Executive Overview

Title: D1.3.3-Simulation and evaluation of the CARLINK-UMA scenario by using VanetMobiSim/Ns-2

Summary: This report presents the simulation results of the CARLINK-UMA scenario using VanetMobiSim/Ns-2 simulation tool. The results obtained during the simulations are interesting for the global consortium in order to know the behaviour of different VANETs' configuration before deploy them.

Goals:

1. Establishing the different experiments for simulating VDTP protocol.
2. Featuring the different simulation experiments for VanetMobiSim/Ns-2.
3. Simulation results analysis and comparison against the real world experiments.

Conclusions:

1. The obtained results during the simulation allow us to conclude that the ad-hoc operation model of the WiFi Standard may be an alternative to communicate MEUs directly.
2. The comparison between the results achieved during the simulations and the ones obtained during the real experiments allows us to conclude that VanetMobiSim/Ns-2 simulation tool is suitable for the CARLINK proposals.

D1.3.3-Simulation and evaluation of the CARLINK-UMA scenario by using VanetMobiSim/Ns-2

CARLINK::UMA

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1 Introduction

Vehicular Ad-hoc Networks (VANETs) are a special type of Mobile Ad-hoc Networks (MANETs), so both share the main characteristics (i.e., a distributed and self-organizing communication network or the mobility of the involved nodes). However, the higher mobility of the nodes and the limited degree of freedom in the mobility patterns in VANETs make standard networking protocols defined for MANETs inefficient or unusable in this kind of networks.

Vehicular Data Transfer Protocol (VDTP) [1] is a file transferring protocol defined specifically to be used in ad-hoc communication between Mobile End Users (MEUs) in the CARLINK project. These kinds of communications are considered mainly in the CARLINK-UMA scenario. The need of evaluating the behaviour of this protocol is interesting for the whole CARLINK project, because after these experiments it is possible to analyze its performance and to decide whether the service provided is reliable and efficient enough to use it for our proposals. The goal of this deliverable the analysis of the simulation results obtained when transmitting files between two MEUs connected by ad-hoc wireless mode using the VDTP. For carrying out the simulations, VanetMobiSim/Ns-2 simulation tools [4] have been used.

The obtained results are compared with the related real experiments performed at UMA [2]. This way, the realism of the simulation tool used can be analyzed as well.

The next sections aim at presenting the main aspects of these simulations and results analysis. The remainder of this report is organized as follows: Section 2 describes the simulation scenarios. Section 3 shows the results of different simulations. Finally, Section 4 presents the comparison real experiments and simulation results and finishing with the conclusions.

2 Simulation definition using VanetMobiSim/Ns-2

The simulation is defined using VanetMobiSim/Ns-2 simulator. VanetMobiSim is used to model the different characteristics of the simulation scenarios. The communication environment is defined using ns-2.

2.1 The scenario of experiments

This section outlines the scenarios to simulate. These ones represent the scenarios analyzed during the real experiments already performed at UMA [2]. The real test scenario consists of a bi-directional two lanes road segment, where there are two vehicles moving at 30 Km/h. Depending on the start and the final position, there are two different scenarios: **Scenario A** and **Scenario B**:

- The Scenario A (see Figure 1) reflects two MEUs (file owner and file requester) separated 30 meters far. They move through a lane in the same direction with a smooth acceleration and velocity around 30 Km/h.

- The Scenario B (see Figure 2) reflects the same two MEUs separated 500 meters far at first moving through a two-way road in opposite directions with a smooth acceleration and velocity around 30 Km/h.

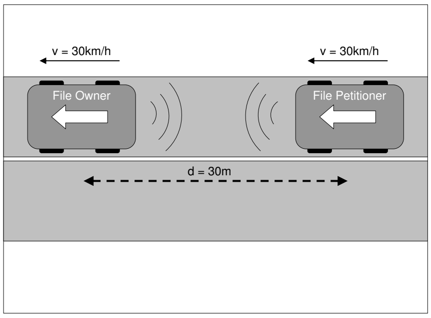

Figure 1: Scenario A

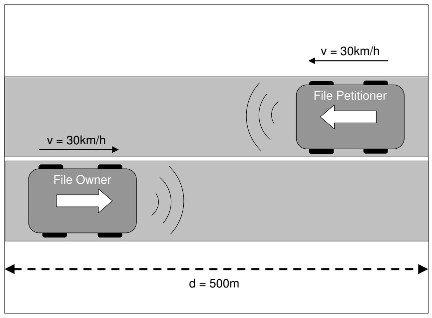

Figure 2: Scenario B

There are defined two different experiments for each scenario, depending on the size of the transferred file. The file type 1 is a 1 MB file that represents sample documents with traffic information and file type 2 is a 10 MB file that represents multimedia files. The experiments consist of **ten repetitions** of each transmission. These are named as follows: **TestA1**, **TestA2**, **TestB1** and **TestB2**. The letter describes the scenario and the number the file type.

