

Implementing new OpenFlow features in ns-3 network simulator

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Abstract

We are witnessing a rapid growth in communication, and current networks are becoming larger and more complex. Many works point to the use of Software-Defined Networking (SDN) and the OpenFlow protocol as enabling technologies to overcome current limitations. As the use of software-based simulation is a straightforward option for researchers in this area, the main contribution of this work is the validation and enhancement of the OpenFlow module for the well-known ns-3 network simulator.

Key words: Software-Defined Networking, OpenFlow Protocol, ns-3 Network Simulator.

Introduction

The Software-Defined Networking (SDN) is receiving great attention from the academia and industry. The SDN decouples the system that makes decisions about where traffic is sent (the software controller) from the underlying systems that forward traffic to the selected destination (the hardware data plane). OpenFlow is the first standard interface designed specifically for SDN, providing high-performance, granular traffic control across multiple network devices¹. Since software-based evaluation is a common approach used by research to fast experimentation purposes, this work focuses on enhancing the well-known ns-3 network simulator² with cutting-edge OpenFlow technology. The ns-3 is a free software widely used by researchers. The project objectives include new features implementation, documentation improvements and some novel test cases.

Results and Discussion

The authors identified that the existing module was very outdated, and many new major OpenFlow features were introduced since its development. So, an entire new OpenFlow module was developed in parallel to this project: the ofswitch13³ module. The ofswitch13 interconnects the ns-3 simulator to the external library, to create both an OpenFlow 1.3 switch device and an OpenFlow 1.3 controller interface, as illustrated in Image 1. With this module it is possible to interconnect simulated ns-3 nodes to send and receive traffic using the existing Ethernet device models. This project improved the new module with a set of novel example scenarios, which can be used by new users as a starting point for coding new simulations. Also, some test cases were proposed to validate the ofswitch13 implementation, and the module documentation was written in accordance to ns-3 design guidelines. The module is under releasing process, and there is a webpage³ with more information about the project.

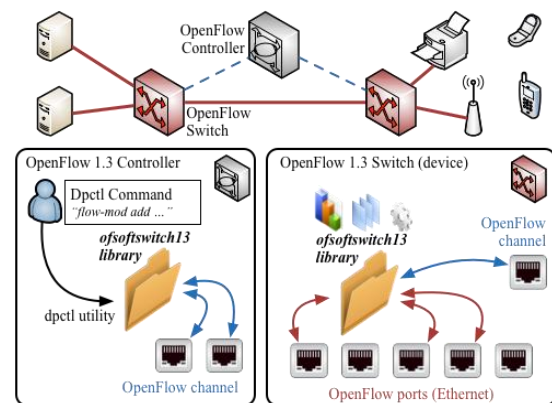


Image 1. The ofswitch13 module³.

Still regarding module validation, it was validated by the authors under experiments involving the integration of SDN networks with mobile 4G (LTE) networks. This integration led to a paper entitled "Integrating OpenFlow to LTE: some issues toward Software-Defined Mobile Networks"⁴, published in IEEE NTMS 2015 conference.

Conclusions

The ofswitch13 module was designed to enhance the ns-3 with SDN technology support. The new module was enhanced with new examples and test cases throughout this project. The results led to a publication at an international conference, and the module release process is an ongoing work.

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