

Deploying P4 Applications in Server-Based Networks

Although originally designed to program reconfigurable ASICs, P4 has rapidly been adopted by the networking community for developing data plane applications on end hosts as well. Netronome has taken a leadership position as an end host target and toolchain for developing P4 applications. Developers can implement new P4 applications using the Netronome SDK, and run them on the Agilio family of SmartNICs. Moreover, Netronome supports academic research through the Open-NFP portal. Consequently, developers and researchers have created a variety of powerful network services targeting Netronome SmartNICs, including offloading, tunneling, media streaming, and performance monitoring.

As the ecosystem of end-host applications and services grows, data plane developers are facing an old problem: how to manage, configure, build, install, and upgrade their software. In this presentation, we will propose a system to manage and deploy P4 applications on server-based Smart NICs much like any other application on a server: using a package manager. The presentation will detail the trade-offs required to make package-based SmartNIC application management possible. Specifically, we will propose broad design guidelines for SmartNICs. With these guidelines, data center operators can use a repo-based approach with Smart NICs from any manufacturer. Package creation is vendor-specific as is the method by which the packages are loaded onto a SmartNIC.

As a case study, we will demonstrate how our system, named ICONICS, can be used to package a P4 implementation of the Paxos consensus protocol for distribution on Netronome SmartNICs. Paxos is the foundation for building many fault-tolerant distributed systems and services, and prior work has shown significant performance improvements can be achieved by running Paxos on a Netronome or FPGA-based SmartNIC. We will demonstrate how ICONICS can be used to provision a set of SmartNICs in an entire system, easily providing a data plane implementation of consensus.

With ICONICS, data center operators can deploy and operate P4 apps for server-based networking much like other applications on the server are managed. P4 target vendors will be expected to provide packaging tools in addition to development and debug tools. Application reuse and application deployment at scale will both be made possible.