2.2 Mobility model definition using VanetMobiSim

The simulation of the CARLINK-UMA scenario does not need a complex mobility model definition, since it is just composed by two MEUs which move straight on. These scenarios definition using VanetMobiSim can be summarized as follows:

- Macro-mobility features:
  - The road topology is *user-defined* by two vertex and *one lane* road for Scenario A and *two lanes* road for Scenario B.
  - The initial and destination points are defined by *attraction points*.
  - The trip is generated by activity sequence.
  - The road's speed limit is 50 Km/h.
- Micro-mobility features are defined by the *Intelligent Driver Motion* (IDM) [3] module of VanetMobiSim. The minimum speed is set to 7.5 m/s (27 Km/h) and maximum speed to 9.0 m/s (33 Km/h), trying to reflect real world where it is difficult that the cars maintain exactly the same velocity.

The visualization of the mobility model generated for Scenario A and Scenario B are shown in figures 3 and 4, respectively. The lines represent the road lanes and the letters (A and B) the MEUs.

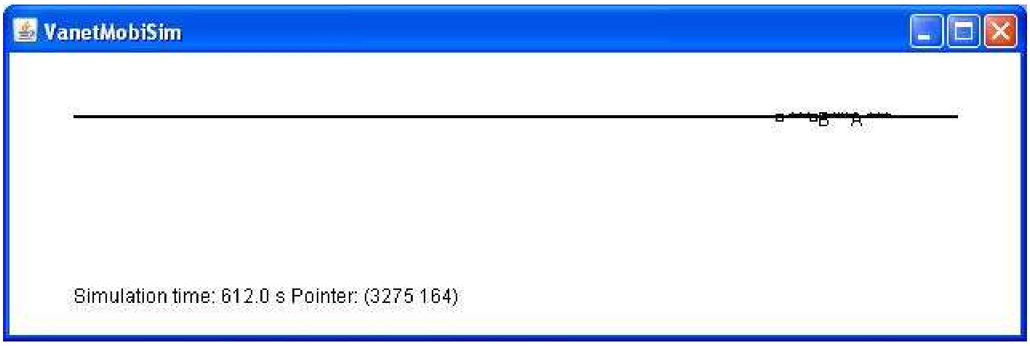

Figure 3: VanetMobiSim representation of Scenario A

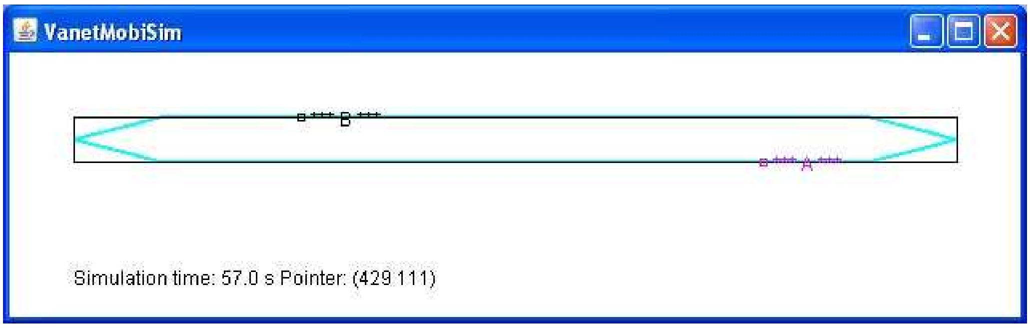

Figure 4: VanetMobiSim representation of Scenario B

2.3 Communication environment definition using ns-2

The communication environment defined using ns-2 has been parameterized in order to reproduce faithfully the real experiments of CARLINK-UMA scenario [2]. *PROXIM ORiNOCO PCMCIA transceivers*[1] were used by each MEU, working in the ad hoc operation mode of the IEEE 802.11b standard. These transceivers define the *physical* and *link* layer to use, the **IEEE 802.11b** standard provided by ns-2 as well. According to the values indicated in the technical specification of the ORiNOCO PCMCIA cards, the *signal strength* has been set to **12 dBm** and the *antenna gain* to **7dBi**. Note that some parameters of this protocol have been tuned in order to achieve the perturbations of the real world. The routing protocol used is **Ad Hoc On-Demand Distance Vector (AODV)** [5]. It is important to remark that the routing protocol does not pay a significant role in these scenarios, since there are only one-hop communications. VDTP [1] protocol is used over **UDP** transport protocol to make transfers between the MEUs. VDTP splits the file into chunks of a configurable size, in the simulations it has been set to 25 KB, following the configuration used during real experiments [2].

