Exercise 2 – OpenFlow

1. OpenFlow Basics (10P)

a) (5P) Which SDN elements communicate via OpenFlow?
Control plane(controller) and data plane(network devices).

b) (5P) Please list and briefly explain the different tables present in a switch implementing the OpenFlow protocol.
Flow table: Define incoming and outgoing forwarding in preacive or reactive way.
Entry structure consists of match filed, priority, counters, instructions, timeouts, cookies, and flags.

Group table: allows for more complex forwarding, such as multicast.
Entry structure consists of group identifier, group type, counters, and action buckets.

Meter table: for Quality of Service (QoS) implementation, counts packet rate of a matched flow, have QoS control.
Entry structure consists of meter identifier, counters, and meter bands.

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).
Packet come, packet will match with flow tables, from flow table 0 to flow table n. If match success, then execute the instructions. If no table matches with that packet, check if the table miss flow entry exists, if it exists, then execute the table miss instructions. If no table matches with the packet, and no table miss flow entry exists, then the packet will be dropped.
If the packet through the flow tables, then it will group table, if group table have corresponding instructions, then it will be executed. If there is no group action or the action is executed, then check if there are output actions, if there are output actions, go to egress processing. If there is no output actions, drop the packet.
If the switch does not have egress tables, the packet out. If the switch has egress tables, then the packet will go through the same process like ingress.

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?

Switch Port	…	IP src	…	Action	Priority	Timeouts
	…	1.1.1.1	…	Port1	Highest priority	300s

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.

Switch Port	MAC src	MAC dst	Eth type	VLAN	IP src	IP dst	IP port	TCP sport	TCP dport	Action
					3.3.3.3			80		drop

Switch Port	MAC src	MAC dst	Eth type	VLAN	IP src	IP dst	IP port	TCP sport	TCP dport	Action
					4.4.4.4			80		drop

All the stream packet from Netflix will be dropped. So Even the students sent the stream request to the Netflix they cannot receive any stream data from Netflix.

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.

First in table 0 find the instruction “go to table 2”, then in table 2 find the instruction “go to interface2”

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.

If there is table miss flow entry, if there is a table miss flow entry, then execute the instructions in table miss flow entry. If there is no miss flow entry, drop the packet.

3. OpenFlow Control Channel (40P)

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

OpenFlow channel is responsible for communication between OpenFlow switches and controllers.

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

1. Controller register its IP address to OpenFlow switch.
2. Switch try TCP connection.

3. Controller sends Hello message and wait for response of Hello message to get version information.(Hello (SM))
4. Controller sends features request and wait for responses to get switch function information.(Features Request(CSM)+ Features Reply(CSM))
5. Controller sends configuration information to switch to configure the switch. (Set Config(CSM))
6. Controller sends states request and wait for responses to get status of switch. (PortStatus)
7. Other vendor defined instructions(may be LLDP request and response).

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.
Aggregated routing and proactive flow rules.
ii) (5P) Your task is to ensure that a small company network implements a specific security policy.
Flow-based routing and reactive flow rules.

Appendix:

Switch Port	MAC src	MAC dst	Eth type	VLAN	IP src	IP dst	IP port	TCP sport	TCP dport	Action