structure of the LDR-LT demonstrator

The complete specifications of the platforms can be found in the following documents :

- IST PULSERS Phase II deliverable D3a3.3: “LDR-LT Concept Specifications - PHY and MAC Layers”, Jul. 2008 [9]
- IST PULSERS Phase II deliverable D3a-4.2 “LDR-LT architecture specification – Network to Application layers” [6]
- EUWB deliverable D7.1.1a “LDR-LT platform requirements, feasibility analysis and specification (initial)”

3.2 Graphical user interface

The Graphical User Interface developed for PULSERS 2 LDR-LT platform was focused on showing the location capabilities. It also includes some other functionalities like network configuration, monitor and set-up tasks of all the sensors and actuators included in the boards. This graphical user interface has been kept for EUWB and some debugging has been performed during the first period of EUWB.

A detailed description of this application is provided in [6].

The Main window, divided in four parts: a menu (serial or Ethernet communication), several tabs (status, monitor and location), network configuration section (init the network, showing the routing

table, binding process...) and a debug area, where all the primitives sent and received are shown to the user.

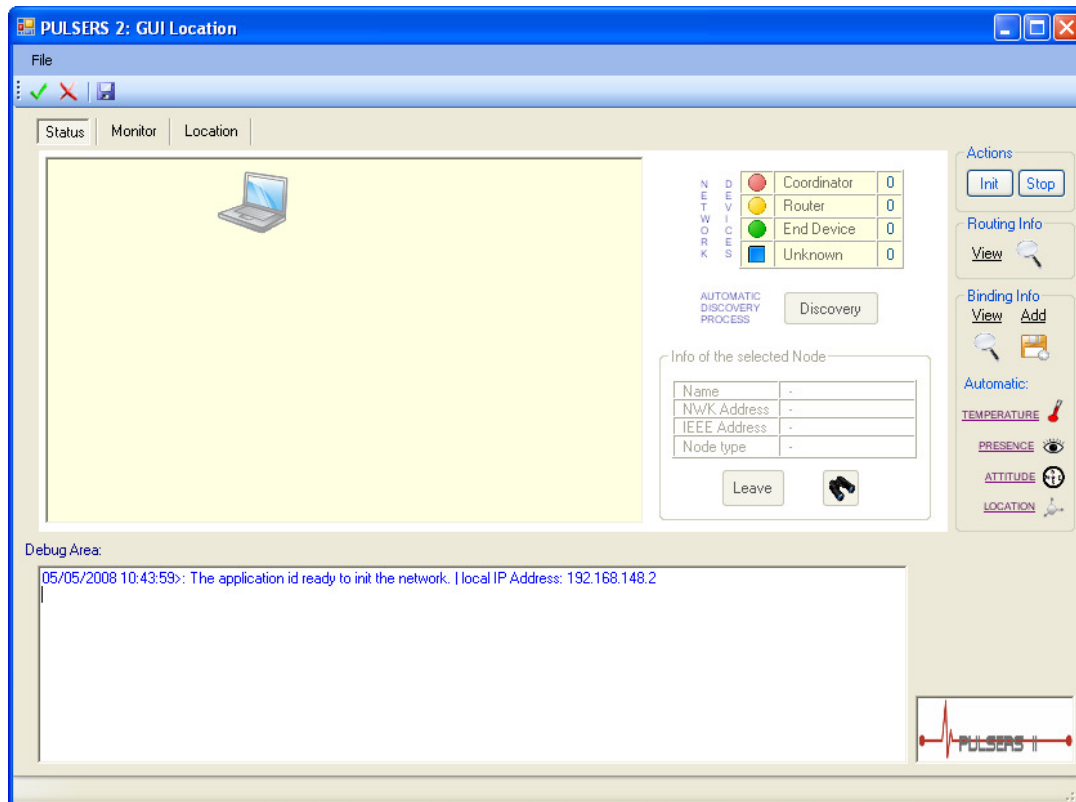


Figure 3-4 : EUWB GUI main window

The different tabs offer the user several options:

The possibility to know the status of the network. The user can see how many devices are connected, their type, and detailed information about them.

