



SE4YH SMART ENERGY FOR YOUR HOME DESIGN DESCRIPTION

Version 1.4

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

Revision History

Date	Version	Description	Author
2015-11-05	1.0	Initial Draft	Eugen Družin, Marko Vojić
2015-11-11	1.1	All sections added	Eugen Družin
2015-11-12	1.2	Introduction and background provided	Ondrej Kollar
2015-11-13	1.3	Added System structure, Sequential diagrams	Marko Vojić
2015-11-13	1.4	Technologies, System architecture, Mobile mock-up	Eugen Družin

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

Table of contents

- [1 Introduction](#)
 - [1.1 Purpose of this document](#)
 - [1.2 Document organization](#)
 - [1.3 Intended Audience](#)
 - [1.4 Scope](#)
 - [1.5 Definitions and acronyms](#)
 - [1.5.1 Definitions](#)
 - [1.5.2 Acronyms and abbreviations](#)
- [2 Background and objectives](#)
 - [2.1 Overview](#)
 - [2.2 High-level description of the functionalities](#)
- [3 High-level system structure](#)
 - [3.1 OpenHab](#)
 - [3.2 SE4YH application](#)
 - [3.3 User application](#)
- [4 Communication and integration](#)
 - [4.1 REST API](#)
 - [4.2 JSON](#)
 - [4.3 Sequential diagrams](#)
- [5 Technologies](#)
 - [openHAB](#)
 - [openHAB Designer](#)
 - [Java](#)
 - [Android](#)
- [6 System architecture](#)
 - [openHAB Event Bus](#)
 - [openHAB](#)
 - [Bindings](#)
 - [Custom application](#)
- [7 Mobile mock-up](#)

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

1 Introduction

This document describes the design of the application as realized during the realization of the project. This includes a short background preview, an architecture design, the technologies used, the software design, frontend design as well as backend design. The last section will cover the mobile application GUI.

1.1 Purpose of this document

The purpose of this document is to expose the design decisions that have been made by team **SE4YH** during the **SE4YH** project which is being developed as part of the Distributed Software Development course simultaneously at Mälardalen University situated in Västerås, Sweden and the University of Zagreb situated in Zagreb, Croatia.

1.2 Document organization

The document is organized as follows:

- Section 1, *Introduction*, describes contents of this guide, used documentation during developing process etc.
- Section 2, *Background and objectives*, overview of the project and high-level description of functionalities
- Section 3, *High-level system structure*
- Section 4, *Communication and integration*
- Section 5, *Technologies*,
- Section 6, *System architecture*
- Section 7, *Mobile mock up*

1.3 Intended Audience

This document is intended for developers that need to follow this structure during the development process, even if some details may be changed further on. Moreover, the customer can check our progress and read about the decisions we have taken.

1.4 Scope

The document concerns the design the **SE4YH** Project. It provides an description of the structure and style of the overall system. It shows the design decisions we have taken.

1.5 Definitions and acronyms

In the following tables we will present and explain definitions and acronyms or abbreviations that will be used in the document.

1.5.1 Definitions

Keyword	Definitions
SE4YH User	The user who will use the SE4YH System.
REST API	API that adheres to the REST architectural constraints

1.5.2 Acronyms and abbreviations

Acronym or abbreviation	Definitions
SE4YH	Smart Energy for Your Home
FER	Faculty of Electrical Engineering and Computing, University of Zagreb

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

MDH	Mälardalen Högskola, Sweden
UML	Unified Modeling Language
GUI	Graphical User Interface
REST	Representational State Transfer
API	Application Programming Interface
JSON	JavaScript Object Notation

2 Background and objectives

2.1 Overview

The purpose of the project is to develop a system that allows users to define their own preferences and rules for the management of energy consumption by their appliances (e.g., conflicts, priorities, goals), and to manage the appliances in the house depending on them.