3 Result analysis

This section presents the results of simulating the experiments described above. After that, the primary results are explained.

Figure 5 shows the result of transferring one file of type 1 in Scenario A. The average transmission time is 1.679 seconds, with an average transmission rate equal to 609.886 KB/s.

[1] http://www.proxim.com

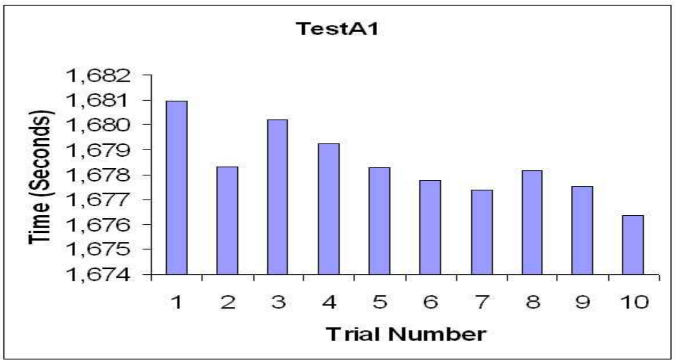

Figure 5: TestA1 results

Figure 6 shows the result of transferring one file of type 2 in Scenario A. The average transmission time is 16.757 seconds, with an average transmission rate equal to 611.087 KB/s.

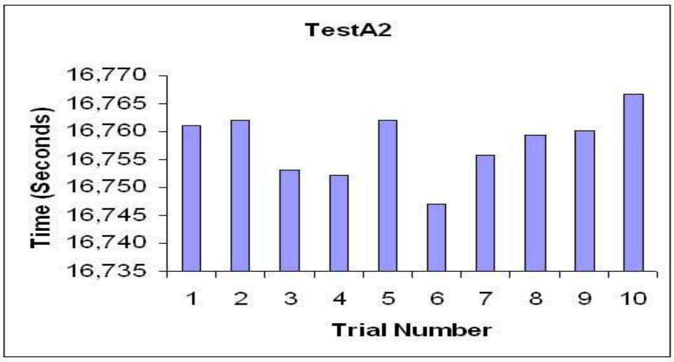

Figure 6: TestA2 results

Figure 7 shows the result of transferring one file of type 1 in Scenario B. The average transmission time is 2.154 seconds, with an average transmission rate equal to 475.181 KB/s.

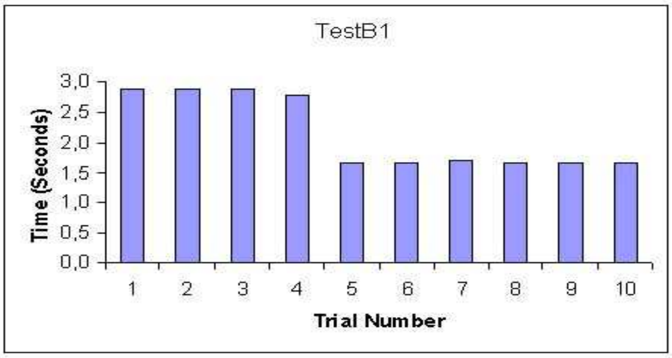

Figure 7: TestB1 results

Figure 8 shows the result of transferring one file of type 2 in Scenario B. The average transmission time is 19.945 seconds, with an average transmission rate equal to 513.341 KB/s.

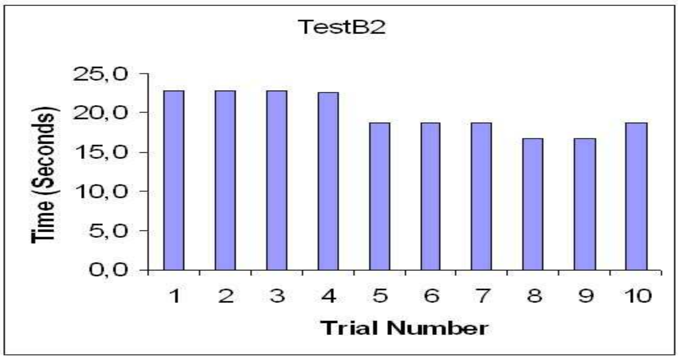

Figure 8: TestB2 results

Examining the figures 7 and 8, we find out that there are some large differences between the transmission times during the same test. The *standard deviation* capture these differences. During TestB1 the standard deviation value is **0.61** and during TestB2 is **2.51**. They are large for the result range values reflected in the mean values, **2.154** for TestB1 and **19.945** for TestB2. The reason of this is the dependence between the transmission time and the distance between the MEUs. When they are far the transmission time is larger than when they are close.

