Fading illustration with SDR – Project Plan

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	Date	Signature
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1 Introduction

For the semester thesis at the Eastern Switzerland University of Applied Sciences (OST) it has been requested to create a demonstrative setup to show the fading effect, which is present in real world wireless communication systems. The device is intended to be used for pedagogical purposes such as to show the effect at the Open Days or for demonstrations during future lectures on fading channels.
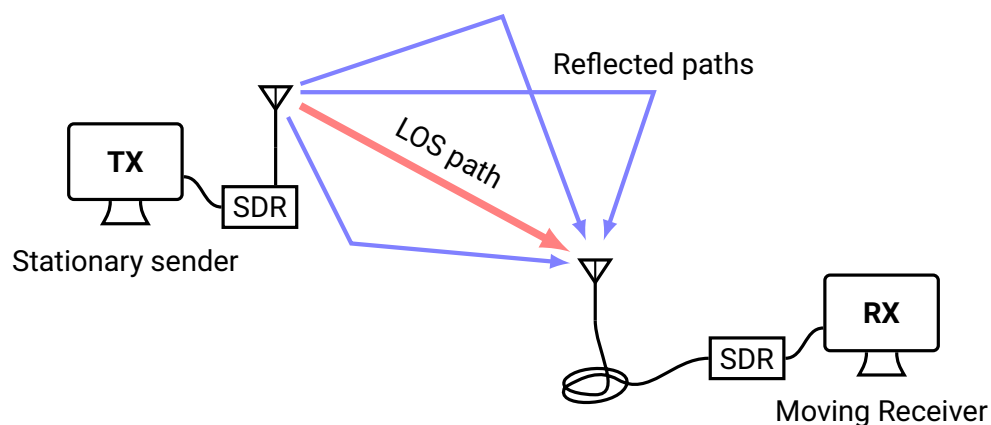
2 Task Description

Figure 1: Sketch of the setup that will be modelled and implemented. The model will need to be adjusted depending on whether there is a line of sight (LOS) between the sender and receiver.

The scope of the project is to realize a demonstration of a fading channel using a software defined radio (SDR). Out of the many types of fading effects that exist only small scale fading effects ought to be shown in the demonstration, specifically multi path propagation fading is of interest. The project requirements that must be fulfilled are thus:

- Understand of one or more mathematical models of the fading effect.

- Evaluate a suitable development environment for the SDR.

- Develop of a signal processing chain for the SDR transmitter and receiver.

- Develop of an interface to vary the parameter of the transmission, such as the modulation scheme.

- The demonstration should work with both stationary and moving receivers.

3 Development plan

The development of the project will be carried out roughly in three phases, of which the first two will start in parallel.

1. Develop an understanding of fading and how to work with SDR devices.

2. Create a basic TX – RX line *without* a fading channel model.

3. Integrate the fading channel model into the prototype.

3.1 SDR Device

At the time of writing, we are given an *USRP B210* SDR as hardware device for the project. An evaluation based on various criteria, including software compatibility and performance, will be made to decide which combination of SDR devices and software toolboxes will used.

3.2 Prototype

The first concrete step will be the realization of a prototype both simulated and with the hardware. A TX – RX line with an ideal channel[1] will be used to test the modulation and demodulation steps of the signal processing chain. Furthermore in this phase a software interface to select the modulation scheme and to configure the modulation parameters will be developed.

3.3 Fading channels

Once the prototype works we will integrate one or more fading channel models, both in software (simulation) and in hardware. The latter will be done by taking out the devices around the campus. Some effects of the channel will require the receiver to move, walking will be used to demonstrate those a scenarios. If there will be some time left, we may also use a car to demonstrate some other effects that are not observable at a walking speed.

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[1]In hardware that means a short coaxial cable between the two SDR devices.

