NSF 2118311: Cybertraining on P4 Programmable Devices using an Online Scalable Platform with Physical and Virtual Switches and Real Protocol Stacks

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Goals

1. Facilitate the adoption of programmable P4 devices by CI professionals and learners in general, by developing virtual labs.
2. Promote the integration of P4 and virtual labs into academic degrees.

Motivation

There is no systematic material to learn P4.

P4 switches permit the programmer to program the switch data plane:

- Define and parse new protocols.
- Customize packet processing functions.
- Measure events with high precision (nanosecond resolution).
- Offload applications to the data plane (terabits per second processing rates).

Programmable parser — Programmable match-action pipeline — Programmable deparser

■ Packet   ■ Memory   ◤ ALU
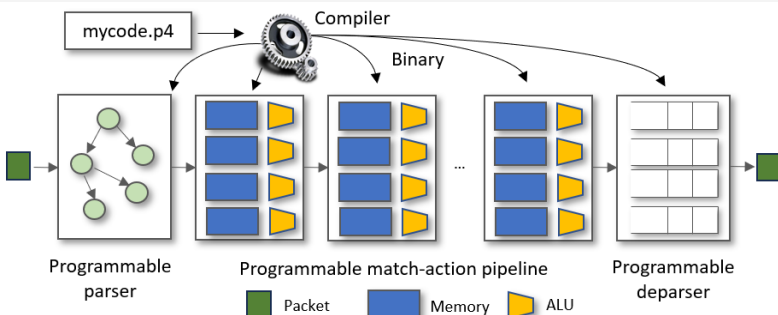
Academic Cloud

- A virtual platform that manages and orchestrates computing resources.
- Tailored for education and research.
- Physical hardware can be attached to the cloud, e.g., Tofino-based switches.

Impact - Academic Cloud

- Virtual labs on P4 used for training and academic courses at several institutions.
- 13,416 experiments, 66,072.42 hours (2022-3)

📈 Community Usage		
Reservations Made	Labs Attended	Hours Attended
13922	13418	66073.97

Reservation 296 > Lab 2: Introduction to P4 Tofino Software Development Environment (SDE)
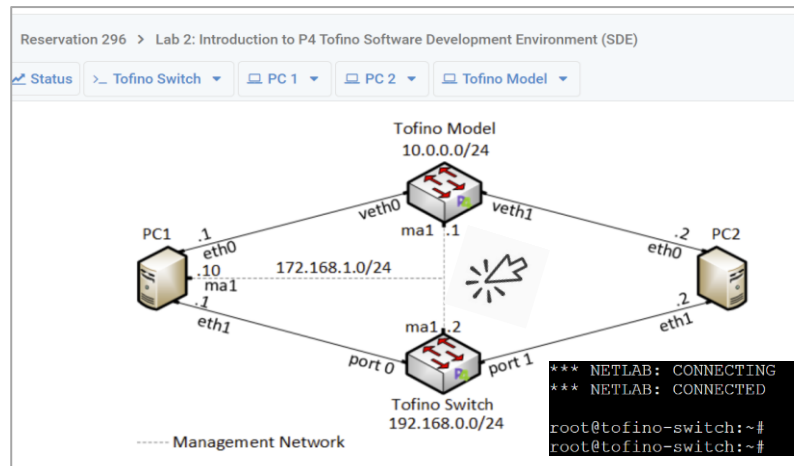
Impact - Workshops

Workshops

- 21 hands-on workshops between 2022-3.
- Nearly 1,500 learners.
- Stand-alone and co-located to conferences such as Internet2 Technology Exchange.
- Partnership with Internet2, FABRIC, LBNL / ESnet, ORNL, regional training centers, RENs from TX, LA, CA, SC, NC, MO, IN, AZ, NY, etc.

Impact - Publications

- 6 virtual lab libraries with booklets.
- 5 conference papers.
- 5 journal papers, including extended tutorials.
- One book w/ virtual labs.