Exercise 2 – OpenFlow

1. OpenFlow Basics (10P)

a) (5P) Which SDN elements communicate via OpenFlow?

b) (5P) Please list and briefly explain the different tables present in a switch implementing the OpenFlow protocol.

2. OpenFlow Packet Matching (50P)

a) (20P) Please describe the packet matching process of OpenFlow in detail (use your own words and/or illustrations, do not copy the figures from the lecture).

b) (10P) Assume that you have an OpenFlow flow rule A on a switch that instructs the switch to forward all incoming packets with IP source address 1.1.1.1 via switch interface 2. Because the link connected to switch interface 2 becomes temporarily congested, you want to steer traffic with IP source address 1.1.1.1 via switch interface 1 for five minutes. After these five minutes you want to switch back to interface 2 again. How can you implement this policy with adding a single flow rule?

c) (10P) Assume that you are the network operator for a university network. You observe that lately there has been a lot of video traffic in the network, caused by students using Netflix in class, which is reducing the quality of service for other users. From your logs, you detect that the Netflix traffic usually originates from one of two IP addresses (Netflix CDNs), 3.3.3.3 and 4.4.4.4, and in most cases, uses TCP port 80 to stream the video data. What OpenFlow flow rule(s) could you install on your switches to reduce or completely deny this kind of traffic? Explain why your flow rules will have the envisioned effect. Note that there are multiple solutions possible.

d) (10P) In the Figure below, the flow tables of a switch are illustrated.

i. (5P) Please sketch the way a packet takes through the tables after arriving on ingress port 45.

ii. (5P) Please explain what the options of handling a packet that arrives on ingress port 1024 are, depending on the configuration of the switch.

TABLE 0	TABLE 1	TABLE 2
Port | Priority | Instruction 30 | 100 | Table 1 45 | 50 | Table 1 45 | 100 | Table 2 80 | 500 | Table 1 21 | 0 | Drop	**Port | Priority | Instruction** 30 | 100 | Forward Interface 1 45 | 50 | Forward Interface 1 80 | 500 | Forward Interface 0	**Port | Priority | Instruction** 45 | 100 | Forward Interface 2

3. OpenFlow Control Channel (40P)

a) (5P) What is the task of the OpenFlow Channel?

b) (25P) Please describe what happens in terms of exchanged OF protocol messages once a switch connects to an OF controller.

c) (10P) Assume you are a network administrator. As you have learned in the lecture, OpenFlow offers you different approaches towards routing of packets: you can either implement per-flow routing or aggregated routing, and you can also use either proactive or reactive installation of flow rules. As a network administrator, which combinations of these options would you employ in the following scenarios:

i) (5P) Your task is the efficient operation of the core routers of Deutsche Telekom.

ii) (5P) Your task is to ensure that a small company network implements a specific security policy.