

1. Inicialização e execução do Terraform

Prints mostrando a execução dos comandos `terraform init`, `terraform plan` e `terraform apply`, responsáveis por preparar e aplicar a configuração para criação das máquinas virtuais no VirtualBox.

```
lucas@lucas-Nitro-AN517-54:~/Documentos/ifes-3ano/SI-IFES-III/SERINT/atividades/tarefa
01$ terraform init
```

Initializing the backend...

Initializing provider plugins...

- Reusing previous version of terra-farm/virtualbox from the dependency lock file
- Using previously-installed terra-farm/virtualbox v0.2.2-alpha.1

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see any changes that are required for your infrastructure. All Terraform commands should now work.

If you ever set or change modules or backend configuration for Terraform, rerun this command to reinitialize your working directory. If you forget, other commands will detect it and remind you to do so if necessary.

```
lucas@lucas-Nitro-AN517-54:~/Documentos/ifes-3ano/SI-IFES-III/SERINT/atividades/tarefa
01$ terraform plan
```

Terraform used the selected providers to generate the following execution plan. Resource actions

are indicated with the following symbols:

+ create

Terraform will perform the following actions:

```
# virtualbox_vm.node[0] will be created
```

```
+ resource "virtualbox_vm" "node" {
```

```
  + cpus    = 1
```

```
  + id      = (known after apply)
```

```
  + image   =
```

```
"https://app.vagrantup.com/ubuntu/boxes/focal64/versions/20230803.0.0/providers/virtualbox
.box"
```

```
  + memory  = "1024 mib"
```

```
  + name    = "node-01"
```

```
  + status  = "running"
```

```
  # (1 unchanged attribute hidden)
```

```

+ network_adapter {
  + device          = "IntelPro1000MTServer"
  + ipv4_address     = (known after apply)
  + ipv4_address_available = (known after apply)
  + mac_address      = (known after apply)
  + status           = (known after apply)
  + type             = "internal"
}
}

# virtualbox_vm.node[1] will be created
+ resource "virtualbox_vm" "node" {
  + cpus    = 1
  + id      = (known after apply)
  + image   =
"https://app.vagrantup.com/ubuntu/boxes/focal64/versions/20230803.0.0/providers/virtualbox
.box"
  + memory  = "1024 mib"
  + name    = "node-02"
  + status  = "running"
  # (1 unchanged attribute hidden)

  + network_adapter {
    + device          = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)
    + ipv4_address_available = (known after apply)
    + mac_address      = (known after apply)
    + status           = (known after apply)
    + type             = "internal"
  }
}

# virtualbox_vm.node[2] will be created
+ resource "virtualbox_vm" "node" {
  + cpus    = 1
  + id      = (known after apply)
  + image   =
"https://app.vagrantup.com/ubuntu/boxes/focal64/versions/20230803.0.0/providers/virtualbox
.box"
  + memory  = "1024 mib"
  + name    = "node-03"
  + status  = "running"
  # (1 unchanged attribute hidden)

  + network_adapter {
    + device          = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)

```

```

    + ipv4_address_available = (known after apply)
    + mac_address           = (known after apply)
    + status                 = (known after apply)
    + type                   = "internal"
  }
}

# virtualbox_vm.node[3] will be created
+ resource "virtualbox_vm" "node" {
  + cpus    = 1
  + id      = (known after apply)
  + image   =
"https://app.vagrantup.com/ubuntu/boxes/focal64/versions/20230803.0.0/providers/virtualbox
.box"
  + memory  = "1024 mib"
  + name    = "node-04"
  + status  = "running"
  # (1 unchanged attribute hidden)

  + network_adapter {
    + device          = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)
    + ipv4_address_available = (known after apply)
    + mac_address      = (known after apply)
    + status           = (known after apply)
    + type             = "internal"
  }
}

```

Plan: 4 to add, 0 to change, 0 to destroy.

