

## **Using Ad Hoc Networking in Emergency Situations**

Spreading information in an emergency situation to help both people in danger and the emergency services

### **Project Specification**

**Freddie Brown**  
**u1716717**

Supervisor: Dr. Matthew Leeke  
Department of Computer Science  
University of Warwick  
2019-20

# Abstract

When an emergency situation occurs, people want to tell others where they are and get help. This can often be difficult to do because key infrastructure that is heavily relied on could be damaged. Situations around the world show there is a significant need for systems to help people connect with no, or very little, working cellular infrastructure. By using commodity hardware in our devices, survivors can opportunistically send information to nearby devices. This could then be sent to an internet connected device for transmission, other nearby devices or, the emergency services. Moving information in emergency situations could get alert those who save lives and could aid rescue efforts.

*Keywords: Bluetooth, Ad Hoc, MANET, Emergency, Disaster*

# Abbreviations

**MANET** - Mobile Ad Hoc Network

**VM** - Virtual Machine

**BCS** - British Computing Society

# Introduction

The main part of this project is investigating an application of MANETs, an interesting technology which fits the emergency use case well. They are low infrastructure networks which use homogenous and heterogenous devices to form a network dynamically. This is good for situations which may be quite fluid, with nodes coming in and out of the network [1]. There are some other areas which this project will also explore, such as keeping devices alive for a long time, biological inspired routing and security issues related to passing packets of potentially sensitive data to unverified devices to distribute.

## Motivations

In todays world, most people in the world rely on telecommunications to connect with family members, friends, work colleagues and, very importantly, the emergency services. When we get a disaster, or group of them, as was seen in Puerto Rico in 2017, it can impact lives and even end them prematurely. A study estimates the increase in mortality at 62% [2], and this is thought to be an underestimate. Remote areas were hit hardest and were without services such as cellular data access for up to 41 days. This can make it very difficult for rescuers to know the situation in these places and creates a mismatch in information.

Incidents such as these illustrate the tragic consequences that can happen without vital services which are required in the world today. In 2016, the United Nations voted that access to the internet is a human right that should be protected [3]. This type of action brings into focus the need to have systems in place to help people maintain connectivity, even when traditional infrastructure fails.

## Project Aims

The aim of the project is to produce a prototype of a system which could be implemented by governments and technology companies which could help people. Companies like Google and Apple produce the Operating Systems for most phones but they don't have any sort of inbuilt emergency system like the

one I hope to accomplish.

I want to explore the different ways this could be implemented, what holds them back and how well they actually perform in action. Also, I want looking at why there is no widely implemented system such as this in consumer phones already.

## **Stakeholders**

The stakeholders for this project would be those who can benefit from it. Those people are those who live in areas which are frequently affected by natural disaster and have weak infrastructure. These are the people that would benefit most from having a system which could help them maintain contact with the world if they couldn't through traditional methods.

# Research

Discuss the research that I've done so far. Talk about different approaches to the problem which have been implemented already. Discuss what they have done well and what could be improved. Also discuss other aspects such as routing.

# Ethical, Social, Legal and Professional Issues

## Ethical Issues

Ethical issues arise when there are competing goods and competing evils. An example of this is using data collected through using a product to target certain groups without their consent. A firm may make more money by doing this, but whether it is right to do so is something that should be considered. Fundamentally, stakeholders in the project should be protected and their data shouldn't be used against them. Data should be kept anonymous and protected somehow, through traditional encryption or other means.

## Social Issues

Social issues are those that may have an affect on the lives of many people. It could be problems which affect how they interact with other people or those relating to access to goods and services that others can but they can't. Currently, it is hard to see any issues of this nature relating to the project but this should be continually considered as the project moves forward.

## Legal Issues

This project will deal with sending data about an individual to others and allowing them to hold and send this data to whomever they wish to send it to. There are legal issues as, without proper protections, this kind of data could be used against individuals that are in trouble, such as in a terror incident.

In this project, I will strive to protect sensitive data, such as location data, so that no one is privy to this information at any time if they shouldn't have access to it. As discussed above in Ethical Issues, this should be done by maintaining data privacy through encryption or other means.

Also, in any testing or data collection, a persons personal data should be kept

private so that it can't be shared and used by people who shouldn't have access to it.

## **Professional Issues**

Throughout this project, I will adhere to the BCS Code of Conduct [4]. I want to produce a research project which can be trusted and respected and so I will adhere to all rules that I am required to follow. This means I will also follow the Research Code of Practice at the University of Warwick [5]. This means all work I use to support my research will be referenced.



# Project Requirements

Come up with some basic functional and non-functional requirements like in SE

**Functional**

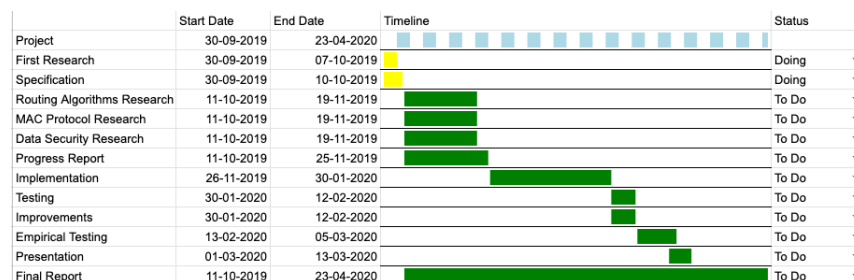
**Non-Functional**

**Constraints**

# Project Management

Do a gantt chart to go here and what tools I am going to use, e.g Git and Trello

## Project Timeline



The above figure shows the predicted project timeline in a Gantt chart as well as displaying the dates between which each task will take place. Looking at the timeline, ample time has been left for research for the different aspects of the project (about a month). During this time, the second project deliverable can also be written. After this, a large block of time has been left for the implementation of the project, about 2 months. After this, a period of product testing and iteration has been scheduled so that bugs and improvements can be made so it performs better. After this, further testing will take place where results of the performance of the project will be done so they can be presented in the final report and presentation.