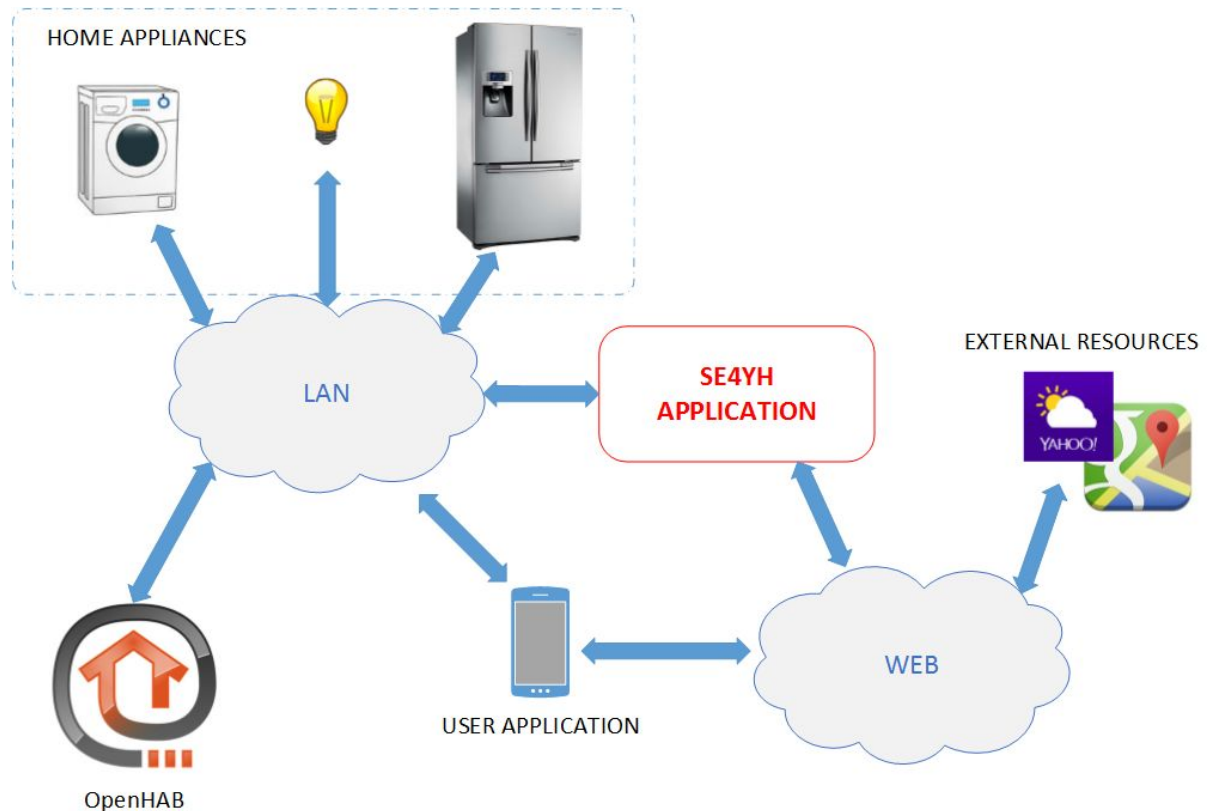
http://www.fer.unizg.hr/_download/repository/SE4YH_ProjectPlan_v1.1.docx

2.2 High-level description of the functionalities

SE4YH project aims to build a secure, flexible system that allow a user to manage and monitor the smart devices that are in user's house. Specific rules are created and applied in order to ensure that the application fits user profile and preferences. Initially the system will work with a finite number of device types. The user will be able to add devices and each device will be categorized as part a room based on its type (kitchen, bedroom, etc.). The user will be able also to manage the devices depending on their type and "smartness".

3 High-level system structure

The system consists of 3 main components: OpenHAB, SE4YH application and the user application. OpenHAB is the main part for communication with the users' home appliances on a local area network. SE4YH will be developed by the team and will have the core logic for automatisaton and energy saving. With user application the user will have look into the system, and he will be able to use it in local area network and over the WEB.



3.1 OpenHab

OpenHAB is a powerful technology software for home automation. We will use it to simplify communication with home appliances. OpenHAB has built-in communication protocols for variety of devices. To SE4YH, OpenHAB will provide a standardized virtual representation of home appliances to simplify the control of them.

