Lab 14. VyOS, Tunnel, Cable

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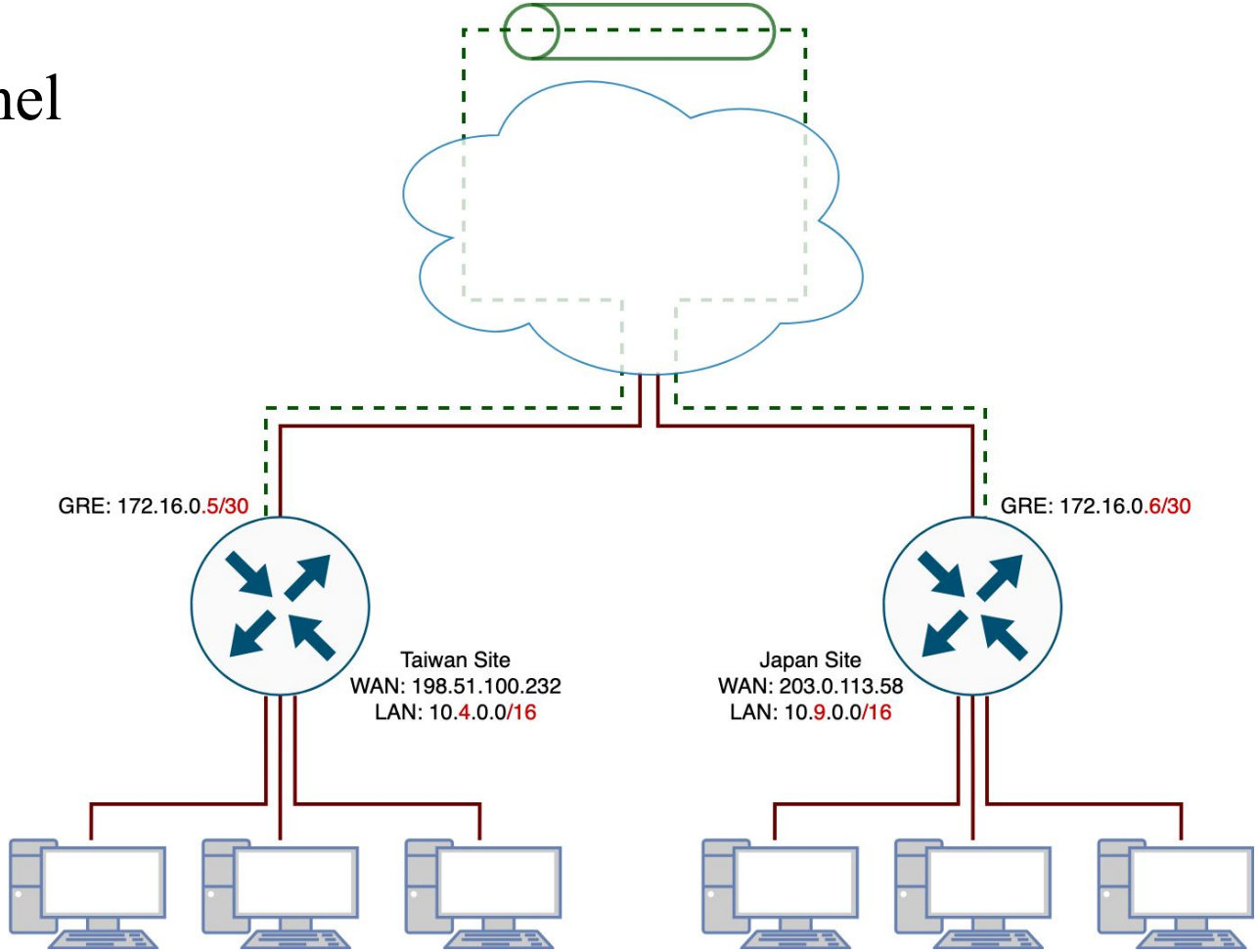
Credit to Sean

Tunnel

- Create an **overlay network** on an existing network.
- Connects two separated networks (e.g., due to geographic location)
- Encrypts and protects network traffic.
- Include site-to-site tunnels and client-server VPNs.
- Common protocols for Tunnel technology includes:
  - GRE
  - IPsec
  - L2TP
  - PPTP
  - PPPoE
  - VXLAN

