

Higher Nationals - Summative Assignment Feedback Form

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Unit Title	Unit 02: Networking		
Assignment Number	1	Assessor	Mr. Lahiru
Submission Date	17/08/2025	Date Received 1st submission	16/08/2025
Re-submission Date		Date Received 2nd submission	

Assessor Feedback

Grade:

Assessor Signature:

Date:

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- Please note resubmission feedback is focussed only on the resubmitted work

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Student name: Fathima Sameeha Rimzan		Assessor name: Mr. Lahiru
Issue date: 11/05/2025	Submission date: 17/08/2025	Submitted on:16/08/2025
Programme: Pearson BTEC HND in computing		
Unit: Unit-02 Networking		
LAN Design & Implementation for Redco Development.		

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Student declaration

I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.

Student signature: Sameeharimzan7722@gmail.com

Date:17/08/2025

Unit 2 – Networking Assignment Brief

Student Name/ID Number	Fathima Sameeha Rimzan E244970
Unit Number and Title	Unit 2 – Networking
Academic Year	2024/2025
Unit Tutor	Mr. Lahiru
Assignment Title	LAN Design & Implementation for Redco Developments.
Issue Date	11/05/2025
Submission Date	17/08/2025

Submission Format

The assignment submission is in the form of the following.

Presentation - A formal 10–15-minutes presentation (8-10 slides as a guide, with supporting speaker notes) to communicate an investigation to a non-technical audience discussing the key features and characteristics of a range of network types, topologies, hardware, and software that you have been used for the new network implementation. This should demonstrate your network blueprint and the packet tracer simulation.

A Written report- The submission should be in the form of an individual report written in a concise, formal business style using single spacing and font size 12. You are required to make use of headings, paragraphs, and subsections as appropriate, and all work must be supported with research and

referenced using Harvard referencing system. Please also provide an end list of references using the Harvard referencing system.

The recommended word count is 3,000–3,500 words for the report excluding annexures, although you will not be penalised for exceeding the total word limit.

Note: Please Don't add any ZIP files to the ELMS it should be a PDF document with relevant could links to the packet tracer files.

Unit Learning Outcomes

LO1. Examine networking principles and their protocols.

LO2. Explain networking devices and operations.

LO3. Design efficient networked systems.

LO4. Implement diagnose and demonstrate prepared networked systems.

Transferable skills and competencies developed

- Computational thinking (including its relevance to everyday life)
- Demonstrate knowledge and understanding of essential facts, concepts, principles, and theories relating to computing and computer applications.
- Use such knowledge and understanding in the modelling and design of computer-based systems for the purposes of comprehension, communication, prediction, and the understanding of trade-offs.
- Recognize and analyze criteria and specifications appropriate to specific problems, and plan strategies for their solutions.
- Critical evaluation and testing: analyze the extent to which a computer-based system meets the criteria defined for its current use and future development.
- Methods and tools: deploy appropriate theory, practices and tools for the design, implementation, and evaluation of computer-based systems.

Computing-related practical skills:

- The ability to specify, design and construct reliable, secure, and usable computer-based systems.
- The ability to evaluate systems in terms of quality attributes and possible trade-offs presented within the given problem.
- The ability to deploy effectively the tools used for the construction and documentation of computer applications, with particular emphasis on understanding the whole process involved in the effective deployment of computers to solve practical problems.
- The ability to critically evaluate and analyze complex problems, including those with incomplete information, and devise appropriate solutions, within the constraints of a budget.

Generic skills for employability

- Intellectual skills: critical thinking; making a case; numeracy and literacy.
- Self-management: self-awareness and reflection; goal setting and action planning.
- Independence and adaptability; acting on initiative; innovation and creativity.
- Interaction: reflection and communication.
- Contextual awareness, e.g. the ability to understand and meet the needs of individuals, business, and the community, and to understand how workplaces and organisations are governed.

OBSERVATION RECORD

Learner name:			
Qualification:			
Unit number & title:			
Description of activity undertaken			
Assessment criteria			
How the activity meets the requirements of the assessment criteria			
Learner name:			
Learner signature:		Date:	
Assessor name:			
Assessor signature: Sameena Riazan	E244970	Networking	Date: Assignment no.1

WITNESS STATEMENT

Learner name:			
Qualification:			
Unit number & title:			
Description of activity undertaken (please be as specific as possible)			
Assessment criteria (for which the activity provides evidence)			
How the activity meets the requirements of the assessment criteria, including how and where the activity took place			
Witness name:	Job role:		
Witness signature:		Date:	
Learner name:			
Learner signature:		Date:	
Assessor name:			
Assessor signature:		Date:	

Assignment Brief and Guidance:	
	<p>Redco Developments is a Sri Lankan based Mobile app development company, which the head office is in Kandy. The company develops mobile applications for Sri Lanaka's leading organizations for both mobile platforms IOS and Android.</p> <p>The CEO plans to expand the company operations of Redco development in Southern province in Sri Lanka. The management has decided to open a new branch office in Galle and wants it to be one of the most prominent tech-oriented offices in Galle with the latest tech facilities including smart devices such as auto lighting, physical security solutions, smart gates and new ERP software IP camera Systems.</p> <p>You have been appointed as the Junior implementation Engineer of Redco and your task is to design a new network for the Galle branch and restructure the existing Kandy network that connects both networks.</p> <p>Prepare a network architectural design and implement it with your suggestions and recommendations to meet the company requirements.</p> <p>The floor plan of the head office in Kandy is as follows:</p> <p>Floor 1:</p> <ul style="list-style-type: none">• Reception area (2 employees)• Sales & Marketing Department (10 employees)• Customer Services Area – with Wi-Fi facilities• Developers (25 employees) <p>Floor 2:</p> <ul style="list-style-type: none">• Director suits (3 suits)

- Boardroom with Video conferencing facility and Wi-Fi.
- Administration Department (15 Employees)
- HR Department (4 employees)

Floor 3:

- Accounting & Finance Department (12 employees)
- IT Technical support (4 employees)
- The Server Room

The newly established floor plan of the Galle is as follows:

Floor 1:

- Reception area (2 employees)
- Customer Services Area– with Wi-Fi facilities
- Developers (40 employees)
- 5 IP cameras

Floor 2:

- Administration Department (10 Employees)
- HR Department (5 employees)
- Accounting & Finance Department (12 employees)
- IT Department (5 employees)
- The Server Room
- 6 IP cameras

The following requirements are given by the Management.

- All the departments **must be separated with unique subnets.**
- **The conference room of the head office and Customer Services Areas of each**

branch are to be **equipped with Wi-Fi connections with the security enabled.**

- **Connectivity between two branches** (Kandy & Galle) which would allow intra-branch connectivity between departments. (Use Inter VLAN routing RIP or any routing protocol- evidence must be provided)
- **IP range for 200.100.10.0/24** for Kandy and **200.100.20.0/24** for Galle branch and subnetting calculations must be provided within the report **except the server room.**
- **All the PC must retrieve IP from the DHCP server.**
- **The number of servers required for the Server room** needs to be decided by the Network designer and should be assigned with **200.100.50.0/24** subnet. (Uses **static IPs**)
- **The Sales and Marketing Team** also needs to access Network resources **using WIFI connectivity.**

(Note: Clearly state your assumptions. You are allowed to design the network according to your assumptions, but the main requirements should not be violated)

Activity 01

- Discuss the benefits and constraints of different network system types that can be implemented in the Galle branch as well as for the restructuring process what type of network recommended for the Galle and Kandy offices.
- Discuss the different protocols utilized for communication and the connectivity of the 2 offices which can be implemented in the Galle branch and the How the OSI and TCP model influencing in designing network for Galle office.
- Discuss the importance and impact of network topologies that are used in

network design using examples.

- Recommend suitable network topologies and network protocols for the above scenario and evaluate your answer with valid points.

Activity 02

- Discuss the operating principles of network devices (Ex: Router, Switch, Etc.).
- Explain different server types that can be used for the above scenario while exploring different servers that are available in today's market with their specifications. You should recommend a server/server for the above scenario and justify your selection with valid points.
- Discuss the inter-dependence of workstation hardware and networking software, networking operating systems you use based on the scenario. Provide examples for networking software that can be used in the above network design.

Activity 03

- Prepare a written network design plan to meet the above-mentioned user requirements including a blueprint drawn using a modeling tool (Ex: Microsoft Visio, EdrawMax). Test and evaluate the proposed design by analysing user feedback with the aim of optimizing your design and improving efficiency.
- Support your answer by providing the VLAN and IP subnetting scheme for the above scenario and the list of devices, network components and software used to design the network for the above scenario and while justifying your selections.
- Install and configure Network services, devices and applications
Ex: VLAN, WiFi, DNS, Proxy, Web, Etc

According to the proposed design to accomplish the user requirements. Design a detailed Maintenance schedule for the above Network.

***Note:** - Screen shots of Configuration scripts should be presented in your document. Your packet tracer file must be submitted to the cloud drive and share the link in the appendix of document for the assessor verification purposes.

Don't add any ZIP files to the ELMS it should be a PDF document with relevant could links to the packet tracer files

Activity 04

- Implement a networked system based on your prepared design with valid evidence.
- Develop test cases and conduct verification (Ex: Ping, extended ping, trace route, telnet, SSH, etc.) to test the above Network and analyse the test results against the expected results.
- Recommend potential future enhancements for the networked system with valid justifications and critically reflect on the implemented network, including the plan, design, configurations, tests, and the decisions made to enhance the system.

Activity 05 – Presentation

- Prepare and present 10-15 minutes presentation which includes the design (Network type, topologies, devices, and software you used for the implementation. You need to justify your design with the valid reasons.
- The presentation should include,
 - Blueprint of the design
 - Packet tracer demonstration

- Testing interface pinging's
- Trace routes

Note: Add your presentation slides in the appendix of the report.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine networking principles and their protocols		LO1 and LO2
P1 Discuss the benefits and constraints of different network types and standards. P2 Explain the impact network topologies have on communication and bandwidth requirements.	M1 Assess common networking principles and how protocols enable the effectiveness of networked systems.	D1 Evaluate the topology and protocol suite selected for a given scenario and how it demonstrates the efficient utilisation of a networking system.
LO2 Explain networking devices and operations		
P3 Discuss the operating principles of networking devices and server types. P4 Discuss the interdependence of workstation hardware and relevant networking software.	M2 Explore a range of server types and justify the selection of a server for a given scenario, regarding cost and performance optimisation.	
LO3 Design efficient networked systems		LO3 and LO4
P5 Design a networked system to meet a given specification. P6 Design a maintenance schedule to support the networked system.	M3 Analyse user feedback on your designs with the aim of optimising your design and improving efficiency.	D2 Critically reflect on the implemented network, including the design and decisions made to enhance the system.
LO4 Implement and diagnose networked systems		
P7 Implement a networked system based on a prepared design. P8 Document and analyse test results against expected results.	M4 Recommend potential enhancements for the networked systems.	

Recommended resources

Please note that the resources listed are examples for you to use as a starting point in your research – the list is not definitive.

Weblinks:

- <https://blog.netwrix.com/> (2022) Network Devices Explained [online] Available at:
<https://blog.netwrix.com/2019/01/08/network-devices-explained/> [Accessed 1 August 2022]
<https://www.checkpoint.com/> (n.d.) What is a Firewall? [online] Available at:
<https://www.checkpoint.com/cyber-hub/network-security/what-is-firewall/> [Accessed 1 August 2022]
- <https://www.checkpoint.com/> (n.d.) What is an IoT Gateway? [online] Available at:
<https://www.checkpoint.com/cyber-hub/network-security/what-is-iot/what-is-an-iot-gateway/> [Accessed 1 August 2022]
- <https://www.cloudflare.com/en-gb/> (n.d.) A global network built for the cloud [online] Available at: <https://www.cloudflare.com/en-gb/learning/network-layer/internet-protocol/> [Accessed 1 August 2022]
- <https://www.comparitech.com/> (2020) Variable Length Subnet Mask (VLSM) Tutorial [online] Available at: <https://www.comparitech.com/net-admin/variable-length-subnet-mask-vlsm-tutorial/> [Accessed 1 August 2022]
- <https://www.comptia.org/> (n.d.) What Is a Network Protocol, and How Does It Work? [online] Available at: <https://www.comptia.org/content/guides/what-is-a-network-protocol> [Accessed 1 August 2022]
- <https://www.ibm.com/uk-en> (2021) Networking [online] Available at:
<https://www.ibm.com/uk-en/cloud/learn/networking-a-complete-guide> [Accessed 1 August 2022]
- <https://www.ibm.com/uk-en> (2022) TCP/IP protocols [online] Available at:
<https://www.ibm.com/docs/en/aix/7.2?topic=protocol-tcip-protocols> [Accessed 1 August 2022]
- <https://www.lifewire.com/> (2022) What Is Bandwidth? Definition, Meaning, and Details [online] Available at: <https://www.lifewire.com/what-is-bandwidth-2625809> [Accessed 1 August 2022]
- <https://www.ncsc.gov.uk/> (2019) Secure design principles [online] Available at:
<https://www.ncsc.gov.uk/collection/cyber-security-design-principles> [Accessed 1 August 2022]
- <https://www.serverwatch.com/> (2021) Network Server [online] Available at:
<https://www.serverwatch.com/servers/network-server/> [Accessed 1 August 2022]
- <https://www.techtarget.com/> (2022) IoT gateway [online] Available at:
<https://www.techtarget.com/iotagenda/definition/IoT-gateway> [Accessed 1 August 2022]

- <https://www.univention.com/> (2022) Brief Introduction: DHCP and DNS [online] Available at: <https://www.univention.com/blog-en/brief-introduction/2019/03/brief-introduction-dhcp-dns/> [Accessed 1 August 2022]

Virtual Network Simulators:

- <https://www.adobe.com/> (n.d.) DNS/DHCP/EMAIL VIA PACKET TRACER [online] Available at: <https://express.adobe.com/page/7ogipygZfOh0B/> [Accessed 1 August 2022]
- <https://techgenix.com/> (2019) Tips and tools for simulating a complex network in a virtual lab [online] Available at: <https://techgenix.com/simulating-network-in-virtual-lab/> [Accessed 1 August 2022]
- <https://www.eve-ng.net/> (2022) EVE - The Emulated Virtual Environment For Network, Security and DevOps Professionals [online] Available at: <https://www.eve-ng.net/> [Accessed 1 August 2022]
- <https://www.gns3.com/> (2022) The software that empowers network professionals [online] Available at: <https://www.gns3.com/> [Accessed 1 August 2022] <https://www.netacad.com/> (n.d.) Cisco Packet Tracer [online] Available at: <https://www.netacad.com/courses/packet-tracer> [Accessed 1 August 2022]

Journal articles.

