

# Planning RouterOS Networks with GNS3

*By: Michael Omondi*

**Name: Michael Omondi**

Preferred Name: **Mike**

8+ years in the IT industry.

Introduced to Mikrotik in 2014

Areas of interest:

- ✓ ISP Solutions
- ✓ Wireless Services
- ✓ Network Security

Certifications

- ✓ Mikrotik:- MTCNA, MTCRE, MTCWE & MTCTCE,
- ✓ Other Vendors:- Cisco, CompTIA, Vmware, Solarwinds, Ubiquiti, Cyberoam

We are an IT company

- Training
- Consultancy
- Design, deployment and management of computer networks
- Server deployment and management
- Cloud services (storage, backup & archiving, web & application hosting etc.), Data Center Virtualization and many more.
- For more about us, please visit <http://lockstepit.com>

Provide adequate knowledge to  
make you comfortable running  
RouterOS in GNS3

- In 2015, Mikrotik released a virtual RouterOS instance for x86\_64 architecture.
- They called it Cloud Hosted Router (CHR)
- Designed for virtualized environments.

- Currently there are 4 levels of licensing.
  - a) Free- 1Mbps interface speed
  - b) P1- 1Gbps
  - c) P10- 10Gbps
  - d) P-Unlimited

- **Training classes**
- **Exam preparation**
- **Testing configuration before deployment**
- **Production**

- **Graphical Network Simulator**
- **Originally developed to emulate Cisco's IOS**
- **It's capabilities have been extended beyond just Ciscos' IOS**
- **For this Lab setup version 1.5.2 of GNS3 installation and its Virtual Machine counterpart will be used.**



- **Quick Emulator**
- **Developed to virtualize x86\_64 architectures in Linux**
- **REMEMBER: RouterOS is a Linux**
- **To successfully build a virtual RouterOS Lab we will enlist QEMU version 2.5.0**

- **64bit CPU with virtualization support**
- **128 MB or more RAM for the CHR instance**
- **128 MB disk space for the CHR virtual hard drive**

CHR has been tested on the following platforms:

- **VirtualBox 5 on Linux and OS X**
- **VMWare Fusion 7 and 8 on OS X**
- **Qemu 2.4.0.1 on OS X**
- **Hyper-V on Windows Server 2012 (*Only Generation 1 Hyper-V virtual machine is supported at the moment*)**

**GNS3 can run on Windows, Linux and OSX**

**For my Presentation, I have used;**

**Processor: Intel Core i5 2.50GHz**

**RAM: 8GB**


**OS: Windows 10 Pro**

**Hypervisor: VMware Workstation 12 Pro**

- Download GNS3 from her:  
<https://gns3.com/software/download>
- NB: sign in is required or create an account

## Download GNS3


Select the installer for your favourite OS




### Windows

Version 1.5.2

 **DOWNLOAD**


 [Install Guide for Windows](#)




### Linux

Version 1.5.2


 **DOWNLOAD**


 [Install Guide for Linux](#)



### Mac

Version 1.5.2

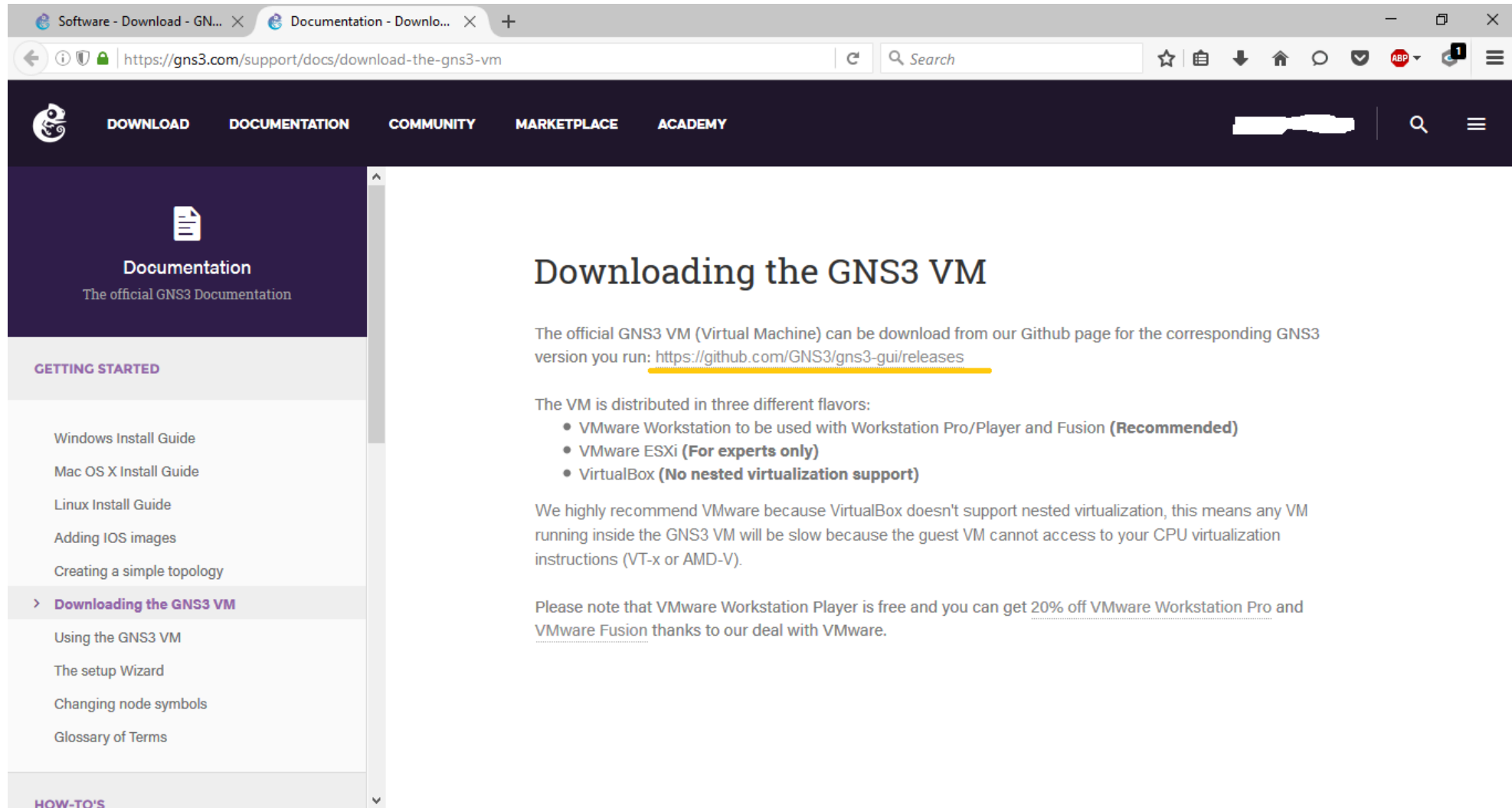
 **DOWNLOAD**

 [Install Guide for Mac](#)

[Download the GNS3 VM](#)

**Click Here**

GNS3 is a Free and Open Source software under GPL v3 licensing




Software - Download - GN... × Documentation - Downlo... × +

https://gns3.com/support/docs/download-the-gns3-vm

Search

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 Documentation  
The official GNS3 Documentation

GETTING STARTED

- Windows Install Guide
- Mac OS X Install Guide
- Linux Install Guide
- Adding IOS images
- Creating a simple topology
- > **Downloading the GNS3 VM**
- Using the GNS3 VM
- The setup Wizard
- Changing node symbols
- Glossary of Terms

HOW-TO'S

## Downloading the GNS3 VM

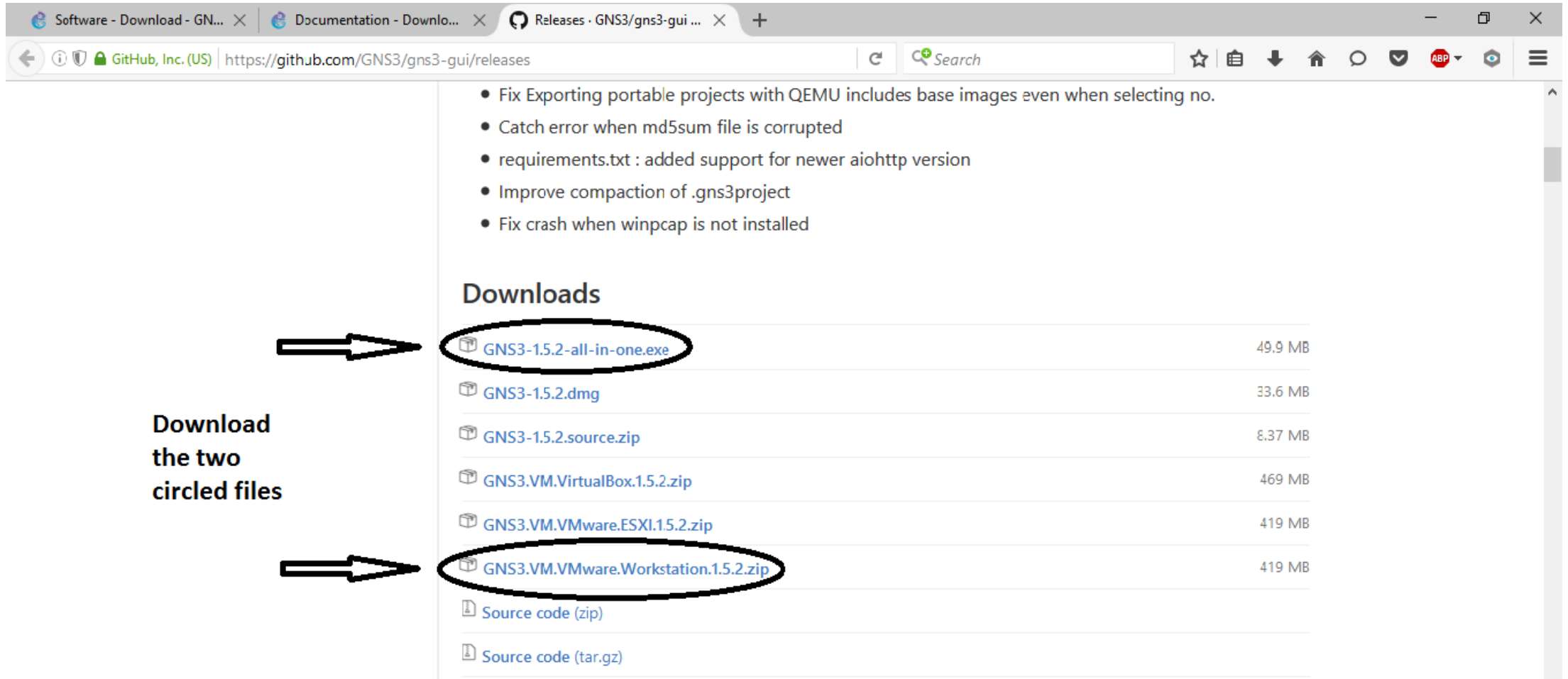
The official GNS3 VM (Virtual Machine) can be download from our Github page for the corresponding GNS3 version you run: <https://github.com/GNS3/gns3-gui/releases>

The VM is distributed in three different flavors:

- VMware Workstation to be used with Workstation Pro/Player and Fusion (**Recommended**)
- VMware ESXi (**For experts only**)
- VirtualBox (**No nested virtualization support**)

We highly recommend VMware because VirtualBox doesn't support nested virtualization, this means any VM running inside the GNS3 VM will be slow because the guest VM cannot access to your CPU virtualization instructions (VT-x or AMD-V).

