

Virtualizing the Network for Testing & Development

Abstract:

Testing and experimentation is a key aspect to the future development of a network by ensuring that new configurations and topologies work properly. However, these forms of research require either a physical or virtual solution. A physical approach can require on-site management and investment in potentially unused or unfit equipment. Instead, a virtual solution is more fit for this application, as virtualization presents reduced cost, easier remote interaction, and the ability to efficiently clone or modify existing setups. Currently, Los Alamos National Laboratory (LANL) high-performance computing (HPC) division does not have a representation of their production networking infrastructure to experiment with different network configurations. With a network that's as large as Trinity, with 20,000 nodes, it can be very difficult to make a scale model of the network to test. In order to tackle this issue we set up a Kernel-based Virtual Machine (KVM) server where we created virtual machines (VMs) for Arista, Cumulus Linux, and CentOS. In our project we show that by using VMs we're able to simulate a large network at a fraction of the cost of using dedicated test infrastructure. With this virtual network we were then able to gather different sFlow metrics with Prometheus and pull that information into Grafana.

Through creation of a virtual network similar to currently deployed networks, it was found that virtualization presents unique challenges while still allowing for network testing and experimentation. These challenges come in the form of limitations such as kernel restrictions on how network bridges operate, and how KVM's command line tool interacts with open VM sessions. Despite these restrictions, we were able to construct a virtual network that closely resembled one of the network configurations that LANL HPC currently uses. We were then able to test sFlow and Prometheus features inside of this virtual network. KVM's flexibility and accessibility along with other features help to create a highly modular environment for network emulation for testing new use cases in a nonproduction environment. KVM is a great virtualization tool for networking administrators to be able to test and emulate different network configurations that they want to bring into production.