

Component 1

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and Services

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Introduction

Modern enterprise organisations increasingly depend on virtualised infrastructures to deliver secure, scalable and cost-effective network services across geographically distributed locations. By abstracting physical hardware into multiple virtual environments, virtualisation enables organisations to optimise resource utilisation, simplify infrastructure management and improve operational flexibility while reducing deployment costs. Consequently, the ability to design, deploy and administer virtual enterprise networks has become an essential competency for modern network administrators and systems engineers.

The NOSSLONDON2026 scenario reflects a realistic enterprise environment by requiring the deployment of a virtual network connecting two geographically separated offices in Birmingham and London using Windows Server, Debian Server and clients operating systems. This report critically evaluates the technologies underpinning the proposed implementation, including hypervisor architectures, IP addressing strategies, routing approaches and enterprise network services. Rather than examining these technologies independently, the discussion analyses how their integration supports reliable communication, centralised administration, network security and the future scalability of the infrastructure required.

1. Research Report

1.1 Hypervisor technologies

Virtualisation has become a key technology in enterprise infrastructures, because it enables operating systems and services to run on common physical hardware. As well as reducing infrastructure cost, virtualisation helps to improve resource utilisation, streamline system administration and offer a platform to deploy and test enterprise services. For NOSSLONDON2026 a hypervisor should be selected. It supports Windows Server, Debian Server and client operating systems for future network service and infrastructure expansion [1], [2].

1.1.1 Hypervisor architecture and virtualisation evolution

The evolution of hypervisor technology has revolutionized enterprise computing by converting physical hardware into virtual machines, and operating systems can be stored and operated safely on one host. It is easier to install hardware on the system, and tests, maintenance and disaster recovery are further facilitated by snapshots and virtual networking [1], [3].

1.1.2 Comparison of Type 1 and Type 2 Hypervisors

Type 1 hypervisors execute directly on physical hardware, providing superior performance, scalability and security for enterprise production environments. Conversely, Type 2 hypervisors operate on top of a host operating system, offering greater deployment flexibility and hardware compatibility. Although hosted hypervisors introduce modest performance overhead, they are particularly suitable for educational laboratories where ease of deployment and administration outweigh maximum processing efficiency [2], [4].

1.1.3 Justification of Oracle VM VirtualBox

Considering the objectives of the proposed topology, Oracle VM VirtualBox represents the most appropriate hypervisor because it supports both Windows and Debian operating systems while providing snapshots, multiple virtual network adapters and configurable networking modes required to reproduce the Birmingham and London network segments. Its compatibility with standard desktop hardware, combined with support for future domain services introduced in Coursework 2, provides an effective balance between functionality, compatibility and cost, making it well suited to the proposed enterprise infrastructure [1], [4].

1.2 IP addressing

An enterprise IP addressing strategy is fundamental to network design because it enables devices, services and users to communicate reliably across interconnected networks. Beyond uniquely identifying hosts, structured IP addressing improves traffic management, supports service availability and provides a scalable foundation for future infrastructure expansion. Within the proposed NOSSLONDON2026 topology, effective address planning ensures reliable communication between the Birmingham and London offices while supporting enterprise services and administrative efficiency [6], [7].

1.2.1 Data transmission across modern networks

Data is transmitted across enterprise networks as IP packets that travel between source and destination devices. Switches forward traffic within local area networks using MAC addresses, whereas routers examine logical IP addresses to determine the most appropriate path between different network segments. Consequently, accurate IP addressing and correctly configured network devices ensure reliable communication across the enterprise infrastructure, allowing the Birmingham and London offices to exchange data efficiently despite operating on separate network segments [6], [10].

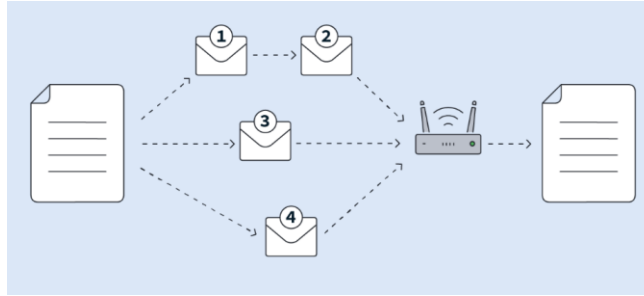


Figure 1. Packet transmission [Source: AVG]

1.2.2 IPv4, IPv6 and enterprise address planning

Effective address planning requires organisations to balance compatibility with future scalability. Although IPv6 provides the long-term solution to address exhaustion, IPv4 remains widely deployed because many enterprise systems continue to rely on existing infrastructure. IPv4 uses a 32-bit dotted decimal format, IPv6 employs a 128-bit hexadecimal representation, providing significantly greater address capacity and supporting future network growth. Consequently, dual stack deployment enables organizations to maintain compatibility while facilitating a gradual transition towards IPv6 without disrupting existing services [7], [8].

1.2.3 Subnetting and efficient address allocation

Subnetting improves enterprise network efficiency by dividing larger networks into smaller logical segments, reducing broadcast traffic and strengthening administrative control. Combined with CIDR and VLSM, subnetting enables efficient utilization of available address space while supporting scalable and manageable network growth. Within the proposed topology, this approach allows the Birmingham and London offices to operate as independent network segments without compromising connectivity [9], [13].

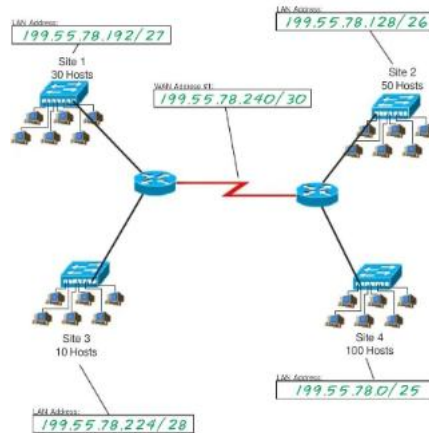


Figure 2. Subnet allocation [Source: Chegg]

1.2.4 Application to the proposed topology

The proposed implementation assigns independent IP networks to each office while reserving static addresses for infrastructure devices supporting enterprise services. This structured addressing strategy simplifies network administration, improves troubleshooting and establishes the foundation for routing, Active Directory, DHCP relay and future infrastructure expansion without requiring significant changes to the existing addressing design [5].

1.3 Research on routing

Routing connects independent IP networks by forwarding packets based on destination IP addresses and routing tables. This enables communication between the Birmingham and London offices within the NOSSLONDON2026 infrastructure [6], [10].

1.3.1 Static and dynamic routing approaches

Static routing uses manually configured routes, making it suitable for small and stable topologies. Dynamic routing uses routing protocols to exchange route information automatically, allowing routes to adapt to network changes [11].

1.3.2 Routing strategy for the proposed topology

For the proposed topology, static routing is the most appropriate solution because it provides predictable routes with minimal administration. This approach is well suited to the limited number of interconnected subnets, where frequent route updates are unnecessary. It also ensures reliable communication between critical network services, including the Windows Server and the Debian Server operating as a DHCP Relay. If the infrastructure expanded to include additional sites or frequent topology changes, dynamic routing protocols would become a more suitable option because they automatically exchange routing information. Therefore, static routing provides a practical and reliable solution for maintaining communication across the proposed enterprise network [12].

1.4 Research on network services

1.4.1 Network Services

Enterprise network services provide the foundation for secure communication, centralized management and efficient resource administration. Within the proposed NOSSLONDON2026 topology, integrating DHCP, Active Directory Domain Services, Virtual Private Networks and Certificate Authorities provide a reliable and manageable enterprise environment [5], [14].

1.4.2 Main network services

DHCP automatically assigns IP addresses and network configuration, while AD-DS centralises authentication, authorisation and policy management for users and devices. VPN provide secure remote connectivity, whereas Certificate Authorities issue and manage digital certificates that support authentication and trusted communications [15], [16]. A recognised best practice is to integrate these services within a centrally managed infrastructure to improve consistency, security and administrative efficiency. In the proposed topology, Windows Server hosts AD-DS and DHCP, while VPNs provide secure remote connectivity. Certificate Authorities (CAs) support authentication and trusted communications by issuing and managing digital certificates, providing the foundation for the enhanced enterprise services [17], [18].

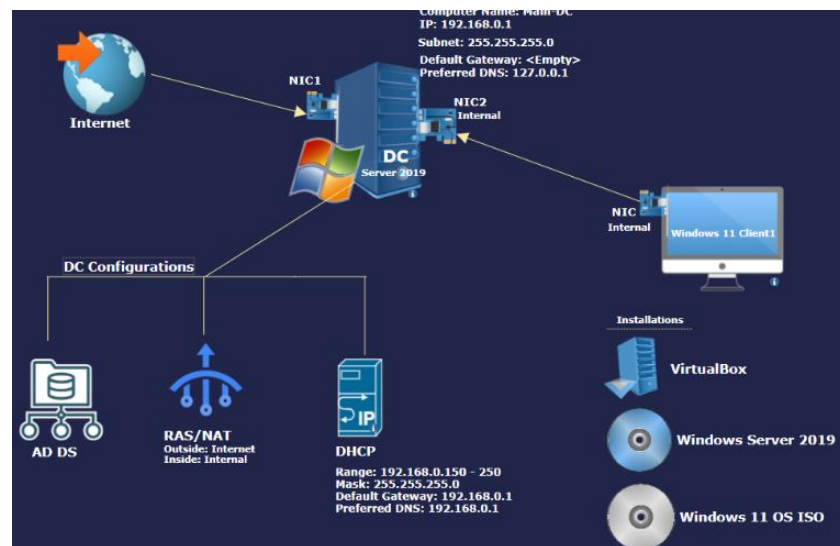


Figure 3. Services integration [Source: Medium]

2. Technical Documentation

2.1 Hypervisor selection

Oracle VM VirtualBox was evaluated as the deployment platform based on its hardware compatibility, virtual networking capabilities, performance, snapshot functionality, and support for both Windows Server and Debian Linux [5], [1]. These criteria were considered essential because the proposed topology requires a flexible and reliable environment for deploying, configuring and testing multiple virtual machines while supporting future enterprise services.

2.1.1 Justification of Oracle VM VirtualBox

Oracle VM VirtualBox was selected because it provides the features required to implement the proposed NOSSLONDON2026 topology on standard desktop hardware. Its support for multiple virtual network modes, efficient resource allocation and snapshot management simplifies deployment and testing while maintaining full compatibility with Windows Server and Debian Linux. These capabilities provide a reliable foundation for implementing Active Directory, DHCP Relay and the additional enterprise network services required in Coursework 2 [1], [5].

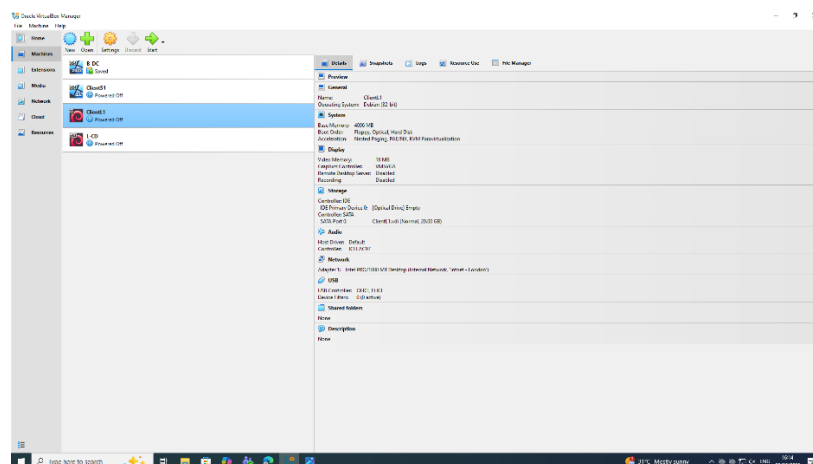


Figure 4. Oracle VM VirtualBox [Source: Author]

2.2 Virtual machine creation

Four virtual machines were created to implement the proposed topology: B-DC (Windows Server 11), ClientS1 (Windows Client), L-CD1 (Debian Server) and ClientL1 (Debian Client). Each virtual machine was configured with appropriate CPU, memory, virtual disk capacity and installation media according to the operating system requirements. This ensured a consistent virtual environment for configuring and testing the enterprise network [1].

