

Master Thesis:
Secure and stable communication over wireless networks
under heavy load

A Goal Document for a Master's Thesis work
by

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1 Introduction

When transmitting important data over a wireless connection it is important that the data arrives in a timely manner. The medias used in a network should meet all the requirements which the user imposes upon it. A dependency should be enforced upon all the components in a network to ensure the stability of the entire network.

2 Background and motivation

Uniti is a new company that is producing an electric vehicle that can be controlled remotely. For this purpose Uniti has expressed the need for a stable wireless communication link between their vehicle and peripheral devices, such as a tablet or laptop.

Today Uniti uses a UDP stream for communication between the vehicle and peripheral devices, this is not really ideal as UDP-applications most likely suffers from package-loss, errors, or duplication. This is fine for some applications such as media streaming, real-time multiplayer games, and such where package-loss is not critical.

Using TCP will provide ordered and error-checked delivery of data, however, the application might have to wait for retransmission of packages. This approach is not ideal as latency might cause issues when controlling the vehicle.

Furthermore, the media over which the communication is transmitted needs to be taken into consideration. Depending on the location, WiFi might not be available or stable enough. In such cases, could 4G be used instead? Or is 4G reliable enough to be used exclusively for this purpose? Reliable is in this case referring to low latency and low package loss.

3 Project aims and challenges

The goal of this thesis is to evaluate different mediums of wireless network transmission to and from a unit in motion. This includes implementing a wireless connection between the unit and different peripheral devices. This work involves certain research into different network protocols and wireless technologies such as 4G or WiFi.

The focus of the work will be to find a solution which results in a long range transmission with minimal latency and a minimal rate of packet-loss.

4 Approach and methodology

The majority of our thesis project will be put into implementing a wireless connection between Uniti's vehicle and a test platform which will help us evaluate our thesis.

The first part of our thesis project will be put into implementing a connection with the platform which their vehicle uses (Robot operating system), which will be implemented through the use of the package `roslbridge`.

Beyond this we will be able to implement a connection from the vehicle to a test platform through more conventional means.

Finally we will be able to substitute the different factors in our connection, such as medium and protocol, from the vehicle to the test platform with different mediums and protocols to test our thesis and in that achieve the goal we set.

5 Previous work

6 Advancements and Outcome

The outcome from this thesis work is made up of two parts, one practical and one theoretical.

The practical part consists of the connection implementation between Uniti's vehicle and the peripheral devices that will be based on the theoretical findings.

The theoretical part consists of the test-results from the different implementations of the connection between Uniti's vehicle and peripheral devices. The knowledge obtained from these tests could be used as a basis for decisions regarding implementation of wireless application and which protocol and connection media that should be used.

The theoretical knowledge used within this project will be rather easy to verify the success of, seeing as the implementation of the different protocols and integration with different wireless medias will provide feedback easily. Something that is harder to verify by oneself is whether or not a certain solution is safe in terms of network security or whether or not it is stable under heavy loads, as these things require larger experiments to verify.

7 Resources

We will work with our thesis at Uniti's office in Lund where Uniti will provide office space, workspace, and workstations. Uniti will also provide access to their test platform and their prototype car, with potential access to extra external hardware if needed.

During our thesis work, we will work by integrating our ideas into Uniti's current source code. Network tests and simulations will be performed with the help of Uniti's equipment.

References

- [1] Giuseppe Bianchi. Performance analysis of the ieee 802.11 distributed coordination function. 2000.

- [2] Les Owens Tom Karygiannis. Wireless network security. Technical report, National Institute of Standards and Technology, 2002.

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