

Jeys Consulting Group

Desktop Virtualization Design

D086 – Desktop Virtualization

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A. PROBLEM STATEMENT

Sparkit Company(SC) has experienced increased sales over the past three years. This has led the Board of Directors and Leadership to formulate plans to cut costs, while also growing in profitable areas to further build out the educational brand that both kids and parents have grown to love.

To support this initiative, virtualization technology will help modernize and improve productivity for SC's gaming business. This will prove to be critical in expanding SC's brand as it allows for the adoption of both Windows and Linux environments for its gaming products. For this solution, Hyper-V Manager will be utilized to create and test gaming software in Windows 10, CentOS & Ubuntu operating systems. This will cover most of the operating systems in the market today.

B. HARDWARE SPECIFICATIONS

Describe the specifications of the hardware system purchased to support the proposed solution. Use the "Supply Order Form" attachment to choose your hardware system. Include a justification for how your hardware recommendation meets the business need.

Supply Order Form

Components	Price
Processors	
Intel Core i3-8100 Quad-Core 3.6 GHz LGA 1151	\$156.95
Hard Drives	
4x - 500GB Internal SSD - SATA III 6Gb/s	\$69.99
Memory	
32GB (2 x 16GB) 288-Pin DDR4 SDRAM DDR4 3200 (PC4 25600)	\$182.99
Network cards	
PCIe Gigabit Ethernet Multimode SC Fiber Network Card Adapter	\$149.95



Processors: The Intel processor chosen supports virtualization technology, is a relatively newer generation of processor with the optimal number of cores and is available at a decent price point.

Hard Drives: The order of 4 SSD hard drives is recommended based their storage capacity, speed over standard HDDs, the ability to create RAID groups, and due to the low storage costs of the individual drives.

Memory: The memory chosen maximizes the amount of RAM available, has ample speed and transfer rate, and falls within the overall budget.

Network Cards: The selected network card provides a full and low-profile option allowing for multiple install options and will support fiber networking and the associated high network speed.

C. HYPERVISOR

For this solution, Hyper-V Manager will be used. Hyper-V is a Type 2 hypervisor as the hardware being used is not dedicated to just running virtual machines. The hypervisor configurations in the four primary computing categories are as follows, based on the situational requirements...

Processors: The CPU utilization of the hypervisor is not to exceed 50% of the available CPU

Hard Drives: Storage consumption of total physical storage is not to exceed 30%

Memory: The memory will be configured statically, and consumption should not exceed 60%

Network: Two separate and isolated virtual networks will be created with pfSense software to keep network traffic segregated.

In addition to these four areas, NUMA Spanning & Enhanced Session Mode Policy will be enabled.

D. ALLOCATIONS

Processor Allocations for All VMs: Each VM is configured with a single core. In the current lab environment, a single core is more than sufficient in satisfying the situational requirements while not exceeding 50% CPU utilization of the physical server.

Storage/Hard Drive Allocations for All VMs: All VMs are configured with a 20GB virtual disk, with an additional 5GB virtual disk attached. This equates to 125GB of total storage which will prevent the virtual environments from consuming more than 30% of the approx. 447GB of storage, which is the total amount available on the physical server.

Memory Allocations: The VMs memory is calculated to not exceed 60% of the 16GB of total memory available on the physical server. The VMs combined are configured with approx. 9.6GB of memory. Each VM's memory allocation is listed below...

- ClientA – 1920MB
- ClientB – 1920MB



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- C01 – 2048MB
- UBU1 – 2048MB
- Router – 1664MB

Network Allocations: The ClientA and C01 virtual machines contain one virtual network adapter each. Those adapters are attached to the NetWest virtual switch, and that switch is connected to the Router virtual machine's 'NetWest' virtual network adapter.

The ClientB and UBU1 virtual machines also contain one network adapter each. Those adapters are attached to the NetEast virtual switch, and that switch is connected to the Router virtual machine's 'NetEast' virtual network adapter.

The Router virtual machine contains two virtual network adapters. One network adapter is attached to the NetWest network and the other network adapter is attached to the NetEast network. To isolate the networks, a firewall will be configured blocking traffic from the virtual machines in the NetWest network from communicating with the virtual machines within the NetEast network, and vice versa.

E. IMPLEMENTATION

- 1) Hyper-V Manager needs to be enabled within Windows Features.
- 2) Hyper-V settings should be setup with the appropriate default storage location for the virtual machines and hard disks along with NUMA Spanning and Enhanced Session Mode Policy enabled.
- 3) Virtual Switch Manager is used to create the NetEast and NetWest virtual switches
- 4) Setup ClientA virtual machine with the following...

- Windows 10
- 1 CPU core
- 1920MB RAM
- Primary virtual disk – 20G
- Secondary virtual disk – 5G
- One network adapter
- IP address configured – 172.16.1.2/24
- Gateway configured – 172.16.1.1

- 5) Setup ClientB virtual machine with the following...

- Windows 10
- 1 CPU core
- 1920MB RAM
- Primary virtual disk – 20G
- Secondary virtual disk – 5G
- One network adapter
- IP address configured – 172.16.2.2/24



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- Gateway configured – 172.16.2.1

6) Setup C01 virtual machine with the following...

- CentOS
- 1 CPU core
- 2048MB RAM
- Primary virtual disk – 20G
- Secondary virtual disk – 5G
- One network adapter
- IP address configured – 172.16.1.3/24
- Gateway configured – 172.16.1.1

7) Setup UBU1 virtual machine with the following...

