Poster Abstract: RFID-Based Localization in Heterogeneous Mesh Networks

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ABSTRACT
This paper will describe current and ongoing developments of wireless-connected RFID reader systems for evaluation of a passive user localization system. A two-tier architecture of different wireless-connected RFID readers will be introduced. On the lower level, i.e. the first tier, several wireless technologies can co-exist using different kinds of communication technologies to connect different RFID readers. These technologies are connected through a fully meshed WiFi/WLAN network to bring them into the IP world. This IP infrastructure is the second tier, built up on IEEE 802.11.

Categories and Subject Descriptors
C.2.1 [**Network Architecture and Design**]: Wireless communication

General Terms
Management, Measurement, Performance, Design, Experimentation.

Keywords: Software Development, Gateways, Network, Wireless Sensor Networks and Tools, Ad-hoc Mesh Networks, RFID, Localization.

1. INTRODUCTION
RFID systems are already used in many places and business environments like logistics, freight services and maintenance. Authentication and localization of individuals is still not very popular but could be very helpful for the individual itself as well as for operators of e.g. airports, shopping malls or trade shows. Enhancing the flexibility of RFID based systems by using wireless technologies for networking will clearly improve the usability and acceptance of RFID solutions. Therefore, an approach for a (low cost) RFID reader network solely based on wireless communications is proposed. This approach will minimize the installation overhead and will result in a flexible and highly mobile and portable system with minimized management overhead.

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2. GENERAL SYSTEM OVERVIEW
The system consists of a set of RFID reader of different types (see section 2.1.1 and 2.1.2) being connected through wireless links. The system consists of two different reader devices. Information gathered by these reader nodes is stored in a database.

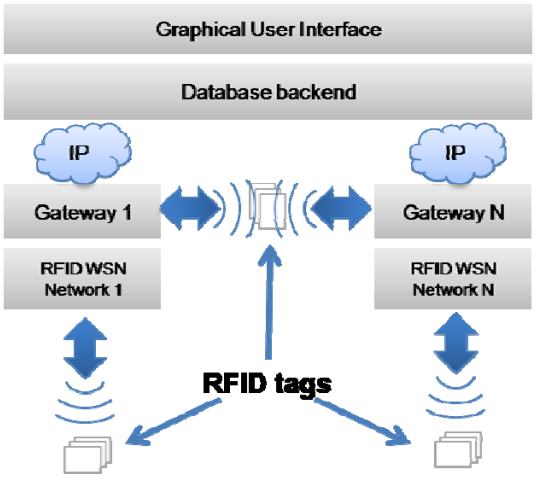

Figure 1: Infrastructure Overview

The stored information implies for instance the reader position, stationID and time as well as user specific information (e.g. user id or user acronym). A graphical user Interface (GUI) is being developed for configuration and maintenance of the RFID reader network. This GUI allows to access the information in a user friendly way. This includes technical data like the network topology or the RFID user data like the station id visited at a certain time. The RFID solution is currently built with LF (135 KHz) for the WSN integrated version (see section 2.1.2) and HF (13MHz) for the Wifi version (see section 2.1.1).

2.1 Hardware
The main hardware components are briefly described in this subsection.

2.1.1 RFID Router
To build a Wifi backbone for the underlying wireless technologies, routers WL500gP from ASUS [1] are used

(266MHz, 8MB flash). The router is able to perform ad-hoc networking including mesh networking based on OLSR [2] running on a Linux based OpenWRT System [3].

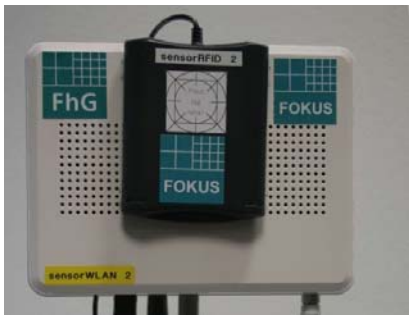

Figure 2: WLAN Meshed RFID Reader Device

For the prototypical evaluation of the system the routers are equipped with the Integration CompXS USB IEEE 802.15.4 dongle. This dongle is fully compliant with the ZigBee 2006 Specification [4]. An Xbee [5] module is included for a second revised version of the gateways. In Figure 2 a router device with an attached RFID Omnikey [6] reader is shown. To control the reader device the open source platform librfid [7] is used. The librfid is supporting the RFID standards ISO 14443 A, ISO 14443 B, ISO 15693, Mifare Ultralight and Mifare Classic as well as several RFID reader from different vendors.

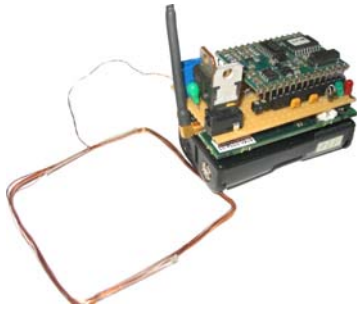

Figure 3: RFID Reader WSN Node

2.1.2 RFID Sensor Node

Figure 3 shows a piggybacked TIRIS [8] low frequency (LF) RFID Reader on top of a MicaZ sensor node [9]. This ultra mobile RFID sensing device allows establishing a distributed network which is able to cover a large scale area. Detected RFID Tags are reported to a database located in the backbone network through the RFID router devices.

2.2 Graphical User Interface

A web interface for user interaction and data visualization is under development. It allows locating people if they have registered themselves at a RFID station. Tools for RFID position analysis are included as well as an active search engine for people and their whereabouts. For evaluation purposes this system is used to develop a prototypical demonstration for a lecture management system for universities. This system allows organizing individual services for students and gives faculties a tool to evaluate lectures (e.g. student attendance or room utilization).

3. CONCLUSION & OUTLOOK

This paper describes the ongoing work of RFID integration into a wireless communication infrastructure. It presented a two-tier architecture of wireless sensor nodes built on top of IEEE 802.15.4 and Wifi components built on IEEE 802.11[a/b/g]. First evaluations will be done by using this system for a lecture management system. Future work will include the enhancement of this system for battery powered devices. Field tests are planned covering several buildings located in Berlin/Germany.

4. Acknowledgement

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