Note: You didn't use the -out option to save this plan, so Terraform can't guarantee to take exactly these actions if you run "terraform apply" now.

lucas@lucas-Nitro-AN517-54:~/Documentos/ifes-3ano/SI-IFES-III/SERINT/atividades/tarefa
01\$ terraform apply

Terraform used the selected providers to generate the following execution plan. Resource actions

are indicated with the following symbols:

+ create

Terraform will perform the following actions:

virtualbox_vm.node[0] will be created

```
+ resource "virtualbox_vm" "node" {
  + cpus   = 1
  + id     = (known after apply)
  + image  =
```

```
"https://app.vagrantup.com/bento/boxes/ubuntu-20.04/versions/202401.25.0/providers/virtual
box.box"
```

```
  + memory = "1024 mib"
  + name   = "node-01"
  + status = "running"
```

```
  + network_adapter {
    + device           = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)
    + ipv4_address_available = (known after apply)
    + mac_address      = (known after apply)
    + status           = (known after apply)
    + type             = "internal"
```

```
  }
}
```

```
# virtualbox_vm.node[1] will be created
```

```
+ resource "virtualbox_vm" "node" {
  + cpus   = 1
  + id     = (known after apply)
  + image  =
```

```
"https://app.vagrantup.com/bento/boxes/ubuntu-20.04/versions/202401.25.0/providers/virtual
box.box"
```

```
  + memory = "1024 mib"
  + name   = "node-02"
  + status = "running"
```

```
  + network_adapter {
    + device           = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)
    + ipv4_address_available = (known after apply)
    + mac_address      = (known after apply)
    + status           = (known after apply)
    + type             = "internal"
```

```
  }
}
```

```
# virtualbox_vm.node[2] will be created
```

```
+ resource "virtualbox_vm" "node" {
  + cpus   = 1
  + id     = (known after apply)
  + image  =
```

```
"https://app.vagrantup.com/bento/boxes/ubuntu-20.04/versions/202401.25.0/providers/virtual
box.box"
```

```

+ memory = "1024 mib"
+ name   = "node-03"
+ status = "running"

+ network_adapter {
  + device          = "IntelPro1000MTServer"
  + ipv4_address     = (known after apply)
  + ipv4_address_available = (known after apply)
  + mac_address      = (known after apply)
  + status           = (known after apply)
  + type             = "internal"
}
}

# virtualbox_vm.node[3] will be created
+ resource "virtualbox_vm" "node" {
  + cpus   = 1
  + id     = (known after apply)
  + image =
"https://app.vagrantup.com/bento/boxes/ubuntu-20.04/versions/202401.25.0/providers/virtual
box.box"
  + memory = "1024 mib"
  + name   = "node-04"
  + status = "running"

  + network_adapter {
    + device          = "IntelPro1000MTServer"
    + ipv4_address     = (known after apply)
    + ipv4_address_available = (known after apply)
    + mac_address      = (known after apply)
    + status           = (known after apply)
    + type             = "internal"
  }
}

```

Plan: 4 to add, 0 to change, 0 to destroy.

Do you want to perform these actions?

Terraform will perform the actions described above.

Only 'yes' will be accepted to approve.

Enter a value: yes

```

virtualbox_vm.node[3]: Creating...
virtualbox_vm.node[1]: Creating...
virtualbox_vm.node[0]: Creating...
virtualbox_vm.node[2]: Creating...
virtualbox_vm.node[2]: Still creating... [10s elapsed]

```

virtualbox_vm.node[3]: Still creating... [10s elapsed]
virtualbox_vm.node[0]: Still creating... [10s elapsed]
virtualbox_vm.node[1]: Still creating... [10s elapsed]
virtualbox_vm.node[3]: Still creating... [20s elapsed]
virtualbox_vm.node[2]: Still creating... [20s elapsed]
virtualbox_vm.node[1]: Still creating... [20s elapsed]
virtualbox_vm.node[0]: Still creating... [20s elapsed]
virtualbox_vm.node[0]: Still creating... [30s elapsed]
virtualbox_vm.node[1]: Still creating... [30s elapsed]
virtualbox_vm.node[3]: Still creating... [30s elapsed]
virtualbox_vm.node[2]: Still creating... [30s elapsed]
virtualbox_vm.node[0]: Still creating... [40s elapsed]
virtualbox_vm.node[3]: Still creating... [40s elapsed]
virtualbox_vm.node[2]: Still creating... [40s elapsed]
virtualbox_vm.node[1]: Still creating... [40s elapsed]
virtualbox_vm.node[1]: Still creating... [50s elapsed]
virtualbox_vm.node[2]: Still creating... [50s elapsed]
virtualbox_vm.node[0]: Still creating... [50s elapsed]
virtualbox_vm.node[3]: Still creating... [50s elapsed]
virtualbox_vm.node[1]: Still creating... [1m0s elapsed]
virtualbox_vm.node[3]: Still creating... [1m0s elapsed]
virtualbox_vm.node[2]: Still creating... [1m0s elapsed]
virtualbox_vm.node[0]: Still creating... [1m0s elapsed]

