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## **Praktikum Computernetze im WS0910**

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<http://www.ibr.cs.tu-bs.de/courses/ws0910/pcn/>

### *Network Simulator Programming*

#### *1. Background*

Simulators are a crucial part of research. Particularly, in computer networks a major part of research is analyzed through simulators before its actual implementation. Simulators are designed to provide a virtual view of the real scenarios so that the research outcomes can be evaluated and analyzed beforehand. There is another aspect which motivates the use of simulators. Most of the time, a researcher is working on a relatively small component in the network domain. However, the performance of this component is dependent on many other components, or can affect many other components. For example, a change in the functionality of MAC layer can affect the behavior of layers above and below it. Similarly, the performance of this change can also be largely dependent on the behavior of other layers. To have a true analysis of this component, the whole picture needs to be painted. Thus, during the analysis of a change in MAC layer, we require a complete implementation of all the layers; rather than just the component which is being changed.

It is not a simple and easy job to design an application which simulates all the components of network domain. One important aspect to keep in view while designing such simulators is to give the users adequate facilities to put in their components for analysis purpose. Research groups have done joint efforts over the years to come up with some solutions which can help the fellow researchers in their work. NS (Network Simulator) is the most popular and widely used open source and free-license simulator, a collaborative effort of some US based agencies, research organizations and universities. OPNET is another example; it contains a complete family of quality network R&D tools, but unlike NS it is a commercial product.

#### *2. Objective*

In this praktikum, we are offering two tasks about network simulator programming. The objective of these tasks is to give the students some experience of working with simulators. Usually, the major task in implementing some component into an existing full scale simulator (like NS or

OPNET) for analysis purpose is; to understand the structure of the simulator, identify the right location to place own component, design and implement the required component, and finally integrate this component into the simulator in a fully functional manner. The tasks offered in this praktikum target these aspects of simulator programming.

The first task is about OSPF routing protocol. We have designed a limited feature OSPF simulator which simulates the OSPF operations performed by a router. We have eliminated some functions from the simulator code. Students are required to re-write those functions so that the simulator eventually works according to the OSPF specifications.

The second task is about ARQ protocols. Again, we have a small scale simulator which provides the basic structure to implement ARQ protocols. Students are required to implement the functionality of the three ARQ protocols: Stop and Wait, Go Back N, and Selective Repeat.

### *3. Pre-Requisites*

- The simulators provided in this assignment are mainly written in C++ and have a complete class based structure. Therefore, the first important pre-requisite is the basic understanding of C++ programming language and Object Oriented Programming.
- For the OSPF task, clear understanding of the basic concepts of networking and routing is required. Although, students will get the opportunity of reading the OSPF RFC during the praktikum, it would be better if they already have some basic understanding about the OSPF protocol.
- Similarly, the basic idea of ARQ protocols and mechanisms would be a plus.

### *4. Helpful Reading Material*

- The main reading source for the OSPF task is RFC 2328. A copy of this RFC is provided on the course website. Sections required for this task are already marked for convenience. Few sections are beyond the scope of this task but are highlighted so that the student's can have enough background knowledge about it.
- Many major books on networking provide brief introduction on OSPF. These books can additionally be consulted to have a basic understanding of the OSPF. One good option is, "Routing in Internet" by Christian Huitema.
- Similarly, details of ARQ protocols are available in many networking books. Communication Networks-Fundamentals Concepts and Key Architecture by Alberto Leon-Garcia and Indra Widjaja has a very detailed article on these protocols. We will be following this article as main reference for the ARQ task. A pdf version of this section is also provided on the course website.