3.2 SE4YH application

SE4YH application will contain the main functionalities such as rule management and automation of home appliances. Application will control the appliances through OpenHAB REST API and also provide content for user application with its own API. The application should also communicate through the web with other services like Yahoo Weather to provide more information significant for the system.

3.3 User application

User application provides the functionalities for monitoring and controlling the home appliances, adding new rules in order to conserve energy, easy to use for basic users, but also with some additional functionalities for more advanced users. We will develop at least for the android platform. Other optional platforms are web and iOS platforms.

4 Communication and integration

4.1 REST API

The REST API will be used for communication between openHAB and the user application. Also it will be used for communication inside openHAB components.

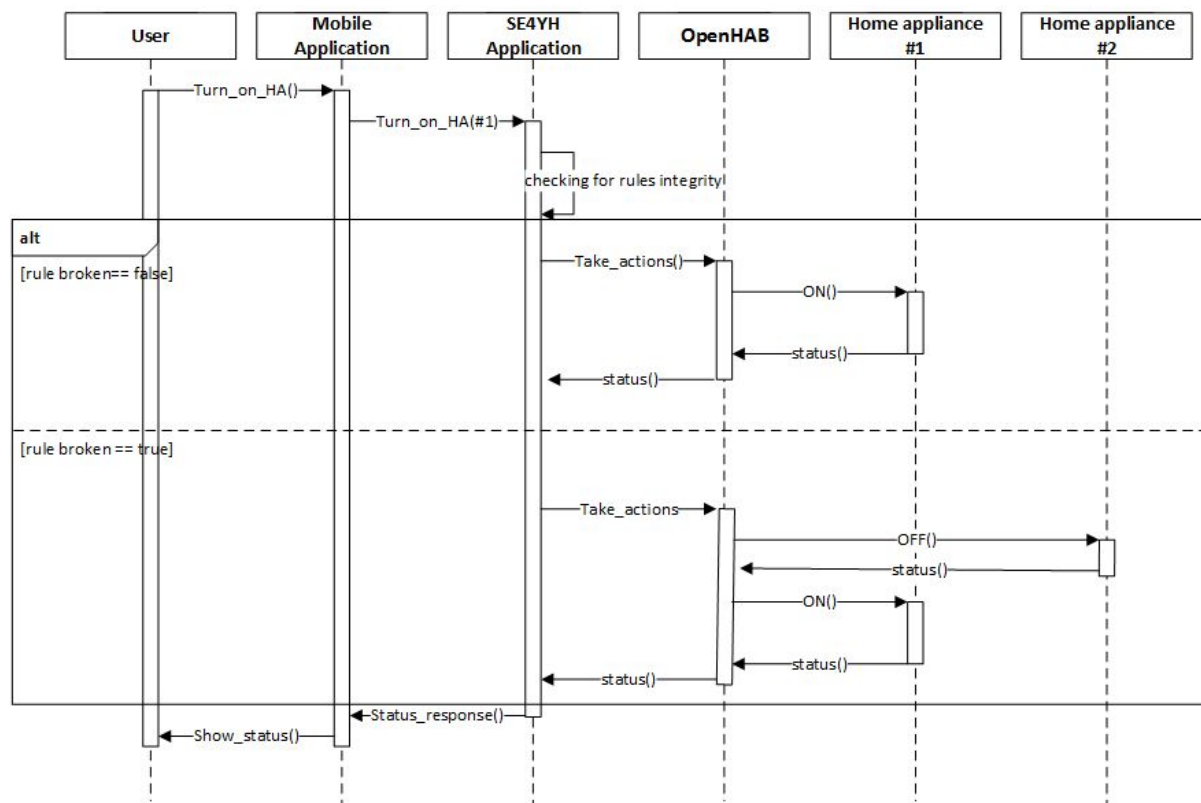
4.2 JSON

JSON is a language-independent data format. The REST API methods will provide responses as JSON serialized objects. It will be used because it is easy to parse and lightweight in comparison to XML.

