

Simulation of Wireless Networks

Project description

DRAFT

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Abstract

Wireless LANs get more and more important. Especially the wireless LANs in ad hoc mode open up new possibilities. Although many people use them, there is no deep understanding of its possibilities yet. This simulation should reveal some new insights about wireless LANs in ad hoc mode, and also provide a test bench for developers of the protocols B.A.T.M.A.N. and olsr-ng.

1 Introduction

Computer networks range from small home networks over local area networks (LANs) in companies to wide area networks (WANs) connecting cities.

Specially in the smaller networks (homes and companies) there is a tendency to use wireless LANs instead of wired networks. Currently wireless networks are not as fast as wired ones, but for most use cases they are sufficiently fast. The main advantage to wireless communication is its easy installation. There is no need for cost intensive laying of wires and moreover they provide an increase of mobility for the users.

The most common standard used for wireless LANs is IEEE-802.11. All modern mobile computers are equipped with wireless cards operating on that standard and there exist a lot of cheap other devices (e.g. access points).

Wireless LANs can be set up in two different modes. The most common is the infrastructure mode. This one has some similarities with mobile phone networks. There are special devices, call access points, managing the complete communication. This way the communication is done the most efficient way. All wireless devices (e.g. laptops) have to connect to these access points.

The second mode is the ad hoc mode. In this mode no access points are needed and all devices have equal rights. There are no central points where the transmission scheduling is done. Organizing the transmissions has to be solved in a distributed fashion. Due to that fact, the ad hoc mode does not perform as well as the infrastructure mode. On the other hand it has the advantage that it does not need any extra access points or other management devices.

2 Project description

This simulation deals only with wireless networks in the ad hoc mode. It provides a model of wireless LANs, which is as realistic as possible. The results from the simulation should be as close to a real world network as possible.

All commonly used protocols of the IEEE-802.11 family are supported. This includes 2,4 GHz as well as 5 GHz protocols. IEEE-802.11 covers protocols for both, layer 1 (physical layer) and layer 2 (data link layer). Both layers are included in the simulation. Any upper layer communication is outside this simulation.

The simulation captures all important properties of WLANs. This includes visibility and interference ranges of devices, multi channels, packet loss as well as collisions of packets.

3 Project goals

There are three main goals of the simulations.

- **Deeper insights**
The simulation should reveal new insights of ad hoc networks. It should provide a better understanding of what can be expected from WLANs.
- **Test bench**
Currently it is hard to test layer 3 routing protocols in a realistic environment. There exists no simulation method which is sufficient. The simulation should provide a realistic test bench for these protocols.
- **Network optimization**
The simulation should show how the network behaves if nodes or links are added or remove. It should reveal bottlenecks and optimization possibilities.

4 Simulation design

The main part of the simulation is developed as a demon for linux systems. Although the code is held as portable as possible, the main target system is linux. The interface to upper layer are stream devices (e.g. named pipes). They can either be used directly or are used in combination with virtualization tools (e.g. VServer, QEmu).

The simulation is started with a configuration file defining the network and all properties of the links. During run time there is a management interface for dynamic changes in the network and its properties.

The internal time of the simulation is split up in discrete time stamps. It is possible to run the whole simulation with a virtual time as long as the upper layer applications support this behavior. If they do not, then the simulation can also be run in real time. In this case all time stamps are synchronized to the clock of the operating system.

The simplest network exists of some nodes and links between them. For more realistic networks it is possible to define the following additional parameters:

- separate bandwidths for unicast and multicast
- probability of packet loss due to external noise
- different links for transmissions and interferences

The simulation automatically takes care of collisions of packets. If packets are send in multicast mode, they are lost, in unicast they are resent several times.

5 Network editor and visualization

The network editor provides a graphical user interface for setting up networks. The nodes can be drawn on a geographical map. Links between nodes can either be created manually or automatically depending on a transmission radius of the nodes. All other properties of links (e.g. bandwidths, packet loss) can be set individually.

Moreover the editor also serves as a visualization tool. While the simulation is running, different properties (e.g. airtime, collision statistics) of nodes and links can be displayed and investigated.