- Ubuntu
- 1 CPU core
- 2048MB RAM
- Primary virtual disk – 20G
- Secondary virtual disk – 5G
- One network adapter
- IP address configured – 172.16.2.3/24
- Gateway configured – 172.16.2.1

8) Setup Router virtual machine with the following...

- pfSense
- 1 CPU core
- 1664MB RAM
- Primary virtual disk – 20G
- Secondary virtual disk – 5G
- Two network adapters
- IP address configured for network adapter #1 – 172.16.1.1
- Network adapter #1 connected to NetWest virtual switch
- IP address configured for network adapter #2 – 172.16.2.1
- Network adapter #2 connected to NetEast virtual switch

F. TESTING/EVALUATION

For testing, network connectivity, memory utilization, and CPU performance will be measured to ensure the expected acceptance criteria is achieved.

F.1. NETWORK CONNECTIVITY

Testing scenario:



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The NetWest & NetEast networks must be isolated from each other.

Tool:

The ping utility will be used for this test.

Describe the acceptance criteria for the scenario:

To test network connectivity, each virtual machine on the NetWest network will perform ping tests to ensure connectivity to all devices within the network. This same exercise will be performed on the virtual machines in the NetEast network. In addition, ping will be utilized to verify that the virtual machines on the NetWest & NetEast networks are unable to ping each other.

Strategy:

A firewall will be implemented on the Router virtual machine to disallow network traffic between the NetWest & NetEast networks.

F.2. MEMORY UTILIZATION

Testing scenario:

Memory utilization should not consume more than 60% of the total memory available.

Tool:

Performance Monitor will be used with a Data Collector set to track the memory of all virtual instances.

Describe the acceptance criteria for the scenario:

Performance Monitor metrics will show that memory consumption will not exceed 60% during testing and typical system usage.

Strategy:

The virtual machines have been staged with the appropriate amount of memory to ensure consumption does not exceed 60%. Performance Monitor will also be used to show that memory consumption has met this criterion.

F.3. CPU PERFORMANCE



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Testing scenario:

CPU utilization should not exceed 50% of the total CPU available to the physical host.

Tool:

Performance Monitor will be used with a Data Collector set to track the processor time of all virtual instances.

Describe the acceptance criteria for the scenario:

Performance Monitor metrics will show that CPU utilization of all virtual instances will not exceed 50% during testing and typical system usage.

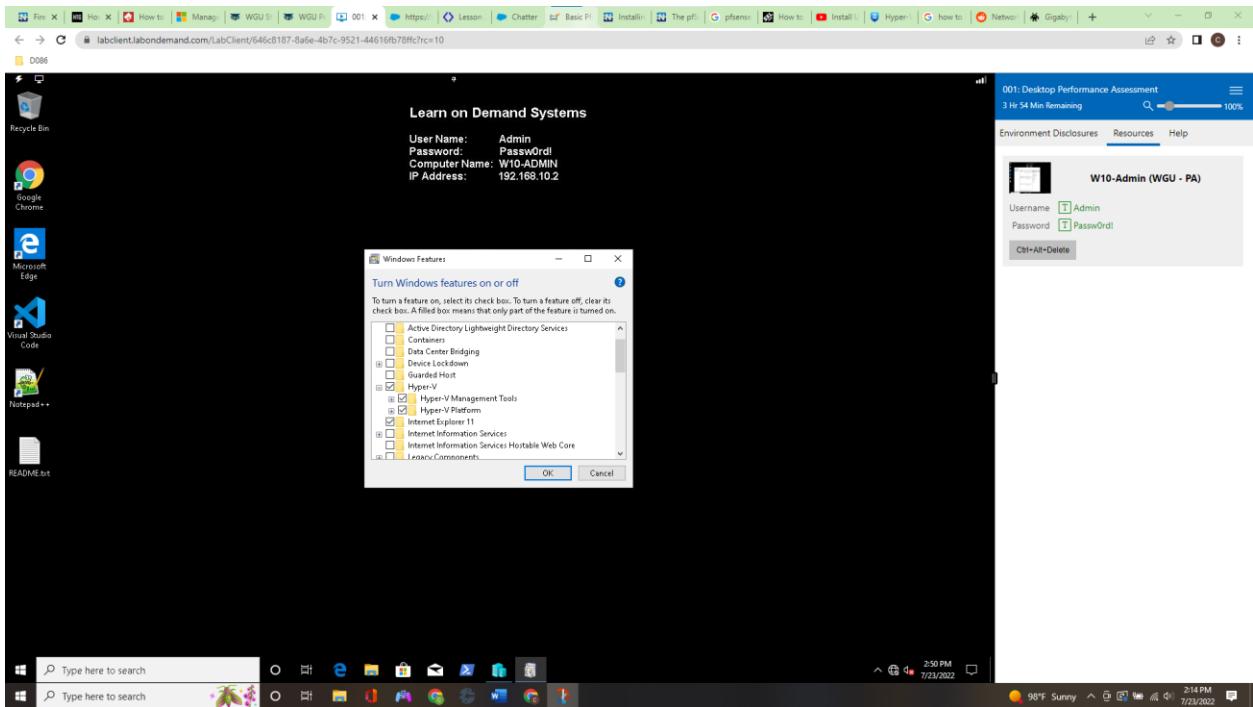
Strategy:

The virtual machines have been staged with the appropriate amount of CPU to ensure utilization does not exceed 50%. Performance Monitor will also be used to show that CPU utilization has met this criterion.