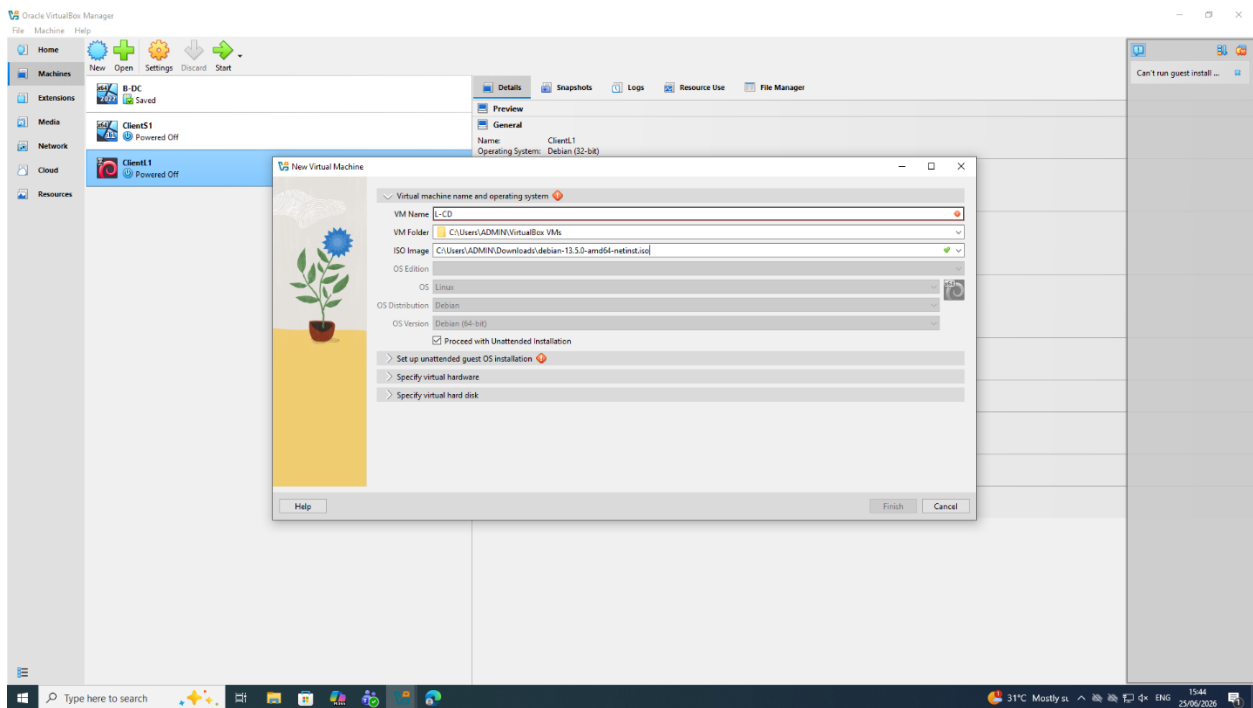


Figure 5. Creating a new virtual machine in Oracle

2.2.1 Network adapter configuration

Virtual network adapters were configured to support both Internet access and internal communication between the virtual machines. NAT was assigned to provide external connectivity for software installation and updates, while Internal Network enabled isolated communication between the enterprise hosts without exposing traffic to the physical network [1].