- Agyemang, J., Kponyo, J. and Klogo, G., 2022. The State of Wireless Routers as Gateways for Internet of Things (IoT) Devices. [online] Pubs.sciepub.com. Available at: [Accessed 1 August 2022].
- Oje, A. (2021) Optimization and analysis of the packet switched network with focus on the 3G network. Journal of Physics: Conference Series, Volume 1734, International Conference on Recent Trends in Applied Research doi:10.1088/1742-6596/1734/1/012037 Available at: <https://iopscience.iop.org/article/10.1088/1742-6596/1734/1/012037/meta> [Accessed 1 August 2022].
- Tyagi, A. (2020) TCP/IP Protocol Suite. International Journal of Scientific Research in Computer Science Engineering and Information Technology doi:10.32628/CSEIT206420 Available at: https://www.researchgate.net/publication/346829282_TCPIP_Protocol_Suite [Accessed 1 August 2022].
- Van der Toorn et al. (2022) Addressing the challenges of modern DNS a comprehensive tutorial. Computer Science Review, Volume 45, 2022, 100469, <https://doi.org/10.1016/j.cosrev.2022.100469>
- Xu, G. (2021) Research on the Application of the IPv6 Network Protocol. Journal of Physics: Conference Series doi:10.1088/1742-6596/2031/1/012040 Available at:

<https://iopscience.iop.org/article/10.1088/1742-6596/2031/1/012040/pdf> [Accessed 1 August 2022].

- Bonaventure, O. (2011) Computer Networking: Principles, Protocols and Practice, The Saylor Foundation, Available at: <https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2012/02/Computer-Networking-Principles-Bonaventure-1-30-31-OTC1.pdf>

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Also a big thank you to my friends and classmates who were always there to help, share ideas, and motivate me. Working together and learning from each other made this experience a lot more enjoyable I truly appreciate everyone who played a part in helping me complete this assignment. Thank you all for being a part of this journey as well.

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Introduction

Redco Developments is an emerging and growing Sri Lankan mobile application development company and has its head office in Kandy, Sri Lanka and Redco Developments has recently approved the opening of a new branch in Galle and upon completion of its plan to develop this office into a more like a modern and tech orientated one for the Southern Province and hopes to keep expanding more and the main goal of this network design is to build a stable, fast, and scalable network that can connect to the Galle and Kandy offices together to allow for better and effective communication.

As the appointed Junior Implementation Engineer, I have been assigned and tasked to create a new network for the Galle Branch and reorganize the current network in the head office based in Kandy as well.

This report includes Wifi setup, device configuration, VLAN segmentation, blueprint of the network diagram, network implementation, maintenance schedule, inter branch communication and set up using RIP and IP cameras in Galle Branch and also recommends the most suitable network topology, server type, protocol and potential future enhancements for the networked systems. The following solution ensures a good secure performance and manageability across both locations in Kandy and Galle meeting all the future requirements of Redco and helping it grow successfully as well.

Activity 01

Discuss the benefits and constraints of different network types and standards

1.Explain what is a computer network and Advantages of Computer Network.

1.1 Explanation of a computer network

A computer network is a system where multiple computers and other digital devices are connected to share information and resources and these devices are connected using communication media like cables, optical fiber or wireless systems including Wi-Fi. The main purpose of a computer network is to allow data to be exchanged through sharing of information such as files, applications, and hardware devices like printers, or storage devices (TechTarget, 2024).

In a computer network, each device also called a node can send and receive data to/from other devices and Computer networks are essential to allow users to communicate with one another, work together collaboratively, access the internet, and store data in a centralized system. Moreover, Communication in a computer network needs consistency and can be governed by a protocol ensuring that data can be reliably communicated through available communication media thus, computer networks form the basis of our modern communication and information systems.

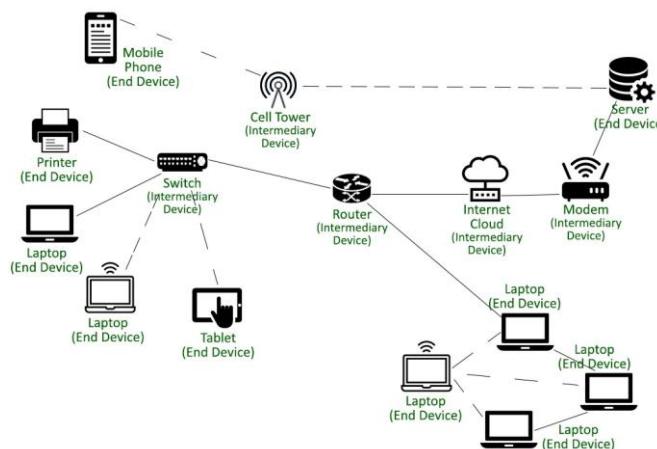


Figure 1: End devices in a network (GeeksforGeeks, n.d.).

1.2 Advantages of a computer network

Computer networks have provided greater efficiencies and benefits in our digital lives through connectivity, communication, and data exchange in real-time and anywhere around in the world. Also have provided us with more capability to share resources and data more than anything else and Computer networks have made it possible for everyone in a home and organization of any size to interact with not just their computer but with multiple computers as well

Mostly we use computer networks to provide access to shared hardware for example like printers, storage drives and shared software applications. Sharing multiple devices reduces the costs, improving productivity and Computer networks may use servers or cloud storage to provide a centralized approach to store and manage data as a centralized management can lead to efficiencies within a company, less complicated processes for backup of data and depending on the circumstances, more management control which is a less complicated form of management control.

Computer networks make it easier for the people to communicate and work together using tools like email, chat apps, video calls, and online programs. These tools let people connect and work in real time even if they are in different places of Srilanka and even out of Galle and Kandy area. This is especially useful for Redco developments as the redco teams can work together and Computer Networks also give people access to lots of information on the internet which helps them learn new things and stay updated with the latest technology also people can shop online from anywhere around the world, transfer money easily due to updated banking services, use social media to sell items and even can stream music and movies with computer networks (McKinsey & Company, 2007).

Also, other advantages of computer networks include flexibility, which allows employees to work from home easily. This means Redco can hire workers from any country giving the organizations a wider range of employees to choose from and helping them to compare and find the most suitable employee for the job and boost productivity easily.

Moreover, Redco can use centralized network administrators to send users security updates and ensure all users follow the same rules and be updated with software versions as well. This means Redco will be able to save time and there will be fewer errors in the system. And it can use firewalls to protect users' data from unauthorized access and protect sensitive information from hackers and so on.

2.Discuss the benefits and constraints of different network system types that can be implemented (LAN,MAN,WAN...)

2.1 LAN (Local Area Network):

A local area network or LAN is a network that connects devices in a smaller geographical area. LANs provide low latency speeds which means the data can be easily transferred to devices without significant delays. Additionally, because these network types are smaller they are very easy to set up and manage making them perfect for small local businesses. For example LAN can be used in a building, office, or school (Cisco, 2023).

Benefits of LAN for Redco Developments:

1. High-speed data transfer, like stated above LAN can transfer data easily as the network alone is small. Therefore the data can be transferred quickly without delays which means low latency speed as the time taken to transfer data is low. In the case study, the Kandy and Galle branches can benefit from high-speed data transfer between departments as the transfer time is low.
2. Supports file sharing and resource access, for example, Redco Developments, can share printers among workers, which means lower costs for organizations as they do not have to purchase individual printers for each workstation (Tanenbaum, 2011).
3. Inexpensive setup, the cost of setting up this network is relatively low when compared to other networks. For Redco Developments, setting up a LAN within the Kandy and Galle offices would be cost-effective, since LANs cover small area, less cabling is needed and shorter wires.

4. For Redco Developments maintaining LAN between Kandy and Galle would be inexpensive, since all the devices are close to each other like in a room or building it's easier and faster to fix problems and issues. Also, most of the parts like cables and switches are affordable and easy to replace if something breaks as they can be operated without a lot of costly equipment.

Constraints of LAN for Redco Developments:

1. Limited coverage, Redco Developments has offices in two different cities, which are Kandy and Galle, a LAN network can only connect devices in a much smaller space, like a building and offices. Therefore, using LAN to connect two different cities will not be possible, and for Redco Developments a LAN will not be a suitable solution (Computer How To Guide, 2023).
2. Security threats, Redco Developments has departments like HR, Finance, and IT operating in both Kandy and Galle this means the organization hold lots of sensitive information and there can be multiple users on the same network which means there is a high risk and threat of unauthorized access to information or data.
3. Network congestion, when many devices are connected at the same time for example, Redco Developments has a large team with 40 developers in Galle and 25 in Kandy, when transferring large amount of data at the same time the network can become overloaded and congested, which means this can slow the data transfer speed.

2.2 MAN (Metropolitan Area Network):

A Metropolitan Area Network (MAN) is a computer network that connects several Local Area Networks (LANs) in a single city or city-sized campus (Kurose and Ross, 2020) A MAN is smaller than a Wide Area Network (WAN) but larger than a local area network as Redco Developments has several departments and floors in the Galle and Kandy office the organization can use a MAN for

connecting networks within each city to enable employees to exchange information and resources easily.

Benefits of MAN for Redco Developments:

1. Wide coverage, this network is designed to cover larger geographical areas, such as an entire city. This allows Redco Developments with branches across cities such as Kandy and Galle to be connected under one network. Therefore, workers can be connected and this can improve coordination in the organization as well (Cisco, 2023).
2. High-speed connectivity, this network is relatively larger than LAN which means this requires high-speed technologies like fiber optics, thus providing faster data transfer rates than WANs and is very useful for the IT departments and developers in Redco Developments who rely on fast network to exchange projects in between Kandy and Galle.
3. Centralized data management, this means that workers on the network can store, share, and maintain all their important data and files in one main location, for example, at Redco Developments employees at Kandy and Galle branches can store and access important files like finance documents and keep everything organized as they hold individuals' sensitive information (Glue Up, 2024).

Constraints of MAN for Redco Developments:

1. High setup cost, since these networks have to cover a large area the cost of cables like fiber optics, other specialized equipment and setting up the infrastructure may be high for Redco, connecting both Kandy head office and Galle branch will cost a lot of investment and network equipments and this can increase its expenses without allowing it to grow.

2. Complex maintenance, maintaining MAN is technically challenging because it requires skilled IT professionals to handle maintenance incase something goes wrong it can be very hard to fix and may face challenges, maintaining the network across Kandy and Galle (Tanenbaum, 2011).

3. Security risks, the organization and network involve more users which means the chance of data leak and misuse can be high. Also, there is a high chance of unauthorized access as well, which can put clients' sensitive information to risk. Therefore, Redco can protect these information by using strong firewalls, encryption methods, and passwords are used in both Kandy and Galle offices.

2.3 WAN (Wide Area Network):

A WAN is a network that connects computers and devices in a large geographical area like different cities, countries, or even around the world. An example of the biggest WAN is the Internet. Although there is a physical distance between Redco Developments head office in Kandy and the new branch that is opening in Galle a WAN would enable both locations to be connected and allow employees to share and exchange data, and work together effectively (GeeksforGeeks, 2023)

Benefits of WAN for Redco Developments:

1. Wide area communication, a WAN is a large network which means that the employees from different locations such as Redco head office in Kandy and the new branch in Galle can share information and work, communicate, and collaborate efficiently even the distance of being in different parts of Sri Lanka.

2. WAN Supports remote work as employees can manage and access company files from home for example by using Google Drive, the employees at Redco Developments can update project files from different locations without needing to travel which saves time and increases overall productivity (GeeksforGeeks, 2021).

3. Centralized backup and recovery because the data can be stored and backed up in central servers for better safety as Redco deals with sensitive mobile app development data also this can help reducing the risk of data loss as well (GeeksforGeeks, 2021).
4. WAN connects locations spread across cities or countries although both branches are in different parts of Sri Lanka, the Kandy head office and the new branch in Galle can communicate and operate as one network of Redco

Constraints of WAN for Redco Developments:

1. High setup cost, WAN connects to long distances which means it needs expensive equipment like fiber optics, cables and so on to connect therefore setting up a WAN connection between Redco Developments's new branch in Galle and its head office in Kandy could be a heavy investment for the organization.
2. Slower speeds, since data has to travel from Kandy to Galle it may take a long time to pass through many devices because of the distance which can affect the real-time development and communication and it can be much slower when compared to LAN or MAN (Stallings, 2017).
3. Difficult to troubleshoot, in case there are any issues in the network, finding it can be harder because the network spans in two different cities and covers so many locations and devices so Redco might need IT professionals to find the problem and troubleshoot, and that can increase the expenses of organization (Itential, 2025).

