

FLINDERS UNIVERSITY

COMP-9710A Master Project Thesis

by

Theo DE FRAMOND

Functional testing and qualification
of the Serval Mesh Extender

in the
School of Computer Science

March 2017

Declaration of Authorship

I, Theo DE FRAMOND, declare that this thesis titled, ‘Functional testing and qualification of the Serval Mesh Extender’ and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

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“Laugh, smile and live your life.”

Goose Santoro

FLINDERS UNIVERSITY

Abstract

School of Computer Science

Master Project Thesis

by Theo DE FRAMOND

This paper is the thesis of my Master Project COMP9710A in Flinders University, School of Computer Sciences as an exchange student from France. It explains all the work, tasks and experiments I have done during my project which is the Serval Project and how I did it. The remainder of this content concerns the perspectives and the motivations of such a project and also what I have retained about it...

Acknowledgements

I would like to thank the all telecommunication laboratory of Flinders in Tonsley for their participation in the project and for having supported my work and helped me get results of better quality. I am particularly grateful to my supervisor Paul Gardner-Stephen for his patience and support in overcoming numerous obstacles I have been facing through my research. Thanks him for having accepted me in his team.

I would like to thank my fellow students and the ISS of Flinders University for their feedback, cooperation and kind welcome.

Nevertheless, I am also grateful to my French school INSA Lyon for having given me the opportunity to get here and work in this wonderful country which is Australia. Thanks Isabelle Auge-Blum and the DRI for having organized my student exchange and thanks the jury for having changed their decision regarding this exchange which was at first forbidden for me.

I would like to thank my friends for accepting nothing less than excellence from me. Last but not the least, I would like to thank my family: my parents and to my sister for supporting me spiritually throughout writing this thesis and my life in general.

...

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Abbreviations

LAH List Abbreviations **Here**

Physical Constants

Speed of Light $c = 2.997\,924\,58 \times 10^8 \text{ ms}^{-\text{s}}$ (exact)

Symbols

a	distance	m
P	power	W (Js^{-1})
ω	angular frequency	rads^{-1}

For/Dedicated to/To my...

Chapter 1

Introduction

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1.2 Another Section

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Chapter 2

Literature Review

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2.1 Serval Mesh and Serval Mesh Extender

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2.1.1 First Generation Serval Mesh Extender

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2.1.2 Second Generation Serval Mesh Extender Design

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2.2 Testing Methodologies

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2.3 Pacific Humanitarian Challenge

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Chapter 3

FAC Method and Material

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3.1 Test methodology...

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3.2 Simulation methodology...

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Chapter 4

Functionnal Hardware testing of Serval Mesh Extender

4.1 Environmental testing

4.2 Post-assembly testing

4.2.1 Test 1 : Boot-loader and flash firmware update

This is the very first task I have to implement. The goal is to prepare the manufactured Mesh Extender units for the tests and use. In order to do it, we have to install a special Linux distribution on it called OpenWrt. OpenWrt is an embedded operating system based on Linux, primarily used on embedded devices to route network traffic. All components have been optimized for size, to be small enough for fitting into the limited storage and memory available in home routers as the Serval Mesh Extender.

In order to install the latest version of the OS, we will use here the command-line interface Shell. This will allow to boot directly the Domino from a laptop. But at this point, we need to make these two entities capable of communicate to each other. That is why we need cables and especially one that can deals with the extender serial port. For this one, we have for the moment a home-made cable that use a D-SUB 25 pins male port on one side and whatever we want on the other side by cutting the edge of the cable and weld components on the desired nude wires. That is why we have welded here a serial port to USB adapter and a power plug to power the PCB.

So now we can talk to the PCB with the laptop through command lines. But there is a problem remaining. Serial port is too slow to transfer data and at some point, we will have to download on the Domino the OpenWrt software binaries. That is why we also

use an ethernet cable to install the distribution in addition to the serial cable.

The procedure is simple, we first connect the laptop and the Mesh Extender with the serial and ethernet cables. Then we plug the power cable in order to make the PCB run. We have to install the Serval software which create the OpenWrt files to transfer to the PCB on a linux environment. To this end, we have to install lots of dependencies like for example GNU awk, SVN, OpenSSL library ...etc. That is why we need to install VirtualBox on Macintosh laptop first. Then, just clone the repository OpenWrt from the Serval Project Github source and run the following commands :

```
└ ./scripts/feeds update serval
└ ./scripts/feeds install -p serval
└ ./scripts/feeds install -a serval
└ make world (long time running...)
```

Therefore, the binary for installation should then be in: bin/ar71xx/openwrt-ar71xx-generic-gl-ar150-initramfs-kernel.bin

To flash the PCB, we have to connect to the serial port at 115200 by typing:

```
└ cu -l /dev/cu.usbserial -s 115200
```

or if we have trouble with cu:

```
└ screen /dev/cu.usbserial 115200
```

In either case, change /dev/cu.usbserial to the correct device name for the USB to serial adapter. Reboot the node in some way, so that you see the uboot prompt. Then press any key to interrupt the boot process.

The Mesh Extender node will have an IP of 192.168.1.1, so pick another IP address on that subnet for the connected computer and type "httpd" to start the firmware update webserver. Then, just browse to <http://192.168.1.1> and select the firmware file to upload, and trigger the firmware update.

So here is my expect script for that :

```
#!/usr/bin/expect
#Expect script installing an openWrt image on the Serval Mesh Extender
```

```
set timeout -1
log_user 0

spawn cu -l /dev/cu.usbserial -s 115200

expect {
    "Connected."
    {
        puts "\n#####\n# MESH EXTENDER
        FIRMWARE UPDATER\n#\n# 1/7 > Please, boot or reboot the PCB"
    }
}

expect {
    "Hit any key"
    {
        send "\r"
        puts "# 2/7 > Autoboot well interrupted"
    }
}

expect {
    "uboot>"
    {
        send "httpd\r"
        puts "# 3/7 > Server HTTP well started"
    }
}

expect {
    "HTTP server is ready!"
    {
        puts "# 4/7 > Uploading the image..."
        system curl --silent -o /dev/null -F
        'firmware=@./openwrt-ar71xx-generic-gl-ar150-squashfs-sysupgrade.bin' -F
        'filename=\$openwrt-ar71xx-generic-gl-ar150-squashfs-sysupgrade.bin'
        http://192.168.1.1/
    }
}

expect {
    "upload is done!"
    {
```

```
        puts "# 5/7 > Upload successful\n# 6/7 > Upgrading the firmware... DO\n        NOT POWER OFF "
    }
}

expect {
    "done!"
    {
        puts "# 7/7 > HTTP upgrade is done! Rebooting..."
    }
}

expect {
    "Hit any key"
    {
        send "\r"
        puts "#\n# FIRMWARE SUCCESSFULLY UPDATED,\n        ENJOY!\n#####\n"
    }
}
```

Chapter 5

Functionnal Software testing of Serval Mesh Extender

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Chapter 6

Simulated Field Operation of Serval Mesh Extender

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Chapter 7

Discussion

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7.1 A Section

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Chapter 8

Conclusions and Future Direction

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Appendix A

An Appendix

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