G. VIRTUALIZATION BUILD

G.1. STEP ONE

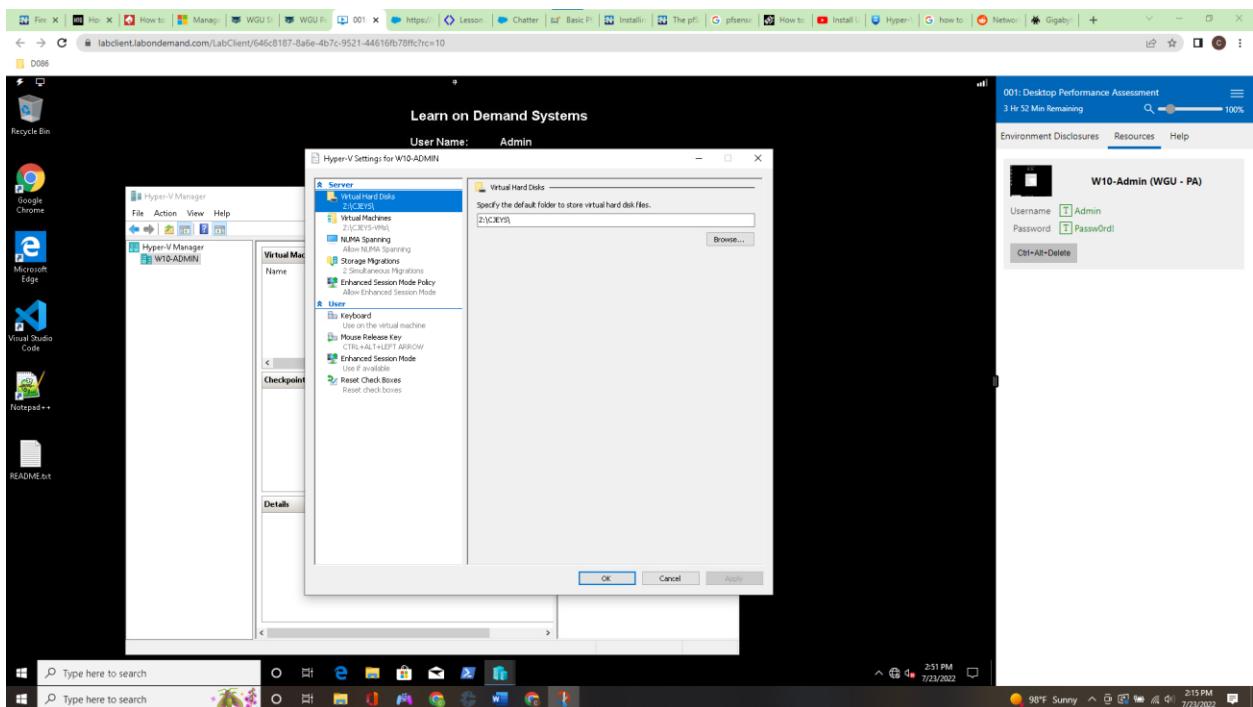
Hyper-V Manager needs to be enabled within Windows Features. The screenshot below depicts the settings required to enable Hyper-V Manager



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G.2. STEP TWO

Hyper-V settings should be setup with the appropriate default storage location for the virtual machines and hard disks along with NUMA Spanning and Enhanced Session Mode Policy enabled. The screenshot below depicts where the Hyper-V settings are to be changed.