## Project Tools

This project will use C++ for programming. This has been chosen because it is a low level programming language so the code will be easier to optimise for increased performance. Furthermore, there are some good libraries for dealing with technologies like Bluetooth which are needed. One such library is BlueZ [6]. This will provide a good api to interface with Bluetooth with on Linux machines.

In terms of hardware, the project is going to be written for Linux-based devices such as the Raspberry Pi which have Bluetooth. This is a pretty basic requirement for the hardware as Bluetooth standard for a lot of devices. Having very few requirements greatly decreases barrier to entry to use the project and makes it easier to see how it could be used on a variety of devices.

A variety of other tools will be used for other aspects of the project. Trello will be used to keep track of tasks that need to be done. This is a simple and clear way to see what is left to do and allows deadlines to be built into tasks. It also fits in with an Agile development methodology, which is preferable. On top of this, Github will be used as the version control system to store code. It makes it easier to access project resources from multiple locations and provides a good back up if something went wrong and all physical devices which hold the project, were to break for some unforeseen reason.

## **Risk Management**

In this project, there aren't too many major risks that could have an effect on its performance. One risk, which was discussed above, is losing all physical machines which hold the project. This can be mitigated by storing any code and reports on Github, as well as maintaining a local copy on a hard drive. This provides extra layers of assurance that the project won't be lost.

Another risk is that persons who work on the project fall ill or are unable to do work. This can be mitigated by keeping in contact with DCS and discussing any factors that could lead to a delay in the projects completion because of this reason.

Furthermore, there is always a risk that something might take longer than it is planned for to complete. This could be because hardware access has been delayed or there are extra technical difficulties that weren't foreseen during the planning of the project. Because of this, generous allowances have been made for each task in the project. If something finishes earlier than planned, other tasks can use this time. Also, if a task is running late, subsequent tasks have extra time built in to accomodate for any delays.

# Testing

Testing in this project will be used to verify the functionality of the project while changes are made as well as being able to verify that requirements have been fulfilled. The project will use a couple of different technologies to accomplish this. For unit testing an established C++-specific framework will be used, such as CppUnit. For integration testing, TravisCI will be used. Once more, its a robust service and it has very good integration with Github and is very customisable.

## Unit Testing

With unit testing, tests will be written for each feature that is created. These will be lined up with the requirements so that it is easy to see that they are being fulfilled. For writing unit tests, Agile development methodologies will be adhered to by writing the tests before writing the feature.

## Integration Testing

By using TravisCI, larger tests can be written which incorporated more of the project. This can be run on a clean VM which means there is nothing external to the project which could influence its testing. This enables more rigorous testing.

## Success Management

The way success of the project can be measured is if the project can transmit packets across a group of devices with to a target device. This would simulate a device in a disaster scenario which is either the emergency services or an internet connected device. This will be tested on a number of topologies and in different environments to test performance when taking in lots of different physical and real world factors.

# Conclusion

Overall the project has begun well. The tools which are going to be used as coming into shape and there is a greater understanding about what needs to be done in terms of further research and future implementation. Over the next few weeks a greater plan of what needs to be done will be created and more cards for Trello will be made so that the project stays on track.

# Bibliography

- [1] J.-Z. Sun, “Mobile ad hoc networking: an essential technology for pervasive computing,” in *2001 International Conferences on Info-Tech and Info-Net. Proceedings (Cat. No. 01EX479)*, vol. 3. IEEE, 2001, pp. 316–321.
- [2] N. Kishore, D. Marqués, A. Mahmud, M. V. Kiang, I. Rodriguez, A. Fuller, P. Ebner, C. Sorensen, F. Racy, J. Lemery *et al.*, “Mortality in puerto rico after hurricane maria,” *New England journal of medicine*, vol. 379, no. 2, pp. 162–170, 2018.
- [3] H. R. Council, “Promotion and protection of all human rights, civil, political, economic, social and cultural rights, including the right to development,” *UN General Assembly*, vol. A/HRC/32/L.20, June 2018.
- [4] “British computer society code of conduct,” British Computing Society, BCS The Chartered Institute for IT, First Floor Block D, North Star House, North Star Avenue, Swindon, SN2 1FA. [Online]. Available: <https://www.bcs.org/membership/become-a-member/bcs-code-of-conduct/>
- [5] “Research code of practice,” Univeristy of Warwick, University of Warwick, Warwickshire, CV4 7AL, United Kingdom. [Online]. Available: [https://www.warwick.ac.uk/services/ris/research\\_integrity/code\\_of\\_practice\\_and\\_policies/research\\_code\\_of\\_practice/](https://www.warwick.ac.uk/services/ris/research_integrity/code_of_practice_and_policies/research_code_of_practice/)
- [6] “Bluez: Official linux bluetooth protocol stack.” [Online]. Available: [www.bluez.org](http://www.bluez.org)