Lab 13: GNS3 and Routing Protocol Configuration

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Online notes:

- GNS3 online documentation: https://docs.gns3.com/docs/
- Running the VyOS router on GNS3: https://docs.vyos.io/en/latest/installation/virtual/gns3.html
- Virtual Env: https://docs.vyos.io/en/latest/installation/virtual/index.html

Theoretical Background

GNS3 (Graphical Network Simulator 3) is a powerful open-source emulator that simulates complex networks. It integrates with authentic router images or virtual appliances to create realistic network topologies. VyOS is an open-source network operating system that offers enterprise-level routing capabilities such as OSPF, BGP, and firewalling. In this lab, students will install VyOS using two methods: (1) via VirtualBox and (2) using the GNS3 Marketplace Appliance. They will then build a 3-router network topology and configure routing between the nodes using OSPF or BGP.

Software and Hardware Requirements

Software Requirements:
- GNS3 and GNS3 VM
- VirtualBox
- VyOS ISO or GNS3 VyOS Appliance

Hardware Requirements:
- CPU: 4 cores minimum
- RAM: 8 GB minimum
- Disk: 40 GB free space

Part A

Method 1: Install VyOS in VirtualBox

1. Download VyOS ISO from https://vyos.io.

2. Create a new VM in VirtualBox:

   a. Type: Linux, Debian (64-bit)

   b. RAM: 1024–2048 MB

   c. Network Adapter: set to Host-only or Internal Network

3. Attach the ISO and install VyOS.

4. Set user credentials during installation.

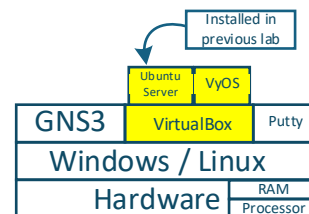5. Export the VM as a .ova or register it for GNS3 import.

Figure 1:Architecture of VyOS in VirtualBox

Method 2: Add VyOS to GNS3 as an Appliance

1. Launch GNS3.

2. Go to File > Import Appliance.

3. Select the downloaded GNS3 VyOS appliance file (.gns3a).

4. Link it to your downloaded VyOS image (ISO or QEMU).
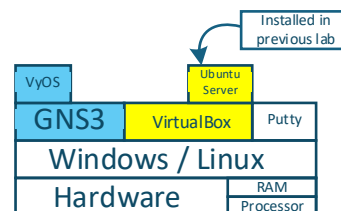
5. Finish the import and test launching a node.

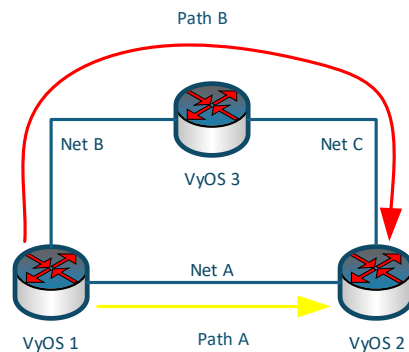Figure 2:Architecture of VyOS as an Application in GNS3

Part B

Figure 3: Three-Node Topology

Building the Router Network Topology in GNS3

1. Build the three VyOS routers network shown in Figure 3.

2. You can decide if you want to use the VyOS router running on VirtualBox or the VyOS router installed via the application. Both architectures are shown in Figure 4 and Figure 5.
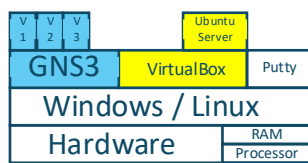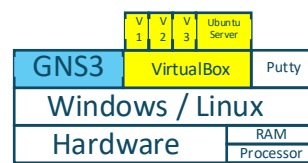

Figure 4: GNS3 Architecture

Figure 5: VirtualBox Architecture

3. In GNS3, connect the routers using the Add Link tool.

4. Assign IP addresses to interfaces:

    - R1-R2: 10.0.12.0/30

    - R2-R3: 10.0.23.0/30

    - R3-R1: 10.0.31.0/30

5. On each router, configure interfaces and enable OSPF:

    - Example OSPF:

    set interfaces ethernet eth0 address 10.0.12.1/30

    Set protocols ospf area 0 network 10.0.12.0/30

    Commit

    save

Validation Tests

- Verify interfaces are up and IP addresses are correctly configured using `show interfaces`

R1
```
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface    IP Address    MAC                VRF        MTU    S/L    Description
----------   -----------   ----------------   -------    -----  -----  -------------
eth0         10.0.12.1/30  0c:b5:5a:92:00:00  default    1500   u/u
eth1         10.0.31.1/30  0c:b5:5a:92:00:01  default    1500   u/u
eth2         -             0c:b5:5a:92:00:02  default    1500   u/D
lo           127.0.0.1/8   00:00:00:00:00:00  default    65536  u/u
             ::1/128
```

