P01 Ericsson Project Plan

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1 Introduction

This report explains the project plan for our project, "Flying Access Points" for the MF2063 Embedded Systems Design Project Course being supervised by Ericsson.

The idea behind the flying access point is to attach an electronic device to an existing flying drone platform (multicopter). This platform will have both WiFi and cellular (LTE/3G) connection capabilities and will act as a bridge device allowing nearby users to connect to the internet trough the drone platform. In addition the drone will be modified to allow for automatic flight between locations based on commands received from the attached device. This will allow a remote administrator, or even an automatic algorithm, to direct a swarm of such drones to provide WiFi connectivity on demand. This could be useful, for example, to provide temporary connectivity for sports events, festivals or other high volume events. It could also be used to provide temporary coverage during disasters.

The report includes the description of the project management methodology, the goals of the project, organization of project, time estimates and a risk analysis.

2 Goals

Our client provided a set of "phases" as tentative goals, each subsequent phase delivering a working product including and expanding on the features of previous phases, we are at least required to reach the requirements of phase one, but ultimately will do our utmost to fulfill as many phases as possible.

2.1 Phase 1: Basic Drone Flight and Access Point Setup

Flight: The Drone flies autonomously from A to B in GPS coordinates sent from the cloud.

Wifi: We can remotely setup the AP system and establish an open WiFi network.

2.2 Phase 2: Advanced Navigation, and Precise Landing

Landing :
The Drone can now autonomously accurately land on its targets, including a cart that simulates a bus.

Portal :
We now have a captive portal for the open Access Point

Management :
We have a management tool from the cloud.

2.3 Phase 3: Smart Battery Management and Obstacle Avoidance

Autonomous charging :
The drone is capable of landing precisely on a charging system and charge itself.

Charge management :
The drone is self aware of its battery capacity and will fly to a charger when it needs to.

3 Organization

3.1 Overview

The project will be run using a SCRUM-like model. Work will be divided into sprints with each sprint being approximately 2 weeks long. At the beginning of each sprint a sprint planning meeting will be held to decide which items from the project backlog will be completed for that sprint. At the end of each sprint a retrospective meeting will be held to reflect on the sprint and try to improve the model for the next sprint.

The project will be documented using three artifacts. The first of these is the project plan (this document) which describes how the project will be organized.

The second is the task board which provides a detailed overview of the status of the current sprint. The third and final artifact is the project backlog which contains all the features to be implemented into the project ordered by their importance and grouped according to the goal phases.

In keeping with the principles of agile project models there will be no formal division of work. Instead each team member is responsible for selecting a suitable task to work on from the task board. Frequent SCRUM meetings will be held to ensure that team members get a chance to discuss task allocation and any problems that may have occurred.

3.2 Roles and Responsibilities

As SCRUM is an agile project model the team has tried to avoid defining formal roles for project members instead choosing to rely on the teams ability to self-organize in whatever configuration the project currently demands.

Nevertheless the team has found it advantageous to formally define certain responsibilities. These are as follows:

Mattias Durovic	Maintains SCRUM artefacts (Task board, backlog, project plan). Organizes meetings.
Johan Westlund	Coordinates communication with product owner (Vlasios Tsiatsis).
José Morales	Tracks project budget and inventory. Ensures that needed tools and parts are procured.

3.3 Sprints

Sprints will last approximately two weeks each. The start and end weeks for each sprint can be seen in Table 1.

Sprint	**Starts**	**Ends**
1	w.43	w.44
2	w.45	w.46
3	w.47	w.48
4	w.49	w.50

Table 1: Sprint starting and ending weeks.

3.4 Meetings

3.4.1 Sprint Planning

Sprint planning meetings will be held at the beginning of each sprint to decide what features are to be completed in the coming sprint. Any risks related to the features being implemented in the current sprint will be discussed and preventative actions, if any are necessary, will be decided upon.

