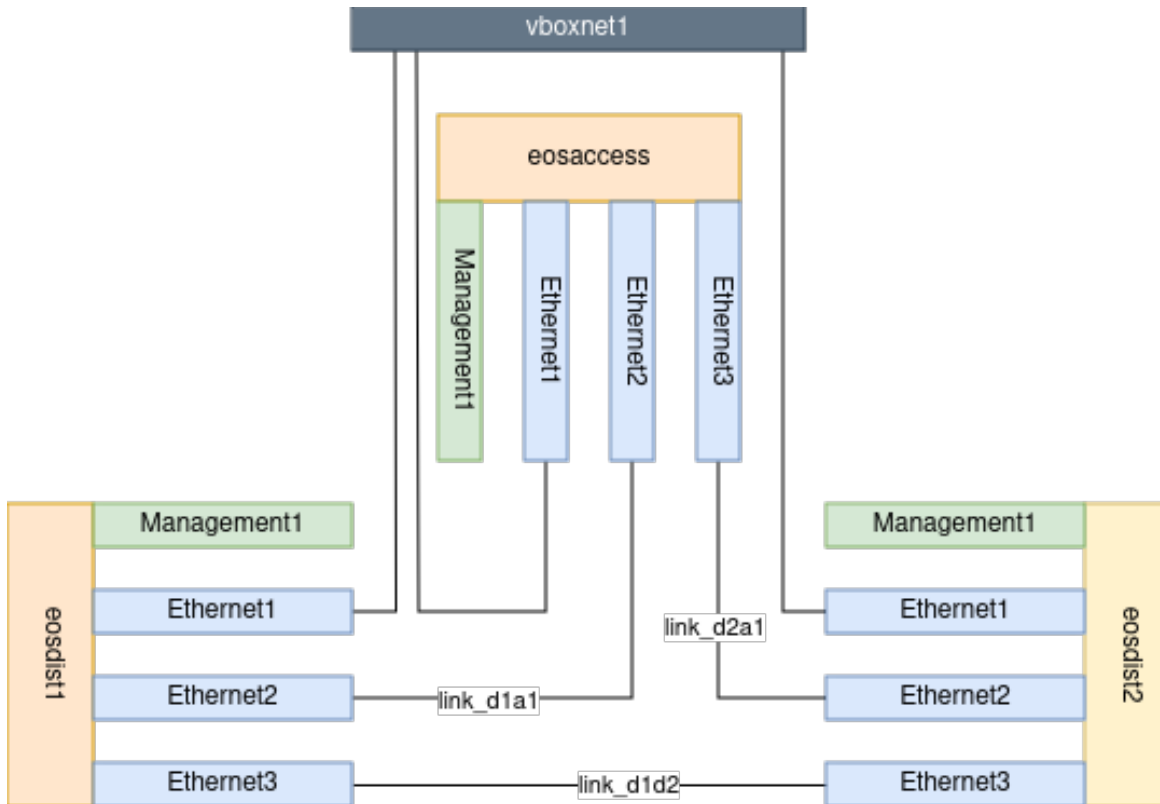


CNaaS NMS Development Environment

In addition to installing the requirements for running the Python code for [CNaaS-NMS](#) you might also want a test environment so you can run integration tests for your newly developed code. For this you will need docker to run all the components of CNaaS, and a virtualization software to run some virtual switches. In this example we will use VirtualBox and Arista vEOS switches.



Create VMs

Download the VMDK for Arista vEOS (tested with vEOS-lab-4.22.3M.vmdk , possibly issues with early 4.23 releases?). Copy this file into three new VMDK files that we will use to create the actual VMs:

- eosdist1.vmdk
- eosdist2.vmdk
- eosaccess.vmdk

Then start VirtualBox and create three new VMs, using **2 GB memory** each and choose to **point them to an existing harddrive file** (you will need to "add" the VMDK files you copied earlier to the "Virtual media manager" in VirtualBox). Choose

Linux Fedora 64-bit as type and version.

