# A scalable emulation framework for Software Defined Networks in Data Centres

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NetOS

## Abstract

We present the design of an emulation framework aiming to facilitate the early-stage evaluation of large-scale SDN deployments in virtualised data centre environments. Our approach builds on top of two of the most popular virtualisation tools, Xen Server and OpenVSwitch. The user describes a network topology via a custom language which provides basic components like switches, hosts, virtualised guests and OpenFlow controllers. Given an emulation scenario that specifies workloads and virtual machine migrations, the emulator automatically builds, runs and assesses SDN's performance.

## Goal

To build an emulation framework for early stage testing of SDN deployments in virtualised data centre environments.

## Design Requirements

- Native support for host VMs and SDN components
- Scale well
- High network behaviour fidelity. Model the network topology, link layer protocols, NIC queues and link speeds.
- Require zero modifications in OpenFlow controllers
- Combined model both for VM and SDN migration.
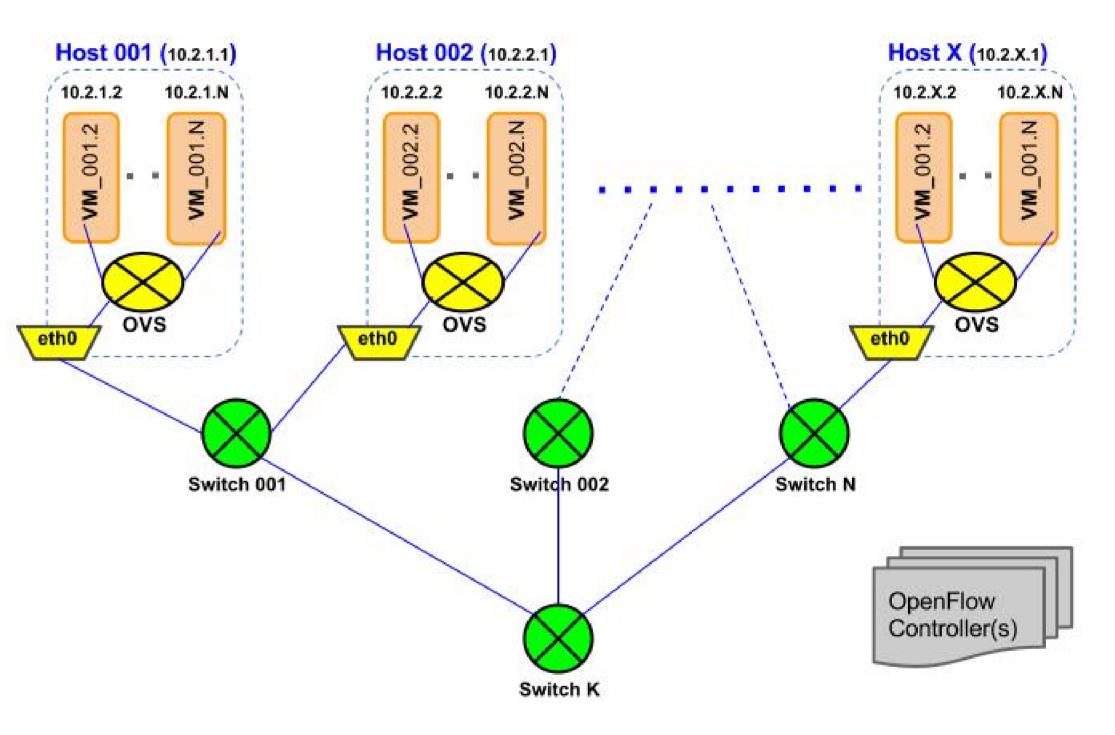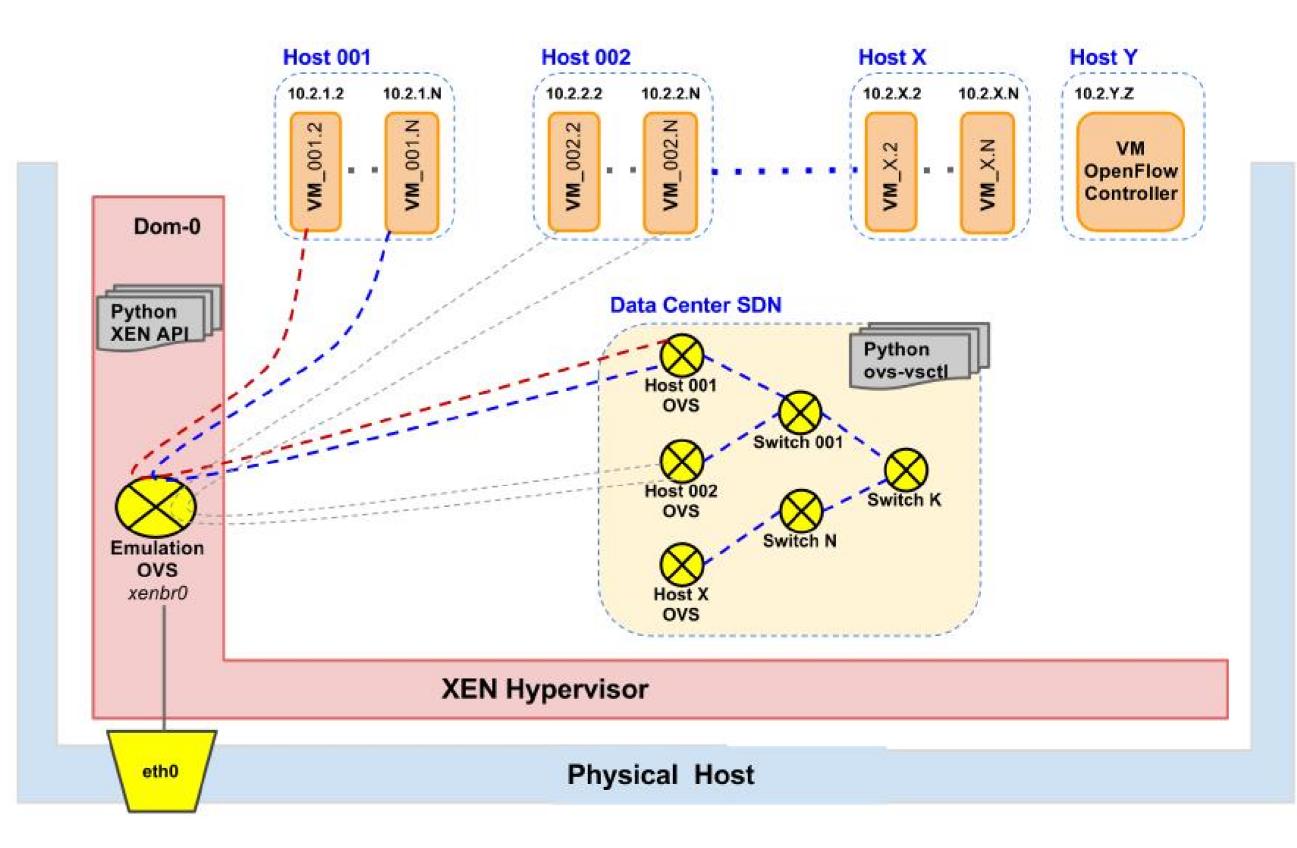- Pluggable energy models
- Tuning points for trading emulation speed for scalability.

## Implementation

- Technoologies: XCP, Xen API, Python, OpenVswitch
- Guest OS: Custom Debian VMs with ~20KB mem footprint
- OpenFlow: FloodLight controller
- OpenVswitch: SysCalls via ovs-vsctl
- Link rate adjustment to match emulated network speed
- Controlled time-dilation of Virtual Host time.
- Automated emulation setup and execution via Python management scripts

## An example SDN emulation



Figure 1: A data centre SDN example



Figure 2: Equivalent emulated SDN

## Acknowledgements