WebMaDa: Web-based Mobile Access And Data Handling Framework for Wireless Sensor Networks

Corinna Schmitt, Michael Keller, and Burkhard Stiller
Department of Informatics IFI, Communication Systems Group CSG, University of Zürich
Binzmühlestrasse 14, CH–8050 Zurich, Switzerland. Email: {schmitt, stiller}@ifi.uzh.ch, michael.f.keller@bluewin.ch

Abstract—Users request comfortable frameworks not only to configure and manage their wireless sensor networks (WSNs) but also to monitor them independent of the user's location. CoMaDa is a framework supporting the aforementioned two requirements but does not allow monitoring from outside the network using the Internet. Thus, the Web-based Mobile Access and Data Handling (WebMaDa) framework supports those mobility requirements and, therefore, incorporates online database storage, access control management, and visualization with responsive design for different screen sizes of mobile devices (e.g., smartphones, tablets). WebMaDa is as flexible and hardware independent as CoMaDa and additionally allows the user to monitor WSNs on mobile devices if they are the owner or have the corresponding rights.

I. INTRODUCTION

Today, many individual solutions specialized for specific hardware/platforms or designed for specific tasks (e.g., simulation, visualization), exist and support the user (e.g., habitants, doctors, engineers) with developing applications for specific platforms and with monitoring the wireless sensor networks (WSNs) [1]. Examples are the medical information sensor [2] or the UvA Bird Tracking System [3]. The Configuration, Management and Data Handling framework (CoMaDa) offers a centralized way to design applications that interact with any kind of WSN including functionalities for data export and network control. This is done by offering an abstract interface to WSNs that can be shared between different types of WSNs, allowing a user to write applications that dynamically adapt to different WSNs and, therefore, offering the possibility to design applications that interact with WSNs independent of the underlying network hardware/software. In order to achieve this, the framework adds an additional layer of abstraction, in form of a virtual representation of the WSN, between the part of the application, which defines the desired logic, and the part that actually interacts with the network. [1]

However, CoMaDa lacks mobility support, because it only allows monitoring the current activated and physically linked WSN as indicated in Figure 1 in the right part. Here the extension Web-based Mobile Access and Data Handling (WebMaDa) framework brings mobility support to the CoMaDa framework. Arrows indicate data exchange between components (e.g., upload data to database, update access right, download monitoring data). As Figure 1 shows, WebMaDa consists of three major parts, resulting in three platform requirements as described in Section II [4]. A description of the planned demonstrator is given in Section III. Finally, the benefits and practical relevance of WebMaDa and the envisioned licensing scheme concludes the paper.

II. DESIGN AND PLATFORM REQUIREMENTS

In order to create the aforementioned mobile access framework three major components are required that are described in the following.

The User Management Tool is necessary to ensure that only selected users are able to view or deploy WSNs on the Internet by creating user accounts with different access rights. Thus, it is a virtual component, as it is used to control system access, to support transparency and fulfill the user’s trust requirements. For security reasons, this is implemented in a separate part and not included in the website. If the website would have a subsection where new users can be registered, it would need to be protected so that only the administrator(s) can use it. Otherwise all implemented security measurements would be pointless, as everybody could just generate his own account and view the representation of other peoples WSNs. But if the mechanism to create a new account is only accessible for someone that is logged-in as an administrator, then it cannot be used before the first account was generated. This means, that the website would have to generate a default administrator account. Because of that, the person setting up the framework website would need to take conscious steps to guarantee the safety of the service - namely logging in with the default account, then changing its login credentials and disable the websites mechanism to generate the default account. If those steps are not taken, anyone who knows the credentials of the default account can access every WSN representation, as well as generate, alter and/or remove user accounts at will. And even if those steps are taken when the framework is set up, account generation and deletion can still be misused by anyone who manages to get his hands on an administrator account. Those problems do not exist when the whole account registration and removal mechanism is provided in a stand-alone tool. Accounts created with the User Management Tool can have one of two major roles: (1) Administrator of WebMaDa, and (2) user of WebMaDa that might own a WSN or want to view
other WSNs. In order to manage the access rights a database with three tables was established that save access requests, granted rights, and account status. The Backend Module enables accounts with uploading rights to publish their WSN data on the website by activating the corresponding function in CoMaDa. This module requires successful authentication of the account and then pushes all monitored data to the online database storage that is linked to the web site. In the backend of the system tables are created that log the deployed WSNs and display them to the user on the website. The website accesses the online database and visualize the running systems analog to CoMaDa. But before accessing those WSNs the user must authenticate again on the website. Depending on the access rights the user can view the selection of currently active WSNs. Visualization includes WSN topology, raw data packets, and graphical visualization by Xively [5].

