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| Course name | **Network Architectures and Protocols / Computer networks** |
| The topic of the document | **Laboratory exercise booklet for university students** |
| Laboratory exercise booklet no. | **5.** |
| The title and the topic of the laboratory exercise | **Addressing in IPv4 part 2. Routing functions.** |

**1. Preparation and implementation requirements:**

- The student is obliged to read in advance the content of the present laboratory exercise booklet, to do the preparations for the laboratory and to observe the rules defined for the laboratory.
- The students should read the description of the special terms, mechanisms listed in the „Theoretical background information" chapter to accomplish the laboratory tasks successfully.
- The appearance happens at the beginning of the laboratory, delay can be allowed only in justified cases.
- The use of students' own mobile phone and PC is forbidden in the laboratory, except the case when the laboratory leader permits their use for the students because of the type of the laboratory exercise to be done.
- Browsers can be used exclusively for the access to information which is necessary for the accomplishment of the laboratory exercise, in the case of the laboratory leader's permission or instruction.
- By the end of the class the laboratory leader evaluates each participant's activity based on the composed questions which are included in this present material and further possible questions.
- The laboratory will be successful, if the student provides a correct answer to each question on the basis of the laboratory exercises which are carried out on the premises.
- The replacement of the laboratory is possible at dates of time determined by the laboratory leader.

**2. Theoretical background information:**

During the laboratory the following special terms will be used in practice:

- Network intermediate node types and functions – ppt slides of the lecture, slide no. 43-53
- IP subnets and aggregated supernets – ppt slides of the lecture, slide no. 166-172
- Linux commands
  - route – https://man7.org/linux/man-pages/man8/route.8.html
  - ping – https://man7.org/linux/man-pages/man8/ping.8.html
  - ifconfig – https://man7.org/linux/man-pages/man8/ifconfig.8.html

- Windows commands
  - route – https://docs.microsoft.com/en-us/windows-server/administration/windows-commands/route_ws2008
  - ping – https://docs.microsoft.com/en-us/windows-server/administration/windows-commands/ping
  - ipconfig – https://docs.microsoft.com/en-us/windows-server/administration/windows-commands/ipconfig

During the laboratory the following mechanisms/technics will be used in practice:

- Subnetting the network into equally sized subnetworks – sample exercise video on the Moodle e-learning page
- Subnetting the network into different sized subnetworks – sample exercise video on the Moodle e-learning page
- Routing between networks with the same size and different size / routing algorithm – ppt slides of the lecture, slide no. 169-172

**3. The following tasks have to be performed on the site:**

| 3.1. | Intermediate nodes, broadcast domain and collision domain |
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| | • Construct a network topology/configuration which includes at least two routers, two L2 switches and two L1 connection devices (hubs). Mark clearly on your figure which icon represents which connection device.<br>• Mark all the broadcast domains and collision domains on your figure. |

| 3.2. | Routing table configuration. |
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| | • Connect all the three virtual machines that were created in the fourth laboratory to separate logical networks with the following prefix lengths: (10.0.1.0/24, 10.0.2.0/24, 10.0.3.0/24)<br>• With the configuration of the routing tables make possible for the first VM to communicate with the second one.<br>• Configure the routing tables in such a way that the first VM could communicate with the third one via the second one (a simple node can be enforced to forward/send the IP packet with the following Linux command: sysctl -w net.ipv4.ip_forward=1) |

| 3.3. | Equally sized subnetting |
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| | • Generate a random IP address on https://www.tunnelsup.com/subnet-calculator/ webpage. The netmask has to be a maximum of: /26.<br>• Create 6 subnets with the same size within the network including the generated IP address in a way that they could cover the possible greatest part of the initial network. |

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| 3.4. | Non-equally sized subnetting |
| | • Generate an IP address with a maximum of a 16 prefix length on https://www.tunnelsup.com/subnet-calculator/ webpage.<br>• Create subnets within the network including the generated IP address which satisfy the following requirements:<br>1. subnet: 6000 nodes<br>2. subnet: 1500 nodes<br>3. subnet: 3500 nodes<br>4. subnet: 2000 nodes<br>• Solve the task supposing that all the data above is immediately available at the solution of the task (requirements arrive with a small difference in time). |

**4. The following questions have to be answered by the end of the laboratory:**

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| 4.1. | A) How many collision domains and broadcast domains did you find? |
| | B) How would the domains change if you used L1 connection devices instead of all L2 connection devices on your figure? |

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| 4.2. | A) After the configuration of the IP address (using ifconfig command) the routing table will be empty or not? |
| | B) Why is it not enough to configure the routing table only on one node? |
| | C) Can we configure a node as a default gateway with a network address/ prefix length 10.0.4.25/24? Why? |

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| 4.3. | A) Determine the obtained subnets together with their netmask. |
| | B) Is it possible to refer somehow to the first 4 subnets all together from the obtained subnets? If it is possible, how can we do it? |

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| 4.4. | A) Determine the obtained subnets together with their netmask. |
| | B) What happens if the requirements arrive with a bigger difference in time, i.e. subnetting has to be performed in the order of entering routes in the routing table?/<br>C) How many nodes approximately left from the initial network with a thousand precision which can be used?<br>D) What is the size of the biggest subnet/network which can be used from the remaining host addresses? |