



Introduction

- Network traffic monitoring and analysis are critical for managing large scale networks. However, as link speeds scale to **100Gbps** and beyond, capturing complete packet traces becomes challenging.
- In recent work, we built a dataplane profiler called **Patchwork** and used it on the FABRIC testbed to profile its network traffic.
- We relied on **software-only** traffic processing solutions, but that does not scale. We need **hardware support** for Patchwork to handle high volumes of traffic.

Motivation

1. Boost Patchwork's traffic monitoring capabilities by handling high volumes of traffic without packet loss, filtering traffic at full line-rate, and exporting traffic statistics.
2. Use FABRIC's AMD-Xilinx Alveo U280s to process traffic in the data plane.

Approach

- Design and implement advanced **packet filtering logic** in P4, targeting **FABRIC's Alveo SmartNICs**, with features including configurable **sampling rates**, variable header **packet truncation** and address **pseudonymization** for enhanced privacy.
- Compile **P4 code** and integrate with **FABRIC testbed** using Patchwork by leveraging existing **dataplane monitoring** capabilities.
- Validate the **line-rate** of the implemented solution by generating **standardized traffic profiles**, conducting thorough testing for packet loss at various speeds (**10 Gbps ... 100 Gbps**), and profiling the achieved sampling rates to ensure optimal performance.

