TUM

Thesis B.Sc.

IDP

Hardening Ethernet using P4 and eBPF

Motivation

P4 (www.p4.org) is a programming language intended to describe the behavior of packet processing systems. P4 was introduced in 2014 and can be used to define entirely new networks with new protocols which behave differently from the networks we currently use.

P4 programming language

This is possible because P4 allows to program P4-enabled forwarding devices. Currently forwarding devices like switches or routers can only be configured or programmed in a rather restrictive way. For instance, only certain protocols with pre-defined functions can be used. P4-enabled devices offer higher flexibility; they can be programmed to act as a switch or a router – but it does not stop there – the design of entirely new functions and devices becomes possible and gets as easy as just replacing a piece of software without the need to change any hardware.

One interesting use case is the authentication of Ethernet frames for domains that have strict requirements for the communication (e.g. airplane networks). As Ethernet does not support message authentication by default, an P4 enhanced Ethernet protocol can be defined which enables switches to authenticate each other's messages. Assuming that a Switch A includes a cryptographically secure digest in a frame, Switch B can be sure that the packet was once processed by Switch A.

For this purpose, we want to integrate a cryptographic hash function implemented in eBPF in a simple P4 switching/forwarding program. A prototype application has to be developed for different architectures of software and hardware P4 switches. To evaluate the approach, the performance of the different implementations has to be compared using blackbox measurements.

Your Task

- Create a simple P4 example fitting our scenario
- Implement a hash function with eBPF
- Integrate the hash function with your example
- Analyse the performance of the switch

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