EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

MATHEMATISCH-
NATURWISSENSCHAFTLICHE FAKULTÄT
Kommunikationsnetze

# P4-Protect: 1+1 Path Protection for P4

Steffen Lindner, Daniel Merling, Marco Häberle, Michael Menth

***http://kn.inf.uni-tuebingen.de***

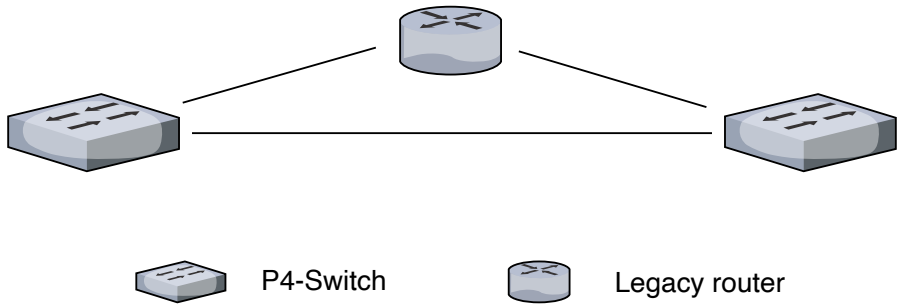
# Agenda

- Motivation
- Mechanism
  - Overview
  - Packet selection
- Evaluation
  - Processing time
  - TCP Throughput
  - Influence on Jitter
- Conclusion

# Motivation

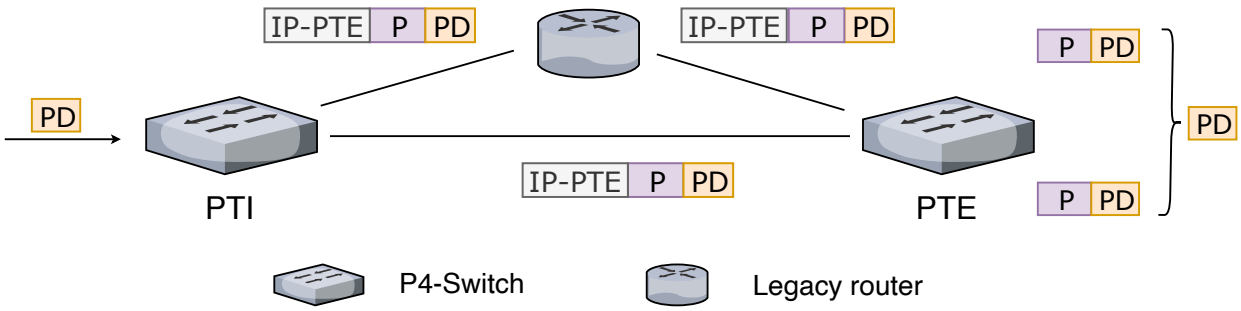
- Critical traffic requires 100% reliability
  - Classical FRR mechanisms/reconvergence have too long response times
  - Reconvergence happens at time scale of a seconds
  - FRR detection may take a few 10s of milliseconds
- 1+1 Protection protects 100% at SLF/SNF without packet loss
- Classic field of application: Optical Networks, MPLS, Ethernet
- Our solution: 1+1 Path Protection for IP networks with P4
- Requirement: Start and end point are P4 switches (e.g. Tofino Edgecore Wedge)

