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**Applied Computing**

**Wales Institute of Science and Art (WISA)**

# Network Operating Systems and Services (NOSS)

# (ACCA5023)

## Worksheet 1

BUILDING A VIRTUAL LAN USING TYPE 2 HYPERVISOR MANAGEMENT SOFTWARE

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## Objectives

- In this part of the assessment, you are tasked with first creating two, 'disconnected' ***Virtual networks.***
- You will use a Type 2 Hypervisor program called "Oracle VirtualBox" to create 4 Virtual Machines (VMs);
    - 2 of these VMs will comprise 2 x Server Operating System (Windows Server 2019) and the other 2, 2x client Operating system (Windows 10)
- Once all operating systems are installed; the network configurations should enable the hosts to be separated onto 2 different Local Area Networks.
- Following the network design/build, you are required to test connectivity and demonstrate successful 'pings'.
- Finally you are required, using the Schools accepted referencing system, to complete the Observational Tasks at the end of the worksheet.

**Trial Network Configuration**

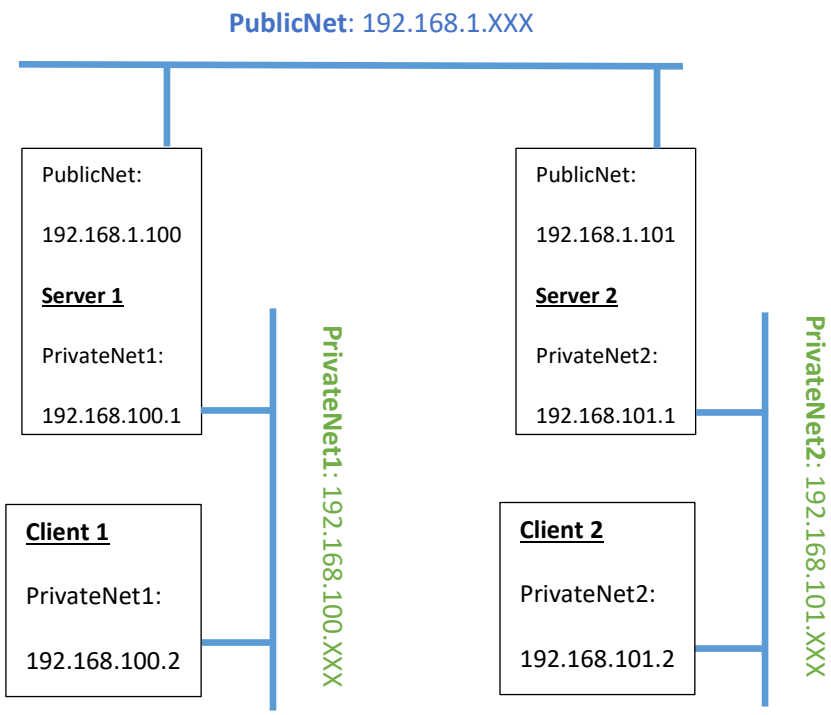


*Figure 1 Trial Network Configuration*

**Brief:**

*Figure 1* represents the virtual network design that is required.

The Server machines (1 and 2) have 2 network adapters.

> The first network adapter is a public network adapter which is also known as an Enterprise network connection. This is usually a machine connected to the Internet.
>
> The second adapter is an Internal Network adapter which only connects to each of the respective clients **(e.g. Server 1 connects to client 1 and Server 2 connects to client 2).**

The Class C network addresses are provided as an example and depending on your level of understanding of networking and IP addresses, these can be altered to suit your own preference.