Please note that VMware Workstation Player is free and you can get 20% off VMware Workstation Pro and VMware Fusion thanks to our deal with VMware.











Software - Download - GN... X Documentation - Downlo... X Releases · GNS3/gns3-gui ... X +

GitHub, Inc. (US) | <https://github.com/GNS3/gns3-gui/releases> Search

- Fix Exporting portable projects with QEMU includes base images even when selecting no.
- Catch error when md5sum file is corrupted
- requirements.txt : added support for newer aiohttp version
- Improve compaction of .gns3project
- Fix crash when winpcap is not installed

### Downloads

 <a href="#">GNS3-1.5.2-all-in-one.exe</a>	49.9 MB
 <a href="#">GNS3-1.5.2.dmg</a>	33.6 MB
 <a href="#">GNS3-1.5.2.source.zip</a>	8.37 MB
 <a href="#">GNS3.VM.VirtualBox.1.5.2.zip</a>	469 MB
 <a href="#">GNS3.VM.VMware.ESXi.1.5.2.zip</a>	419 MB
 <a href="#">GNS3.VM.VMware.Workstation.1.5.2.zip</a>	419 MB
 <a href="#">Source code (zip)</a>	
 <a href="#">Source code (tar.gz)</a>	

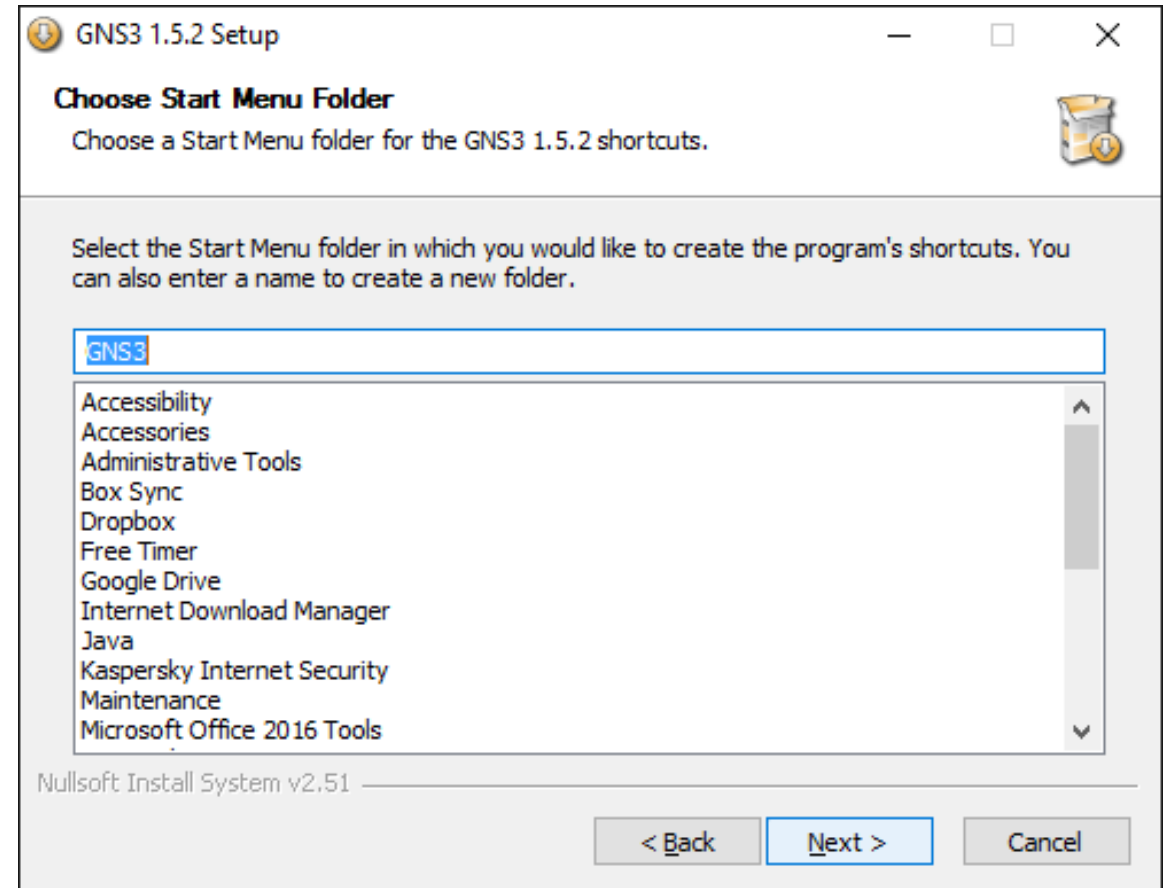
Download the two circled files

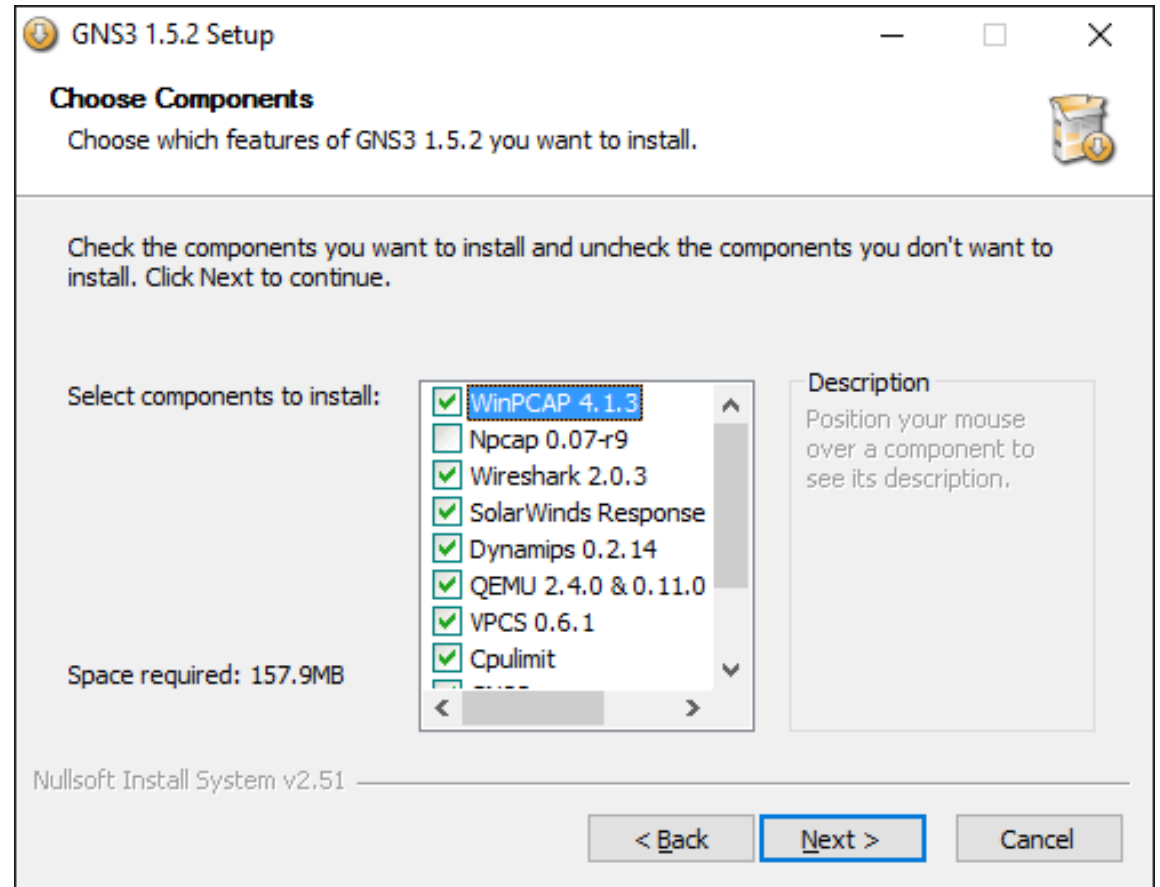
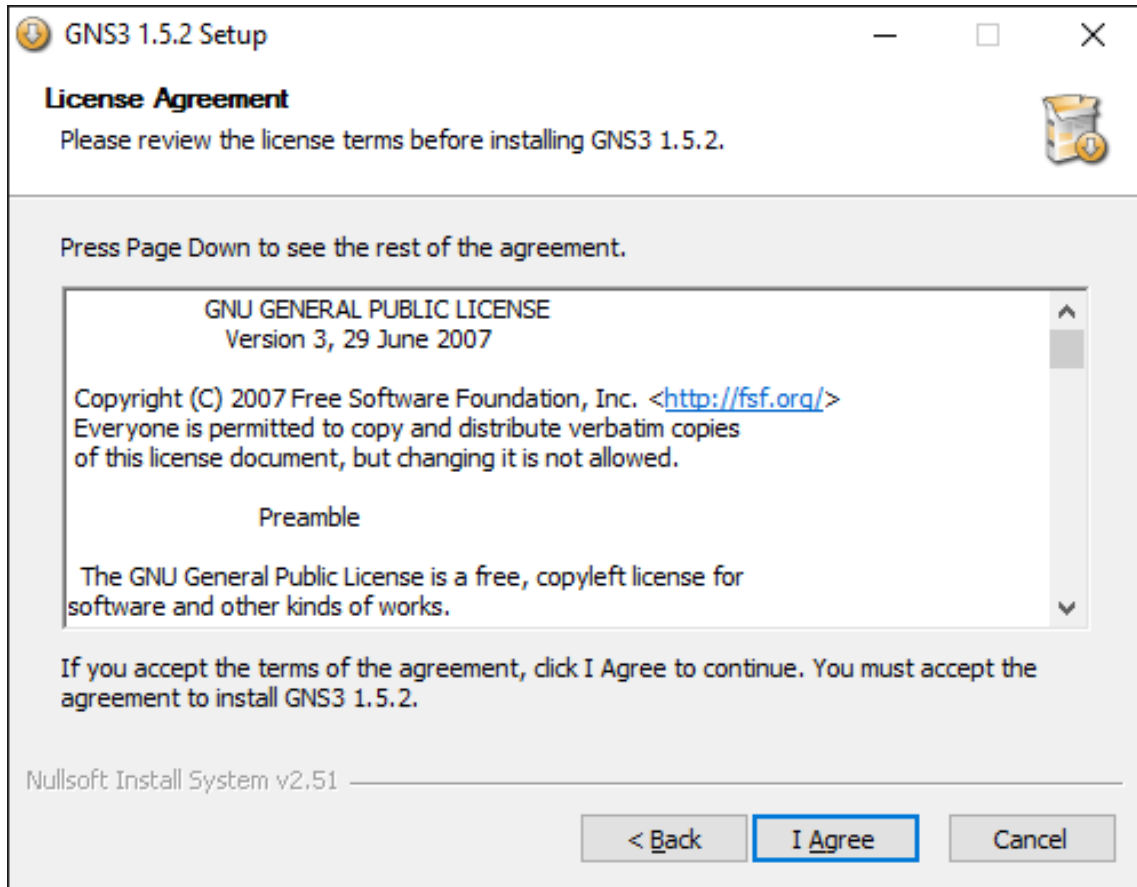