2.4 PAN (Personal Area Network):

A PAN is a small network that connects devices over a short distance for example, a developer at Redco might connect their smartphone to their laptop via Bluetooth to transfer files and data (Cloudflare, 2025).

Benefits of PAN for Redco Development:

1. Easy and quick to set up, the employees at Redco can easily connect their devices, like laptops, smartphones, and wireless earphones (Techopedia, 2024).
2. No cables needed as PAN is wireless for example, employees at Redco can easily connect their wireless earphones for conference calls without worrying about tangled wires or being restricted to a specific location within the office and they can move around while working which also enhances mobility and convenience.

Constraints of PAN for Redco Development:

1. Very short range as it usually works only within a few meters Redco Developments would only work effectively within a small area such as within an individual's workspace or a limited section of the office and can limit functionality within Redco's larger office network needs (Kizza, 2017).
2. Low data transfer speed, since PAN is designed for small, personal connections it is not ideal and suitable for sending and sharing large files over a big network like Redco
3. PANs can usually connect only a limited number of devices which means not all employees working can try to connect their devices via PAN for communication or data sharing as the network can become overcrowded and inefficient (Kizza, 2017).

3. Discuss the type of networks recommended for Redco.(Recommend for the Galle and Kandy offices.)

3.1 Recommended Network Type for Galle Office

A Local Area Network (LAN) connects devices in a small geographical area (Cisco, 2023).

For Redco's Galle branch which operates entirely within one building a LAN is the best option which also enables high-speed data transfer between both floors, data sharing, and connectivity.

The Galle branch has departments such as Reception, Developers with 40 staff, HR, IT, Admin, and Finance, all located in just two floors and a LAN can connect all devices within this network making it ideal for Redco to set up and allows fast data sharing as well since the developers will have to share important project development files.

Since the newly opened Galle branch is a tech-oriented office it includes smart systems like IP cameras, auto lighting, smart gates for automatic exit and entry with a total of 11 cameras, 5 on Floor 1 and 6 on Floor 2, and ERP software. Therefore, all these systems should be maintained, controlled, and connected smoothly within the office so a LAN setup will fit this network type perfectly as it provides a secure, fast, and centralized communication for example, when using auto lighting, the lights will turn on and off automatically this will control the light settings for both floors in Galle based on sensors, room occupancy and staff presence which will provide energy-efficient lighting and save cost for the organization a fast and stable LAN ensures that lighting systems react quickly without any delay as it will quickly turn off when there is no one in the room.

A LAN allows employees to share and receive files instantly and this is very important for Redco's developers who often exchange codes, project development files and documents with other teams. Moreover, the developers can send and receive files within the network without relying on internet based application and cloud platforms this ensures faster and more secure communication between the organization.

Additionally, the Galle branch uses a mix of wired Ethernet and Wifi both of these are cost effective technologies. Since all the departments are located within the same branch Redco can reduce the cost of cabling and other network hardware and this helps the company to expand as the branch grows (Smith, 2023).

The Local Area Network (LAN) in the Galle branch can bring major security advantages because the LAN runs within the office building and all the data such as project files, camera footage, ERP, and smart devices logs are stored locally this reduces the need to rely on cloud services which can prevent cyberattacks and unauthorized access in the building since the data doesn't need to travel over the internet therefore the data remains safe and more private for Redco.

3.2 Recommended Network Type for Kandy Office

Redco's head office is located in the Kandy Branch and has three floors in the building which includes departments such as Sales and Marketing, Finance, IT Support, HR Department and the Server room. Also there are over 85 employees working on different floors and in different departments so a Local Area Network (LAN) is the effective and efficient network type for the Kandy branch as LAN enables fast communication and data sharing which is very important for a mobile app development company.

Also LANs also provide good security for the Kandy branch as it holds sensitive data like financial documents, software codes, and clients' information, LANs can reduce the threats of hackers and other unauthorized users trying to access their data as it is stored locally in their servers rather than using online services making LAN a reliable network type for the Kandy branch (Morgan, 2024).

Likewise the IT department and third floor server room can effectively manage and maintain the entire system of network, the performance and security as well. Furthermore, the IT Team can use a firewall

to enforce strong protection and encrypt the data and control the entire network from the server room ensuring daily monitoring, fast troubleshooting and updates (Stallings, 2020).

Also departments such as Developers, Sales, and Admin can often work together on mobile app development projects and client work and the Boardroom uses video conferencing and Wi-Fi which both provide a fast and secure LAN and with the number of high-bandwidth file transfers during video calls or meetings with clients or individual branches the LAN is very useful to provide a smooth connectivity for the Kandy branch.

In conclusion to that, both the offices located at Galle and Kandy at Redco Developments can operate efficiently using Local Area Networks (LAN) as each branch is within a single building therefore LAN is the best option for Redco Development as it perfectly fits the employees and their office plan creating an effective working environment. In order to enable communication and data sharing between the two geographically separated offices in two different cities, a secure Wide Area Network (WAN) such as a Virtual Private Network (VPN) can be used a VPN creates a secure, encrypted tunnel over the internet allowing users to access a private network remotely while protecting sensitive data (Kaspersky, 2024) this allows the two LANs to be connected as one ensuring smooth collaboration between departments in Kandy and Galle while obtaining the benefits of Local Area Network (LAN). Therefore by implementing LANs Redco can build a cost-effective and reliable network that supports the current needs.

3.3 IEEE Ethernet Standards for LAN and WLAN in Redco's Design

When developing the network architecture and structure for Redco Developments' Kandy and Galle branch offices it is very important to see the relevant IEEE Ethernet standards for the network to ensure performance, scalability, and compatibility.

The **IEEE 802.3** standard controls Ethernet technologies for wired Local Area Networks (LANs) for the office environment the appropriate standard is **IEEE 802.3ab** Gigabit Ethernet in which the 1 Gbps data rate over Cat6 can provide stability and speed for each of the departmental networks developers, administration, IT and so on to ensure that the relevant employee are able to access the data they need to complete their tasks without any delays or issues when developing the mobile app

Also, to improve speed and performance in the server rooms and backbone links between devices while maintaining scalability the other Ethernet standard to suggest is **IEEE 802.3an** with 10 Gigabit Ethernet over twisted pair copper with a 10 Gbps data rate this capacity allows the backbone to transfer heavy data loads in the network like development codes and files at 10 Gbps between servers and access switches without delays and problems (IEEE, 2023)

In terms of wireless connectivity in both branches the recommended IEEE standard is **802.11ac** or ideally **802.11ax** (Wi-Fi 6) these standards provide improved and good speeds, coverage depending on density area and efficiency for the high-density areas like customer service zones and conference meeting rooms planned at each branch location so a Wi-Fi 6 has features like OFDMA and MU-MIMO which allow connections to support multiple devices while lowering latency to provide an efficient experience for every user (Gast, 2021) these technologies will mean a reduced workload and the performance for sales, marketing and face customer processes faster , as well as secure authentication for wireless access for example a WPA3 or required standards.

Therefore use of the wireless and wired standards needs to be combined and used to provide a good security also the use of VLANs with **IEEE 802.1Q** will allow each department to work on an isolated subnet and provide security for high data transfers while reducing and limiting visibility of a VLAN on the switch. In conclusion to that, the implementation of these standards can meet Redco's current operational requirements and are ready to accommodate potential future business growth (TechTarget, 2021; Mitchell, 2022).

4. Discuss the different protocols utilized for communication and the connectivity of the 2 offices which can be implemented in the Galle branch and the How the OSI and TCP model influencing in designing network for Galle office.

4.1 Evaluation of protocol implementation and network models for Redco Developments

Network protocols are formal specifications that define the rules for transmitting and receiving data in networks. This enables reliable communication between devices by specifying how the connection will be initiated, formatted, and transferred, as well as how to handle errors (Tanenbaum and Wetherall, 2011).

In the case of Redco Developments, the network protocols are important to the function of smooth communications between Kandy and Galle branches and between departments such as IT, HR, accounting, and so on.

In order to create an efficient and effective network for Redco Developments' galle office and to ensure a good, smooth connection with the Kandy head office, it is important to understand the importance of communication protocols and network models. A communication protocol is important because they set the rules and standards that allow devices across a network to securely, properly, and accurately communicate and share information. This means that for Redco, data such as sensitive client records and information, mobile app development data, and administrative information exchanged between Kandy and Galle should be transferred to the required destination properly. Therefore, protocols are important to their daily operations.

In this I have recommended that the core framework implemented in the network design will be the Transmission Control Protocol /Internet Protocol (TCP/IP) suite, and this suite is used in business LANs and WANs. For this, the main transmission of communication is the internet, a TCP provides reliable data packet delivery in the correct order, and this is an important feature for Redco when transferring sensitive files such as client records, software updates, and financial records from Kandy to Galle. The Internet Protocol contained in the TCP/IP suite can be used for logical addressing to define

the routing of devices on the network so that each device on the company network is uniquely identifiable and can be reached wherever they may be properly (Cisco, 2023).

Furthermore, the implementation of Dynamic Host Configuration Protocol (DHCP) would provide the assignment of IP addresses for all employee workstations in the different departments such as IT, accounting, HR and so on. By automatically assigning the IP addresses for devices, administrative responsibilities will be reduced and the chance of user error as employees can simply plug their devices into the specific network and connect without configuring their device IP settings manually also by using DHCP's association with Domain Name System (DNS) to use human names to convert the IP addresses makes day to day tasks easy for the redco employees as they can ssh, ftp, and access servers by hostname instead of having addresses to remember which will ultimately enhance productivity in the business as well

Redco must also focus on securing their communications with their planned operational enhancement which includes smart devices, IP camera systems in Galle branch, and ERP that requires the implementation of secure protocols such as HTTPS, Secure Shell (SSH), and File Transfer Protocol Secure (FTPS).

A HTTPS provides encryption for web based access to company intranets and intranet applications, which adds so much protection against interception and unauthorized access to the network, whereas a SSH provides administrators a secure means of managing servers and other network devices remotely and FTPS provides a secure means of transferring files between branch locations example Kandy and Galle or off-site backups (IBM, 2024).

Understanding and using network architecture models are very important when designing a network design. The Open Systems Interconnection (OSI) model defines for how data flows across a network with seven layers from a physical medium to the application layer. One layer in the OSI model has specific responsibilities and an OSI model layer can interact with a layer above and a layer below in the model (Imperva, 2024).

Also the Data link layer is where Ethernet and VLAN's provides Redco the ability to divide and separate the network traffic or resources so each department has its own space also using VLAN's consistent with the IEEE802.1Q standards will reduce traffic from the IT, HR, Finance and Development teams and this is very good because it increases security and reduces the possibility of unintentionally having broadcast and network traffic

In the network layer, routing protocols like RIP (Routing Information Protocol) are used and these protocols connect Kandy and Galle networks via line and are easy to set up and is a good fit for smaller business settings like Redco because they can monitor each subnet's reachability in the event that the topology changes or anything like that because RIP can keep track of the reachability (CompTIA, 2023).

In comparison, both models shows their different strengths, the OSI model offers better clarity and separation which can help in designing a secure organized network for Redco developments as the use of the TCP/IP model is the standard used in the operations and is where the engineers will deal with the protocols that Redco will use daily. therefore a understanding of both models will help Redco's engineers to build a standard based infrastructure while still being practical for the implementation and allowing it to grow in the future

In conclusion to that using these protocols and standards will positively impact Redco's network because it can ensure a secure , reliable and scalable communications between Kandy and Galle, the standards based protocols will also be able to exchange information effectively between devices and reduces the chances of misconfigurations and is suitable for future expansions as Redco grows, the same principles will allow for the adaptation and growth of new technologies including like smart building systems, enabling remote working, sharing and moving traditional services to a cloud-based system that supports the future potential enhancements for the company.

5. Explain the impact of network topology communication and bandwidth requirements, explain what is network topology, types of network topologies with their advantages and disadvantages, importance and Impact of Network Topologies and bandwidth requirements.

Introduction to Network Topology

Network topology describes the physical or logical configuration of devices in a network, and the paths through which data will flow between devices (Forouzan, 2017). The choice of the topology can impact the performance, scalability, fault tolerance, and bandwidth of the network so choosing the right topology means good communication and easy management between branches

Types of Network Topologies with Advantages and Disadvantages

5.1 Bus Topology:

Bus topology connects devices to a single cable or backbone. Data is sent from one device on the network over the backbone and it travels in both directions until it reaches its desired destination (UniNets 2025). The bus topology is linear and devices communicate over a shared backbone with terminators on each end of the bus line to eliminate signal bounce.

Advantages of Bus Topology for Redco Developments:

1. Bus topology uses less cabling than star topology and is therefore very cheaper to install and easier to setup and deploy
2. Works well in smaller networks, Bus topology is useful for networking small numbers of devices where high performance speeds and complex configurations are not needed. Redcos' temporary training lab with a few devices could easily use bus topology because it is simple and low cost.

Disadvantages of Bus Topology for Redco Developments:

1. High risk of network failure, if the central backbone cable is broken, the chance is high that the whole network goes down. An example would be if this were used in Galle, or Kandy, and there was a fault or break in the main backbone cable, they would have a complete failure of network and will need IT techs to sort this problem
2. Limited scalability and performance, adding more departments and devices to the network like IP cameras and ERP systems means the network creates errors with data collision and reduces performance (Tanenbaum & Wetherall, 2011).
3. Troubleshooting can be ineffective as the Kandy and Galle has many departments' with multi-floor office, finding the fault in a long shared backbone cable could take so much time and affect every department's workflow as well making it not suitable for Redco Developments.

