ICA-XFG-202

COUNTERS AND METERS

COURSE PROSPECTUS

ICA-XFG-202 is 1-unit advanced, instructor-led course module that offers detailed exploration of the counter and meter externs, available in TNA and T2NA. Course participants will learn how these stateful externs work, how they are organized and addressed and how to properly use them to solve specific problems, both on the data plane and control plane side. The course addresses a variety of advanced topics, necessary to perform accurate counting and metering. A detailed discussion of the control plane interface explains how to access these objects with maximum efficiency and flexibility.

This course is recommended to all data plane and control plane designers.

ICA-XFG-202 is a part of Intel® Connectivity Academy XFG course series and can be taken either in-person or online.

COURSE GOALS

Counters and meters are standard functionalities expected to be present in any practical, modern data plane program. However, there is nothing standard about then in $P4_{16}$, since each $P4_{16}$ architecture is allowed to implement them in its own way. Tofino and Tofino Native Architecture offer advanced implementations of both counters and meters that are also accessible by the control plane through Barefoot Runtime Interface (BRI).

Upon the completion of the course, the students will:

- Obtain the detailed understanding of counter and meter functionality and the underlying algorithms, including specific constraints, imposed on those externs by the high-speed environments.
- Be able to correctly place counters and meters in either ingress or egress pipeline, depending on the specific requirements.
- Understand the specific hardware resources used by counters and meters and be able to optimize their programs for resource usage.
- Understand the concept of table symmetricity, how it applies to stateful resources and how it can be used to optimize both data and control plane programs.
- Understand the concept of volatile table fields and use synchronization correctly and efficiently.

DETAILED SCHEDULE

Each unit consists of a 2-hour-long lecture (presentation) with one break and is followed by the hands-on labs.

In online format, each unit is conducted on a separate day – please consult the [P4ica Calendar](#) for details. Both morning and evening (Pacific Time) sessions might be offered to accommodate students from different time zones.

When conducted in-person, each 8-hour day constitutes 2 units.

UNIT 1

- Introduction
- Direct Counters in P4/TNA and Barefoot Runtime Interface (BRI)
- Indirect Counters
- Hardware resources used for counter implementation, their constraints and typical workarounds.
- Meters and their organization
- Hardware resources used by the meters and their optimal usage.
- Table symmetricity and its relation to counters and meters
- Counting and metering accuracy
- Topics for further exploration

TARGET AUDIENCE

This course is most suitable for data plane and control plane designers tasked with implementing networking software on Intel Tofino™ ASIC family devices.

PRE-REQUISITES

- Successful completion of ICA-XFG-101
- Good understanding of standard network protocols, including Ethernet, IPv4, IPv6, TCP, UDP and MPLS
- Knowledge of Python language
- General understanding of Linux and ability to use it as a development system
- Experience in data or control plane design is extremely helpful
- When taken online, good and reliable Internet access for both online lectures and VM access is a must
- When taken in-person, each participant is expected to have a laptop with a standard browser. No other software is required

HOW TO REGISTER

Class dates and times are announced on the P4ica Calendar Page ahead of time and you can register right on the site using the credit card or PayPal to pay for the tickets. The tickets can also be purchased through our partner, STORDIS, who provide additional services such as convenient invoicing or lodging booking for in-person courses. Please, contact your STORDIS sales representative for more details.

Please, note that most courses require all the participants to have a valid NDA and SLA (SLACA for academic and research organizations) in place. Their existence will be verified after the purchase, and you will be notified if additional steps are required, or the ticket will be refunded.

LOGISTICS

ONLINE COURSES

To attend an online presentation, you will need to create a **free Zoom account, associated with your work email address**. Upon the registration, you will receive a link to the online event. You will also receive invitations to establish accounts on Slack and the [P4ica Support Portal](#) for lab support and materials access, also **associated with your work email address**.

A high-speed internet connection is required to attend the online presentation. Call-in numbers for higher voice quality might be provided, depending on the region. Please, connect to the online meeting 5-10 minutes before the start to work out all potential connection problems.

All necessary materials, including the presentation PDFs and lab exercises will be available through the [P4ica Support Portal](#) a day before the start of the class. We highly recommend that you print the presentation PDFs and use them to take notes. Alternatively, these presentations can be loaded on a tablet, where the notes can be taken with an electronic pen.

The information about the lab Virtual Machines will be provided at the end of the first lecture. VMs will be kept running throughout the duration of the course and shut down 48 hours after the end of the last class. Additional time can be purchased as a ticket add-on.

IN-PERSON COURSES

The location address and the arrival time can be found on the registration site and will be emailed to you as well. You are responsible for your own lodging and transportation; Academy stuff will be happy to provide some recommendations.

You will receive invitations to establish accounts on Slack and the [Academy Support Portal](#) for lab support and materials access, also **associated with your work email address**.

All necessary materials will be printed for you and are yours to take notes and take them back home. You will also get a lifetime access to the updated versions of these materials on the Academy Support Portal.

The information about the lab Virtual Machines will be provided at the end of the lecture. VMs will be kept running throughout the duration of the course and shut down 48 hours after the end of the last class. Additional time can be purchased as a ticket add-on.

CONTACT

For more information, please contact academy@p4ica.com.

IMPORTANT NOTES

P4ica, LTD is an independent training and consulting company. It delivers Intel Connectivity Academy classes under the special license from Intel, using approved materials and lab exercises. It also acts as a custodian for the Academy archives, thereby providing the alumni lifetime access to the class materials.

Intel® P4 Studio SDE is a software product, developed independently from the software, available via p4.org. Some components of the SDE were contributed by Intel 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 Intel® P4 Studio SDE and **not** p4.org software. Specifically, not covered are the Behavioral Model (BMv2), v1model and PSA P4$_{16}$ architectures and neither is P4Runtime protocol.

P4$_{16}$ compiler for Intel® Tofino™ and Intel® Switch Runtime Interface APIs are in active development as is the course module material. While Intel® Connectivity Academy team strives to introduce Intel customers to the leading-edge software, bugs, errors and omissions may occur. The later versions of these course modules might significantly differ from the earlier ones.

The course module material covers both Tofino and Tofino2 devices. Relevant enhancements and differences are emphasized and discussed whenever applicable.

The availability of each course is announced separately. Please, visit P4ica Calendar Page for more information.

The online presentations may be recorded and may be published, in whole or in part, in various media, including print, audio and video formats without further notice. If you do not want to participate, you may choose to either keep your audio and video connections muted or turned off or leave the call. By choosing to remain, you are consenting to the recording of the session.