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Network Operating Systems and
Services (ACCA5023)

Research, Build and Deploy a
Virtualised Enterprise Network

Hypervisor Architecture and Suitability

Virtualisation works by using software called a hypervisor to divide up a computer's physical hardware and share it between multiple virtual machines (VM's). Instead of one OS controlling the whole machine, the hypervisor manages certain resources, including CPU, memory and storage and allocates them to each VM. There are two main types of hypervisor; Type 1 and Type 2.

Choosing the correct hypervisor type is critical. [1] Type 1 hypervisors run directly on the physical hardware. Since there is no host operating system working underneath them, they tend to have lower overhead and a smaller attack surface. This means that they will have a better performance and improved security. For environments where scalability and security are critical; Type 1 hypervisors are usually the ideal choice. [2]

Type 2 hypervisors, like Oracle VM VirtualBox, run on top of a host OS like Windows. They are easier to install and use, particularly on standard desktop or laptop hardware. They are ideal for educational use where convenience and accessibility are more important than performance. [3]

In the enhanced topology, a Type 1 hypervisor would not provide sufficient practicality, due the lack of physical RAM, CPU cores and storage capacity.

For the NOSS2026 topology, which includes Windows Server 2022, a Debian server and an Active Directory domain (SWANSEA.ACCA), a Type 1 hypervisor would technically provide better performance and separation between systems. However, considering hardware limitations and a controlled scale, using a Type 2 hypervisor is a more realistic choice. It supports both Windows and Linux virtual machines effectively and still allows you to configure the internal networking required to simulate a multi-site environment.

IP Addressing and Network Communication

IP addressing is what makes communication possible across different networks. It provides each device with a logical address so that data can be transferred further than its local network. [4] When a host sends data, the packet includes both a source and destination IP address. Routers analyse this information and forward data to the relevant location.

Switches and routers have different roles in this process. Switches operate at Layer 2 of the OSI model and forward frames using MAC addresses, but only within the same subnet. [5] Routers operate at Layer 3 and examine IP addresses to move the signals between separate networks. This difference is especially important in multi-site setups

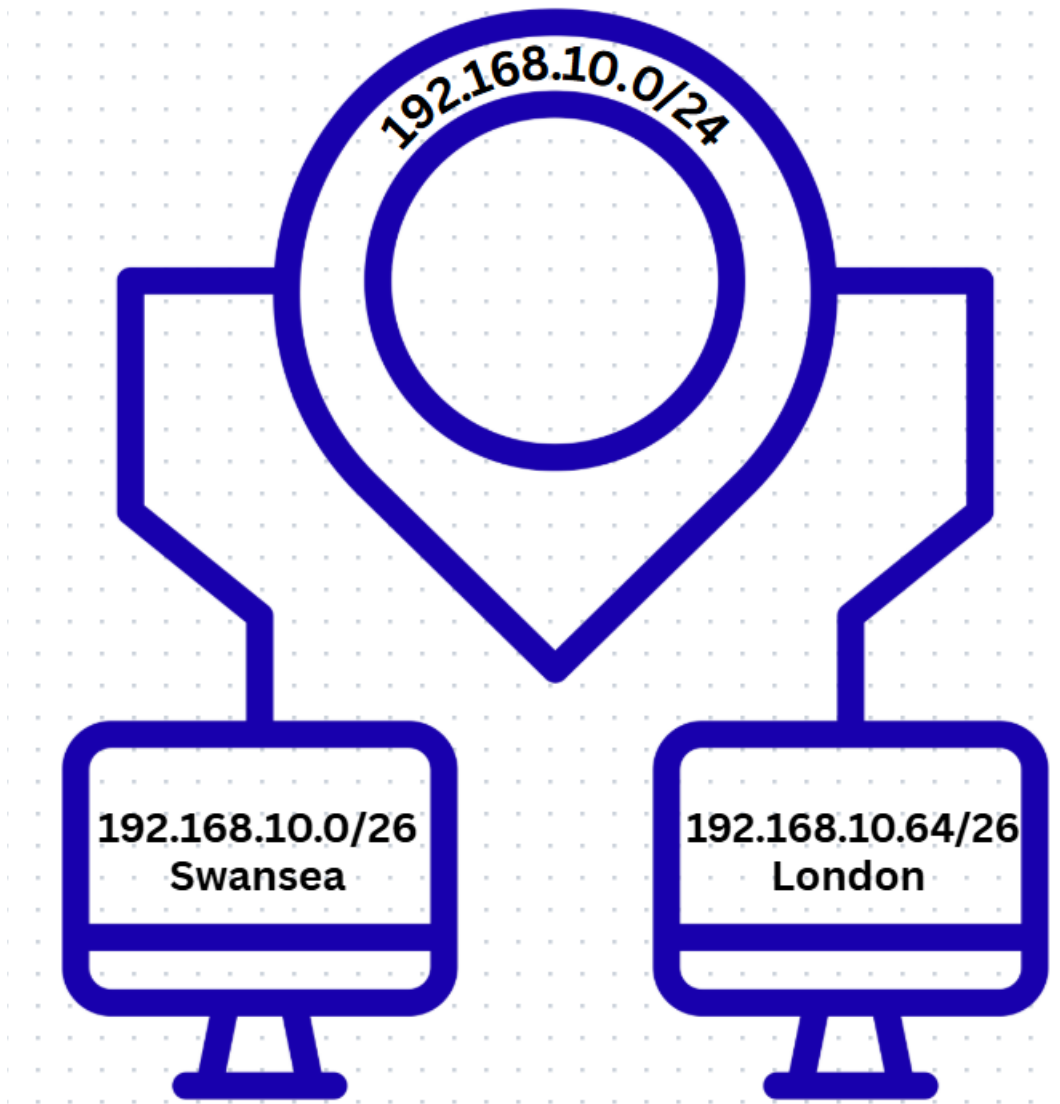
where communication between locations depends on correct IP addressing and accurate gateways.