|
| Error: [ERROR] Wait VM until ready: waiting for VM (node-03) to become ready: [ERROR]
| can't convert vbox network to terraform data: No match with get guestproperty output

|
| with virtualbox_vm.node[2],
| on main.tf line 29, in resource "virtualbox_vm" "node":
| 29: resource "virtualbox_vm" "node" {
|
|

|
| Error: [ERROR] Wait VM until ready: waiting for VM (node-04) to become ready: [ERROR]
| can't convert vbox network to terraform data: No match with get guestproperty output

|
| with virtualbox_vm.node[3],
| on main.tf line 29, in resource "virtualbox_vm" "node":
| 29: resource "virtualbox_vm" "node" {
|
|

|
| Error: [ERROR] Wait VM until ready: waiting for VM (node-02) to become ready: [ERROR]
| can't convert vbox network to terraform data: No match with get guestproperty output

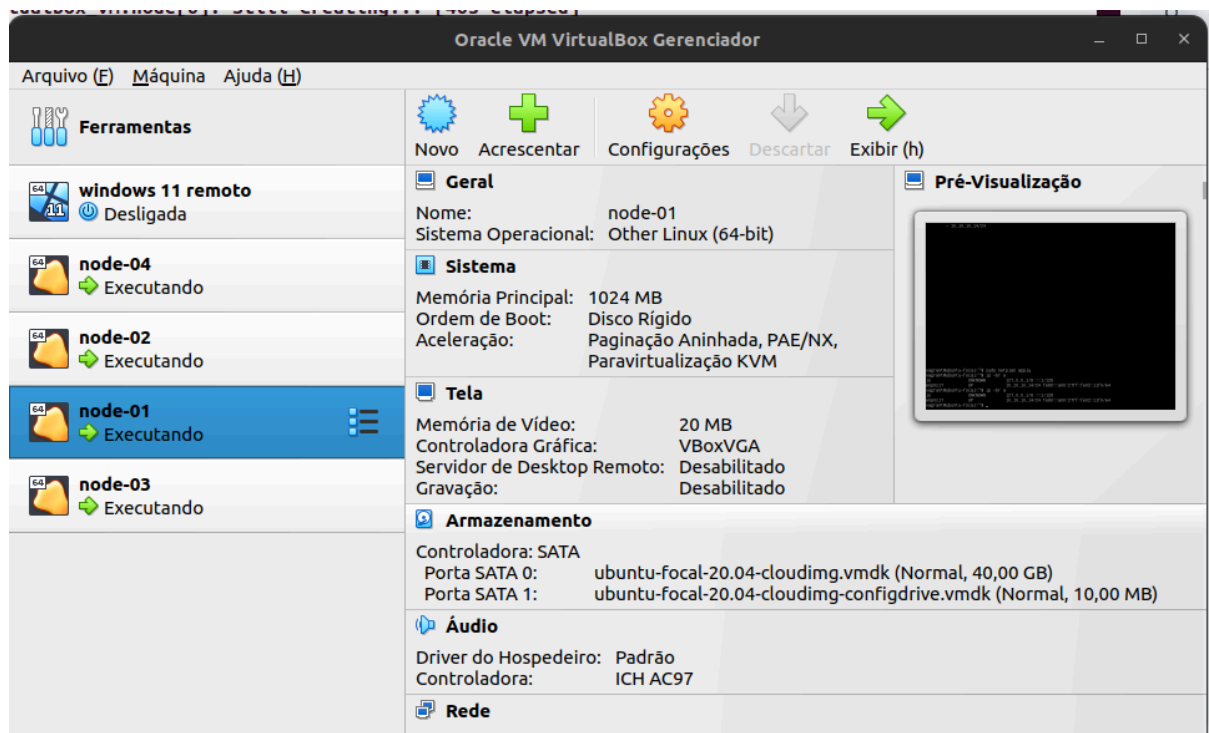
|
| with virtualbox_vm.node[1],
| on main.tf line 29, in resource "virtualbox_vm" "node":
| 29: resource "virtualbox_vm" "node" {
|

