

PDP - A Flexible and Programmable Data Plane

Massimo Gallo, Nokia Bell Labs

The recent trend of network virtualization has witnessed an increasing proportion of specialized hardware equipment being replaced by functionally equivalent software implementations. A seminal step in this direction was moved by the Click router, which established a modular software data plane for packet switching and header manipulation. Click's influence on the two later decades of research in software-defined control planes has been huge, paving the way for the successful SDN architectures that redefined the practice of network management.

In the **Programmable Data Plane (PDP)** project we address the following question: *can we enhance network's data planes with increased functionalities that goes beyond classical forwarding and switching operations?* Despite its interesting and influential architecture, Click is by design oblivious to transport layer semantics and only used nonblocking I/O, limiting its scope to stateless L2-L3 network functions. We developed **ClickNF [1,2]**, a general-purpose modular packet processing environment based on Click, to provide libraries of modular transport and application-layer building blocks for the development of middleboxes and server-side network functions directly in the data plane. ClickNF is open source and was made publicly available on GitHub page in 2017. We are presently expanding the ClickNF platform to accommodate new use cases and architectures for multiple scenarios such as multi-tenant scenario [3], micro-NF execution [4], multi-server orchestration, etc. .

[1] "CliMB: Enabling network function composition with click middleboxes" R Laufer, M Gallo, D Perino, A Nandugudi – 2016 ACM SIGCOMM Computer Communication Review (CCR 2016)

[2] "ClickNF: a Modular Stack for Custom Network Functions" M Gallo, R Laufer - 2018 USENIX Annual Technical Conference (USENIX ATC 18)

[3] "vNS: a modular programmable virtual network switch" M Gallo, F Pianese, ACM SIGCOMM 2018, Poster and Demo session

[4] "CliMBOS: A Modular NFV Cloud Backend for the Internet of Things" M Gallo, S Ghamri-Doudane, F Pianese, 2018 9th IFIP International Conference on New Technologies, Mobility and Security (NTMS 2018)