Once the download is finished;

**Run the .exe file, follow the prompts.**

**NB: you need to be connected to the internet as the installation will download additional files**





Once the installation is finished;

**Extract the zipped VM (OVA) file**

**Import it into VMware**

**NB: you can use VMware player (free) or VMware workstation (license required).**

**We will use VMware Workstation 12 Pro.**

Import Virtual Machine

×

**Store the new Virtual Machine**  
Provide a name and local storage path for the new virtual machine.

Name for the new virtual machine:

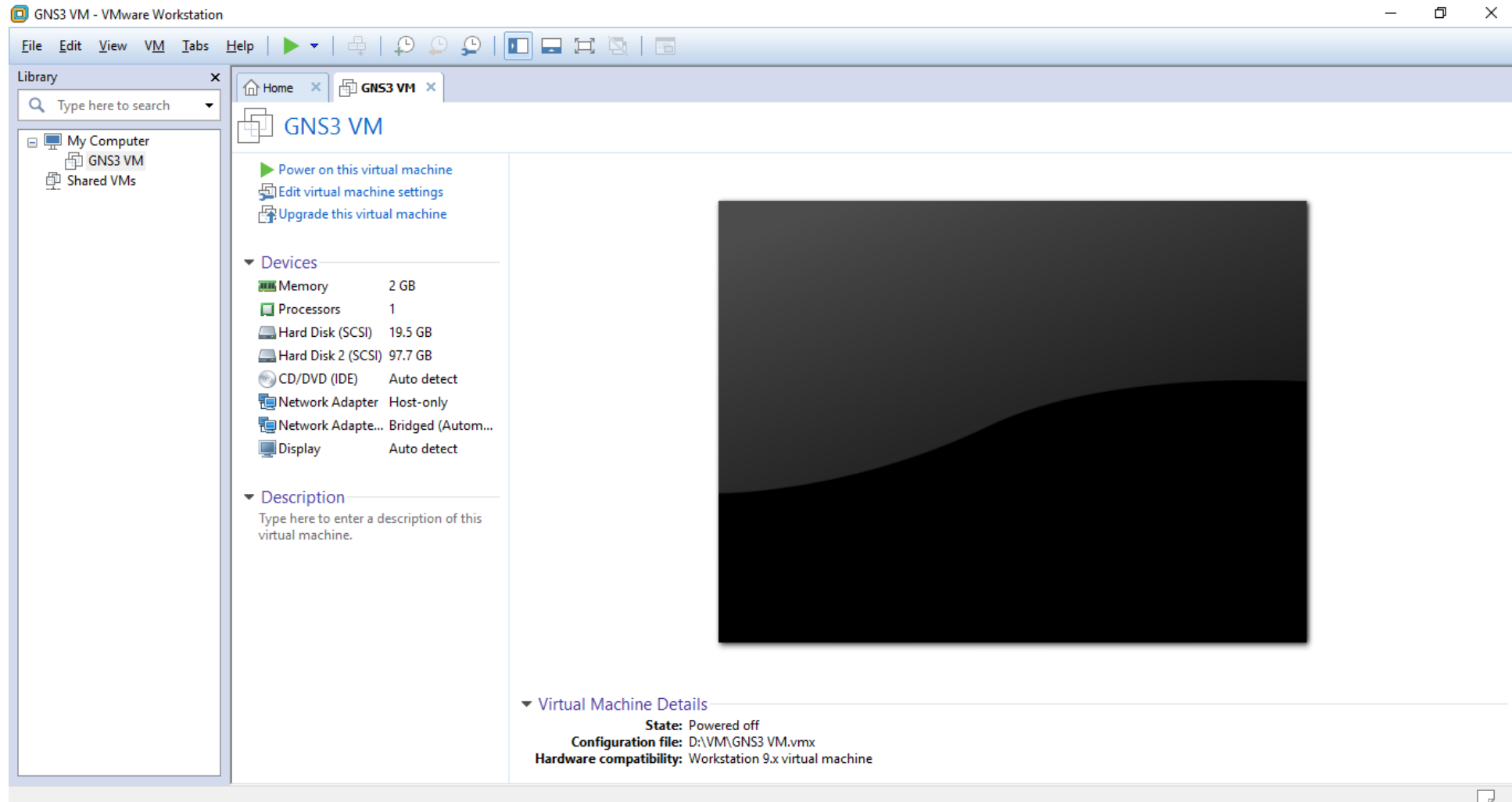
Storage path for the new virtual machine:

Browse...

Help

Import

Cancel



The Next thing is;

**Download CHR from here:**

**<http://www.mikrotik.com/download>**

**NB: The file format to be downloaded depends on the hypervisor.**

**For our case we will download the VHDX file.**

Time to put the pieces together.

**Open GNS3**

**Configure GNS3 to use the GNS3 VM**



Setup Wizard

**Server**  
Please choose a server type to run your GNS3 network simulations. The GNS3 VM is strongly recommended on Windows and Mac OS X.

☒ Local GNS3 VM  
☐ Local server

☐ Don't show this again


Next > Cancel

**Setup Wizard**

**GNS3 VM**  
In order to run the GNS3 VM you must first have VMware or VirtualBox installed and the GNS3 VM.ova imported in one of these.

Virtualization software:

☒ VMware (recommended)  
☐ VirtualBox



The GNS3 VM can [downloaded here](#).  
Import the VM in your virtualization software and hit refresh.

VM name:

GNS3 VM Refresh


vCPU cores:

2

RAM size:

4048 MB

< Back Next > Cancel

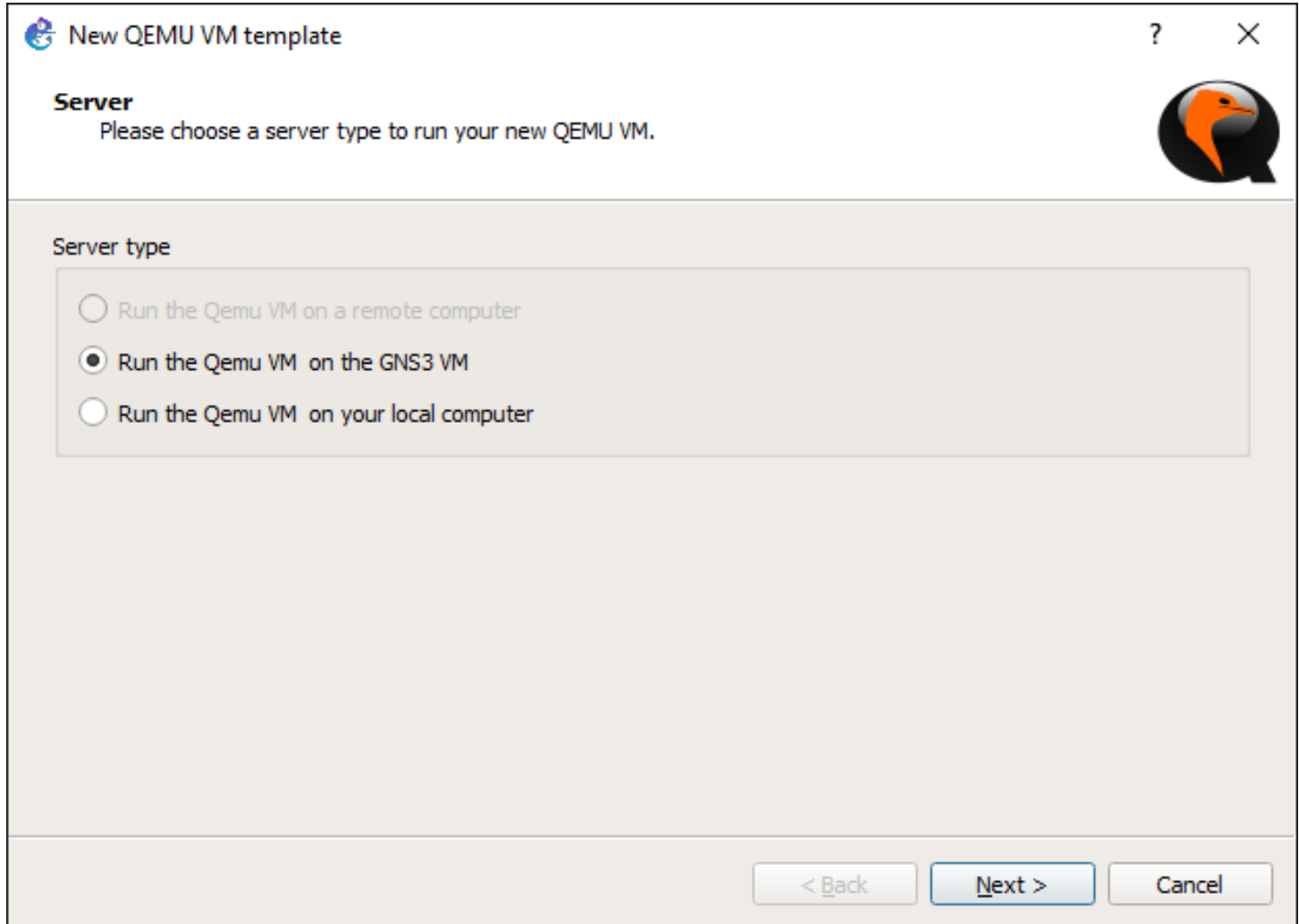
 Setup Wizard ? ×

**Add virtual machines**  
Now that you have configured the server type you can choose to add one or more virtual machines (VMs) of different types.

