

Fabric Emulator

Realistically emulate Data Center Fabrics on a single hardware box

Problem: Complexity of Reproducing Realistic Behavior of System Test Network

Performance of modern distributed compute-intensive systems is often limited by throughput of network interconnections between cluster nodes. Innovators in this field disaggregate infrastructure components into specialized modules with hardware offload capabilities, coupled with development of new transport protocols.

Such designs must account for the data center topologies that their target customers employ.

Complexity and friction in reproducing realistic datacenter network behavior in a lab—how much equipment do you have to set up and maintain?—is a major factor contributing to excessive cost of innovation in this area.

Solution: System Network Emulation with Fabric Emulator

The Fabric Emulator product brings the realism of customer networks into experimentation and test workflows, for developers of the next generation of system components ranging from Data Processing Units, SmartNICs, and storage to communication libraries and transport protocols.

The Fabric Emulator, is a specialized network operating system (NOS) capable of:

- Emulating complex data center topologies on a single open switch hardware unit.
- Fairly reproducing real data plane behavior.
- Generating background traffic in the fabric to introduce buffer pressure.
- Impairing workload communications with crafted packet loss scenarios.

Highlights

- Logically create a **multi-stage ECMP network** to mimic data center fabric Clos topologies on a **single white box switch**
- Fairly reproduce **traffic forwarding** behavior of a data center fabric by leveraging the same switching **ASIC** as those deployed in production network
- **API first, declarative models** along with a **developer centric** UI simplifies configuration of all elements, including **oversubscription** between stages, **QoS** knobs, shared/reserved **buffer allocations**
- **Chaos experiments** with **fabric load** enabled by support for injecting up to **1 Tb background traffic** into various points of the fabric, or **controlled faults** like configuring the emulated topology to **periodically drop frames** on specific links
- **25GE, 50GE, 100GE, and 200GE** front panel and fabric ports
- Insights and observability with the ability to **mirror ports** and **visualize dimensional metrics** through Prometheus/Grafana integration
- Wire external servers and appliances **once**, and logically re-attach to different points in the topology during experiments

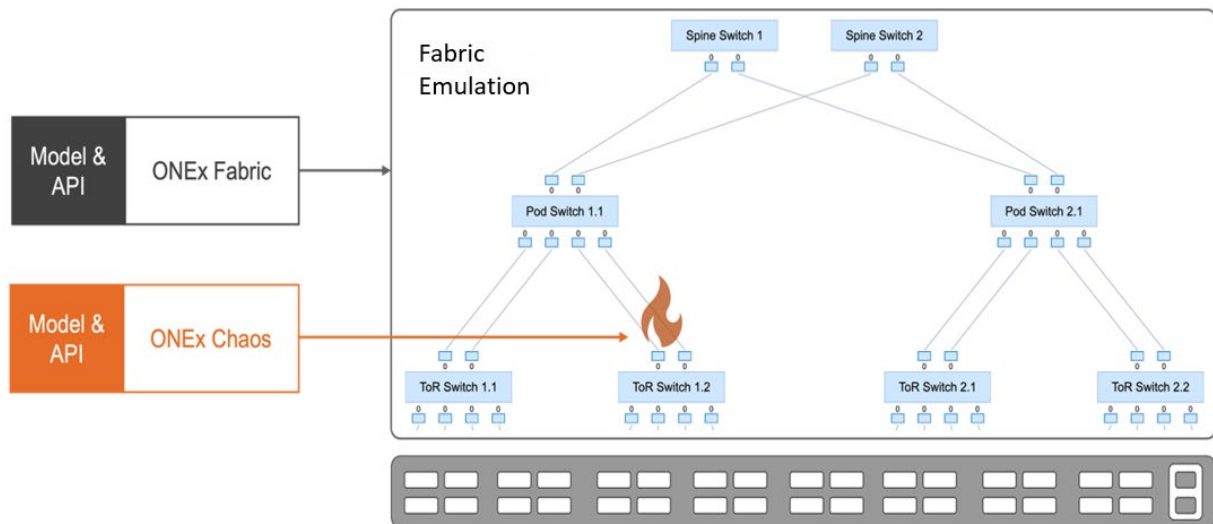


Figure 1. Fabric Emulator Topology with Impairments. Source: Keysight.com

To reproduce topologies and conditions found in real data center environments, Fabric Emulator leverages the Open Network Experiments model and API (**ONEx**). With ONEx, you can share topology data and fabric utilization patterns, and quickly and programmatically iterate through various scenarios as part of an experimentation batch run or continuous-integration pipeline job.

Product Capabilities

Fabric Emulator provides the following capabilities by leveraging the functionality of a switching ASIC it is running on:

- Emulate two or three tier Clos fabrics, with programmable oversubscription.
- Single or multiple disjoint L2 or L3 switches.
- Multi-stage ECMP with traffic load balancing by using ECMP random spray mode, 5-tuple hashing, and 3-tuple hashing, configurable per tier and direction.
- Layer 2 flooding for L2 discovery protocols.
- QoS at tier or switch level: packet classification and scheduling, ECN marking, control of ingress-admission shared, and reserved buffer sizes.
- Congestion in the fabric by injecting background traffic in different points at the topology.
- Internal traffic sinks, to send packets to a certain IP address without having a destination server with the IP physically connected to the front panel.
- Impairments: drop frames on up to six links during experiments.
- Traffic insights by mirroring any port in the emulated topology to a front panel port.
- Configurable through a gRPC API.
- Hop by hop statistics provided by a Prometheus monitoring agent.
- 25GE, 50GE, 100GE, and 200GE port speeds, uniform throughout the fabric.
- Support for FEC and for auto-negotiation with the option to advertise FEC.

Specifications

Fabric Emulator on Broadcom TH3 ASIC Specification

ASIC Specification		Links Speed			
		25GE	50GE	100GE	200GE
Fabric					
Emulated ports*		128	96	96	64
Background Traffic					
Max background traffic total throughput		1Tbps			
Per flow rate		Up to 100 % of link speed			
Per flow group (that is, injection point) rate		Up to 100 % of link speed			
Max flow counts per flow group		128		256	
Max flow groups per configuration		126	126	94	62
Chaos Experiments					
Drop Frames on a Link		Up to 6 links			
Insights					
Port Mirroring		Up to 4 ports			
Layer 1 Settings					
Auto-negotiation		yes	no	yes	yes
Manual FEC		yes	yes	yes	no
FEC Modes	RS-FEC / RS 528	yes	yes	yes	no
	KP4-FEC / RS 544	no	no	no	Yes
	Firecode / Base-R	yes	no	no	no

* Internal traffic sinks will use up an extra port. Configuring background traffic will use two extra ports.

Supported Hardware

Fabric Emulator can be installed on the following hardware:

- Edgecore AS9716-32D Open Switch Platform

Ordering information

Part Number	Description
950-1101	Keysight Fabric Emulator software license bundle. Supports: 1 (one) Edge-Core AS9716-32D switch. Includes: topology emulation and impairments, including up to 1 (one) Tbps of internal traffic. Licensed for operating on 1 (one) switch unit at a time.
950-1102	Keysight Fabric Emulator software license bundle. Supports: 2 (two) Edge-Core AS9716-32D switch. Includes: topology emulation and impairments, including up to 1 (one) Tbps of shared internal traffic. Licensed for operation on 2 (two) switch units at a time.

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