(Demo) MACSAD: An Exemplar Realization of Multi-Architecture P4 Pipelines

Abstract

Despite having received less attention compared to the control and application plane aspects of Software Defined Networking (SDN), datapaths are critical to achieve full network programmability as envisioned by ongoing efforts like P4. This demo presents our efforts towards SDN dataplanes concurrently offering three contending characteristics, namely, programmability, portability, and performance. Our proposal called Multi-Architecture Compiler System for Abstract Dataplanes (MACSAD) combines the high-level protocol-independent programmability of P4 with low-level cross-platform (HW & SW) APIs brought by the OpenData-Plane Project (ODP). The focus and main contributions of this activity are on portability and performance of MACSAD pipelines. We consider different packet I/Os (DPDK, Netmap, Socket_mmap) and target platforms (x86, ARM) with 10G, 40G and 100G interfaces while exploring different pipelines of varied degree of complexity written in $P4_{14}$ and $P4_{16}$ panning from Ethernet and IPv4/v6 to VXLAN-based Data Center Gateway (DCG) and Broadband Network Gateway (BNG).

Our initial work showed the first proof of concepts [1,2] towards Portable Dataplane Applications which can seamlessly work on different target platforms including bare-metal switches, x86 servers, ARM based servers and also the ability a possibility to embrace use cases around Virtual Network Functions (VNFs) too. P4 and ODP were the obvious choices for us despite these two projects just started showing their mantle recently and brought lots of challenges due to their unique and fresh approach to solve dataplane programmability obstacles. P4 helped us to define different use cases using very high level network abstractions while ODP laid down a strong foundation for portability. We contributed into bringing P4 abstractions on to the level of ODP and implementing a simple PISA style packet pipeline.

Going forth we started exploring 3 new directions [3]. First, we focused on performance improvement to be able to leverage higher throughput systems. Second, being determined to stay updated with P4 language development, we added support for $P4_{16}$ to MACSAD. Lastly, we started exploring new use cases to demonstrate the versatility of P4 and implemented L2-FWD, L3-FWD (IPv4, IPv6) use cases using both $P4_{14}$ and $P4_{16}$ language versions. Then to bring more complex pipeline to MACSAD, we implemented DCG with VxLAN using $P4_{14}$ and BNG using $P4_{16}$.

In this demo, we present our MACSAD compiler system capable of creating various dataplanes written with $P4_{14}$ and $P4_{16}$ versions. The Demo platform will range from Raspberry Pi (ARM) [on-site] to x86_64 platform [on-site and remote servers] with increasingly powerful network interfaces like 10G, 40G, and 100G. The user can select a use-case from our pool of P4 programs available at `https://github.com/intrig-unicamp/macsad-usecases`, compile and run on different target platforms to validate the pipeline and achieved performance.

References

1. Towards a Sweet Spot of Dataplane Programmability, Portability and Performance: On the Scalability of Multi-Architecture P4 Pipelines [*Under Submission: IEEE COMSOC JSAC'18 Special Issue on Scalability Issues and Solutions for Software Defined Networks*]
2. MACSAD: High performance dataplane applications on the move [*Accepted: IEEE HPSR'17*]
3. MACSAD: Multi-Architecture Compiler System for Abstract Dataplanes (Aka Partnering P4 with ODP) [*Accepted: ACM SIGCOMM'16 Demo and Poster Session*]

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