- ☐ Add an IOS router using a real IOS image (supported by Dynamips)
- ☐ Add an IOU (IOS on UNIX) device using a L3 or L2 IOU image
- ☒ Add a Qemu virtual machine
- ☐ Add a VirtualBox virtual machine
- ☐ Add a VMware virtual machine
- ☐ Add a Docker container

< Back Finish Cancel

Select “Run Qemu VM  
on the GNS3 VM”



New QEMU VM template

**Server**  
Please choose a server type to run your new QEMU VM.

Server type

☐ Run the Qemu VM on a remote computer

☒ Run the Qemu VM on the GNS3 VM

☐ Run the Qemu VM on your local computer

< Back   Next >   Cancel

**Give Your VM a  
name**

New QEMU VM template

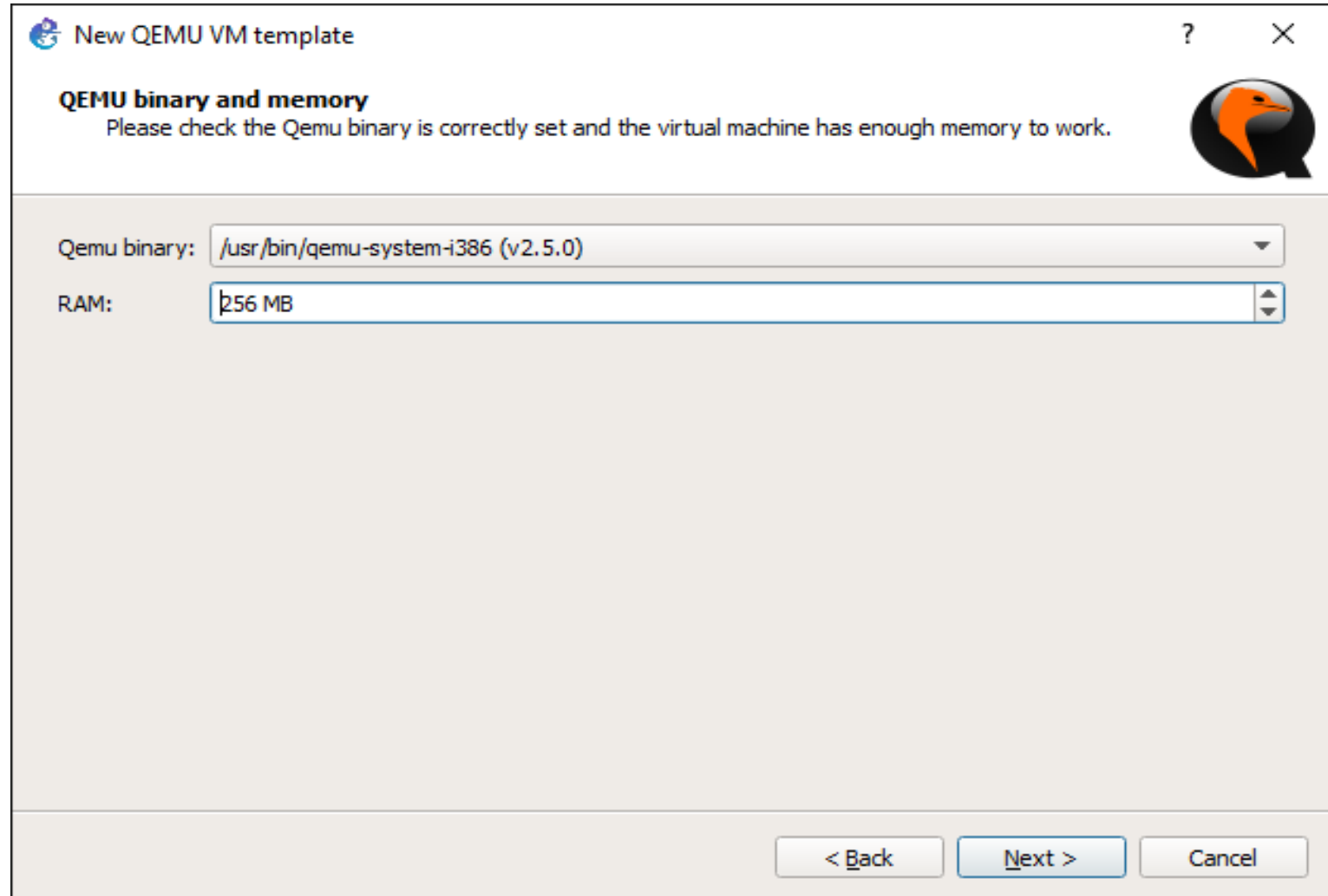
**QEMU VM name**  
Please choose a descriptive name for your new QEMU virtual machine.

Name:

☐ This is a legacy ASA VM

< Back Next > Cancel

- Select the Qemu binary & location
- Set the Memory



New QEMU VM template

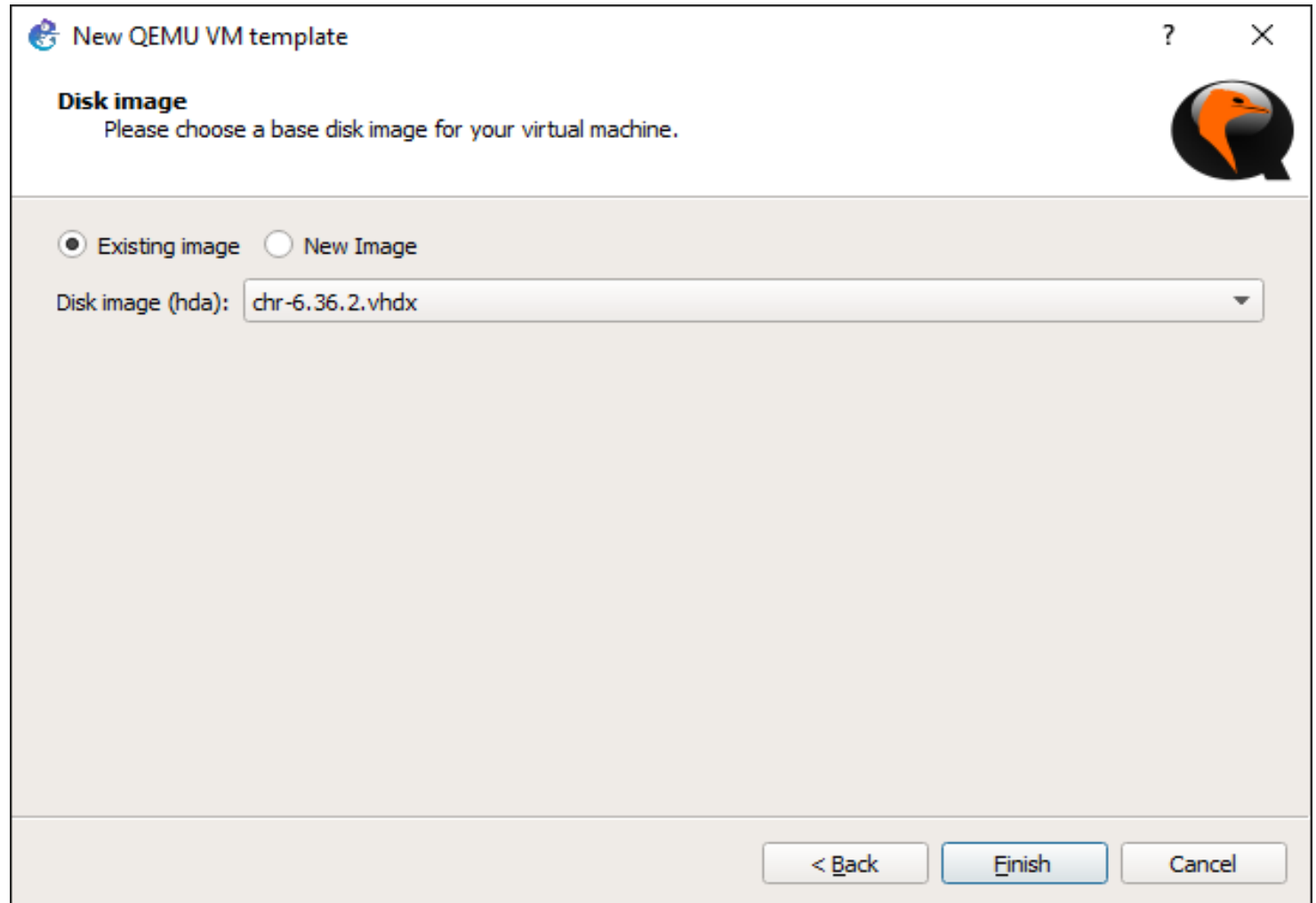
**QEMU binary and memory**  
Please check the Qemu binary is correctly set and the virtual machine has enough memory to work.

