



# BAREFOOT ACADEMY

## BA-102

# Introduction to Data Plane Development with P4<sub>16</sub>, Tofino™ and P4 Studio™ SDE

### Course Prospectus

BA-102 is an intensive 3 or 4-day course\* that provides a robust introduction to data plane programming in P4, Tofino™ device architecture and P4 Studio™ Software Development Environment (SDE), including Barefoot APIs and development workflows.

### Course Goals

Upon the completion of the course, the students will have gained the following skills:

1. P4<sub>16</sub> Language fluency, allowing them to program in P4<sub>16</sub> as well as being able to read and understand P4 code written by others
2. Understanding of basic data plane development approaches and ability to design fully-functional data plane programs
3. Understanding of the architecture of the Tofino™ programmable pipeline, P4<sub>16</sub> Tofino Native Architecture (TNA) and its formal representation in P4<sub>16</sub> language
4. Understanding of the main pipeline hardware resources as it pertains to efficient data plane program development. This includes the ability to make informed choices about various P4<sub>16</sub>/TNA coding styles and practices
5. Understanding of the BF-Runtime C++ APIs
6. Understanding of the main fixed function Tofino components, such as MACs, SerDes, and Packet Replication Engine (PRE) and related C and Python APIs necessary for both data and control plane development
7. Detailed understanding of P4 Studio™ SDE components, APIs and tools as well as practical skills in using them for data and control plane development

The course includes both lectures and extensive hands-on labs, conducted in the virtual simulation environment.

---

\* Class duration is specified in the specific class announcement and on the sign-up site

## Target Audience

This course is most suitable for designers and architects, tasked with design and development of data plane and control plane programs for modern networking equipment.

## Pre-requisites

- General understanding of network and telecommunications architecture and protocols
- Knowledge of C and C++ languages, especially as it relates to embedded and NOS development
- Basic understanding of Python

## Sample Day Schedule

All days of training follow the same general schedule:

07:45AM – 08:00AM: Arrival, Registration and Breakfast

08:00AM – 11:00AM: Lecture

11:00AM – 12:30PM: Lab

12:30PM – 01:30PM: Lunch (Labs can be continued)

01:30PM – 04:00PM: Lecture

04:00PM – 06:00PM: Lab (Afternoon snack at 4pm)

## Curriculum

The following topics will be covered during the course. Theoretical material will be reinforced through the labs. Notice that the material is interleaved and therefore the list below does not represent the actual schedule.

- Introduction to P4<sub>16</sub> Language
  - Programmable pipeline model
  - Basic Language constructs
  - Automatic API generation
  - P4 development tools
- Introduction to Tofino™
  - Tofino device architecture
  - P4 programming on Tofino
    - Tofino-specific pipeline components and P4 extensions
    - Tofino-specific optimizations and P4 programming approaches
    - P4 debugging on Tofino
  - Fixed function components and their interfaces
- Introduction to P4 Studio™ SDE
  - SDE components, development and deployment workflows
  - BF-RT C++ APIs
  - Barefoot APIs for Fixed-Function Components
    - Port, SerDes, Multicast, Mirroring
  - SDE initialization and High-Availability approaches

- Port Management and Link troubleshooting
- The Art of Data Plane Development
  - Unicast Forwarding
  - Multicast and Broadcast
  - Learning and Aging
  - Statistics
  - ACLs
  - Link aggregation
  - Interfacing with the control plane
  - Tunneling and header manipulation

## Important Notes

BA-102 is an introductory course, designed to cover a variety of material, therefore allowing the students to jumpstart their development. For in-depth exploration of the selected topics, please ask about our upcoming “Level 2” classes and video training modules.

In-depth coverage of the “switch-p4-16” package is a subject of a separate course. However, taking BA-102 course will allow students to easily read, understand, and modify switch.p4\_16 code and related APIs. Excerpts from switch.p4\_16 will be discussed and used as examples throughout the course.

Barefoot P4 Studio™ SDE is a software product, developed independently from the software, available via p4.org. Some components of the SDE were contributed by Barefoot to p4.org, others rely on the code from p4.org, but the goals of the projects, the tools, and the workflows are different. P4.org software is a community-supported project with many resources freely available. This class covers Barefoot SDE and not p4.org software. Specifically, not covered are the Behavioral Model (BMv2), v1model and PSA P4<sub>16</sub> architectures and P4Runtime.

P4<sub>16</sub> compiler for Tofino and BF-Runtime APIs are still in beta and in active development as is BA-102 course material. While Barefoot Academy Team strives to introduce Barefoot customers to the leading-edge software, bugs, errors and omissions should be expected. The later versions of this course might significantly differ from the early ones.

## Logistics

Public classes are conducted at Barefoot Networks’ training facility in Santa Clara, CA as well as throughout the world. Registration can be completed online ahead of time. Registration fee includes quality printed materials, breakfast, lunch and afternoon snack for all days.

All students are expected to bring a laptop for the labs. No special software is required.

## Contact

For more information, please contact [academy@barefootnetworks.com](mailto:academy@barefootnetworks.com).