CARLINK

UNIVERSIDAD DE MÁLAGA

Executive Overview

Title: D2.3.3-Problem 2. Optimal File Transfer Configuration (problem definition)

Summary: This report presents the definition of an optimization problem for the CARLINK project named *Optimal File Transfer Configuration*. The goal of this problem is to offer to the CARLINK consortium the optimal configuration of *VDTP (Vehicular Data Transfer Protocol)*, in order to obtain the best performance of this protocol.
The optimization problem has been solved using a combination of the optimization techniques and the VanetMobiSim/Ns-2 simulation tool.

Goals:

1. Establishing the parameters to configure the VDTP protocol.
2. Defining the problem of configuring VDTP protocol.
3. Showing how to solve the Optimal File Transfer Configuration problem.

Conclusions:

1. The obtained results of solving the Optimal File Transfer Configuration problem can assist the development of real file transfer software to be used for communication between the MEUs.

D2.3.3-Problem 2. Optimal File Transfer Configuration (problem definition)

CARLINK::UMA

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1 Introduction

The CARLINK project aims at providing a wireless platform for linking cars where there are two different kind of communications: on the one hand, the *MEUs (Mobile End User)* are linked with the *TSCU (Traffic Service Central Unit)* via the *TSBSs (Traffic Service Base Station)* to link wired and wireless networks; on the other hand, the MEUs exchange updated data with each other using only the ad-hoc operation mode of the IEEE 802.11b MAC Layer Standard, known also as *WiFi (Wireless Fidelity)* Standard. This communication is carried out by using *VDTP (Vehicular Data Transfer Protocol)* [2], a file transfer protocol defined specifically to be used in the ad-hoc communication between vehicles in the CARLINK project.

The VDTP protocol leads the ad-hoc data transfers, so the performance of this kind of communication is conditioned by the configuration of this protocol. In this deliverable, we present an optimization problem for CARLINK, called *Optimal File Transfer Configuration*. The goal of this problem is to obtain the configuration of the parameters which define the protocol in order to improve the performance offered for the communication between MEUs.

The optimization problem has been solved using a combination of the optimization techniques for searching the different solutions and the VanetMobiSim/Ns-2 to evaluate the performance of the VDTP by means of simulation.

In this first deliverable (D2.3.3), we give an introduction to the formal denition of this optimization problem. In the next one (D2.3.4), we will present how we solve the problem and the obtained results.

This document is organized as follows: in Section 2, we present a formal approach of this optimization problem. Next, in Section 3, we draw some conclusions about the Optimal File Transfer Configuration problem.

2 Problem definition

The VDTP protocol is the file transfer protocol used by the CARLINK consortium for transferring data between MEUs through ad-hoc multi-hop links. The quality of the service offered by this protocol is dependent on its configuration. We use optimization techniques and VanetMobiSim/Ns-2 to look for the best configuration, in order to provide the global CARLINK consortium with this optimal configuration. In the following, we present the VDTP protocol and how we solve the optimization problem.

2.1 The file transfer protocol

The VDTP protocol provides a reliable file transfer service for VANETs (Vehicular Ad-hoc NETworks). It is a connectionless protocol relying on a reactive ad hoc routing protocol [2].

The communication is carried out by a **file petitioner**, which want to download the file, and a **file owner**, which stores the file. Communication between the petitioner and the owner is carried out by using the following packets: *FIRQ (File Information Request)*, *FIRP (File Information Reply)*, *DRQ (Data Request)*, and *DRP (Data Reply)*.

When the file petitioner has the information about the name and the location of a given file, it starts the communication by using the FIRQ packet in order to obtain the file size. Then, the petitioner is waiting for the information coming from the file owner. This information is sent by the owner to the petitioner by using a FIRP packet. After receiving the information about the file size, the requester computes the number of segments in which the file will be split, dividing the file size by the **chunk size**. The petitioner starts the transfer by sending a DRQ packet asking for the first segment of the file; then it has to wait for the first data segment sent by the owner by using the DRP packet. This last operation will be repeated by both, the requester and the owner until transferring the last segment of the file (see Figure 1).