Error: [ERROR] Wait VM until ready: waiting for VM (node-01) to become ready: [ERROR]
can't convert vbox network to terraform data: No match with get_guestproperty output

```
with virtualbox_vm.node[0],  
on main.tf line 29, in resource "virtualbox_vm" "node":  
29: resource "virtualbox_vm" "node" {
```

2. Configuração das interfaces de rede no VirtualBox

Prints confirmando que todas as VMs (**node-01** a **node-04**) estão com o adaptador configurado como **Rede Interna** e utilizando o mesmo nome de rede (**intnet**), garantindo comunicação apenas entre elas.



3. Configuração de IP estático em cada VM

IP configurado manualmente via Netplan no **node-XX**, utilizando a interface **enp0s17** e endereço na faixa **10.10.10.0/24**, sem gateway ou DNS para manter isolamento.

Node01:

node-01 [Executando] - Oracle VM VirtualBox

Arquivo Máquina Visualizar Entrada Dispositivos Ajuda

GNU nano 4.8 /etc/netplan/90-static.yaml

```
network:
  version: 2
  ethernets:
    enp0s17:
      dhcp4: false
      addresses:
        - 10.10.10.14/24
```

[Read 7 lines]

Get Help	Write Out	Where Is	Cut Text	Justify	Cur Pos	Undo
Exit	Read File	Replace	Paste Text	To Spell	Go To Line	Redo

Ctrl Direito


```
node-01 [Executando] - Oracle VM VirtualBox
Arquivo  Máquina  Visualizar  Entrada  Dispositivos  Ajuda
ethernets:
  enp0s17:
    dhcp4: false
    addresses:
      - 10.10.10.14/24

vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN      127.0.0.1/8 ::1/128
enp0s17           UP          10.10.10.14/24 fe80::a00:27ff:fe02:11f0/64
vagrant@ubuntu-focal:~$ _
```