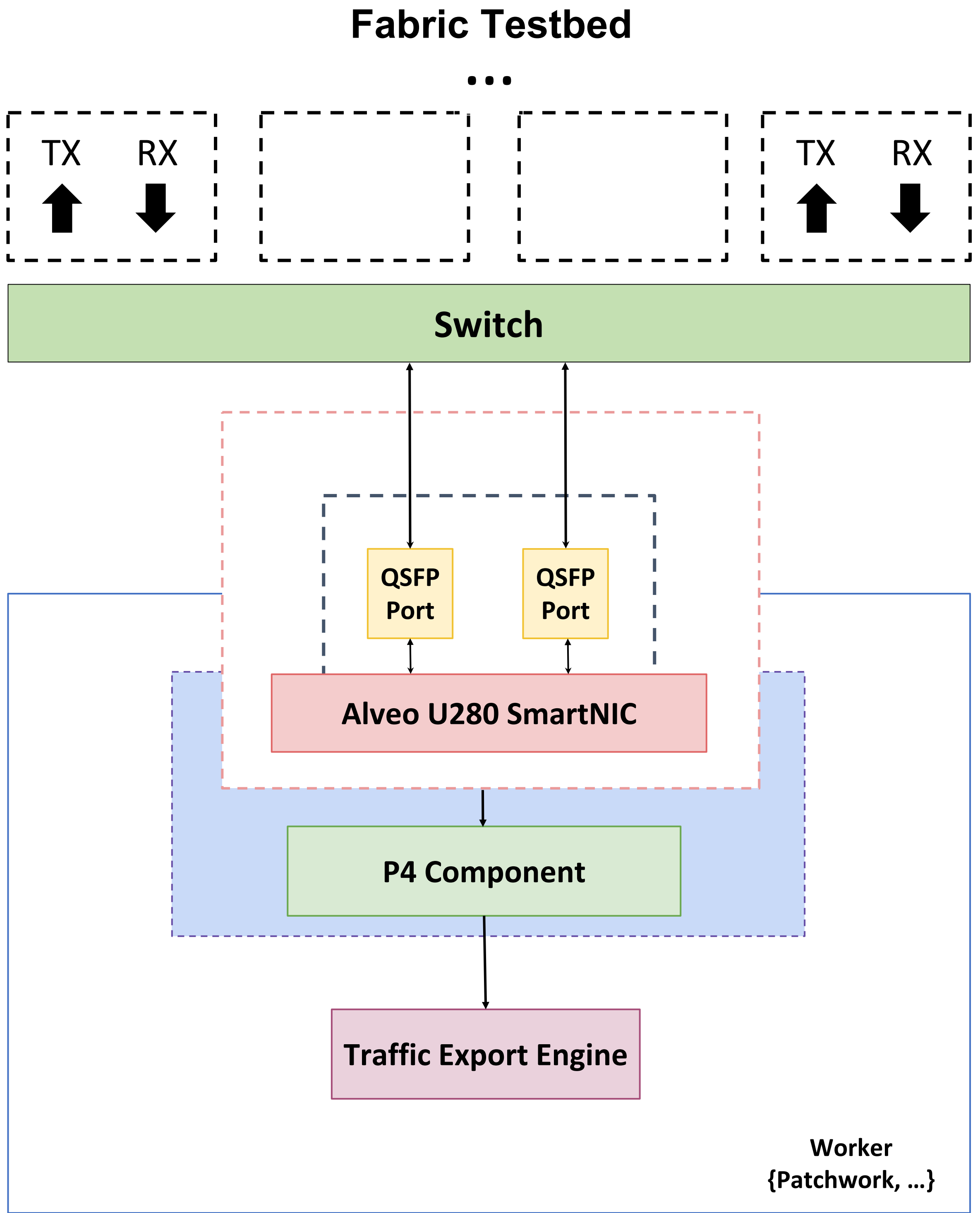
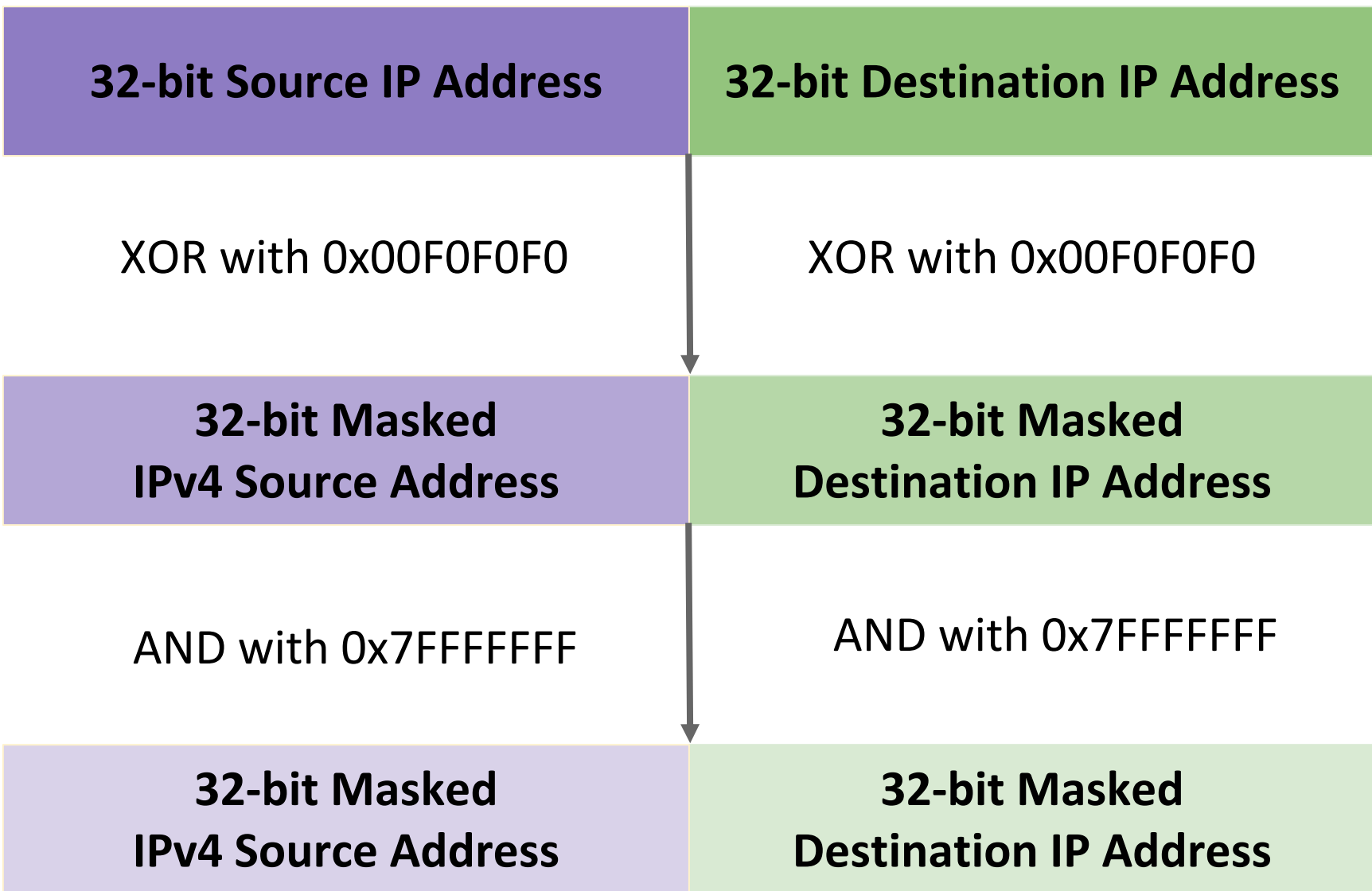


