Influence of digital systems based on a deterministic channel characterization on Ad-hoc network routing

Ruddy DELAHAYE, Anne-Marie POUSSARD, Yannis POUSSET and Rodolphe VAUZELLE

Signal Image et Communication (SIC), FRE-CNRS 2731, Université de Poitiers (UFR SFA)
Bât SP2MI – Téléport 2 – Bd Marie et Pierre Curie, BP 30179, 86962 Futuroscope Chasseneuil Cedex (FRANCE).
Phone : (+33) 5 49 49 74 86, Fax : (+33) 5 49 49 65 70
E-mail: {delahaye, pousset, poussard, vauzelle}@sic.sp2mi.univ-poitiers.fr

Abstract: *The aim of this paper is to study the influence of different digital transmission chains based on Wifi systems (norm 802.11) on Ad-hoc network routing. To simulate an Ad-hoc network we have developed a simulation platform. This last one uses digital systems based on a deterministic channel characterization. This characterization is provided by a 3D ray tracing tool to quantify each radio link by the resulting BER (Bit Error Rate). Finally, we represent the studied Ad-hoc network by a connectivity graph and obtain routing results thanks to the Dijkstra algorithm.*

Keywords: Ad-hoc network, Deterministic channel characterization, Digital transmission chain, Bit Error Rate, Dijkstra algorithm.

1. INTRODUCTION

Nowadays, an increasing interest is devoted to wireless network. Ad-hoc networks [1] represent an interesting alternate to current wireless networks, because we can deploy them quickly. Indeed, there are no centralized infrastructures to connect each mobile : they communicate directly each other. Nevertheless, this lack of infrastructures involve problems and notably in Ad-hoc network routing.

Firstly, we describe the Ad-hoc network simulator used to create the studied scenario in a 3D realistic environment. Secondly, we present the realistic cost functions associated to different digital systems. Thirdly, we introduce the propagation tool allowing to obtain the deterministic channel impulse response between two mobiles in the considered environment. Finally, we illustrate the first obtained results and we describe the results will present in the final paper .

2. AD-HOC NETWORK SIMULATOR : AdNS

AdNS allows to simulate a complete Ad-hoc network. The first step consists in the creation of the studied scenario. The second one is associated to the simulation execution and the last one to the analysis of the results.

2.1. Creation of the scenario

First of all, we can choose a real 3D environment. In this area, we define the initial position, route and speed of each mobile. Each trajectory can be cyclic or not and is composed of several points called checkpoints. Mobile's speed can be changed at each checkpoint. Figure 1 illustrates a complete scenario with six mobiles in the campus of Poitiers's University.

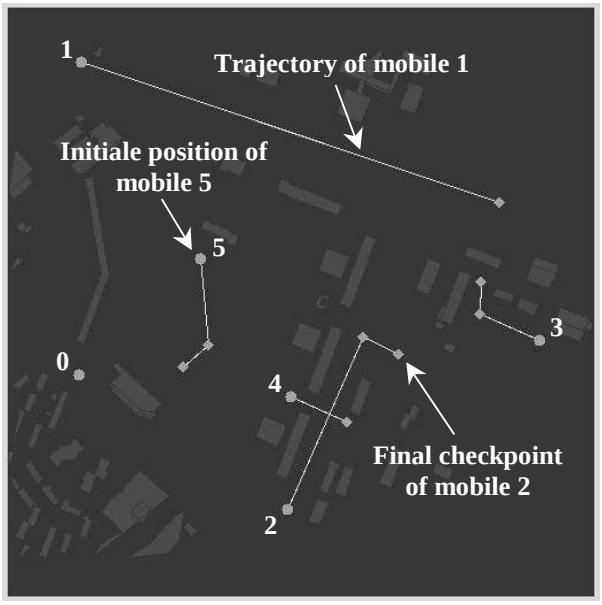

Figure 1: AdNS scenario interface illustration

Secondly, we define the global parameters necessary for the scenario simulation :

- The sample time representing the elapsed time between two successive iterations during the simulation.
- The number of iterations associated to the scenario simulation.
- The cost function detailed in the next section and its necessary parameters used to evaluate the quality of each radio link in the network.