Based on those three major components WebMaDa has the following requirements: A web server with HTTPS support, a server with MySQL Database behind a SSH Host, and a computer for CoMaDa are needed. The user is free to choose any mobile device that has Internet connection, a web browser, and Adobe Flash Player. Different screen sizes a supported by the responsive design.

III. DEMONSTRATOR

The demonstrator at NetSys 2015 will show a similar setup as indicated in Figure 1. The difference will be that three WSNs will be deployed in different locations (Cottbus, Munich, and Zürich), linked to individual CoMaDa deployments, and visualized by WebMaDa under https://www.tinyurl.com/WebMaDa. At the conference the users can see an exemplary WSN setup that measures environmental data like temperature, light, and humidity. The measured data is uploaded to the website and can be viewed in parallel using CoMaDa and after user account creation for WebMaDa also on mobile devices by accessing the website after rights were granted and successful log in. In parallel the users can view the WSNs in Munich and Zürich via WebMaDa. Here the users can only view the WSNs and not directly manipulate it, because it is physically in a different location. Manipulation is only possible for the WSN in Cottbus, because CoMaDa runs on sight and supports this functionality. This includes deletion of transmitted data to the website (e.g., temperature or humidity values), where data is still stored unaltered in the backend system of CoMaDa. Another example is to demonstrate access creation and handling of access requests. Figure 2a lists the currently active WSNs using the website of WebMaDa [4]. The user can see which WSNs he can access (white marked) or not (grey marked). For accessible WSNs he can receive additional information like topology, data streams, and raw-data. Figure 2b shows a data stream example sponsored by Xively. The user can select the shown time interval ranging from 5 min to 1 year. If the user wants to access a grey marked WSN he has to click on it. Another window is opened, where the user has to fill out required sections and an access request is sent out to the WSN owner. Via the WebMaDa the access can be granted or rejected by the owner resulting in an update in Figure 2a by changing colors of the available WSNs for the user.

IV. SUMMARY, PRACTICAL ISSUES, AND BENEFITS

WebMaDa extends the flexible CoMaDa framework with mobility support. The user is now able to monitor the deployed WSN from everywhere in the world. Third parties can monitor the WSN also if they have proper access right that can be given by each WSN owner, or an administrator. Before accessing the data on the websites each access request must undergo an authentication process. Given rights can be revoked by the WSN owners at any time. Due to the responsive design the users are free to use any kind of device that fulfills the mentioned requirements in Section II. An example for showing the relevance to WebMaDa’s application in practice is the environmental data collection of different skiing areas on one website. Usually each skiing areas have deployed their own WSNs and report the status (e.g., temperature, snow heights) on their own website. But the skiing tourist is interesting in comparing different locations with each other. Instead of hopping between websites the data can be published using the proposed CoMaDa extension on one single website with all relevant information. Other use-cases can be found in Industry 4.0 supporting autonomic production tasks, quality observation, and global monitoring. Version 1.0 of WebMaDa includes all mentioned component from Section II[4]. WebMaDa was tested with several heterogeneous WSNs at the same time including devices of type IRIS, TelosB, OPAL. The responsive design was successful tested on iPhone 5, Samsung Galaxy, iPad 2, and notebooks. It is envisioned to release WebMaDa under MIT-License in 2015 and to support other network types in the future.

REFERENCES