



**Politechnika Łódzka**  
Instytut Elektroniki

LABORATORY: „TELECOMMUNICATION SYSTEMS & NETWORKS”

PART 2

MODELING NETWORKS WITH NCTUNS SIMULATOR

## 1 Terms to complete 'the modeling part' successfully

The laboratory with NCTUns simulator covers two groups of the problems:

- Basic problems (P) – the student must complete them to obtain a positive grade (3) – the student may decide (after successful completing the report) that she/he will not go to additional problems,
- Additional problems (D).

Basic problems' simulation and answering the questions is sufficient for '3' (sufficient); grade. .

All three basic problems and one additional D give the possibility of '4' (good) grade or, of course higher .

The teacher estimates the student group's (1 or 2 persons) final report. The report should be prepared and delivered to the teacher in a *names.pdf* file.

## 2 Basic Problems (P)

### 2.1 Comparing TCP and UDP transport protocols' properties

Make a simple network covering at least one router and three or more hosts. Declare applications (use stg) on the hosts: some of them should send packets UDP or TCP and one host should receive (rtg). Then:

- Plan and perform a simulation for your network according to your scenario with UDP protocol
- Plan and perform a simulation for your network according to your scenario with TCP protocol
- Plan and perform a simulation for your network according to your scenario with both: UDP and TCP protocols
- Define BERs for links between the router and the hosts (several percent?); compare TCP and UDP protocols when errors occur
- Modify the project to simulate a link failure between the host and the target node; compare TCP and UDP protocols when the target node is not accessible

Basing on your results answer the following questions:

- 'connection-less' and 'connection-oriented' – which name stands for which protocol?
- Estimate the reliability
- Which protocol is of 'best effort' type?
- Estimate, what happens when transmission errors occur, and what happens in case the link is lost
- Estimate, which protocol should (and why) be used for the following services: e-mail, web page access, ftp, VoIP, TVIP...

## 2.2 Overloads in IP Networks

Make a simple network with a star topology (one router and several hosts). Declare applications to send packets from hosts (TCP or UDP – use stg) and to receive (on one host – rtg). Then test what happens (compare the protocols) when the load grows (change parameters of links or add more hosts...). Make a scenario when links are overloaded. Perform the analysis.

Test the bandwidth and the delay with the following assumptions:

- two senders and one router, at a given speed, and buffers with infinite capacities
- two senders and one router, at a given speed, and buffers with limited capacities
- more complex network (four senders, two routers etc...)

Basing on your results answer the following questions:

- which tested protocol allows for overload control of the link?
- 'fair access to the link' – describe and estimate
- what actions are necessary when an overload occurs?
- Can you introduce a scenario when the link bandwidth decreases to zero?
- How can one struggle against overloads?

## 2.3 Basic topologies' properties

Design complex networks (more than ten hosts, several hubs, switches, routers) in various topologies (tree, star, mesh). Plan and perform simulations to compare various topologies' properties.

Make sure that you will test:

- problems of collisions and data insulation;
- broadcasting

Basing on your results answer the following questions:

- what a difference is between a hub and a switch?
- And what between a switch and a router?

### 3 Additional experiments (D) (choose one topic)

#### 3.1 Design a network for an office space (or a building)

You may take our B9 building or other example one and design two options for network structures. Compare them considering bandwidth, delays, resistance against failure, possibilities to develop, etc.

#### 3.2 Real time service protocols RTP/RTCP

Design an example WLAN. Plan a scenario to perform multimedia services between chosen hosts, with the application of RTP/RTCP protocols. Analyze properties of real time service protocols.

#### 3.3 Compare networks 802.11b and 802.11e for real time services

Design a WLAN meeting 802.11b standards and a one meeting 802.11e standard. Plan scenarios of stream transmission in the networks. Compare the parameters you obtain in the 802.11e network with QoS mechanisms' implementation to the quality of real time services in the traditional 802.11b network.

#### 3.4 DiffServ networks with differentiated service quality levels

Design a model of DiffServ network consisting of several edge routers, several core routers and several hosts. Define traffic classes and perform simulations to present basic properties of DiffServ networks.

#### **IN GENERAL**

**THE REPORT SHOULD COVER ANSWERS WHICH ARE PROVEN BY YOUR SIMULATIONS AND ARE INTRODUCED IN YOUR GRAPHS, FIGURES, IN LOG FILE...**

**PLEASE, DO NOT COPY THE THEORY – YOU SHOULD GIVE PROOF OF IT**

## 5 References

[1] Shie-Yuan Wang, Chih-Liang Chou, Chih-Che Lin, The GUI User Manual for the NCTUns 6.0 Network Simulator and Emulator, National Chiao Tung University, Tajwan 2010

[2] Shie-Yuan Wang, Chih-Liang Chou, Chih-Che Lin, Chih-Hua Huang, The Protocol Developer Manual for the NCTUns 6.0 Network Simulator and Emulator, National Chiao Tung University, Tajwan 2010

Standards, manuals and books on networks