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Informe Ejecutivo

TÍTULO: VANET-1.3-2009: Problema de la optimización de la transferencia de ficheros, *OFTC*, (definición)

RESUMEN: En este informe se define el problema de optimización de la transferencia de ficheros en redes vehiculares *Optimal File Transfer Configuration*. El objetivo es ofrecer la configuración óptima del protocolo *VDTP (Vehicular Data Transfer Protocol)*, para que el mismo presente el mejor rendimiento posible.
Este problema se ha resuelto empleando una combinación de técnicas de optimización (metaheurísticas) y el simulador de redes vehiculares VanetMobiSim/Ns-2.

OBJETIVOS:

1. Establecer los parámetros de configuración del protocolo VDTP.
2. Definir el problema OFTC de configurar el protocolo VDTP.
3. Presentar la estrategia seguida para resolver el problema OFTC.

CONCLUSIONES:

1. Los resultados obtenidos resolviendo el problema OFTC pueden ser empleados en el desarrollo de software para la comunicación entre vehículos.

RELACIÓN CON ENTREGABLES:

CO: VANET-1.0-2008 (simultáneo o aconsejable de leer)

Málaga, December 22nd, 2009

Executive Summary

TITLE: VANET-1.3 Optimal File Transfer Configuration problem (definition)

ABSTRACT: This report presents the definition of the *Optimal File Transfer Configuration* problem. The goal of this problem is to offer to 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 vehicles.

RELATION WITH DELIVERABLES:

CO: VANET-1.0-2008 (advisable reading)

Optimal File Transfer Configuration problem (definition)

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December 2009

1. Introduction

The use of IEEE 802.11 (*not cellular*) standards to deploy VANETs (Vehicular Ad hoc Networks) implies that vehicles communicate within a limited range while moving, thus exhibiting a topology that may change quickly and in unpredictable ways. In such kind of networks, it is crucial to provide the user with an optimal configuration of the communication protocols in order to increase the effective data packet exchange, as well as to reduce the transmission time and the network usage (with their implications on higher bandwidth and lower energy consumption). This is specially true in certain VANET scenarios in which buildings and distances discontinue communication channels frequently, and where the available time for connecting to vehicles could be really short.

In the present deliverable, we define the Optimal File Transfer Configuration (OFTC) problem in VANETs, which deals with the optimization of VDTP (*Vehicular Data Transport Protocol*) [2]. VDTP protocol leads the ad hoc data transfers, so the performance of this kind of communication is conditioned by the configuration of this protocol. The efficient protocol configuration for VANETs without using automatic intelligent design tools is practically impossible because of the enormous number of possibilities (*NP-problems*). This 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.

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 for transferring peer-to-peer information between vehicles 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 of this protocol. 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).

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).

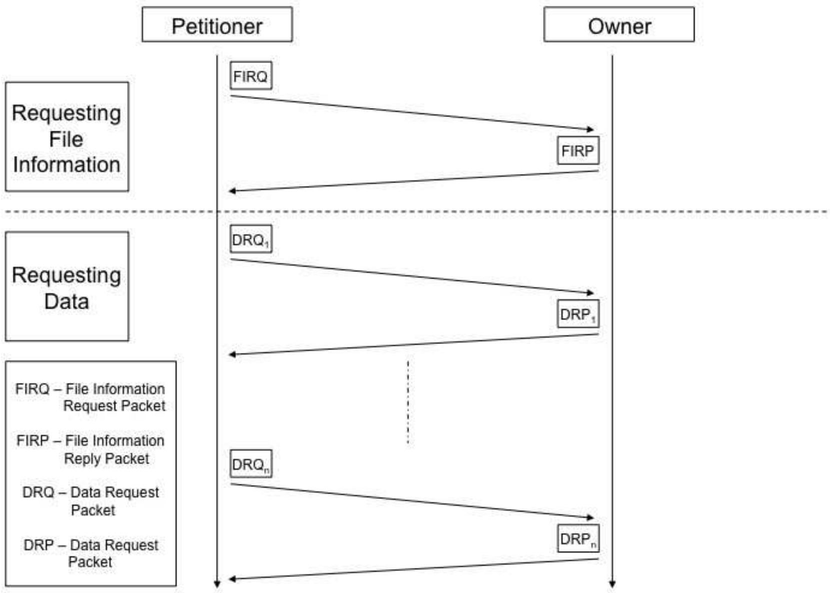

Figura 1: VDTP time diagram. The file is split in n chunks and it is successfully downloaded.