Sprint planning meeting will be held early during the first week of each sprint. The sprint planning meeting for sprint 1 will be held on Monday the 19th of October.

3.4.2 Stand-ups

Stand-ups are short meetings whose purpose is to give the team a chance to synchronize task allocation and discuss any problems that might have appeared. They will also be used to follow up on any risks being monitored during the current sprint.

Stand-ups occur twice a week, possibly in conjunction with some other planned meeting. Date and time for the following stand-up will be decided during each meeting.

3.4.3 Sprint Retrospectives

Sprint retrospectives will be held at the end of each sprint to give the team a chance to reflect on, and suggest improvements for, the project organisation. The meeting will end with the team deciding what improvements should be implemented during the next sprint. The project plan should be updated accordingly.

Sprint retrospectives should be held at the end of the last week of the sprint.

3.5 Artefacts

3.5.1 Project Plan

The project plan is this document. It explains the organization and procedures that should be followed when working with the project. It also contains a risk analysis and a copy of the project backlog.

The master copy of the project plan resides on the overleaf platform. Team members who lack access should request it from Mattias Durovic via email.

3.5.2 Task Board

The project task board is used to track the progress of the current sprint and can be seen in Figure 1. The task board can be roughly divided into three parts. The Todo list contains all tasks (in the form of cards) that should be completed during the current sprint. The Studying/Implementing/Testing lists show which tasks are currently being worked on and, when applicable, in what way. Note that not all tasks will go trough all three stages. Finally the Done lists contains all items that have been completed.

Each card on the task board represents a task. It has indicators (in the example FL and MD) showing which team members are working on it. Each card contains one (or several) check-lists describing what should be delivered and demonstrated for the task to be complete. Each card also contains an activity log and an area for comments related to the card task. An example of this is shown in Figure 2.

The following guidelines apply when working with the task board:

1. When you start working on something add your name to it and move it into the studying/implementing/testing list. Whichever makes most sense. Avoid adding yourself to tasks long before you actually start working on them.

2. When all things in the check lists are finished you are done. Move the task into the done list. Leave your name on it. A deliver item is done when it is tested and uploaded to github. A demo item is done when you have actually shown someone that it works.

3. Work on one thing at the time. Change tasks only if you cannot work on your current task (waiting for parts or another task to finish) or if you don't know how to complete the task (see rule 4).

4. If joining a card with people already on it ask them what they have done, what they are doing, and what you can do to help before joining.

5. If you realize you don't know how to complete a task go work on something else. Leave yourself on the card but make a comment saying you are no longer working on it. tell the team immediately with email and verbally during the next meeting.

6. When working on a task and realising that it is actually multiple tasks or makes no sense in its current form split it and add the ones you are not currently working on to the Todo list. If you feel there needs to be more things on the checklists add them. If unsure how ask someone else to do it for you (or bring it up at the next meeting). Only do this if you actually want someone else to take over the new tasks you found.

The task board is implemented using the Trello platform. Team members who lack access should request it from Mattias Durovic via email.

3.5.3 Project Backlog

The project backlog is a list of all features that need to be implemented to meet the project goals. Each feature is time estimated in man-days (eight hour days of work for a single person) if possible. Each feature should have an explanation for how to demonstrate it's implementation for the project owner. It should be noted that the backlog is assumed to be incomplete, features might be added, modified, or removed as the project proceeds.

The master copy of the project backlog is implemented using the Trello platform. Team members who lack access should request it from Mattias Durovic via email. A copy also exists as a list in the project plan document. This will be synchronised with the master copy at least after every sprint planning meeting.