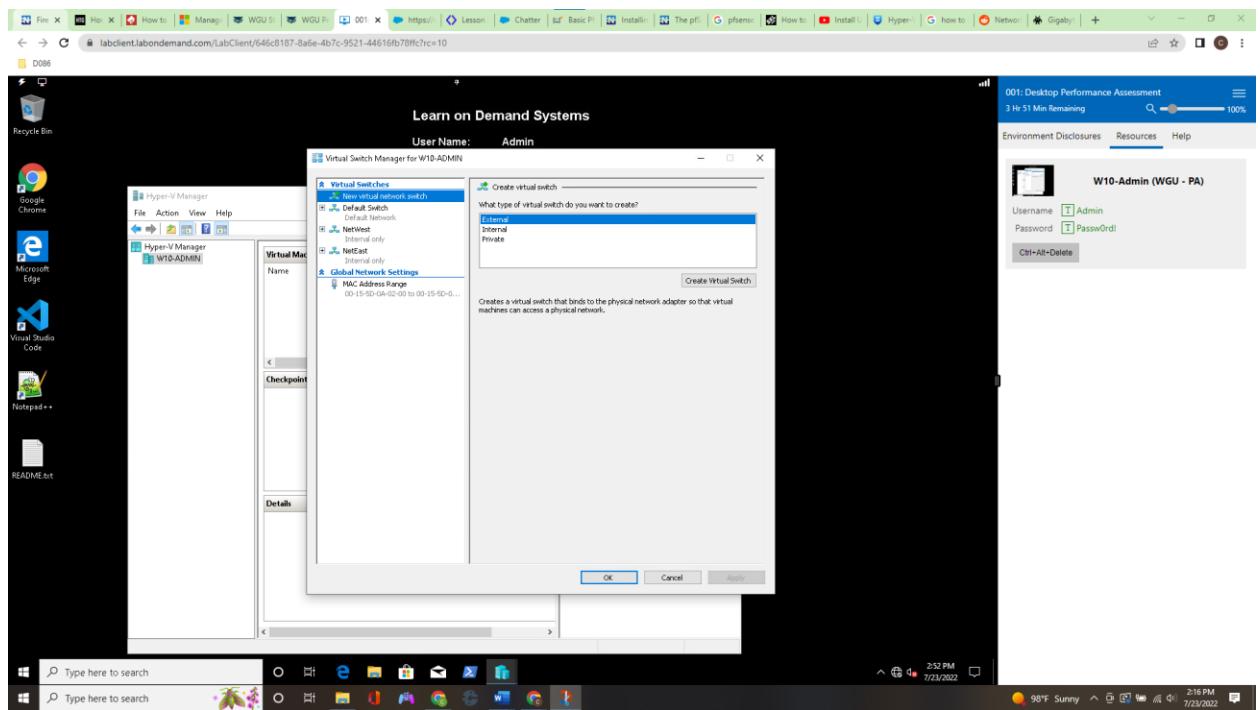


G.3. STEP THREE

Create internal virtual switches - NetEast 172.16.2.1 & NetWest 172.16.1.1. The screenshot depicts both virtual switches within Virtual Switch Manager.



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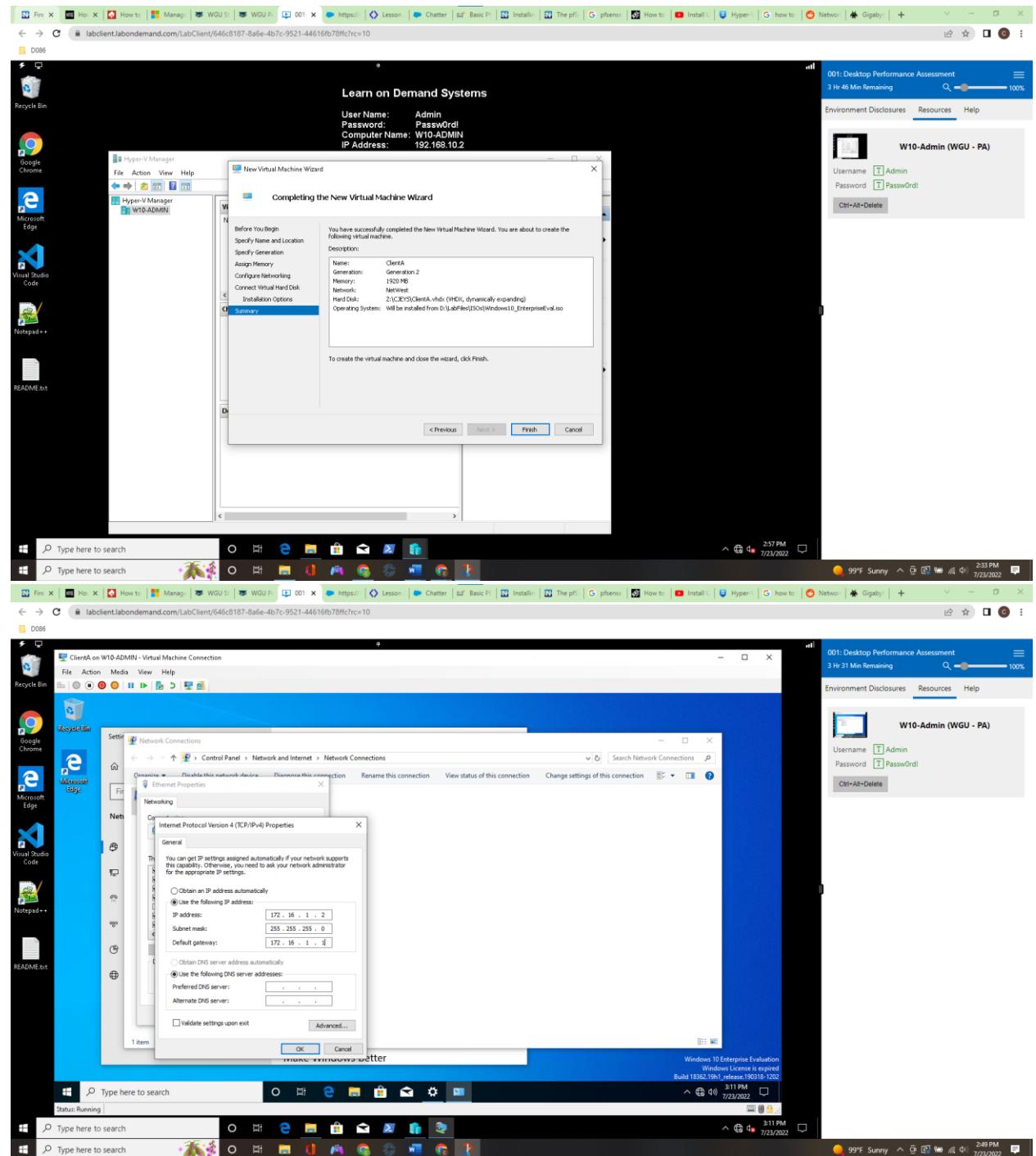


G.4. STEP FOUR

Create the Client A virtual machine with the settings and IP address depicted below.



