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Exercises in PMMC

Exercise 11

Hand out date: **Wednesday Dec 7, 2016**
Submission until and discussion: **Dec 14, 2016 9:45**

Please mail questions that may have arisen and remained in the course of the lecture to pmmk@ifi.uzh.ch so they can be discussed in detail during the lesson on Dec 14.

1) Software-Defined Networks (SDN) Basic Concepts

1.1) Considering that the idea of SDN is not a relatively novel concept (as seen in IP switching and MPLS), describe the main works which empowered SDN.

1.2) Given the definition of SDN and its main characteristics, how does it differ from the traditional networking?

1.3) Describe main advantages and disadvantages of SDNs in contrast of traditional networking under the perspectives of: a) scalability, b) reliability, c) security, d) manageability.

2) SDN Architecture & Functioning

2.1) What are the main elements involved in the SDN architecture? Give a brief definition of each also describing how they relate to each other.

2.2) Relate the controller operation modes **reactive (1)**, **proactive (2)** and **hybrid (3)**, with the events and provide examples on its main benefits and drawbacks regarding the usage of flow-tables.

a) incoming packets are not matched and then forwarded to the controller, which in response install a rule defining an action to the packet.
Operation mode: [ ]
Advantages:
Disadvantages:
b) incoming packets are matched and forwarded. Unmatched packets are discarded.
Operation mode: [ ]
Advantages:
Disadvantages:
c) incoming packets from type addressed to 192.168.56.101 are forwarded and incoming packets addressed to 200.102.75.56 are sent to the controller, which in response install a rule to drop packets.
Operation mode: [ ]
Advantages:
Disadvantages:

2.3) The controller placement problem influences several aspects from an SDN network based on the number of controllers that are deployed, such as performance, fault-tolerance, secu-

rity and manageability-synchronization aspects. Mark which of the following sentences are **true** or **false** regarding the controller placement problem.

a) The **higher** is the number of SDN controllers, the **higher** is the network fault-tolerance and latency to in response to network adjustments.
b) The **higher** is the number of SDN controllers, the **lower** is the latency in response to network adjustments and the **higher** will be the network resilience.
c) The **lower** is the number of SDN controllers, the **higher** is the network security and manageability considering the east/westbound synchronization between controllers.
c) The **lower** is the number of SDN controllers, the **lower** is the network latency in response to network adjustments and the manageability considering the east/westbound synchronization between controllers.

2.4) Describe the impacts of increasing the number of SDN controllers under the perspectives of: a) scalability, b) reliability, c) security, d) manageability.

3) OpenFlow Protocol

3.1) What is the OpenFlow protocol and how does it relate to the SDN concept?

3.2) Describe which controller operation mode is deployed, based on the following OpenFlow messages:

Time	Message
t0	Hello (Controller -> Switch)
t1	Hello (Switch -> Controller)
t2	Features Request (Controller -> Switch)
t3	Features Reply (Switch -> Controller)
t4	Packet-In (Switch -> Controller)
t5	Flow-mod (Controller -> Switch)

3.3) The flow-matching structure is composed by a set of identifiers that describe the characteristics of flows and a set of actions. However, certain characteristics of a flow can be wildcarded. Describe the advantages of using wildcards to define flows and which are the possible actions when a packet do not match a flow-table?

3.4) What is the relevance of OpenFlow counters towards the assurance of QoS requirements? Describe which counters are required to calculate bandwidth, delay and packet losses using OpenFlow counters.