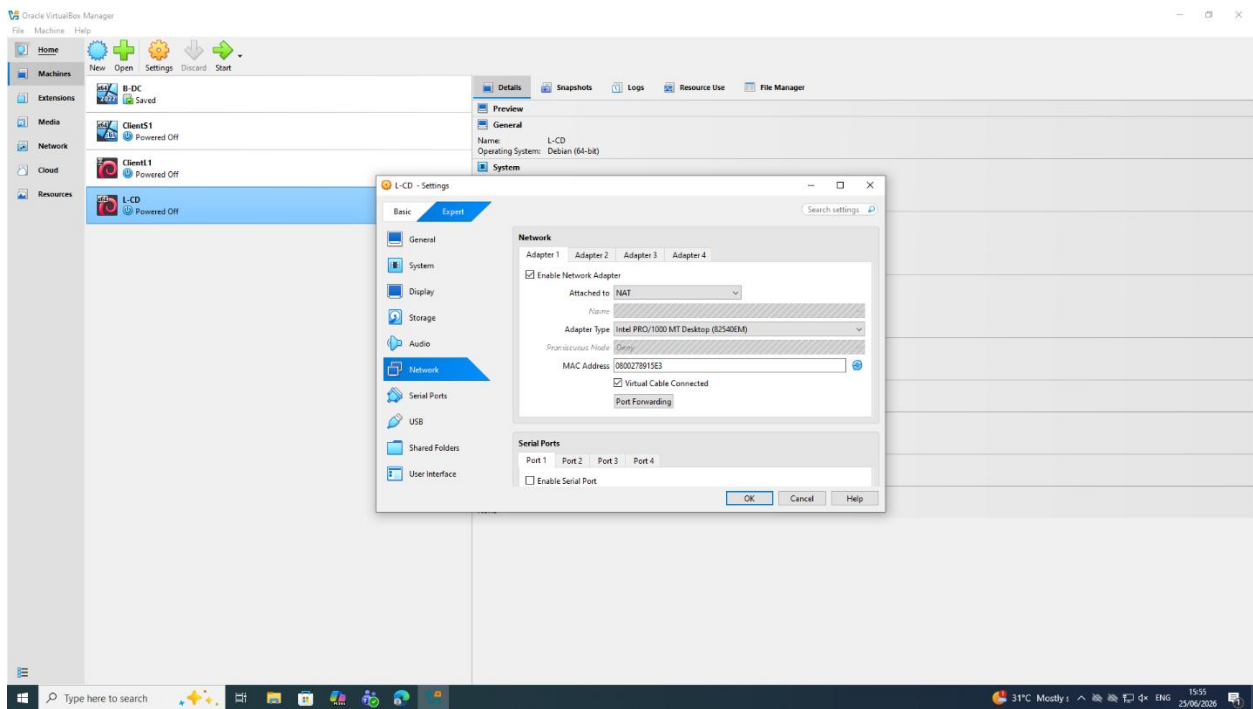


Figure 6. Debian Server Adapter 1

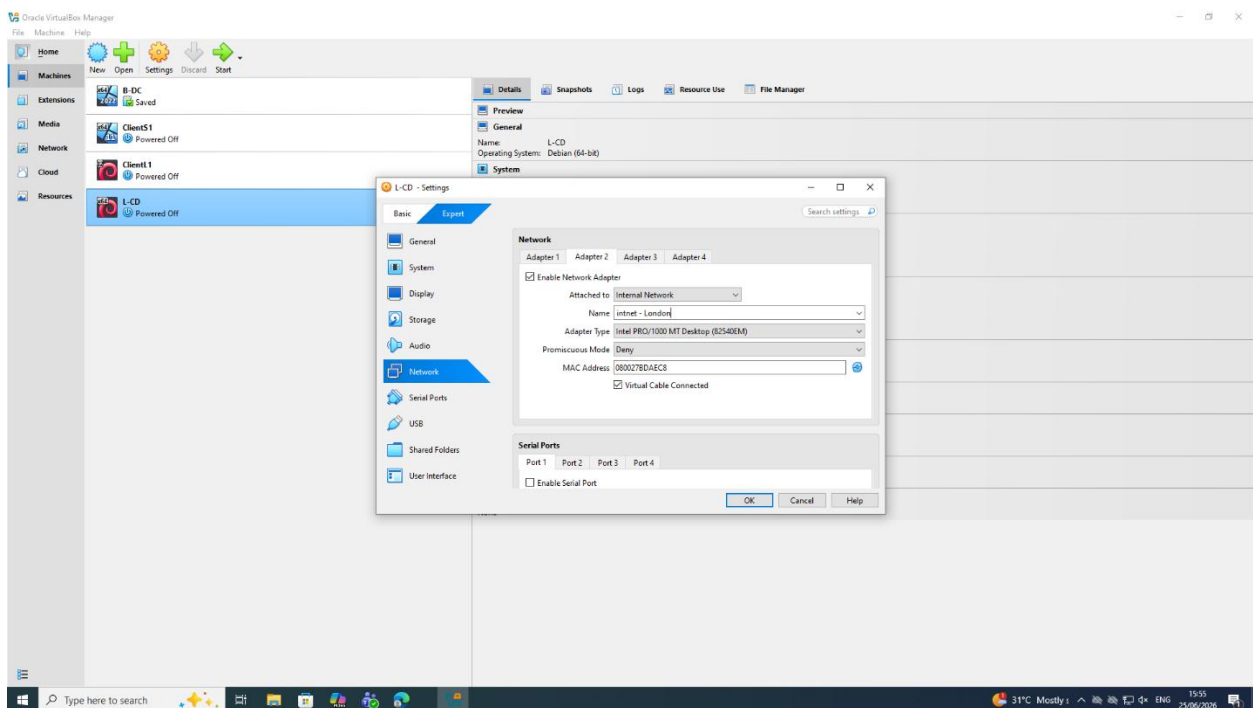


Figure 7. Debian Adapter 2

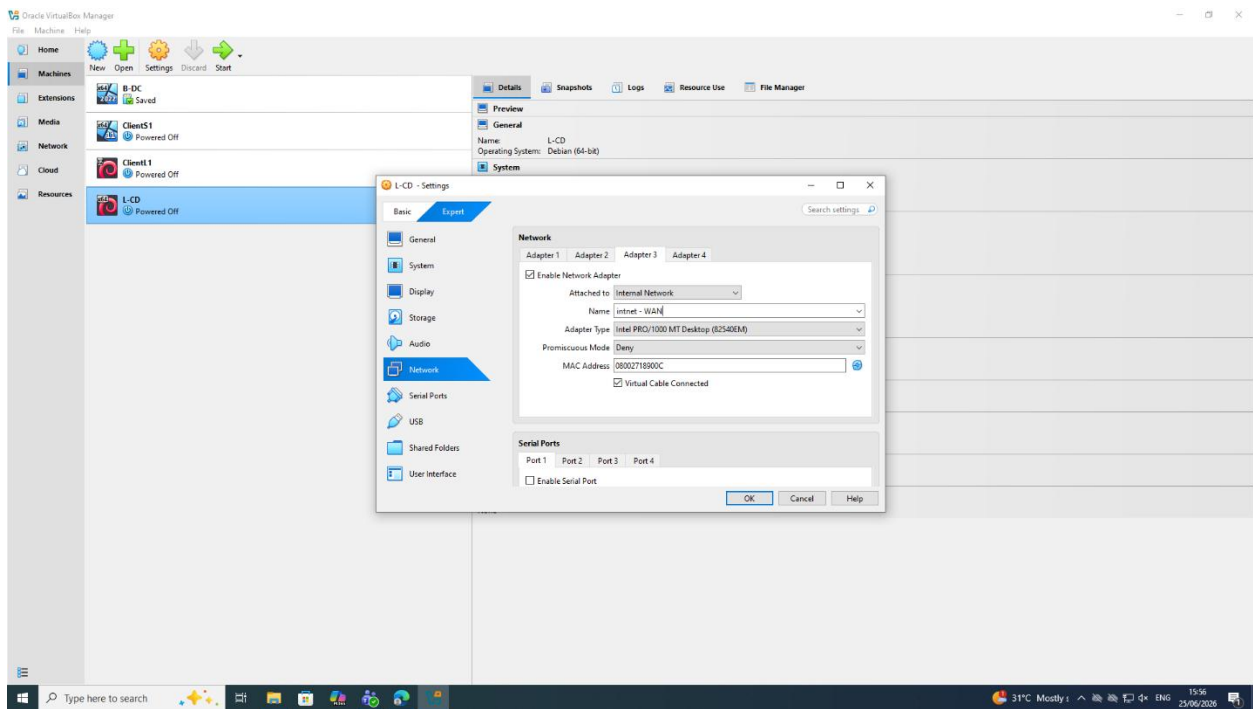


Figure 8. Debian Server Adapter 3

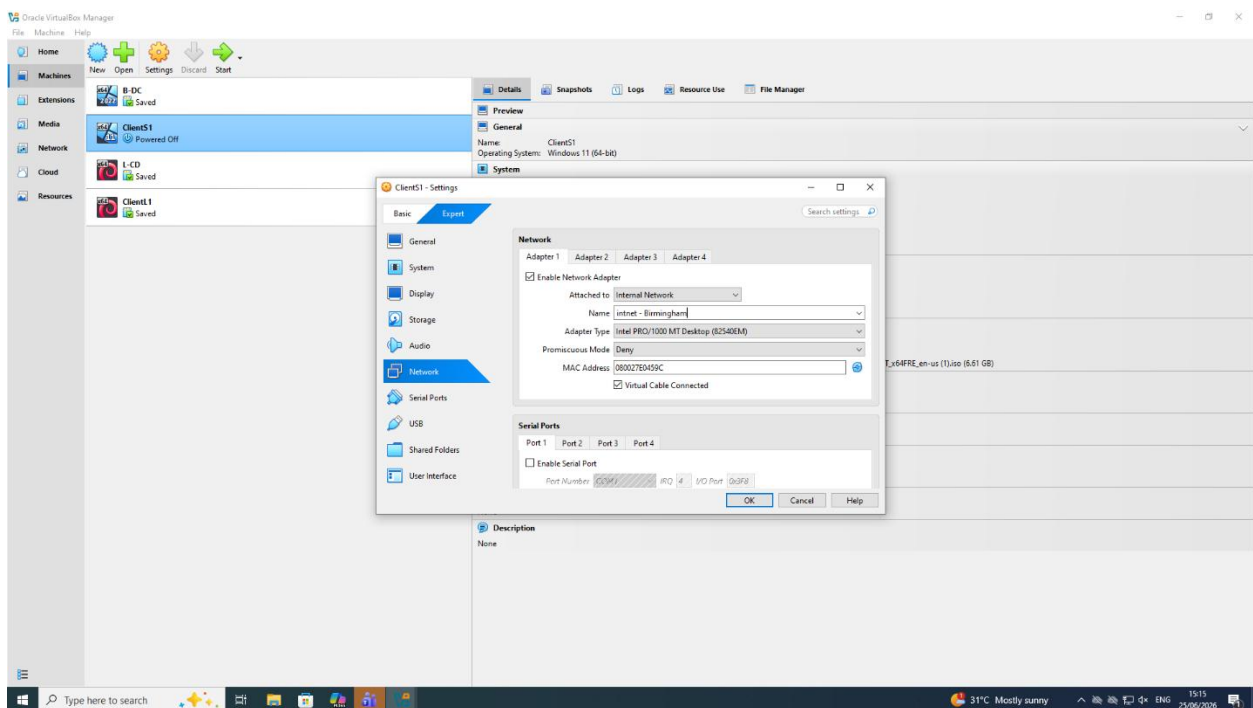


Figure 9. Client S1 Adapter Configuration

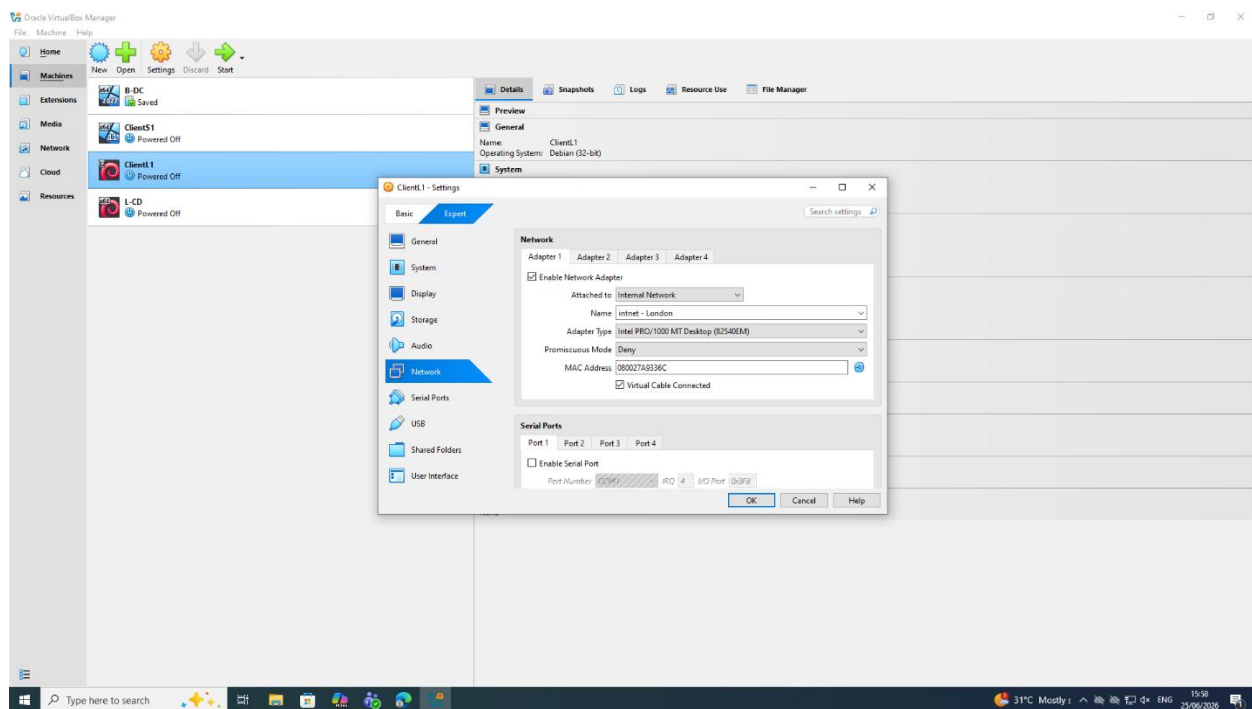


Figure 10. Client L1 Adapter Configuration

