Executive Overview

TITLE: D2.2.2 - WiFi router performance evaluation using one-hop communications (STATIC tests in the CARLINK-UMA scenario).

SUMMARY: This deliverable describes the evaluation of the WiFi equipment used in UMA for the CARLINK project. The experiments consist of transferring files between two cars placed in fixed positions (considering different distances between them).

GOALS:

1. Outline of the equipment.
2. Description of the experiments.
3. Performance analysis and evaluation of the WiFi router used at UMA scope. The analysis contains:
    - One-hop communications.
    - Ad-hoc operation mode.
    - Static nodes.

CONCLUSIONS:

1. The analyzed hardware is able to transfer data at reasonable speeds being the static devices separated for up to 100 meters in a line of sight (LOS) scenario.
2. The high output power of the router allows to obtain enough signal coverage for avoiding to lose any data packet up to 20 meters. When the devices are separated by 100 meters, the probability of losing packets is very low (0.14%).

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CARLINK::UMA

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1 Introduction

The CARLINK project aims at providing protocols and applications in order to establish wireless ad-hoc interconnection between cars constituting VANETs. The main objective of CARLINK is to provide a platform for the connection and communication between 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 applications (e.g. multiplayer videogames). The devices located in cars should be able to communicate with one another directly or using a Traffic Service Base Stations (TSBS).

The main goal of this deliverable consists of evaluating the performance of the hardware devices used in UMA for the CARLINK project. In the technical report [6], we discussed about the most appropriated communication technology to be used in the project. Among other reasons, we have selected the WiFi technology (considered in [2]) since it is free band and the availability of low cost hardware. This way, all the hardware is based on the IEEE 802.11(b/g) standard.

Figure 1 shows the different milestones of all projected the UMA deliverables, 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: UMA time tabling scheduling

This document is structured as follows: Section 2 presents the WiFi equipment used for the performance evaluation. In Section 3, we report all the experimental results, and finally, the conclusions of this work are drawn in Section 4.

2 Hardware Description

This section describes the hardware used for the experiments. In Deliverable 2.2.1 [5], we analyzed the performance of the wireless Orinoco Card[1] together with a range extender antenna. In this case, we include a wireless router: Senao NCB-3220[2]. Its main characteristics are showed in Table 1.

Table 1: Hardware Characteristics

Device	Characteristics
Senao Wireless Router NCB-3220 	• Transfer rate up to 54 Mbps • Support point-to-point, point-to-multipoint bridge connections • Max. Transmit Power 26 dBm • Receive sensitivity -70 dBm
DC car lighter adapter 	• 1-12V voltage • Up to 2000mA intensity

One of the main advantages of using the NCB-3220 router is the transmission power, since, with a maximum value of 26 dBm, it performs quite better than Orinoco. In addition, a range extender antenna is not used in this work, but the default one included with the router. Since the router has not an autonomous battery, we use a power DC adapter for connecting it to the lighter of the car. Another advantage of this router with respect to the Orinoco card is the possibility of connecting several devices to a single router. Thus, it is possible to create a private network inside of a single car which contains several WiFi devices.

3 Experiments

The experiments consist basically of transmitting files between two cars placed in fixed positions. Inside of the cars, the laptops communicate by means of the Senao router (see Figure 2). That is, we only consider an ad-hoc communication between the two terminals in a static environment (we can see in [3] a discussion about of using the WiFi ad-hoc as an alternative for MEUs communication).

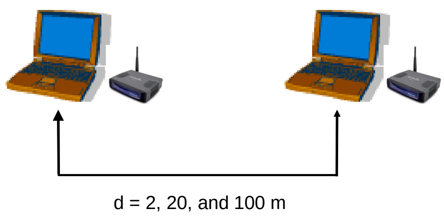

Figure 2: The laptops are equipped with routers in fixed positions. We consider three distances for the experiments: 2 m, 20 m, and 100 m.

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

Three types of files with different sizes were used to test the transference between (cars) devices: 1Mb, 5Mb and 10Mb. The cars (with the routers inside) will be placed in a parking (see Figure 3a). We consider a line of sight (LOS) environment, so there are no obstacles between the cars.