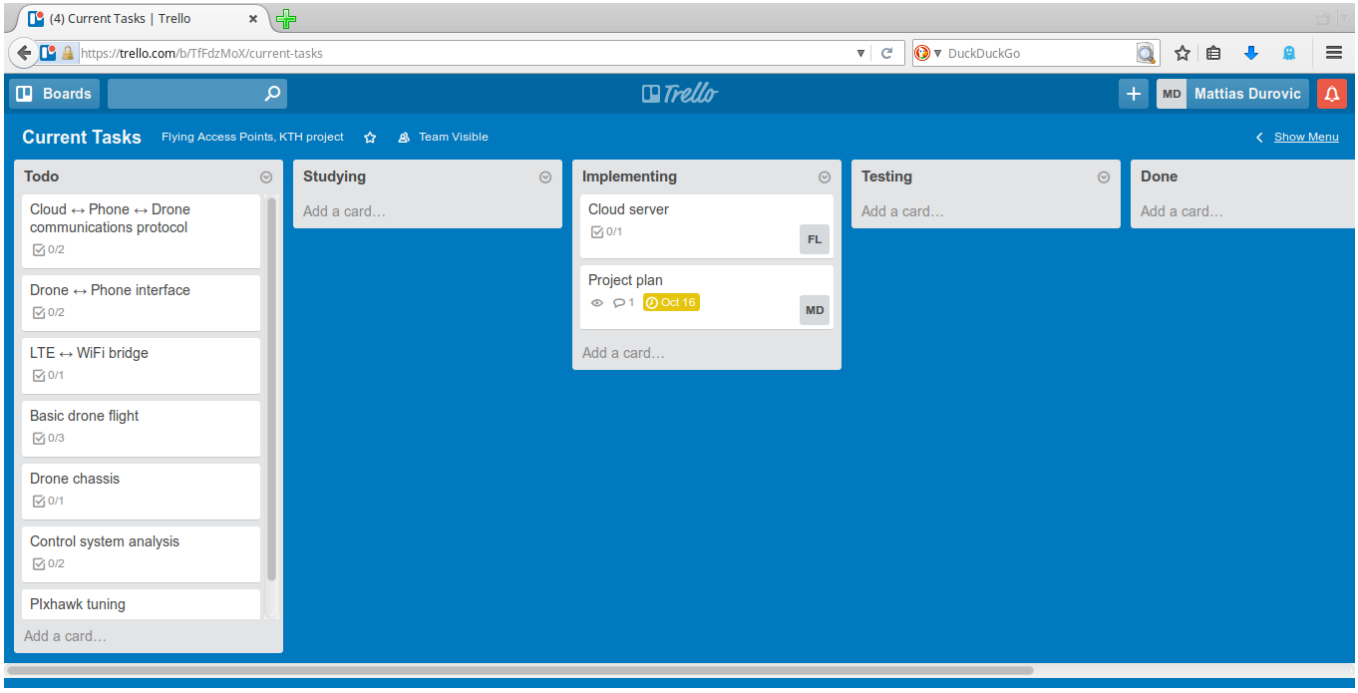

Figure 1: A screen capture of the project task board.