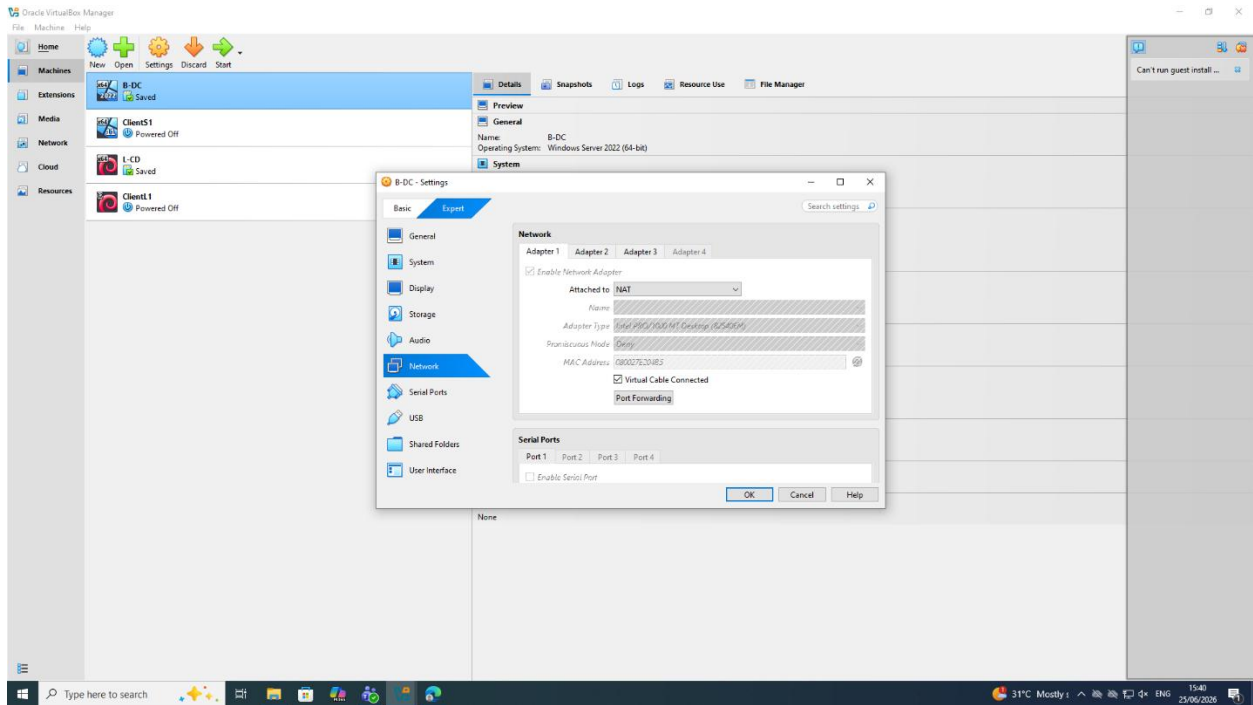


Figure 11. Windows Server Adapter 1

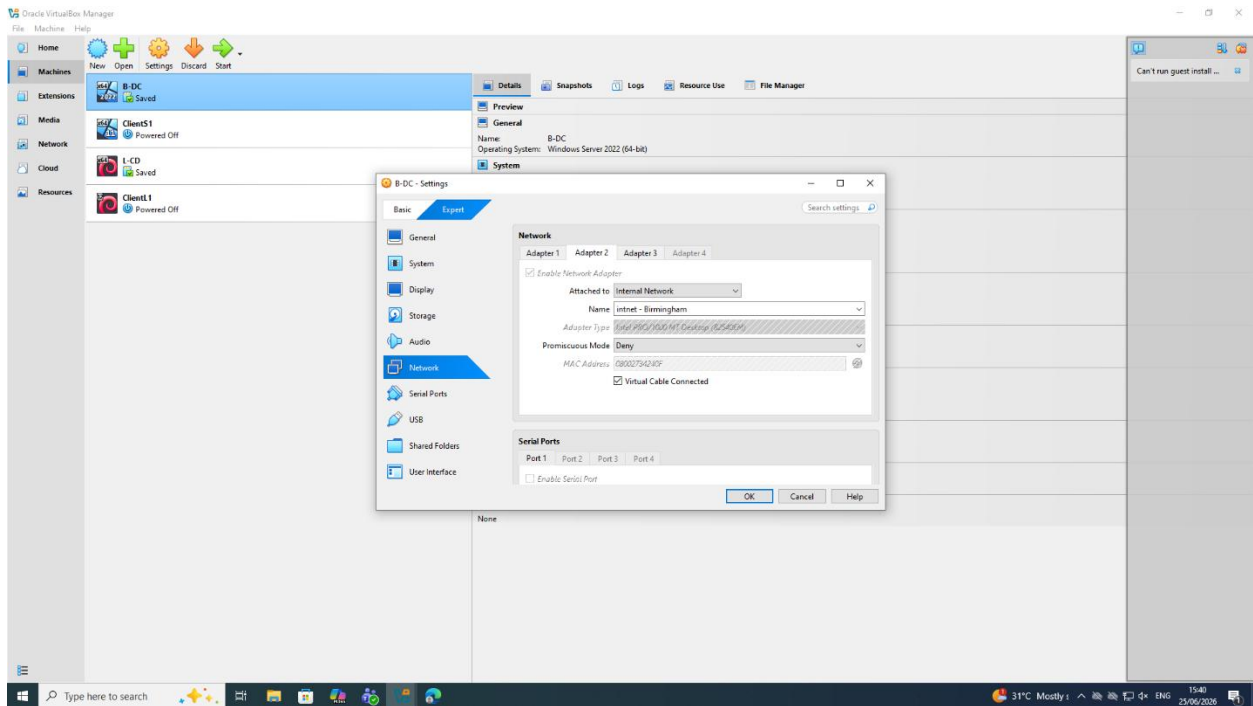


Figure 12. Windows Server Adapter 2

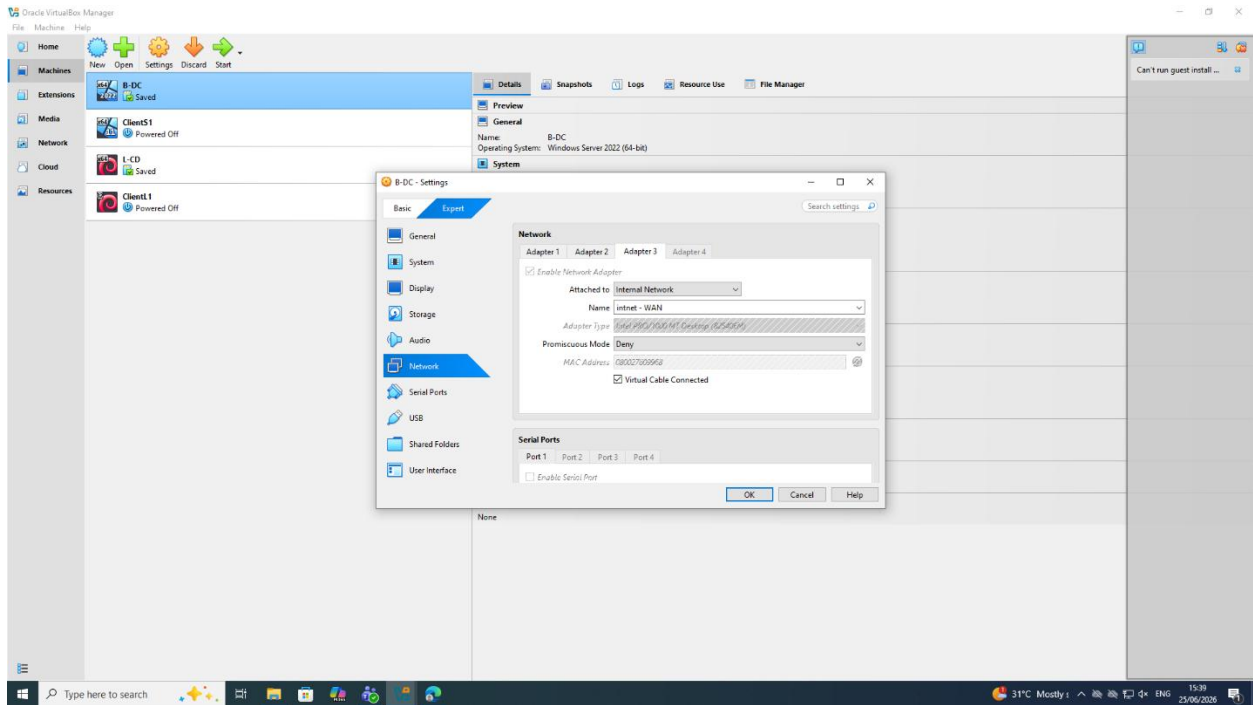


Figure 13. Windows Server Adapter 3

2.2.2 Downloading software components

The deployment process began by downloading Oracle VM VirtualBox, Windows Server 11 and Debian 13 installation media from their official websites.

