# Deploy SD-WAN via SD-WAN Lab Deployment Tool and Modeling Labs

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## Introduction

This document describes how to create a Catalyst SD-WAN Fabric in Cisco Modeling Labs using the SD-WAN Lab Deployment Tool (Open source, BSD-3).

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## Download

- SD-WAN Lab Deployment Tool

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## Background Information

The SD-WAN Lab Deployment Tool automates SD-WAN fabric creation in CML and dramatically simplifies various steps including adding SD-WAN Edge Routers to the Fabric, certificate installation, and other onboarding tasks. Before the SD-WAN Lab Tool, users had to manually deploy SD-WAN controllers and edge routers in CML. This process is fully automated and takes minutes, not hours; YouTube Demo.

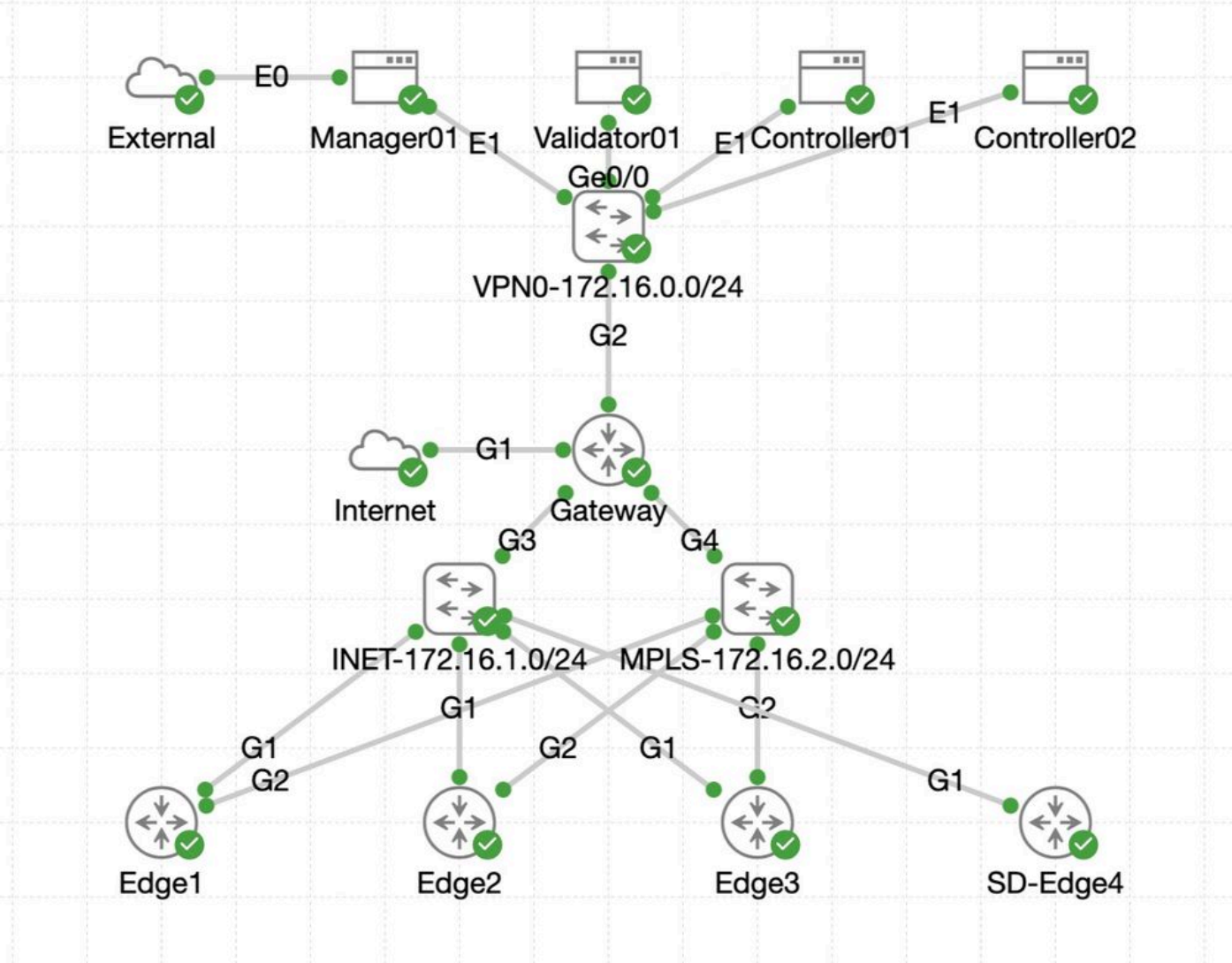
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## Key Benefits of the Lab Deployment Tools