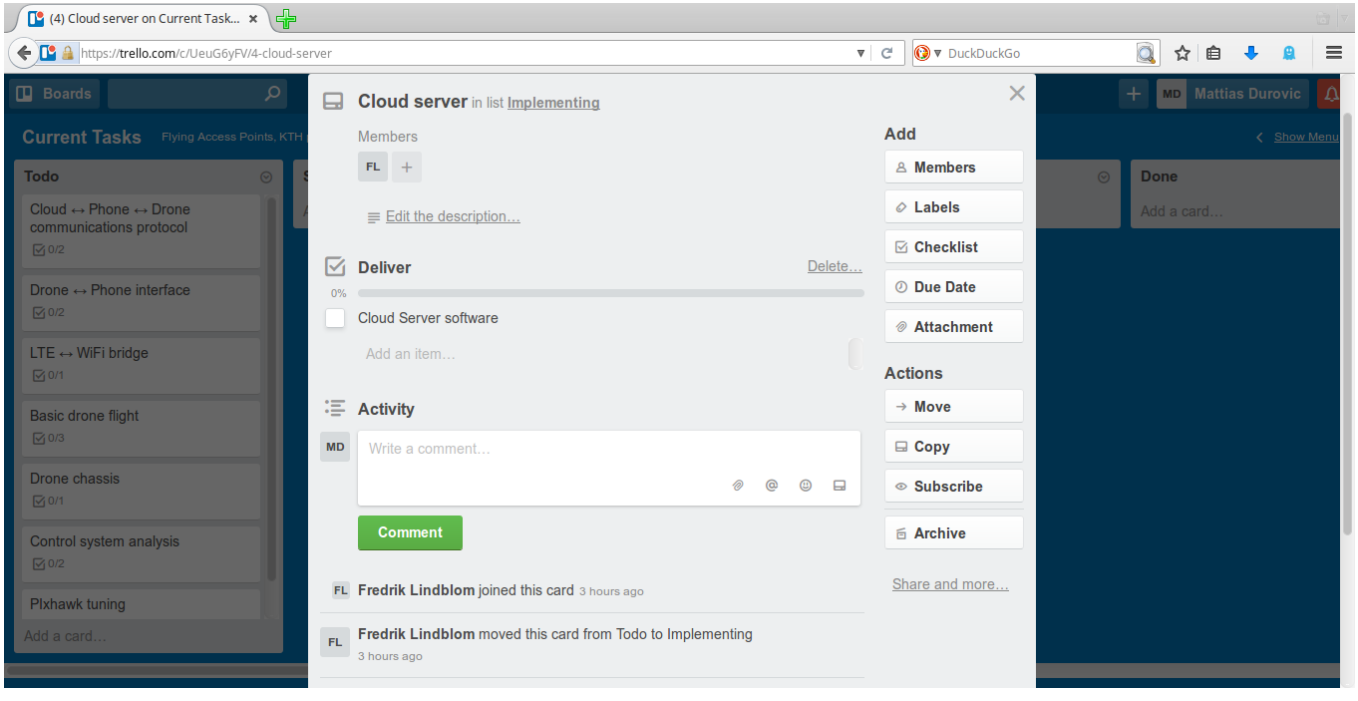

Figure 2: A screen capture of a single card on the task board. The card represents an individual task to be worked on.

4 Delivery Estimate

As can be seen in Table 2 the current time estimate for completing phase 1 is 23 days, phase 2 is 27 days, and phase 3 is at least 55 days. The team will as an initial estimate assume that it will complete 2 days of work per team member and week. This sums up to 36 days of work for the team every sprint.

At current estimates it would then take at least 3 sprints to complete all features in the backlog. The team would like to note that it believes this to be an optimistic estimate. Nevertheless it indicates that the team will have no problem completing phase 1 which is the mandatory part of the project. The team is also optimistic about managing to complete phase 2. It does not currently believe that it will complete any of the phase 3 features.

The team will update this estimate after every sprint by averaging the completed work over previous sprints. This should allow for increasingly accurate estimates after every sprint.

5 Risks

A risk analysis was carried out using the minrisk method. The risks found can be seen in Table 3. The team will follow up on these risks as described in subsection 3.4.