Go into the menu *FileToolsNetwork Manager...* in VirtualBox and create a new network called **vboxnet1** for example, and enter **IP 10.100.2.2 / 255.255.255.0 (no DHCP server)**. This will be used on NIC2 below. On Linux/MAC you need to allow this IP-range in by creating `/etc/vbox/networks.conf` and specifying allowed ranges there. For example, to allow 10.0.0.0/8 and 192.168.0.0/16 IPv4 ranges as well as 2001::/64 range put the following lines into `/etc/vbox/networks.conf`:

```
* 10.0.0.0/8 192.168.0.0/16
* 2001::/64
```

After creating the new VMs, we need to configure them with the following network adapters:

eosdist1:

Make sure all NICs are "Intel PRO/1000 T Server" or Desktop, but **not** "MT", and NIC 2-4 have Promiscuous mode: Allow all

- NIC1: NAT (Management1)
- NIC2: Host-only adapter: **vboxnet1** (Ethernet1)
- NIC3: Internal network: link_d1a1 (Ethernet2)
- NIC4: Internal network: link_d1d2 (Ethernet3)

eosdist2:

Make sure all NICs are "Intel PRO/1000 T Server" or Desktop, but **not** "MT", and NIC 2-4 have Promiscuous mode: Allow all

- NIC1: NAT (Management1)
- NIC2: Host-only adapter: **vboxnet1** (Ethernet1)
- NIC3: Internal network: link_d2a1 (Ethernet2)
- NIC4: Internal network: link_d1d2 (Ethernet3)

eosaccess:

Make sure all NICs are "Intel PRO/1000 T Server" or Desktop, but **not** "MT", and NIC 2-4 have Promiscuous mode: Allow all

- NIC1: NAT (Management1)
- NIC2: Host-only adapter: **vboxnet1** (Ethernet1)
- NIC3: Internal network: link_d1a1 (Ethernet2)

- NIC4: Internal network: link_d2a1 (Ethernet3)

You will also need to add some static routing on your host so return traffic will find it's way through eosdist1 to the correct VM:

```
sudo ip route add 10.0.6.0/24 via 10.100.2.101 dev vboxnet1
sudo ip route add 192.168.0.0/24 via 10.100.2.101 dev vboxnet1
sudo ip route add 10.100.3.101/32 via 10.100.2.101 dev vboxnet1
sudo ip route add 10.100.3.102/32 via 10.100.2.102 dev vboxnet1
```

These commands will not persist through a reboot of the host, and they must be added after Virtualbox/vboxnet1 adapter is started.

Configure VMs

Start up eosdist1 and eosdist2. Login with **admin** then <enter>. Enter the command `zerotouch cancel` when they have booted up. To gain privileges and enter configure mode, type the following in the console

```
enable
configure terminal
```

Then enter a config like this using on eosdist1:

```
hostname eosdist1
username admin privilege 15 role network-admin secret abc123abc123
vrf instance MGMT
interface Ethernet1
  no switchport
  vrf MGMT
  ip address 10.100.2.101/24
  no lldp transmit
  no lldp receive
interface Ethernet2
  description DOWNLINK
  switchport mode trunk
  channel-group 3 mode active
!
interface Port-Channel3
  description DOWNLINK
  switchport mode trunk
  port-channel lacp fallback individual
  port-channel lacp fallback timeout 3
!
interface Loopback1
  vrf MGMT
  ip address 10.100.3.101/32
!
interface Vlan1
  description ZTP DHCP
  vrf MGMT
  ip address 192.168.0.1/24
  ip helper-address 10.100.2.2
ip routing vrf MGMT
management api http-commands
  no shutdown
!
vrf MGMT
  no shutdown
```

Note: Don't forget to save configuration with `write`!

Mappings between VirtualBox and eosdist1 interfaces should be:

- Adapter1/NIC1 in Virtualbox should correspond to the interface called Management1 inside the VM.
- Adapter2/NIC2 (vboxnet1) Ethernet1 in the VM.
- Adapter3/NIC3 (link_d1a1) Ethernet2 in the VM.
- Adapter4/NIC4 (link_d1d2) Ethernet3 in the VM.