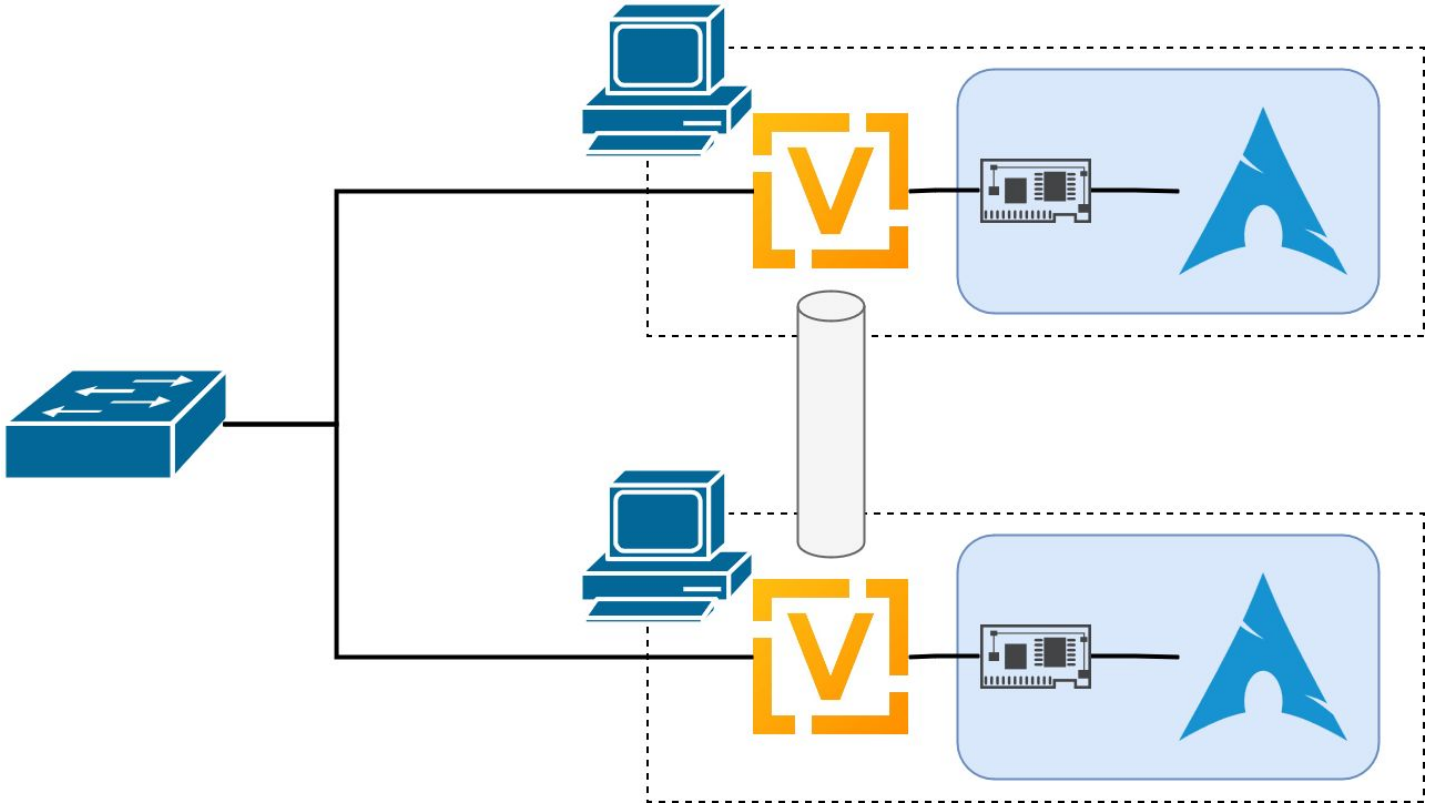
Site-to-Site Tunnel



What is VyOS

- Open source Network Operating System based on Debian
- Operation mode likes Cisco IOS
- Configuration mode likes Juniper Junos OS

Lab Scenario



Lab Spec (1/2)

- Interface
  - WAN: EC324's network
    - VirtualBox: Bridged Adapter
    - IP Address: 192.168.24.ID/24 (DHCP)
  - LAN: Gateway for your Intranet (Arch Linux)
    - VirtualBox: Internal Network
    - VyOS IP address: 172.20.ID.254/24
    - DHCP Range: 172.20.ID.{11 - 50}
  - GRE: Interface for GRE Tunnel
    - Your IP address: 10.ID1.ID2.1/30
    - Peer's IP address: 10.ID1.ID2.2/30

Lab Spec (2/2)

- OSPF
  - Area: **ID**
  - Router ID: 192.168.24.**ID** (Same as WAN address)
  - Interfaces: LAN and GRE
- Passwords
  - VyOS: `vyos` / `vyos`
  - ArchLinux: `ccna` / `ccna`