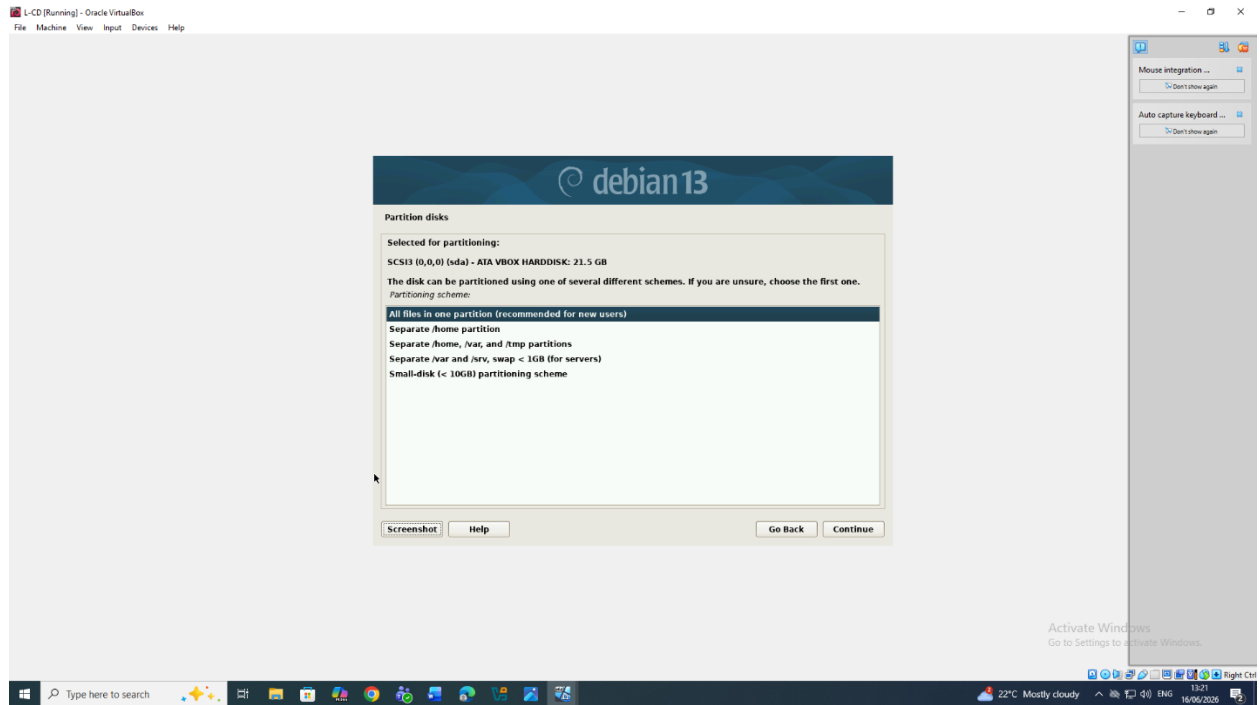


Figure 14. Download Debian 13

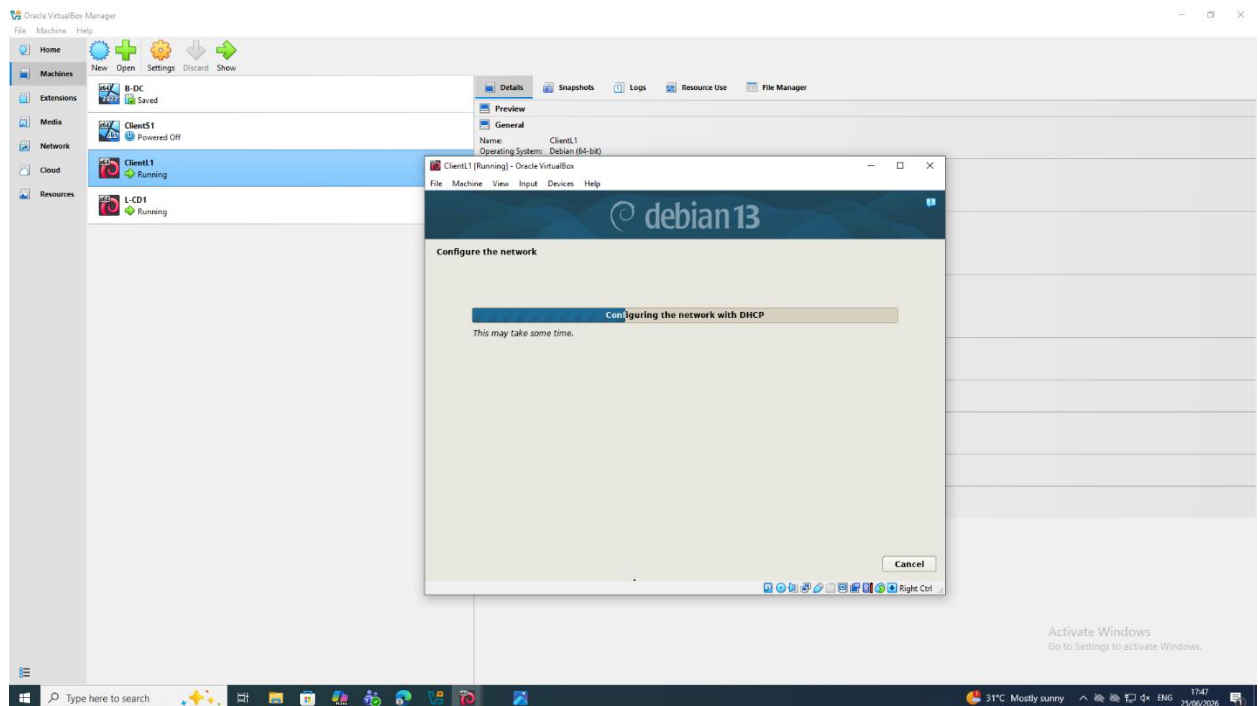


Figure 15. Installing Client L1

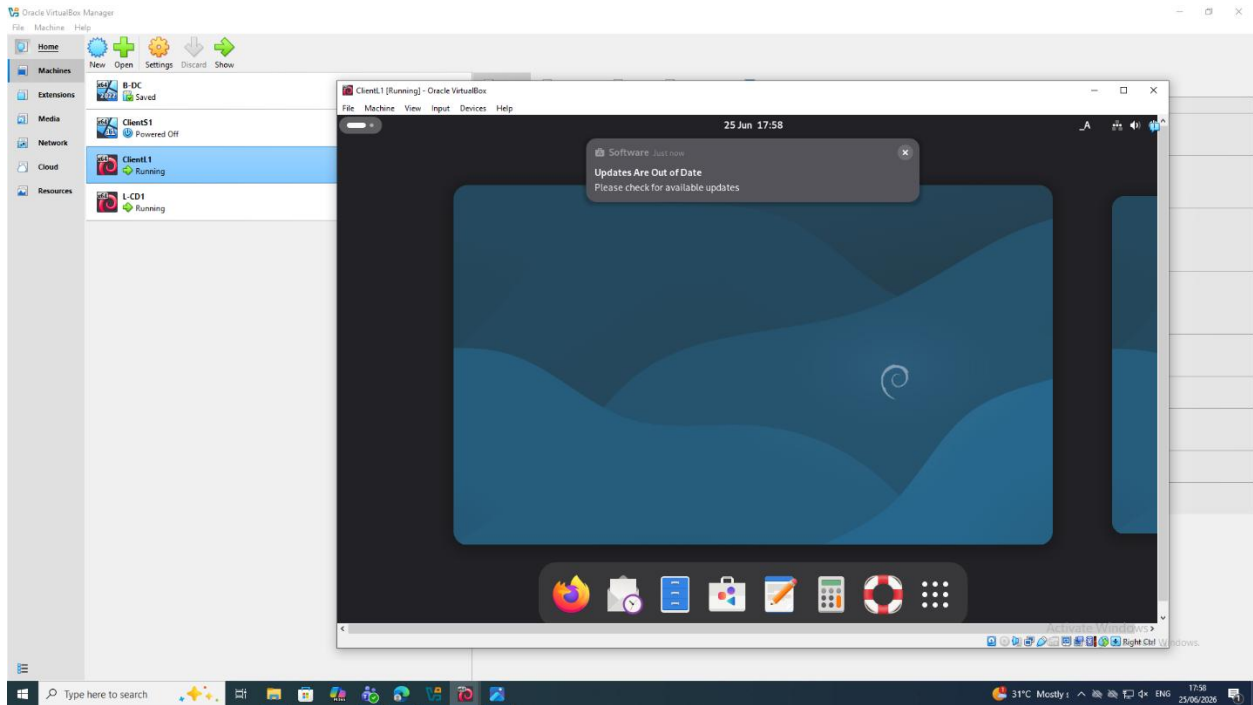


Figure 16. Client L1 Interface

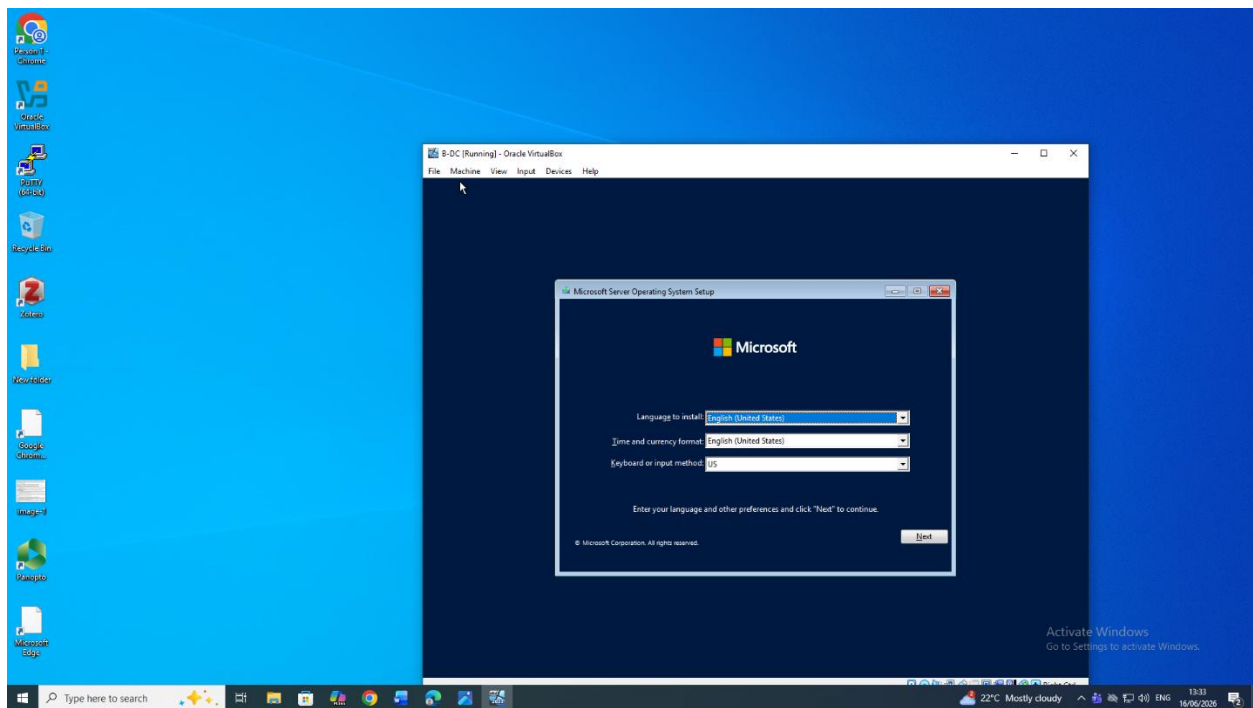


Figure 17. Download Windows 11

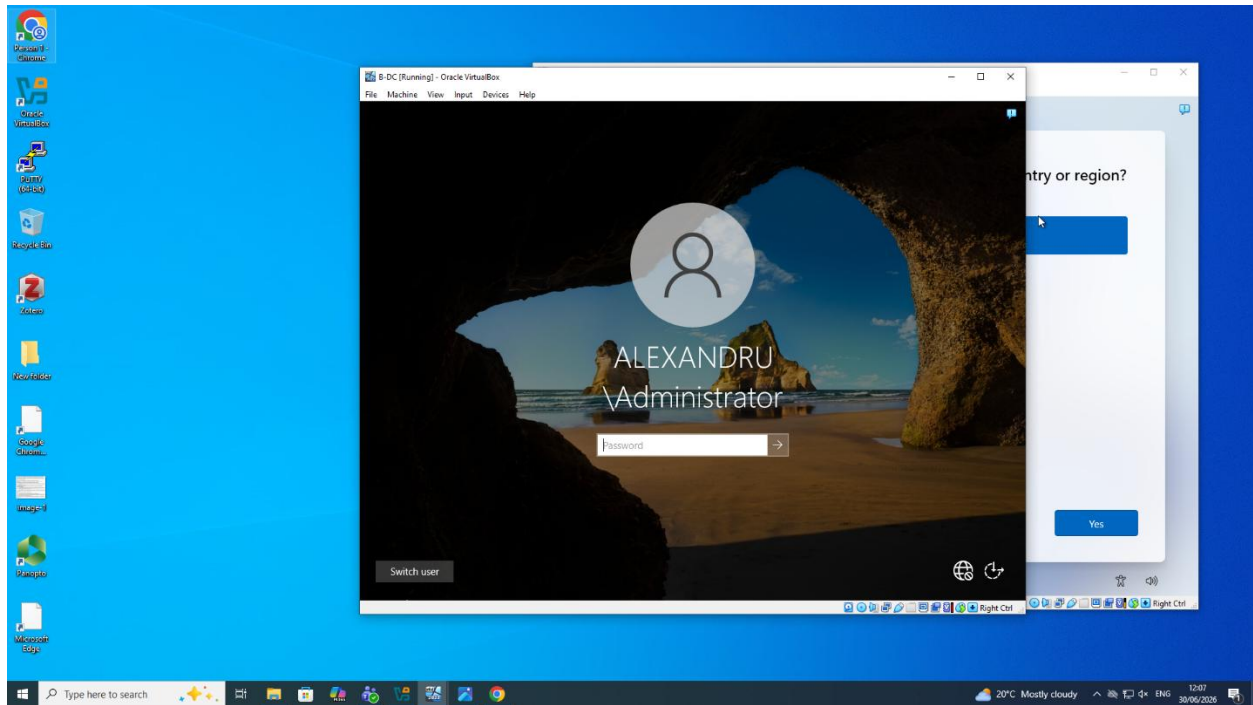


Figure 18. Windows Server Interface

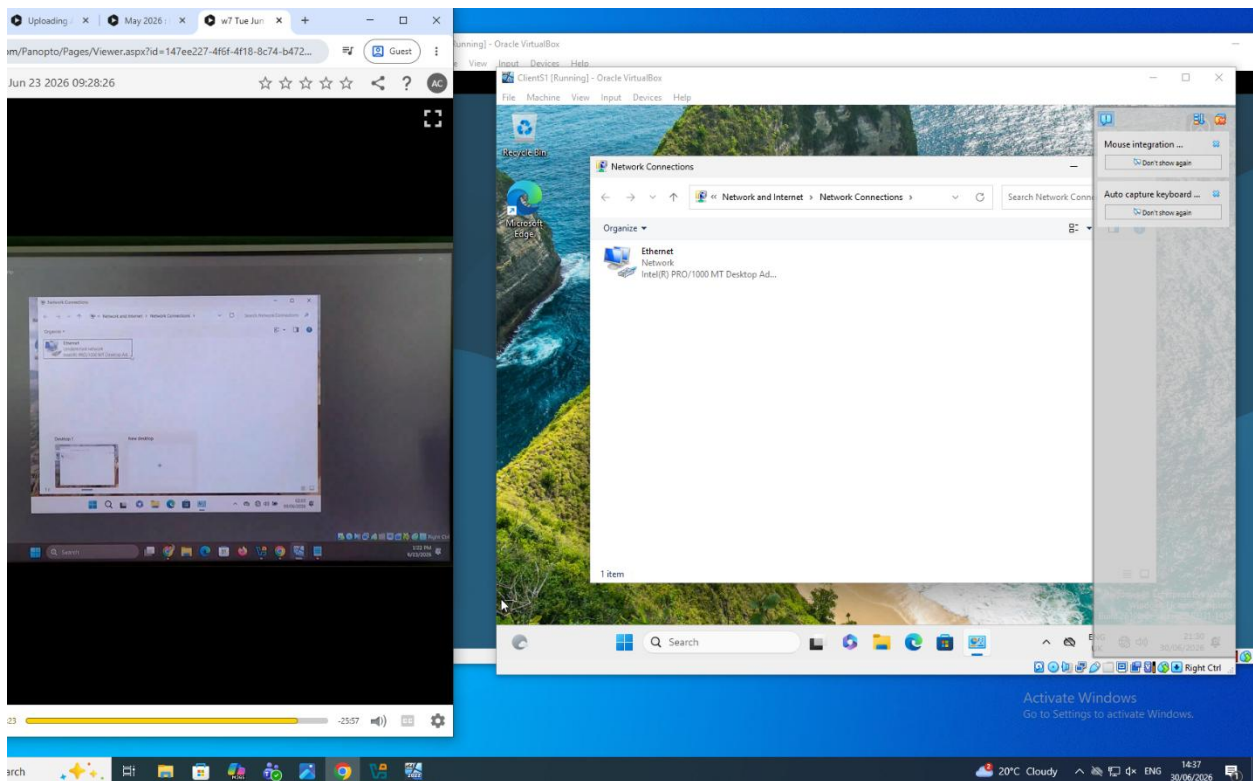


Figure 19. Client S1 interface

2.3 IP address configuration

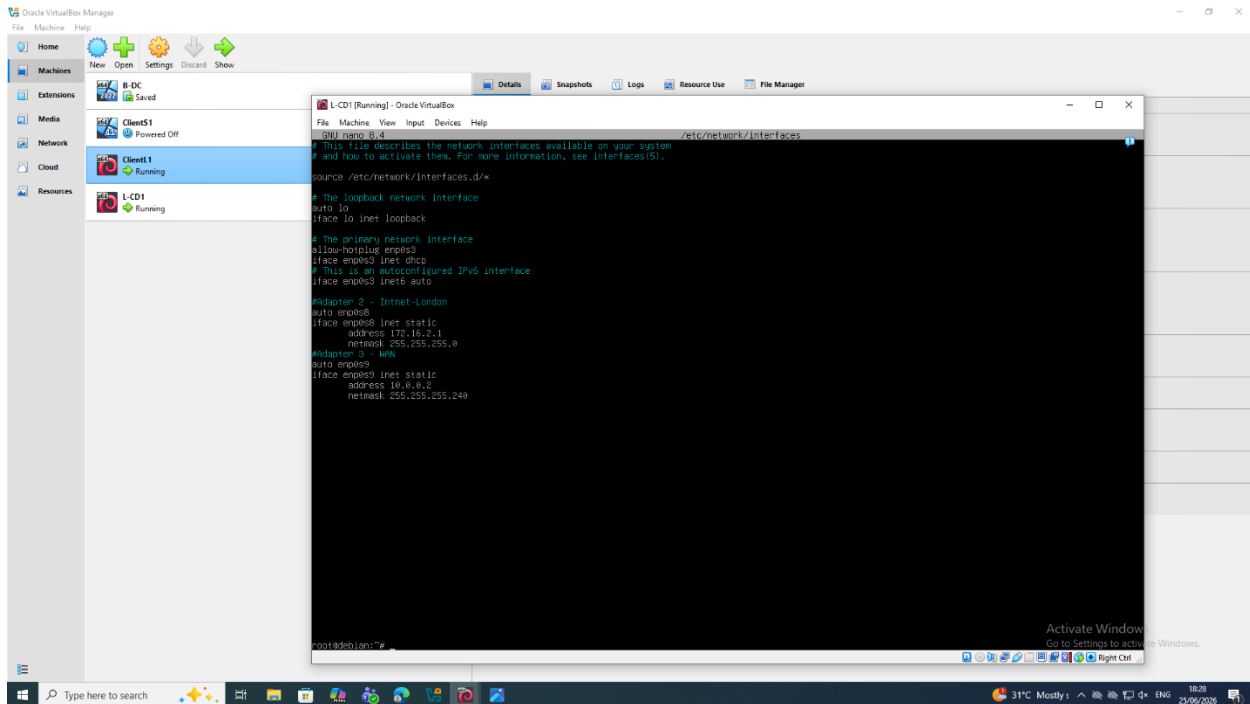


Figure 20. Client L1 config

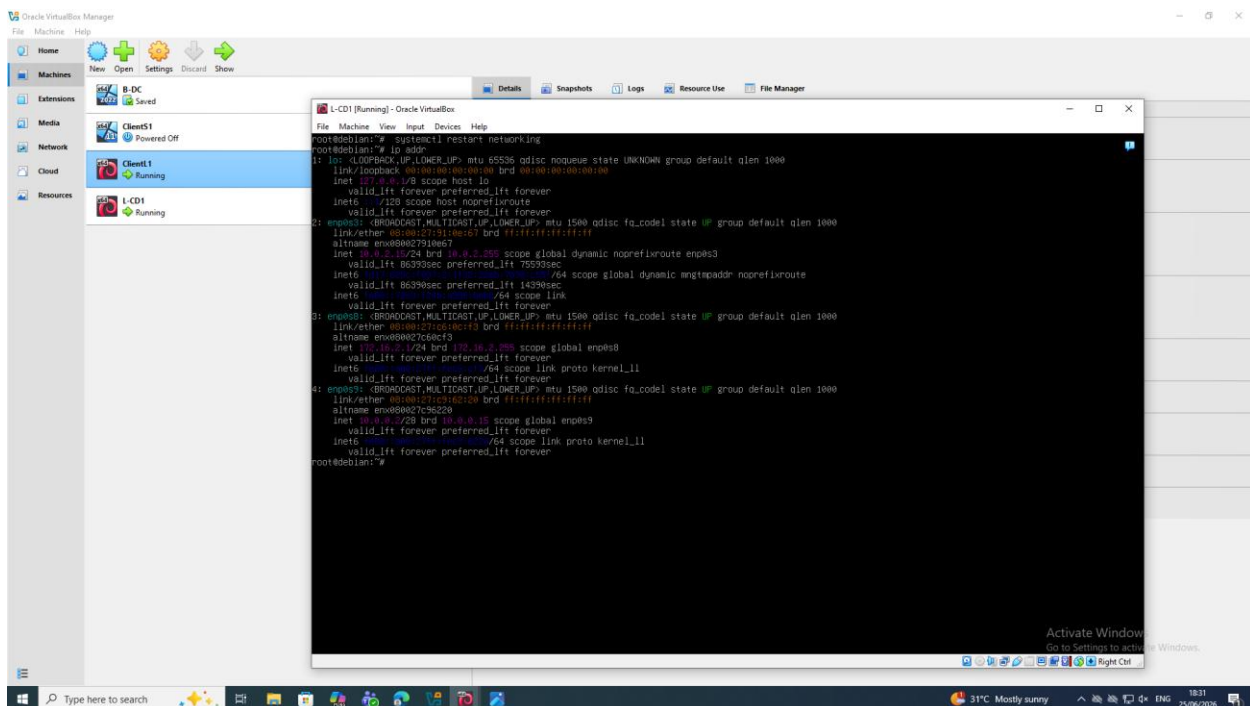


Figure 21. ip addr command

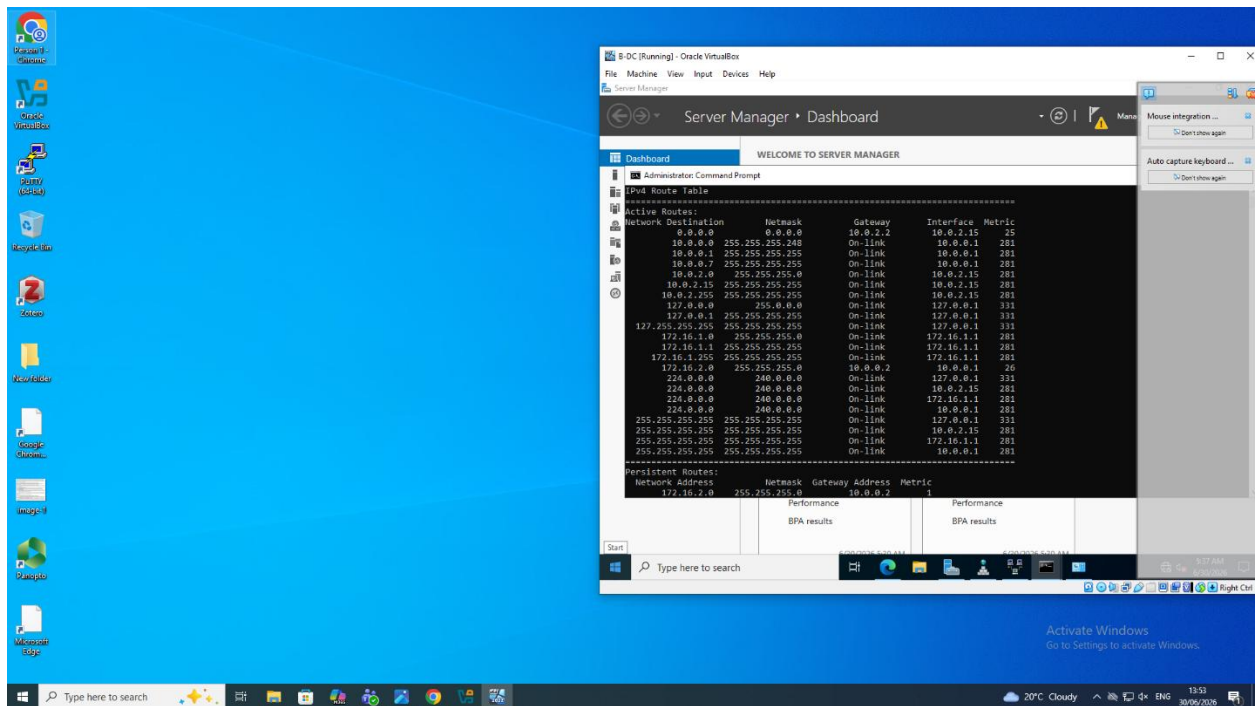
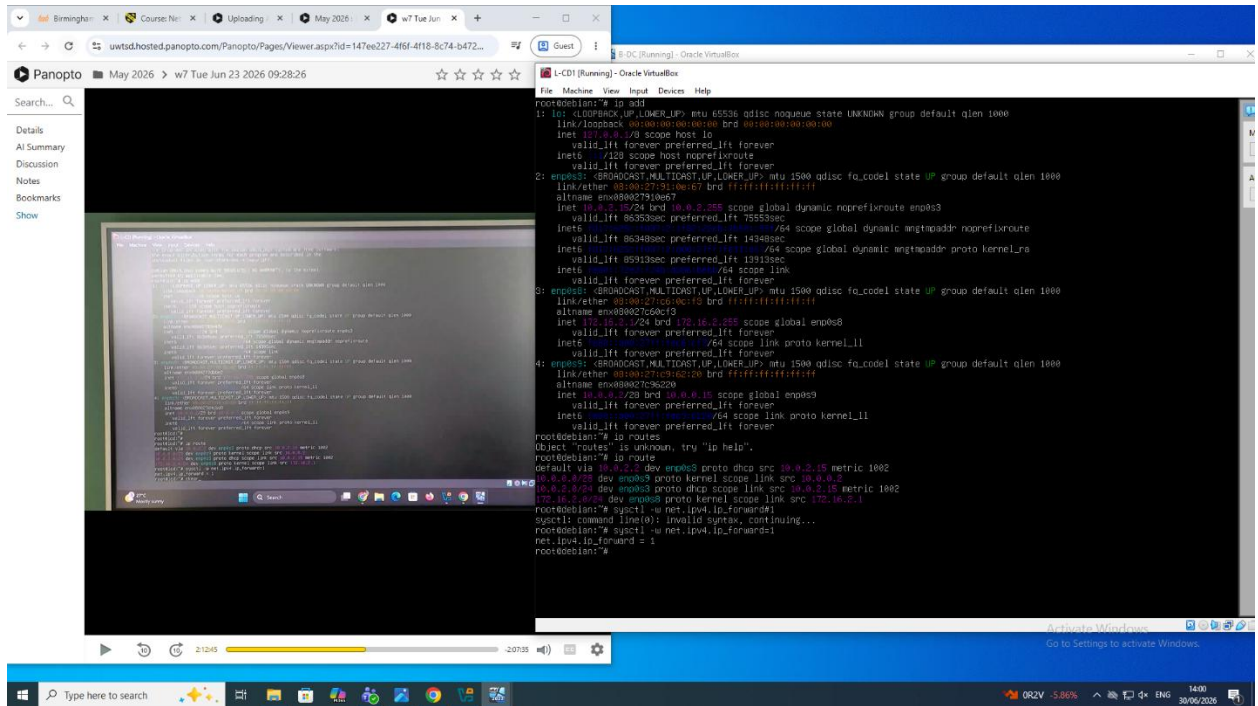
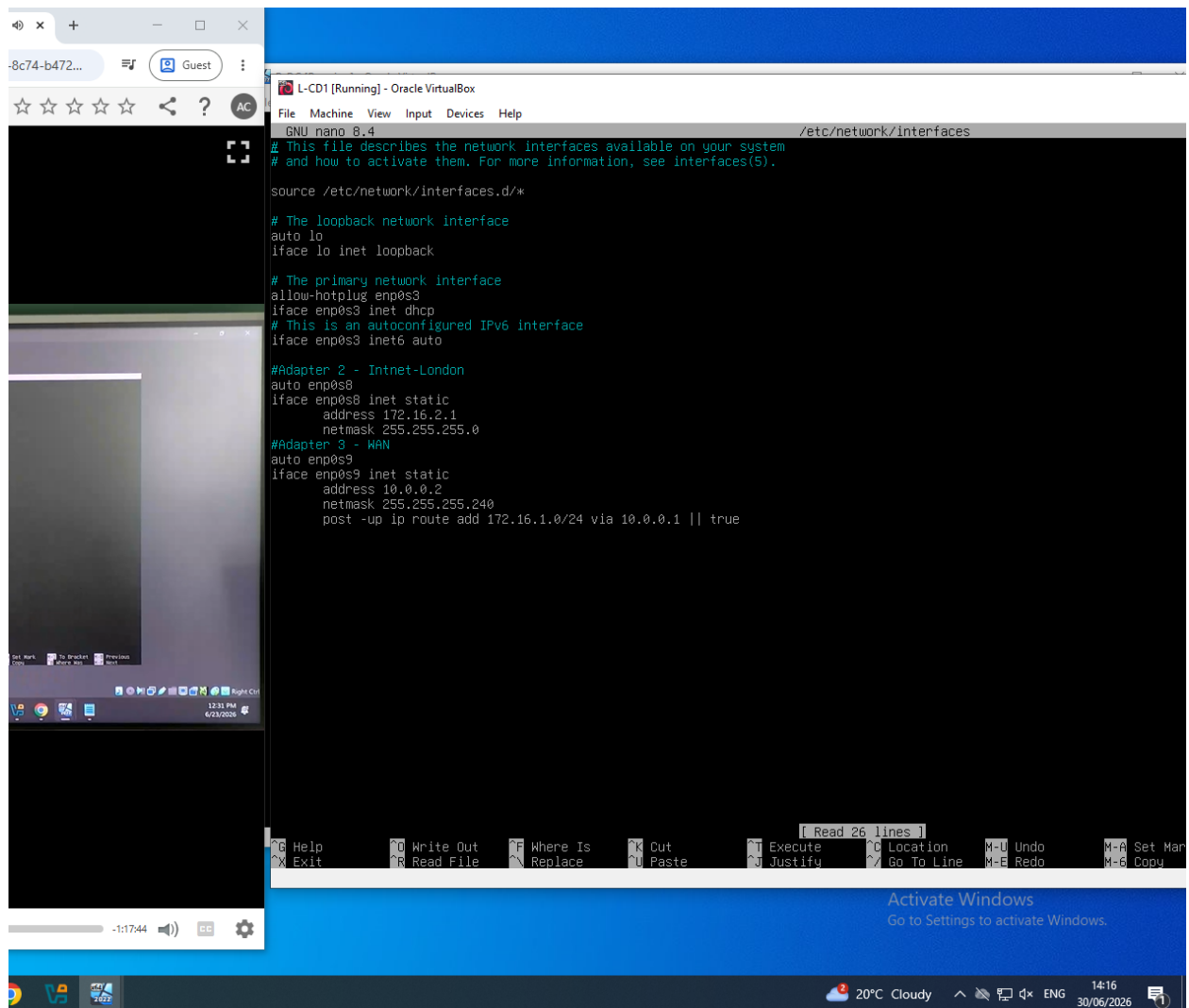


Figure 22. Windows route table ipv4





2.3.1 Device configuration

Windows Server, Windows Client, Debian Server and Debian Client were assigned the appropriate IP address, subnet mask and default gateway, while hostnames were configured to match the proposed topology. Configuration was verified using `ipconfig` on Windows systems and `ip addr` on Debian systems to confirm that the assigned network parameters were correctly applied before connectivity testing.

Static IP addressing was configured on each virtual machine according to the addressing scheme shown in pictures above shown in table using command `iptables` [6], [9].

2.4 Testing and troubleshooting

2.4.1 Successful connectivity tests

Connectivity testing was performed using the `ping` command to verify communication between devices within the same network segment. Successful responses confirmed that the configured IP addresses, subnet masks and default gateways were correctly applied and that the virtual network adapters operated as expected. These tests verified that the Windows and Debian hosts could communicate reliably with devices located on the same subnet, demonstrating that the network configuration had been implemented successfully [6].