Eosdist2 only needs a hostname of "eosdist2" for the current tests to run, but you could also configure it in a similar way to eosdist1.

To test that routing through eosdist1 works correctly you can run some ping commands from inside the eosdist1 VM:

```
ping vrf MGMT 10.100.2.2
ping vrf MGMT 10.100.2.2 source 192.168.0.1
```

If the first command doesn't work something with the interface configuration might be wrong. If the second command doesn't work, it might be "ip route add" commands in the previous section is missing.

If you can not ping, the problem can be the firewall on your machine. The network is created by VirtualBox is on the host machine. The following commands show how to allow the communication for ping and ssh with nft:

```

sudo nft add rule inet filter input ip saddr { 10.100.2.101/24 } tcp dport 22 counter accept comment "allow-ssh-fr-vbox-eth"
sudo nft add rule inet filter input ip saddr { 10.100.2.101/24 } icmp type echo-request accept comment "allow-ping-fr-vbox-eth"

sudo nft add rule inet filter input ip saddr { 192.168.0.1/24 } tcp dport 22 counter accept comment "allow-ssh-fr-vbox-vll"
sudo nft add rule inet filter input ip saddr { 192.168.0.1/24 } icmp type echo-request accept comment "allow-ping-fr-vbox-vll"

```

Run integrationtests.sh

Git clone cnaas-nms and go to the directory *test/*, there you will find a script called *integrationtest.sh*. This script will start the necessary docker containers and then begin running some tests for ZTP and so on. Before starting the docker containers we need to create a few volumes:

```

docker volume create cnaas-templates
docker volume create cnaas-settings
docker volume create cnaas-postgres-data
docker volume create cnaas-jwtcert
docker volume create cnaas-cacert

```

To get authentication working you need a JWT certificate. You can either download this [dummy public.pem](#) cert for example and place it inside the API container at */opt/cnaas/jwtcert/public.pem* (or setup some external JWT server like [SUNET auth poc](#)).

You are now ready to start the integration tests. When running *integrationtests.sh* it will wait for a device to enter the DISCOVERED state for 10 minutes, so you can start by booting up eosaccess now, and then start *integrationtests.sh*. eosaccess should start ZTP boot via DHCP from the DHCPd container started by *integrationtests.sh*, and then reboot once again. The second time it starts up a job should be scheduled to discover the device, you can check the progress here by tailing logs from the dhcp and api containers like this: `docker logs -f docker_cnaas_dhcpd_1` (or `docker_cnaas_api_1`).

After a device in state DISCOVERED has been found ZTP will automatically start and then the rest of integration tests will run. After the integration tests has completed you will get a prompt to continue, if you want to log in to VMs or docker containers to check some results or errors now is a good time, otherwise press *Enter* to continue. Next the script will wait for jobs to finish and then run some unit tests. Once all this is completed the code coverage results will be gathered and optionally uploaded to codecov.io. Code coverage reports will be mapped to your currently checked out branch of git.

Troubleshooting

After running *integrationtests.sh* 5 containers should be started. You can check their status with the command `docker ps`:

```

[johanmarcusson@indy-x1 docker]$ docker ps