Qemu binary: /usr/bin/qemu-system-i386 (v2.5.0)

RAM: 256 MB

< Back Next > Cancel

- Select “existing image”
- Browse to the location of your VHDX and select



New QEMU VM template

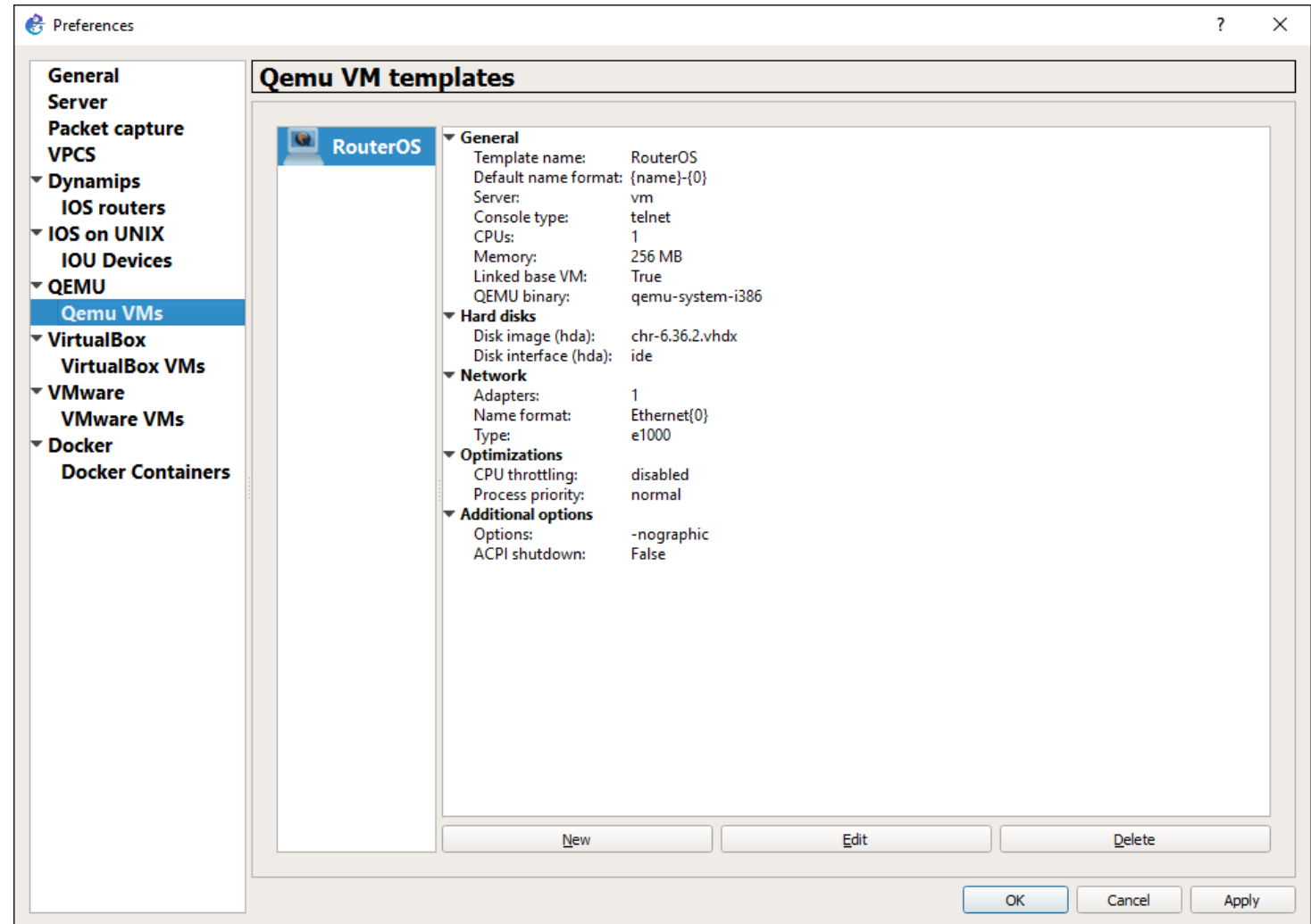
**Disk image**  
Please choose a base disk image for your virtual machine.

☒ Existing image ☐ New Image

Disk image (hda): chr-6.36.2.vhdx

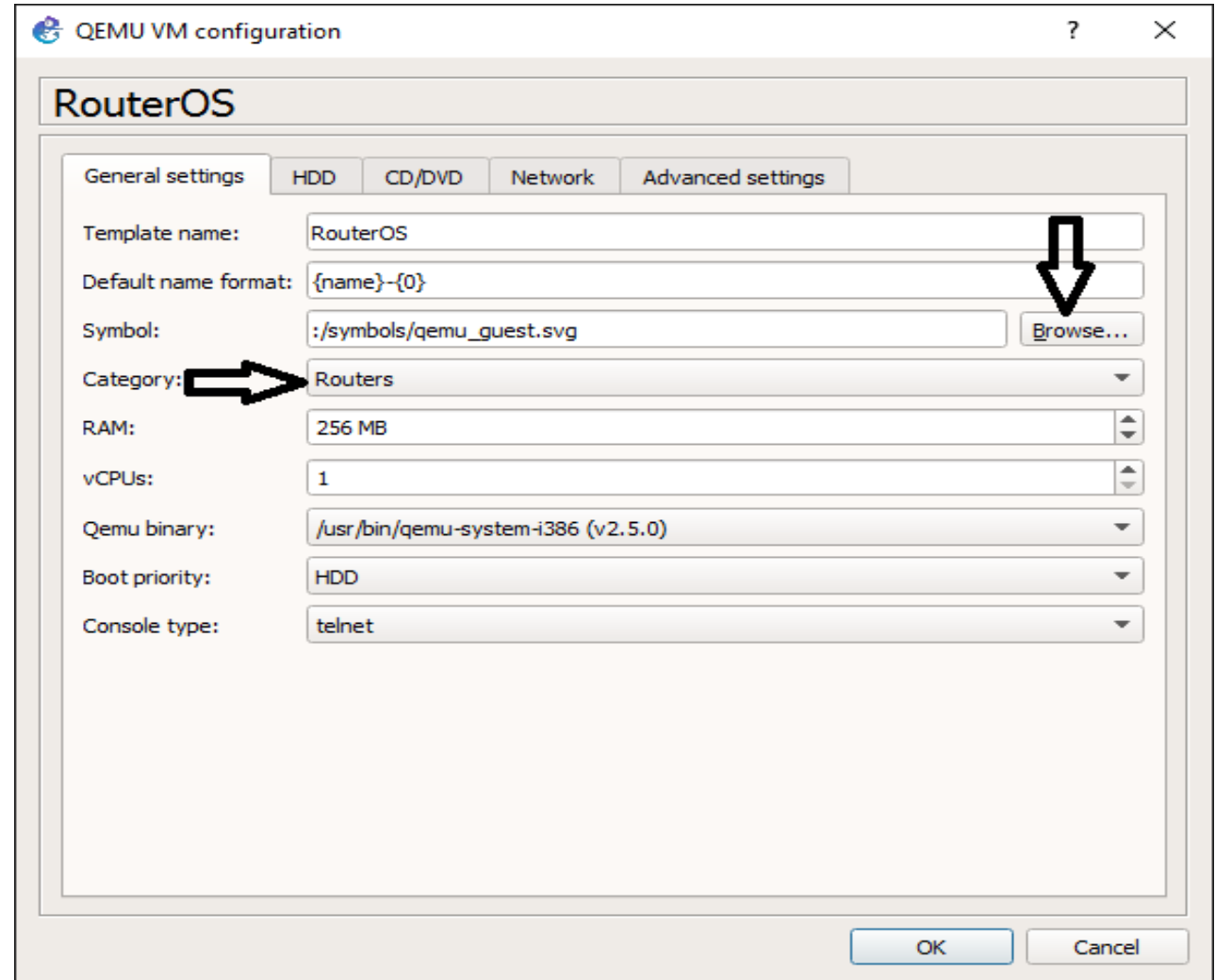
< Back Finish Cancel

**Qemu VM template is  
now set and ready for use**





- Click 'Edit' then general tab
- Change category to 'Routers'
- Change Symbol to that of a router



QEMU VM configuration

### RouterOS

General settings | HDD | CD/DVD | Network | Advanced settings

Template name: RouterOS

Default name format: {name}-{0}

Symbol: /symbols/qemu\_guest.svg [Browse...](#)