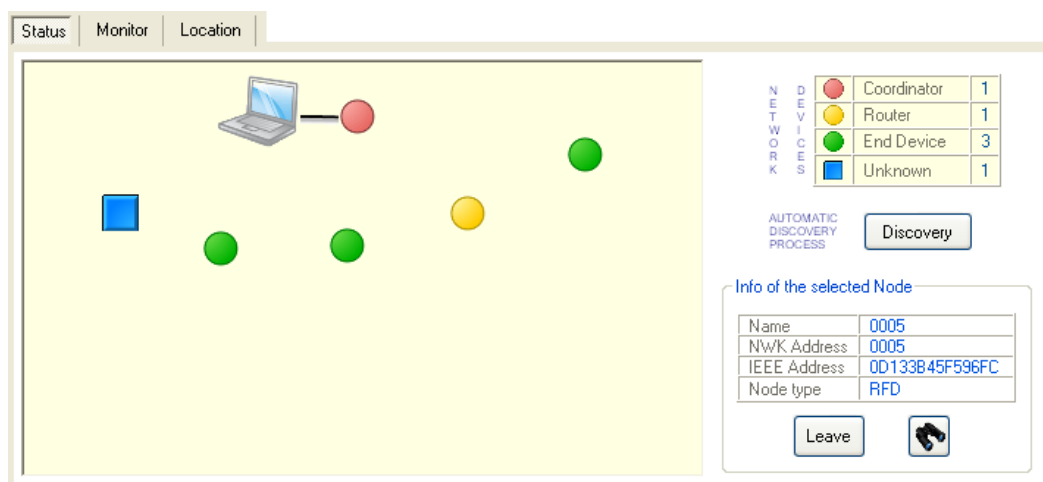


Figure 3-5 : Status Tab

Monitor tab are divided in three different sub-tabs to show all the sensors (temperature, presence and attitude) and actuators discovered inside the network. All of these sensors and actuators can be set up, and some data can be requested.

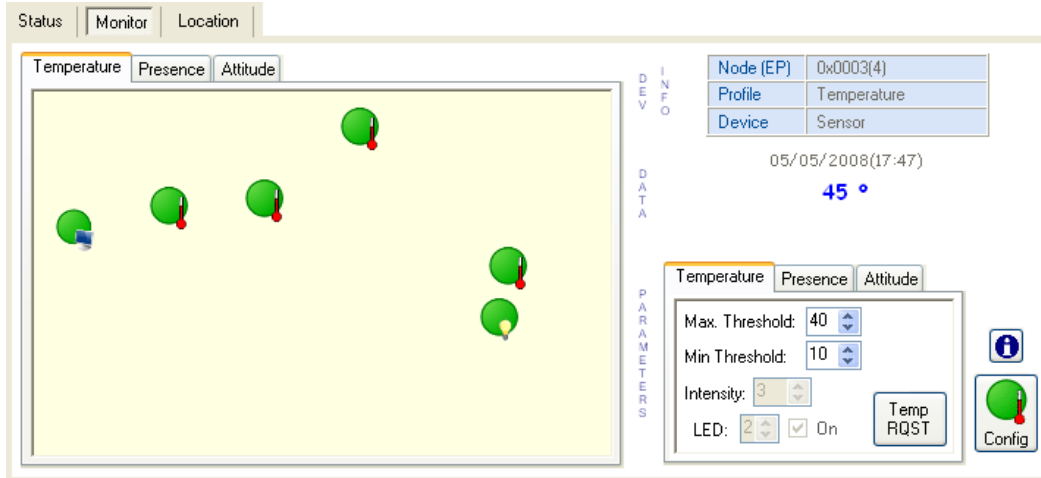


Figure 3-6 : Monitor Tab

Location Tab: This tab has been implemented to offer the user the possibility to select one of the two location algorithms implemented (distributed and centralized). Also, several actions can be performed over each device: device configuration, range measurement and access to different information such as the neighbourhood table, ranging information and calculated positions.



Figure 3-7 : Location tab

The user can choose where to see the results of these algorithms: over a map or a grid.

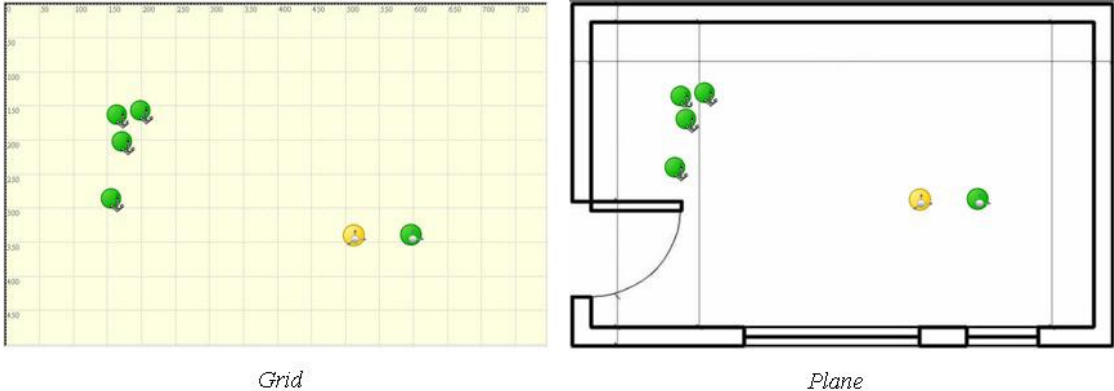


Figure 3-8 : GUI Location scenario background

4 Conclusions

In this deliverable, the initial WP7 integrated IR-UWB LDR-LT platform was shortly presented. This deliverable is an addendum to the delivery of the platform by themselves. All partners involved (CEA, THA, ACO) have made the necessary modifications in order to provide a stable version of the platform. Tests have been made at the system level by THA and gave its green light to provide the platforms to all users.

References

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Acknowledgement

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