IPv4 is the most used addressing system. It uses 32-bit addresses written in dotted-decimal format. Although IPv4 faces address exhaustion, it is still heavily used in networks.

IPv6 was then introduced to solve the exhaustion and scalability issues. It uses 128-bit hexadecimal addresses, which means there is a larger address space and improves scalability. Although, many enterprise networks continue to rely on IPv4 because it is familiar, compatible with existing systems, and easier to manage. [6]

Subnetting is used to divide a larger network into smaller sections. This reduces unnecessary broadcast traffic and strengthens security boundaries. [7] Variable Length Subnet Masking (VLSM) builds on this by allowing address space to be allocated based on the number of hosts needed, rather than following set class-based structures.

Within the NOSS2026 topology, VLSM allows separate subnets to be assigned to Swansea and London while conserving address space. Careful IP planning has a direct impact on performance, scalability, and overall network management.



Routing Strategy and Suitability

Routing controls how packets move between networks. Static routing involves manually entering routes into a router's routing table. This gives full administrative control and predictable behaviour, but it does not automatically adapt if the network changes [8]. In contrast, dynamic routing protocols will automatically exchange topology information between routers, show optimal paths in response to network changes. Even though dynamic protocols enhance scalability as well as resilience, they introduce complex configuration.

In the context of the NOSS2026 topology, routing decisions have to consider network scale, administrative overhead, and specific functional requirements. The environment consists of two defined site networks (Swansea and London) with controlled traffic patterns. With these set conditions, static routing provides set predictable behaviour

and additional controls for the administrator without the complexity that comes along with dynamic protocols. Furthermore, the Debian server's role does not inherently require dynamic routing, as the communication depends on directed forwarding rather than route discovery.

Even though dynamic routing would be more appropriate in a geographically distributed network, the constrained scope of this topology would work more efficiently with static configuration. This would reduce misconfiguration risks. It would also be an example of foundational routing principles.

Critical Evaluation of Network Services

Enterprise network environments rely on coordinated services to maintain security, manageability, and operational continuity. DHCP automates IP address allocation, reducing potential errors caused by Admin users and preventing address conflicts in expanding networks. Centralised management becomes especially critical in multi-site deployments where manual addressing would introduce potential inconsistencies and future issues with scalability.

Active Directory Domain Services (AD DS) provides identity management, authentication, and policy enforcement across networks created specifically for organisations. Within the NOSS2026 topology, deploying AD DS supports structured access control, group policy management, and integration with clients across connected domains. This centralisation enhances security and reduces potential risks by reducing reliance on local accounts and enforcing uniform configuration on the policy that is used. [9]