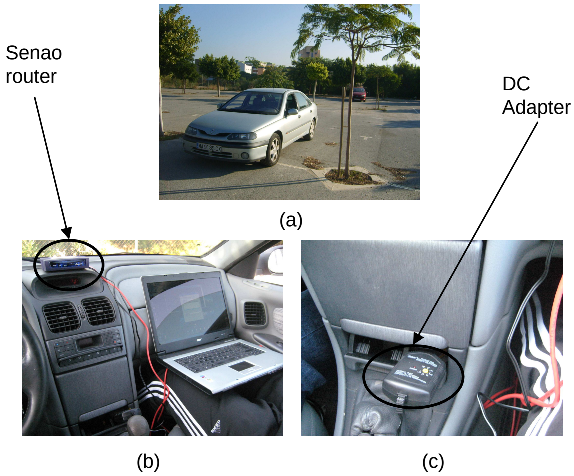

Figure 3: a) The parking scenario b,c) The routers and DC adapters are placed inside of the cars

Table 2 shows the parameterization of the tests. We compare the obtained results by transferring 15 times the files in each scenario. Three different distances are considered for separating the laptops: 2 m, 20 m and 100 m. The selected software for carrying out the experiments is the Finding and Sharing Files (FSF) [7] 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 send packets, number of lost packets,...) after each file transmission. The communication protocol used by this application (VDTP [4]) splits the file into chunks of 25 KB (this parameter is also configurable).

Table 2: Test parameterization

Equipped network hardware	Senao router NCB-3220
Speed of the devices	0Km/h (static tests)
Wireless Ad hoc Application	FSF [7]
WiFi Standard	802.11g
File sizes	1 MB 5 MB 10 MB
Distances	2 m 20 m 100 m
Chunk size	25 KB
Number of trials	15

Table 3 shows the results of the tests. We present two values for each configuration (file size and distance): the best download rate among all the file transfers (Best column) and the average download rate (Avg column) in MB/s. The highest rates are obtained when the cars are separated by 2 m. When we increase the distance (20 m and 100 m), both average and best download rates decrease clearly. This fact is shown in Figure 4 where is evident to observe the notorious fall from 20 m distance.

Table 3: Results in terms of best value and average of the download rate obtained in MB/s, according to each file size and distance configuration

	2m		20m		100m	
File size	Avg	Best	Avg	Best	Avg	Best
1Mb	0.79	0.90	0.47	0.5	0.31	0.34
5Mb	0.71	0.76	0.45	0.48	0.26	0.29
10Mb	0.54	0.63	0.40	0.44	0.23	0.26

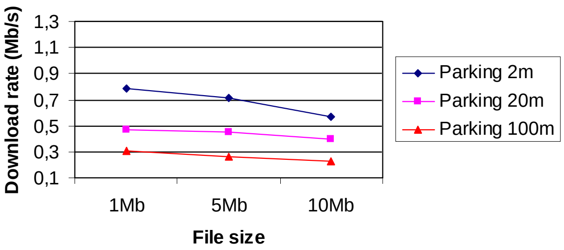

Figure 4: Average download rates considering different distances and file sizes

Figure 5 shows the average number of lost packets in each scenario. None packet is lost up to 20 m distance. Moreover, when the devices are separated by 100 m, it is possible to lose packets, but the average number is always lesser than 1, being the percentage of lost packets of 0.14%, 0.06% and 0.22% in the 1 MB, 5 MB and 10 MB files, respectively. In the 10 MB file, the number of lost packets is higher because the application needs to split this file in more chunks than in the other files (1 MB and 5 MB).

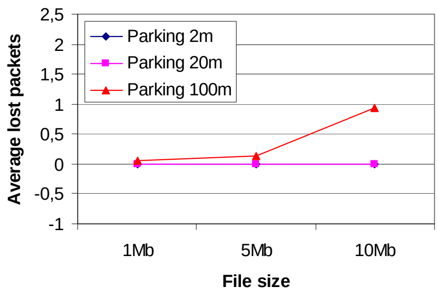

Figure 5: Average of lost packets considering different distances between the devices and file sizes

4 Conclusions

This deliverable aims at evaluating the real performance of the WiFi router equipment at UMA. All the communications have used the ad-hoc operation mode of the IEEE 802.11g protocol (considered in CARLINK [1] for transmitting critical car to car data between two MEUs), and the terminals were placed in fixed positions. The tests reveal that it is possible to transfer files between two terminals separated up to 100 m without obstacles. An important result is the low probability of losing packets, (up to 20 m none packet is lost and in 100 m the probability is very low (0.14%)). The resulting download rates (0.23 MB/s - 0.76 MB/s) are enough for transmitting low amounts of data (shorter than 1 Mb) in reasonable times.

References

[1] CARLINK. CARLINK D2.1 - Architecture definition. Chapter 1: Physical platform overview. CARLINK consortium, September 2007.

[2] CARLINK. CARLINK D2.1 - Architecture definition. Chapter 5: Communications technologies. CARLINK consortium, September 2007.

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

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

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