**NB: YOU ARE REQUIRED TO SCREEN CAPTURE THE COMPLETION OF THESE TASKS IN EVERY WORKSHEET AS YOUR EVIDENCE OF UNDERTAKING THE TASKS REQUIRED. PRACTICE USING THE SNIPPET TOOL AND THEN CAPTURE EVIDENCE AND BUILD YOUR WORKSHEETS USING A WORD PROCESSING PACKAGE SUCH AS MICROSOFT WORD.**

**YOU SHOULD READ EVERY ELEMENT IN THE WORKSHEETS <u>'VERY CAREFULLY'</u> AS THERE ARE PRE-REQUISITE SNIPPETS OF INFORMATION YOU WILL NEED TO UNDERSTAND, BEFORE UNDERTAKING EACH TASK.**

**YOU SHOULD PROVIDE SUITABLE NARRATIVE ALONGSIDE THE SCREEN CAPTURES TO IMPROVE THE QUALITY OF YOUR PRACTICAL TASKS.**

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**Task 1: VM creation and Operating System installations.**

- In order to begin building this design, first install Virtual Box; obtain the most recent x64 (64-bit) version for Windows Hosts, from here:.

  **https://www.virtualbox.org/wiki/Downloads**

- Installing VirtualBox, comprises clicking Next to most settings and accepting the creation of a virtual adapter on your host OS (this is done as part of the install).
- Once VirtualBox has installed, you will need to create 4 Virtual Machines (VM).
- To create a VM in VirtualBox, click on the ***New*** button
- The Create Virtual Machine dialog window will open,
  - name the first machine **Server1**
  - Leave the Machine Folder as is;
  - In the Type field; ensure that **Microsoft Windows** is selected.
  - In the Version field; choose **Windows Server 2019 (64-bit)**
  - In the Memory Size Window – move the slider until **4096MB** is shown in the field to the right of the slider, click Next
  - In the hard disk window, choose **Create a virtual hard disk now** and click on the **Create** button.
  - Select **VDI** (Virtual Disk Image) as the type of file to use for the virtual hard disk, click **Next**
  - In the storage on physical hard disk window; choose **Dynamically Allocated**, click **Next**
  - Leave the location of the virtual hard disk as is, but change the size value to **25GB, click Create.**

This completes the creation of the Server 1 VM, repeat this process to create the VMs for Server 2 and Client 1 and 2. To create the 2 client machines, the process is near identical, only that Windows 10 (64 bit) will be the OS selected and the hard drive size could be made smaller (e.g. 20GB) so as to save physical hard drive space.

When the 4 VMs are created, the Operating systems must be installed (here, Server1 is demonstrated but you should repeat the task for the other server and then complete

2 installations of Windows 10, you only need to include screen captures for one server and client install:

**NB: You will need to obtain the ISO for Windows Server 2019, this is available on the OneDrive Share (the link to all the Operating Systems you need is sent to your email address, but you will need to download the ISO file from there).**

- In the Oracle Virtual Box Manager window, left hand side of the window, select Server 1 and click on **Settings.**
- From the Storage category, click on the icon that resembles a CD and has Empty as its value,
- From the right hand side of the window, under Attributes, next to the SATA Port 1 value there is another CD icon, click on this.
- Select **'Choose a Disk File'**; and **select the ISO** you have downloaded from the OneDrive share for **Windows Server 2019.**
- Now repeat this process for Server 2, and then in turn for the Client 1 and Client 2 VMs, ensuring that you have selected the Windows 10 ISO for both the client Operating Systems.
- At this point it is possible to install Windows Server 2019 on the Server 1 VM.
- But ***first*** there are a number of ways we need to 'optimise' the Type 2 Hypervisor program to better facilitate the demands of running these 4 VMs.
- Running a VM obviously borrows resources from the physical host and this can be both a benefit and a drawback of using Type 2 hypervisor programs. These are a number of ways you can optimise a program such as VirtualBox, shown here:
  **http://www.rawinfopages.com/tips/2017/07/speed-up-virtualbox-in-windows/**
- For the benefit of this example: Choose Server 1 and select **Settings**
- On the System Category, click on the **Processor** tab. Ensure that **enable PAE/NX is checked on.** This enables the physical address register of the Host system CPU to be more readily accessible to each VM. Choose Ok.
- Next ensure that the maximum display memory is selected. To do this click on Server 1 and then choose Settings, click on the Display Category and ensure that **at least 128MB** is set for Video Memory.