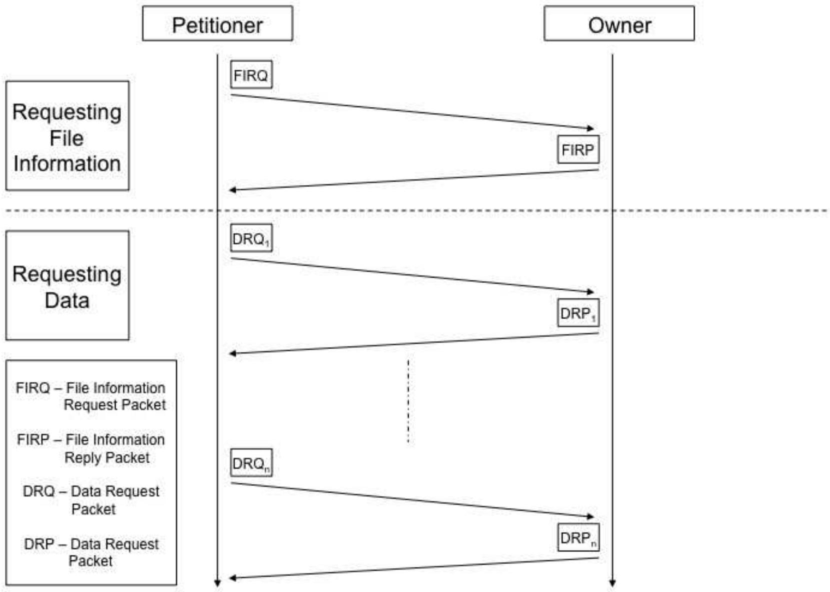

Figure 1: VDTP time diagram. The file is split in n chunks and it is successfully downloaded.

The file transfer can be carried out in a hostile communication medium, so there is a real possibility of packet lost. Therefore, VDTP offers some tools for solving problems concerning lost or delay packets using a timer and a counter. The timer controls the waiting time until a concrete DRQ or FIRQ packet has to be resent (**retransmission time**). Figure 2 shows an example about how the DRQ and the DRP packets are lost and after the time out they are retransmitted. The counter counts the number of DRQ or FIRQ packet resents, since after a specified number of retransmissions of the same DRQ or FIRQ (**maximum attempts**) the communication between the vehicles is refused (see Figure 3).

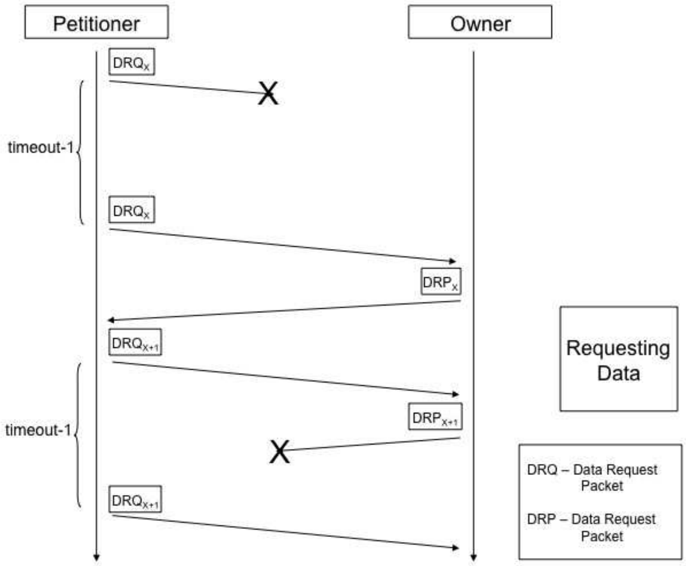

Figure 2: VDTP time diagram. There are lost packets: First, the DRQ_x packet is lost and is resent by the petitioner. After the data is received through the DRP_x. Second, the DRP_{x+1} packet is lost and the petitioner resent the DRQ_{x+1} asking again for the data.

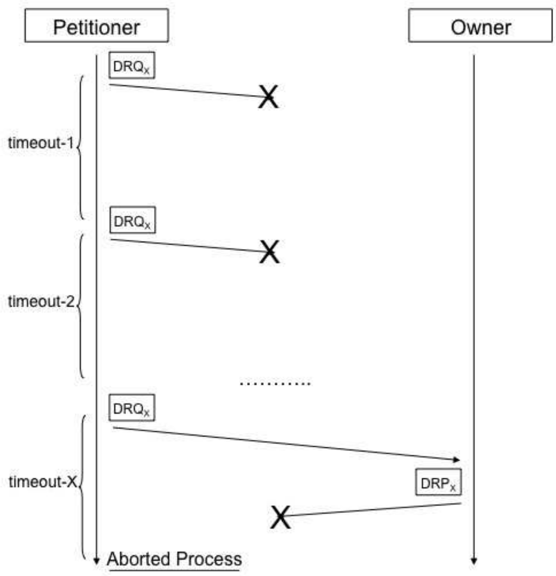

Figure 3: VDTP time diagram. After X retransmissions of the DRQ_x packet, the connection is refused (aborted process).

2.2 Problem resolution

"Many optimization problems of practical as well as theoretical importance consist of the search for a best configuration of a set of variables to achieve some goals" [1]. In this deliverable, we aim to offer the "best formed" VDTP configuration. This configuration is based on the three critical parameters which configure the protocol: the **retransmission time**, the **chunk size**, and the **maximum number of attempts** per chunk. For achieving that we combine two different tools: an optimization technique that is used to search the different feasible VDTP configurations and the Ns-2 to simulate a given scenario using the provided configuration by the optimization technique in order to evaluate the different parameters that define the performance of VDTP (see Figure 4). Ns-2 can be used since the VDTP protocol was already developed to be used over this simulator ([4], [5], and [6]).