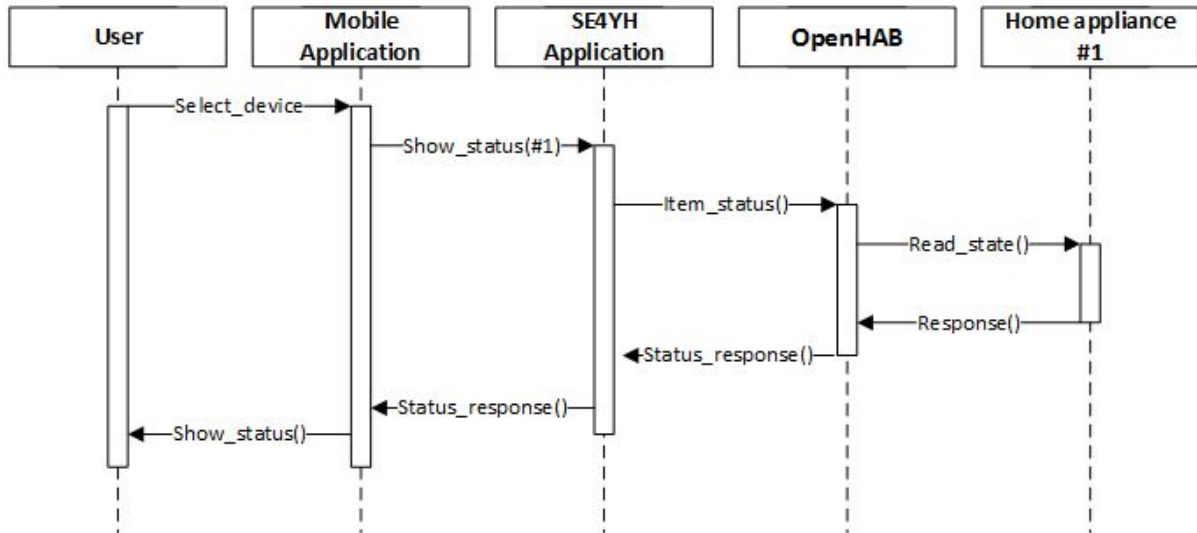
4.3 Sequential diagrams

These sequential diagrams show the communication flow between parts of the system and represent some of the use cases.

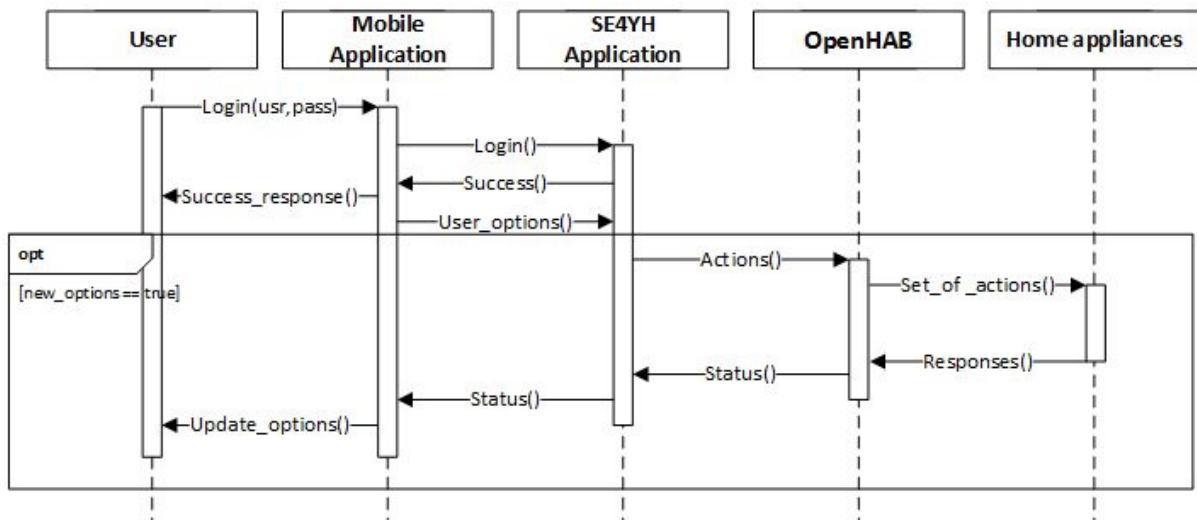
Use case UC7 - As a user I want to be able to change the status of a selected smart device.