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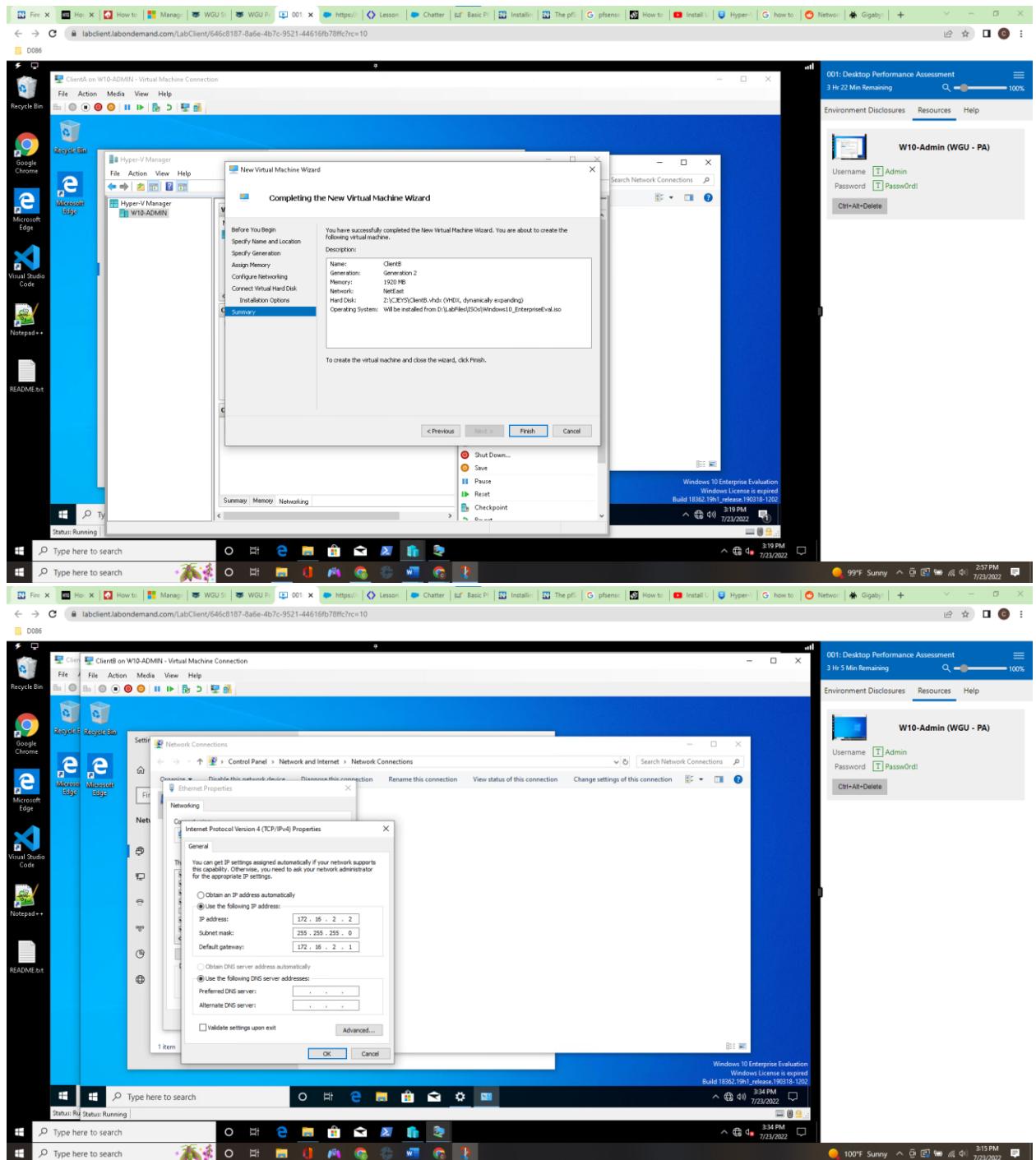


G.5. STEP FIVE

Create the ClientB virtual machine with the settings and IP address depicted below.