```

CONTAINER ID	IMAGE	COMMAND	CREATED
STATUS	PORTS	NAMES	
9d1c5ecd239e	docker_cnaas_dhcpd	"/bin/sh -c 'supervi...'"	3 minutes ago
minutes	0.0.0.0:67->67/udp	docker_cnaas_dhcpd_1	
0b71d9f984b1	docker_cnaas_api	"/bin/sh -c 'supervi...'"	3 minutes ago
minutes	0.0.0.0:443->1443/tcp	docker_cnaas_api_1	
d21cfc296bc0	docker.sunet.se/auth-server-poc:latest	"/bin/sh -c 'supervi...'"	3 minutes ago
minutes	0.0.0.0:2443->1443/tcp	docker_cnaas_auth_1	
d933a4324e1c	docker.sunet.se/cnaas/httpd	"/bin/sh -c 'supervi...'"	3 minutes ago
minutes	1443/tcp, 0.0.0.0:80->1180/tcp	docker_cnaas_httpd_1	
6b3bee0d55ce	docker_cnaas_postgres	"docker-entrypoint.s..."	9 days ago
days	0.0.0.0:5432->5432/tcp	docker_cnaas_postgres_1	
53c953d2db8f	docker_cnaas_redis	"docker-entrypoint.s..."	9 days ago
days	0.0.0.0:6379->6379/tcp	docker_cnaas_redis_1	

If you have some other service running on port tcp 443 or udp 67 for example that container will not be able to start. Use `netstat -anp | grep <port>` to find out what program on your computer might be conflicting with the container and stop it.

If *integrationtests.sh* crashes and it will not stop the containers after exiting, so you might want to manually bring down the containers. You can do this with `docker-compose`:

```
docker-compose -f docker/docker-compose.yaml down
```

To rebuild just the API container you can use the command:

```
docker-compose build --no-cache cnaas_api
```

Or if you want to try build a specific branch:

```
docker-compose build --no-cache --build-arg BUILD_BRANCH=feature.myfeature cnaas_api
```

Resetting / rerun of tests

You might need to run the tests many times to get everything to pass cleanly with a good code coverage. To make things go a bit faster you can skip the DHCP boot / ZTP of the eosaccess switch, then log in via SSH and paste something like this:

```
conf t
hostname mac-0800275C091F
interface Ethernet2
  no channel-group 1 mode active
  switchport mode access
interface Ethernet3
  no channel-group 1 mode active
  switchport mode access
int vlan 600
  shutdown
inte vlan1
  ip address dhcp
  dhcp client accept default-route
end
```

Usually eosdist1 does not come back to "fallback" mode on it's portchannel automatically, so you will need to log in and run: `conf t int eth2 shutdown no shutdown end` to reset it.

You also need to reset the postgres database, the easiest way to do this while the docker container is run running is simply: `docker volume rm cnaas-postgres-data && docker volume create cnaas-postgres-data`

Then start `integrationtests.sh` again and to trigger the DHCP hook to start ZTP log in to eosaccess and run: `conf t int vlan1 shutdown no shutdown end`, check the logs of the DHCP container and wait for the DHCP lease to be given out and make sure it added a new device to the database. When that is done do shut/no shut on vlan1 once more to trigger discovery of the device, this will take a few minutes but then the integration tests should run through.

If you don't have enough memory or don't want to start eosdist2 you can skip that VM entirely, but then you have to manually "fake" the neighbor in the database by inserting this row into PostgreSQL exactly at the point where eosaccess got it's first DHCP lease:

```
docker exec -i -t docker_cnaas_postgres_1 psql -U cnaas
INSERT INTO linknet (device_a_id, device_b_id, device_a_port, device_b_port) VALUES (3, 2, 'Ethernet3',
'Ethernet2');
```

Running the API outside of docker

For faster development and debugging you might want to run just the python API part on your local system instead of in a docker container. This is described in <https://github.com/SUNET/cnaas-nms> README.

The docker image runs debian 10 which uses Python3.7.3. If your system python is not using this version you might want to use pyenv:

```
apt-get/dnf install pyenv
pyenv virtualenv 3.7.3 cnaas373
cd cnaas-nms/
cp etc/db_config.yml.sample /etc/cnaas-nms/db_config.yml
pyenv local cnaas373
python3 -m pip install -r requirements.txt
cd src/
python3 -m cnaas_nms.run
```

You will need to have postgres and redis running to be able to start the API. You can start just those containers with:

```
cd docker/
docker-compose up --no-deps -d cnaas_postgres
docker-compose up --no-deps -d cnaas_redis
```