For the last experiment, TestB2, the speed of each MEU was reduced to achieve the results, because with the initial defined speed (30 Km/h), it is impossible to transfer any file of type 2 (10 MB) completely during the ten tests. The explanation is clear: according to TestA2 (Figure 6), the average time to transfer the file type 2 is equal to 16.757 seconds, and the connection between the MEUs remains during around 15 seconds in Scenario B (observed during the simulation). There is not enough time to transfer the file entirely when the MEUs' speed is 30 Km/h. However, this result shows that it is possible to transfer around 7 MB files in Scenario B.

Lost packages

An important measurement to analyze the performance of ad hoc communications is the percentage of lost packages, which in all the tests is **zero**. It means that during all tests zero PDUs have been lost. Which is an important issue in this kind of platforms.

Transmission rates

The average transmission rate for VDTP is 610,486 KB/s for Scenario A and 494,261 KB/s for Scenario B. They are quite low compared to the transmission rate of the IEEE 802.11b Standard defined for this kind of communications, 11Mbps. Therefore, for transferring small files no larger transmission rate is needed.

Data transferred

The data transferred using VDTP are received in order, since it is a stop-and-wait based protocol. The data is always correctly received, since there is not any lost package and the data is received in order.

Comparation between simulations and real tests

The comparison against the results of real experiments [2] is done because the simulation tool performance may be analyzed, too. The measure used consist on how close are the average transmission rates of each tests (showed in Figure 9). Seeing this figure, there are no significant differences between them, the transmission rates obtained during the simulations are close to the ones during the real tests. That is, VanetMobiSim/Ns-2 simulator operates correctly.

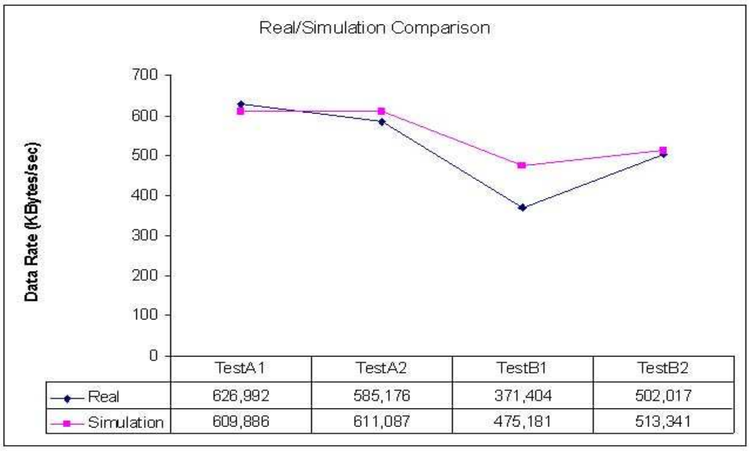

Figure 9: Comparison between real and simulation transmission rates

4 Conclusions

Analyzing the results of these simulations, we have observed that the application of the ad hoc operation mode of the IEEE 802.11b Standard for MEUs communication is possible. For this kind of communications, VDTP is a reliable protocol to use for transferring information between MEUs, because the files are correctly received.

The differences between the results achieved during Scenario A and Scenario B show the importance of the MEUs position during the communication; that is, the importance of choosing the best MEU as a information source. The MEU with the same direction is the best choice to transfer and receiver some information.

The purposed simulator, VanetMoviSim/Ns-2, has achieved results close to the real experiments ones. This aims at it may be used during the whole CARLINK project.

References

[1] CARLINK::UMA. D2006/10 - VDTP: A file transfer protocol for vehicular ad hoc network. Technical report, University of Malaga, Spain, 2006.

[2] CARLINK::UMA. D2006/8 - VDTP performance evaluation: An outline of the real experiment. Technical report, University of Malaga, Spain, 2006.

[3] CARLINK::UMA. D1.3.1-VanetMobiSim: The vehicular mobility model generator tool for carlink. Technical report, University of Malaga, Spain, 2007.

[4] CARLINK::UMA. D1.3.2-VanetMobiSim/Ns-2: A VANET simulator for CARLINK. Technical report, University of Malaga, Spain, 2007.

[5] Ch. E. Perkins, E. M. Belding-Royer, and S. R. Das. Ad hoc On-Demand Distance Vector (AODV) Routing. RFC Experimental 3561, Internet Engineering Task Force, July 2003.