

Advanced Track Agenda (morning session)

- **8:00 - 8:30am**
 - *Registration and Breakfast*
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- **8:30 - 9:00am**
 - Technical Set-up for Hands-on Lab
 - In order to complete the Developer Day exercises, we will distribute a virtual machine with all required software installed.
 - **9:00 - 9:10am**
 - Welcome and Introductions
 - Speaker: Nate Foster (Cornell University)
 - **9:10 - 10:30am (80 min)**
 - Tutorial overview: Building an SRv6-enabled fabric with P4 and ONOS
 - Session 1: Software tools basics
 - Hands on introduction to software tools used in this tutorial. Participants will be provided with a VM including a starter P4 program, PTF-based unit tests, skeleton ONOS app code, and Mininet script to emulate a fabric topology. In this session, students will be asked to apply changes to the P4 code and ONOS app to support controller packet-in/out for link discovery. The lesson will progressively introduce concepts around the use of arbitrary P4 programs with ONOS and how to re-use existing ONOS apps such as topology discovery with custom P4 programs. Students will also be introduced to using the PTF framework to write Python-based unit tests for their P4 program. By the end of this session, students will be able to run ONOS controlling a 2x2 fabric topology of stratum-bmv2 devices with links automatically discovered.
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- **10:30 - 11:00am**
 - *Break*
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- **11:00 - 12:30 (90 min)**
 - Session 2: Bridging
 - In this session students will have to extend both the P4 code and ONOS app to add support for L2 bridging for hosts connected to the same top of rack (ToR) switch, including host learning based on cloning of ARP/NDP packets, and set up of L2 forwarding entries. The lesson will cover concepts such as writing ONOS apps that react to events such as switch and host discovery, and programming of P4 table entries and packet replication groups.
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- **12:30 - 1:30pm**
 - *Lunch*
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Advanced Track Agenda (afternoon session)

- **1:30 - 1:50pm**
 - P4 Showcase: “Coherence and Consensus in P4”
 - *Speaker:* Dejan Vucinic, Western Digital Corporation
 - *Abstract:* Programmable data plane introduces a new era of rapid innovation and transformation of data storage at scale. What used to require servers and software can now be done in switches--four orders of magnitude faster! At Western Digital Research we are exploring embedded uses of P4 switches and their impact on the Big Data ecosystem. We will showcase our Consensus protocol implementation in P4, enabling wearout-tolerant non-volatile main memory scaleout, as well as OmniXtend, a new open-standard coherence protocol enabling independent scaling of purpose-built compute, memory and storage using off-the-shelf P4 switches.

 - **1:50 - 2:10pm**
 - P4 Showcase: “High Performance User Plane Function (UPF) for 4G/5G Networks with P4”
 - *Speaker:* Michel Gemieux, Kaloom
Abstract: Presenting Kaloom Cloud Edge Fabric™, an optimized solution for edge data centers running 4G and 5G applications. Providing an embedded Hyperscale 5G UPF capable of sustaining terabits of data, traffic throughput with extremely low latency.

 - **2:10-3:10 (60 min)**
 - Session 3: IPv6 routing
 - This session will focus on adding support for routing of IPv6 packets between different ToR switches. Students will have to modify their P4 program and ONOS app to handle IPv6 NDP Router Advertisement and Solicitation messages, as well as programming of P4 table entries and action profile groups to route packets across the fabric, using ECMP to distribute traffic between multiple spines.
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- **3:10 - 3:40pm**
 - *Break*
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- **3:40 - 4:40pm (60 min)**
 - Session 4: Segment Routing v6 (SRv6)
 - In the final session, students will focus on adding support for a simplified version of SRv6. By the end of the lesson students will be able to use the ONOS CLI to set waypoints across the fabric for specific flows.

 - **4:40 - 5:00pm**
 - P4 Showcase: "Leveraging P4 for Automated Switch Validation"
 - *Speaker:* Konstantin Weitz, Google
Abstract: Network switches are complex devices that are currently being validated with hand crafted tests. As we move to a world with more

heterogeneous switches and more stringent availability requirements, this manual approach to testing does not work anymore. In this talk, we'll show how we can automatically generate tests for our switches (thus reducing the manual test effort and increasing our test coverage) using the formal semantics of our switches developed in the P4 language, and techniques like SAT solving and fuzz testing.

- **5:00 - 5:20pm**

- P4 Showcase: “P4 and Programmable Dataplane Use-cases in Enterprises, Telcos, and MSDCs”

- *Speaker:* Chang Kim, Barefoot Networks

Abstract: There are hundreds, if not thousands, of professional P4 developers working in various companies. In this talk I'll try to share roughly what kinds of products they're developing and for what types of markets.

- **5:20 - 5:30pm**

- Wrap up

- **5:30-6:30**

- *Reception*