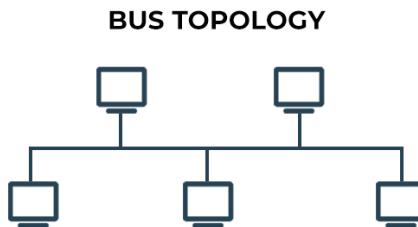


Figure 2: Bus Topology (Hossein Ashtari, 2022)

5.2 Star Topology:

In a star topology, all devices are connected to a central device such as a switch or hub (Cisco, 2024). This Topology type is perfect for Galle and Kandy department separation as this provides a good, simple control for each department, for example Developers, human resources and Administration can be all linked up to a central switch on each floor. It also makes it very easy and simple to implement VLANs, which is important for Redco as it wants to have its own subnets so that there will be more control of the network traffic

Advantages of Star Topology for Redco Developments:

1. Easy to manage and troubleshoot, in this topology each and every device is connected separately to the switch or hub, this makes it very easy to identify, manage and troubleshoot any issues (TechTarget, 2024) which means in case there's a malfunction in a single device the rest of the network remains unaffected and can function and perform normally, for example if a Developer in Galle branch meets any connectivity issues the IT team can quickly track and trace the issue without causing problems to other departments like HR or Finance and so on.
2. Centralized Control since all the data passes through a central device it is easy to manage, monitor and have control over the entire network, the IT department of Redco can effectively manage WiFi access in customer areas and conference room where meetings will be held this setup gives the branches more control over the network traffic.
3. Devices are simple to add or remove because the rest of the network is not disrupted or affected which is very helpful for a growing business like Redco Developments, if a new developer joins in Galle branch or more IP cameras and smart devices are added, the IT team of the company can easily connect the gadgets without affecting the operations of the network.

Disadvantages of Star Topology for Redco Developments:

1. In a star topology, the entire network solely depends on the central switch or hub which means if this device fails the whole entire network will not operate or function as well as the devices connected to it, for example, the linked departments like HR, Administration, and IT will lose connection if the main switch in floor 2 of Galle Branch fails and this can lead to major network operation downfall.
2. Star topology has a higher set up cost due to cabling and switches, since Redco has multi-floor building with multiple departments the setup cost will be even higher to connect every device to the central switch
3. Centralized device must be high performance, as the central switch or hub carries all the data, it must also be a high-performance device (Network Encyclopedia, 2024) the central switches in

both branches must provide high-speed data throughout and be able to handle high-speed file transfers from the Developers Department, which means regular transfer of large files and if the low grade equipments cant handle heavy workloads this can create network traffics

4. star topology is simple with only a few devices but once you add more devices and departments managing connections, managing VLANs and performance becomes very hard as the company grows and new employees and departments are added. Moreover, the IT team will need to constantly check the port usage and will require the management of multiple VLAN configurations which may not be ideal for Redco.

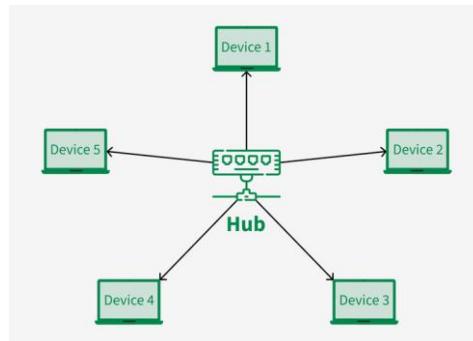


Figure 3: Star Topology (GeeksforGeeks, 2025)

5.3 Ring Topology:

In a ring topology a circular data path is formed by each device (or node) being connected to exactly two other devices, depending on the kind of ring being utilized, data can move either one way or both ways (GeeksforGeeks, 2024) in this every device sends the data to the next until it reaches its target functioning like a repeater.

Advantages of Ring Topology for Redco Developments:

1. Effective transmission of data, when compared to bus topology, performance is more predictable since data issues are reduced and all devices have equal access. A Ring topology can provide even

data flow in departments like accounting or development where consistent and reliable server access is very important.

2. Finding data bottlenecks is simple as it is easy to identify any issues in a larger network because the data flows through every device or node, if the HR department is slow the IT team can easily monitor the data flow and identify the problem.
3. Every device has equal access, not a single device can take more control of the bandwidth because all devices have the same priority. A good performance can be implemented by using equal access to the network and network resources for all departments regardless of the size, like HR to developers.

Disadvantages of Ring Topology for Redco Developments:

1. The entire network is affected when a single device or cable fails unless a twin ring configuration is used which cause additional costs for Redco Developments. For example, the failure of a single device in the Galle Developers department could cause issues for the entire network floor and stop 40 employees from working, this can decrease the efficiency of the company and its future growth as well.
2. Difficult to reconfigure or expand, in case devices are added or removed the ring must be broken which means it can disrupt the entire network again
3. More complex troubleshooting, because the data must pass through many devices and nodes therefore finding exactly where a fault is can take longer than in star topology for example if there's a problem in the Admin department Floor 2 of Galle the IT team will have to check each device one by one which can take a very long time and even delay the work of other departments like Finance (Forouzan, 2017).

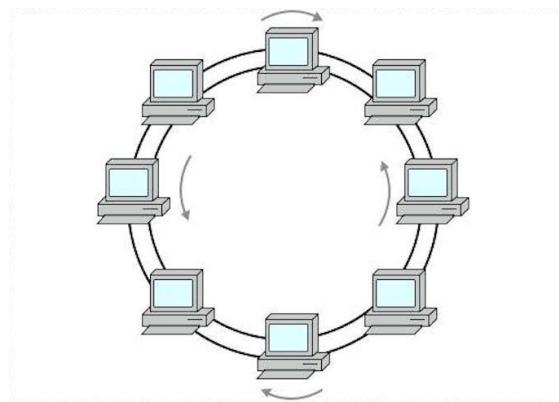


Figure 4: Ring Topology (Junaid Rehman, 2019)

5.4 Mesh Topology:

In a mesh topology every device is directly connected to other device and there are two types of mesh topology, full mesh and partial mesh, in a full mesh every device has a direct link or a connection to all other devices whereas in partial mesh some devices are fully connected while others are connected only to the ones they communicate and interact the most. A mesh topology provides multiple paths and ways for data to travel which makes the network highly reliable and easy (IBM, 2024).

Advantages of Mesh Topology for Redco Development:

1. Simple fault isolation. In case there is an issue it is very simple to remove the error without affecting the network as a whole for example customer service and sales departments won't be impacted by problems with the administrative department in Kandy
2. Enhanced privacy and security, because data follows a specific route which means there is less possibility of data interception or disruption therefore data is more difficult for outsiders to gain access to. This ensures that Redco only have access to particular resources which is perfect for a business that handles customers sensitive information since it's a mobile development company.
3. High reliability and fault tolerance, because the devices are all interconnected this means that the data can travel in several directions even if a link fails which means this will keep the network

running without any problems or issues (Cisco, 2023). In case if the server room in Galle is temporarily disconnected from one department like the Accounting or Finance other connections are not interrupted at all and this can be very useful for Redco

4. Mesh topology can manage high traffic volumes without slowing down the network as it has multiple pathways and helps to prevent network congestion during busy working hours such as when developers are submitting development code, and the boardroom is hosting a video conference between branches in Galle and Kandy.

Disadvantages of Mesh Topology for Redco Development:

1. Costly setup, creating and building a Full mesh is expensive and costly because it needs a lot of wires and network connections. Since Redco Development has so many departments and devices it would be very costly to fully mesh the two floors of the Galle branch or all three floors of the Kandy branch, therefore it can stop the company from growing due to its heavy expenses.
2. Difficult to maintain and manage, as the company is growing more devices are added because of that keeping track of all the links becomes difficult. Since Redco plans to expand and grow having a mesh network would mean a more complex and difficult infrastructure for the IT department to handle and manage the multiple branches.
3. Resources may be wasted due to redundancy, most of the times not all links are used at the same time making them useless and wasteful for Redco, therefore the mobile company might spend more on devices and extra cables that are rarely used which is a waste and not ideal for cost efficiency

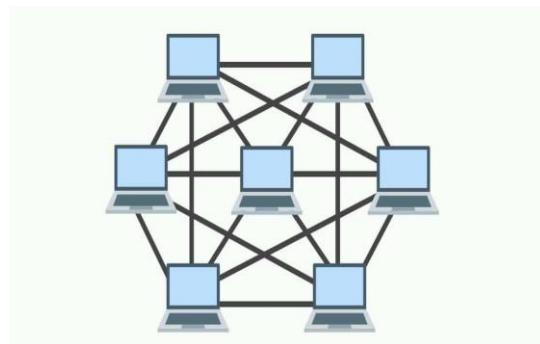


Figure 6: Mesh Topology (Junaid Rehman, 2021)

5.5 Hybrid Topology:

A hybrid topology is a combination of two or more different types of network topologies, such as star, bus, ring, or mesh, blended together to fit the specific needs of an organization (TutorialsPoint, 2024).

By doing this topology, businesses like Redco can increase the benefits of various topologies while reducing their drawbacks as this provides the best choice for flexibility especially for larger company with a variety of departments and branches.

Advantages of Hybrid Topology for Redco Developments:

1. A Hybrid topologies combine simple topologies like star with mesh to offer manageability but however Redco's server room can be connected via Mesh for maximum uptime this makes sure that operation continue even when there are hardware problems in the company.
2. Every department or floor can have a topology that matches its requirements well (Studytonight, 2024) for example one floor may use mesh while another may use star for easy simplicity the Galle Branch which has 40 person developers in its department can be connected to a star topology as it is easy whereas a partial mesh can be used to connect and maintain the ERP systems and IP cameras.

3. Hybrid topology allows Redco to expand its departments by adding new devices, creating new VLANs without changing or redesigning the entire network which can be very helpful for the company which means that Redco's IT team can easily connect new floor, plug in new switches without interfering the network, making it capable to grow in the future

Disadvantages of Hybrid Topology for Redco Developments:

1. Complex design and planning, designing a hybrid topology means a deep understanding of network requirements and careful planning is very important and the IT team of Redco must understand which department might need higher bandwidth, and what branch may take more time and all (Cisco, 2023).
2. Difficult maintenance, because the network consists of multiple topologies troubleshooting and finding issues in the network can become harder if clear network maps and plan are not maintained this fault can affect both mesh-connected cameras and star-connected developers, therefore IT staff needs to be able to identify which system has malfunctioned and where within a shorter period of time

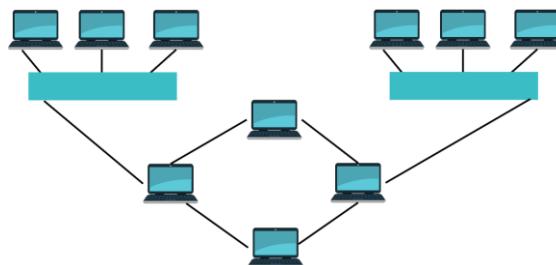


Figure 7: Hybrid Topology (GeeksforGeeks, 2023)

Importance and Impact of Network Topologies

The choice of topology directly impacts and effects how well bandwidth is used, the reliability of the network and how easy it is to maintain (Tanenbaum & Wetherall, 2011). For example, Star topology reduces traffic in each departments and improve how the bandwidth is used. This could be especially important for other departments as well that require a high volume of data such as Redco's Developers or Sales teams and so on

Recommended Topology for Redco

Redco Developments should use a Hybrid Topology comprising of Star topology for each branch office internally and Partial Mesh topology from branch to branch between Kandy to Galle, the internal departments of Sales, Marketing, IT and HR for example will connect using a Star topology to central switches which creates a more manageable network and can easily separate networks between departments and a major benefit is the availability of secure access to WI-FI. For example, a department like Sales and Marketing could connect to the network using the secure WI-FI network, while a department of Developers connects to the network using wired Ethernet connections for performance.

Inter-Branch Connectivity and Evaluation

The inter-branch connectivity of Kandy and Galle offices would be a Partial Mesh by design that will use routing devices with IP routing protocol to support successful inter-branch data communications with acceptable tolerance for failure (Stallings, 2014). With communication of inter-VLAN routing in any subnets this would allow data exchange between the departments securely and safely and each device within the network will use DHCP for their IP address. Moreover, the servers in the server room will use Static IP addresses within their subnet and having a server room designed with smart technology like IP cameras and ERP software is very important for the configuration level of the network

Bandwidth Considerations

Bandwidth consideration is very important for Redco Developments as they are using smart technologies such as EPR systems, IP cameras and the number of users is increasing in both Kandy and Galle offices it is very important to accurately calculate and manage the bandwidth and its requirement to ensure a smooth network experience.

1. IP Cameras and Surveillance Systems (Galle Branch)

- Total Cameras: 11 (5 cameras on the ground floor, 6 camera on the first floor)
- Resolution: 1080p (Full HD)
- Frame Rate: 15-30 fps
- Estimated Bandwidth per camera: 3–5 Mbps
- Total estimated bandwidth:
 $11 \text{ cameras} \times 5 \text{ Mbps} = 55 \text{ Mbps}$

In Galle there are 11 IP cameras located on each of the two individual floors with 2-5 Mbps of data for video streaming purposes, this increased throughput requirement will impact overall bandwidth requirements for the branch

2. Video Conferencing (Kandy Branch Boardroom)

- Usage: Weekly meetings
- Bandwidth per session: 1–4 Mbps depends on video quality and the number of users
- Recommended Reserved Bandwidth:
 $4 \text{ Mbps} \times 2 \text{ concurrent sessions} = 8 \text{ Mbps}$

The Kandy boardroom video conferencing facilities will require between 1-4 Mbps per session as it requires good stable connectivity for low latency for smooth meetings in the organization (Cisco, 2023; Axis Communications, 2022).

