# ABSTRACT

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| You must get the essence of what your report is about, usually in about 200 words. Most informative abstracts also have key parts in common. Each of these parts might consist of 1-2 sentences. The parts include: ♣ background ♣ aim or purpose of research ♣ method used ♣ findings/results ♣ conclusion |

The text of the abstract begins here. You may select this text and replace it with your own. The abstract counts as page iii, but as for all other pages with main headings (titles in all capital letters), a page number is not shown on it. The abstract is a required component of the thesis or dissertation, even in cases where individual chapters have their own abstracts. It should be a concise, carefully composed summary of the contents of the thesis or dissertation in which the problem is defined, the research method and design are described, and the results and conclusions are summarized.

There should be no more than 350 words in the abstract, which will normally make up about one and a half pages. No diagrams, citations, illustrations, or subheadings are included. If there are two pages in the abstract, the second page will be numbered iv, and this page number should appear centered at the bottom of the page.

# GLOSSARY

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| SD | Succinct Data |
| SMAC | Short Message Arithmetic Compressor |
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# Introduction

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| This is the introduction part, the aim of this part is to introduce the Serval project, its background and main components, as well as the Succinct Data application, its background, its scope, how it works in a high level understanding. |

## Report structure

This report will go through my personal work on the Succinct Data application within the context of the Serval project. The structure is made in the way that every reader can find his way, depending on his knowledge on the project. As a matter of fact, it goes for each part of the report from the overview, motivations and background to the specific details. The aim is firstly, through the remainder of the introduction chapter, to understand the motivations and the background behind the Serval Project and Succinct Data and develop a good overview. Then, the second chapter presents the specifications of the current Succinct Data application and the background and specification of the needs which make the core of my work. The third chapter presents the design of the solutions fulfilling the needs. The fourth chapter introduces the materials and methods used to implement the solution. The fifth chapter goes into the specific implementation of the solution. The sixth chapter presents the results. Finally, the seventh and eighth chapter conclude the work and presents some potential further improvements.

## The Serval Project

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| At the end of the part, the reader should have an overview of the Serval Project, knows the main idea, the why, and the main components of the implementation of the project (the how). |

### Overview and background

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| Explain generally in what consists the Serval project: What is the main idea? What is the aim? How it is generally implemented? What problem it is solving ? |

The Serval Project project has been launched in 2010 and consists essentially on direct communications between terminals (D2D) through their Wi-Fi interface. This technology finds its applications in several fields, for example:

In some third-world countries or countries under development, the network infrastructure is partly or totally absent (or accessible only by a minority of urban/higher class people). Then the cost to set up a totally new infrastructure would be higher than relying on direct communications (and satellite).

Natural disasters happen often in places where the network infrastructure is poor (ocean, islands, high mountains, etc.) or destroys the existing network infrastructure.

Some NGO as Red-Cross New Zealand have often assignments in places where the network infrastructure is poor and the reliability on direct communications between Red-Cross staff members and also the communication to the rest of the world through satellite would be critical.

### Key elements on the Serval Project

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| What are the main components of the implantation? How does everything work? Keywords : Mobile phones, Serval Mesh, Serval Mesh Extender, InReach devices, Satellites |

The Serval Project relies on many components to fulfill its requirements.

The first flagship element of the project is the Serval Mesh, an android application that is able to use the phone as a root, activates the Wi-Fi interface and communicate directly through this interface with other devices. The current possible types of communication are voice calls through the VoMP (Voice over Mesh Protocol), text messaging with MeshMS,

## Succinct Data

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| In what consists the Succinct Data application? What is the context and the why behind its implantation? How does it work generally? What is the idea of the compression? Results of the compression? |

The work of the current project is focused on Succinct Data, a mobile application that operates right after Magpi/ODK phone application in order to minimize the data produced by this application.

Magpi is a phone application that allows people to create surveys and polls that are materialized into a form with questions that can be a simple text field to fill or a multiple choices question.

Succinct Data takes the XML file representation of the Magpi record (Which is also refer to as an “XML record”) and “extremely” compresses it to as less bits as possible, getting close to the Shannon entropy (i.e. the minimal and necessary quantity of information contained in the data).

### Overview on the Magpi application

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| What is generally the Magpi application? What types of forms can we create? How are the forms filled in? What are the files generated by the Magpi application for each action (create form, fill in a record …) ? |

### Context and interests behind Succinct Data

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| In what consists the Succinct Data application? What is the context and the why behind its implantation? |

Succinct data works…

One significant example of application is when the Red-Cross staff members work together for assignments such as maritime observation or natural disaster relief. The zone is then often cut from the network infrastructure and a direct communication between the devices is one of the solutions to overcome the critical need of intra and intercommunication (see schema 1 for general understanding).