- Fully automated creation of SD-WAN Controllers
- Add multiple branches with SD-WAN Edge routers in one automated task

- Two SD-WAN Transports; Internet and MPLS
- Ability to introduce latency as WAN Link Emulation
- Backup and Restore capabilities
- Open Source BSD-3 license hosted on GitHub

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# CML Requirements for SD-WAN Use Cases

- CML can be deployed on bare metal or via virtual machine (ESXi or AWS).
- Supports clustering for increasing capacity.
- The recommended option for SD-WAN Simulation is on-prem CML cluster with a few servers.

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# SD-WAN Lab Deployment Tool Details

- The tool is currently supported on Linux/MacOS systems as a dependency package (pyats) and is available only for those systems.
- To run the tool on Windows, you need a Linux VM/container or Linux on Windows with WSL. You can find all the dependencies in the **pyproject.toml** file: SDWAN Lab Deployment Tool.
- See all installation steps, usage examples, and source code on GitHub.
- Ensure the network connection between the host running the Lab Tool and the CML server/cluster is fast enough. This helps during the SW image upload of the SD-WAN Controllers.
- If you have any questions on the SD-WAN Lab Deployment Tool? Send an email to cml-sdwan-lab-tool@external.cisco.com

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# SD-WAN Lab Deployment Tool in dCloud Environment

This tool works with CML in the dCloud environment. Review these steps to deploy an SD-WAN/SD-Routing lab in the dCloud CML.

1. In the dCloud catalog, find and reserve the **CML - Catalyst SD-WAN 26.1 Lab Custom Topologies** session.

2. Once the reservation is ready for use, click **View > Info > AnyConnect Credentials**, and use the Secure Client to VPN into the session.

3. Prepare a file with the environment variables to be used for the SD-WAN Lab Deployment Tool. This is an example file used:

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**Note**: The MANAGER_IP is the IP address for the SD-WAN manager in the dCloud Management network, usually in the 198.18.128.0/18 subnet with a gateway of 198.18.128.1.

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```
(venv) [csdwan] $ more lab_rc.sh
export CML_IP='198.18.134.1'
export CML_USER='admin'
export CML_PASSWORD='C1sco12345!'
export MANAGER_IP='198.18.128.100'
export MANAGER_USER='sdwan'
export MANAGER_PASSWORD='Cisco123!'
export MANAGER_MASK='/18'
export MANAGER_GATEWAY='198.18.128.1'
export LAB_NAME='sdwan'
```

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1. Source this file to ensure the environment variables take effect:

```
(venv) [csdwan] $ source lab_rc.sh
(venv) [csdwan] $
(venv) [csdwan] $ env | grep "CML\|MANAGER"
CML_PASSWORD=C1sco12345!
MANAGER_MASK=/18
CML_IP=198.18.134.1
CML_USER=admin
MANAGER_USER=sdwan
MANAGER_PASSWORD=Cisco123!
MANAGER_GATEWAY=198.18.128.1
MANAGER_IP=198.18.128.100
```

---

2. Download any qcow2 images not available in the dCloud CML image definition to the directory where the tool is running from, and run **setup** to add new image definitions in CML:

```
(venv) [csdwan] $ ls -l *qcow2
-rw-r--r--@ 1 cisco  staff  1849884672 Sep 20 12:12 c8000v-universalk9_16G_serial.17.15.01a.qcow2
-rw-r--r--@ 1 cisco  staff   360185856 Sep 10 16:26 viptela-bond-20.15.1-genericx86-64.qcow2
-rw-r--r--@ 1 cisco  staff   360185856 Sep 10 16:09 viptela-smart-20.15.1-genericx86-64.qcow2
-rw-r--r--@ 1 cisco  staff  4717608960 Sep 10 16:09 viptela-vmanage-20.15.1-genericx86-64.qcow2
(venv) [csdwan] $
(venv) [csdwan] $ sdwan-lab setup --list
Verifying software images...Uploading viptela-bond-20.15.1-genericx86-64.qcow2
 |##################################################| 360185856/360185856 100.0% [00:00:22]
Upload completed
Uploading viptela-vmanage-20.15.1-genericx86-64.qcow2
 |##################################################| 4717608960/4717608960 100.0% [00:04:59]
Upload completed
<snip>
Upload completed
Setup task done
Available Software Versions:
- cat-sdwan-manager: ['20.12.3', '20.14.1', '20.15.1', '20.9.5.2']
- cat-sdwan-controller: ['20.12.3', '20.14.1', '20.15.1', '20.9.5.1']
- cat-sdwan-validator: ['20.12.3', '20.14.1', '20.15.1', '20.9.5.1']
- cat-sdwan-edge: ['17.09.05a', '17.12.03', '17.14.01a', '17.15.01a']
```

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3. Deploy the lab:

```
(venv) [csdwan] $ sdwan-lab deploy 20.15.1
Deploy task done
##########################################
Lab is deployed.
CML URL: https://198.18.134.1
SD-WAN Manager URL: https://198.18.128.100:443
Use the username/password set with the script for CML and SD-WAN Manager login.
All other nodes use default username/password.
##########################################
```

---

4. Add SD-WAN Edges, SD-Routing Edges, or both to the lab topology:

```
(venv) [csdwan] $ sdwan-lab add 2 edges 17.15.01a
(venv) [csdwan] $ sdwan-lab add 2 sdrouting 17.15.01a
```

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**Note**: Sometimes when deploying Edges, the deployment can appear to be stuck at the **Waiting for WAN Edge Onboarding**... message. Log into the CML dashboard and check if the control connections on the edges have been established. If not, a reload of the Edge device usually fixes the problem. Confirm this by logging into the SD-WAN Manager dashboard and check the device status.

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# Troubleshoot

## Python Version Mismatch

The Lab Tools requires Python Version 3.11 and later. If you have a different Python version that does not match the package requirement, the installation can fail.

This is an example of a failed installation because of the incorrect Python version:

```
(venv) [csdwan] $ pip install --upgrade catalyst-sdwan-lab
Collecting catalyst-sdwan-lab
  Downloading catalyst_sdwan_lab-2.0.9-py3-none-any.whl.metadata (20 kB)
...
  Downloading catalyst_sdwan_lab-2.0.6-py3-none-any.whl.metadata (20 kB)
ERROR: Cannot install catalyst-sdwan-lab==2.0.6, catalyst-sdwan-lab==2.0.7, catalyst-sdwan-lab==2.0.8 a

The conflict is caused by:
    catalyst-sdwan-lab 2.0.9 depends on pyats<24.0 and >=23.1
    catalyst-sdwan-lab 2.0.8 depends on pyats<24.0 and >=23.1
    catalyst-sdwan-lab 2.0.7 depends on pyats<24.0 and >=23.1
    catalyst-sdwan-lab 2.0.6 depends on pyats<24.0 and >=23.1

To fix this you could try to:
1. loosen the range of package versions you've specified
2. remove package versions to allow pip attempt to solve the dependency conflict

ERROR: ResolutionImpossible: for help visit https://pip.pypa.io/en/latest/topics/dependency-resolution/
(venv) [csdwan] $
```

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To fix this issue, use a Python virtual environment to meet the specific Python version requirements.