VyOS - Installation

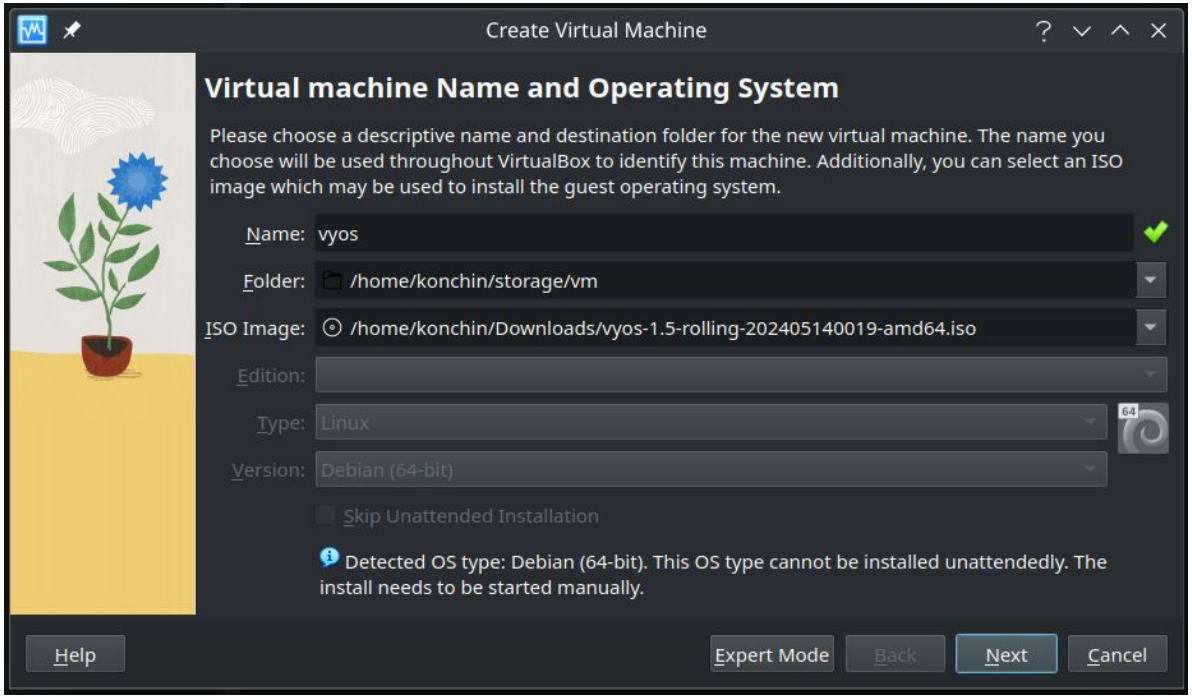
VyOS - VM Setting

The VyOS rolling release iso is in D:/

RAM: 1024MB

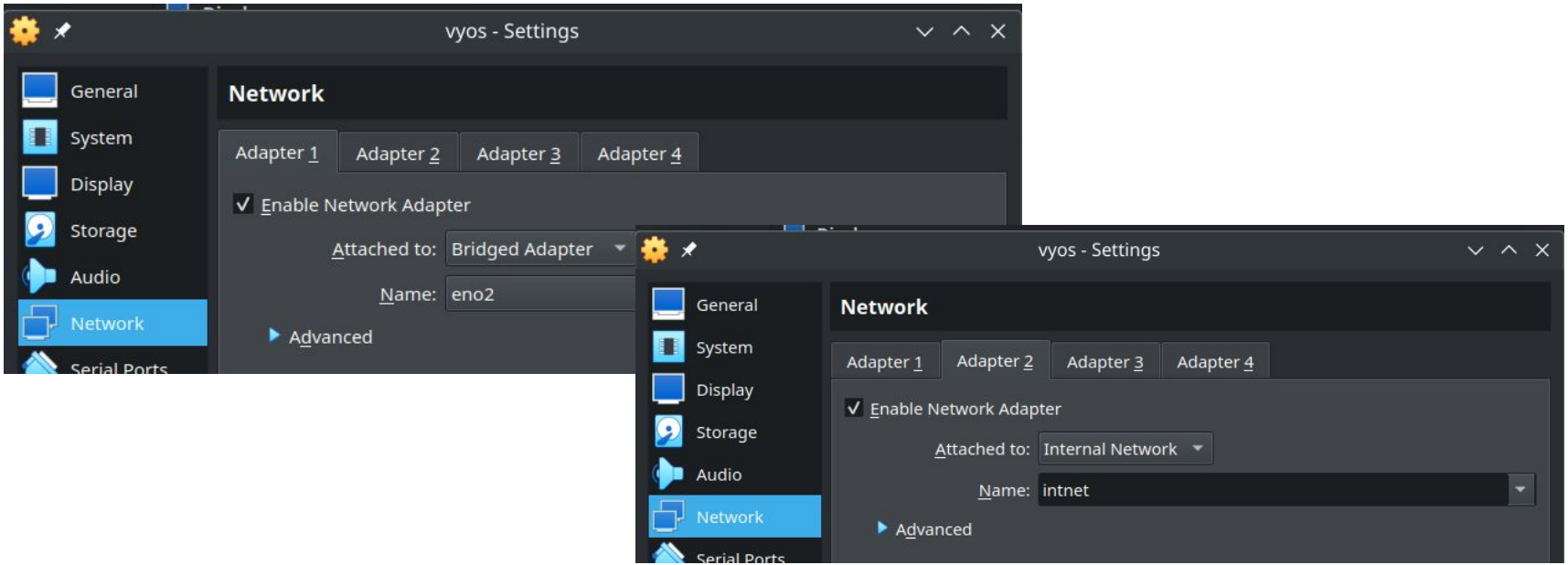
Processor: 1

Disk: 8G



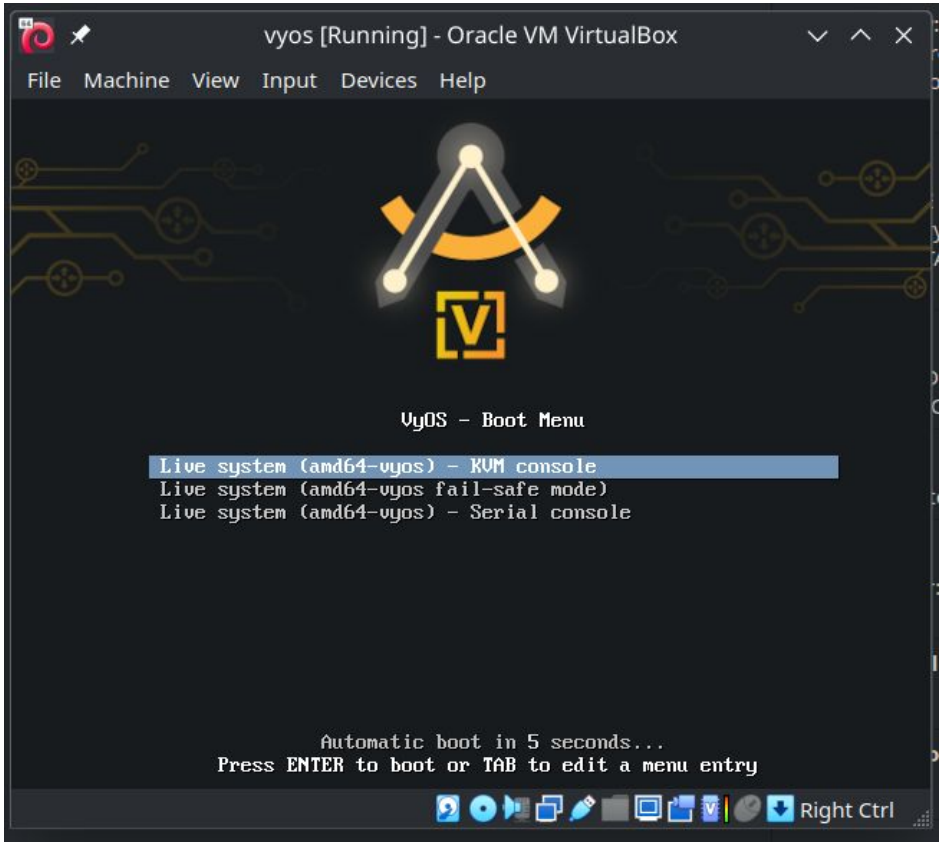
VyOS - Network Setting

- Adapter 1 - Bridged Adapter
- Adapter 2 - Internal Network



VyOS - ISO Boot up

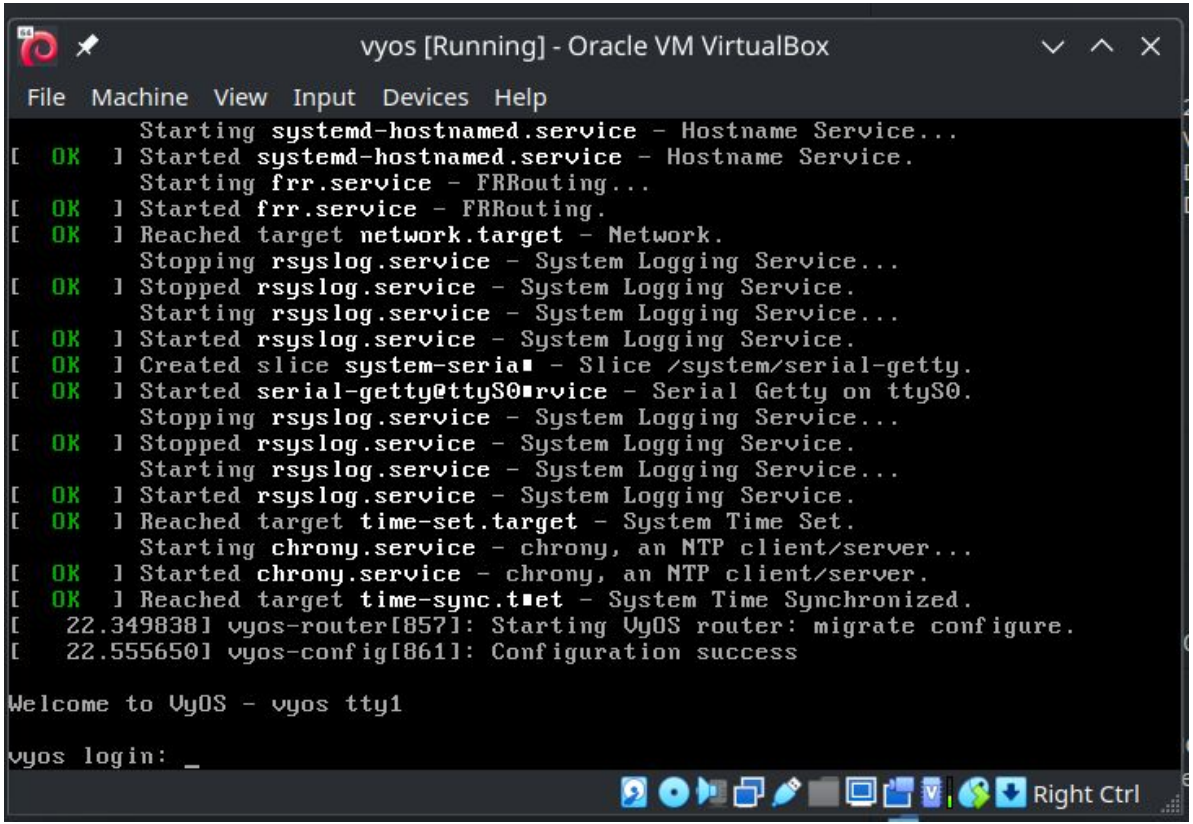
Choose the first one



VyOS - ISO Login

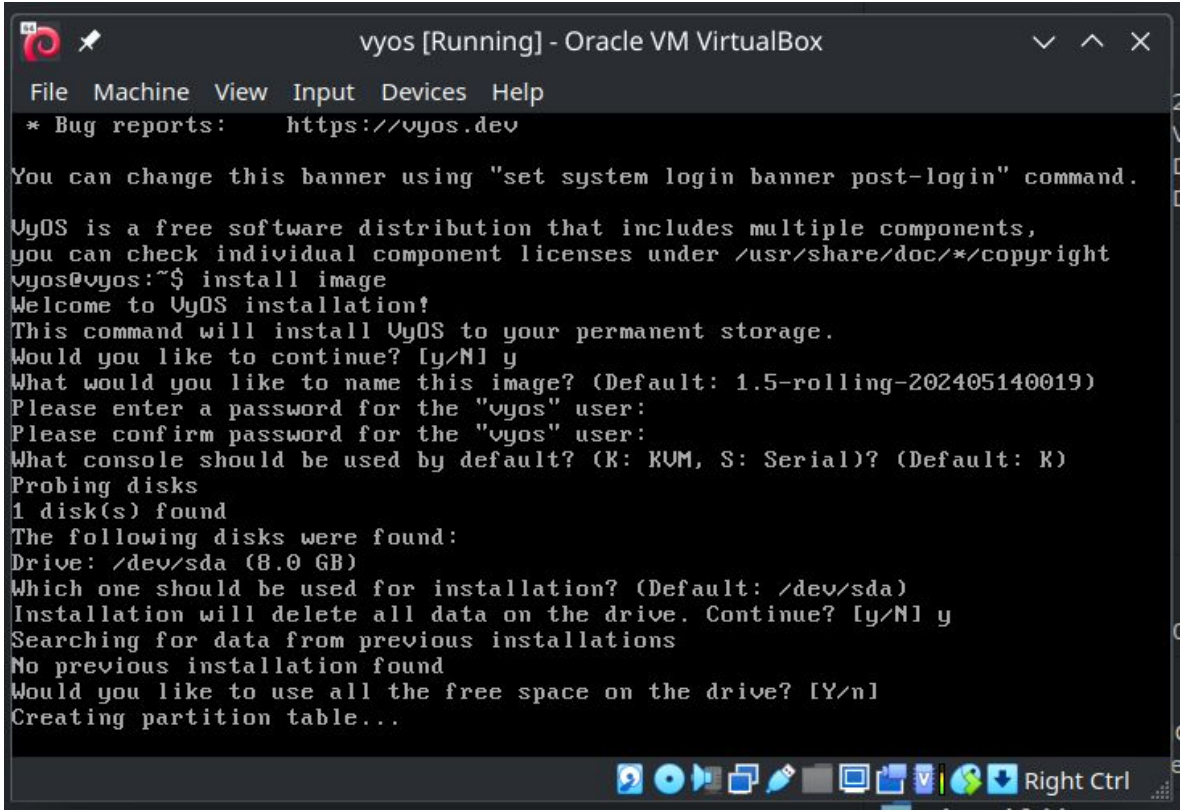
User: vyos

Passwd: vyos

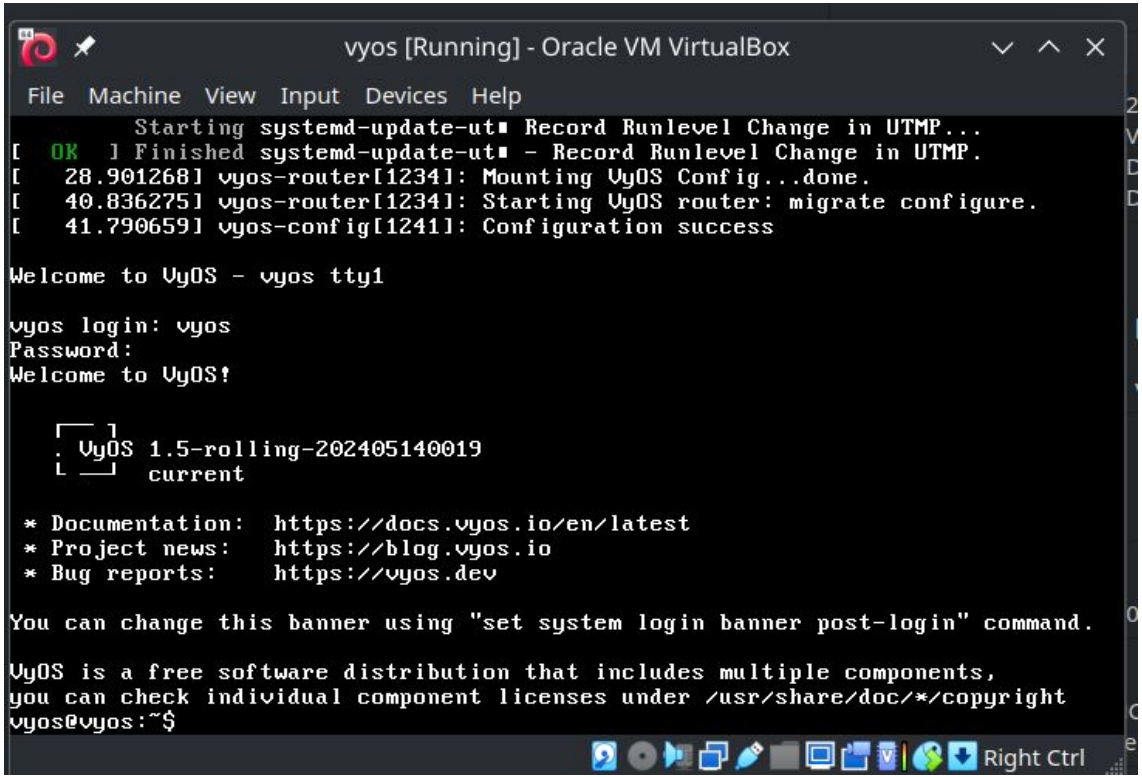


VyOS - Install

- RUN `install image`
- Use default options
- Enter a password
- Poweroff
- Disconnect ISO



VyOS - Installation Complete



VyOS - Basic Config

Operation Mode

- Default mode after login
- Works like Cisco IOS

```
vyos login: vyos
Password: ********
Welcome to VyOS!