4 Milestones

Table 1: Milestones of the project

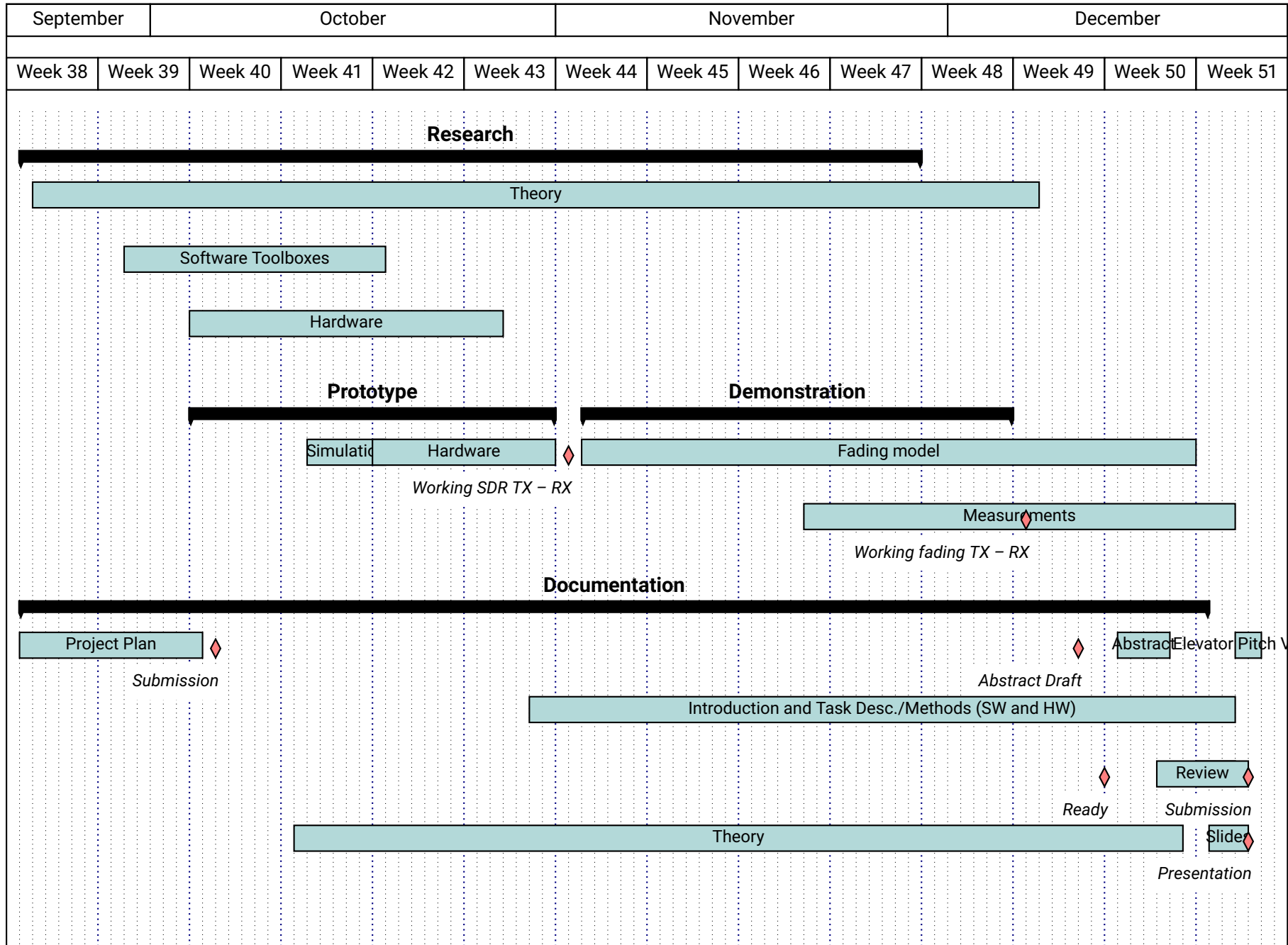| Name	Due date	Description
Project plan	Week 40	Finalization of this document.
Working SDR TX − RX	Week 44	Completion of an RX − TX line on SDR with variable parameters for configuration.
Working fading TX − RX	Week 49	Both the simulated and the physical transmission lines work and it is possible to observe the consequences of fading.
Abstract	17 Dec. 2021	The abstract is handed in.
Documentation	Week 50	The documentation is complete both on the theory and practical sides.
Presentation	23 Dec. 2021	Presentation of the project on Campus.
Submission	24 Dec. 2021	—

