UNIVERSIDAD DE MÁLAGA

Executive Overview

Title: D2.2.5-MEUs ad-hoc communications performance evaluation in highway scenarios (DYNAMIC tests in the CARLINK-UMA scenario)

Summary: This deliverable aims at evaluating the performance of the WiFi standard in a highway itinerary.

Goals:

1. Description of the experiments.
2. Performance analysis and evaluation of the WiFi equipment at UMA. The analysis contains:
   - One-hop communications.
   - Ad-hoc operation mode (car-to-car).
   - Dynamic nodes in a highway scenario.

Conclusions:

1. The test reveals that is possible to transfer files in a highway scenario when the cars are separated up to 100 m and their speeds are from 50 Km/h to 90 Km/h.
2. The high speeds reached at highways produce low data rates (0,011 MB/s - 0,014 MB/s) since the 802.11b/g standard was not designed for vehicular environments. It is advisable to transmit only small amounts of data under these conditions.

D2.2.5-MEUs ad-hoc communications performance evaluation in highway scenarios (DYNAMIC tests in the CARLINK-UMA scenario)

CARLINK::UMA

February 28, 2008

1 Introduction

The CARLINK project aims for providing protocols and applications in order to establish wireless interconnection among cars. The main objective of CARLINK is to provide a platform for the connection and communication among cars which circulate through different scenarios such as: city, highway, etc. This connectivity allows the cars to broadcast useful information to the drivers (such as traffic or weather information), it could also allows them to share information and even run distributed (e.g. multiplayer videogames). We use the ad-hoc operation mode of the WiFi standard to offer car-to-car communications. We want to measure the performance of this standard for the CARLINK project.

In the UMA deliverable D2.2.4 [5], we analyzed the performance of the Senao router [4] in an urban scenario. In this deliverable, we study the performance of the ad-hoc communications registered in cars traveling through a highway itinerary. Compared with the urban scenario, the difficulty of this experiment lies mainly in the high mobility of the devices.

Figure 1 shows the different milestones of all the UMA work scheduling, emphasizing with an ellipse this one. This deliverable is associated to the Work Package 2 (*Wireless Traffic Service Platform*) in the task 2.2 (*Platform Definition*).

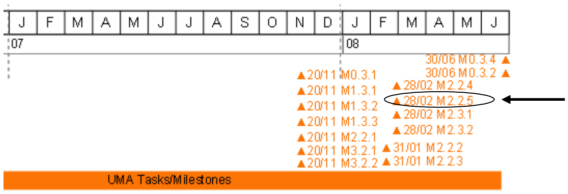

Figure 1: The UMA time tabling scheduling shows the milestone of all our planed deliverables. This deliverable is marked within an ellipse

This deliverable is structured as follows: In Section 2 we report all the experimental results, and finally, the conclusions of this work are drawn in Section 3.

2 Experiments

For our experiment, two cars are equipped with laptops connected to the router described in [4]. Both cars are connected throw the WiFi ad-hoc standard (we can see in [2] a discussion about the use of WiFi ad-hoc as an alternative for MEUs communication). This technology is considered in CARLINK [1], mainly when transmitting critical car to car data between two MEUs. Both cars traveling across a highway itinerary (see Figure 2). This route placed in Malaga, covers an area of approximately 12 Km. Figure 3 illustrates a capture during the travel (3a) and the equipped hardware inside the cars (3b).

Figure 2: Itinerary track

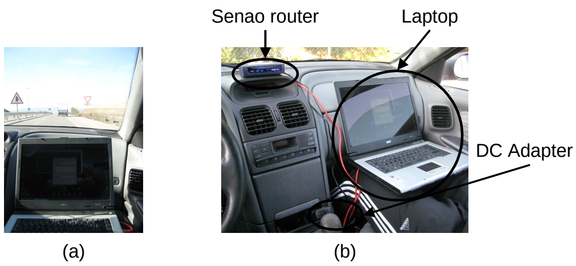

Figure 3: (a) A snapshot during the itinerary. (b) The equipped hardware is placed inside the cars

Table 1 shows the parameterization of the tests. We compare the obtained results by transferring four times a file with 1 MB size (filled with random dummy content). The distance between the cars during the travel is not constant and oscillates between 2 m and 50 m. We use the output tracking information given by the GPS for recording the cars speed, which is between 50 Km/h and 90 Km/h. The selected software for carrying out the experiments is the Finding and Sharing Files (FSF) [6] application. This program has been developed at UMA, and its goal is sharing files in an ad-hoc network. FSF shows statistical data (i.e., transmission time, number of sent packets, number of lost packets...) after each file transmission. The communication protocol used in this application (VDPT [3]) splits the file into chunks of 25 KB (this parameter is also configurable).