Check out project news at https://blog.vyos.io
and feel free to report bugs at https://vyos.dev

You can change this banner using "set system login banner post-login" command.

VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*/copyright

vyos@vyos:~$
```

Configuration Mode

- Enter by **`configure`** command in operation mode.
- Works like Juniper Junos OS, try `edit`, `up`, `top` and `show` commands.

```
vyos@vyos:~$ configure

[edit]
vyos@vyos# edit interfaces
[edit interfaces]
vyos@vyos#
```

```
[edit interfaces]
vyos@vyos# show
 ethernet eth0 {
     hw-id 08:00:27:cc:7a:42
 }
```

How to Config

- Use **set** and **delete** to configure.
- The config will apply AFTER **commit** command.

```
[edit interfaces]
vyos@vyos# show
 ethernet eth0 {
     hw-id 08:00:27:cc:7a:14
 }

[edit interfaces]
vyos@vyos# set ethernet eth0 address dhcp

[edit interfaces]
vyos@vyos# commit
```

Save Config

- The config will apply AFTER **`commit`** command.
- Use **`save`** command, just like `write` in Cisco IOS.

```
[edit interfaces]
vyos@vyos# set ethernet eth0 address dhcp

[edit interfaces]
vyos@vyos# commit

[edit interfaces]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done

[edit]
vyos@vyos#
```

Commit with Confirm

- Use 2-steps **`commit-confirm`** and **`confirm`** instead of `commit`.
- If disconnected, the VyOS will reboot and reset in 10 minutes.

```
[edit]
vyos@vyos# commit-confirm
commit-confirm will automatically reboot in 10 minutes unless changes
are confirmed.
Proceed ? [Y/n] y
Initialized commit-confirm; 10 minutes to confirm before reboot

[edit]
vyos@vyos# confirm
Reboot timer stopped

[edit]
vyos@vyos#
```