Use case UC6 - As a user I want to be able to view the status of a selected smart device.



Use case UC1 - The user can connect to his SE4YH System. Either he is at home or remotely.



Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

5 Technologies

5.1 openHAB

The main core of this project is based on using the openHAB technology. It enables us to connect and control different predefined home appliances from light, climate, ventilation and, heating to TV and remote controls. Connecting to that many different devices is enabled using openHAB bindings. Bindings are not only limited to devices but also supports protocols like HTTP. Commands to bindings are provided using events. There are mainly two types of events: commands which trigger an action or a state change of some device and status updates which inform about a status change of some device. Events enables easy transfer between devices similar features but different connection protocols.

5.2 openHAB Designer

The openHAB Designer is an Eclipse Rich Client Platform application for configuring the openHAB. It comes with editors for configuration files. Its big advantage over simple text editors is the full IDE support like syntax checking, auto completion, highlighting and content assist. It is also meant to implement and deploy rules for automatic actions.

5.3 Java

Java programming language is used to build the user mobile application. Java will also be used to build mock-ups of home appliances.

5.4 Android

The user mobile application will be built for the Android mobile operating system.

6 System architecture

Basic system architecture is shown on the figure 6.1. System consists of 4 main parts: openHAB core, openHAB Event Bus, Bindings and Custom app. Items in blue are part of the openHAB technology.

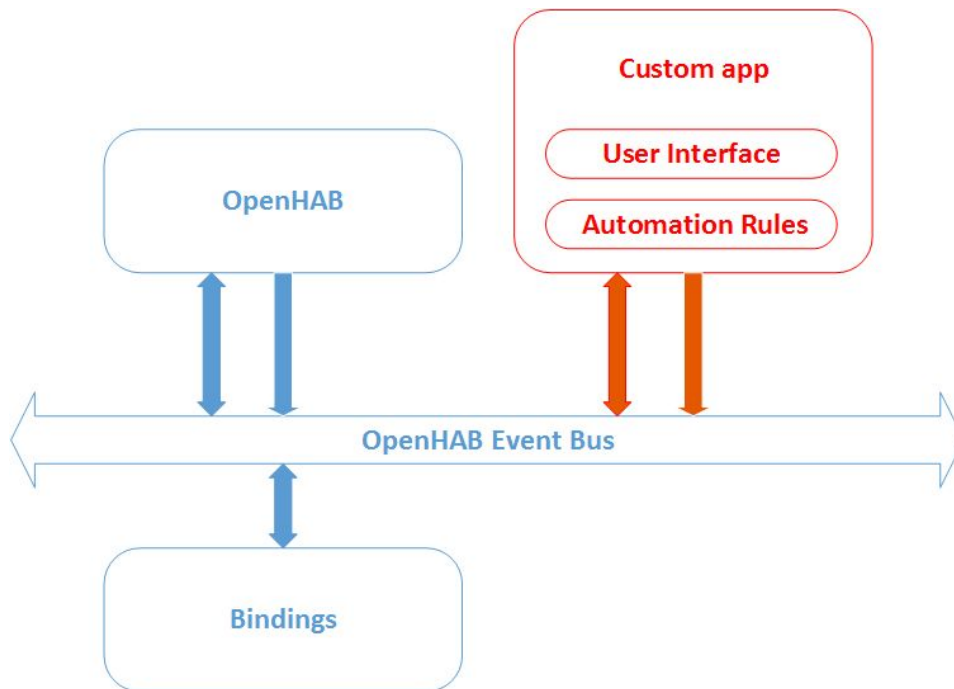


Figure 6.1

6.1 openHAB Event Bus

As shown on the figure 6.1, all parts are connected via the openHAB Event Bus. It is called Event Bus because all information transferred through it are event objects. Commands and status updates are Events passed on Event Bus.

6.2 openHAB

OpenHAB consists of openHAB Item Registry, predefined User Interface, Automation Rules, openHAB Persistence and Consoles. Item Registry is used to track Events from Event Bus. User Interface and Automation Rules can be easily created using openHAB Designer tool. Persistence can be used for storing or visualizing Items/Events.