Schema 1: Current architecture for SD forms sending

### Overview on Succinct Data

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| How does Succinct Data work generally? What is the idea of the compression? Results of the compression? |

Current SD application takes XML data and transforms it into stripped data (consisting of name-value pairs extracted from the XML) by fixing the order of the fields and removing the common data (such as the type of the field). Then, considering the constraints specified in the form specification and the type of the fields (Boolean, String, …) we can reduce drastically the number of possible answers and thus the number of bits needed to encode the answer. Thus, the SD application encodes the data to the minimum possible of bits and the transmission by satellite can take place. (c.f. Succinct Data Extreme Compression for ODK forms, P.G. Stephen et al., 2014).

# General specifications

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| The specifications part enters with a lower level of understanding in the Succinct Data application. It explains what is the main architecture of the application, what are the components and the links between then (the android application, the jni library, xhcreate, strip, rexml, compress, decompress). Then it goes into the reason for what we need improvements and the specifications of this need (What is expected). |

## The current Succinct Data application

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| Part description : The current Succinct Data application explained in low level |

### The android application

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| Explain how the android application generally works, Inputs, Outputs, and the link with the compression application. |

### The compression application

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| Explain how the compression application generally works for each part explained in the overview in the part I (xhcreate, strip, compress, decompress, rexml). For each component, try to explain in in a nice way (If possible include graphics). The reader should already have an understanding of the purpose of each part of the work and now we feed him with the detailed way it work for each part. |

#### Creation of recipes and templates out of a form specification

#### Creation of the stripped file out of a record

#### Retrieving the record from a stripped file

#### Compressing a stripped file to a succinct data file

#### Decompressing a succinct data file to a stripped file

## Specification of the needs

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| There we go into the reasons for what we need improvements and the specifications of this need (What is expected). |

### Context and interests

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| The context behind the need |

SD users may have the need to use sub-forms in case of a survey that will be applied on an element that contains sub-elements. For example, in the case of a fire in a remote village containing 3 houses: A, B and C, the form will consist on general questions about the village (Village location, Village name, Number of households affected, …), then we can have sub-forms for each household in the village (House location, number of people damaged, list of materials damaged, …). The answers for a form will be the same for every sub-elements of the element (for example: The same answers for every house of the village). So, a solution for this issue that was implemented by Magpi is the sub-forms. That is why the support of sub-forms by the Succinct Data application is essential.

The SD application doesn’t manage the sub-forms. What we would like to do is to modify the code in the SD application so it is able to firstly recognize the tags and the elements of a sub-form and then process it correctly by transforming it into stripped data. Then, the code that transforms stripped data to binary data has to recognize the new stripped data structure and be able to transform it into binary data.

We want also that the method that creates a recipe from a form specification recognises the sub-form specification and calls itself recursively to create a recipe file for the sub-form.

### Functional specifications

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| Functional or technical specifications given for the solution : What are the functionalities to implement, the expected results |

# Design of the solution

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| In this part, we enter into the design explanation of the solution. After an introduction on the Serval project and on Succinct Data and the specifications of the needs, this part will explain the approach to implement the solution, the main algorithms, if possible state diagrams, any good graphical way to represent the design … |

## Overview

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| Overview of the solution : How will the solution be designed generally knowing that we have a legacy code and knowing how the legacy code works ? |

## Forms to recipes and templates

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| Part description : Design of the creation of recipes and templates from forms with subforms |

## Records to stripped data conversion

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| Part description : Design of the creation of stripped data from records with subforms and regeneration of xml file (reverse process). |

### XML record to stripped data

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| Part description : Design of the creation of strippeed data from records with subforms |

### Stripped data to XML record

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| Part description : Design of the regeneration of the original xml file from stripped data with subforms |

## Stripped data to succinct data conversion

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| Part description : Design of the compression of stripped data with subforms and reverse process (decompression) |

### Stripped data to SD

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| Part description: Compression |

### SD to stripped data

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| Part description: Decompression |

# Materials and methods

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| Description of the environment, the tools, and the methods for understanding the code, coding, testing. Also, it’s possible to give a planning of what was done from the beginning to the end |

# Implementation details

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| Part description: After presenting the design of the solution, we present here the implementation details for each part: What are the key variables and structures of data? How are they manipulated? What are the states and what is done for each state? … For each implementation part we can talk about some difficulties and how did we solve that. |

## Forms to recipes and templates

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| Part description : Recipe xhcreate |

## Records to stripped data conversion

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| Part description : Recipe strip and rexml |

### XML record to stripped data

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| Part description : Recipe strip |

### Stripped data to XML record

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| Part description : Recipe rexml |

## Stripped data to succinct data conversion

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| Part description : Recipe compress and decompress |

### Stripped data to SD

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| Part description : Recipe compress |

### SD to stripped data

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| Part description : Recipe decompress |

# Results

## Overview

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| Part description: Give an overview on the results and on what is achieved. What were the expectations, what did I achieve, what remains to do… |

## Test cases

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| Part description: Here give the test cases ran against the code to check its validity (either manual or automatic tests…). |

## Impacts / Discussion

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| Part description: What are the impacts of what I achieved |

# Conclusion

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| Part description: Talk about personal experience, path, general difficulties, achievements, sum up all the process and give a personal reflection about the work… |

# Further work

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| Part description: Further improvements |

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