Run Operation Commands in Config Mode

- Use **`run`** `cmd` just like `do cmd` in Cisco IOS.
- It support `Tab` and `?` for auto complete.

```
[edit]
vyos@vyos# run show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address                        S/L  Description
---------      ----------                        ---  -----------
eth0           192.168.24.101/24                 u/u

[edit]
vyos@vyos# run show arp
Address          Interface    Link layer address    State
--------------   -----------  --------------------  ---------
192.168.24.254   eth0         00:02:c9:4f:a3:00     REACHABLE
```

Enable SSH Service

- Set the hostname to your name. (Need to login again to take effect)
- Activate SSH service for all interfaces.

```
[edit]
vyos@router101# set system host-name router101

[edit]
vyos@router101# set service ssh listen-address 0.0.0.0

[edit]
vyos@router101# commit

[edit]
vyos@router101# save
Saving configuration to '/config/config.boot'...
Done
```

VyOS - LAN Config

Config LAN IP Address

- Use `eth1` as LAN interface.
- The IP address should be 172.20.**ID**.254/24 (with CIDR).

```
[edit]
vyos@router101# edit interfaces ethernet eth1

[edit interfaces ethernet eth1]
vyos@router101# set address 172.20.101.254/24

[edit interfaces ethernet eth1]
vyos@router101# set description "My internal network"

[edit interfaces ethernet eth1]
vyos@router101# commit
```

Config DHCP Service

- Enable DHCP server for 172.20.**ID**.0/24 subnet.
- We use 172.20.**ID**.{11 - 50} as DHCP IP address pool.

```
[edit]
vyos@router101# edit service dhcp-server shared-network-name ccna subnet 172.20.101.0/24

[edit service dhcp-server shared-network-name ccna subnet 172.20.101.0/24]
vyos@router101# set default-router 172.20.101.254

[edit service dhcp-server shared-network-name ccna subnet 172.20.101.0/24]
vyos@router101# set range 0 start 172.20.101.11

[edit service dhcp-server shared-network-name ccna subnet 172.20.101.0/24]
vyos@router101# set range 0 stop 172.20.101.50
```

Verify DHCP Config

```
vyos@router101:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface       IP Address                        S/L  Description
---------       ----------                        ---  -----------
eth0            192.168.24.101/24                 u/u
eth1            172.20.101.254/24                 u/u  My internal network

vyos@router101:~$ show dhcp server statistics
Pool    Size    Leases    Available    Usage
------  ------  --------  -----------  -------
ccna    40      1         39           2%

vyos@router101:~$ show dhcp server leases
IP Address    MAC address        State    Lease start          Lease expiration     Remaining    Pool    Hostname
------------  -----------------  -------  -------------------  -------------------  -----------  ------  -----------
172.20.101.11 08:00:27:a1:b1:7e  active   2023/05/18 11:05:00  2023/05/19 11:05:00  23:59:30     ccna    arch
```

VyOS - GRE Config

Setup GRE Tunnel

- Use `tun1` as interface name.
- The `remote` and `source-interface` should be WAN of VyOS.

```
[edit]
vyos@router101# edit interfaces tunnel tun1

[edit interfaces tunnel tun1]
vyos@router101# set address 10.101.102.1/30  # Your peer should use 10.101.102.2/30

[edit interfaces tunnel tun1]
vyos@router101# set encapsulation gre

[edit interfaces tunnel tun1]
vyos@router101# set source-interface eth0

[edit interfaces tunnel tun1]
vyos@router101# set remote 192.168.24.102    # Peer's VyOS WAN IP address
```

Config Static Route

- Connect LAN for both side.
- Don’t forget to commit in both side.

```
[edit]
vyos@router101# set protocols static route 172.20.102.0/24 next-hop 10.101.102.2

[edit]
vyos@router101# commit

[edit]
vyos@router101# save
Saving configuration to '/config/config.boot'...
Done
```

