

Disclaimer

The author of this document shall not carry responsibility for any damage to the network, computer(s) software or hardware either direct or indirect as a result of following the instructions herein.

Introduction

This document provides steps on building a virtual network using **pfSense**. **pfSense** will act as a virtual router/Gateway interface between the existing production network and the virtual environment using **Oracle VirtualBox**. This gives us the ability to build a virtual lab of servers and workstations without interfering with the exiting services in a production environment, all for testing purpose and beyond.

This document also highlights steps on setting up remote desktop connection between a production workstation and a virtual instance, this in addition to a scenario where you may need to virtually connect multiple pfSense virtual routers together for certain testing, under **Additional Comments**.

You may find some of the steps confusing, just carry on and it will become clear and make sense at completion.

This document uses **Oracle VirtualBox 5.0.16 r105871** and **pfSense 2.2.6 64-bit**. Latest release for both products may be obtained from the following links, unless changes at a later date by manufacture:

<https://www.virtualbox.org/>

<https://www.pfsense.org/download/>

This document is intended for I.T. professionals. However, other users may find this document useful and straight forward to follow.

Requirements

- A PC with a network card, adequate processing power, adequate memory and hard drive capacity
- **Oracle VirtualBox**
- **pfSense**
- A virtual instance, such as **Windows Server 2012** to connect to the newly created virtual network by **pfSense** and test Internet connectivity

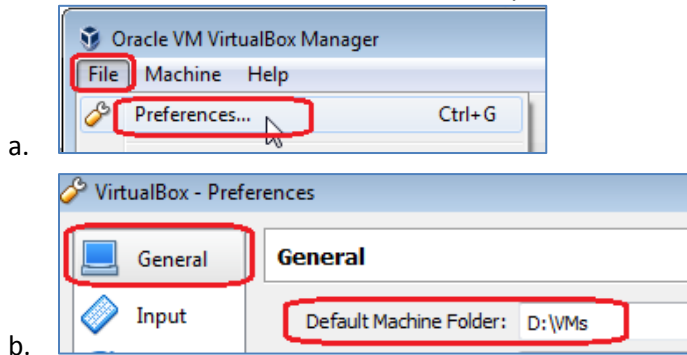
Brief

- On the PC, download and install **Oracle VirtualBox**
- On the PC, download and extract **pfSense**
- Create and configure a **pfSense** virtual instance
- Create and configure a virtual instance such as Windows Server 2012 for testing
- Test the virtual network connection and Internet access

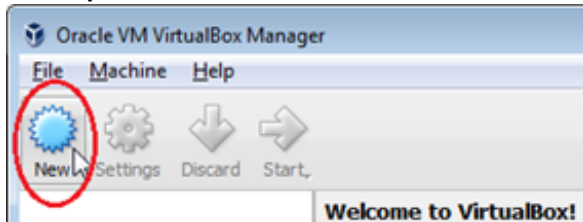
Procedure

1. On the PC, download and install **Oracle VirtualBox**, accept defaults until installation is complete

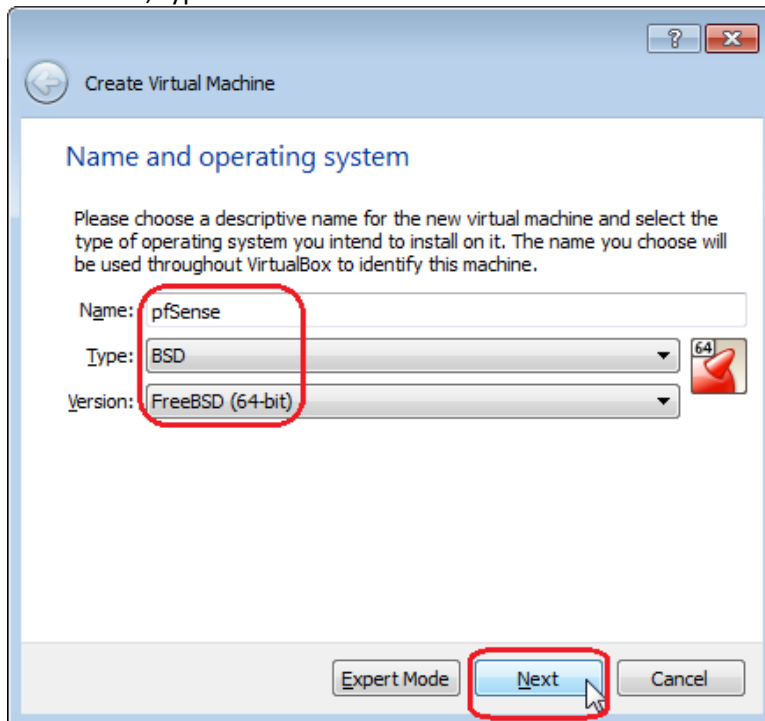
You may consider changing the default path **VirtualBox** uses to create its virtual instances right after installation complete. Simply from the **File** menu, select **Preferences**, and under **General** type-in or browse to the desired location, then click **OK** as illustrated in snapshots **a** and **b** below:



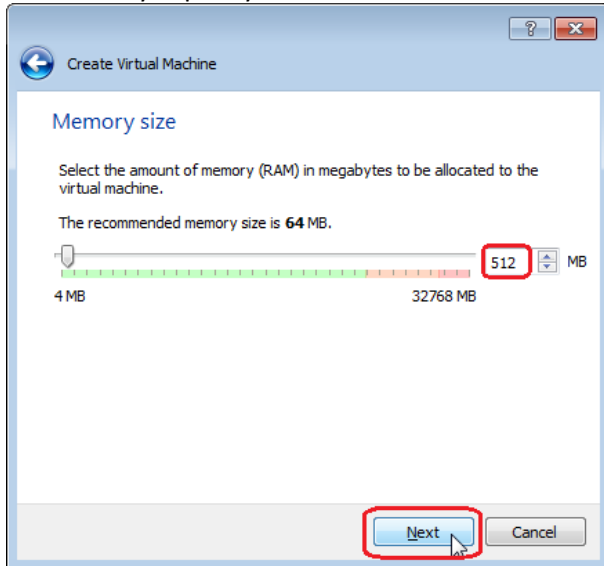
2. On the PC, download and extract **pfSense**, an ISO image should be available after extraction
3. Run **Oracle VirtualBox Manager** and click **New** to create a new virtual instance which will be utilized and configured as our **pfSense** virtual router:



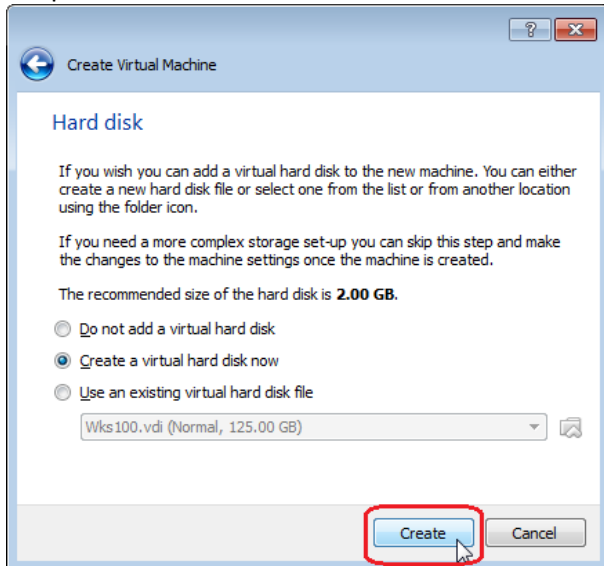
4. Follow below snapshots examples to complete creating the **pfSense** virtual router instance:
 - Enter name, type and version then click **Next** to continue



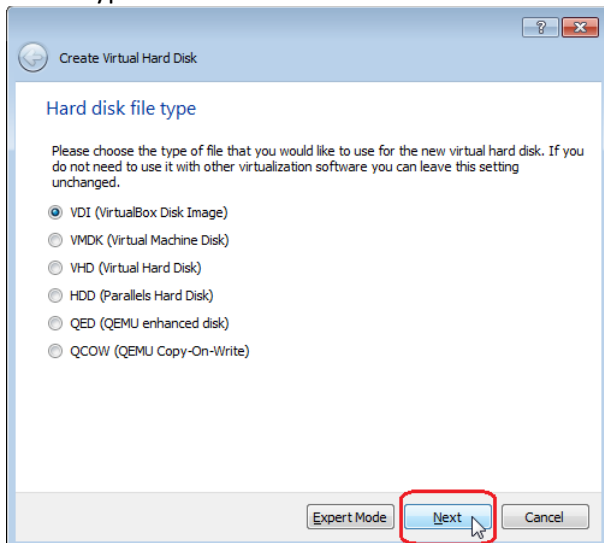
- Set memory capacity as desired then click **Next** to continue



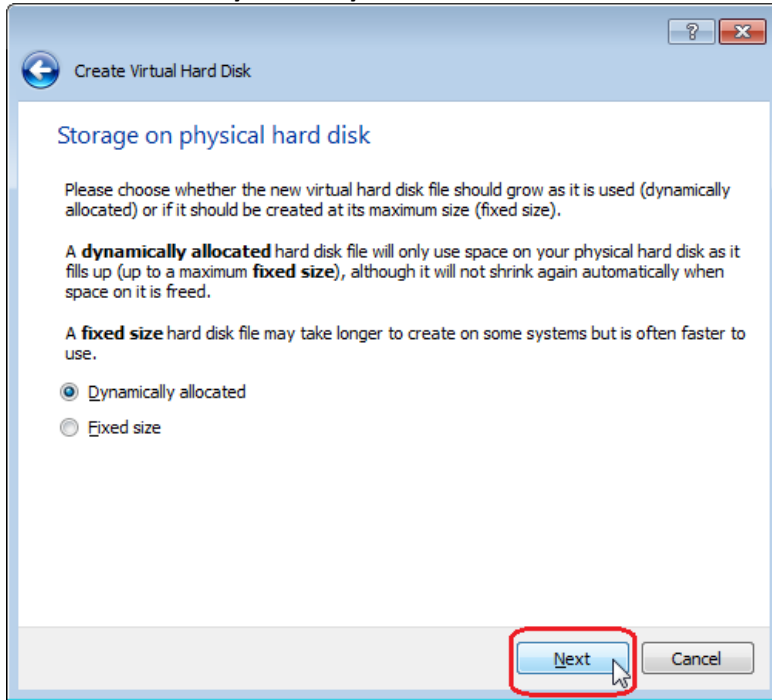
- Keep default selection at **Create a virtual hard disk now** then click **Create**



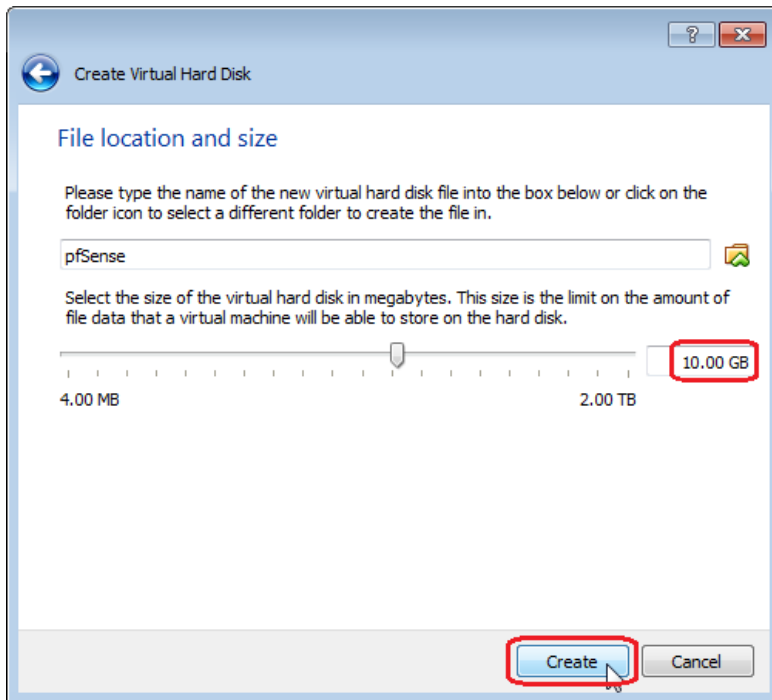
- Select type of file then click **Next** to continue