Node02:

```
node-02 [Executando] - Oracle VM VirtualBox
Arquivo Máquina Visualizar Entrada Dispositivos Ajuda

Ubuntu 20.04.6 LTS ubuntu-focal tty1
ubuntu-focal login: vagrant
Password:
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-216-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

System information as of Sat Aug  9 14:52:15 UTC 2025

System load: 0.0          Memory usage: 17%   Processes:   91
Usage of /:  3.6% of 38.70GB Swap usage:   0%   Users logged in: 0

Expanded Security Maintenance for Infrastructure is not enabled.

0 updates can be applied immediately.

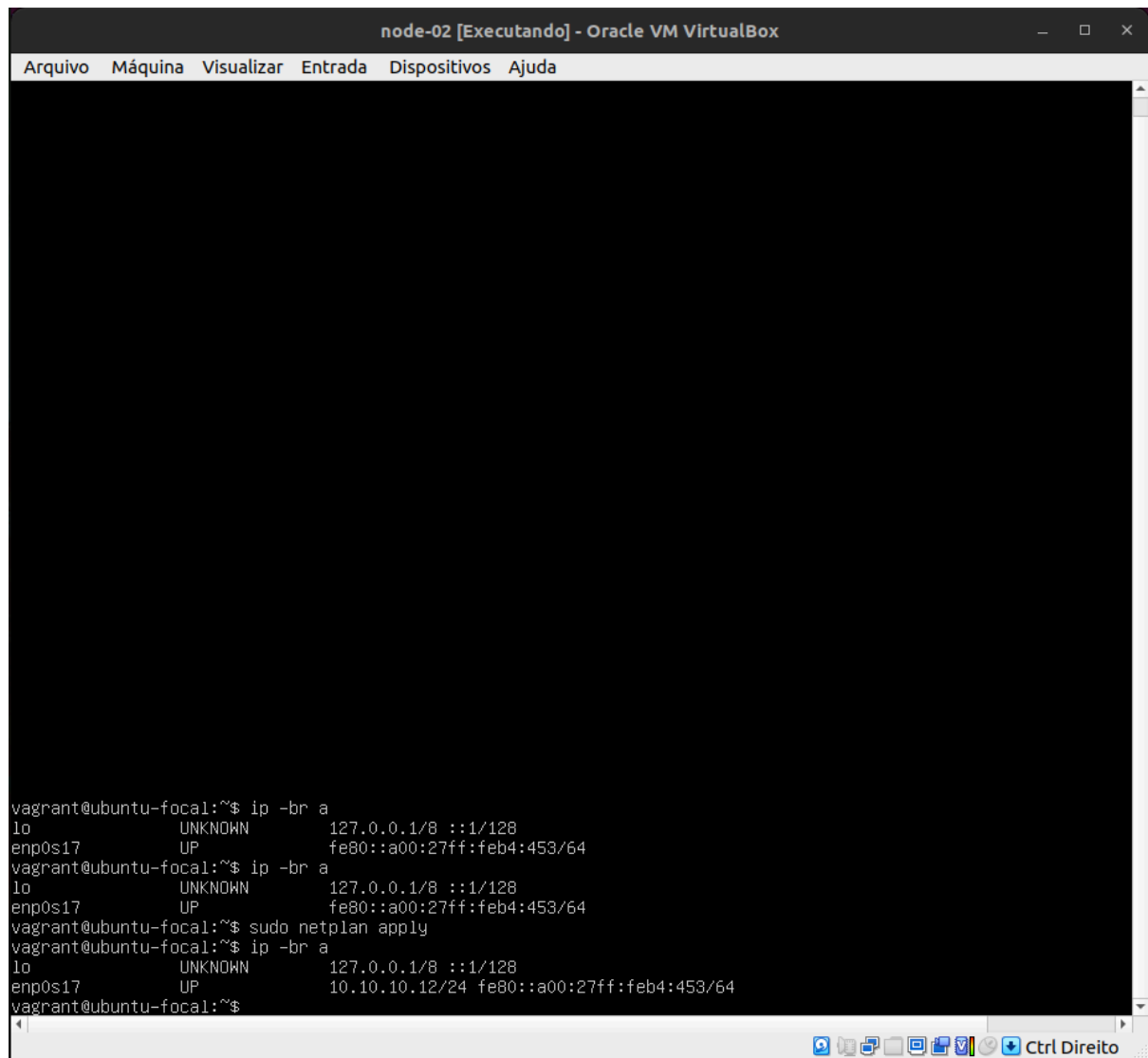
Enable ESM Infra to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN    127.0.0.1/8 ::1/128
enp0s17           UP        fe80::a00:27ff:feb4:453/64
vagrant@ubuntu-focal:~$ _
```



```
vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN    127.0.0.1/8 ::1/128
enp0s17           UP          fe80::a00:27ff:feb4:453/64
vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN    127.0.0.1/8 ::1/128
enp0s17           UP          fe80::a00:27ff:feb4:453/64
vagrant@ubuntu-focal:~$ sudo netplan apply
vagrant@ubuntu-focal:~$ ip -br a
lo                UP          127.0.0.1/8 ::1/128
enp0s17           UP          10.10.10.12/24 fe80::a00:27ff:feb4:453/64
vagrant@ubuntu-focal:~$
```