- You may also want to try setting up some of the options shown in the link provided above to optimise your virtual network environment. Ensure that you repeat these optimisation steps for the other 3 VMs.
- To begin installing the Operating System on Server 1; from the Oracle Virtual Box Manager window, select Server 1 and double click the VM to start it, this should the VM as a normal physical Computer System would start. You should be faced with the Windows Server 2019 installation screen.
- From the ***Windows Setup screen*** **–** choose Time and Currency Format: English United Kingdom and Keyboard Layout – English, United Kingdom. Choose Next
- Click on Install Now
- Choose **I don't have a Product Key**
- Be careful at this point: At the "Select the Operating System you want to install window": **Choose Windows Server 2019 Datacenter Desktop Experience –** choose Next
- Accept the license terms, click Next
- **Choose Custom: Install Windows Only**
- Choose the hard drive you wish to install windows on (note our Virtual Hard drive has been presented to the OS but not the physical one). Select the drive and choose next.
- Windows Server 2019 Datacenter (Desktop Experience) edition will now install.
- Near the final stages of installation, you will be asked to specify an Administrator Password: **FOR THE PURPOSE OF SECURITY USE THE ONE I HAVE PROVIDED: P@ssw0rd**
- Upon completion, you will be faced with the logon screen in your VM. Click on the 'Input' menu option (top of the VMs window) and choose Keyboard – Insert CTRL+ALT+DELETE
- This is the login option, now specify the password given above.
- Once this is installed, shut down Windows on Server 1 as you usually would via the Shutdown menu and repeat the process for Server 2.
- You will need to do this for Server 2 and Client 1 and Client 2,
- Client 1 and 2 installation steps are near identical even though Windows 10 is being installed on these VMs.

## Task 2: Virtual Network Configurations

For this task; all Virtual Machines need to be closed down.

There are a number of considerations for building the virtual networks shown in the brief (Figure 1):

- In the VirtualBox Click on Server 1 and choose **Settings**
- Choose the **Network** Category. Note the Server 1 portion of Figure A shows 2 network adapters connected to Server 1, **PublicNet** which has a Class C assigned IP address of **192.168.1.100** and **PrivateNet1** which has a Class C assigned IP address of **192.168.100.1**
- In order to configure this we need to setup the correct number of network adapters (at present there is only one created, we need 2 in Server 1), the correct LAN name (e.g. either an adapter is connected to a LAN called **PublicNet** or **PrivateNet1**) and the correct Virtual Networking Type.
- First click on the NAT field and change the setting to 'Internal Network'.
- Here is a guide to help understand the different types of virtual networking modes available to use in Oracle VirtualBox: See section 6.2 Introduction to Network Modes: https://www.virtualbox.org/manual/ch06.html
- In the name field specify the name of the network this adapter will connect to, in this case **PublicNet**

**NB: We have essentially created a Virtual Switch and formed a LAN here now called PublicNet.**

- *Now we need to start up Server 1 and rename the Network Connection to PublicNet and statically define the required IP address.*
- **To do this; when Windows Server is running:**
- Click on Start – Choose Control Panel from the right hand window.
- Click on **View Network Status and Tasks**
- Click on the **Change Adapter Settings** on the right hand side of the window.
- You will see an Icon called Ethernet, or something similar with this selected click on the Rename Connection option just above it in the window.
- Rename the connection to PublicNet.