# Mechanism- Overview



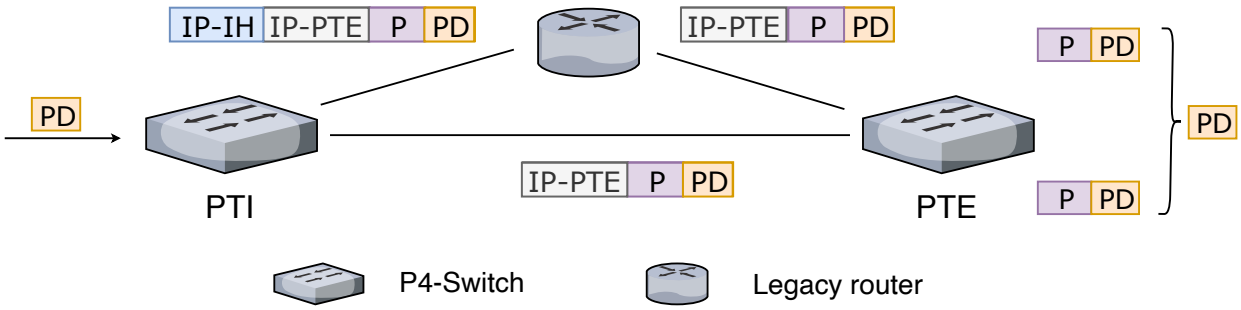

- Setup
  - Two P4 switches are connected via a network with several, preferably disjoint paths
  - The network can be composed of P4 switches and legacy devices
  - It is also possible that the P4 switches are connected to each other via a foreign network
- Objective
  - Redundant transfer of data between the two P4 switches

# Mechanism- Overview



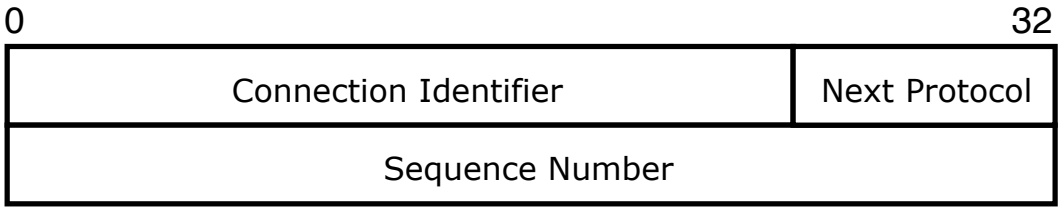

- Mechanism
  - Upon packet arrival, ingress node (PTI) decides if traffic should be redundantly transmitted
  - Redundant traffic gets replicated onto two different paths
  - Traffic is tunneled to egress node (PTE)
  - The PTE decides which packet version gets accepted

# Mechanism- Overview




- Path selection
  - In the own network, traffic engineering can be used to ensure disjoint paths between PTI and PTE
  - To secure traffic over a foreign network, e.g. the internet, we suggest the use of triangular routing
  - One path is build using an intermediate IP hop to enforce as disjoint paths as possible

# Mechanism- Overview




- Protection header
  - PTE needs to forward packets without duplicates
  - Protection header contains connection identifier and sequence number
  - Sequence number is used to accept the first version of each packet

# Mechanism- Packet Selection

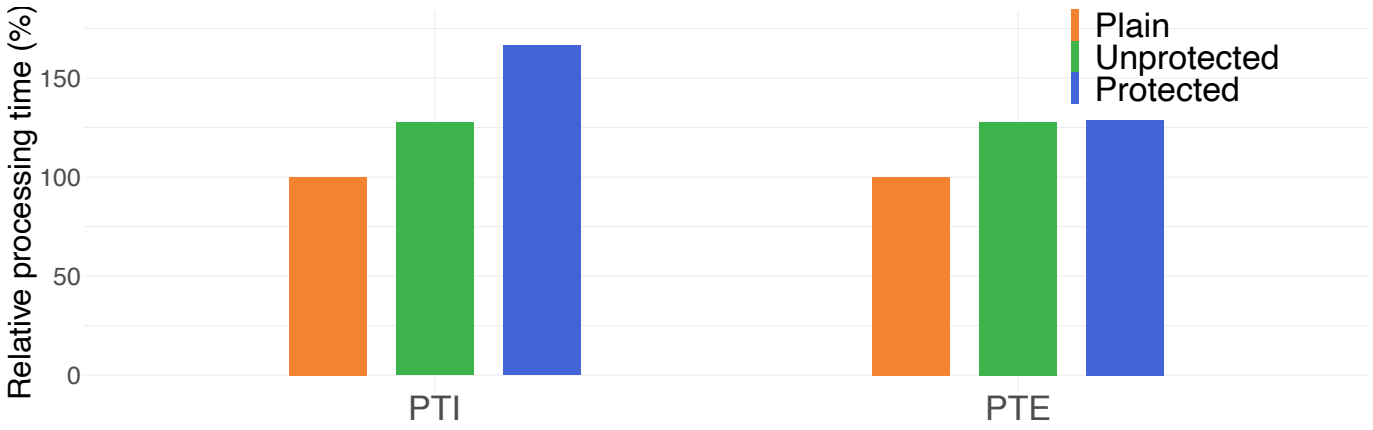
- Packet Selection
  - Duplicates must be recognized at the PTE and must not be forwarded
  - Due to packet loss and latency differences packets with sequence numbers within a given range should be accepted
  - We leverage a receive window to compensate packet loss and latency differences