Node04:

node-04 [Executando] - Oracle VM VirtualBox

Arquivo Máquina Visualizar Entrada Dispositivos Ajuda

GNU nano 4.8 /etc/netplan/99-static.yaml

```
network:
  version: 2
  ethernet:
    enp0s17:
      dhcp4: false
      addresses:
        - 10.10.10.13/24
```

nan@node04:~\$

Ctrl Direito

```
node-04 [Executando] - Oracle VM VirtualBox
Arquivo  Máquina  Visualizar  Entrada  Dispositivos  Ajuda

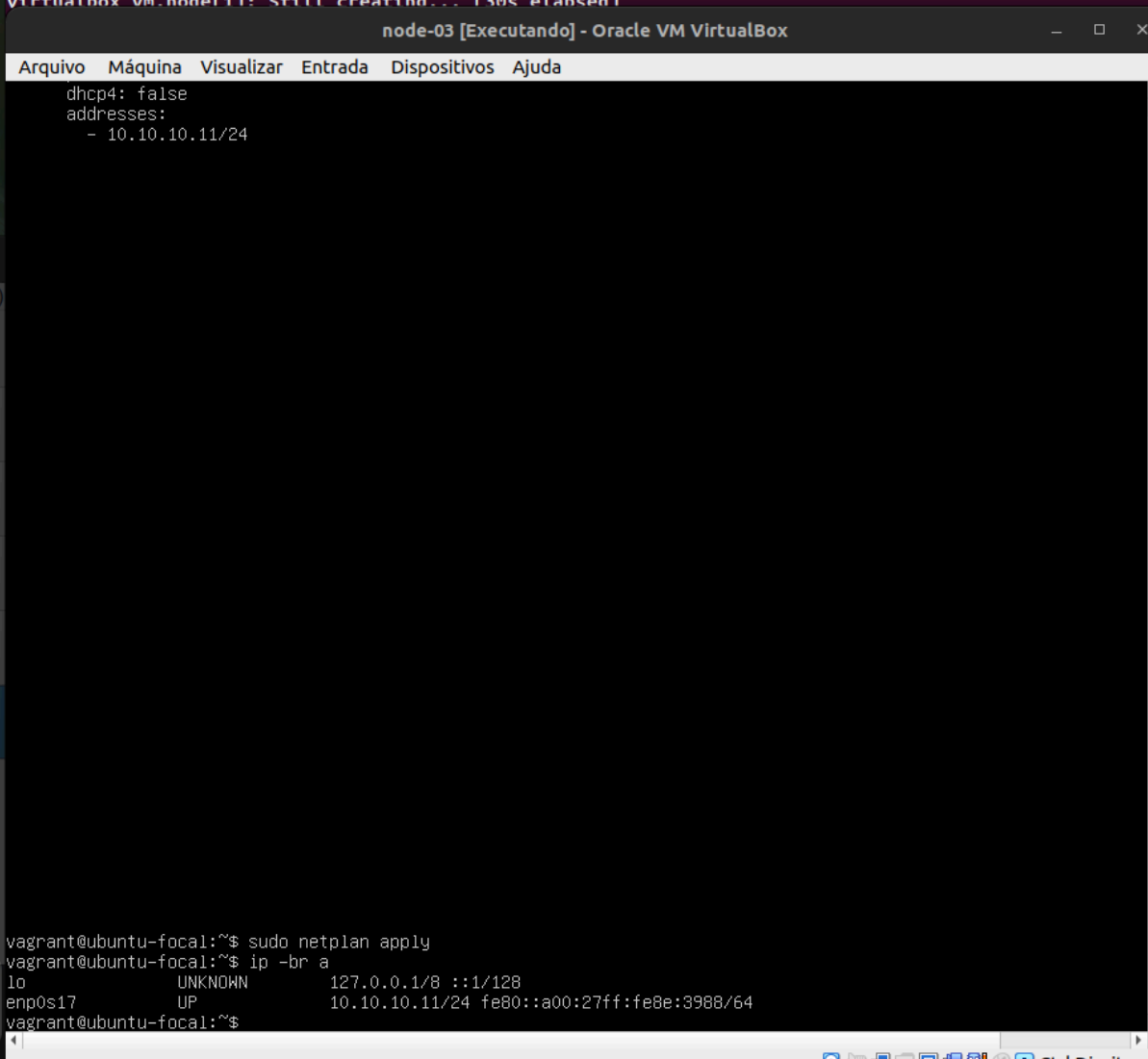
dhcp4: false
addresses:
- 10.10.10.13/24

vagrant@ubuntu-focal:~$ sudo netplan apply
vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN      127.0.0.1/8 ::1/128
enp0s17           UP           10.10.10.13/24 fe80::a00:27ff:febb:231e/64
vagrant@ubuntu-focal:~$
```