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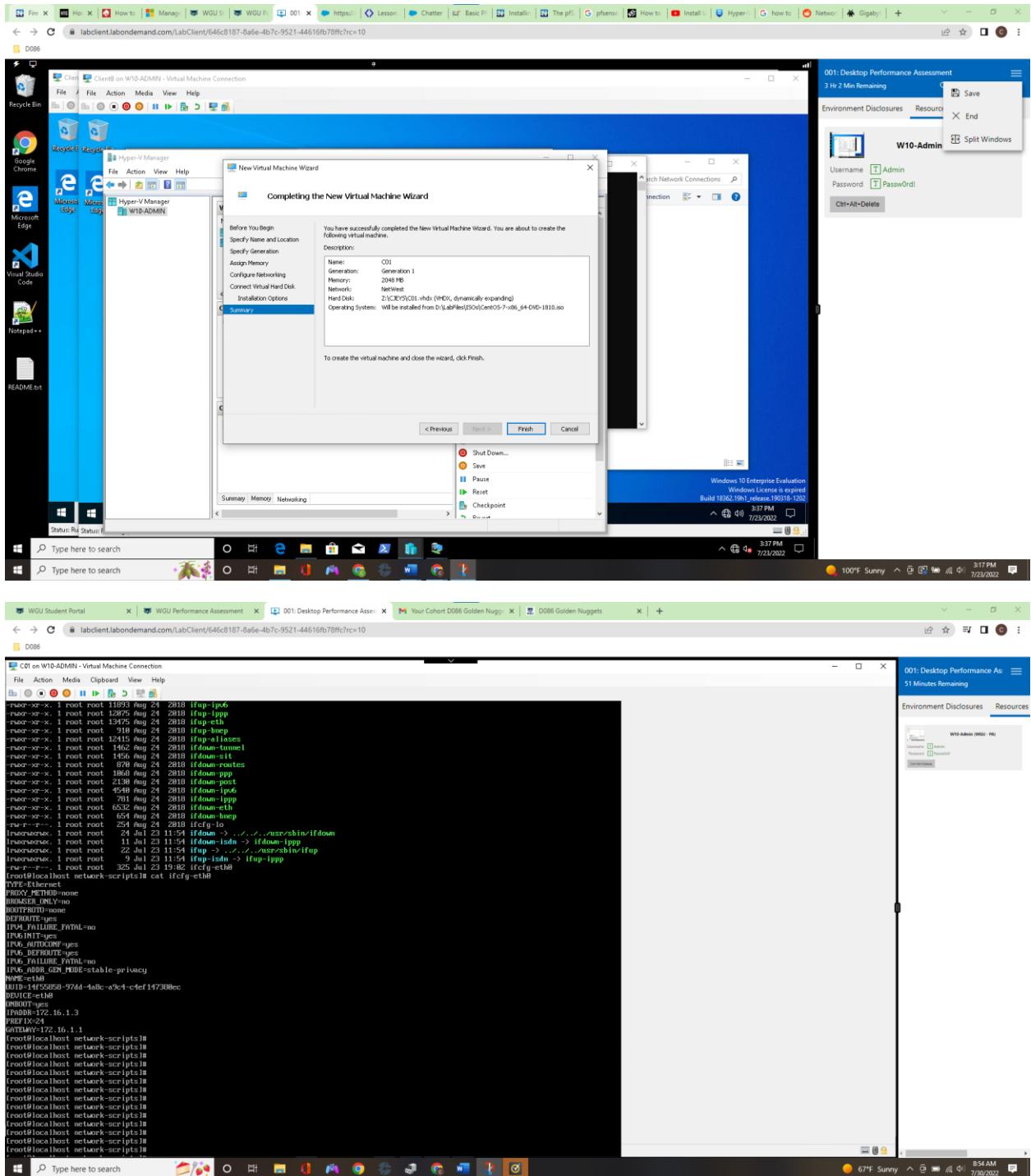


G.6. STEP SIX

Create the C01 virtual machine with the settings and IP address depicted below.



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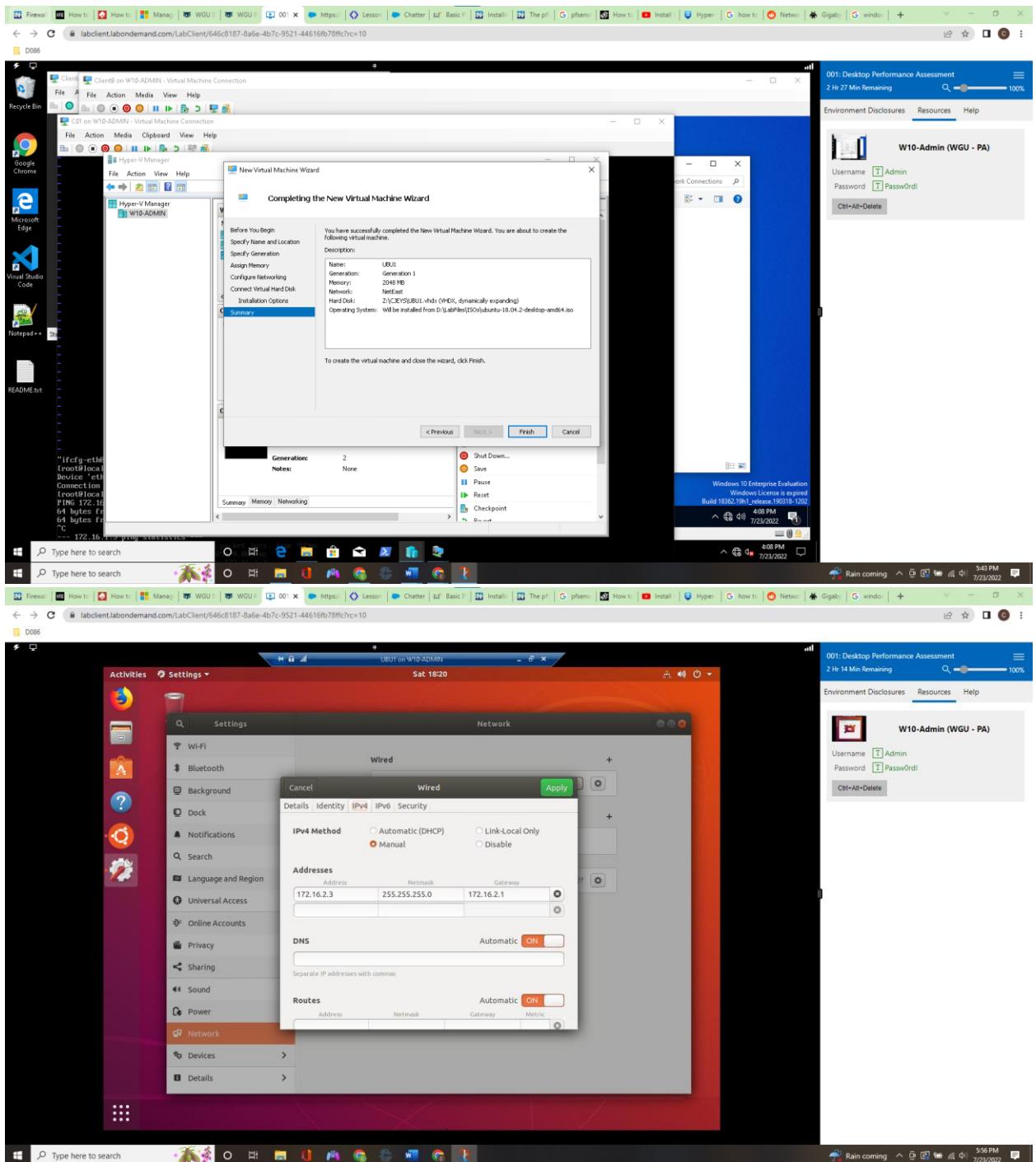


G.7. STEP SEVEN

Create the UBU1 virtual machine with the settings and IP address depicted below.