Feature	Time	Status	Demo
Phase 1			
Cloud to Phone to Drone communications protocol	2	Todo	Present document detailing communication protocol.
Drone to Phone interface	6	Todo	Control drone by sending commands from phone
LTE to WiFi bridge	1	Todo	Connect device to internet trough phone. Enable disable/phone Wifi from cloud
Cloud server	4	Todo	User selects target location for drone. Drone gets command to fly to location. User can enable/disable wifi and get status.
Basic drone flight	5	Todo	Have drone take-off from some point A and then land at some other point B using autopilot
Drone model simulations	3	Todo	Present proof that drone controller will eventually reach destination.
Pixhawk tuning	2	Todo	Present improvements made to pixhawk and effects.
Phase 2			
Land accurately	4	Todo	Show drone landing within ? meters of target.
Basic captive portal for WiFi	10	Todo	Connect device to internet trough phone with login trough captive portal happening.
Bus simulator	2	Todo	Demonstrate and explain simulator concept.
Landing on bus	4	Todo	Show drone landing on bus simulator.
Travel with and take-off from bus	4	Todo	Show drone taking off from bus simulator when simulator reaches a pre-set point and stops.
Travel to target location using bus	3	Todo	Show drone waiting for bus simulator to stop near pre-set location A. Land on bus. Take off from bus at pre-set location B and finally fly to target location C and land.
Phase 3			
Extend captive portal with user management	10	Todo	Show adding/removing/editing users in captive portal software.
Extend captive portal with usage statistics	10	Todo	Show cloud retrieving user and bandwidth statistics from phone on command.
Automatic recharging	15	Todo	Drone lands on charger and starts charging using autopilot.
Autonomous drone energy management	20	Todo	Cloud provides uninterrupted WiFi at location for longer than battery lifetime of single drone by sending new drone to target and old drone to charger as needed.
Obstacle avoidance	?	Todo	A plan for implementing outdoor obstacle avoidance on drone.
Indoor navigation	?	Todo	A plan for implementing autonomous indoor navigation on drone.

Table 2: Table shows the known tasks that need to be completed for the three phases of the project. Times are in days of work for a single person. Some phase three tasks have not yet been time estimated.

Goal 1 :	Basic Drone Control During flight								
						Action	Outcome	Ready date	Responsible
Nr	Risk	P	C	R = P*C					
1	Component failure	4	2	8		Get spares	Replace damaged parts	v42	Mattias
2	Drone instability during flight	2	2	4		Re-calibrate the drone or change damaged components	Stable again		Sharan
3	Inaccurate GPS data	2	1	2		Redundant check	Accurate GPS data or discarded		Mina
4	Structural Damage	1	4	4		Regular maintenance	No lose parts		Fredrik
5	Battery Drained	3	2	6		Always start with fully charged batteries, control the battery level	Battery is always charged		Abeer
6	Injury to people	2	4	8		Minimize the risk by setting up safety protocols	No injuries	v42	Johan
7	Remote control failure	4	2	8		Get spares	Remote control is always functional		Abeer
Goal 2 :	Setting Up WiFi access Point								
Nr	Risk	P	C	R = P*C					
1	The WiFi range of phone is not good enough	4	1	4		Use external antenna or USB dongle	WiFi range is acceptable	v45	Sebastian
2	Drone loses connection with cloud and there is no beacon in range	2	3	6		Land automatically and log the error	Drone can land by it self	v45	Jose

Goal 3 :	Charging the Drone at low battery								
Nr	Risk	P	C	R = P*C					
1	The landing of drone is not precise enough to get charged	4	2	8		Improve controller tuning	Precise enough	v51	Mattias
2	The landing of drone causes short circuit in the charging circuitry because of mismatch of connections	4	4	16		Make a fail safe design, add a fuse	No short circuit	v51	Fredrik
3	The charger causes the battery to explode	1	4	4		Test charger out of circuit first. Have spare batteries on hand.	Shorter downtime	v51	Haider
Goal 4 :	Testing Drone outdoors from one point to another								
Nr	Risk	P	C	R = P*C					
1	Rain, Snow or wind can cause serious damage to the drone during the outdoors flight testing	2	4	8		Plan testing schedules ahead, keeping the weather in mind. Limit outdoors testing when the weather is bad. Isolate critical components.	Drone only tested in good conditions		Sharan
	Other risks								
1	Equipment stolen or damaged in the lab	1	4	4		Restrict room access	No damage		Johan
2	Mishandling of drones by untrained members	1	3	3		Restrict to trained members	Minimize Uncertainty		Johan

Table 3: Risks associated with the project.