Category: **Routers**

RAM: 256 MB

vCPUs: 1

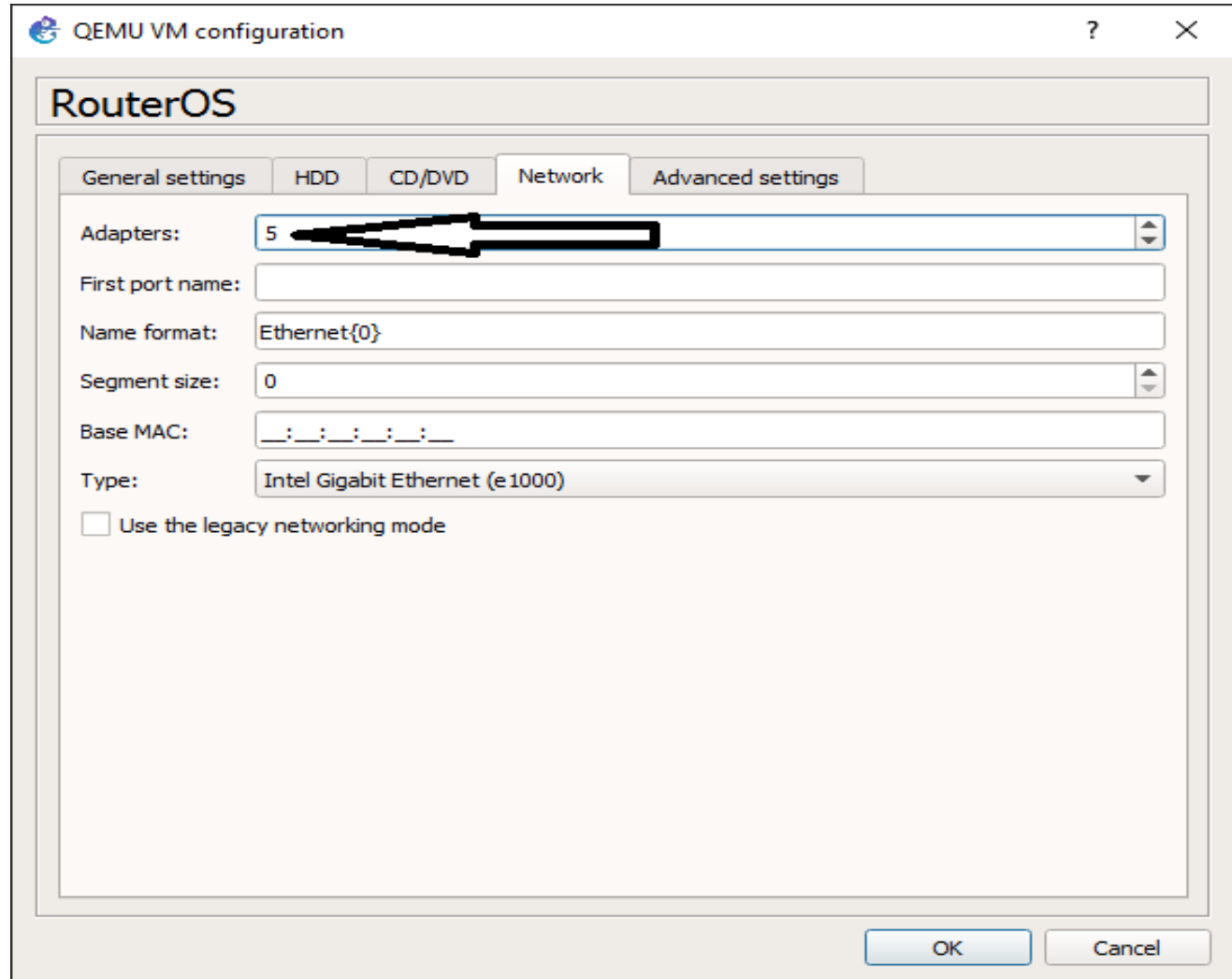
Qemu binary: /usr/bin/qemu-system-i386 (v2.5.0)

Boot priority: HDD

Console type: telnet

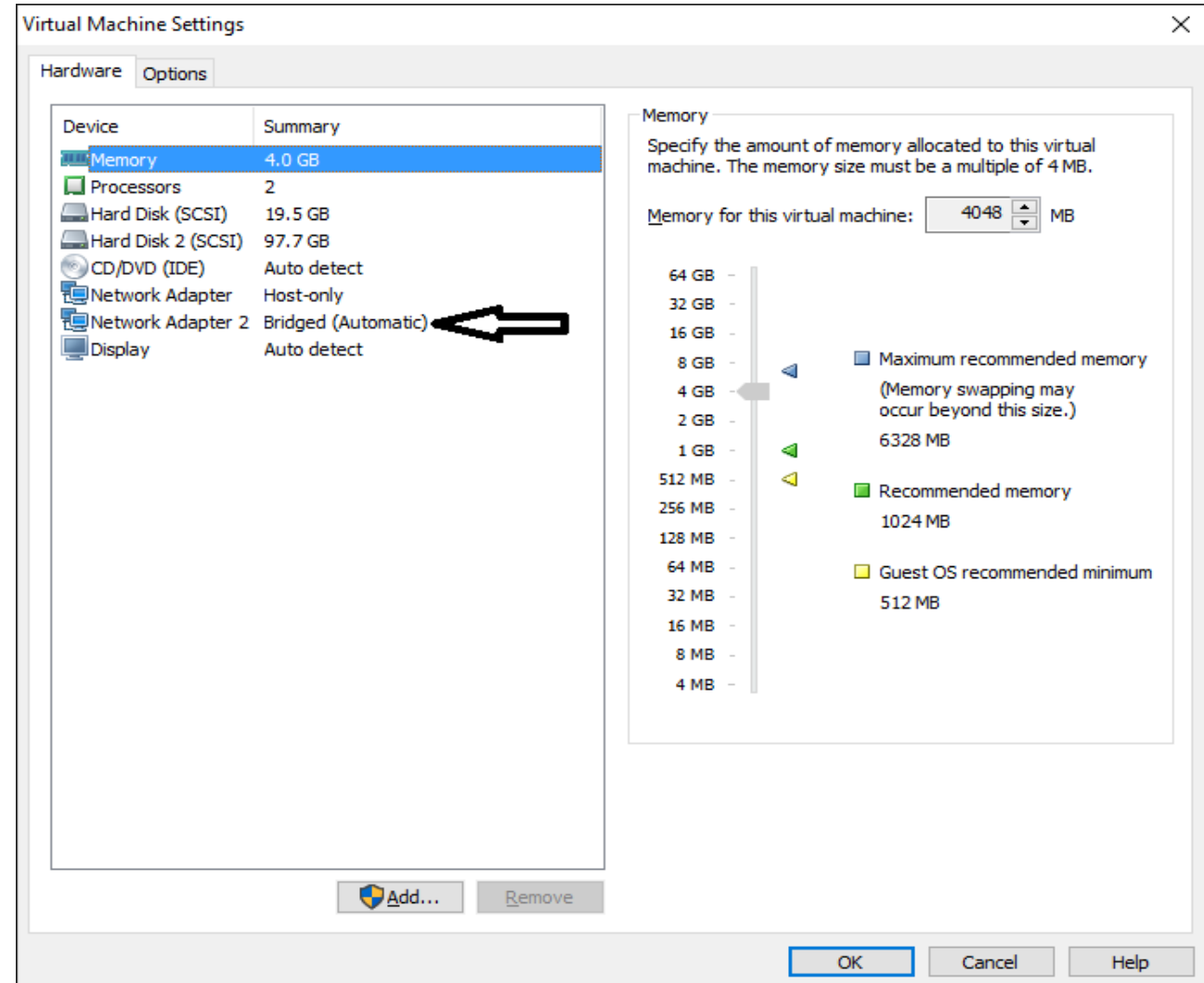
OK Cancel

Navigate to Network tab,  
Under 'Adapters' Specify  
number of interfaces in  
the VM

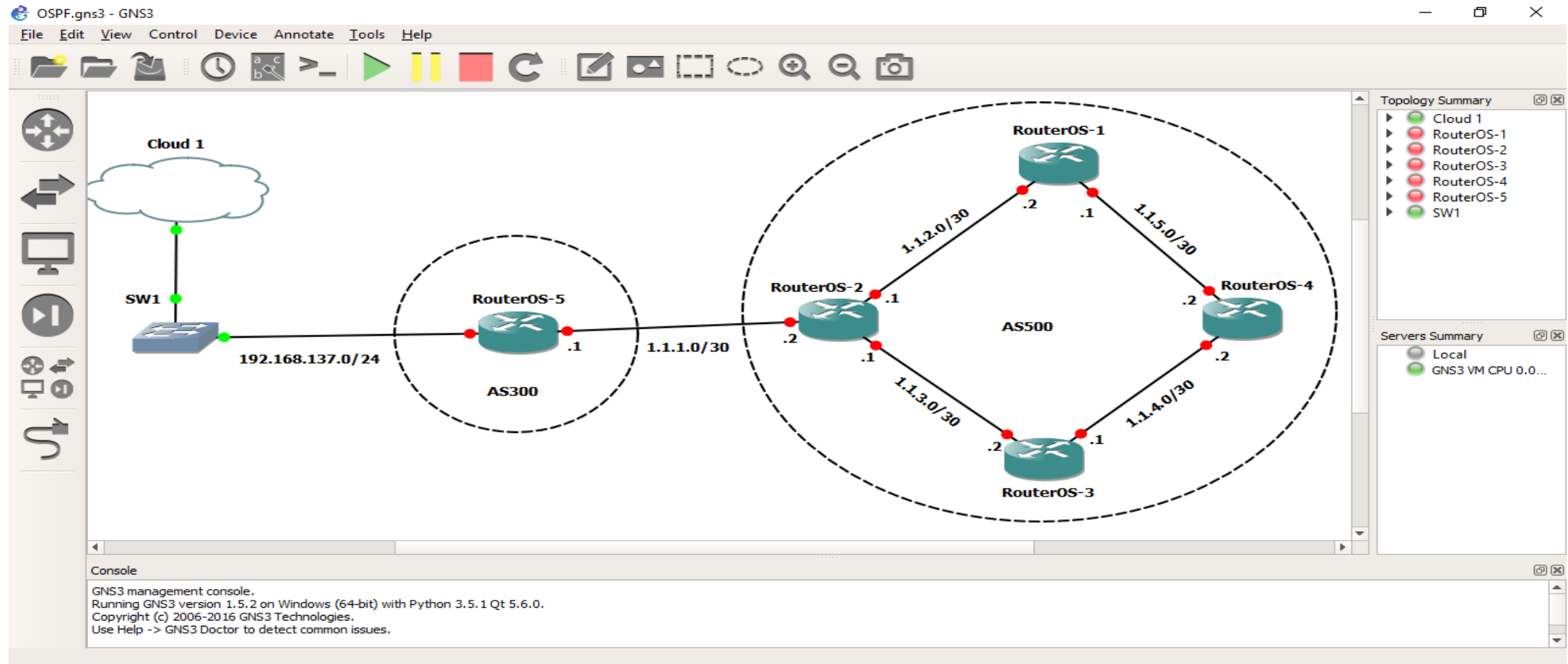


The screenshot shows the 'QEMU VM configuration' window for a VM named 'RouterOS'. The 'Network' tab is selected. Under the 'Adapters' section, the value '5' is entered in the text box, and a black arrow points to it. Other fields include 'First port name', 'Name format' (Ethernet{0}), 'Segment size' (0), 'Base MAC' (a blank field with a colon-separated pattern), 'Type' (Intel Gigabit Ethernet (e1000)), and an unchecked checkbox for 'Use the legacy networking mode'. The 'OK' and 'Cancel' buttons are at the bottom right.