Fig 1: Patchwork Architecture with Alveo U280 SmartNIC Integration

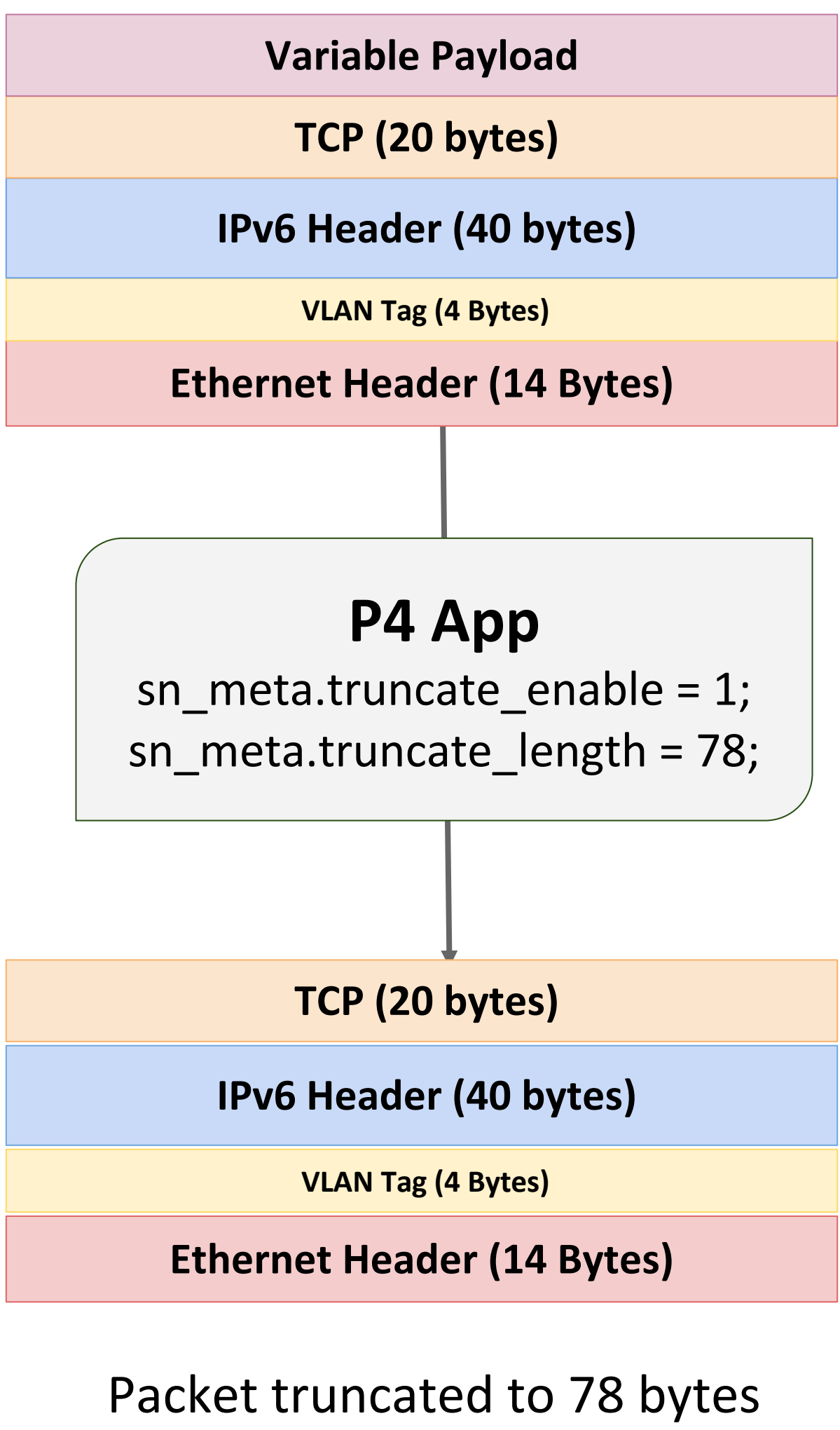
Pseudonymization of IPv4 Address



```
root@smartnic-fu:~# sn-cli probe stats | grep -E "From CMAC 0|From CMAC 1|HOST PF 0 \((c2h)\)|HOST PF 1 \((c2h)\)" -A 3
From CMAC 0
Packets:      177 Bytes:      23331 ok
Packets:      0 Bytes:      0 error/drop
Packets:      0 Bytes:      0 ovfl/drop
--
From CMAC 1
Packets:      167 Bytes:      22884 ok
Packets:      0 Bytes:      0 error/drop
Packets:      0 Bytes:      0 ovfl/drop
--
To HOST PF 0 (c2h)
Packets:       9 Bytes:       1198 ok
Packets:      0 Bytes:      0 ovfl/drop
--
To HOST PF 1 (c2h)
Packets:      167 Bytes:      22884 ok
Packets:      0 Bytes:      0 ovfl/drop
```

- Mirrored packets ingress to P4 App from CMAC 0 (+ CMAC 1 if enabled)
- Packets chosen for sampling egress to HOST PF 0
- Matched packets based on control plane rules egress to HOST PF 1

Packet Truncation



Overall Goal

- Demonstrate **line-rate packet filtering** while handling mirrored uplink traffic up to **100 Gbps** without any packet loss.
- Accelerate Patchwork's packet processing using P4 leveraging FABRIC Alveos

Current State

- Integrated our **optimized P4 pipeline** with the Patchwork system on **FABRIC**, enabling **hardware-accelerated packet processing**.
- Implemented mid-square PRNG for **packet sampling** in P4 and **truncation**, allowing control over data volume and retention of metadata.
- Developed **pseudonymization** functionality in P4 to ensure privacy by **masking IPv4 & IPv6** addresses in the captured network traffic.