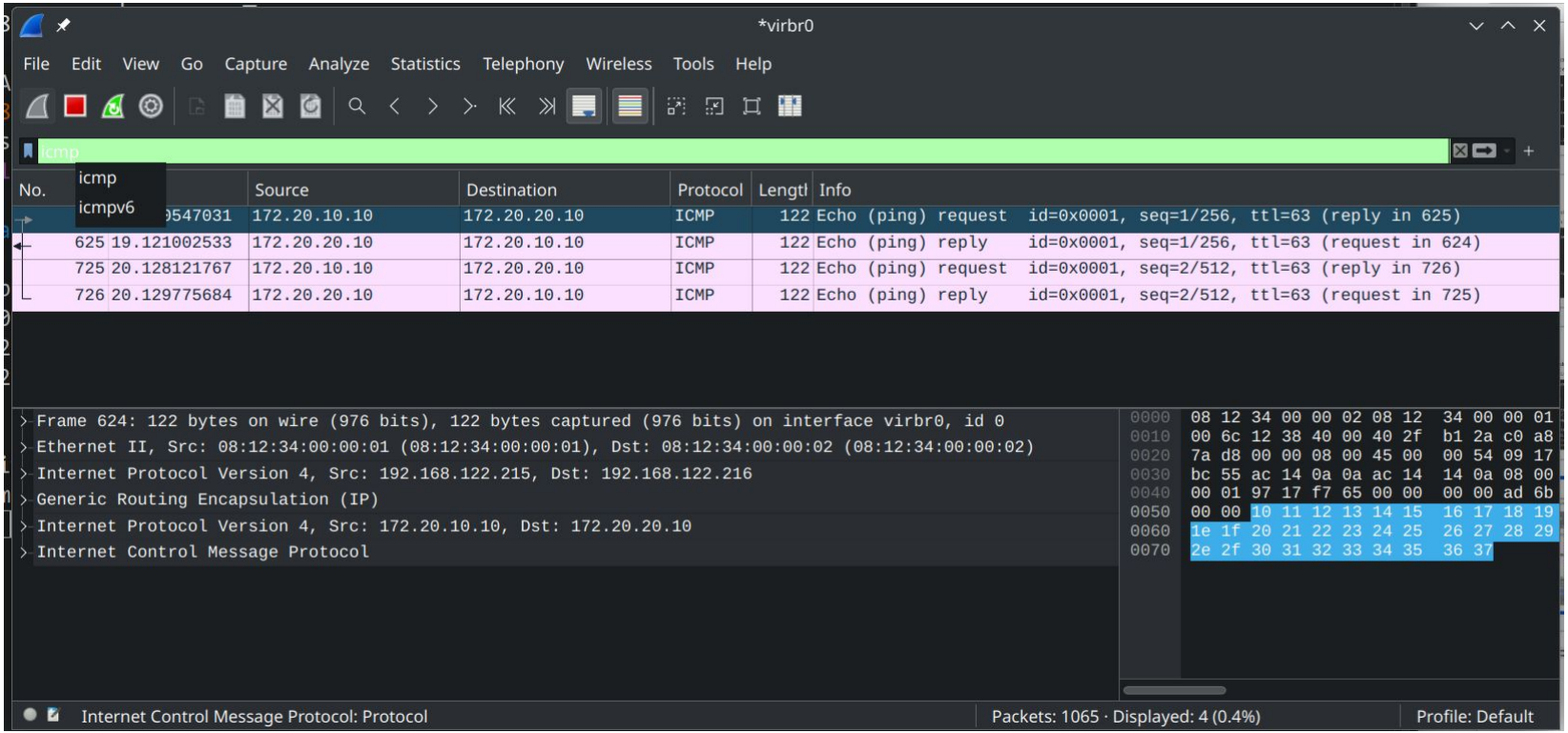
Verify GRE Tunnel

- Check for peering IP address.
- Try to ping each other from Arch Linux.

```
vyos@router101:~$ show interfaces
Interface      IP Address                        S/L  Description
---------      ----------                        ---  -----------
tun1           10.101.102.1/30                   u/u

vyos@router101:~$ ping 10.101.102.2  # Peer's tunnel IP address
PING 10.101.102.2 (10.101.102.2) 56(84) bytes of data.
64 bytes from 10.101.102.2: icmp_seq=1 ttl=64 time=0.512 ms

vyos@router101:~$ ping 172.20.102.254  # Peer's LAN gateway
PING 172.20.102.254 (172.20.102.254) 56(84) bytes of data.
64 bytes from 172.20.102.254: icmp_seq=1 ttl=64 time=0.198 ms
64 bytes from 172.20.102.254: icmp_seq=2 ttl=64 time=0.964 ms
```

GRE Tunnel

Ethernet Header	Outer IP Header	GRE Header	Inner IP Header	...



VyOS - OSPF Config

Remove the Static Route

- Now we are ready to setup OSPF.

```
[edit]
vyos@router101# delete protocols static route

[edit]
vyos@router101# commit

[edit]
vyos@router101# run ping 172.20.102.254
PING 172.20.102.254 (172.20.102.254) 56(84) bytes of data.

^C
--- 172.20.102.254 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9916ms
```

Setup OSPF

- We connect to peer use GRE tunel instead of WAN IP address.
- Q: What happen if we missed network `10.101.102.0/30` statement?

```
[edit]
vyos@router101# edit protocols ospf

[edit protocols ospf]
vyos@router101# set parameters router-id 192.168.24.101       # Your WAN IP address

[edit protocols ospf]
vyos@router101# set neighbor 10.101.102.2                     # Peer's tunnel IP address

[edit protocols ospf]
vyos@router101# set area 10.101.102.0 network 172.20.101.0/24 # Your LAN network

[edit protocols ospf]
vyos@router101# set area 10.101.102.0 network 10.101.102.0/30 # Network of GRE tunnel
```

Verify OSPF

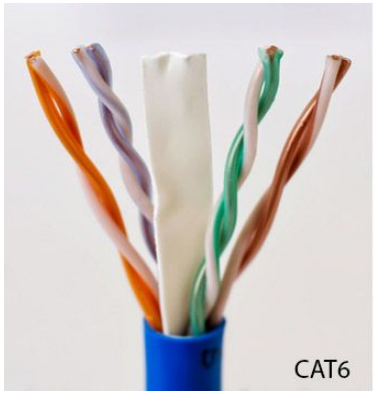
- Wait up to 20 seconds if the route doesn't appear.
- Try to ping each other from ArchLinux again.

```
vyos@router101:~$ show ip ospf neighbor
Neighbor ID     Pri   State           Up Time   Dead Time   Address       Interface          RXmtL   RqstL   DBsmL
192.168.24.102  1     Full/Backup     32.768s   37.220s     10.101.102.2  tun1:10.101.102.1  0       0       0

vyos@router101:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup

S>* 0.0.0.0/0 [210/0] via 192.168.24.254, eth0, weight 1, 01:15:20
O   10.101.102.0/30 [110/1] is directly connected, tun1, weight 1, 00:06:40
C>* 10.101.102.0/30 is directly connected, tun1, 01:10:00
O>* 172.20.102.0/24 [110/2] via 10.101.102.2, tun1, weight 1, 00:00:24
C>* 192.168.24.0/24 is directly connected, eth0, 01:15:30
```

