Technical University of Munich

Thesis M.Sc.

Guided Research

# Sensor Data (Pre)Processing with Linux eBPF Superpowers

## Motivation

The **e**xtended **B**erkeley **P**acket **F**ilter (eBPF) [1][2] introduces new superpowers to Linux. In its core, eBPF is an in-kernel virtual machine which can be programmed at runtime. These programs are verified such that they neither block nor crash the kernel. In order to give such guarantees, eBPF programs are limited in their functionality. Nevertheless, it can be used for several high-performance applications such as networking devices (switches, load-balancer, firewall) and Linux-wide performance tracking.

Due to the deep integration into the kernel, eBPF can be used to improve the performance of many use cases because it may omit the default packet processing. For example, instead of traversing the whole Linux networking stack, packets can be dismissed or forwarded based on some simple detection mechanisms executed in the context of the device driver.

In this thesis, we want to explore the possibility of bringing user space applications to the kernel using eBPF. You will start with simple applications in eBPF, which we then develop to support more complex use cases like an preprocessor that receives high speed readings from an (emulated) sensor, performs plausability/consistency checks, maybe aggregates several readings, and finally hands over the data to the actual application logic.

## Your Tasks

- Familiarize yourself with eBPF
- Analyze capabilities of eBPF programs
- Design an applications which utilizes eBPF superpowers
- Implement your design in a prototype
- Evaluate the performance of eBPF against user space implementations

Note: for a Guided Research, not all tasks need to be completed.

## References

[1] http://docs.cilium.io/en/latest/bpf/
[2] https://www.kernel.org/doc/html/latest/bpf/index.html

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