Figure 6.2

6.3 Bindings

Bindings are translated to the real, physical world. They translate Events (commands) from Event Bus to

control specific devices using different protocols. For testing and simulating our system, plan is to mock up some devices and connect them using openHAB Bindings as show on figure 6.3.

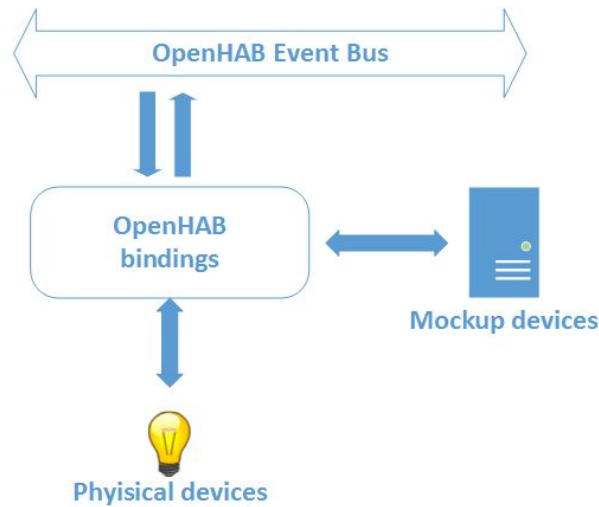


Figure 6.3

6.4 Custom application

Custom application build for Android will provide user interface to see connected devices and rules as well as defining new rules. It is going to communication with openHAB to collect data and send commands. Commands are going to be generated by defined set of specific rules. Rules will depend on user preferences and the current state of the system (all devices).

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

7 Mobile mock-up

For the mobile application on Android mock-ups are build to define each screen with basic functionalities. The start screen, figure 7.1, will provide two input boxes for user name(1) and password(2). User can login(3) if he entered valid user name and password or he can reset the password (4).

If the user name or password is wrong application must show appropriate message(1), figure 7.2.

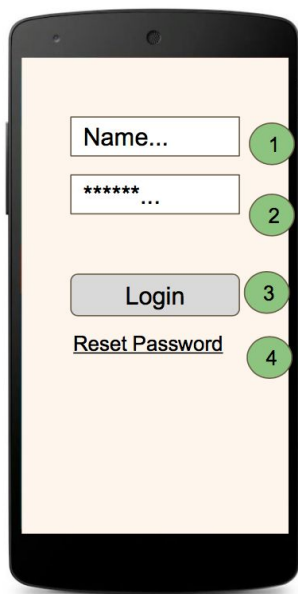


Figure 7.1

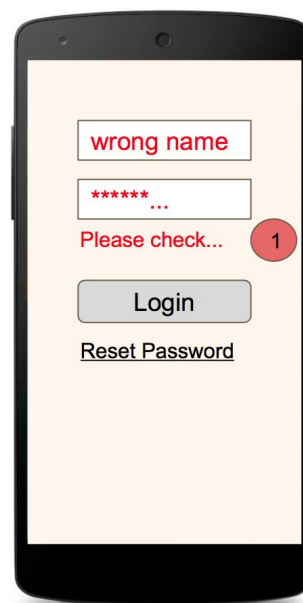


Figure 7.2

Smart Energy for Your Home	Version: 1.4
Design Description	Date: 2015-11-08

After successful login, figure 7.3, each screen will have a top Toolbar with a button for opening the Navigation Drawer(1), title of current screen(2) and Action button in right corner(3) that will provide different actions depending on the current screen. Rest of the screen will be used to display main content e.g. list of the devices.

After opening Navigation Drawer, figure 7.4, user will get list of actions(2) with appropriate icon(1).



Figure 7.3

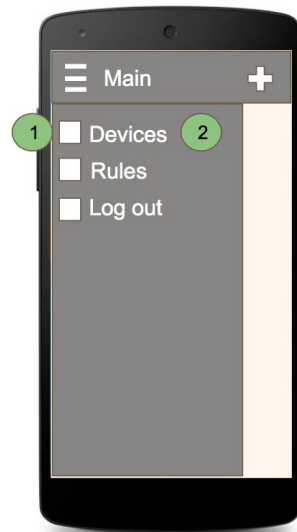


Figure 7.4