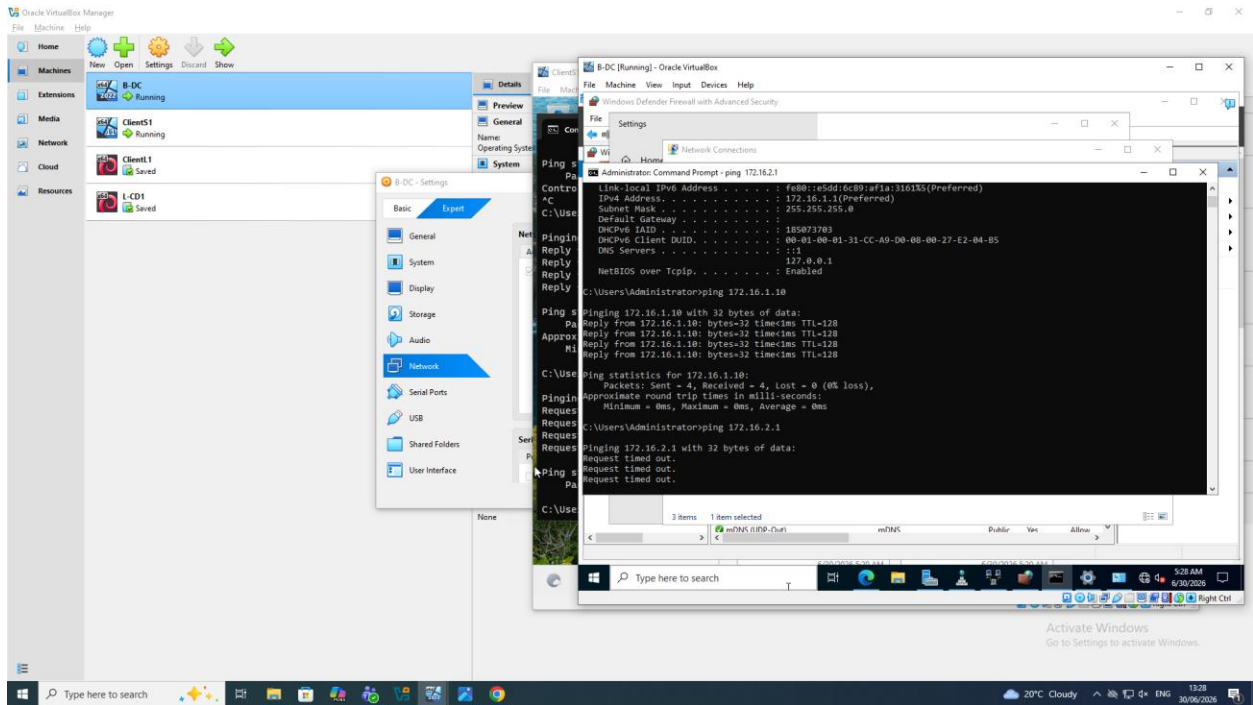


Figure 24. Windows ping

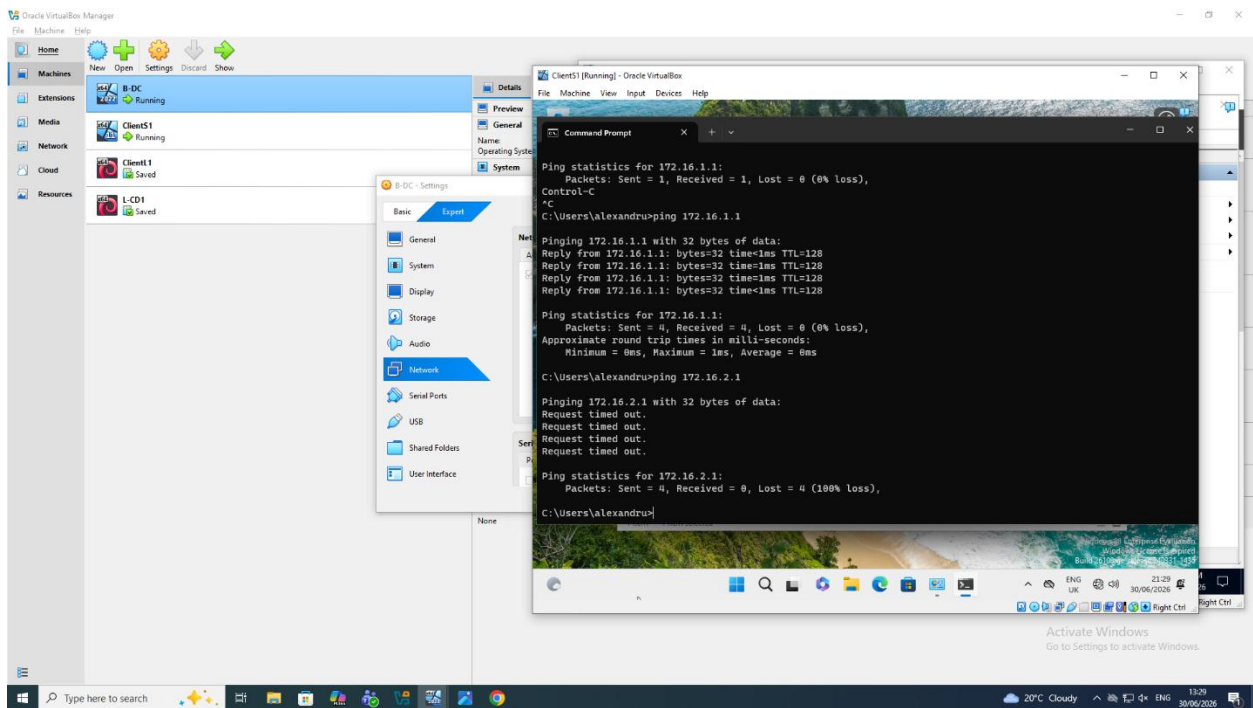


Figure 25. Client S1 Ping

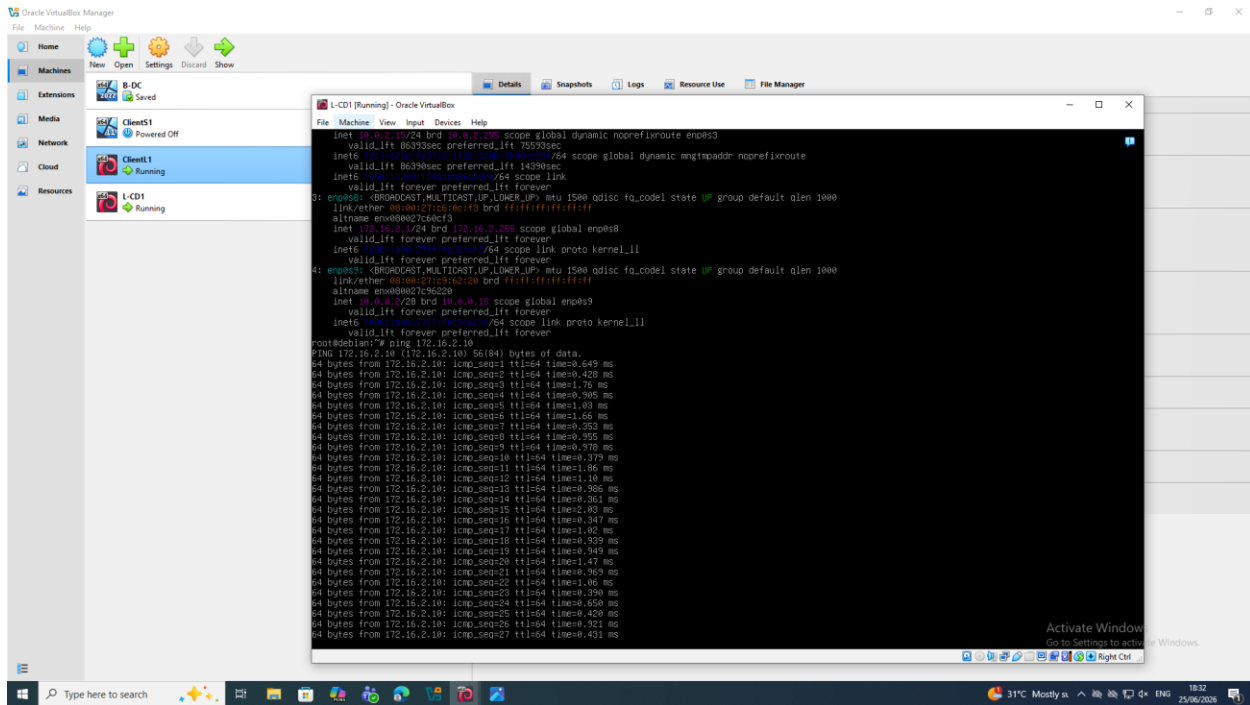


Figure 26. Debian ping

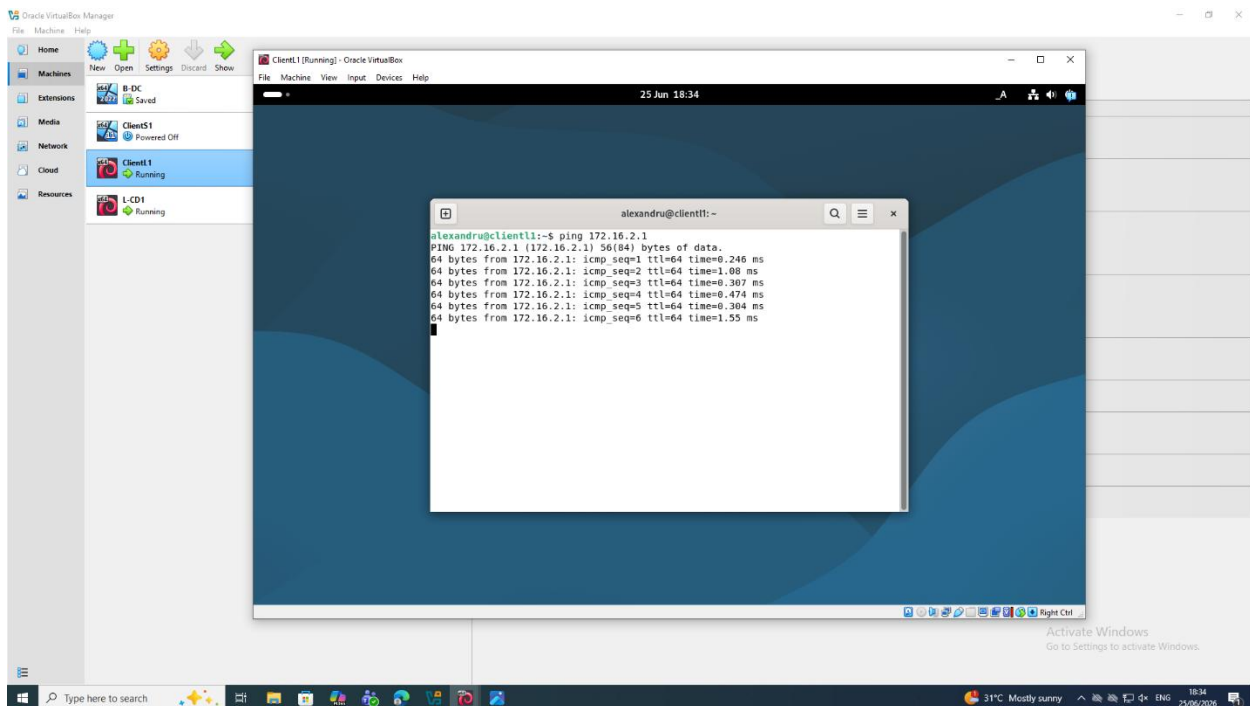


Figure 27. Client L1 ping

2.4.2 Failed connectivity tests

Connectivity tests were also performed between devices located on different network segments. As expected, these ping requests were unsuccessful because route between the Birmingham and London networks had not yet been configured. This outcome confirms that the network segmentation was operating correctly.

