



# How to test MOP to eliminate network downtime




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2019

A dark blue world map with numerous blue dots representing Azure regions. The dots are labeled with region names in white text. Labels include: US 2, Central US, US Gov Iowa, Central US, Canada East, Canada Central, North Central US, US DoD East, East US, East US 2, US Gov Texas, US Gov Virginia, US DoD Central, Brazil South, South Africa North, South Africa West, Norway West, West Europe, UK South, North Europe, UK West, France Central, France South, Norway East, Germany West Central, Germany North, Germany Northeast, Germany Central, Switzerland North, Switzerland West, UAE Central, West India, Central India, South India, China North, China North 2, Korea Central, Korea South, China East 2, China East, East Asia, Japan V, Australia Southeast, and Australia. The text is overlaid on the map.

As of today, Azure has 54 Regions.  
Azure has gone through incredible growth over the last 5 years

To support this growth,  
Azure Network undergo big transformation through a number of migrations

**How did we test our MOP ( Method of Operation)  
to eliminate impact to customer?**

# Challenge and Requirement on Migration

Customer business is 24/7/365

- There is no maintenance window, and down time is not tolerated
- Traffic volume on weekend is almost the same as that on weekday
- Therefore, we must perform non-impacting migrations with live customer traffic

The migration process needs to be repeatable

- 30+ regions needed to be migrated
- Need to be driven by multiple teams for scaling
- **How do we guarantee the quality of the migration work?**

# MOP Testing

## Traditionally

- Setup a few devices in a lab
  - Do unit testing
  - Do Small scale topology test to understand the impact
  - Apply the MOP in production. If it does not work , rollback and try again
- This is not acceptable. We don't want testing in Production

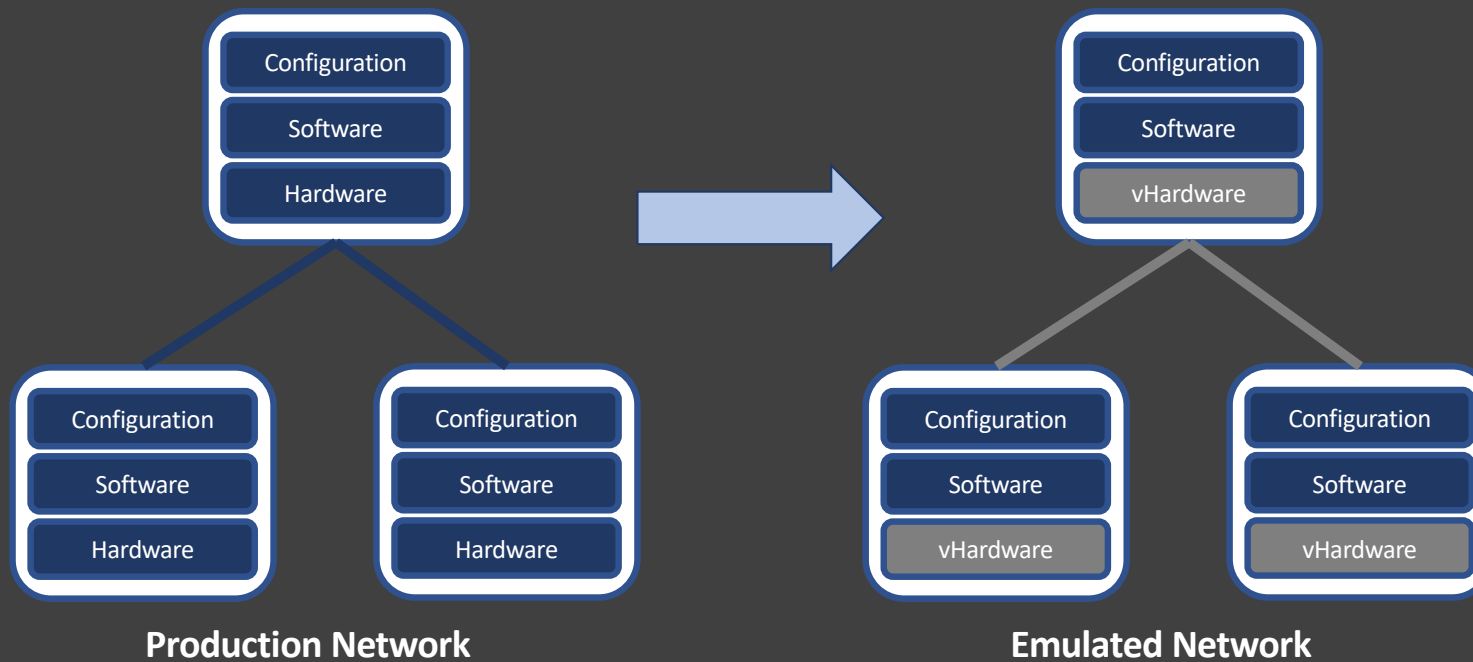
## What if

- We have an emulated replica of production to
  - test the whole MOP step by step
  - reset and try different MOP idea
  - practice and train others