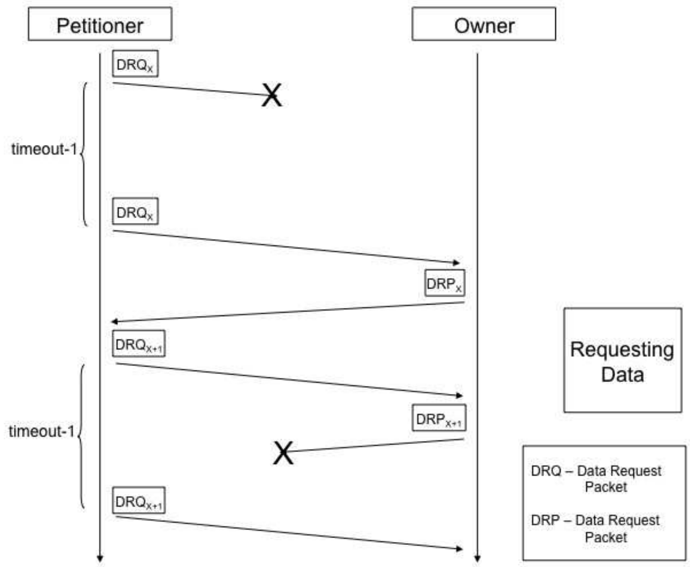

Figura 2: VDTP time diagram. There are lost packets: First, the DRQ_x packet is lost and is resent by the petitioner. After the data is received through the DRP_x. Second, the DRP_{x+1} packet is lost and the petitioner resent the DRQ_{x+1} asking again for the data.

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]).

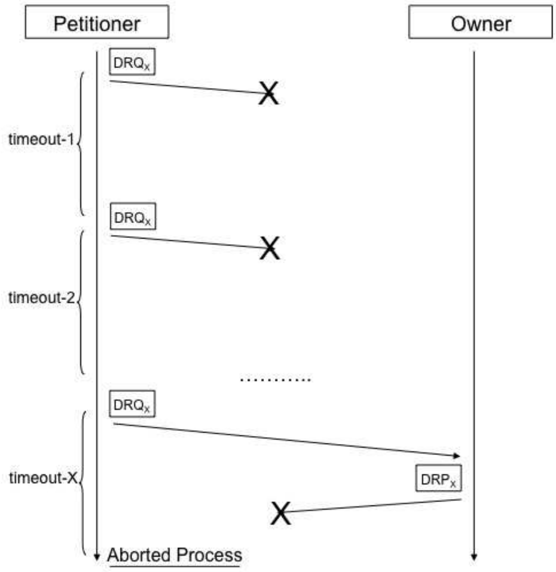

Figura 3: VDTP time diagram. After X retransmissions of the DRQ_x packet, the connection is refused (aborted process).

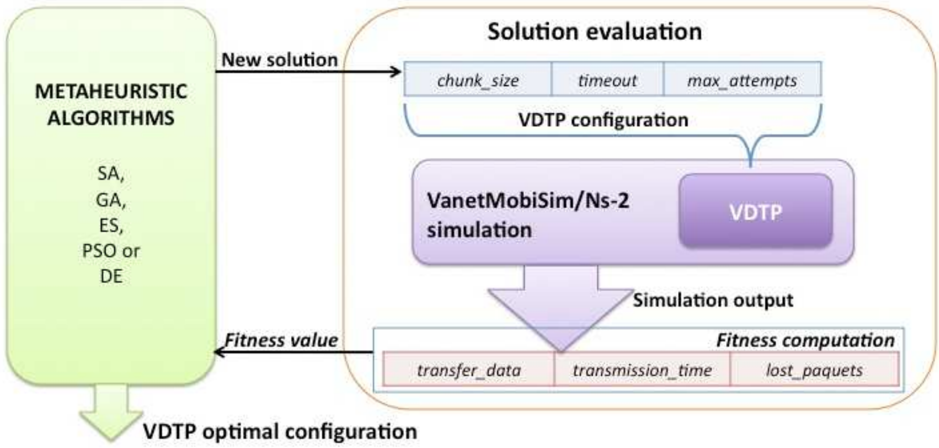

Figura 4: Representation of how the Optimal File Transfer Configuration problem is solved by using an $Optimization\ Technique$ and $Ns-2$.

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 real areas of Málaga. Thus, we use VanetMobiSim [3] for generating the complex simulation mobility model of two different scenarios (urban and highway). The communication environment specification is defined by the different parameters summarized in Table 1.

Tabla 1: Test Parameterization

Number of vehicless	30
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, we will present how the problem is solved applying different metaheuristic techniques [1] to solve it. 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.

Referencias

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