  - Acceptance criterion with window width W:

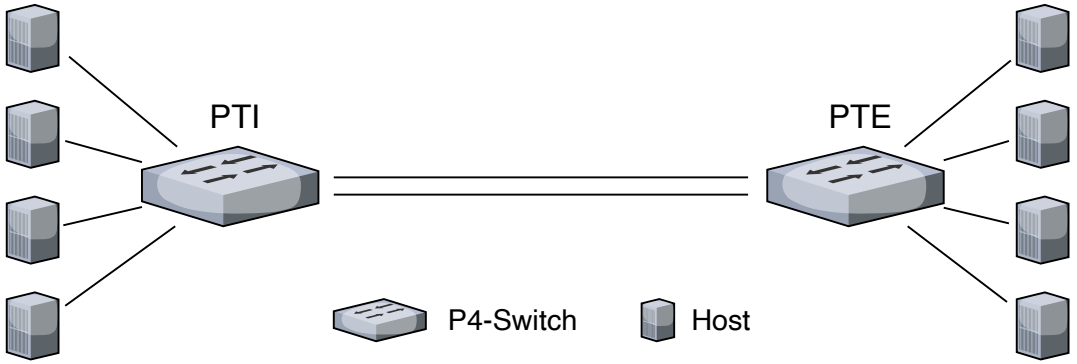
$$SN_{last}^{PTE} < SN \leq SN_{last}^{PTE} + W$$

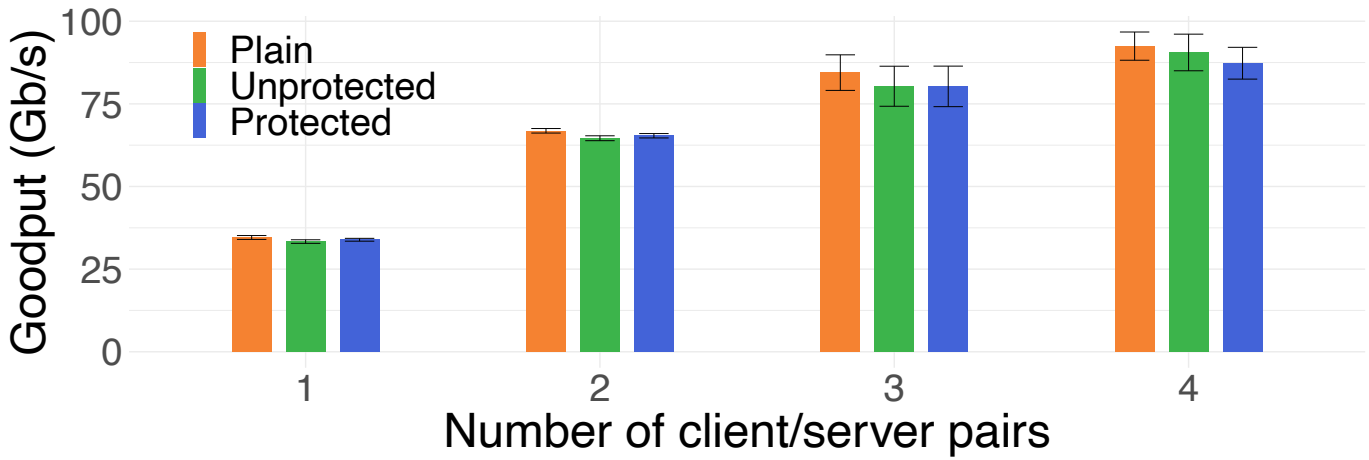
  - Due to cyclic sequence number range wrap-around must be considered