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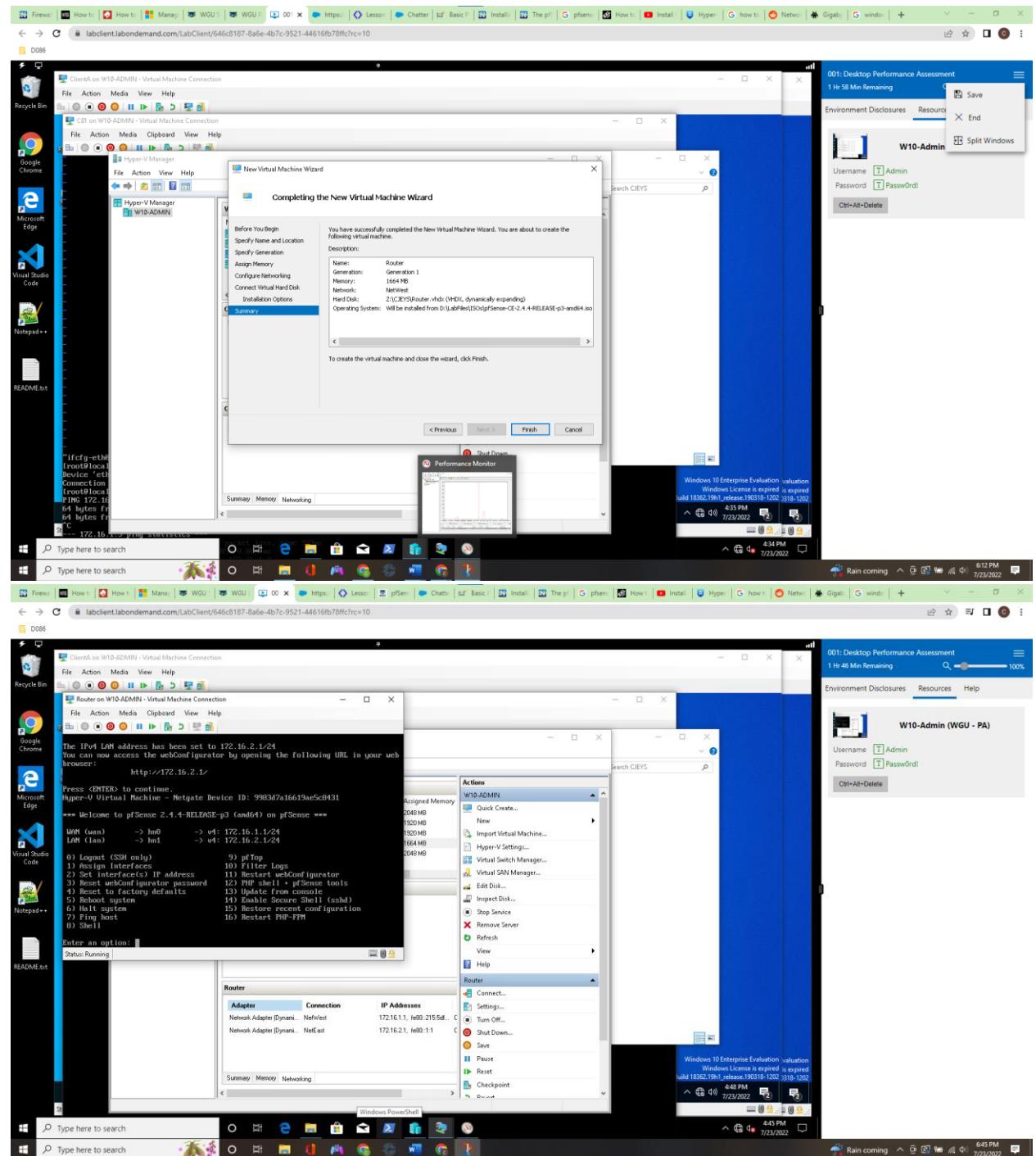


G.8. STEP EIGHT

Create the Router virtual machine with the settings and IP address depicted below.



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G.9. STEP NINE

Create the firewall rules depicted below within pfSense.



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The screenshot shows a Windows desktop environment with several windows open:

- ClientB on W10-ADMIN - Virtual Machine Connection**: A browser window showing the pfSense firewall rules configuration. The "NETEAST" tab is selected, displaying rules for ports 80, 172.16.1.3, 172.16.1.2, and 172.16.1.0.
- Performance Monitor**: A small window showing system performance metrics like CPU usage and memory.
- Taskbar**: Shows various pinned icons and the date/time (7/25/2022).
- pfSense Community Edition**: Another browser window showing the firewall rules configuration, specifically the "NETWEST" tab, which contains rules for ports 172.16.2.3, 172.16.2.2, and 0.0.0.0.
- Desktop Performance Assessment**: A sidebar on the right providing lab instructions and time remaining (1 hr 27 min).