Figure 2: Project schedule planned (Gantt diagram)
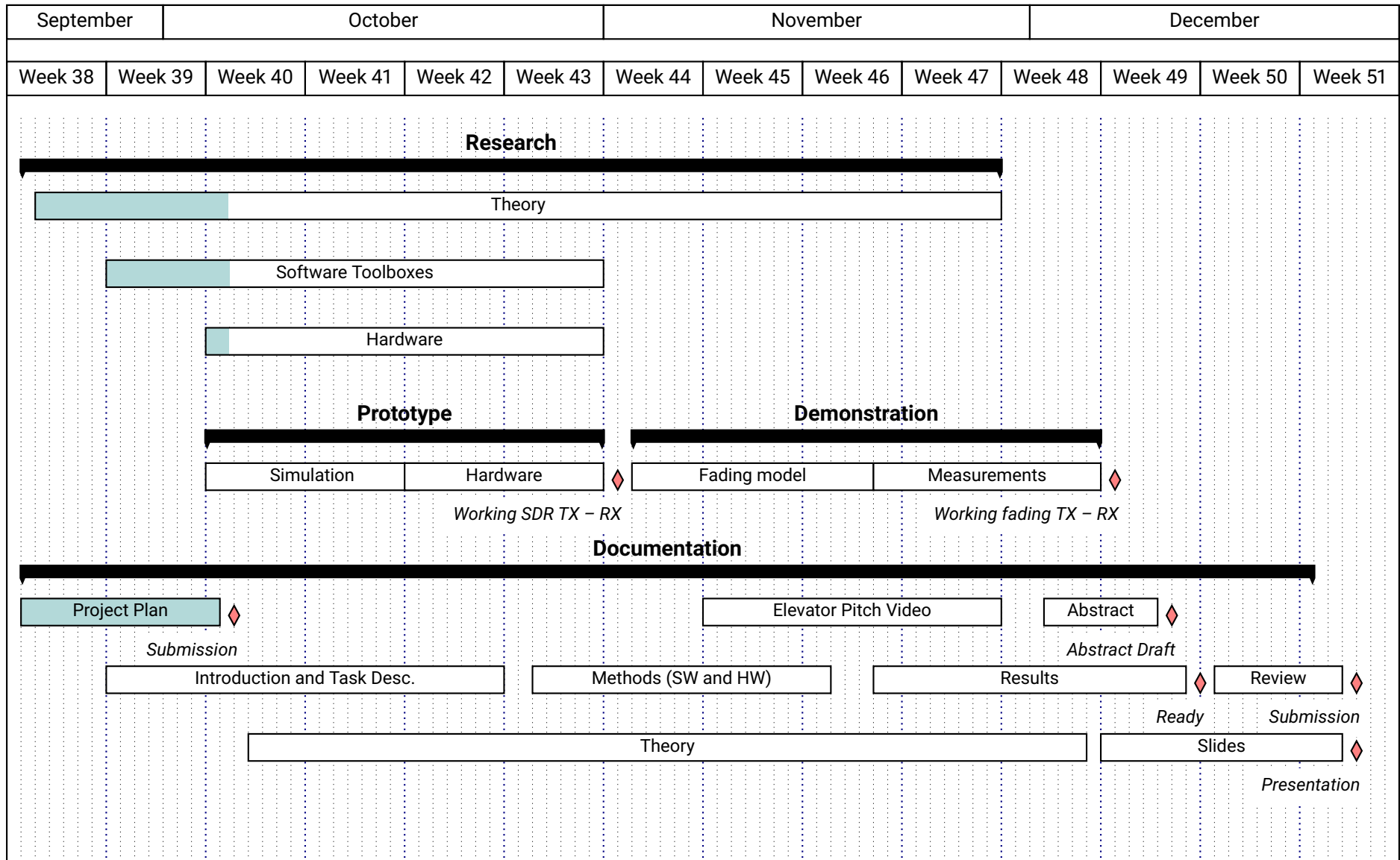
Figure 3: Project schedule effective (Gantt diagram)