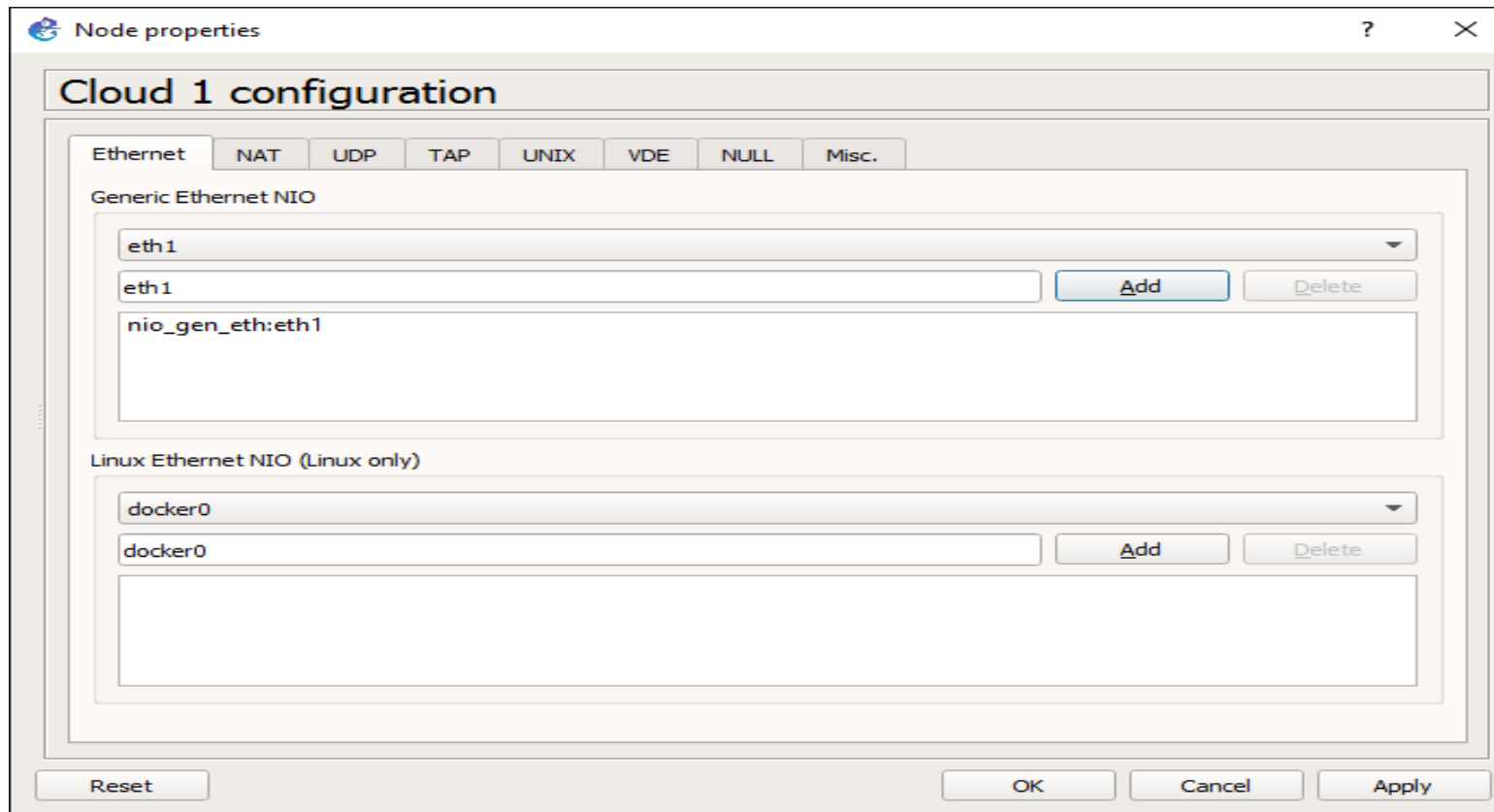
To allow VMs external access,  
Configure GNS3 VM second network adapter to 'bridge mode'



Drag RouterOS to the blank canvas to set up your desired network



Use the Cloud to connect your VMs to external resources



Node properties

### Cloud 1 configuration

Ethernet NAT UDP TAP UNIX VDE NULL Misc.

Generic Ethernet NIO

eth1

eth1

Add Delete

nio\_gen\_eth:eth1

Linux Ethernet NIO (Linux only)

docker0

docker0

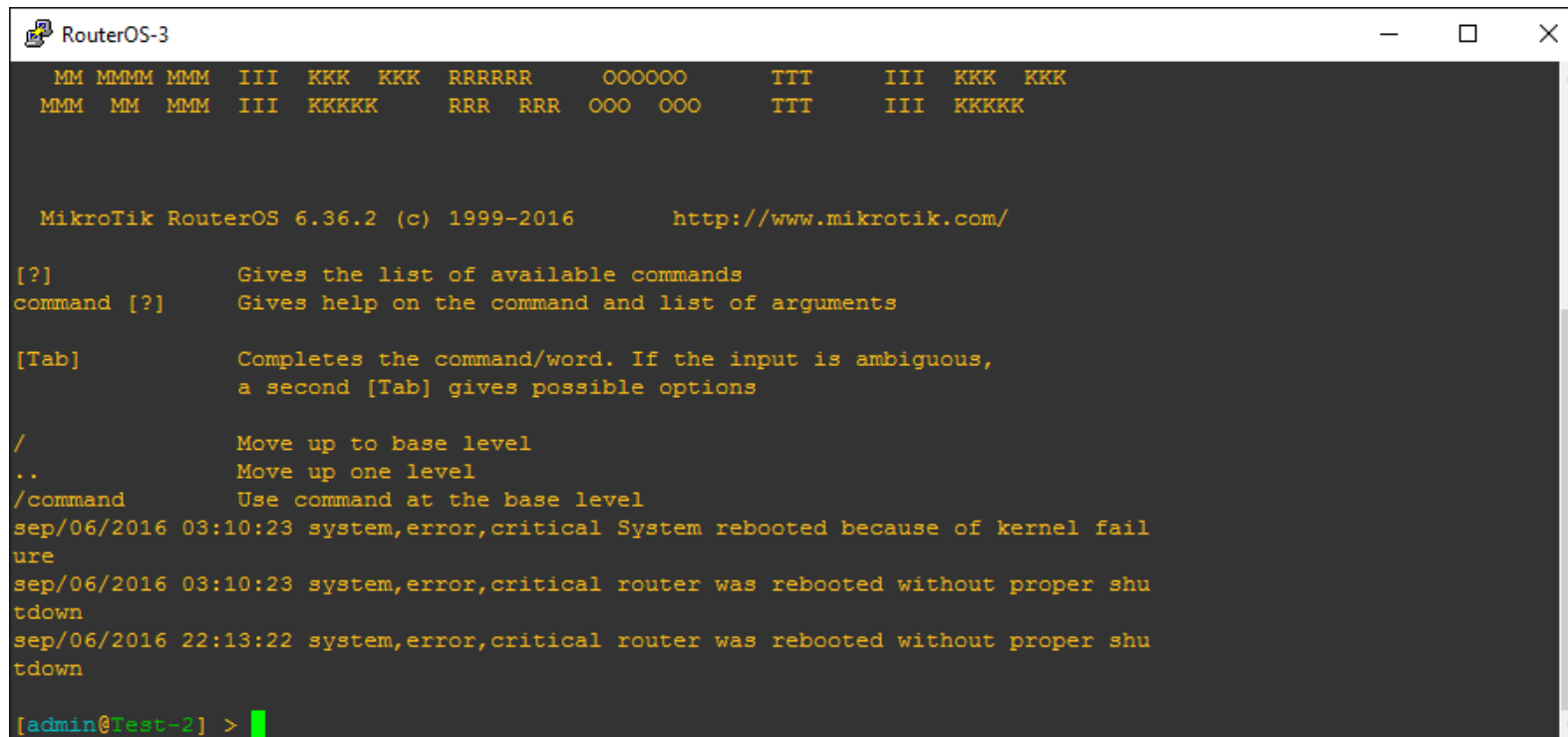
Add Delete

Reset OK Cancel Apply

Power up your routers by right-clicking each and selecting 'start'

Or power all at once with green 'start' button at the top.

Console in by right-clicking and select 'console'



```
RouterOS-3
MM MMMM MMM III KKK KKK RRRRRR OOOOOO TTT III KKK KKK
MMM MM MMM III KKKKK RRR RRR OOO OOO TTT III KKKKK

MikroTik RouterOS 6.36.2 (c) 1999-2016 http://www.mikrotik.com/

[?] Gives the list of available commands
command [?] Gives help on the command and list of arguments

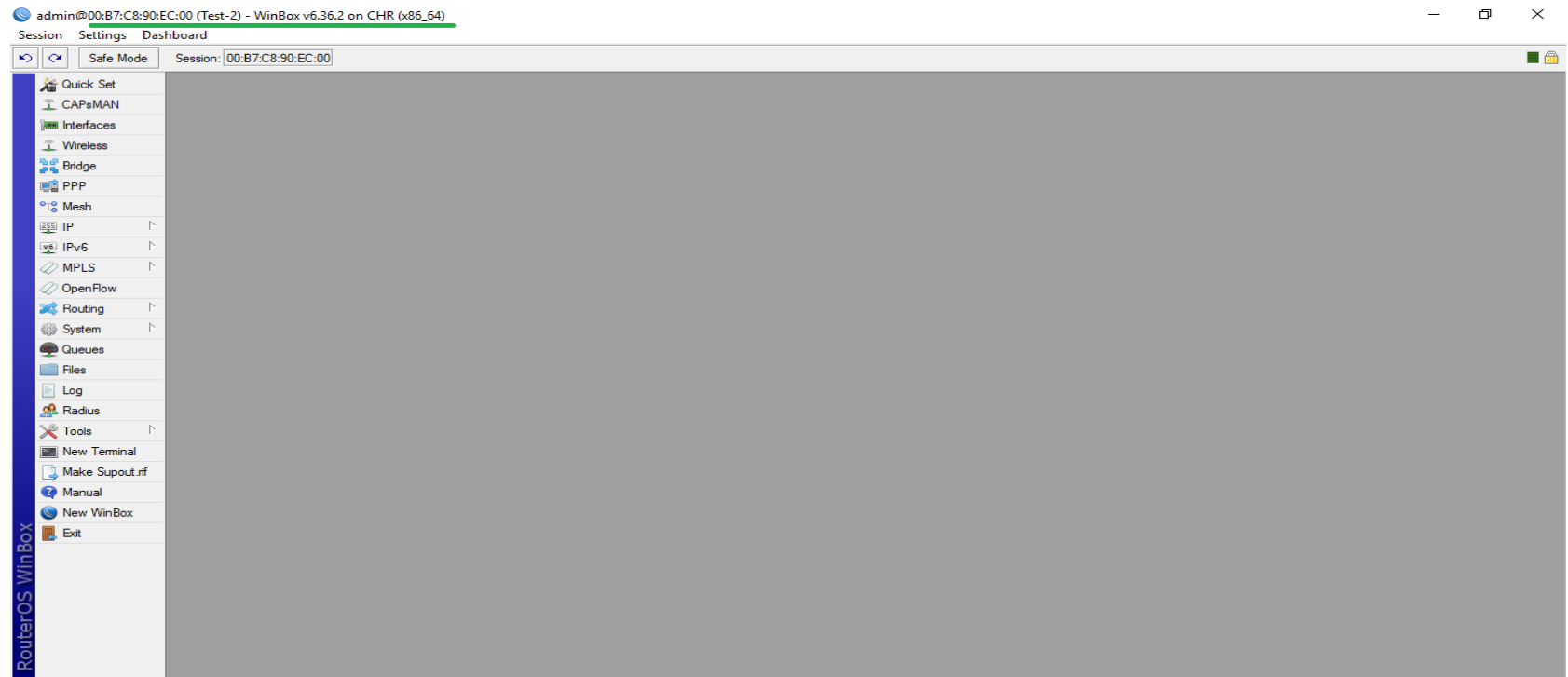
[Tab] Completes the command/word. If the input is ambiguous,
a second [Tab] gives possible options

/ Move up to base level
.. Move up one level
/command Use command at the base level
sep/06/2016 03:10:23 system,error,critical System rebooted because of kernel fail
ure
sep/06/2016 03:10:23 system,error,critical router was rebooted without proper shu
tdown
sep/06/2016 22:13:22 system,error,critical router was rebooted without proper shu
tdown

[admin@Test-2] >
```