G.10. STEP TEN

Enable resource metering and configure counters from within Performance Monitor to track system metrics.



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The screenshot displays a Windows desktop environment with two main windows open:

- Windows PowerShell**: A terminal window showing command-line output for measuring virtual machine performance. The commands run are:


```
PS C:\Windows\system32> Measure-Vm -VmName ClientA
VMbase AvgCPU(MHz) AvgRAM(M) MaxRAM(M) TotalDisk(M) NetworkInbound
ClientA 2069 1920 1920 27820 1

PS C:\Windows\system32> Measure-Vm -VmName ClientB
VMbase AvgCPU(MHz) AvgRAM(M) MaxRAM(M) TotalDisk(M) NetworkInbound
ClientB 2175 1920 1920 26892 1

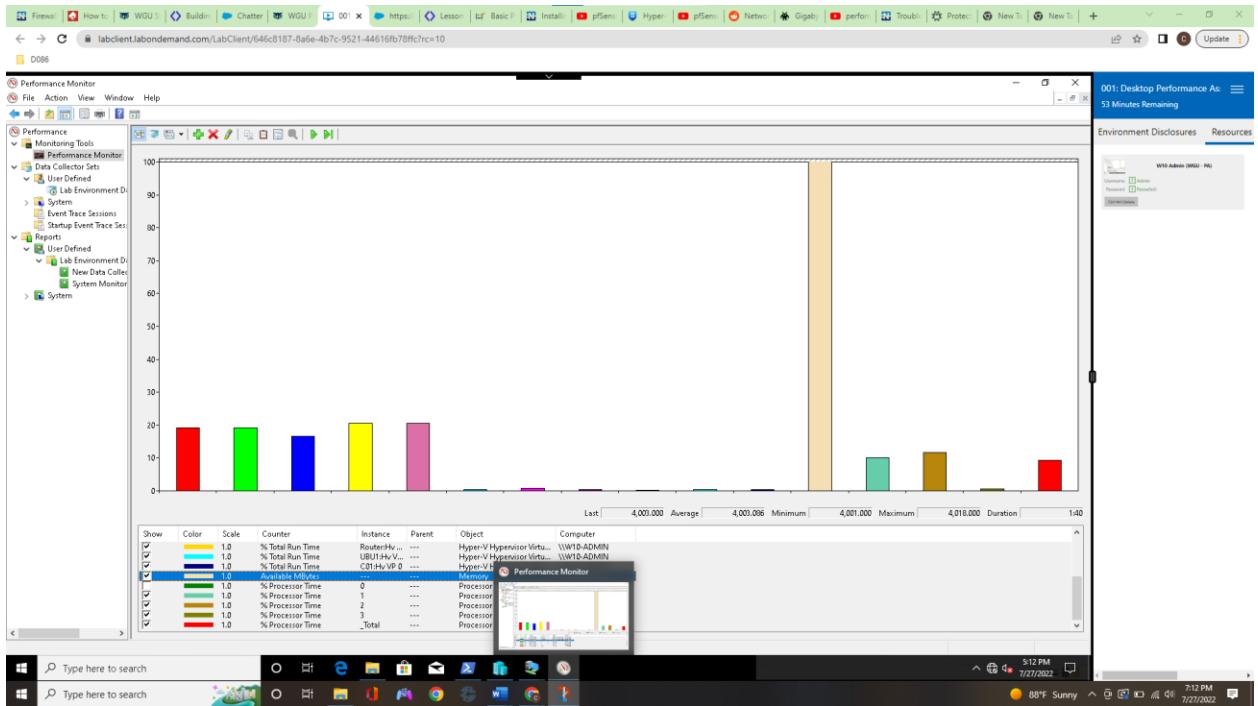
PS C:\Windows\system32> Measure-Vm -VmName Col1
VMbase AvgCPU(MHz) AvgRAM(M) MaxRAM(M) TotalDisk(M) NetworkInbound
Col1 11 2048 2048 2048 45524 1

PS C:\Windows\system32> Measure-Vm -VmName Router
VMbase AvgCPU(MHz) AvgRAM(M) MaxRAM(M) TotalDisk(M) NetworkInbound
Router 17 1664 1664 1664 21636 2

PS C:\Windows\system32>
```
- Performance Monitor**: A monitoring tool window showing a graph of CPU usage over time. The graph tracks CPU instances from 4:35:24 PM to 4:37:03 PM. The Y-axis ranges from 0 to 100%.

Both windows are titled "001: Desktop Performance Assessment". The top right corner of each window shows a progress bar indicating "1 Hr 17 Min Remaining". The desktop background is blue, and the taskbar at the bottom shows various pinned icons.





H. WEB SOURCES

- Basic Pfsense Configuration Tutorial
 - <https://linuxhint.com/pfsense-configuration/>
- Protect home network using subnets with pfSense
 - <https://netosec.com/protect-home-network/>
- Troubleshooting Firewall Rules
 - <https://docs.netgate.com/pfsense/en/latest/troubleshooting/firewall.html>
- How to configure a static IP address on CentOS 7 / RHEL 7
 - <https://www.cyberciti.biz/faq/howto-setting-rhel7-centos-7-static-ip-configuration/>
- How to allow ping on pfSense firewall?
 - <https://www.sxl.net/how-to-allow-ping-on-pfsense-firewall/>



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