3. ERP Systems (Both Branches)

- ERP usage: real-time updates, database queries
- Users: 20 users, 10 ERP systems in each branch
- Estimated Bandwidth per active user session: 1–2 Mbps
- Total Estimated Bandwidth for ERP use:
 $20 \times 2 \text{ Mbps} = 40 \text{ Mbps}$

ERP system areas for both branches will require high and uninterrupted access and connectivity for users, supporting the overall traffic for both branches.

4. Developer Data Transfers

- Galle: 40 developers
- Kandy: 25 developers
- Activity: sharing large file transfers example codebases
- Average estimated transfer bandwidth per user (during peak): 5–10 Mbps
- Total Bandwidth Estimate:
Galle: $40 \times 8 \text{ Mbps} = 320 \text{ Mbps}$
Kandy: $25 \times 8 \text{ Mbps} = 200 \text{ Mbps}$

Both developer departments has 25 people in Kandy and 40 people in Galle will often be exchanging large application files and therefore to support this large data transfer, a local LAN backbone of 1 gbs is recommended within each department (Cisco, 2023; Axis Communications, 2022).

5. Guest Wi-Fi and Staff Wireless Use

- Estimated concurrent users: 10–15 per branch
- Average bandwidth per user (web, email, light streaming): 1–2 Mbps
- Total Estimate:
 $15 \times 2 \text{ Mbps} = 30 \text{ Mbps}$ per branch

Network traffic will be separated by department VLANs which will help to avoid congestion and improve bandwidth management in the business (Cisco, 2022).

Category	Galle Branch	Kandy Branch
IP Cameras	55 Mbps	0 Mbps
ERP Systems	20 Mbps	20 Mbps
Developers (wired)	320 Mbps	200 Mbps
Video Conferencing	4 Mbps	8 Mbps
Guest Wi-Fi & Wireless	30 Mbps	30 Mbps
Total Required	429 Mbps	258 Mbps

Table 1: Bandwidth requirements for Galle and Kandy branches

Why this matters for Redco's design?

An effective bandwidth distribution is supported and given by hybrid topology therefore direct device-to-switch communication is ensured by star topology inside branches between Kandy and Galle which reduces congestion and network traffic in Redco.

VLAN segmentation prevents ERP or Wi-Fi services from being impacted by large traffic kinds like CCTV or developers which means this wont slow down the process of the network speed (TechTarget, 2023).

Routing Protocol Advice and Evaluation

In order to ensure inter-branch communications between Kandy and Galle, a dynamic routing protocol is needed. While RIP (Routing Information Protocol) can be easily used, it will not suit Redco's planned future growth because of its longer convergence times. Because OSPF (Open Shortest Path First) is more efficient and scalable and is a better choice for multi-subnet and VLAN networks, it would be more suitable for Redco (Oppenheimer, 2011).

In comparison to RIP, OSPF also allows route updates to work faster and uses less number of routed hops as well. Additionally, OSPF seamlessly allows inter-branch connectivity regardless of a single

branch's failure, allowing departments in both branches to securely access shared services like ERP systems and servers (Forouzan, 2017; Teare and Vachon, 2019).

In conclusion to that, I would recommend the Hybrid Topology of Star topology and Partial Mesh topology as this suits Redco's aims to create and maintain a modern network design. The solution supports the secure communications and data transfer requirements in each individual branch and between the branches. The analysis so far provides a topology that enables connectivity to smart devices and provides seamless expansion in the future.

6. Recommend suitable network topologies and network protocols for the above scenario and evaluate your answer with valid points.

Selecting the right network design was an important step to take as it makes sure both the Kandy head office and the new Galle branch can work together smoothly and effectively moreover the network must support not just normal day to day office operations and activities but also more advanced systems like IP cameras, ERP software, and smart security devices since Redco is willing to grow and expand its size.

Therefore, after a careful consideration and understanding the aims of Redco developments , a Hybrid topology using Star topology within each branch and a partial Mesh between Galle and Kandy, along with the OSPF routing protocol was chosen as this setup gives Redco a strong and flexible network that matches the aim and the need of the business for its future plan.

Additionally, inside each branch the Star topology is used to connect departments such as Developers, HR, IT, and Finance as this makes the network easier to manage and troubleshoot problems when they happen. For example, if a single device or cable in the Finance department has a problem, the other departments will continue to function as normal and wont have any effect on them, Star topology setup also makes it easier to apply VLANs and helps to keep each department's data separated, secured and

protected and since smart devices and ERP systems are used in Redco, this setup type can protect all the sensitive information and can avoid traffic congestion in the network (TutorialsPoint, 2024).

In order to connect the Kandy and Galle branches a Partial Mesh design is used and this allows data to travel through multiple paths and devices, so for example if one connection fails, the network can automatically switch to another easily and this is especially useful during large file transfers from the IT department when sharing development files and when video conferencing for remote employees, or when employees from one branch need to access files from the other branch, therefore this helps to reduce the downtime and ensures a very smooth connections between both branches located in different cities of Sri Lanka

Moreover, the network uses the OSPF (Open Shortest Path First) routing protocol and an OSPF is more advanced than simpler protocols like RIP because it can react faster to issues and changes and can handle larger networks more effectively and because Redco has multiple VLANs, departments, and is a growing technology company, an OSPF is a better for Redco as it can find the best path to send and receive data automatically (GeeksforGeeks, 2024).

On top of that, Redco has several departments and each department has its own VLAN which is basically like creating separate lanes for their data traffics and this separation helps to stop unnecessary traffic that could be spreading across the whole network and this can protect sensitive data as well. For example, Finance department data stays private and separate from the developers data and this makes it easier for the IT team because then they would know who has access to which resources and can keep all the data organized

As Redco continues to hire more employees, add new smart devices and plans to grow by opening new branches, this network can easily expand because new switches and connections can be added easily without having to redesign everything from scratch and will save a lot of time and money making the network very flexible for its future growth.

Moreover, the Hybrid topology is a smart choice for Redco because it uses two types together, the Star part is used inside each office where all departments connects to a main switch and this makes it easy to manage and which means one issue wont affect the whole network and this is very useful for Redco likewise, the Partial Mesh part connects the Kandy and Galle branches using more than one path so even if one link fails, data can still travel without any issues and the OSPF helps by choosing the best path for data transfers and quickly creates new routes if something happens while keeping the network working and running effectively and smoothly (StudyTonight, 2024).

In conclusion to that, the Hybrid topology along with the OSPF routing protocol provide Redco Developments a efficient and a flexible network solution as it supports smooth communication and data transfer within each branch using Star topology also ensures strong connections between the Kandy and Galle offices with Partial Mesh and the OSPF protocol helps to the keep data flowing quickly and securely by automatically choosing the best route. Therefore, this design meets the current needs of the company but also can be easy to expand as Redco grow making it a practical choice for its future as well.

Activity 02

1. Discuss the operating principles of network devices (Ex: Router, Switch, Etc.)

1.1 Explain Operating Principles of Networking Devices

Since Redco is a mobile development company which handles a lot of sensitive client data, it is very important to learn and understand the fundamentals of networking and how they work in order to design a safe and effective network across both the Kandy and Galle offices. Each and every device has a specific function that plays a unique role in ensuring that Redco has smooth communication and data protection.

1. Router

The router is a device used in networks to connect networks, and to make decisions about the best path for the sender to send packets of data (Mitchell, 2022).

Operating Principle:

Redco has routers located in the Kandy head office and in the Galle branch of the network connecting both offices. The router will use routing protocols like RIP, to exchange routing information and routing tables in order to ensure that the data being sent between departments in both branches is sent as efficiently and reliable as possible. It creates a safe and reliable environment for data the is being sent between each department at both branches located in Kandy and Galle.



Figure 8: Image of a Router (techterms, 2025)

2. Switch

A switch is a device that connects computers and other devices within a local area network (LAN) and forwards data to a specified destination based on MAC addresses (GeeksforGeeks, 2021).

Operating Principle:

Switches are used on each of the floors at the Redco offices to connect together the devices like PC systems, servers, and printers and so on, they will also try to remove the network bottlenecks by only sending the data to the intended device instead of broadcasting it to all the devices and network hosts on the same network so that departments will have the fastest communication as possible.



Figure 9: Image of a Switch (gponnetwork, 2023)

3. Firewall

A firewall is a network security device, or software or hardware that monitors and controls incoming and outgoing network traffic based on security policies (GeeksforGeeks, 2023).

Operating Principle:

There are firewalls at Redco as part of security framework of both the Kandy and Galle networks. Firewalls check any traffic that enters the network and denies unauthorized access trying to gain access into the network. this protects important business data and resources like ERP systems or IP systems cameras from malicious attacks. Moreover, firewalls also help to protect these services from both trusted and untrusted or outside networks, so at the end firewalls only starts and allows trusted services.



Figure 10: Firewall (james Eversoll, 2022)

4. Access point (AP)

Access point is the general term used for a class of devices that extend the wired LAN into another local area network that uses Wi-Fi technology (Rouse, 2021).

Operating Principle:

Redco uses Access points in many places like customer service areas and boardroom community spaces. APs are important devices to allow employees and visitors access to reliable Wi-Fi without either of them having to bypass any access restrictions and security framework so they can get secure access control and encryption while giving employee mobility of access to a business network and maintain businesses security being used by guests, thus ensuring customer safety.

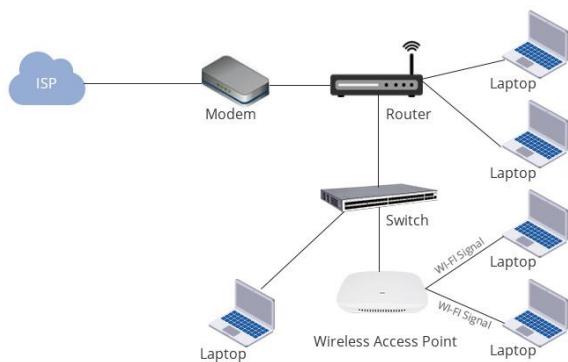


Figure 11: Wireless Access Point (Darshika, 2025)

5. DHCP Server

A DHCP (Dynamic Host Configuration Protocol) server automatically assigns IP addresses and network configurations to devices on the network.

Operating Principle:

A DHCP server automatically assigns IP addresses to all PC and smart devices in both branches, Galle and Kandy, this eliminates the need for manual device configuration at Redco also, this guarantees effective IP management, prevents issues and disputes and enables fast network connections for the devices (Cloudflare, 2023).

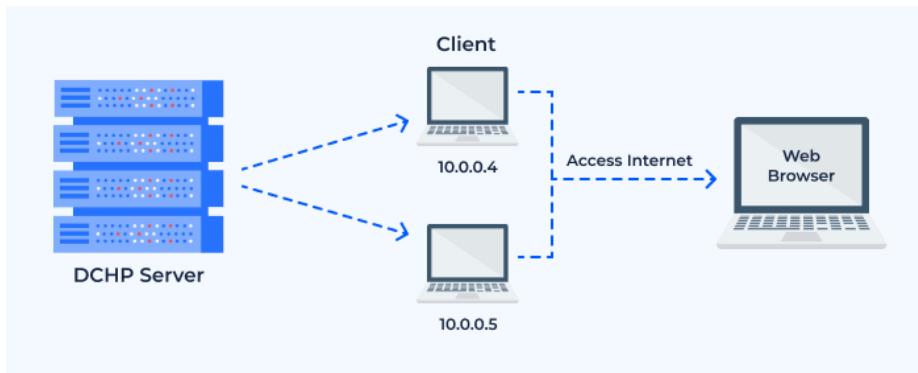


Figure 12: DHCP (Ivan Palii, 2023)

6. Physical Server

A physical server is a dedicated computer that provides centralized services and resources such as file storage, applications, and network management (Rouse, 2020).

Operating Principle:

Redco's physical servers are located in the server rooms of both branches which handles the important services like ERP hosting, IP camera storage, and DHCP. These servers use static IP addresses for stability and make sure that essential services are always available to all employees across the Redco Development (Rouse, 2020; Cloudflare, 2023).



Figure 13: Image of a Physical Server (Philip, 2023)

In conclusion to that, by effectively using devices like routers, switches, firewalls, servers, Redco can build a stable and secure network setup and infrastructure, these devices not only support daily day to

day operation but also helps the company to meet the advanced needs such as smart integration, branch communication and ensure Redco's future planned growth.

2. Explain different server types that can be used for the above scenario while exploring different servers that are available in today's market with their specifications. You should recommend a server/server for the above scenario and justify your selection with valid points.

2. 1 Select and explain the network devices, servers, and server services for the organization, Justify your selection in detail

Recommended Server Specifications for Redco Developments

Kandy Headquarters – HPE ProLiant DL380 Gen11 (Rack Server)

Specifications:

- **Processor:** Dual Intel Xeon Scalable 4th Gen (up to 32 cores per CPU)
- **RAM:** 256 GB DDR5 ECC (expandable up to 4 TB)
- **Storage:** 8 x 2TB SAS 10K RPM Hot-Plug Drives (RAID 10)
- **Network Interface:** 4 x 1GbE, 2 x 10GbE ports
- **Power Supply:** Dual redundant 800W hot-plug PSU
- **Virtualization Support:** VMware, Hyper-V, Windows Server 2022 Datacenter Edition
- **Expansion Slots:** 6 PCIe Gen5 slots
- **Management:** HPE iLO 6 for remote monitoring and management

Source: (ServeTheHome, 2023).

