
Mobile Communications

FEUP

Network Simulation - WiFi

Objectives of the Project

- ◆ To study the performance of wireless network (WiFi) scenarios using discrete event simulation techniques
- ◆ Using the network simulator ns-3
 - » <https://www.nsnam.org/>

Install and start using ns-3

- ♦ Install VMware or VirtualBox in your computer
- ♦ Install Ubuntu as a virtual machine and build ns-3 within Ubuntu
- ♦ You may use 2 alternatives
 1. Download and run the Ubuntu-COMO image available at the netlab (via moodle)
 - includes compiled ns-3 software and examples
 2. Do it by yourself
 - Download the latest version of Ubuntu and update it
 - `sudo apt-get update ; sudo apt-get build-essential`
 - Install Python
 - Build ns-3 according to the ns-3 installation recommendations
 - Copy the provided examples (available in Moodle) to the scratch folder
- ♦ Study the provided examples (one example for each study)
- ♦ Additionally, you may also study other ns-3 tutorials
- ♦ Look at the ns-3 modules related to our course:
 - » network, applications, wifi, propagation, mobility
- ♦ Start your study by using the provided examples

First Study – Throughput vs distance

- ◆ IEEE 802.11
- ◆ 1 AP, 1 STA
 - » Assume that both the AP and the STA have full TCP/IP stacks
 - It simplifies the simulation script
 - » Let the STA generate one TCP flow towards the AP
 - » Carry out simulations for different distances between the STA and the AP
 - » For each distance measure the average throughput obtained by the flow
 - Throughput (in bit/s) is measured at the node that receiving the information
 - » Use both flowmon and wireshark to characterize throughputs
 - Flowmon enables you to obtain relevant statistics, including histograms
 - Wireshark enables you to observe packets along the time, including the TCP congestion control mechanism in action
 - » Represent results as a function of distance

Second Study – Throughput vs number of STAs

♦ 1 AP, n STA

- » Assume again that both the AP and the STAs have full TCP/IP stacks
- » Each STA generates one TCP flow towards the AP
- » Carry out simulations for variable numbers of STA located around the AP
 - same distance for all STA, circumference around AP
- » For each number of STAs measure the throughput obtained by stations
 - aggregated (sum of all stations) and average
- » Represent results as a function of number of STAs

Third Study – TCP Throughput vs UDP bitrate

♦ 1 AP, 2 STA

- » One STA generates one TCP flow towards the AP
- » The other STA generates a Constant BitRate UDP flow towards the AP
 - two ports in AP, one for each STA
- » Same distance for both STAs; the nodes can listen to each other
- » Carry out simulations for different bitrates generated by the UDP STA
- » Measure throughputs, delays and packet losses
- » Represent results as functions of the bitrate generated by the UDP STA

Fourth Study – Throughput vs distance with relay

- ◆ 1 AP, 1 RELAY, 1 STA, positioned in a line
 - » AP and the STA have full TCP/IP stacks
 - » STA generates one TCP flow towards the AP
 - The flow should be sent via the RELAY node
 - » Carry out simulations for different distances d , considering
 - $\text{Distance}_{\text{AP-STA}} = d \quad | \quad \text{Distance}_{\text{AP-RELAY}} = \text{Distance}_{\text{RELAY-STA}} = d/2$
 - » For each distance measure the average throughput obtained by the flow
 - Throughput (in bit/s) measured at the AP
 - » Represent results as a function of distance
 - » Compare the results with the results obtained in the First Study
 - » In which situations should a relay node be used? Why?

Results to deliver

- ◆ Report (maximum 4 pages – 1 page per study, 11pt) describing the experiments and the results
- ◆ Confidence intervals
 - » Simulations studies should always present confidence intervals. The confidence intervals are obtained by running the same simulations multiple times using different runs or seeds
 - » But, in this project, we will accept the results obtained from a single run for each experiment, provided that you generate a large number of packets. But please note that when we use queues, packet delays and packet losses are not independent from each other, so the obtained random sequences will not be IID, and we will be unable to characterize the confidence intervals for the estimated means and estimated probabilities