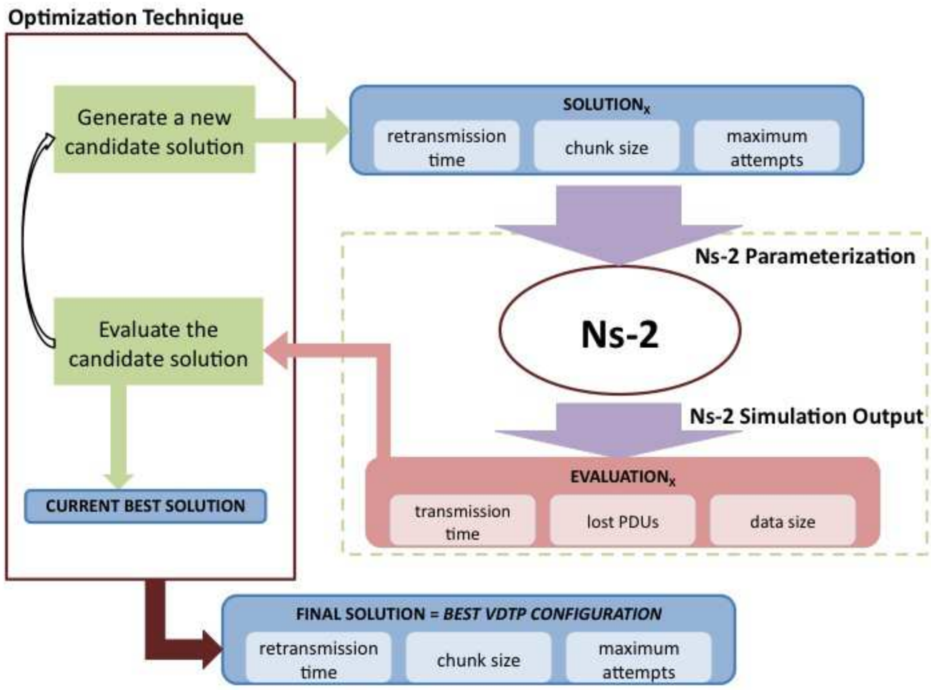

Figure 4: Representation of how the Optimal File Transfer Configuration problem is solved by using an *Optimization Technique* and $Ns-2$.

According to Section 2.1, the protocol configuration is defined by three different parameters: *chunk size*, *retransmission time*, and *maximum attempts*. Solving the problem *Optimal File Transfer Configuration*, we want to provide with an optimal VDTP configuration in order to achieve the performance for the file transferring data between vehicles by using the ad-hoc communication operation mode. The quality of service is measured in terms of the amount of data that can be sent (*data size*), the time that takes the file transfers (*transmission time*), and the number of the lost file chunks that have been to be resent (*lost PDUs*).

The parameters have different and large range values, thus it is necessary to use a optimization technique to compute the feasible optimal solution. The range of these parameters are the following:

- chunk size: integer values between **128 bytes** and **524288 bytes** (512 Kbytes)
- retransmission time: real values between **1 second** and **10 seconds**
- maximum attempts: integer values between **1 attempt** and **250 attempts**

We have located the simulation in a real area in Málaga. Thus, we use VanetMobiSim [3] for generating the complex simulation mobility model, where the vehicles move randomly according to the traffic rules with a velocity between 30 Km/h and 50 Km/h. The communication environment specification is defined by the different parameters summarized in Table 1.

Table 1: Test Parameterization

Number of MEUs	50
Link Layer: transceiver	PROXIM ORiNOCO PCMCIA (IEEE 802.11b)
Link Layer: antenna gain	7dBi
Routing Protocol	DSR (Dynamic Source Routing) [7]
Transport Protocol	User Datagram Protocol (UDP)
VDTP: chunk size	generated *chunk_size* by the Optimization Technique
VDTP: retransmission time	generated *retransmission_time* by the Optimization Technique
VDTP: maximum attempts	generated *maximum_attempts* by the Optimization Technique

3 Conclusions

This document presents the *Optimal File Transfer Configuration* problem which consists of selecting the best VDTP configuration in order to maximize the performance offered by the protocol. The number of possible configurations is very large, thus the problem of finding such a combination manually is very difficult. Therefore it is necessary to automatize the problem solving process.

The problem has bee defined by using a combination of two different tools which work together: an optimization technique, to generate the different feasible solutions, and the Ns-2 simulation tool, to simulate the configuration that has been returned by the optimization technique in order to evaluate it.

In the next deliverable, D2.3.4, we will present how the problem is solved applying different meta-heuristic techniques [1] to solve it. The obtained results can be applied by the CARLINK consortium to develop the file transfer protocol for transferring data between MEUs which compose the VANET.

Our general optimization framework constituted by the **Optimization Algorithm** + **Ns-2 Simulator** can be used to solve multitude of other optimization problems that can be found in the computer network domain.

References

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