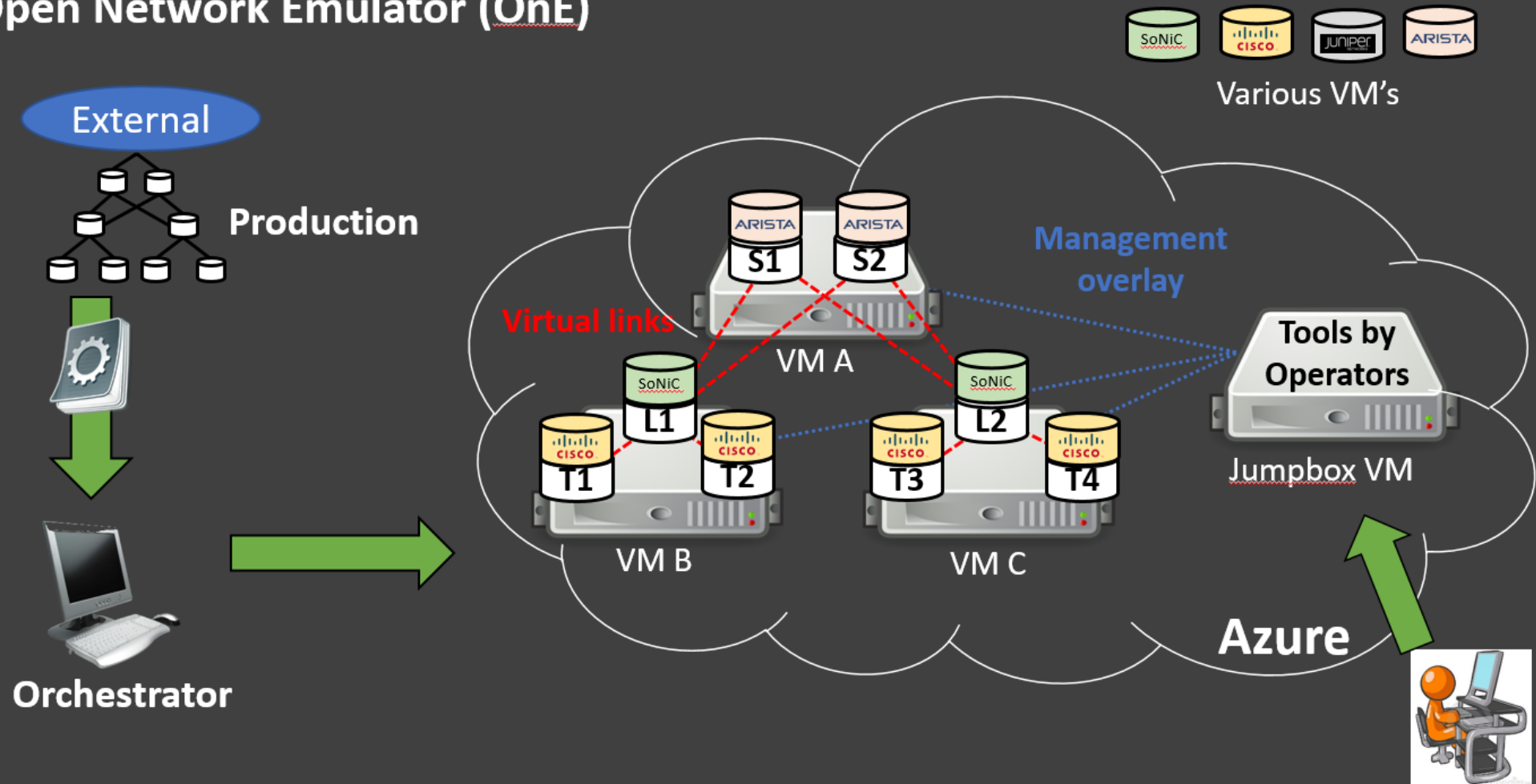
We have successfully created a large-scale emulated replica of production (e.g. ~ 5K routers)

- Using **Open Network Emulator (OnE)**
  - <http://aka.ms/opennetworkemulator>, Email contact point: one-dev@microsoft.com

# High-fidelity “replica” via emulation



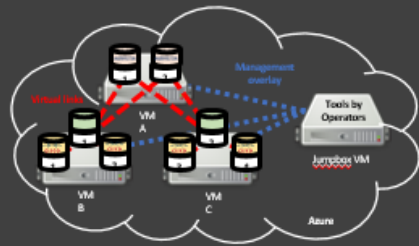
# Open Network Emulator (OnE)



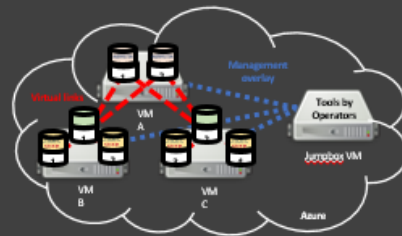
# MOP validation workflow



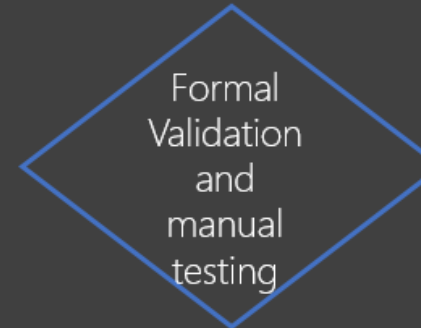
Network engineer describes desired change



An emulated replica is created



Change is applied to emulated replica



Tests are run on replica

Changes safe to apply to production network

All major migrations completed:

Zero customer impact

Thanks to our use of Open Network Emulator (OnE):

- **Bugs found:** 50+, including configuration, management script, device software and operation errors
- **Potential savings:** 5+ outages
- **Incidents in production:** 0