- Now that the adapter is named appropriately, the IP address can be assigned.
- To do this – Right Click on PublicNet and choose **Properties.**
- Underneath where the dialog says **"**This connection uses the following items", double click the item that says **Internet Protocol Version 4 (TCP/IPv4).**
- Select "Use the following IP address"
- Enter 192.168.1.100 and press the Tab key, the Subnet Mask field should automatically populate with the value 255.255.255.0 (recall this is the subnet mask for a Class C IPv4 IP address).
- Choose Ok and Ok again and close all the dialog windows that are open.
- Now the second adapter has to be configured; shutdown Windows Server 2019 and from the Oracle VM VirtualBox Manager window, select Server 1 and choose Settings.
- Click on the Network Category, select the **Adapter 2** tab and enable the adapter.
- This adapter will be configured on a different LAN (e.g. connected to a different Virtual Switch).
- As before next to Attached to: choose 'Internal Networking'.
- In the name field, type in: PrivateNet1
- Choose Ok and Start up Server 1 again.
- Login and as before Rename the network connection to 'PrivateNet1"
- Also set the IP address to: 192.168.100.1
- Once this is done, close down Server 1 and ensure that Client 1 is also in a shutdown state.
- Click on Client 1 and choose Settings.
- Client 1 only has 1 adapter – PrivateNet1, it is connected to the same LAN as the 2nd Adapter on Server 1.
- Start up the Client 1 VM.
- As above with Server 1, rename the Network Connection to "PrivateNet1".
- Assign the following IP address to PrivateNet1 on the client (Windows 10 machine): 192.168.100.2

To complete this worksheet you need to implement this network design on Server 2 and Client 2, but take the following key factors into consideration:

- Server 2 has 2 adapters, 1 is PublicNet and the 2nd is PrivateNet2
- The IP addresses are 192.168.1.101 and 192.168.101.1
- Client 2 should be connected to PrivateNet2 and its IP address set to: 192.168.101.2

When the design is done go first to Server 1, ensure that both Client 1 and Server 1 are running (e.g. Windows is loaded). Ensure that the firewall profile for both systems is disabled. This is because the ICMP command (known as 'ping') is going to be used here to demonstrate connectivity and firewalls (by default) in OOBE environments will DENY the ICMP protocol.

*To turn off the firewall on the Server:*

- Click Start – Control Panel
- Choose System and Security
- Under the 'Windows Defender Firewall' category, click on **Check Firewall Status**
- On the left hand side of the window, choose **Turn Windows Defender Firewall On or off.**
- Under Private Network Settings choose the radio button next to the option **'Turn off Windows Defender Firewall'.**
- Under Public Network Settings, choose the radio button next to the option **'Turn off Windows Defender Firewall'.**

You now need to repeat this process on Client 1.

With the firewall turned off on both Server 1 and Client 1, attempt a ping command to verify LAN connectivity, to do this:

- On server 1, ***'right-click'*** Start – choose **Run**
- Type cmd into the search bar (this stands for Command Prompt, which is a utility within the OS that lets us run various tools.
- From the command prompt window type in **ping 192.168.100.2**

- This command will verify if Server 1 is properly connected to Client 1 on the PrivateNet1 LAN/Network Connection.
- If there is a response/reply received the LAN configuration for Server 1 and Client 1 on PrivateNet 1 LAN is complete.
- Now, repeat this process and verify that there is connectivity between Server 2 and Client 2 on PrivateNet 2 LAN connections.

**NB: Check steps one by one and troubleshoot, if you are not getting a successful ping.**

**Task 3: Observational Tasks**

**NB: You should use a proper referencing style here when submitting your answers.**

3 a) Describe the main differences between Type 1 and Type 2 Hypervisors. Identify benefits and drawbacks of both and provide some example Vendors.

3 b) What is the significance of the subnet mask in IPv4 addressing?

3 c) Cloud computing has revolutionised the way that enterprise networks are hosted. Describe the use of cloud computing including its benefits and drawbacks and identify example vendors within the industry.

3 d) Give an in-detail description about the different terminologies and its purposes (like (not limited to) Ping, Server Management, Firewall, PAE/NX, OOBE etc) you came across during the Task 1 and Task 2. Compare your list of terminologies in the aspect of their operations/functionality with other Network Operating Systems. *(For example: If you select Windows Firewall and describe the operations/functionality of Windows Server 2019 Firewall, you have to compare these features with the operations/functionality of other Network Operating Systems like Linux, Mac)*