Galle Branch – Dell PowerEdge T550 (Tower Server)

Specifications:

- **Processor:** Intel Xeon Silver 4310 (12 cores, 2.1 GHz)
- **RAM:** 64 GB DDR4 ECC (expandable up to 1 TB)
- **Storage:** 2 x 2TB SATA 7.2K RPM (RAID 1)
- **Network Interface:** 2 x 1GbE

- **Power Supply:** 750W Platinum-rated PSU
- **Virtualization Support:** VMware ESXi, Windows Server 2022 Standard Edition
- **Expansion Slots:** 5 PCIe Gen4 slots
- **Cooling:** Active airflow cooling design

Source: (Dell Technologies, 2024).

Server Setup Justification and Explanation

The **HPE ProLiant DL380 Gen11 tower server** is the suitable Redco's Kandy HQ because of its ability to provide business level performance and scalability. The HPE server can also support ERP systems, virtualized environments, and services that will be used by multiple departments for example, Active Directory, DHCP, DNS, secure file storage with **dual Intel Xeon CPUs** and **256 GB of DDR5 ECC RAM**. **RAID 10** was chosen as storage configuration as it provides speed and redundancy to critical data and **10GbE ports** for bandwidth to allow for high-speed communication between departments and with remote users (Hewlett Packard Enterprise, 2024).

The **Dell PowerEdge T550 server** is a good one and is suitable for **Galle branch tower server** because it can provide performance but in a lower cost reliable tower form this means Galle branch server contains **64 GB of ECC RAM** and an **Intel Xeon Silver processor** system so it will support local services easily, and can be used for **DHCP, DNS** and **local file/print sharing** capabilities.

Also, **RAID 1 storage** was used to protect the data for the smaller scale operations at the branch operations and it can be part of basic virtualization so the Galle branch would be able to run separate services on separate VMs without the need for purchasing additional physical hardware, therefore, Redco will be able to save money and improve efficiency as well.

By using a **robust rack-mounted tower** plant at HQ and a **reliable tower server** at the branch, Redco has the appropriate infrastructure to support performance and scalability as well, therefore both servers will make it suitable for future expansions in Kandy and Galle so by knowing what server types are

69

available will help in choosing the right server setup in the most effective and efficient way for Redco Developments (Dell Technologies, 2024).

2.2 Explain server services for Redco with their uses (e.g., Active Directory, DHCP, WDS.....)

Server Services for Redco Developments

There are several key server services that will be needed to support and maintain the Redco Developments operations in Kandy and Galle and these services are checked by the organization's business expansion, department structure needs in order to properly function, make efficient use of resources and leave the organization space for growth.

Active Directory Domain Services (AD DS) will be implemented to manage user authentication and access control to system within the company also Redco operates a number of departments like development, human resources, and administration and accommodates users across 2 branches in Kandy and Galle and AD DS will allow the organization to centrally manage all user logins and access permission as permissions can be set as needed by group users including group-based restrictions (Microsoft Learn, 2024). For example, HR staff may be allowed to access to a group of confidential files and client details while allowing developers to work on a project folder that has a larger set of access permission this effectively helps to manages information security while allowing the organization to manage user accounts and permissions since it has outgrown a small organization therefore this is increasingly important with the growth of the business.

Dynamic Host Configuration Protocol (DHCP) can be used for automatic assignment of IP addresses on all networked devices across the two locations. The mix of laptop and desktop computers, even mobile devices (Cisco, 2023).

For example cell phones, tablets, guest Wi-Fi with users and networked IP cameras makes manually assigning IP addresses for each device and potentially each user highly inefficient and vulnerable to

human errors also a DHCP will allow rapid onboard of new devices on the network, reducing time allocated for device configuration and reducing the likeliness of traffic on the network therefore purpose of this process will be to correct assignments to IP range but the DHCP server will identify each of the devices on the network or assigned VLANs as associated IP addresses.

The **Domain Name System (DNS)** serves network level resource access by translating internal domain names to IP addresses for the Redco network. Although the company uses other hardware and software resources such as ERP systems, printers, and shared drives and so on DNS simplifies resource access additionally, DNS enables efficient use of group policies including Active Directory group policies to restrict access to these resources and files as such, DNS will be necessary for network applications, specifically internal applications performance and functionality.

Windows Deployment Services (WDS) will help with operating system installations on new or repurposed workstations as the footprint of the organization's development team and concurrent increasing depreciation of devices at Redco has resulted in a sufficient number of deployments in both locations. WDS can help with new Windows installation on an existing workstation this can benefit especially when it comes to setting up staff with standardized pre-existing Windows images due to less numbers of IT resources in the Galle branch. Also by using WDS, IT department can preconfigured Windows images rapidly, reducing staff onboarding setup to device setup versus a long installation process to get set up on their assigned workstation (Microsoft Learn, 2023).

File and Print Services makes it easier for employees from different departments to safely access shared files and printers this means Redco can make sure that only those with permissions will be able to see or edit those particular documents by using Active Directory based permissions this provides good security for the mobile company as well and helps to keep the data maintained. For example the development team can safely exchange code but HR still has authority over employee data and details therefore this can lower the hardware expenses as shared printing will reduce the expenses of the company and increases efficiency

For Redco's infrastructure and future plan **virtualization services** like VMware and Hyper-V will be needed for example with a robust rack server at the Kandy headquarters several virtual machines may independently execute various services including AD DS, DNS, and ERP. This makes it easier for the maintenance, lowers hardware costs and enhances system performance because virtualization removes the need for physical machines moreover the Galle can also profit from hosting local services in isolated virtual environments as well.

Additionally, Redco will host its **ERP system** at the Kandy head branch for project management, finance, and human resources moreover performance and high availability are guaranteed when this system is hosted on a dependable, high-spec rack server, which is essential given the importance of ERP tools for everyday workflow and running.

Also **IP camera footage** which is very important for both locations physical security will also be stored on the same server as well therefore a centralized storage at headquarters guarantees that video is securely stored and available when needed (Monk and Wagner, 2021; Milne, 2023).

All of these services have been chosen match the organizational structure guaranteeing a quick and easy setup, safe access to files and resources, effective network traffic control and a very good support for current and upcoming future business requirements therefore Redco will be able to expand efficiently with these services

Recommended Server Setup

A rack server such as the **HPE ProLiant DL380 Gen11** is perfect for the Kandy headquarters and its twin **Intel Xeon CPUs**, 4TB of expandable memory and strong RAID storage make it suitable for virtualization, ERP, IP storage, and multitasking for Redco. Moreover, the **Dell PowerEdge T550** tower server is appropriate for the Galle branch because it supports virtualization and basic services like DHCP and DNS locally (Hewlett Packard Enterprise, 2023; Dell Technologies, 2023). Therefore, making it both powerful and reasonably priced for the organization. In conclusion to that, by using a

combination of tower and rack servers, the Redco can provide scalability, robust security, and high server setup.

3. Discuss the inter-dependence of workstation hardware and networking software, networking operating systems you use based on the scenario. Provide examples for networking software that can be used in the above network design.

3.1 Interdependence of Workstation Hardware and Networking Software in Redco Developments

A modern tech company like Redco Developments where both of its Kandy and Galle branches heavily rely and depends on network based communication and mobile application developments a seamless connection and a smooth between workstation hardware and networking software is very important for the organization as well. Moreover, the head office in Kandy and the newly opened branch in Galle must ensure that the hardware and the software components are perfectly well matched in order to provide a smooth performance with good security making it easier for the Redco to operate.

Networking Software for Redco

1. Network Operating Systems (NOS)

A Network Operating System (NOS) is the main software that is loaded and stored in a server program and it has network resources generally including users, user devices, user permissions, and IP configurations. For Redco both Kandy HQ and Galle branch will benefit from the server-based NOS model to centralize management.

- Windows Server 2022

This is Microsoft's popular enterprise-grade NOS with what were traditionally called NT Domains

(Active Directory - AD) it allows IT administrators to centrally manage users which makes it easier for Redco developments, provide devices and permissions making it easier to use and handle for these businesses (Microsoft, 2024).

DHCP (Dynamic Host Configuration Protocol): Provides an automatic discovery and assignment of IP addresses to all client devices connected to the same network.

DNS (Domain Name System): This translates domain names into IP addresses enabling local name resolution for servers and services.

Group Policy: Configuration or restrictions can be enforced on client computers like password policies, access rights (Microsoft, 2024).

Therefore these provides a security, scalability and integration with Microsoft's cloud-based and collaboration solutions such as Azure and Office 365 which are ideal remote working, file sharing and user authentication across branches as even the employees do not have to travel here and there and can easily access files from anywhere through the internet which improves Redco's flexibility as well. (Microsoft, 2023).

- Linux NOS (e.g. Ubuntu Server, CentOS)

These are open-source server operating systems that are very customizable to Redco's needs and requirement.

With either of these Linux NOS's you can configure for the following key services:

- DHCP and DNS
- Samba or NFS file sharing

- Internal GitLab repositories for your developers
- Apache/Nginx web servers for mobile back-end testing services

Linux only needs fewer resources compared to Windows as open-source licenses usually cost little and Linux is much more secure if you manage it correctly and this is very suitable for Redco Developments also this is useful for hosting your custom applications and services, making it ideal for development

2. Networking Tools and Utilities

The second part of the plan is for tools and utilities that you will need to design, test, monitor and maintain a healthy network environment across both branches.

- Cisco Packet Tracer / GNS3

Cisco Packet Tracer is simulation software for designing, testing virtual networks and it has features that lets you add routers, pcs, switches, many types of cable and so on

GNS3 (Graphical Network Simulator-3) is more emulating real-world routers and switches (Networking Academy, 2024; GNS3, 2024).

This setup is perfect for training employees and helping them understand the ways of Redco and simulate them into the new settings and workplace which allows them to troubleshoot problem that can be caused in the future without causing any problem to the network.

- SolarWinds Network Performance Monitor

This is a monitoring solution that works in real time and it will notice things like network congestion and traffic, any hardware failure, bandwidth usage, downtime and so on and likewise will provide visual dashboards and will alert you if something goes wrong in case. As Redco must always be active

with monitoring, and since we have multiple VLANs like with multiple floor switches, multiple inter-branches routers it is very important that we monitor of all of these so we do not interrupt services hosted by Git, ERP, and the IP camera feeds.

- Wireshark

A packet sniffer analyses packets and traffic on the network that you can apply it when needing to analyse unusual traffic patterns, interception access attempts, or issues at the application layer. Wireshark can also be used in IT Support to explore issues, parent/less app searches for malware communicating over the network or when debugging and correcting apps connectivity during mobile development.

- ERP Software (for example Odoo, SAP Business One)

ERP (Enterprise Resource Planning) software puts together departments of a Redco like hr, , admin, finance, and so on into one application that can be used for reporting and analyzing purposes ,which can be hosted on Redco's server in the central server room or can be accessed from remote via VPN from Galle.

Therefore Redco can use ERP software to make processes, decisions more effective, organize and analyze employee and their information all in one single application and Redco access to ERP should be made available, secured and stable (Odoo, 2024).

3. Security Software

In a distributed network environment with remote access to developers, remote IP cameras, ERP systems, distributed networks means that security is important so Redco has to use some sort of networking security software to protect data and secure communications using branch-to-branch networks.

- Firewall Systems, for example, Cisco ASA Firewalls monitor and filter both incoming and outgoing traffic according to security rules defined by an organization's IT policies. For example Cisco ASA is a hardware-based commercial firewall while pfSense is an open-source software firewall platform and this protects against unauthorized access and enforces security policies for both branches in Galle and Kandy (Cisco, 2023; Netgate, 2024).
- Endpoint Protections for example, Bitdefender, Kaspersky Endpoint Security. Endpoint protection is malware protection for client devices PC's and laptops from malware, phishing, ransomware, and so on which includes real-time scanning, firewall, web filtering as well. As Redco is storing client data it must protect the devices we use from attacks of interception of unauthorized access and secure its data properly.
- VPN Clients, in order to protect the sensitive data that Redco developments holds of its clients and developers who work remotely a VPN can be used as it prevents any data interception by unauthorized users example of VPNs are OpenVPN AND FortiClient that can be used to safely link users from different branches via the internet (Fortinet, 2024).

Hardware Considerations per Department

As there are many departments in Redco the hardware needs may vary from different departments, so each workstation needs to be customized appropriately:

Department	Hardware Needs	Networking Needs
Developers	Powerful PCs and laptops with SSD storage such as GTX/RTX (Soper, 2023; NVIDIA, 2024).	Fast wired and Wi-Fi connection so that development codes can be transferred easily
Sales & Marketing	Light laptops with clear screens for easy presentations	Good wifi connectivity for updating marketing systems
Customer Services	Basic laptops or pcs with headsets for handling calls	A good stable Wi-Fi for VoIP calls

Admin, HR, Finance	Standard computers with minimal VGA, SSD, and 8–16GB of RAM (Anderson, 2023).	Secure access to company files and ERP system
IT Support	Laptops for troubleshooting network issues and setting up devices	Full network and server access for maintenance and control
Boardroom	PC or smart TV for online meetings and future presentations that may take place	Good Wi-Fi for internet access with camera and microphone (GeeksforGeeks 2024)
Reception	Easy to use PC with a built-in screen for front desk work	Access to visitor and guest system and phone calls

Table 2: Hardware Considerations per Department

Interdependence: Hardware and Networking Software

1. DHCP and NIC compatibility

Each workstation relies on a Network Interface Card (NIC) which is compatible with DHCP to dynamically get an IP address. If the NIC does not have driver support for Windows/Linux the machine will not be able to communicate on the network (Cisco, 2023).

2. Video Collaboration for Boardroom

The boardroom machine which we use to run video conferencing applications such Microsoft Teams, and Zoom must have a VGA/Graphics Card and RAM that will work with those applications. The networking software must have support for QoS (Quality of Service) so we can communicate efficiently without delays.