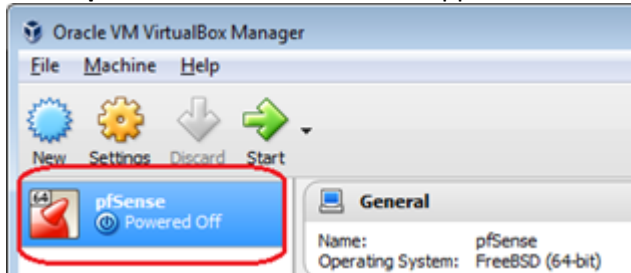
- Choose between **Dynamically allocated** and **Fixed size** then click **Next** to continue



- Set virtual hard drive size as desired then click **Create**



- A new **pfSense** virtual instance will appear on the left menu

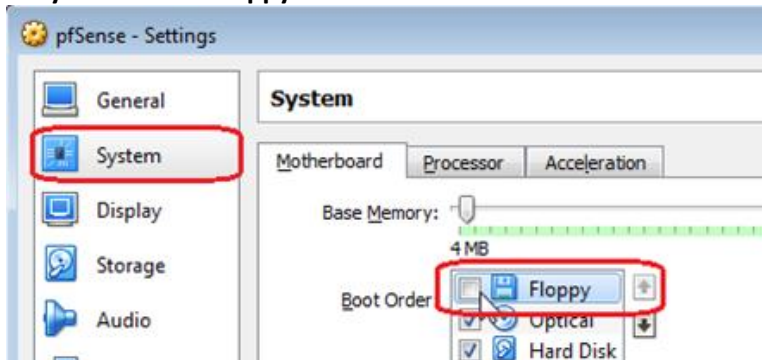


5. Let's review the **Settings** of the **pfSense** virtual instance to make some necessary changes, follow as illustrated in the snapshot examples below:

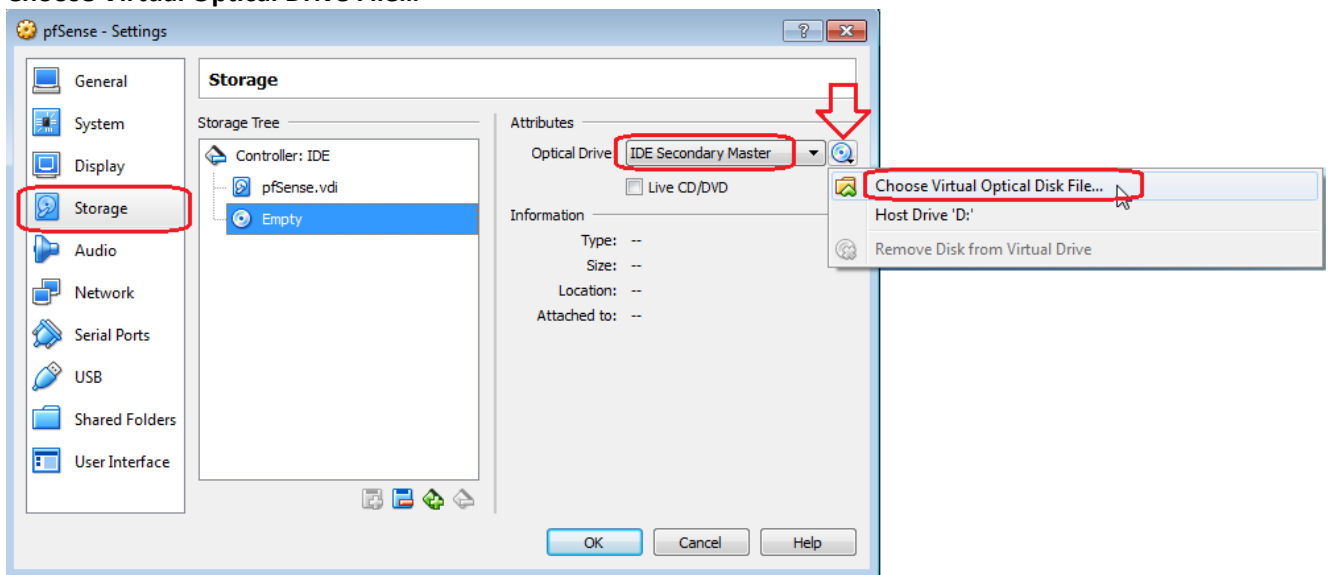
- Select **pfSense** and click on **Settings**



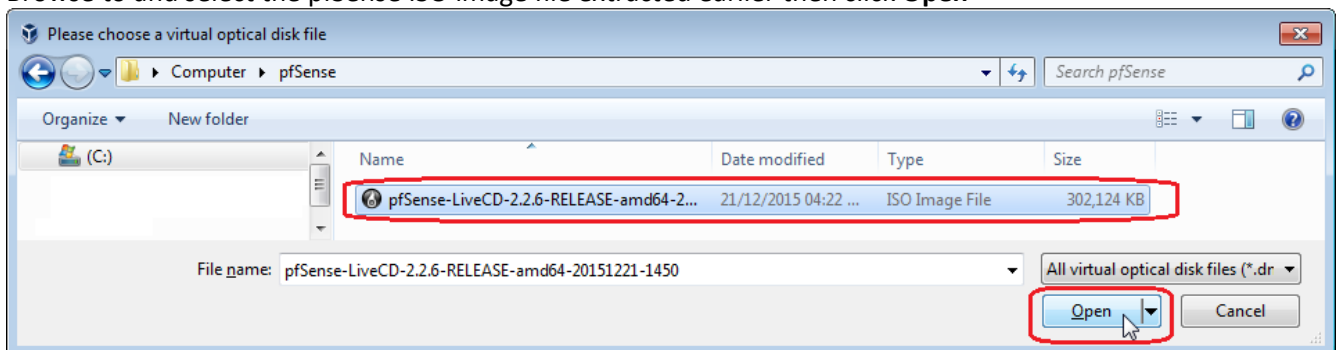
- In **System** untick **Floppy** from the **Boot Order** as it is not needed in this example



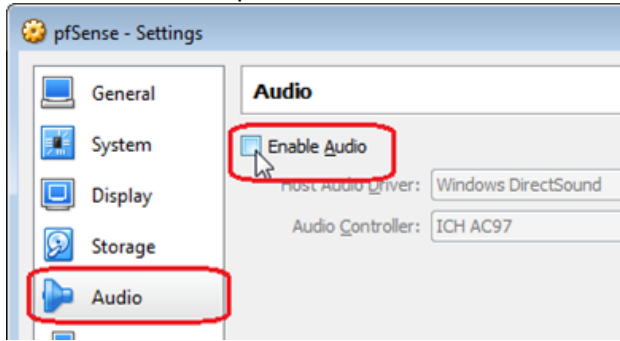
- In **Storage** under **Storage Tree** select the optical disk **Empty**, in **Attributes** click the optical drive icon to select **Choose Virtual Optical Drive File...**



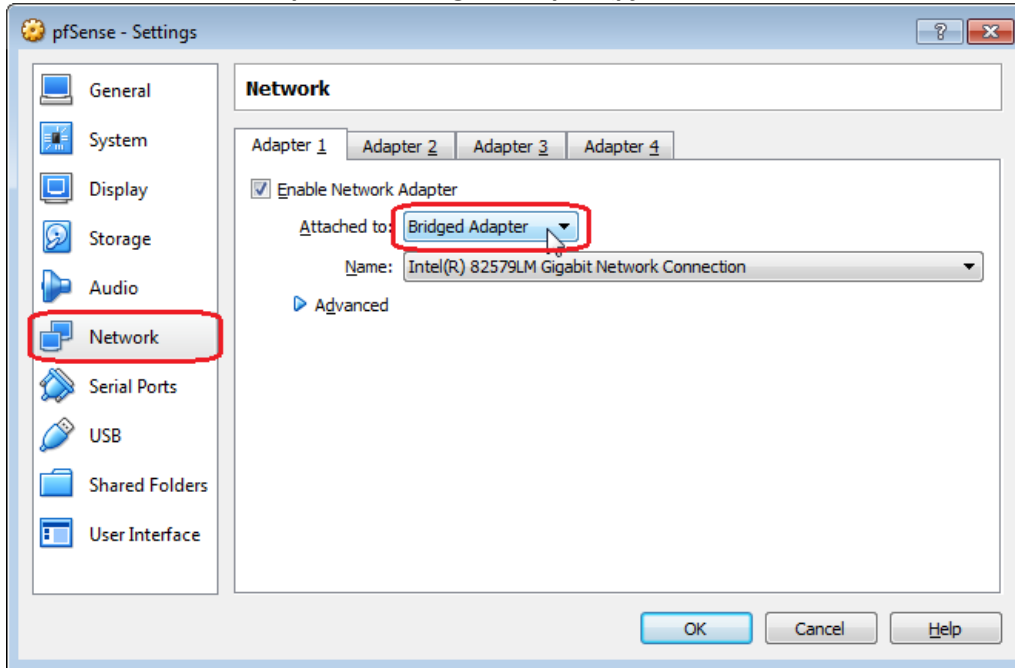
- Browse to and select the **pfSense** ISO image file extracted earlier then click **Open**



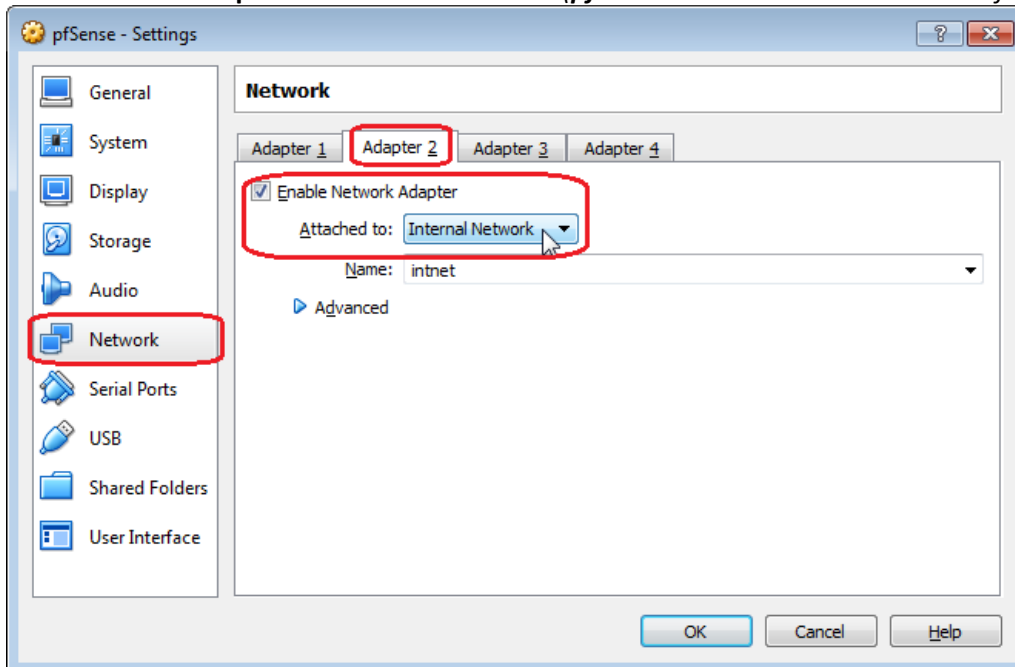
- In **Audio** deselect option as it is not needed in this example



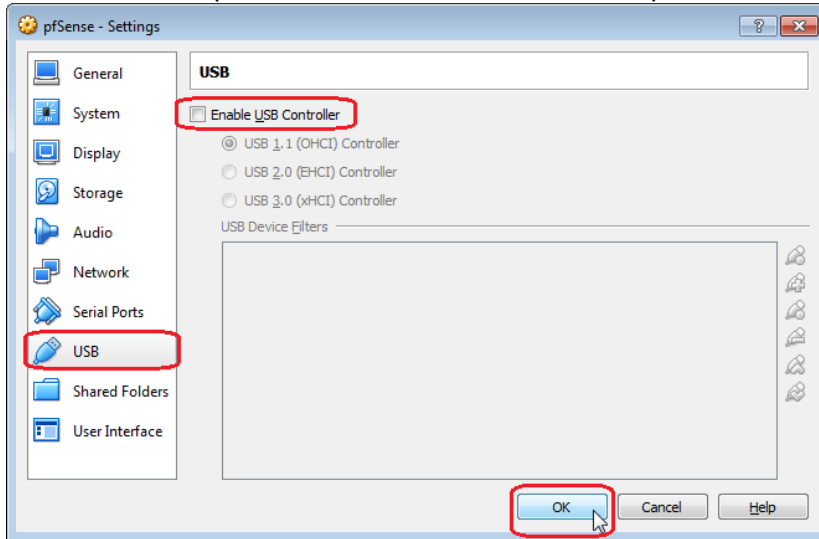
- Under **Network** set **Adapter 1** to **Bridged Adapter** (*pfSense will use this as its WAN interface*)