Physical Cable

Twisted Pair Cable

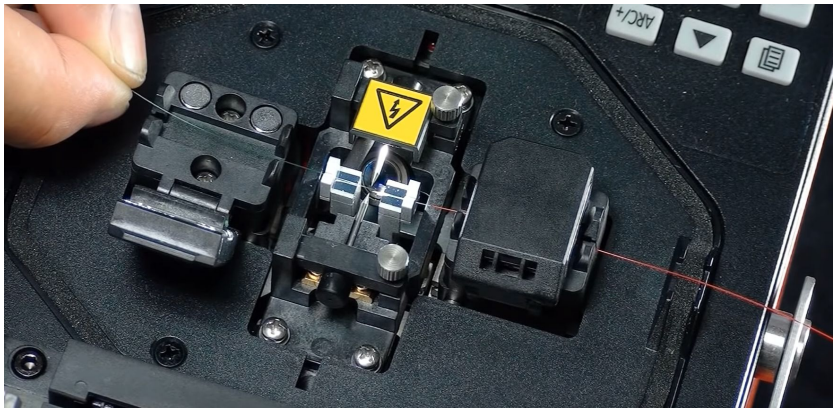
- Connector
  - RJ11: 6P2C
  - RJ45: 8P8C
- Wire
  - Cat 5, Cat 5e, Flat Cable
  - Cat 6, Cat 6a, (Cat 6e)
  - Shielded or not: UTP, STP



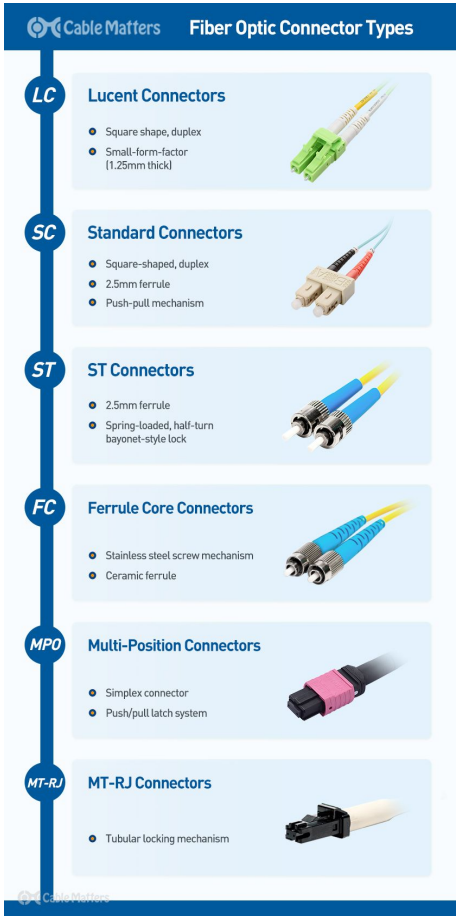
Source: cablesys

Fiber Optic Cable

- Connector: SC, LC, etc.
- Single Mode: OS1, OS2 (Optical Single-mode Fiber)
- Multimode: OM1, OM2, OM3, OM4, OM5
- Use SFP / QSFP+ transceiver module



Source: promax



Source: cablematters

Coaxial Cable

- Common for TV
- Wire: RG-6, RG-59, RG-62 (Radio Guide)
- RF Connectors

Source: Wikimedia

HiNet Boardband

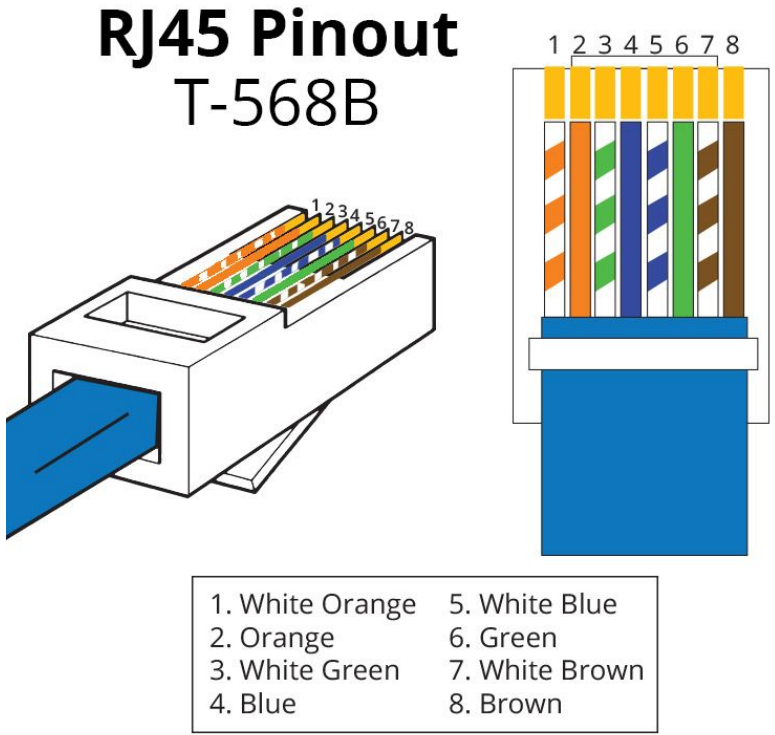
最高速率 (下載/上傳)	2G/1G	1G/600M	500M/250M	300M/150M	100M/40M	60M/20M	35M/6M	16M/3M
上網費牌價 (元/月)	$1,219	$845	$622	$576	$466	$459	$435	$360
電路費牌價 (元/月)	$1,850	$1,054	$677	$623	$442	$389	$366	$293
總金額 (元/月)	$3,069	$1,899	$1,299	$1,199	$908	$848	$801	$653

Source: HiNet

Source: Mobile01

Crimp your own Network Cable

- Things we need:
  - Cat 5e cable: 30 - 90 cm
  - RJ45 connector: 2 pcs
  - Strain Relief Boots: 2 pcs
- Shared tools:
  - Scissor
  - Mini Cable Stripper
  - Crimping tool
  - Cable Tester



Thanks

Any questions?

Related files

- VirtualBox: https://www.virtualbox.org/wiki/Downloads
- VyOS: https://vyos.net/get/nightly-builds/
- ArchLinux: https://archlinux.org/download