R2
```
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface    IP Address    MAC                VRF        MTU    S/L    Description
----------   -----------   ----------------   -------    -----  -----  -------------
eth0         10.0.12.2/30  0c:ce:82:38:00:00  default    1500   u/u
eth1         10.0.23.1/30  0c:ce:82:38:00:01  default    1500   u/u
eth2         -             0c:ce:82:38:00:02  default    1500   u/D
lo           127.0.0.1/8   00:00:00:00:00:00  default    65536  u/u
             ::1/128
```

R3
```
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface    IP Address    MAC                VRF        MTU    S/L    Description
----------   -----------   ----------------   -------    -----  -----  -------------
eth0         10.0.23.2/30  0c:74:c1:67:00:00  default    1500   u/u
eth1         10.0.31.2/30  0c:74:c1:67:00:01  default    1500   u/u
eth2         -             0c:74:c1:67:00:02  default    1500   u/D
lo           127.0.0.1/8   00:00:00:00:00:00  default    65536  u/u
             ::1/128
```

- Confirm OSPF neighbours with `show ip ospf neighbour`

R1
```
vyos@vyos:~$ show ip ospf neighbor

Neighbor ID     Pri State       Up Time      Dead Time Address      Interface          RXmtL RqstL D
BsmL
10.0.12.2         1 Full/Backup  11m46s         32.634s 10.0.12.2   eth0:10.0.12.1         0     0
  0
10.0.23.2         1 Full/Backup  11m46s         37.447s 10.0.31.2   eth1:10.0.31.1         0     0
  0
```

R2
```
vyos@vyos:~$ show ip ospf neighbor

Neighbor ID     Pri State       Up Time      Dead Time Address      Interface          RXmtL RqstL D
BsmL
10.0.31.1         1 Full/DR      12m11s         38.896s 10.0.12.1   eth0:10.0.12.2         0     0
  0
10.0.23.2         1 Full/DR      12m09s         30.874s 10.0.23.2   eth1:10.0.23.1         0     0
  0
```

R3

```
vyos@vyos:~$ show ip ospf neighbor

Neighbor ID    Pri State        Up Time       Dead Time Address    Interface           RXmtL RqstL D
BsmL
10.0.12.2        1 Full/Backup   13m00s          39.864s 10.0.23.1  eth0:10.0.23.2          0     0
  0
10.0.31.1        1 Full/DR       13m02s          37.878s 10.0.31.1  eth1:10.0.31.2          0     0
  0
```

- Ping the adjacent router interfaces to verify routing

```
vyos@vyos:~$ ping 10.0.12.2
PING 10.0.12.2 (10.0.12.2) 56(84) bytes of data.
64 bytes from 10.0.12.2: icmp_seq=1 ttl=64 time=3.77 ms
64 bytes from 10.0.12.2: icmp_seq=2 ttl=64 time=2.35 ms
64 bytes from 10.0.12.2: icmp_seq=3 ttl=64 time=1.98 ms
64 bytes from 10.0.12.2: icmp_seq=4 ttl=64 time=8.95 ms
64 bytes from 10.0.12.2: icmp_seq=5 ttl=64 time=1.76 ms
64 bytes from 10.0.12.2: icmp_seq=6 ttl=64 time=2.34 ms
64 bytes from 10.0.12.2: icmp_seq=7 ttl=64 time=3.28 ms
64 bytes from 10.0.12.2: icmp_seq=8 ttl=64 time=8.08 ms
^C
--- 10.0.12.2 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7018ms
rtt min/avg/max/mdev = 1.763/4.063/8.951/2.653 ms
```

```
vyos@vyos:~$ ping 10.0.31.2
PING 10.0.31.2 (10.0.31.2) 56(84) bytes of data.
64 bytes from 10.0.31.2: icmp_seq=1 ttl=64 time=4.06 ms
64 bytes from 10.0.31.2: icmp_seq=2 ttl=64 time=14.1 ms
64 bytes from 10.0.31.2: icmp_seq=3 ttl=64 time=14.3 ms
64 bytes from 10.0.31.2: icmp_seq=4 ttl=64 time=7.60 ms
^C
--- 10.0.31.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3014ms
rtt min/avg/max/mdev = 4.061/10.013/14.322/4.367 ms
```

```
vyos@vyos:~$ ping 10.0.23.2
PING 10.0.23.2 (10.0.23.2) 56(84) bytes of data.
64 bytes from 10.0.23.2: icmp_seq=1 ttl=64 time=3.35 ms
64 bytes from 10.0.23.2: icmp_seq=2 ttl=64 time=1.30 ms
64 bytes from 10.0.23.2: icmp_seq=3 ttl=64 time=1.98 ms
64 bytes from 10.0.23.2: icmp_seq=4 ttl=64 time=3.22 ms
64 bytes from 10.0.23.2: icmp_seq=5 ttl=64 time=1.26 ms
^C
--- 10.0.23.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4010ms
rtt min/avg/max/mdev = 1.255/2.219/3.346/0.907 ms
```