2.2. Simulation

During the simulation execution, the simulator evaluates at each iteration :

- The real positions of mobiles according to their trajectories, speeds and also the sample time.
- The value of each radio link using the cost function previously chosen. According to this last one, we can used for example a specific digital system and initialized this value by the resulting BER (§3).

2.3. Results analysis

AdNS creates a connectivity graph corresponding to the scenario. Each node represents a mobile and each edge is equal to the cost function resulting value. We can choose a transmitter in the network. At last, the Dijkstra algorithm determines the optimal path between transmitter and a given receiver for each iteration. Consequently, AdNS enables to follow the optimal path evolution, as shown the Figure 4 in the last section.

3. REALISTIC COST FUNCTIONS

The aim of the cost function is to evaluate the quality of each radio link existing in the network at each iteration. Radio links can exist or not according to the network topology and the fixed power dynamic. Different cost functions taking into account the studied environment can be used. We consider for this study different realistic cost functions associated to different digital systems based on 802.11 norms (Wifi). These systems use the deterministic channel impulse response described in the next section and quantify the radio link thanks to resulting BER.

4. DETERMINISTIC CHANNEL CHARACTERIZATION

This characterization is calculated by a propagation tool. This last one combines a ray tracing computing technique and a frequency asymptotic method. It determines not only the narrow band attenuation but the physical impulse channel response between a given transmitter and receiver in the considered environment, as shown the Figure 2.

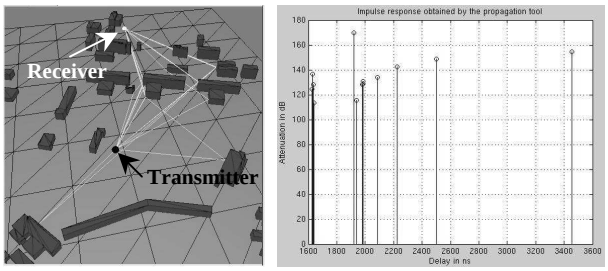

Figure 2: Propagation tool interface and resulting impulse channel response

5. FIRST RESULTS

In this section we present the first routing results obtained with the scenario presented on Figure 1 and the digital transmission chain illustrated on Figure 3. This last one is based on the physical layer of the 802.11b norm [2]. Its channel is simulated by a Tapped Delay Line (TDL) filter using the deterministic channel impulse response calculated by the propagation tool.

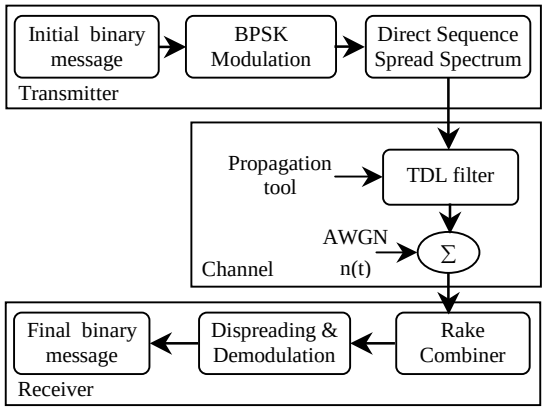

Figure 3: Digital transmission chain example

If we consider 8 iterations and a sample time equal to 10 seconds, we obtain the results illustrated on Figure 4. We can see the multi-hops aspect and the evolution of the optimal path between the transmitter (mobile 0) and the receiver (mobile 3).

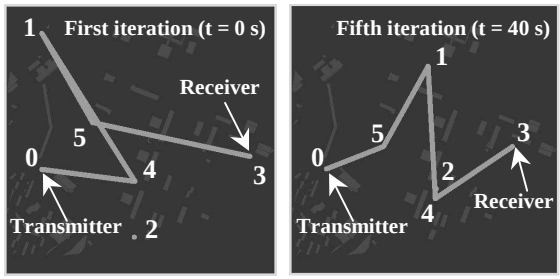

Figure 4: Results for two different iterations

In the final paper, we will present a comparative study of different digital Wifi systems on Ad-hoc network routing. To conclude, we will notably show the influence of the different modulation used in these systems, like BPSK, QPSK, CCK and OFDM, on Ad-hoc network routing results.

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