

# High-Fidelity Validation of P4 Networks with SONiC-P4 Software Switch and CrystalNet

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## **Abstract:**

P4's language and ASICs provide flexible programmability to data-plane which allows switches to perform complex in-network functionalities. Nonetheless, the programmability in data-plane also introduce a tremendous challenge on ensuring the reliability of networks, since bugs are unavoidable in customized P4 programs, the integration between control plane and P4 programs and the interactions between P4 switches and legacy network devices. Therefore, the validation of P4 devices' behaviors in realistic networks is critical to prevent network incidents proactively and accelerate the adoption of P4. The current practices of network validations, such as network verifications, testbed and network emulations (e.g. MiniNet, Emulab), have significant limitations on scalability and adaptivity to heterogeneous devices which prevent them from constructing scenarios those are close to production environments (low high-fidelity). In this talk, we present CrystalNet: a framework building high-fidelity validation environments for P4 networks with SONiC-P4 software switches. CrystalNet runs each device in a virtualized sandbox (container or VM), inter-connects the sandboxes with virtual network links according to real network topologies, and inject real configurations into the sandboxes. It has three essential features: (i) it is high-fidelity due to real control-plane configurations and software and P4 ASIC emulator; (ii) it naturally runs on clouds and can easily scale-out to emulate large-scale networks on server clusters; (iii) it accepts various network devices even black-box devices in hardware. We have deployed CrystalNet in Azure's production networks for 6 months and we will present our experiences of running large-scale, high-fidelity network validations for P4.

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**Bio of the Speaker:** Hongqiang Liu is a Researcher in Microsoft Research, Redmond Lab. He received his Ph.D. degree from the Department of Computer Science at Yale University in 2014 and Master's and Bachelor's degrees from the Department of Electronic Engineering, Tsinghua University. His research interest lies on many fields of networking and cloud computing, including network verification, datacenter networking, software-defined networking (SDN), network function virtualization (NFV), RDMA and container networking. Dr. Liu has published a number of papers in top-tier academic conferences in computer networking field, such as ACM SIGCOMM and USENIX NSDI. He is a recipient of the prestigious ACM SIGCOMM Doctoral Dissertation Award - Honorable Mention (2015).