# Evaluation – Processing time

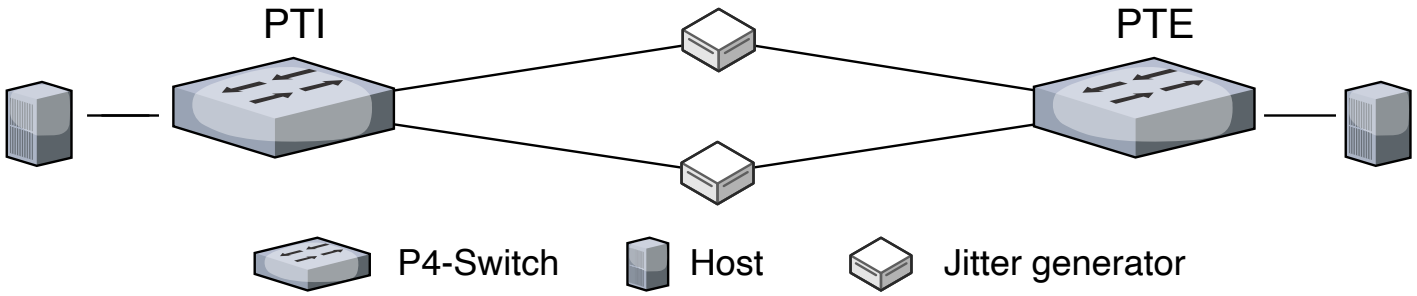


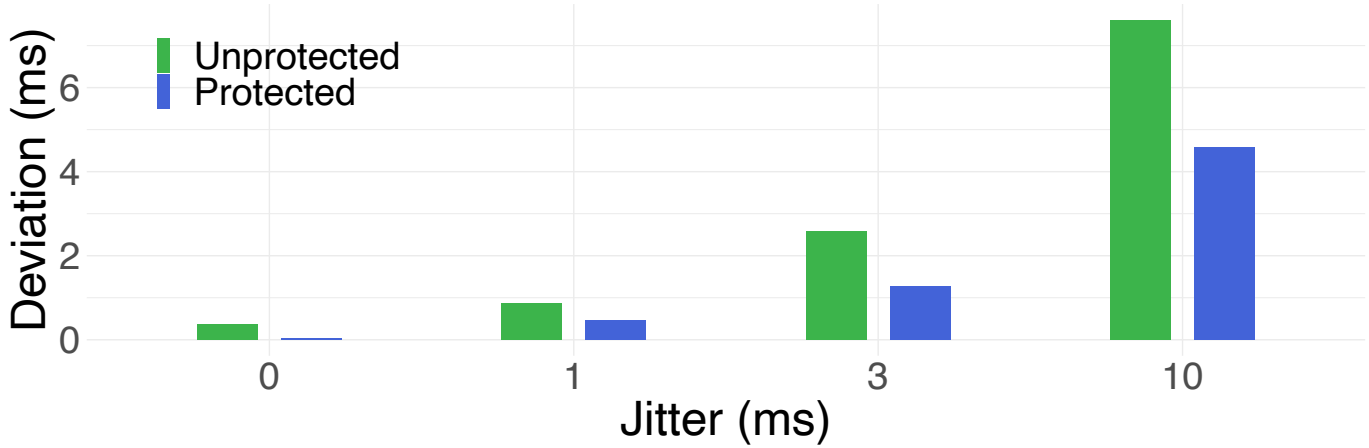
# Evaluation – TCP Throughput



# Evaluation – Influence on Jitter



# Conclusion

- P4-Protect enables 100G 1+1 protection without performance loss compared to legacy implementations
- Only two 100G P4 switches are required (PTI and PTE)
- With the help of triangular routing, P4-Protect can also be used across foreign networks

# P4-Protect: 1+1 Path Protection for P4

**Steffen Lindner**

University of Tuebingen
Faculty of Science
Department of Computer Science
Chair of Communication Networks