
Exercise for Lecture Software Defined Networking

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Problem 5.1 - NEC guest lecture: SDN, NFV, and Service Chaining

a) What does the term "commoditization" refer to?

b) Explain why the flow granularity in OpenFlow is said to be not predefined.

c) Explain the proposed driver-like abstraction on SDN controllers.

d) Explain the concept of “intents” in the context of Northbound Interfaces (NBIs). What are the key benefits for a network architecture of using intents?

Note: As the topic was only very briefly discussed in the lecture, please read the following ONF blog article to deepen your understanding on the topic and to answer the above question: <https://goo.gl/b10MBK>.

e) New Tables proposed by OpenState

In the lecture, an approach called *OpenState* was presented that extends the matching behavior of OpenFlow. For this, it proposes to expose two new table abstractions to the controller: the *state table* and the *XFSM table*. Explain the purpose of these two tables and how they are used in handling of incoming packets. For this, please have a look at the original paper on OpenState (Hint: Sections 2.1 and 2.2 are relevant for answering the question): <http://openstate-sdn.org/pub/openstate-ccr.pdf>

f) Applicability of OpenState

Which types of use cases or applications could benefit most from OpenState?

g) Using OpenState for a simple use case

At the end of Section 2.2 of the above referenced paper on OpenState, the “port knocking” example is realized using OpenState. Briefly explain how it is mapped to the two tables.

Problem 5.2 - Alcatel Lucent Bell Labs guest lecture: Challenges in NFV

a) What is the “state explosion” problem discussed in the lecture and how is it caused?

b) What does the notion of *path switching* refer to and how does it compare to source routing?

The paper presented in the lecture can be accessed here if a deeper understanding is desired:
<http://conferences2.sigcomm.org/co-next/2015/img/papers/conext15-final232.pdf>

c) Why does *path switching* use a pointer field? What would be an alternative approach?

Problem 5.3 - Case Study 5 - OpenState in Action

This task is a case study. You are supposed to demonstrate theoretical concepts defined in the lecture in an applied setting. Only the problem and its rough context is defined. The context may be extended, if necessary. You are intended to define processes and procedures to solve the problem. Your solution should be defined to an extent allowing a team of skilled staff to implement your solution, i.e., details may be omitted, if they do not have a large impact on your solution. The solution should be presented in a text-based form. Additional literature may be used.

Scenario and Setting:

PacketShield is a new player in the network industry that sell their own whitebox switches with OpenFlow v1.5.0 support. Recently, they added support for OpenState to their devices, including the extensions to the OpenFlow protocol that are required to manipulate the new tables introduced by the approach. As first product based on the new features, PacketShield would like to implement a stateful firewall. The firewall should be able to work for both TCP and UDP and shield a company-internal network from the outside. Incoming packets should only be forwarded if a respective connection was previously initiated from the internal network. For this, assume a first simple setup, where a dedicated switches provided by PacketShield is used to connect an external network segment with an already set up router at the edge of the internal network. All external traffic from and to clients/servers inside the company network passes through the firewall switch.

Discuss, how you would realize a stateful firewall as described above using OpenState. Specify the XFSM table for handling TCP sessions and discuss your approach. Describe how the firewall could be extended to inform a controller on TCP sessions that finished their initialization to keep a network-wide consistent view on multiple firewalls in a future setting envisioned by PacketShield.