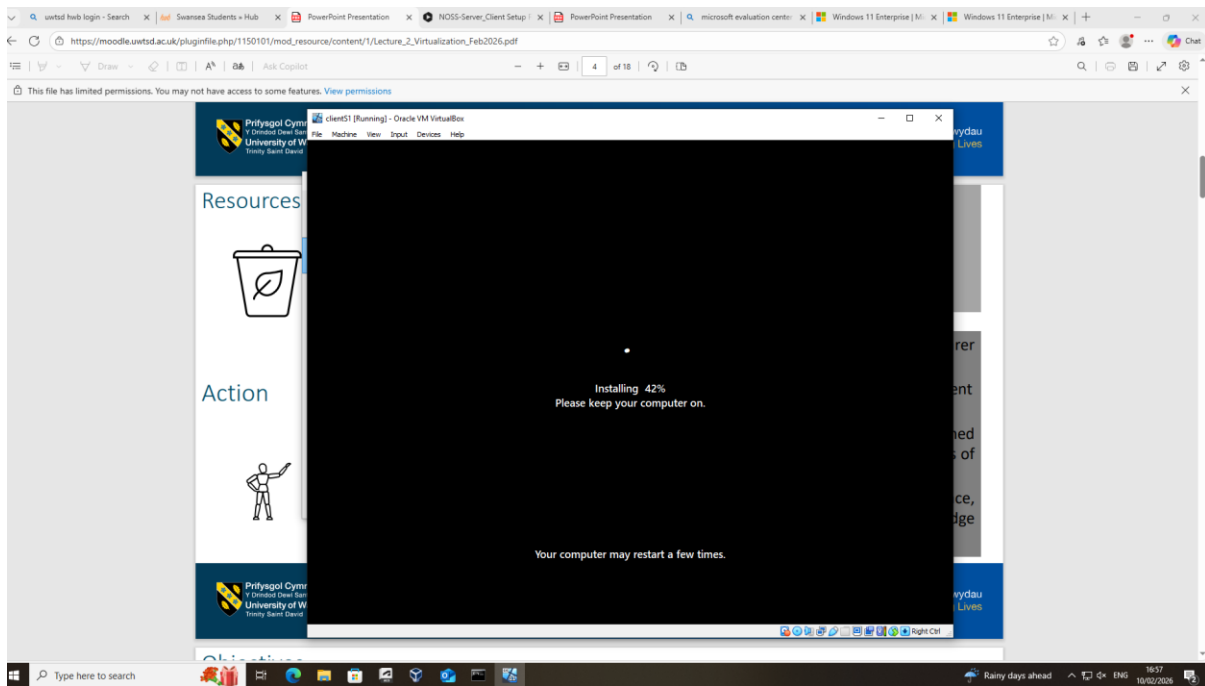
Certificate Authorities (CAs) strengthen trust within relationships in enterprise networks by issuing digital certificates for encryption, authentication, and secure communication protocols and policies. In domain environments, certificates underpin services including, for example, VPN authentication, as well as reinforcing confidentiality and enhancing network usage integrity.

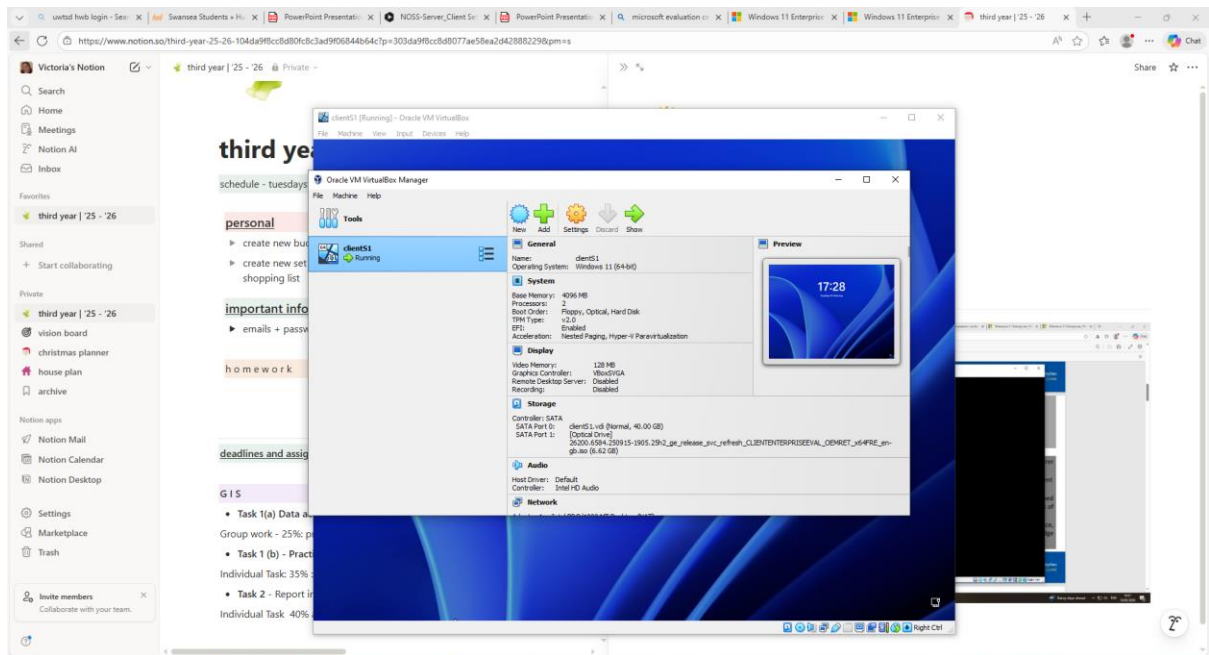
Virtual Private Networks (VPNs) extend secure connectivity across geographically dispersed sites by encrypting traffic over public networks. Although VPN implementation may be useful within this topology, its strategic importance lies in enabling secure between site communication with Swansea and London without exposing internal resources and information.

