

# Tofino Pods for Teaching and Research

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# Tofino Programmable ASIC

- Tofino uses the Tofino Native Architecture (TNA)
- P4 programs are written in P4<sub>16</sub>
- The switch model is Wedge 100BF-32X from Edgecore
- This switch has 32 x 100G QSFP28 switch ports

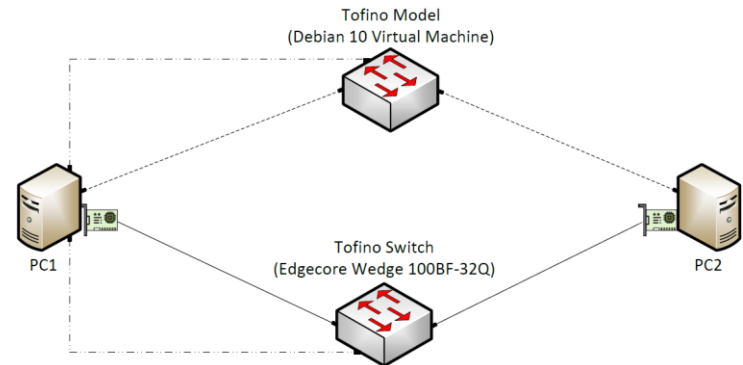
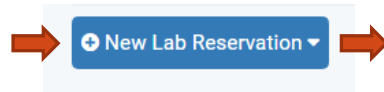
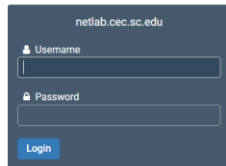


# Tofino Model

- Tofino Model is a software switch used for testing and troubleshooting P4 programs
- The same code that runs on a Tofino model can be ported to a physical switch
- The model allows tracking the lifecycle of a packet traversing the pipeline
- The model has the same purpose as the BMv2 switch

# Development Environment


- The user reserves a pod through the web calendar interface
- The pod consists of a physical switch, Tofino Model, and two virtual machines




----- Virtual Ethernet Link  
(up to 10Gbps)

— 100GbE Multi-Mode  
Fiber (QSFP28)

----- Out-of-Band Link

 Dual-port 100GbE NVIDIA  
Mellanox ConnectX® 5

 Lubuntu 20.04 Virtual Machine  
(8 vCPUs, 16 GB Memory)

Cyberinfrastructure  
Lab @ UofSC

<sup>1</sup>[www.netdevgroup.com](http://www.netdevgroup.com)

# Introduction to P4 on Tofino

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## Lab experiments

- Lab 1: Introduction to P4 and BMv2
- Lab 2: P4 Program Building Blocks
- Lab 3: Parser Implementation
- Lab 4: Introduction to Match-action Tables (Part 1)
- Lab 5: Introduction to Match-action Tables (Part 2)
- Lab 6: Populating and Managing Match-action Tables
- Lab 7: Checksum Recalculation and Packet Deparsing

## Exercises

- Exercise 1: Compiling and Testing a P4 Program
- Exercise 2: Parsing UDP and RTP
- Exercise 3: Building a Simplified NAT
- Exercise 4: Configuring Tables at Runtime
- Exercise 5: Building a Packet Reflector

# Demo

# Demo

- Tofino Model and ASIC running on NetLab
- Programmer can select the target (Tofino model for debugging; physical switch for performance)

The screenshot displays the NetLab+ web interface for a University of South Carolina lab. The browser address bar shows the URL <https://netlab2.cec.sc.edu/lab.cgi>. The page header includes the University of South Carolina logo and navigation links for Home, Reservation, and a user profile for jgomez. The main content area shows a lab titled "Lab1: Introduction to P4 and Tofino" with a "Time Remaining" indicator of 1 hour and 23 minutes. Below the title are navigation tabs for Topology, Content, Status, PC1, PC2, and Tofino Model. The central part of the page features a network topology diagram with the following components and connections:

- PC1** (left) connected to **Tofino Model** (top) via interface `ens224` (port 1) and `ens256np0` (port 1).
- Tofino Model** (top) connected to **Tofino Switch** (bottom) via interface `Veth 0` (port 1) and `Veth 2` (port 2).
- Tofino Switch** (bottom) connected to **PC2** (right) via interface `Port 1` (port 1) and `Port 2` (port 2).
- PC2** (right) connected to **Tofino Model** (top) via interface `ens192` (port 2) and `ens224np0` (port 2).

The IP addresses for the Tofino Model and Tofino Switch are `10.0.0.0/24` and `192.168.0.0/24`, respectively.