Table 1: Test parameterization

Equipped network hardware	Senao router NCB-3220
Wireless Ad hoc Application	FSF [6]
WiFi Standard	802.11b/g
File size	1 Mb
Distances	2 m - 100 m
Speed	50 Km/h - 90 Km/h
Chunk file size	25 KB
Number of trials	4

Figure 4a shows the obtained download rates in the four independent trials. We can see that the rates are between 0,011 MB/s and 0,013 MB/s, so it is necessary 76 seconds at least for transferring 1 MB file (the number of trials is so low because of this). The resulting average value is 0,012 MB/s, representing the 0,17% of the maximum theoritical value (6,75 MB/s) of the IEEE 802.11g standard. This way, it is clear the high fall in the performance under these conditions. Figure 4b presents the percentage of lost packets in each trial. To emphasize the last transmission, with a 19,08% of lost packets. However, this high percentage of lost packets does not influence much in the rate because the timeout value (2 seconds) is very similar to the required time for transmitting one data package (between 1,5 s and 1,8 s according to the range of download rate values).

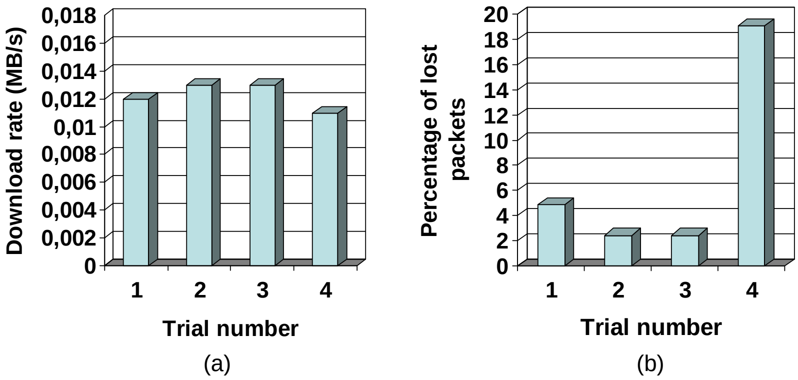

Figure 4: Download rates (a) and percentage of lost packets (b) during the different trials

3 Conclusions

This deliverable aims at evaluating the real performance of the WiFi router equipment at UMA. All the transferences have used the ad-hoc of the IEEE 802.11b/g protocol, considering one-hop communication between the devices. Unlike the static test deliverable D2.2.2 [4], this time the devices were in movement, traveling across a highway itinerary. Because of the download rates obtained (lower than 0,014 MB/s), only four transferences were finished during the travel. We must noticed that the IEEE 802.11b/g protocol is not designed for working with mobile devices neither vehicle environments, and in this case, the cars are moving at high speeds (up to 90 Km/h). This way, because of the low download rates obtained in the experiments, it is only advisable to transfer very low amounts of data in these conditions.

References

[1] CARLINK. CARLINK D2.1 - Architecture definition. CARLINK consortium, September 2007.

[2] CARLINK::UMA. CARLINK::UMA D1.3.4- Simulation of the CARLINK-UMA scenario by using jane. University of Malaga, November 2007.

[3] CARLINK::UMA. CARLINK::UMA D2006/10 - VDTP: A File Transfer Protocol for Vehicular Ad hoc Network. University of Malaga, November 2006.

[4] CARLINK::UMA. CARLINK::UMA D2.2.2- WiFi router performance evaluation using one-hop communications. University of Malaga, November 2007.

[5] CARLINK::UMA. CARLINK::UMA D2.2.4-MEUs ad-hoc communications performance evaluation in urban scenarios (DYNAMIC tests in the CARLINK-UMA scenario. University of Malaga, February 2008.

[6] CARLINK::UMA. D3.2.2 Design and Implementation of CARLINK Wireless ad-hoc applications: Finding and Sharing Files. University of Malaga, October 2007.