Collectively, these services contribute to a secure architecture with a layered security system. Their effectiveness depends not merely on deployment but on correct

integration, access control configuration, and ongoing management within the virtualised infrastructure. [10]

Practical Work





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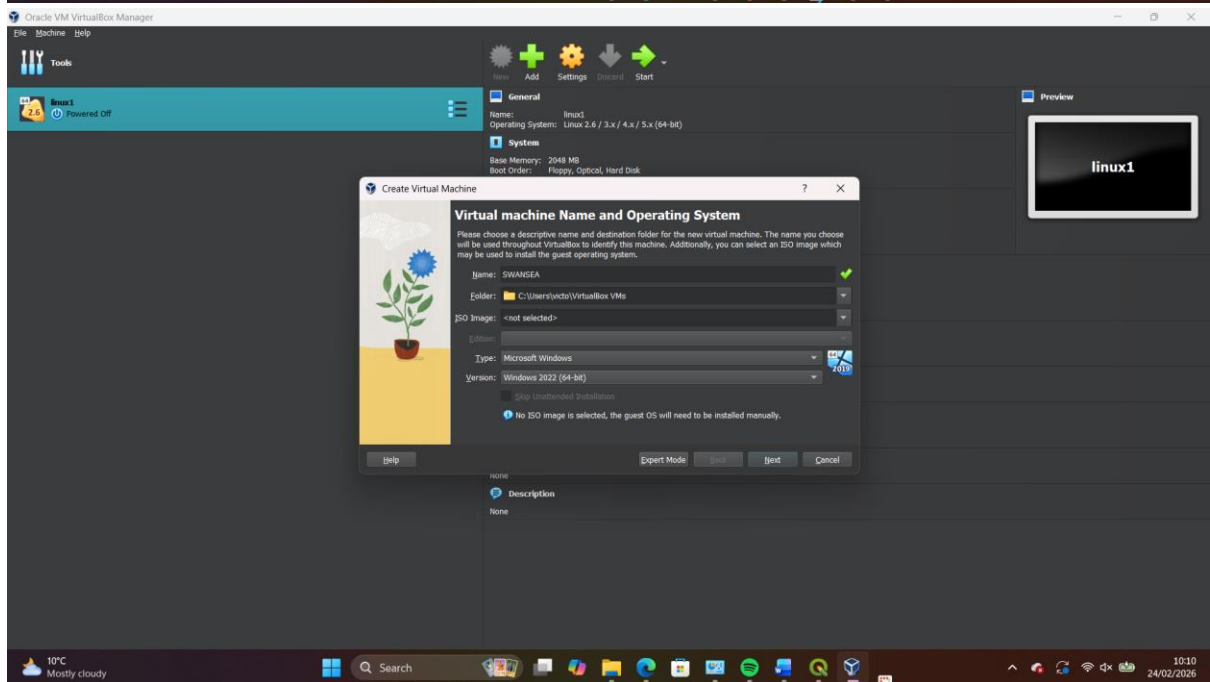
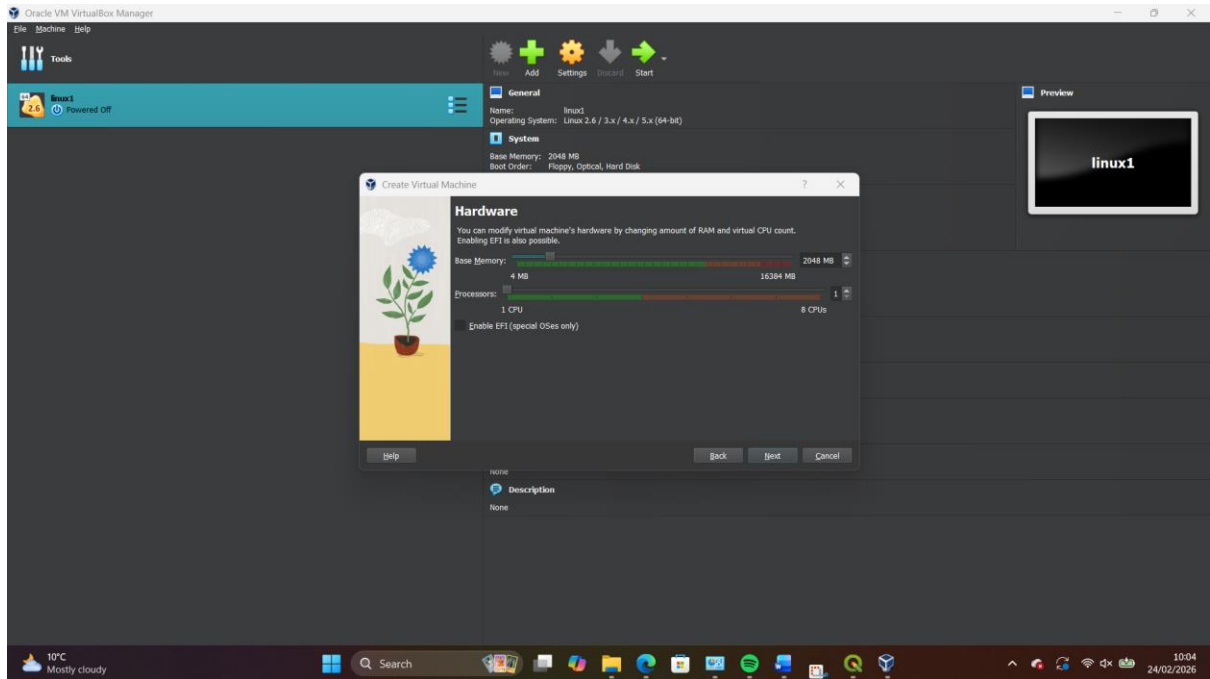