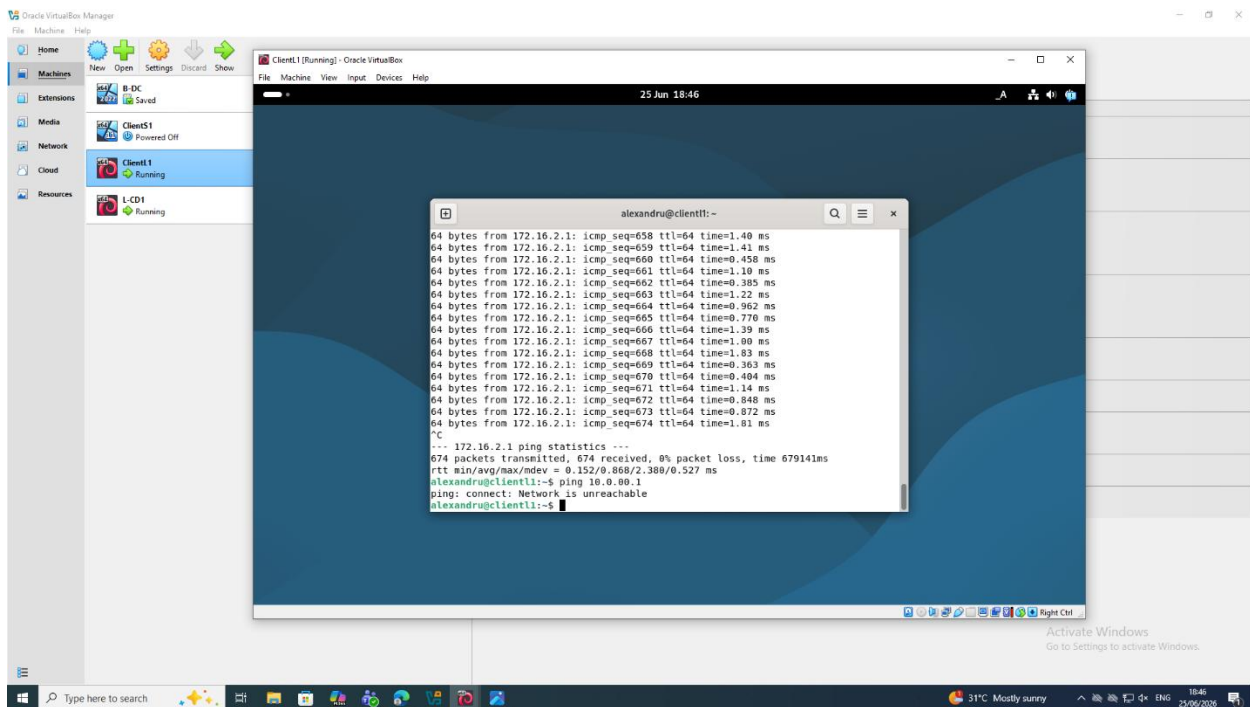


Figure 28. Client L1 failed ping

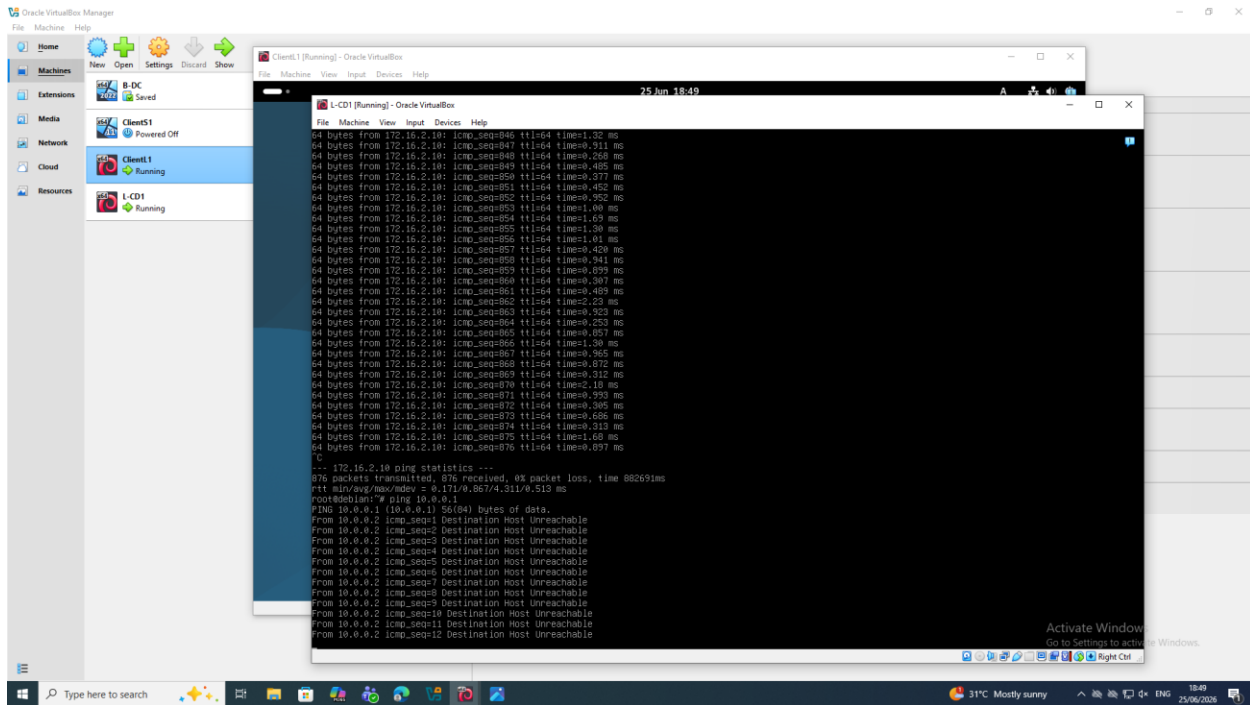


Figure 29. Debian failed ping

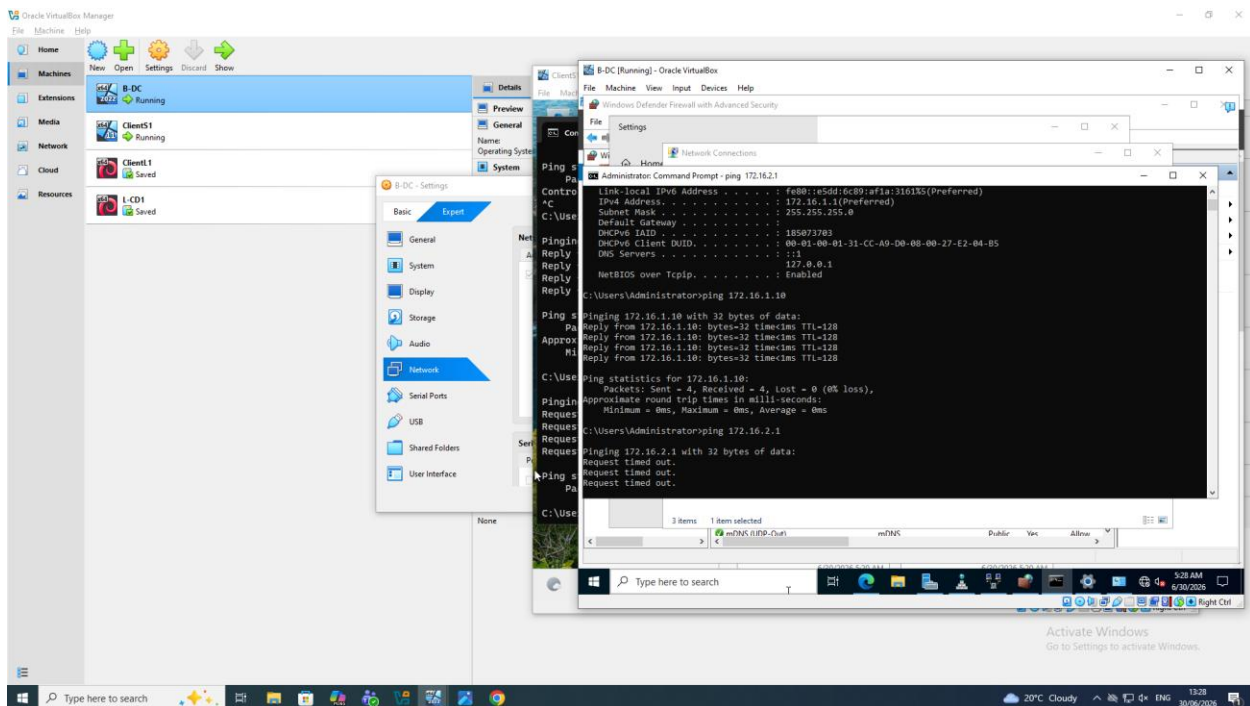


Figure 30. Windows failed ping

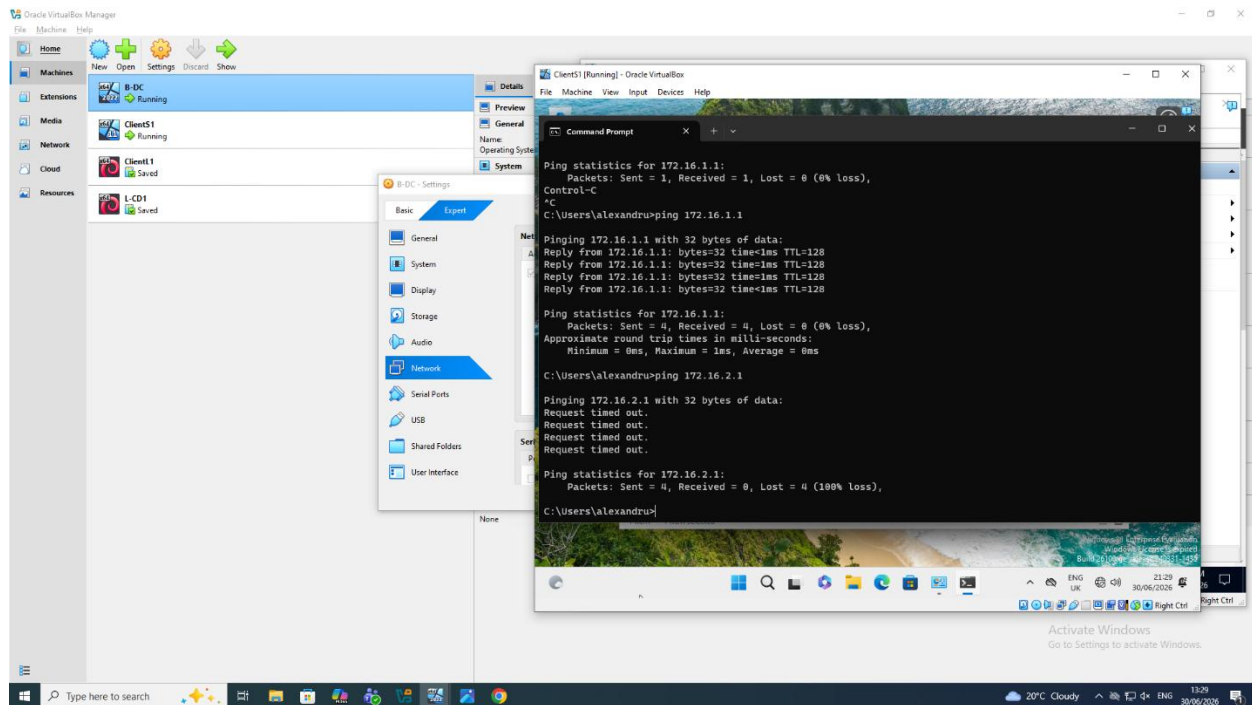


Figure 31. Client S1 failed ping

3. Reflection

3.1 Technical reflection

Deploying the virtual infrastructure improved my troubleshooting skills. Configuration issues were resolved by reviewing virtual machine settings, verifying IP configurations and testing connectivity. Recreating the Debian virtual machine reinforced the importance of careful configuration and systematic validation.

3.1.2 Personal reflection

This coursework improved my practical skills in virtualisation and enterprise networking. It highlighted the importance of planning, documentation and verification, increasing my confidence in implementing more advanced network services in Coursework 2.

L-CD and L-CD1 refer to the same Debian Server. The virtual machine was recreated after configuration issues, and L-CD1 was used for the remainder of the implementation and Coursework 2.

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