Recommendations

The following improvements and suggestions can be used in order to improve Redco Developments network performance and guarantee a seamless operations across the both branches in Galle and Kandy:

Firstly, a Solid-State Drives (SSDs) and with at least 16GB of RAM should be added for developer and IT support computers and Fast application compilation times and high-speed read/write operations are needed for developers as well, SSDs significantly minimize system lag and tasks involving software development which is ensured by 16GB or more of RAM, this can be very useful for Redco and its future growth.

For departments such as Marketing and HR which usually uses portable devices like laptops and tablets, it's best to set them up with dual-band a Wi-Fi 6 adapters. Wi-Fi 6 technology which offers faster speed, improved security, and better performance, this is especially important in Redco's smart office setup which includes auto-lighting systems, IP camera and ERP-based cloud communications, ensuring these users have reliable access (GeeksforGeeks, 2023).

Additionally, VLANs (Virtual Local Area Networks) should also be used to implement network which can be through the use of switches and department-specific VLAN assignment, therefore Redco can enhance security measures and provide effective inter-VLAN routing. While keeping data logically separated, this also makes network administration and troubleshooting easier also, in order to maintain good security with the networking standards, regular updates are required this lowers any issues that could affect system performance which is important for a mobile development company.

Finally, UPS systems should be installed in the server rooms of both Kandy and Galle to protect the main infrastructure in the event of a power outage as this guarantees continuous access to essential services including ERP systems, DNS, DHCP, and so on (Cisco, 2023).

In conclusion to the use of the right and appropriate computers and networking systems is very important to the success of Redco Developments new branch and teams as this allows to perform their jobs effectively, departments from developers to human resources will also need the proper combination of hardware and software, therefore the business may function more efficiently, perform more quickly, and expand in the near future

3. Explore a range of server types and justify the selection of a server for a given scenario, regarding cost and performance optimisation.

Investigating Server Types and Reasons for Redco Developments:

Redco Developments is continuing to expand its operations in Galle while the head office will remain in Kandy. To increase performance, security, and scale, a good stable server infrastructure will benefit Redco and the right types of servers and services will improve business continuity across Kandy and Galle and promote real-time collaboration while managing information in an efficient manner.

Physical Server Types

There are three main physical server types Redco can consider:

Tower Servers - is an inexpensive solution that is designed for only small environments. However, tower servers are not space efficient and cannot easily scale out if the business grows, when considering Redco's size they would only consider referring tower servers for Galle where their workload is not as intensive.

Rack Servers - is basically designed for larger organizations and is specifically made to be space efficient, and allow for better overall cooling and cable management. Rack Servers would also be beneficial for Kandy as well because they have more users and a larger need for scaling out for example, the larger Kandy branch can benefit from improved scalability and resource management using rack servers while the smaller Galle office can afford and use tower servers.

Blade Servers, similarly this server provides for high performance in a big server configuration, but comes with high maintenance costs and need for cooling specifications this is more than Redco should consider especially not at their workloads in Galle (TechTarget, 2023).

Server Services and Usages

- Active Directory (AD)- is designed for centralized user authentication and access control to organization's resources. AD would be a primary resource of managing Redco's growing user population with their devices in both locations such as Kandy and Galle.
- DHCP (Dynamic Host Configuration Protocol)- dynamically assigns ip addresses to client devices and simplifies the overall IP address management and usable resources for both departments and locations easily (Microsoft Learn, 2023).
- DNS (Domain Name System)- resolves domain names to IP Address which allows all employees to use the components of services in Redco either internal and also external.
- WDS (Windows Deployment Service)- this helps with remote OS installations for only new devices in both office spaces ensuring Redco's IT management properly.
- File & Print Services- this allows for a centralized document storage and printer sharing for efficiency as multiple printers do not have to be purchased in redco

Network Devices and Server Setup

In the first iterations of a workflow for networks and IT infrastructures, there are going to be devices that Redco will need to ensure functional connectivity.

These devices will include:

- Managed Switches to allow for VLAN's per department.

- Routers for inter-branch connectivity
- Wireless Access Points with security for the Wi-Fi areas.
- Firewalls for network protections.

Recommended server setup:

The Kandy office of Redco can make use of the **HPE ProLiant DL380 Gen11** which is an extremely powerful server and up to 4TB of RAM can be handled by it, which can be very helpful when you need to run many virtual computers inside the main server, additionally, it can do multiple tasks at once because to its two powerful Xeon CPUs. Also, important services like DHCP which assigns computers to its IP addresses, Active Directory which helps manage the users and passwords, DNS identifies websites and devices by name, and ERP manages business operations like accounts and finances will all be run on this server (Hewlett Packard Enterprise, 2023).

A simpler **Dell PowerEdge T550 Tower Server** can be used in the Galle office. Although it's not as strong as the Kandy one, it's still useful for smaller tasks and performances since the branch is small. Additionally, it can store backup files and manage DHCP and DNS locally as this type of configuration is sufficient for a smaller office with fewer employees and easier activities making it suitable for the Galle office of Redco development.

What Are Port Numbers Used For?

Computers can identify the type of application or service they are connecting to with the use of port numbers. They are compared to a building's room numbers in that each one connects to a distinct location. This helps computers find websites for example port 53 is used for DNS. DHCP, which provides devices with IP addresses, uses ports 67 and 68 (Cisco Networking Academy, 2022).

Whereas port 443 is for secure websites (HTTPS), port 80 is for regular websites (HTTP). When someone connects to a computer using remote Desktop, port 3389 is used so they can control the computer from a distance. Through these ports, the appropriate messages can be shared and transferred to the appropriate services.

Port Number	Protocol
20, 21	File Transfer Protocol (FTP)
22	Secure Shell (SSH)
23	Telnet Protocol
25	Simple Mail Transfer Protocol (SMTP)
53	Domain Name System (DNS)
67, 68	Dynamic Host Configuration Protocol (DHCP)
80	HyperText Transfer Protocol (HTTP)
110	Post Office Protocol (POP3)
137	NetBIOS Name Service
143	Internet Message Access Protocol (IMAP4)
443	Secure HTTP (HTTPS)
445	Microsoft-DS (Active Directory)

Figure 14: Commonly used Port numbers

Network Cable Types

Computers, printers, and servers are frequently connected in office buildings using Cat6 Ethernet connections. For shorter distances such as within a single room or floor which are perfect and quick enough for the majority of business requirements this support for gigabit speeds is excellent for smooth network operation. However, Longer distances are better served by fiber optic lines because they transport data in the form of light, therefore they are far faster and less influenced to interference, or anything that interfere with the signal. These work well for connecting floors of a building or even various office branches such as those in Galle and Kandy, making it very suitable for Redco.

In conclusion to that, the Galle office would profit more from the affordable tower servers, whereas Redco should install rack servers in their Kandy office inorder to satisfy the needs of scalability and performance. Additionally, a stable and secure connectivity between both locations will be ensured by supporting services like DHCP, AD, and DNS, as well as with the right network equipment and cabling can support Redco's ongoing growth



Figure 15: Cat6 Ethernet cable (Robert Anderson, 2020)



Figure 16: Fiber Optic Cable (Vikas Dayal, 2019)



Figure 17: Coaxial Cables (Bolten Technical, 2025)

Activity 03

1. Design a networked system to meet the given specification.

1.1 Introduction

Redco Developments is a growing Sri Lankan mobile application development company and has its head office in Kandy, Sri Lanka and Redco Developments has recently approved the opening of a new branch in Galle and plans to develop this office into a more like a modern and tech orientated one for the Southern Province and hopes to keep expanding and growing big . The goal of this network design is to build a stable, fast, and scalable network that can connect to the Galle and Kandy offices together to allow for better and effective communication.

This involves a lot of things and will require such as a stable connectivity between both buildings in different cities, structured VLANs for each of the departments, a variety of IP camera systems, smart devices, and Wi-Fi that is made available for access to the Internet. The aim of the network is to use the necessities to ensure the network is performing to specifications, that data is secure and easily travelled through new network equipments with the ability to meet future requirements as the organisation grows gradually.

This report will show a detailed network design to fulfil those requirements, the report also highlights aspects of subnetting, good device selection suggestions, interbranch routing, and maintenance in relation to the overall network design proposal.

1.2 Network Design Overview

The network design for Redco Developments aims to provide a secure and efficient method of connecting the Kandy and Galle offices while also being scalable. The device configurations was later simulated using Cisco Packet Tracer, while Microsoft Visio was used to create diagrams

1.3 Design of network structure using a design tool

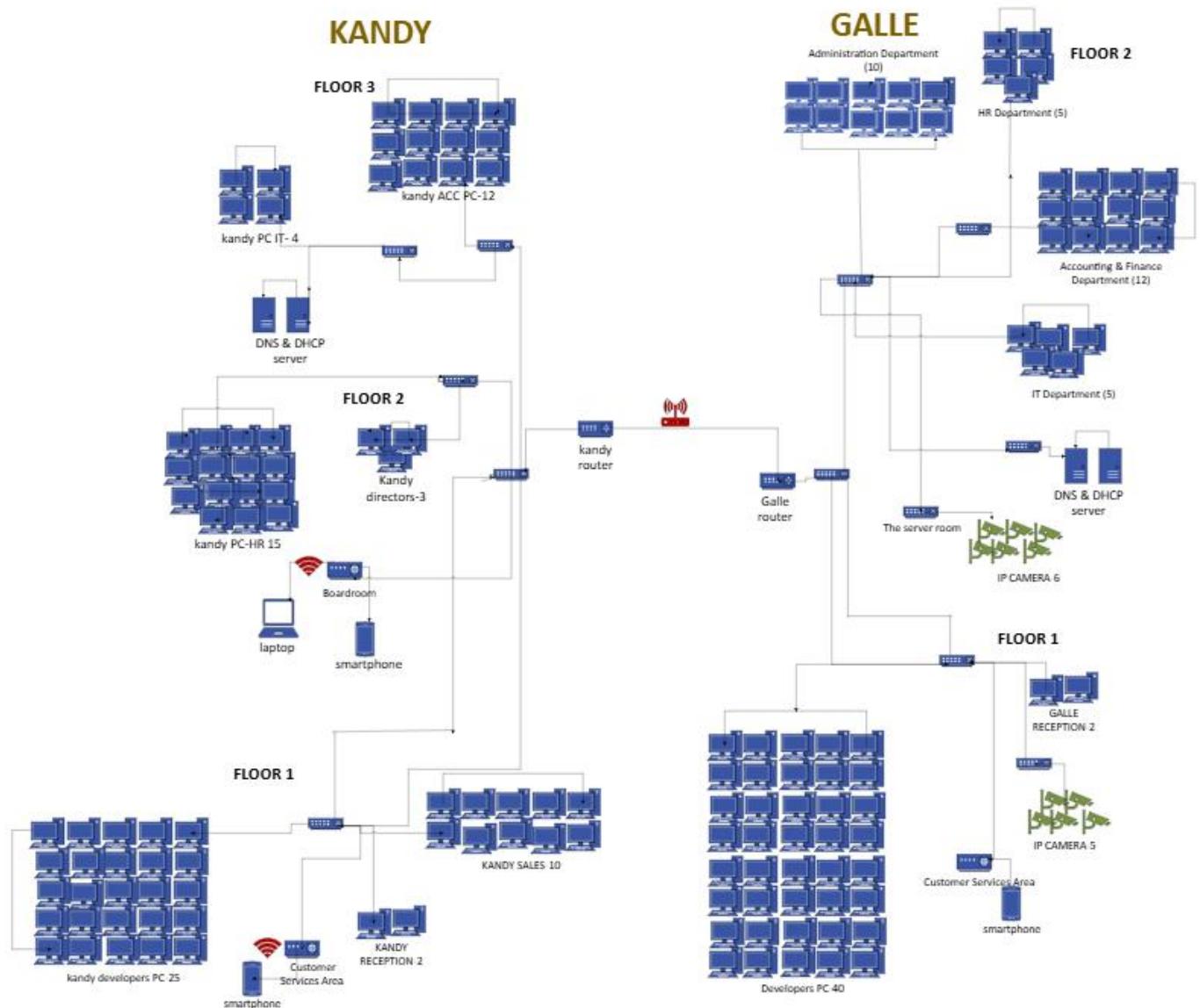


Figure 18: Complete Branch Network Overview

Source: (Author, 2025)