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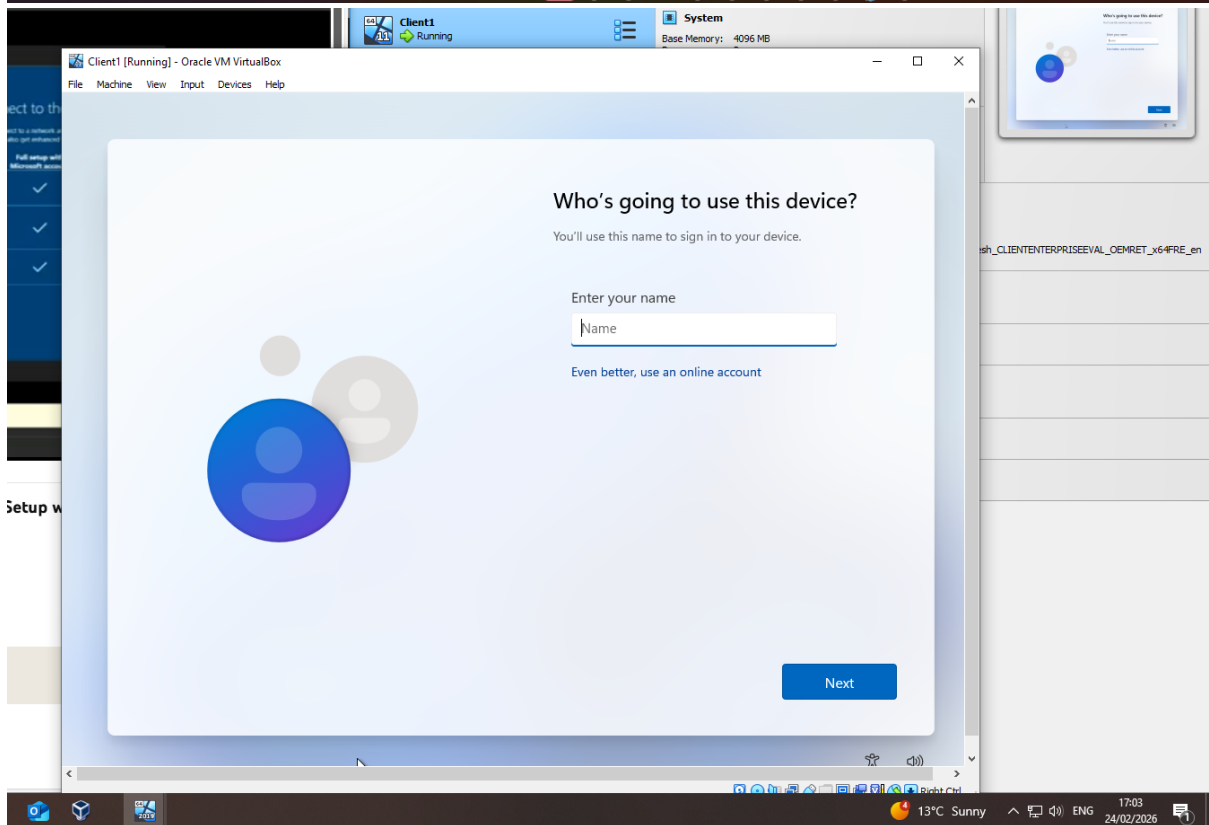
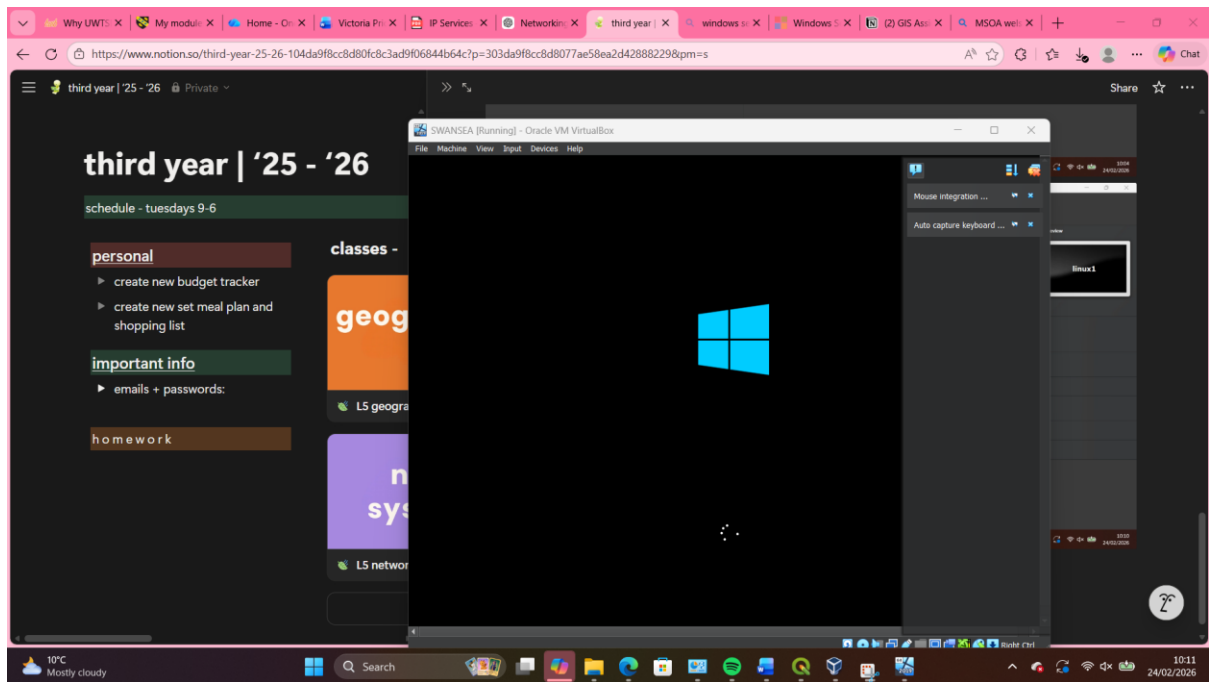
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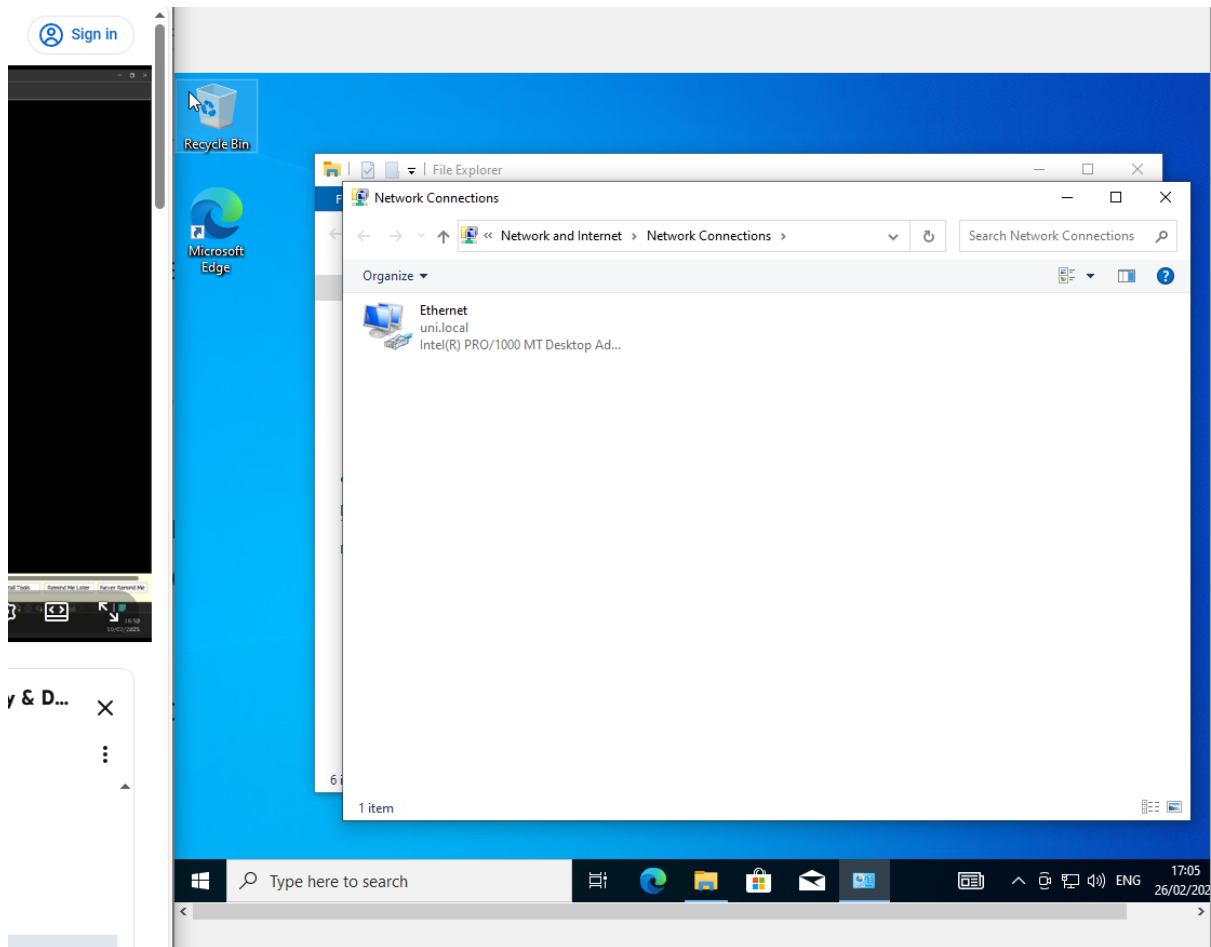
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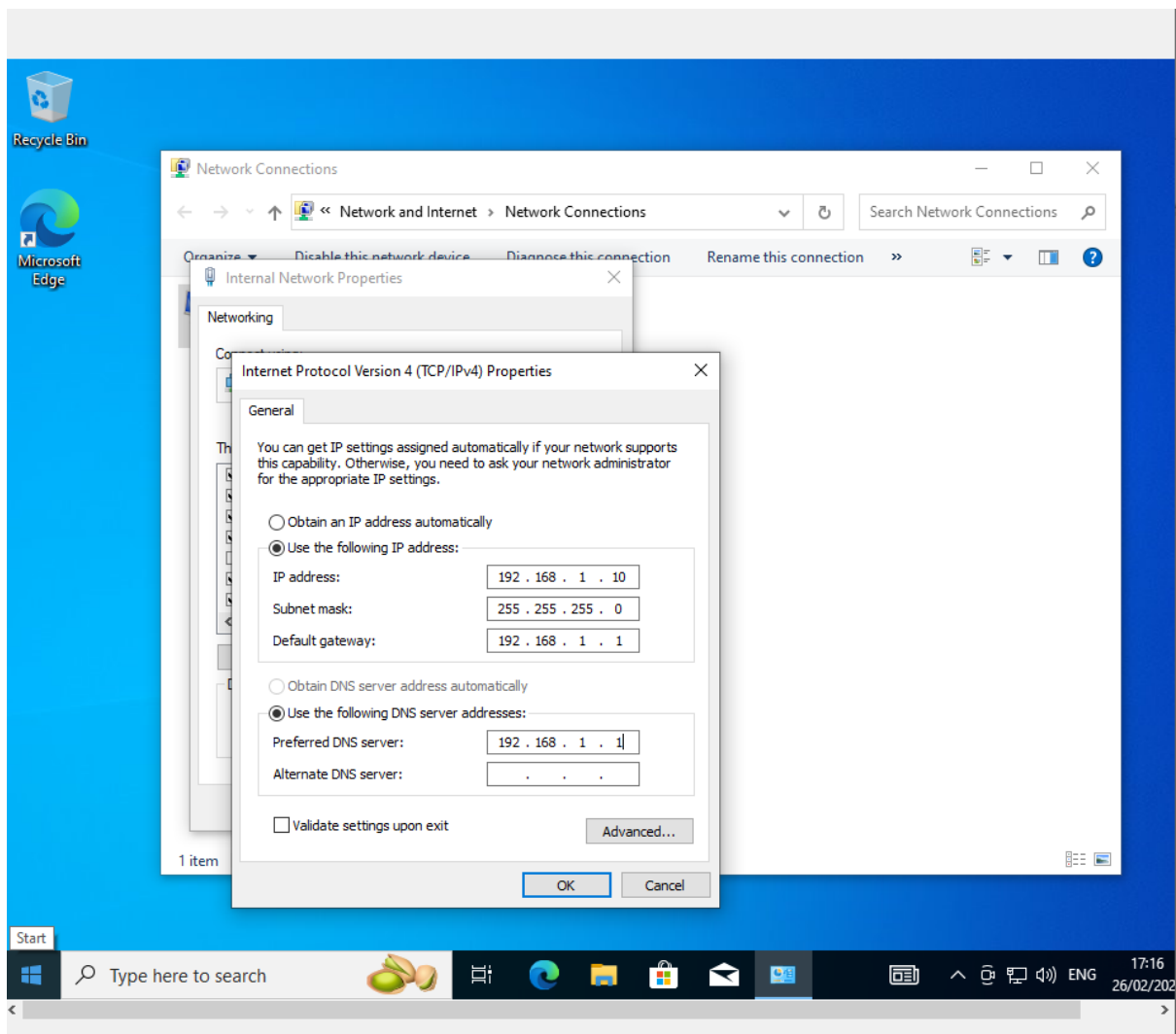
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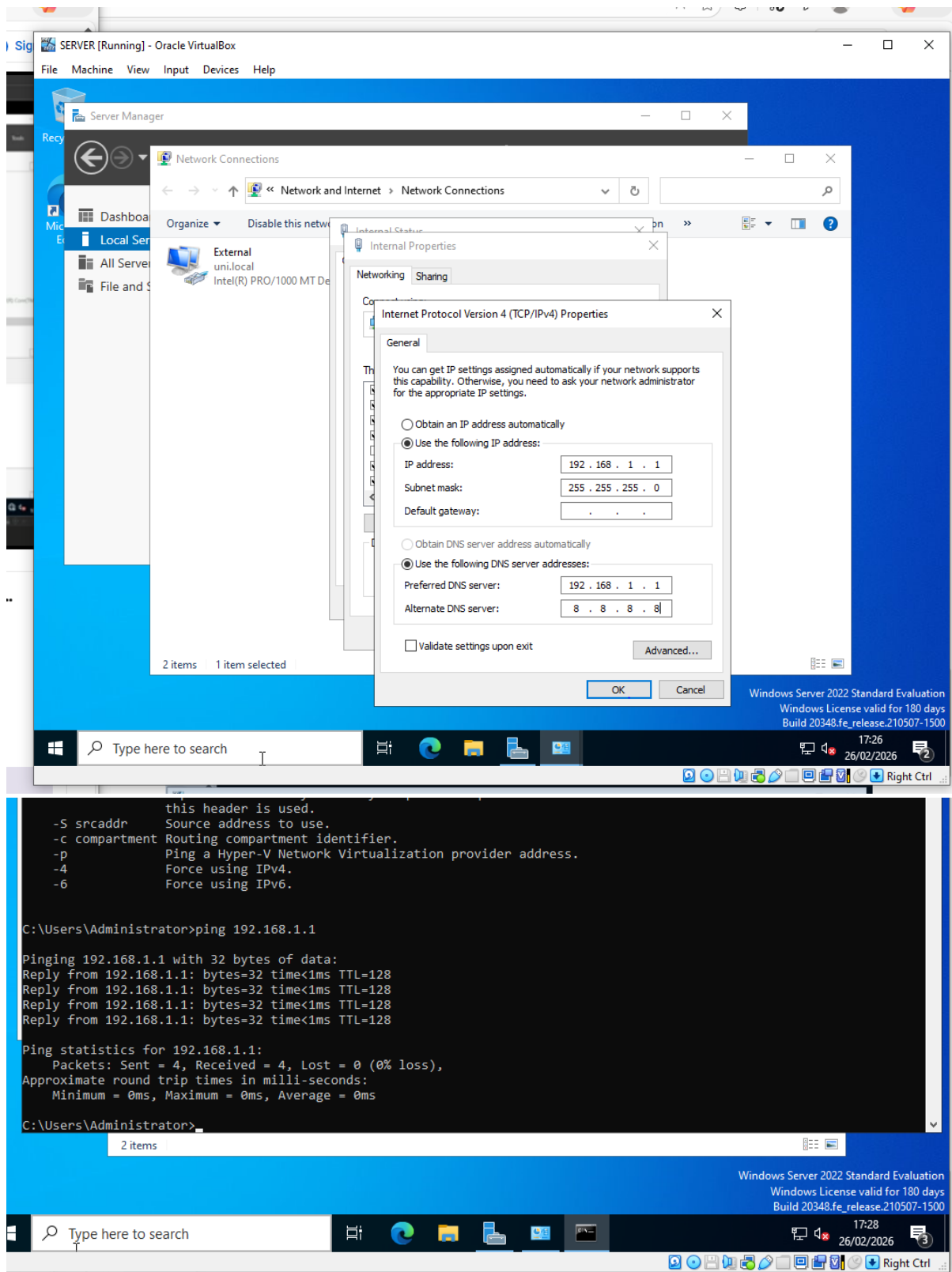
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Reflection

The deployment of the virtualised network environment highlighted the importance of structured planning and systematic troubleshooting. During the initial configuration and set up of the server, my systems were continuously crashing. I was able to get to the stage of IP configuration before my system would shut down before being able to proceed with the next stages of the set up.

Potential causes of the shutdown issues I was facing could have been the RAM allocation in the Oracle VM that I gave for the server and client.

I am unhappy with how far I was able to get in this task. I am dedicated to increasing my knowledge on Network Configuration for future tasks. I faced a myriad of issues configuring my network, understanding how the systems should work and fully understanding the task at hand.

I have improving to do when it comes to time allocation and ensuring that I have a comprehensive knowledge of the task and the systems required to complete the task. Additionally, I will be aiming to improve my practical skills when it comes to IP addressing, subnetting and routing.

Citations

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