- Enable and set **Adapter 2** to **Internal Network** (*pfSense will use this as its LAN interface*)



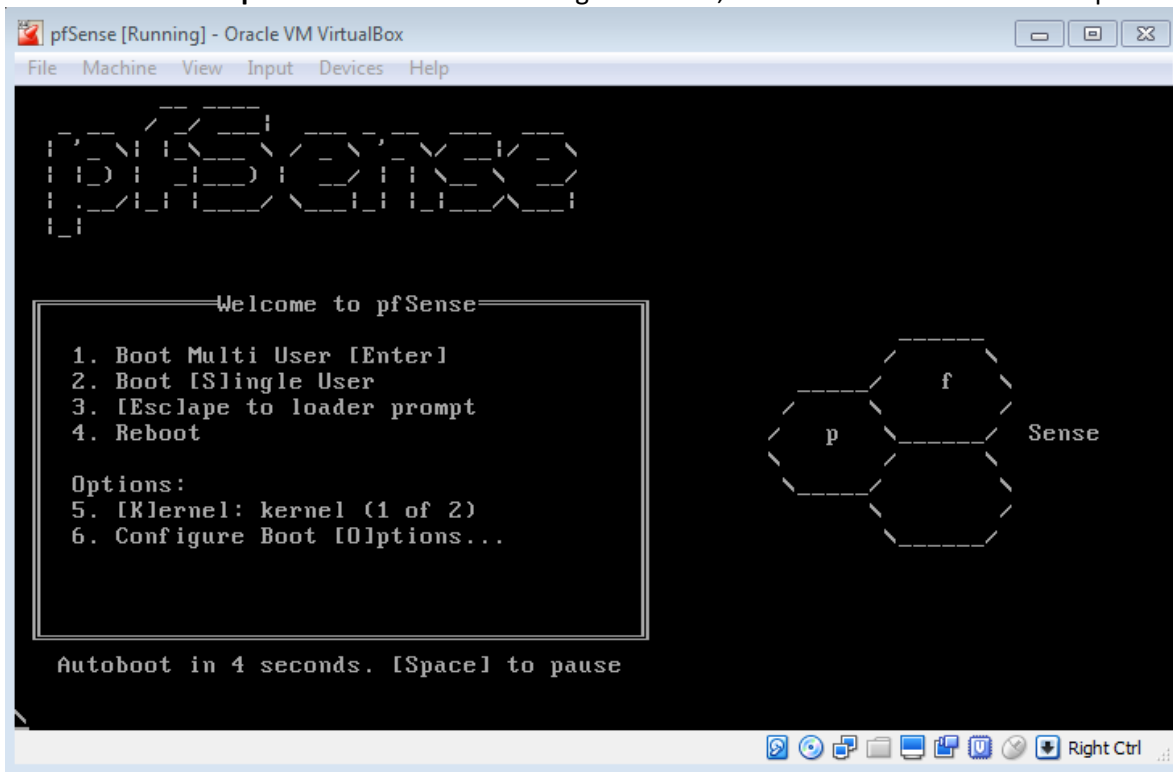
- In **USB** deselect option as it is not needed in this example then click **OK** to save and exit settings



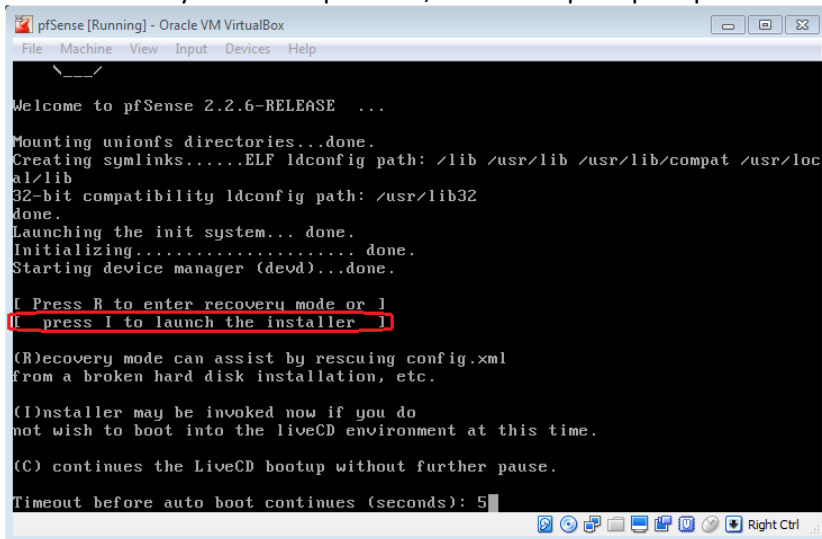
- 6. Now, let's start the **pfSense** virtual instance by clicking **Start**:



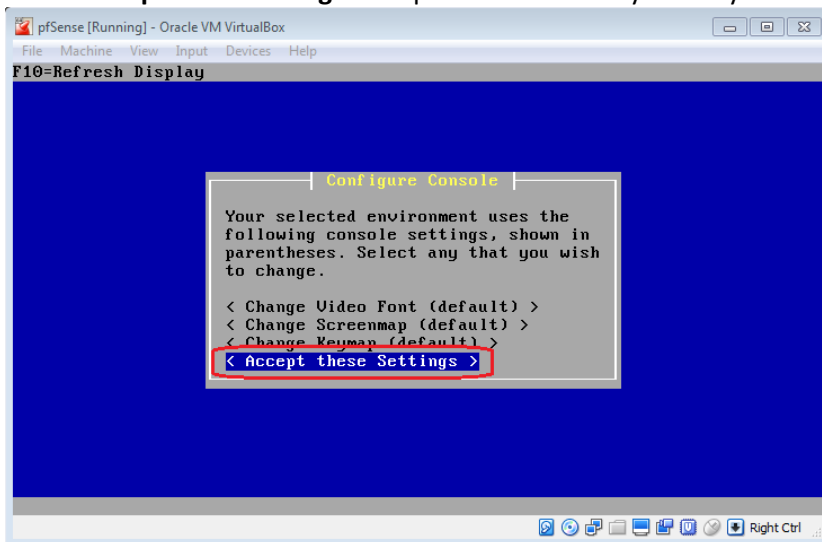
- 7. As we attached the **pfSense ISO** file to the storage selection, our virtual instance will boot up from this ISO image:



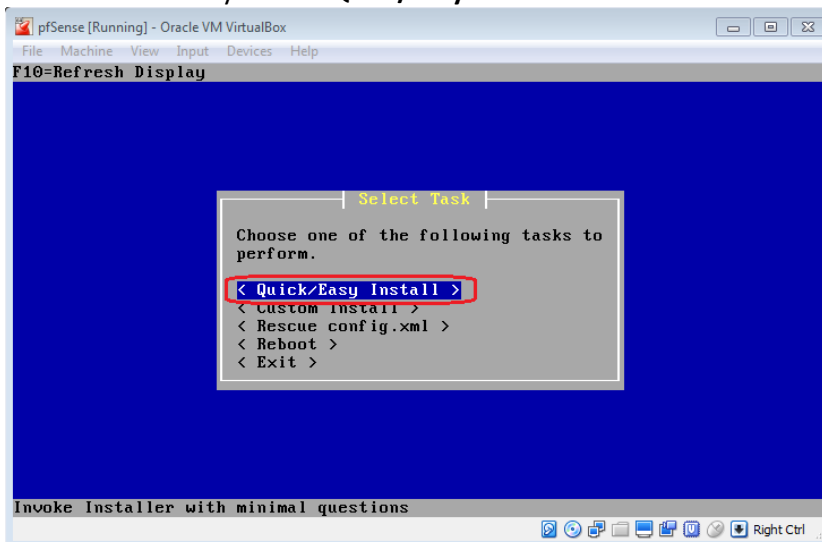
8. Watch carefully the boot up screen, as soon as prompted press 'i' to launch the installer:



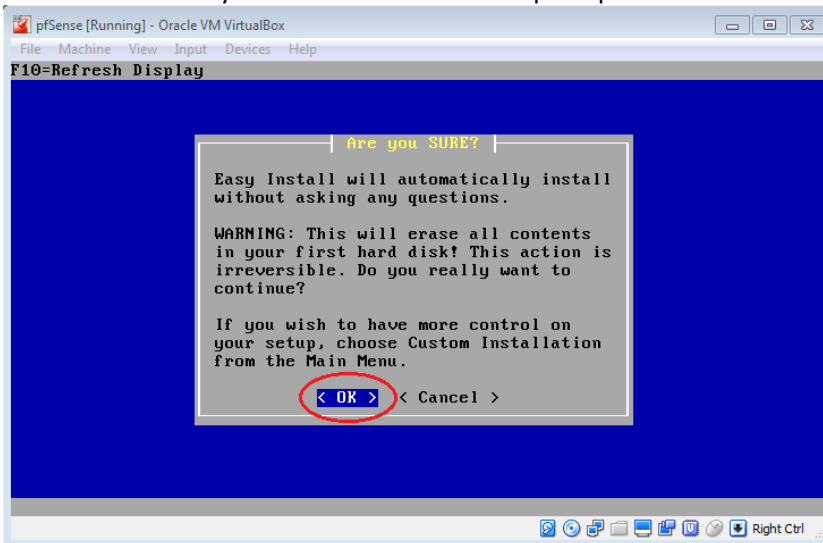
9. Select **Accept these Settings** then press the **Enter** key to carry on:



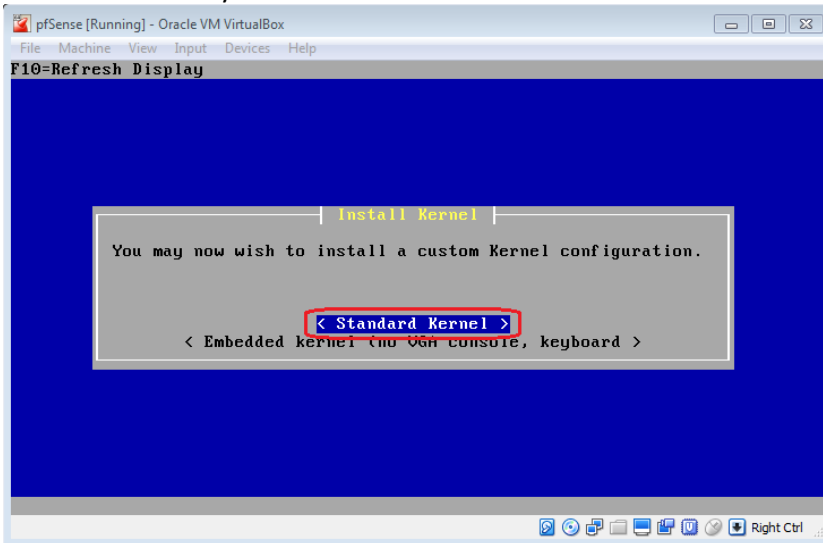
10. Press the **Enter** key for the **Quick/Easy Install** selection:



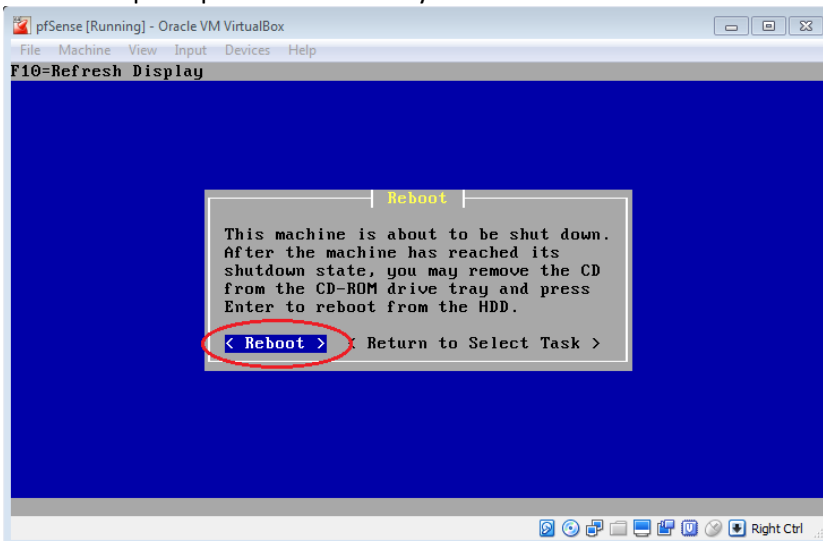
11. Press the **Enter** key for **OK** and wait for next prompt:



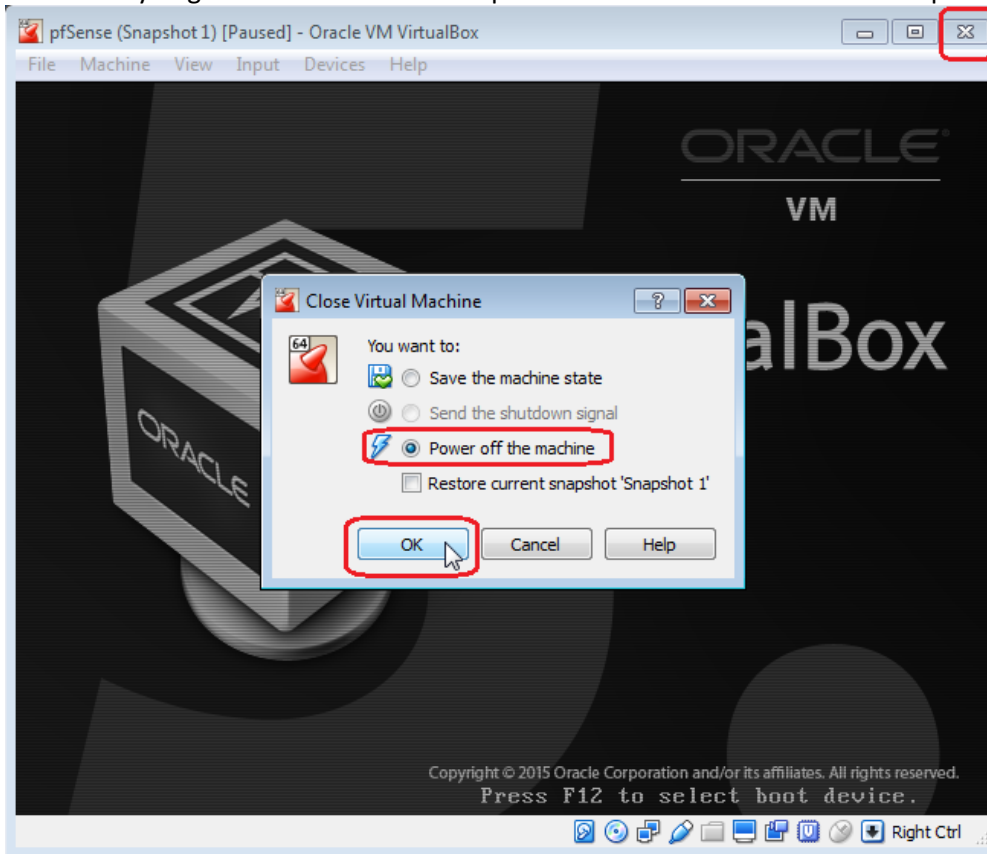
12. Press the **Enter** key for **Standard Kernel** and wait until installation complete:



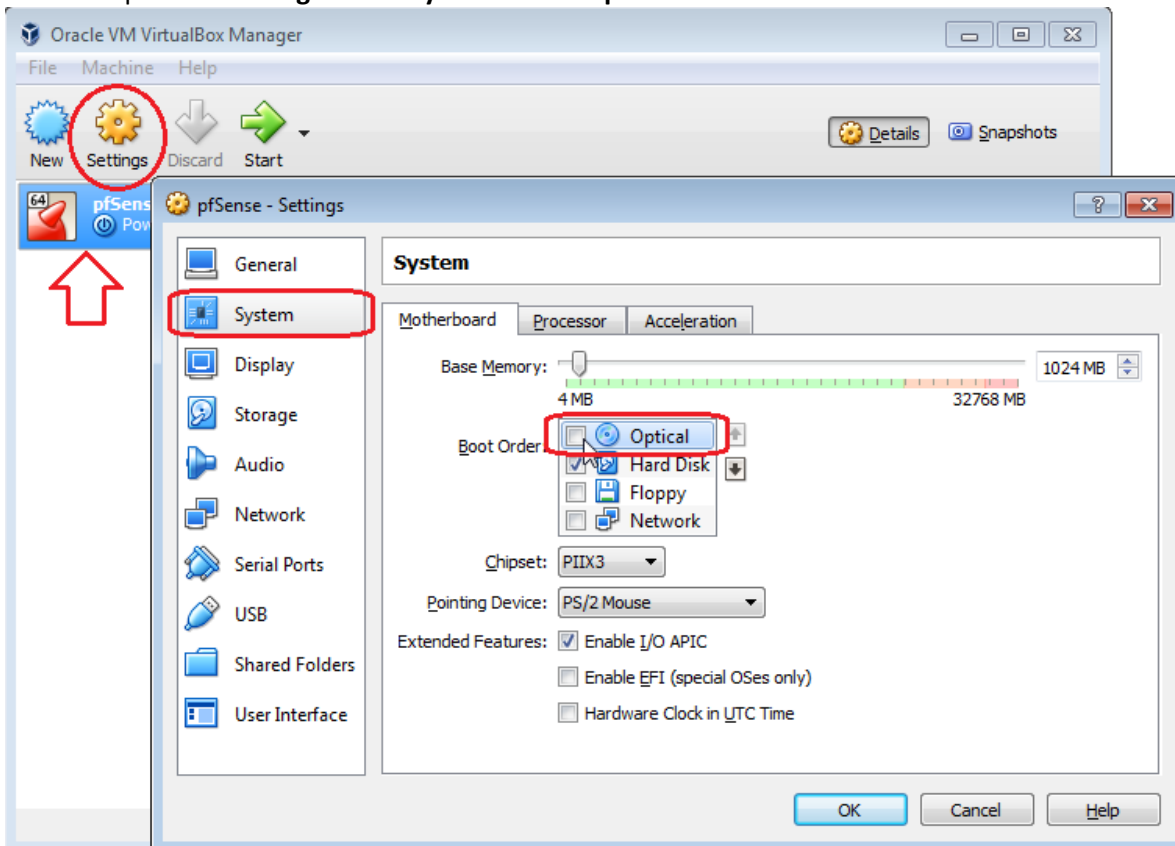
13. When complete press the **Enter** key to reboot the virtual instance:



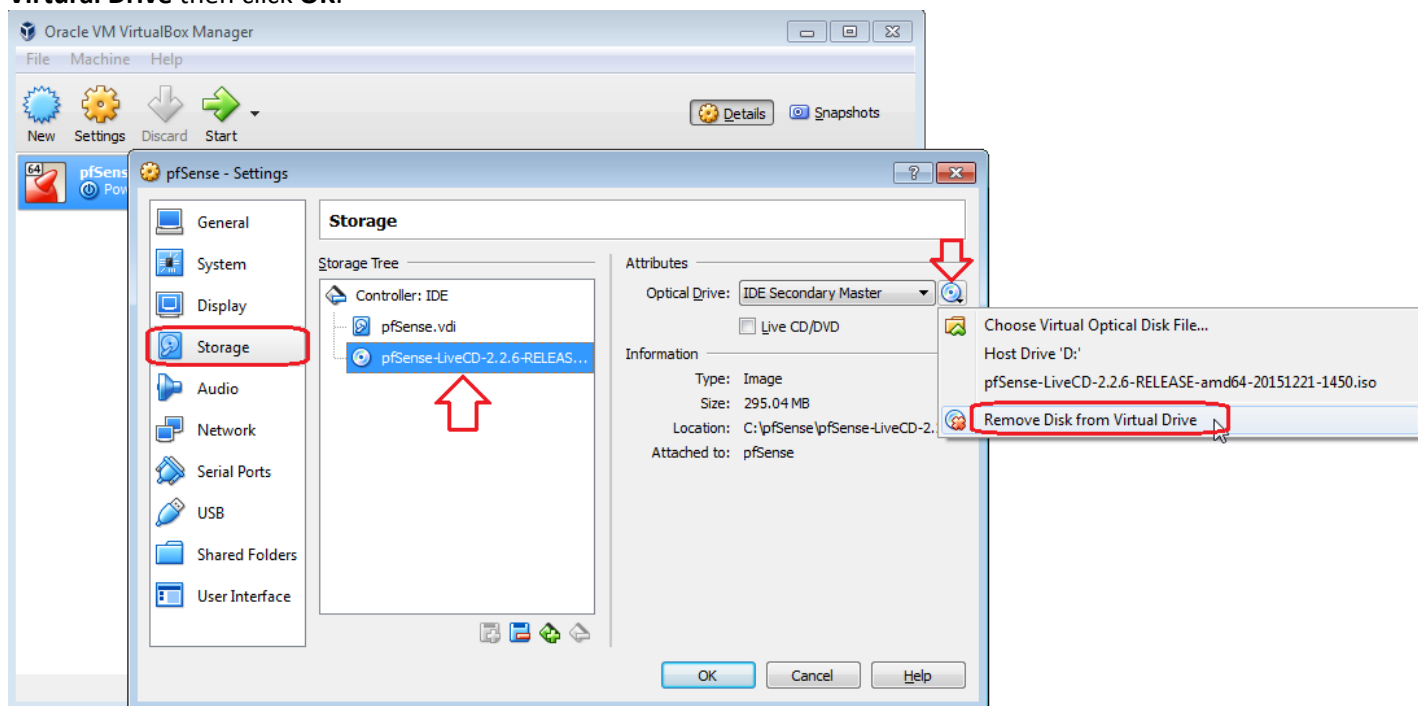
14. As soon as you get the Oracle VM start-up screen click the **X** button corner to power off the virtual instance:



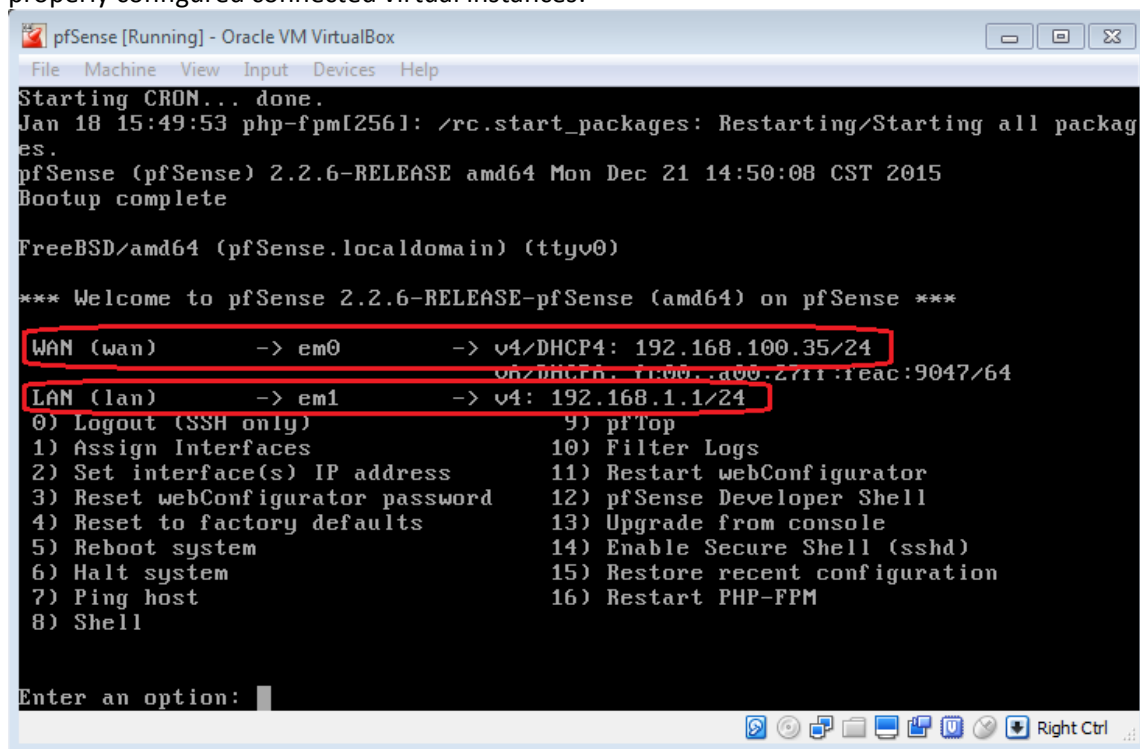
15. Go to the pfSense **Settings** and in **System** untick **Optical** from the **Boot Order** list:



16. In **Storage** under **Storage Tree** select the **pfSense-LiveCD..**, click the optical drive icon and select **Remove Disk from Virtual Drive** then click **OK**:



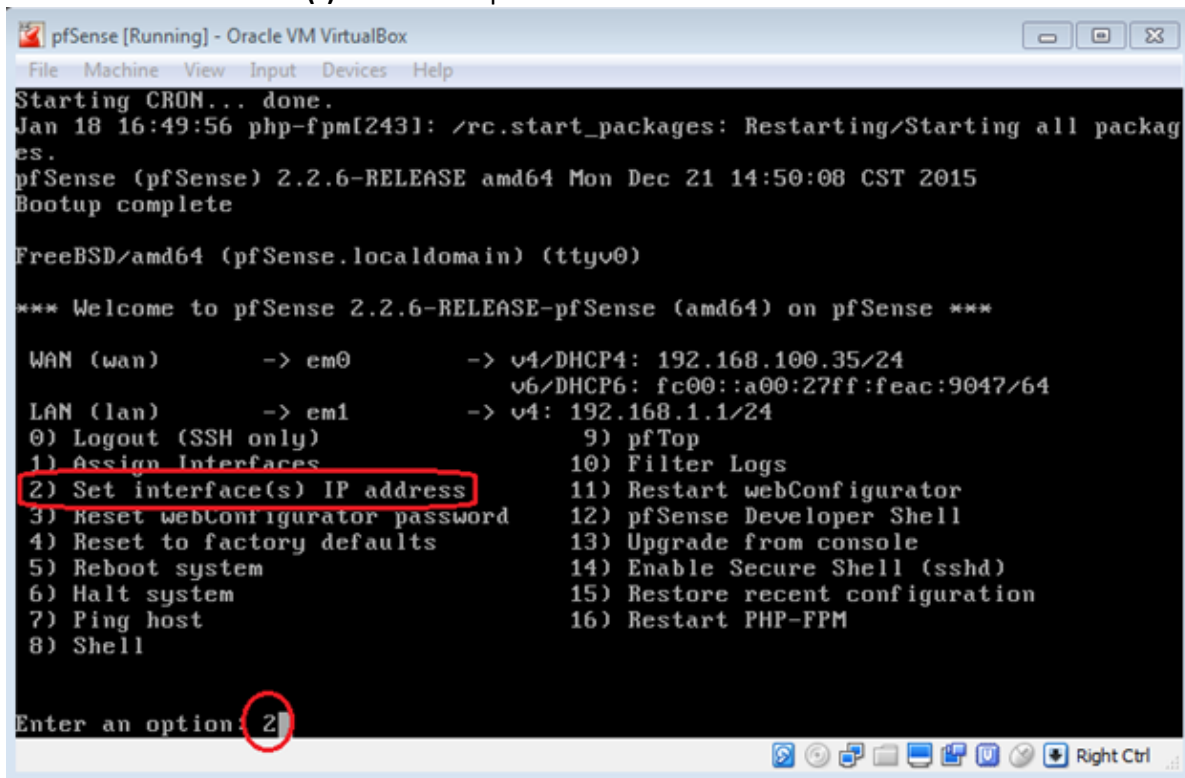
17. Start the **pfSense** virtual instance. When boot-up completes a window similar to below will appear. **pfSense** will be assigned an IP address from the production network for its **WAN** interface (*presuming that DHCP is enabled on this production network*). As **pfSense** has its own internal DHCP service, **pfSense** will provide a **LAN** interface with a default Gateway address. Now, **pfSense** is acting as a virtual router and is ready to assign IP addresses to the properly configured connected virtual instances:



Note: Now all new VM created, which its network adapter is set to **Internal Network**, will be assigned an internal IP address from **pfSense** by default

18. You may confirm the **WAN** setting as illustrated in the snapshots below:

- Enter **2** for **Set interface(s) IP address** option



```
pfSense [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Starting CRON... done.
Jan 18 16:49:56 php-fpm[243]: /rc.start_packages: Restarting/Starting all packages.
pfSense (pfSense) 2.2.6-RELEASE amd64 Mon Dec 21 14:50:08 CST 2015
Bootup complete

FreeBSD/amd64 (pfSense.localdomain) (ttyv0)

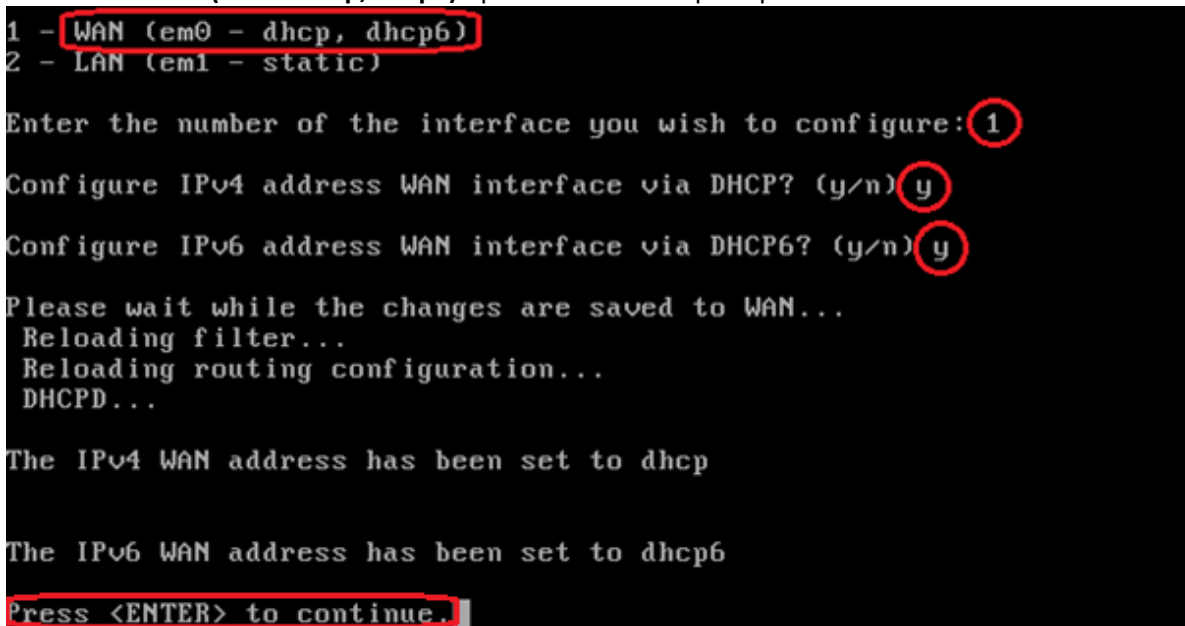
*** Welcome to pfSense 2.2.6-RELEASE-pfSense (amd64) on pfSense ***

WAN (wan)      -> em0      -> v4/DHCP4: 192.168.100.35/24
                v6/DHCP6: fc00::a00:27ff:feac:9047/64
LAN (lan)      -> em1      -> v4: 192.168.1.1/24

0) Logout (SSH only)          9) pfTop
1) Assign Interfaces          10) Filter Logs
2) Set interface(s) IP address 11) Restart webConfigurator
3) Reset webConfigurator password 12) pfSense Developer Shell
4) Reset to factory defaults    13) Upgrade from console
5) Reboot system                14) Enable Secure Shell (sshd)
6) Halt system                  15) Restore recent configuration
7) Ping host                    16) Restart PHP-FPM
8) Shell

Enter an option: 2
```

- Enter **1** for **WAN (em0 – dhcp, dhcp6)** option and answer prompts as illustrated below



```
1 - WAN (em0 - dhcp, dhcp6)
2 - LAN (em1 - static)

Enter the number of the interface you wish to configure: 1

Configure IPv4 address WAN interface via DHCP? (y/n) y
Configure IPv6 address WAN interface via DHCP6? (y/n) y

Please wait while the changes are saved to WAN...
Reloading filter...
Reloading routing configuration...
DHCPD...

The IPv4 WAN address has been set to dhcp

The IPv6 WAN address has been set to dhcp6

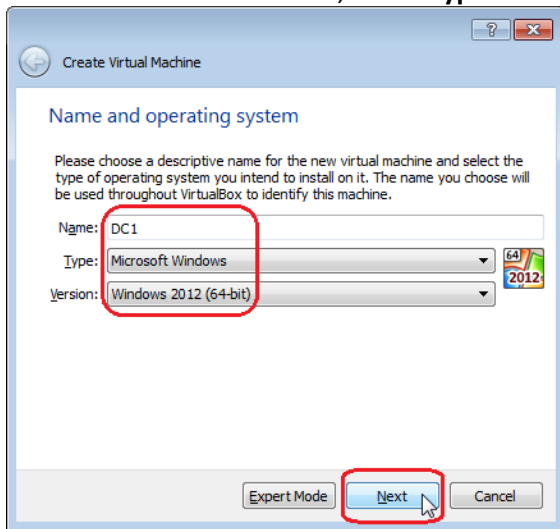
Press <ENTER> to continue.
```

19. Minimize the **pfSense** window let it running in the background. Currently **pfSense** is acting as a virtual router providing a virtual network environment

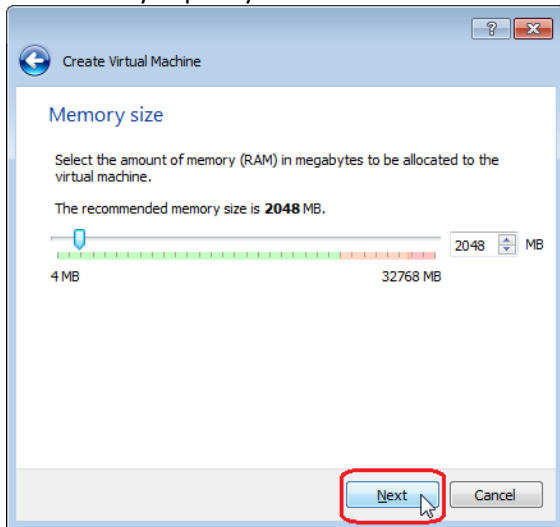
20. Now we are ready to create a lab of virtual instances of servers and workstations and connect them together on this virtual network. The only requirement to be part of this virtual network is during setting up a new virtual instance its network adapter must be attached to the **Internal Network**. Let's carry on by creating a virtual **Windows Server 2012** instance as an example:

Steps to create a new virtual instance are no different than creating **pfSense**, just set the new virtual instance **Settings** as desired. You may carry on as per the following example:

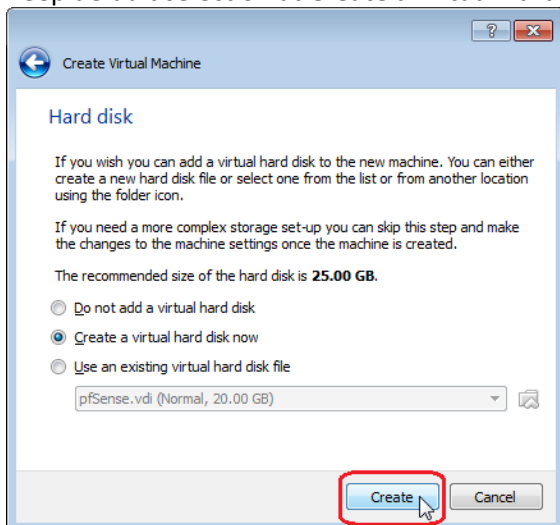
- Back to the **Oracle VM VirtualBox Manager**, click **New** to create a new virtual instance. Type a name for this virtual instance such as **DC1**, select **Type** and **Version** then click **Next** to continue