Node03:

```
virtualbox__vm.node[0]: Still creating... [30s elapsed]
virtualbox__vm.node[1]: Still creating... [30s elapsed]
node-03 [Executando] - Oracle VM VirtualBox
Arquivo  Máquina  Visualizar  Entrada  Dispositivos  Ajuda
version: 2
ethernets:
  enp0s17:
    dhcp4: false
    addresses:
      - 10.10.10.11/24

vagrant@ubuntu-focal:~$ sudo netplan apply
vagrant@ubuntu-focal:~$
```



```
node-03 [Executando] - Oracle VM VirtualBox
Arquivo  Máquina  Visualizar  Entrada  Dispositivos  Ajuda
dhcp4: false
addresses:
- 10.10.10.11/24

vagrant@ubuntu-focal:~$ sudo netplan apply
vagrant@ubuntu-focal:~$ ip -br a
lo                UNKNOWN    127.0.0.1/8 ::1/128
enp0s17           UP         10.10.10.11/24 fe80::a00:27ff:fe8e:3988/64
vagrant@ubuntu-focal:~$
```

4. Testes de comunicação entre as VMs

Teste de conectividade a partir do **node-XX** para os demais nós, confirmando que todos respondem com 0% de perda de pacotes.

```
node-03 [Executando] - Oracle VM VirtualBox
Arquivo  Máquina  Visualizar  Entrada  Dispositivos  Ajuda
-b        allow ping broadcast
-R        record route
-T <timestamp>  define timestamp, can be one of <tsonly|tsandaddr|tsprespec>

IPv6 options:
-6        use IPv6
-F <flowlabel>  define flow label, default is random
-N <nodeinfo opt> use icmp6 node info query, try <help> as argument

For more details see ping(8).
vagrant@ubuntu-focal:~$ ping -c 10.10.10.12
ping: invalid argument: '10.10.10.12'
vagrant@ubuntu-focal:~$ setxkbmap br

Command 'setxkbmap' not found, but can be installed with:

apt install x11-xkb-utils
Please ask your administrator.

vagrant@ubuntu-focal:~$ ping -c 3 10.10.10.12
PING 10.10.10.12 (10.10.10.12) 56(84) bytes of data.
64 bytes from 10.10.10.12: icmp_seq=1 ttl=64 time=18.1 ms
64 bytes from 10.10.10.12: icmp_seq=2 ttl=64 time=0.757 ms
64 bytes from 10.10.10.12: icmp_seq=3 ttl=64 time=0.919 ms

--- 10.10.10.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2006ms
rtt min/avg/max/mdev = 0.757/6.601/18.128/8.150 ms
vagrant@ubuntu-focal:~$ ping -c 3 10.10.10.13
PING 10.10.10.13 (10.10.10.13) 56(84) bytes of data.
64 bytes from 10.10.10.13: icmp_seq=1 ttl=64 time=0.545 ms
64 bytes from 10.10.10.13: icmp_seq=2 ttl=64 time=0.930 ms
64 bytes from 10.10.10.13: icmp_seq=3 ttl=64 time=0.691 ms

--- 10.10.10.13 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2030ms
rtt min/avg/max/mdev = 0.545/0.722/0.930/0.158 ms
vagrant@ubuntu-focal:~$ ping -c 3 10.10.10.14
PING 10.10.10.14 (10.10.10.14) 56(84) bytes of data.
64 bytes from 10.10.10.14: icmp_seq=1 ttl=64 time=1.12 ms
64 bytes from 10.10.10.14: icmp_seq=2 ttl=64 time=0.825 ms
64 bytes from 10.10.10.14: icmp_seq=3 ttl=64 time=0.835 ms

--- 10.10.10.14 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2008ms
rtt min/avg/max/mdev = 0.825/0.927/1.121/0.137 ms
vagrant@ubuntu-focal:~$
```