At this point, the router can be configured using Winbox.

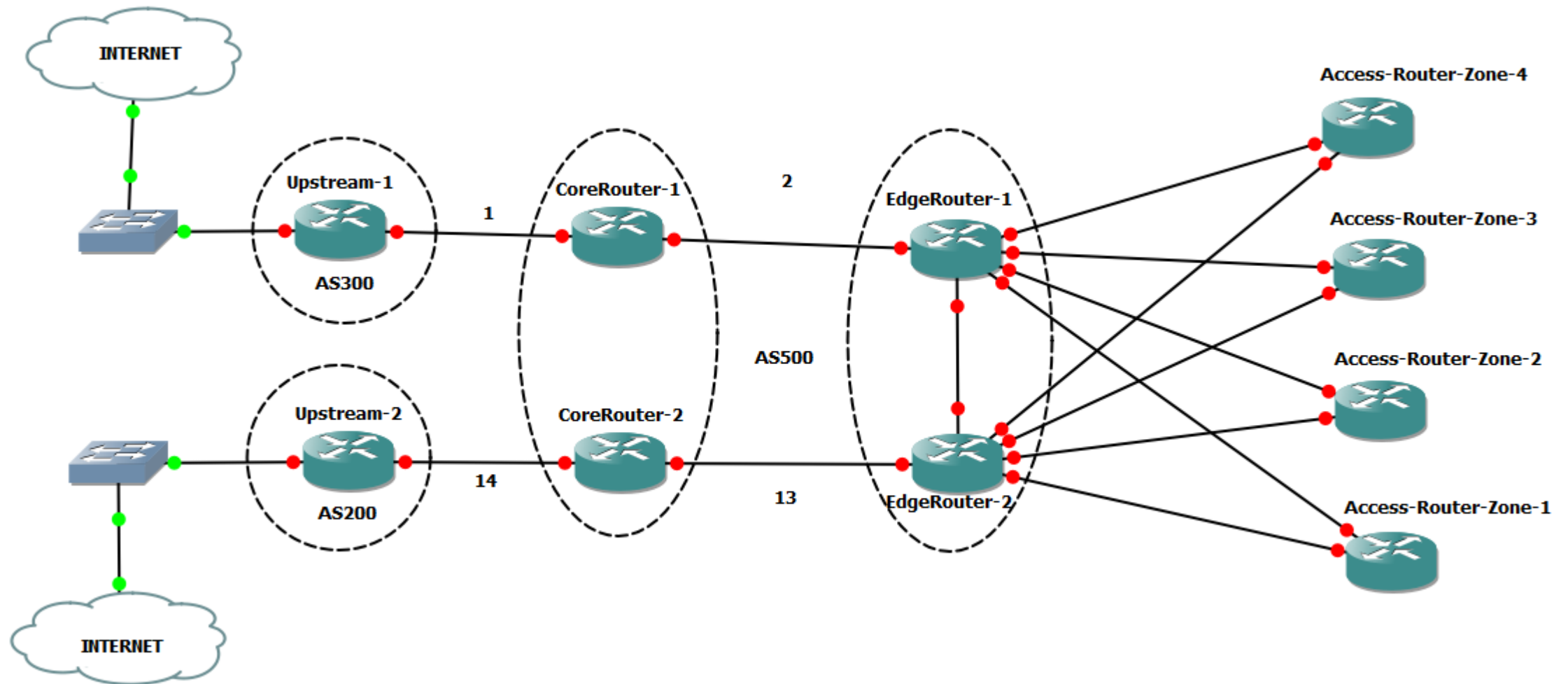
/tool romon set enabled=yes





- **Consulting for a small WISP that wanted to scale up**
- **Need for uptime/HA with BGP**
- **Faster convergence with OSPF**
- **Improved Network Security**





Properties X

```
[admin@CoreRouter-1] > /routing bgp instance set default as=500 redistribute-static=no
```

```
[admin@CoreRouter-1] > /routing bgp peer add remote-address=41.217.X.Y remote-as=200
```

```
[admin@CoreRouter-1] > /routing bgp instance set default redistribute-static=yes
```

**NOTE: Swap IP address and AS Number with the correct ones for each of the Core Routers and the Upstream Routers.**

```
[admin@EdgeRouter-1] /routing ospf instance> add name=default  
  
[admin@EdgeRouter-1] /routing ospf instance> set 0 router-id=1.1.1.1  
  
[admin@EdgeRouter-1] /interface bridge> add name=loopback  
  
[admin@EdgeRouter-1] > ip address add address=X.X.X.X/32 interface=loopback  
  
[admin@EdgeRouter-1] /routing ospf network> add network=Y.Y.Y.0/22 area=backbone
```

**NOTE: Swap Router ID, Network statements, Loopback IP Address with the correct ones for each of the participating routers.**



# *Firewall/Security*

RouterOS WinBox

Session

Settings

Dashboard

Safe Mode

Session:

Uptime: 3d 08:00:42

Memory: 104.7 MiB

Time: 07:57:58

CPU: 4%

Quick Set

CAPsMAN

Interfaces

Wireless

Bridge

PPP

Switch

Mesh

IP

IPv6

MPLS

Routing

System

Queues

Files

Log

Radius

Tools

New Terminal

MetaROUTER

Partition

Make Supout.nif

Manual

New WinBox

Exit

Firewall

Filter Rules

NAT

Mangle

Raw

Service Ports

Connections

Address Lists

Layer7 Protocols

00 Reset Counters

00 Reset All Counters

Find

all

#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	In. Inter...	Out. Int...	Bytes	Packets
::: Add Spammers to the list for 1 day											
0	add...	forward			6 (tcp)		25,587,1...			0 B	0
::: Avoid spammers action											
1	drop	forward			6 (tcp)		25,587,1...			0 B	0
::: Add Spammers to the list for 1 day											
2	add...	output			6 (tcp)		25,587,1...			0 B	0
::: Avoid spammers action											
3	drop	output			6 (tcp)		25,587,1...			0 B	0
4 X	drop	forward								1896.4 KiB	23 000
::: block torrent dns											
5 X	drop	forward			17 (u...		53			1430.3 KiB	20 259
6	drop	input			6 (tcp)		53			168 B	4
7	drop	input			17 (u...		53			2439 B	37
8	drop	input			17 (u...		5060			87.8 KiB	204
9	drop	forward			17 (u...		5060			720.5 KiB	1 660
10	drop	forward								2536.5 KiB	56 649
11	drop	input								0 B	0
12	drop	forward			1 (ic...					113.9 KiB	1 822
13	drop	input			1 (ic...					0 B	0
::: drop invalid connections											
14	drop	forward			6 (tcp)					3704.8 KiB	71 165
::: allow already established connections											
15 X	acc...	forward								0 B	0
16	add...	input			6 (tcp)					0 B	0
17	tarpit	input			6 (tcp)					0 B	0
::: SYN Flood protect											
18 X	jump	forward			6 (tcp)					0 B	0
19 X	drop	SYN-Protect			6 (tcp)					0 B	0
20	drop	input			17 (u...					12.5 MiB	138 904
21	drop	input	0.0.0.0	255.255.25...						0 B	0

22 items

- **GNS3 is bundled with useful tools such as;**
  - ***VPCS (Virtual PC Simulator)- This is a simple network testing tool that has essential commands like traceroute, ping, arp built in.***
  - ***Wireshark: A powerful protocol analyzer that can be used to capture and analyze packets***

***Q. How do we move from simulation to production Or to another platform?***

- ***GNS3 stores all project files under one folder which is movable to another computer. RouterOS template image file (.img) should also be copied together with the project itself and placed into 'GNS3/images' folder on target machine.***
- ***Qemu stores images in qcow2 (copy-on-write) format. These images can be run separately from GNS3.***
- ***If in production environment different hypervisor is used, qcow2 image can be converted to various formats using 'qemu-img convert' command***

- Training –Almost as realistic as building a mock network with real equipment
- Network Validation –Allows you test network designs and changes before they are applied to a production network
- Reduces downtime
- Increases ROI

- **CHR is a fully functional RouterOS**
- **Any descent computer that supports virtualization can be used for Lab scenario**
- **GNS3 Lab configurations can be migrated to other systems or production.**
- **Wireshark and other tools are bundled with GNS3 for testing and analysis**
- **The uses are only limited by your imagination**



# The End



*Thank You!*



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Mobile Airtel : 0787 763 577**