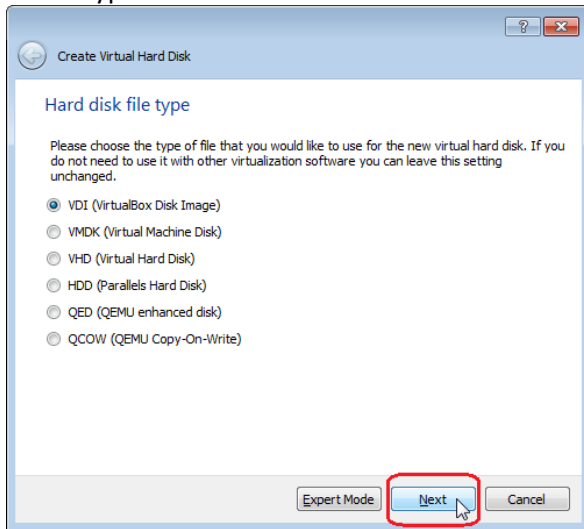
- Set memory capacity as desired then click **Next** to continue



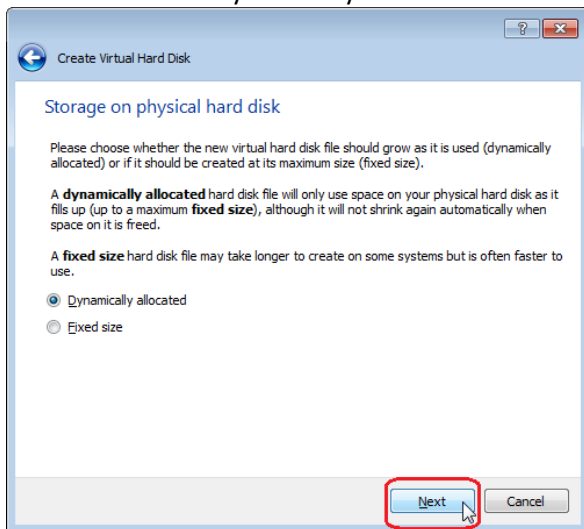
- Keep default selection at **Create a virtual hard disk now** then click **Create**



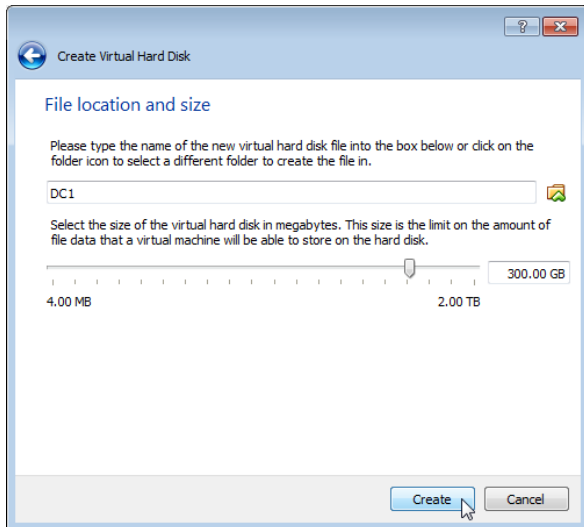
- Select type of file then click **Next** to continue



- Choose between Dynamically allocated and Fixed size as desired then click **Next** to continue

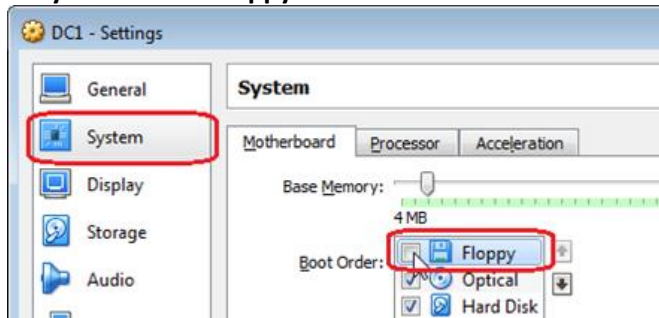


- Set virtual hard drive size as desired then click **Create**

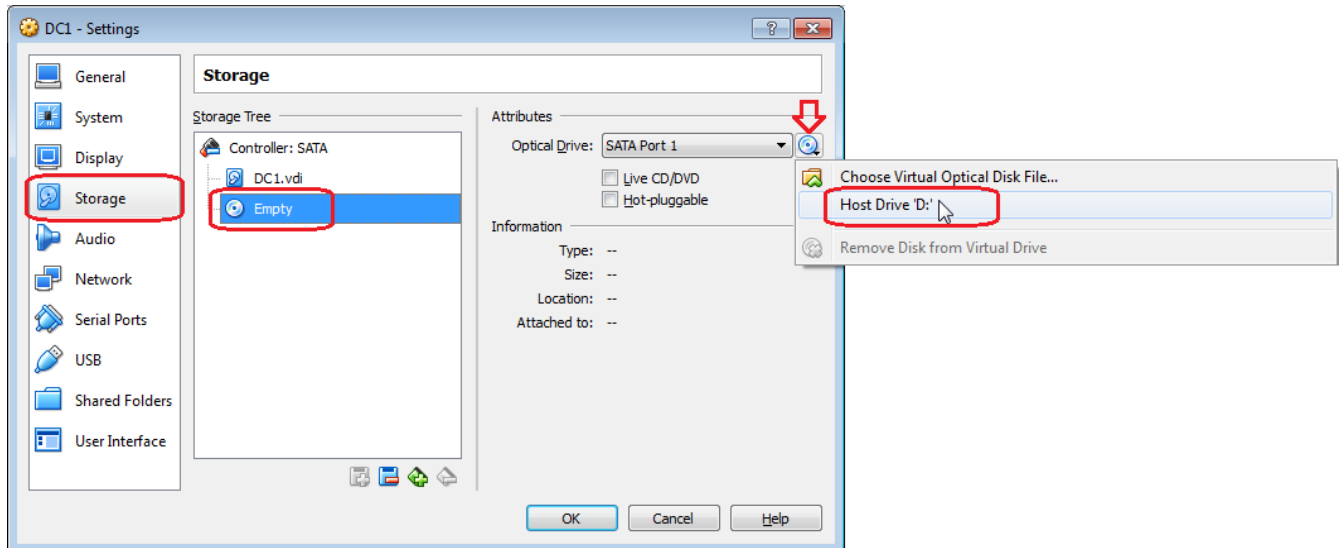


A new **DC1** virtual instance will appear on the left side menu. Now let's carry on by making some necessary changes to the **DC1 Settings**, similar to what we did earlier with **pfSense**

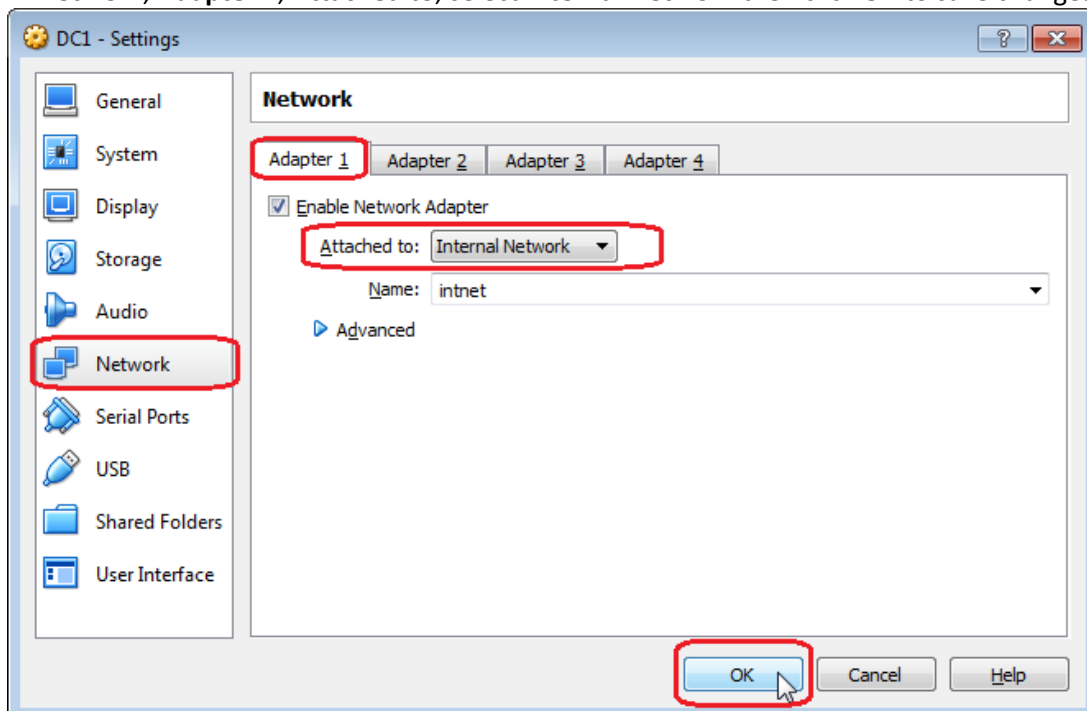
- In **System** untick **Floppy** from the **Boot order**



- In **Storage** under **Storage Tree** select the optical disk **Empty**, in **Attributes** click the optical drive icon to select **Host Drive 'D:'**, which represents the **DVD** drive where the **Windows Server 2012** DVD medium will be placed to start the installation from

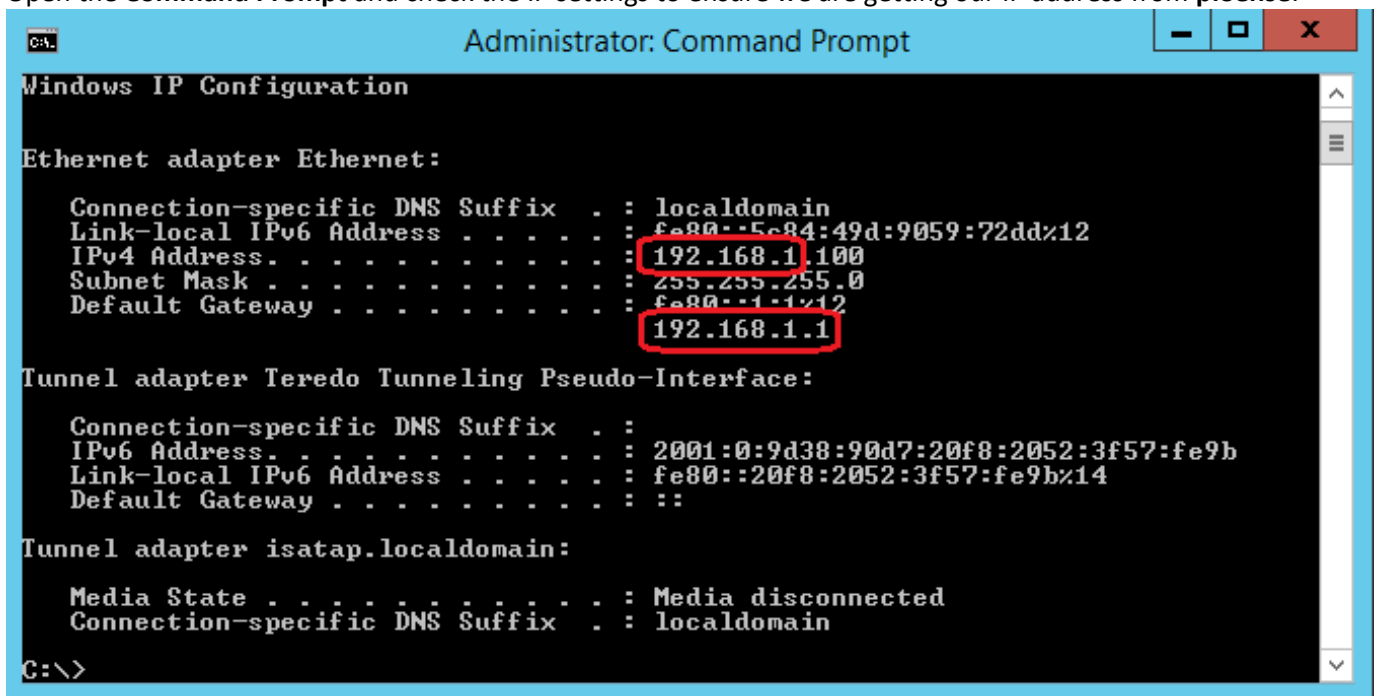


- In **Audio** you may keep defaults configuration or deselect option as desired
- In **Network, Adapter 1, Attached to**, select **Internal Network** then click **OK** to save changes and exit **Settings**



21. Insert the **Windows Server 2012** DVD medium into the PC DVD drive and start the **DC1** virtual instance. As we attached the virtual optical drive to the PC drive letter our DC1 virtual instance will boot up from the Windows Server 2012 DVD disk medium. Follow the prompts until installation all complete
22. After completion, shutdown the Windows Server 2012 virtual instance and remove the optical disk from the PC optical drive
23. Similar to what we did earlier after **pfSense** installation completed (steps 15 and 16 above), open the **Setting** of the **Windows Server 2012** virtual instance, in **System** untick **Optical** from the **Boot Order**, and in **Storage** remove the disk from the virtual drive
24. Start the **Windows Server 2012** virtual instance, login and open up the browser
25. In the browser address bar enter the **pfSense** default Gateway address which should be **192.168.1.1** to test the ability to reach it

Note: As this is the first time to open up the **pfSense** GUI you may be prompted to wait until building setup wizard is complete. You also may need to add **192.168.1.1** to your Internet Explorer **Trusted Sites** and refresh the browser screen to keep going. You may continue with the prompts until wizard completes. The **pfSense** default username is **admin** and default password is **pfSense**
26. Test the ability to connect to the Internet by browsing different websites
27. Open the **Command Prompt** and check the IP settings to ensure we are getting our IP address from **pfSense**:



You may carry on by creating other virtual server and workstation instances for your lab as desired

Additional Comments

1. To shutdown **pfSense** go to the **Shell** session by entering option **8** then type the command **poweroff** followed by pressing the **Enter** key as illustrated in snapshot next page:


```

pfSense [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

es.
pfSense (pfSense) 2.2.6-RELEASE amd64 Mon Dec 21 14:50:08 CST 2015
Bootup complete

FreeBSD/amd64 (pfSense.localdomain) (ttyv0)

*** Welcome to pfSense 2.2.6-RELEASE-pfSense (amd64) on pfSense ***

WAN (wan)      -> em0      -> v4/DHCP4: 192.168.100.35/24
                v6/DHCP6: fc00::a00:27ff:feac:9047/64
LAN (lan)      -> em1      -> v4: 192.168.1.1/24

0) Logout (SSH only)          9) pfTop
1) Assign Interfaces          10) Filter Logs
2) Set interface(s) IP address 11) Restart webConfigurator
3) Reset webConfigurator password 12) pfSense Developer Shell
4) Reset to factory defaults  13) Upgrade from console
5) Reboot system              14) Enable Secure Shell (sshd)
6) Halt system                 15) Restore recent configuration
7) Ping host                   16) Restart PHP-FPM
8) Shell

Enter an option: 8

[2.2.6-RELEASE][root@pfSense.localdomain]/root: poweroff

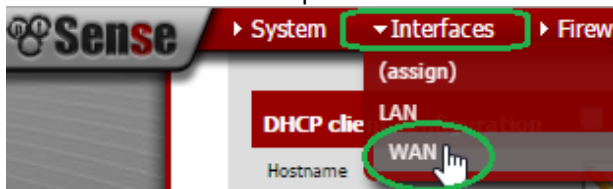
```

Note: By shutting down **pfSense** all connected virtual instances will lose network and Internet connectivity until **pfSense** is started back ON

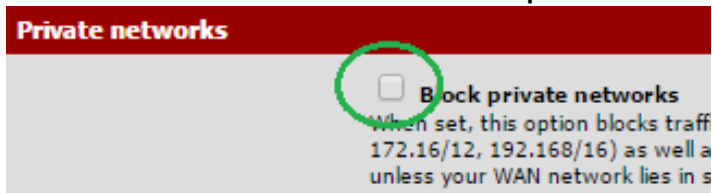
- If there is a requirement to remote desktop from a production workstation to a virtual instance behind **pfSense**, here is how it can be done:

Keeping our **pfSense** virtual instance running in the background, start **DC1** if not started already, login, enable remote desktop connection on it, then run the browser. In the browser address bar enter the pfSense Gateway address **192.168.1.1**, login to the pfSense GUI and change as follow

- In the **Interfaces** menu open **WAN**



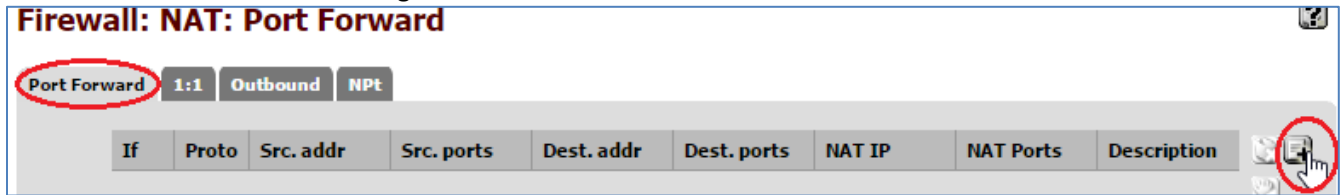
- In the **Interfaces: WAN** screen untick **Block private networks** then click **Save** followed by **Apply changes**



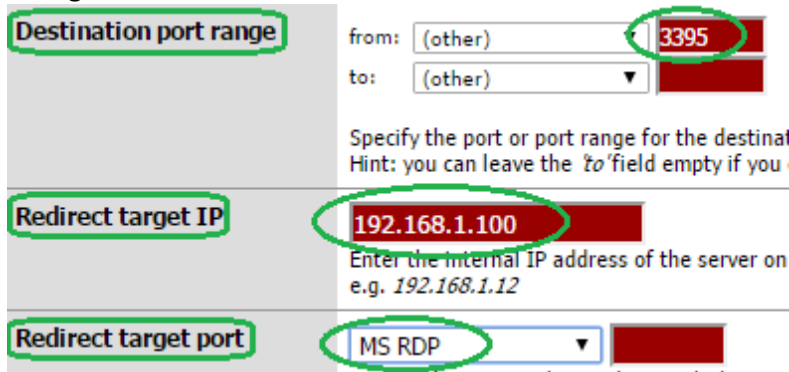
- In the **Firewall** menu open **NAT**



- Under **Port Forward** click the + sign to create a new rule:



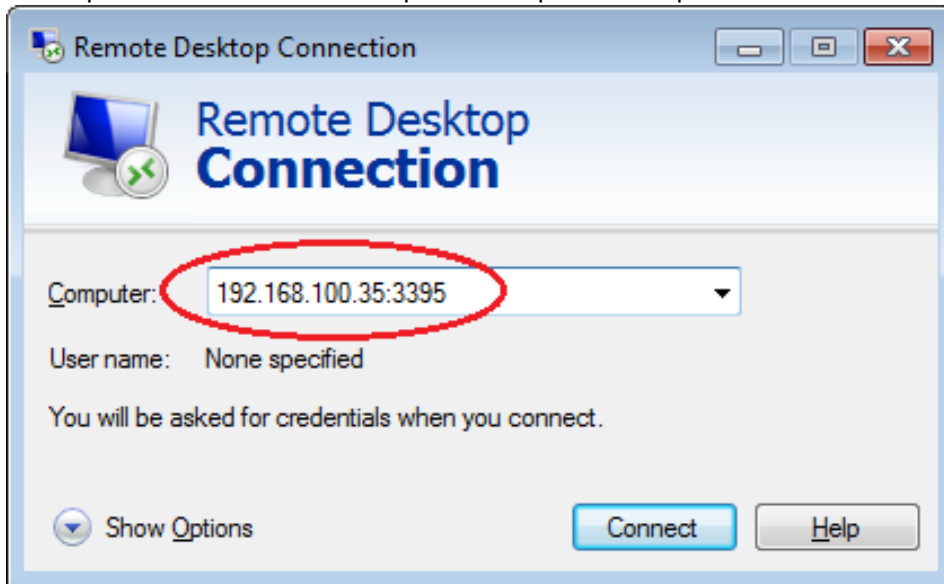
- In the **Port Forward: Edit** screen set as per the snapshot example below then click **Save** followed by **Apply Changes**



Note:

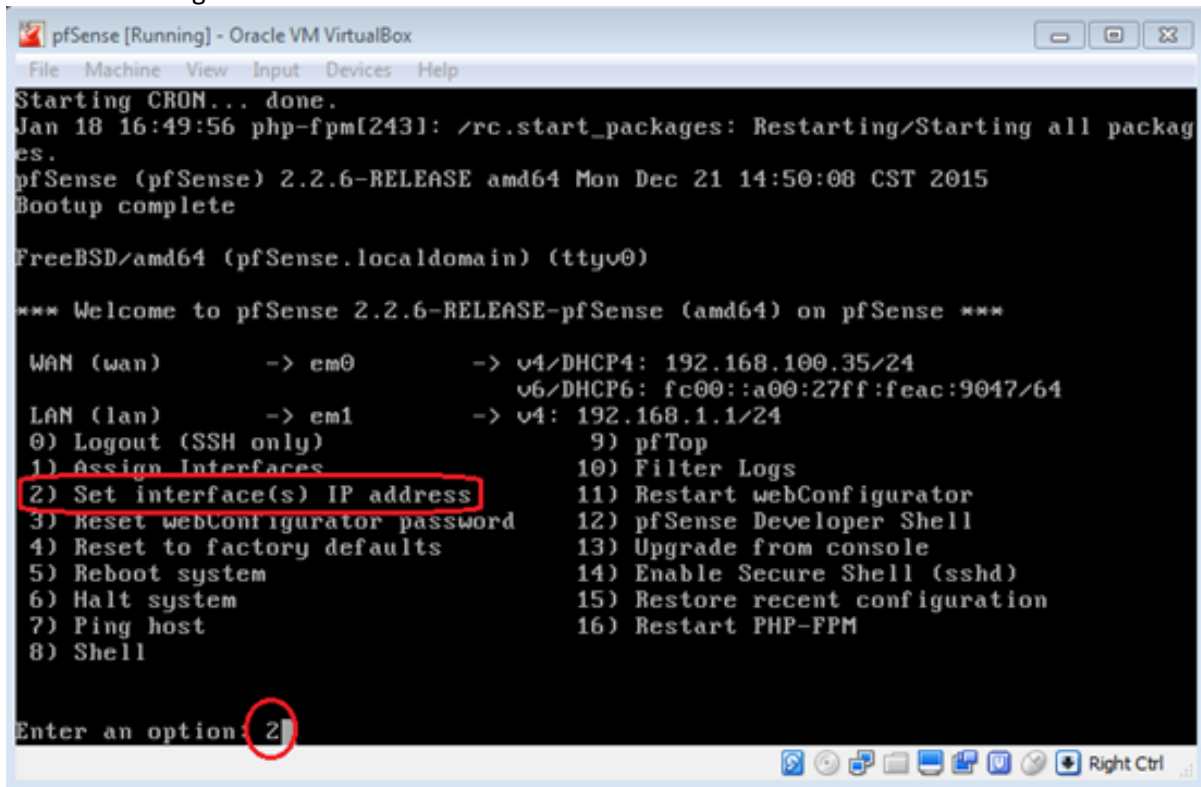
- Port number **3395** used as an example but you may use a different port number
- We presume that **Remote Desktop** is allowed on **DC1** and its virtual internal IP address assigned to it by pfSense remains same **192.168.1.100**
- If you wish to remote connect to another VM behind pfSense, follow the above steps to create a new rule using a unique port number and the virtual IP address of the VM you wish to remote connect to

Now you should be able to remote desktop to the **DC1** virtual instance from a production workstation. Presuming the pfSense **WAN** IP address remains same **192.168.100.35**, move to a production workstation, open up remote desktop connection and enter as per the snapshot example below:

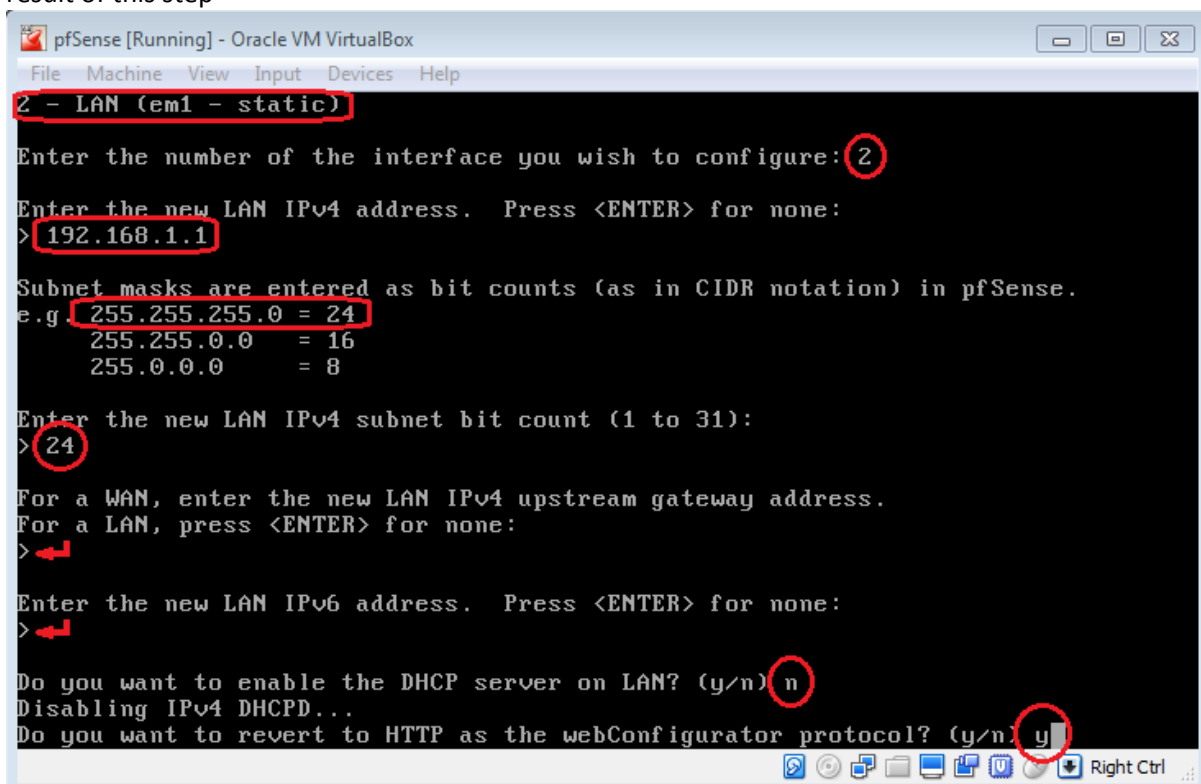


3. In some cases there may be a need to setup multiple virtual routers attached to each other letting some virtual machines receiving their IP addresses from the later one for certain testing. If this is the case here is how it can be done:

- Start the **pfSense** virtual instance if not started. Enter **2** for **Set interface(s) IP address** option, this to switch to **LAN** static configuration

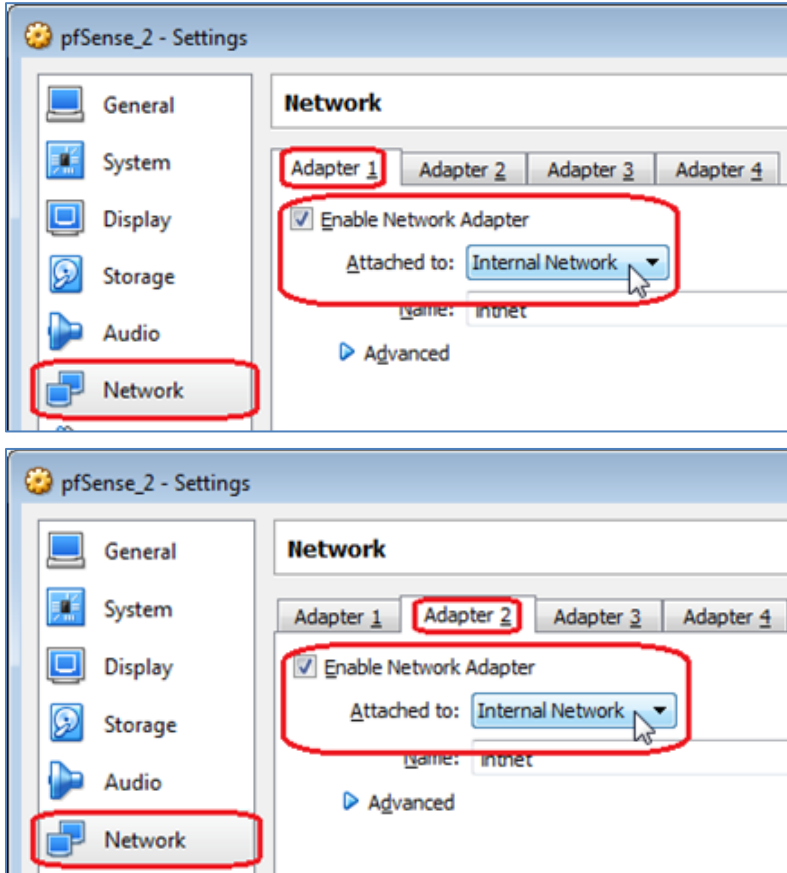


- Switch to **LAN** static configuration as illustrated in the snapshot example below and when complete press the Enter key to go back to the pfSense main menu selection. Please note all virtual machines set to automatically obtaining their IP addresses and connected to the current pfSense virtual network will lose connectivity as a result of this step

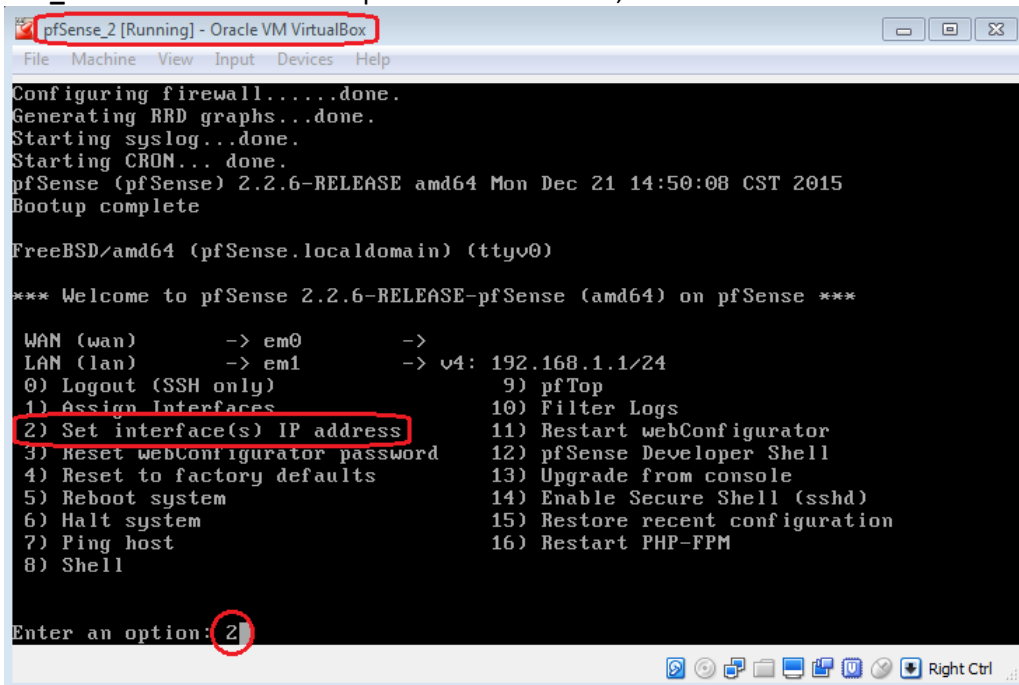


- Create the second pfSense instance, let's call it **pfSense_2** using the same steps we used earlier to create the first **pfSense** (steps 3 to 18) with the following changes instead:

In **Network**, set **Adapter 1** and **Adapter 2** to **Internal Network**



- When installation all complete start the **pfSense_2** virtual instance and make the following changes:
- Pick an Internal IP address available from the private pool of **pfSense** and assign it to the **WAN** interface of **pfSense_2** as illustrated in the snapshots **a** and **b** below, we used **192.168.1.44** as an example



a.

```

Available interfaces:
1 - WAN (em0 - dhcp, dhcp6)
2 - LAN (em1 - static)

Enter the number of the interface you wish to configure: 1
Configure IPv4 address WAN interface via DHCP? (y/n) n
Enter the new WAN IPv4 address. Press <ENTER> for none:
> 192.168.1.44

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0    = 8

Enter the new WAN IPv4 subnet bit count (1 to 31):
> 24

For a WAN, enter the new WAN IPv4 upstream gateway address.
For a LAN, press <ENTER> for none:
> 192.168.1.1

Configure IPv6 address WAN interface via DHCP6? (y/n) n
Enter the new WAN IPv6 address. Press <ENTER> for none:
>

Do you want to revert to HTTP as the webConfigurator protocol? (y/n) y

Please wait while the changes are saved to WAN...
Reloading filter...
Reloading routing configuration...
DHCPD...
Restarting webConfigurator...

The IPv4 WAN address has been set to 192.168.1.44/24
Press <ENTER> to continue.

```

b.

- Set the LAN interface of pfSense_2 as illustrated in the snapshots a and b below

```

pfSense_2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Please wait while the changes are saved to WAN...
Reloading filter...
Reloading routing configuration...
DHCPD...
Restarting webConfigurator...

The IPv4 WAN address has been set to 192.168.1.44/24

Press <ENTER> to continue.
*** Welcome to pfSense 2.2.6-RELEASE-pfSense (amd64) on pfSense ***

WAN (wan)      -> em0      -> v4: 192.168.1.44/24
LAN (lan)     -> em1      -> v4: 192.168.1.1/24
0) Logout (SSH only)
1) Assign Interfaces
2) Set interface(s) IP address
3) Reset webConfigurator password
4) Reset to factory defaults
5) Reboot system
6) Halt system
7) Ping host
8) Shell
9) pfTop
10) Filter Logs
11) Restart webConfigurator
12) pfSense Developer Shell
13) Upgrade from console
14) Enable Secure Shell (sshd)
15) Restore recent configuration
16) Restart PHP-FPM

Enter an option: 2

```

a.

```
Available interfaces:
1 - WAN (em0 - static)
2 - LAN (em1 - static)

Enter the number of the interface you wish to configure: 2

Enter the new LAN IPv4 address. Press <ENTER> for none:
> 192.168.2.1

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0    = 8

Enter the new LAN IPv4 subnet bit count (1 to 31):
> 24

For a WAN, enter the new LAN IPv4 upstream gateway address.
For a LAN, press <ENTER> for none:
>

Enter the new LAN IPv6 address. Press <ENTER> for none:
>

Do you want to enable the DHCP server on LAN? (y/n) y
Enter the start address of the IPv4 client address range: 192.168.2.2
Enter the end address of the IPv4 client address range: 192.168.2.254

Please wait while the changes are saved to LAN...
Reloading filter...
Reloading routing configuration...
DHCPD...

The IPv4 LAN address has been set to 192.168.2.1/24
You can now access the webConfigurator by opening the following URL in your web
browser:
      http://192.168.2.1/

Press <ENTER> to continue.
```

b.

You may need to **poweroff** both **pfSense** and **pfSense_2** instances and start them back one at a time respectively in case of connectivity issues

Now, as **pfSense_2 DHCP** service is the one enabled, all newly created VMs configured to automatic DHCP should pick up its IP address from **pfSense_2** router instance. You may need to restart all existing running VMs, alternatively you may run the **Command Prompt** and use the commands below to release and renew the IP configuration on each running VM without restarting:

```
ipconfig /release
ipconfig /flushdns
ipconfig /renew
```

References:

pc-addicts.com: [Building the Ultimate VirtualBox Lab – Install pfSense](#)
[Building the Ultimate VirtualBox Lab – RDP to VMs](#)

End of document.