KANDY

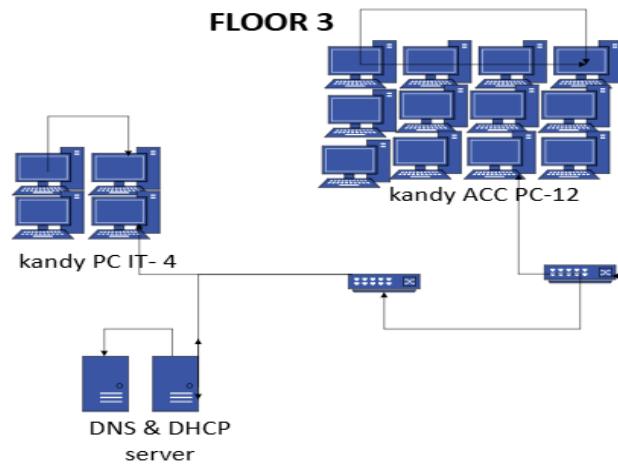


Figure 19: Kandy Branch Floor 3

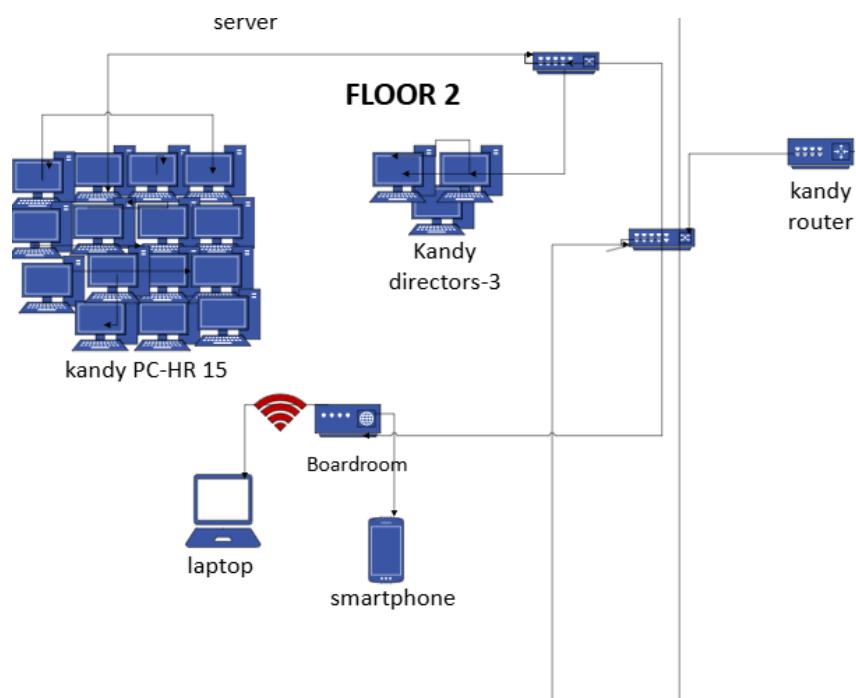


Figure 20: Kandy Branch Floor 2

Source: (Author, 2025)

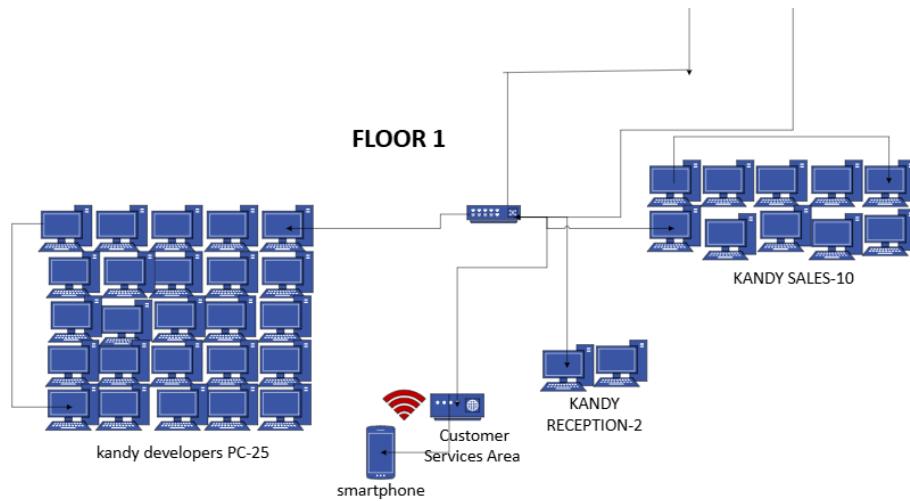


Figure 21: Kandy Branch Floor 1

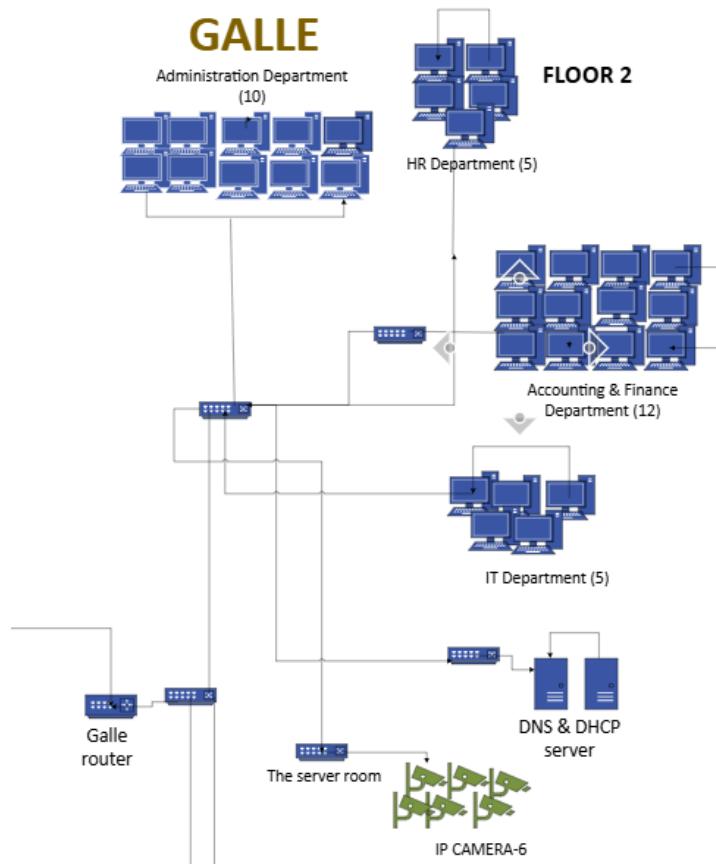


Figure 22: Galle Branch Floor 2

Source: (Author, 2025)

88

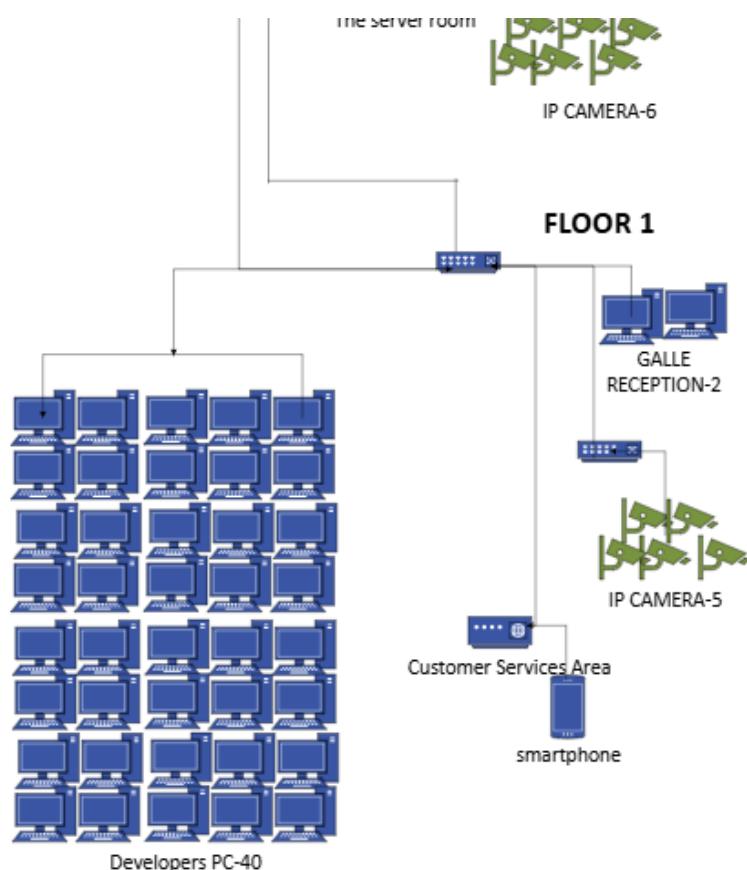


Figure 23: Galle Branch Floor 1

Source: (Author, 2025)

2. REDCO DEVELOPMENTS NETWORK MAINTENANCE SCHEDULE

Maintenance plan for Kandy head office and Galle branch

2.1 Daily Maintenance Tasks

Task	Device/System	Responsible	Time	Action Items	Expected Duration
Check network devices	All Switches & routers	IT support team	8:00 AM	Make sure lights are normal, no errors in logs, and branch links are working as well	30 min
DHCP Pool Monitoring	DHCP server	IT support team	8:30 AM	See if enough IPs are free and check for any duplicate IP problems	15 min
Check wifi performance	Wireless controller & APs	IT support team	9:00 AM	Test Wi-Fi, see if devices are online and passwords are secure	20 min
Check server	All Servers	IT support team	9:30 AM	Look at CPU/RAM usage, storage space	25 min
Check IP Cameras	IP Cameras (Galle)	Security Team	10:00 AM	Test if cameras are working and online, see if the video is clear, clean camera lenses	30 min

Table 3: Daily maintenance tasks

Source: (Internal IT Operations Schedule, 2025).

2.2 Weekly Maintenance Tasks

Task	Device/System	Responsible	Day	Action Items	Expected Duration
Switch Configuration Backup	all Switches	Network Admin	Sunday	Save switch settings and check backups work	45 min
Check router settings	Main router CORE-RTR-01	Network Admin	Monday	Make sure VLAN routing works	30 min

VLAN Optimization	L3 Switches	network admin	Tuesday	See if VLANs are used well, fix trunk links and check VLAN lists	60 min
Security check	All network devices	Security Team	Wednesday	Look at logs and make sure there are no any hack attempts	90 mi
Performance Analysis	entire network	Network Admin	Thursday	check network speed, and response time of the overall network	120 min
Check wifi	Wi-Fi controller & Access Points	Network Admin	Friday	Check Wi-Fi passwords and connection	45 min
Check cables	physical infrastructure	IT Support Team	Saturday	Make sure cables are connected properly	60 mi

Table 4: Weekly Maintenance Tasks

Source: (Enterprise Network Maintenance Plan, 2025).

2.3 Monthly Maintenance Tasks

Task	Device/System	Responsible	Week	Action Items	Expected Duration
Update firmware	All Network Devices	network admin	Week 1	Look for new updates and use them in the network	4 hours
Full security Review	Entire network	Security team	Week 2	update security rules and check who can access what for better protection	6 hours
Disaster recovery testing	Critical systems	IT Manager	Week 3	check recovery works and update documents	8 hours
Update network records	all systems	network admin	Week 4	Update IP addresses	3 hours
Improve performance	Core Infrastructure	Network Admin	Week 5	Check network traffic and improve routing	5 hours
Check physical setup	Data centers and cables	Facilities Team	Week 6	Clean equipment areas	4 hours
User Account Check	All Systems	HR + IT Teams	Week 7	Review user accounts and update access permissions	3 hours

				also remove inactive accounts	
Check backup systems	Backup systems	IT Support	Week 8	Backups	2 hours

Table 5: Monthly Maintenance Tasks

Source: (Author, 2025)

3. Redco Network User Feedback Survey

The following are some of the questions from my form:

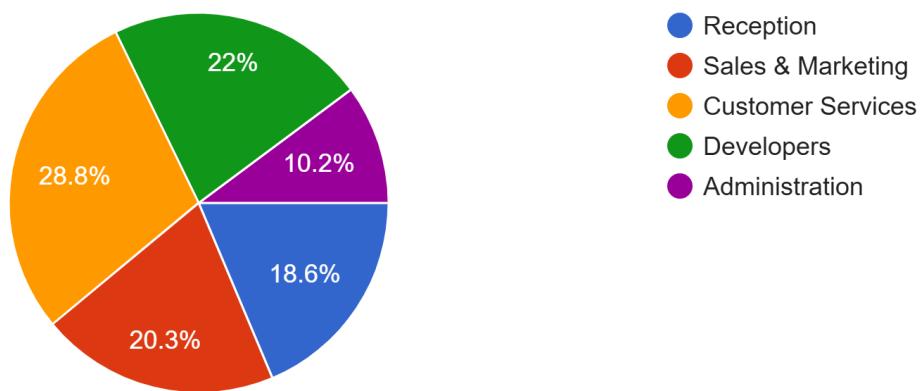
1. Which department do you work in?
2. Which branch office are you located in?
3. How would you rate the overall quality of your network connection?
4. Do you experience frequent disconnections or lag while using the internet or network services?
5. How satisfied are you with the speed of the Wi-Fi in your area (if applicable)?
6. How easy was it to connect to the Wi-Fi network in your department?
7. Do you have access to the network resources you need (shared drives, printers, servers, etc.)?
8. Have you faced any issues accessing or using the smart devices (e.g., auto lighting, smart gates, IP cameras)?
9. Do you feel the network is secure and safe to use (passwords, firewalls, no unauthorized access, etc.)?
10. Have you contacted IT support for network-related issues? If yes, how satisfied were you with the support received?
11. Are the video conferencing and ERP systems working smoothly without delays or interruptions?
12. Any suggestions or feedback to improve the network performance or features?

https://forms.gle/AazPwb2SGrvxxwDA_ Google Form link for the feedback

3.1 Feedback Form Responses

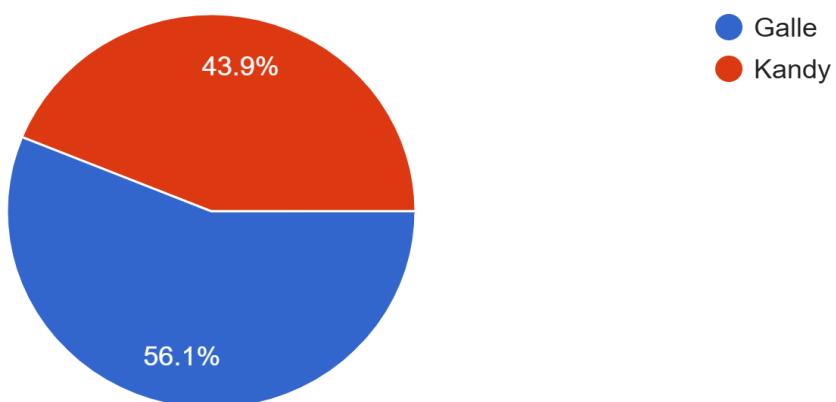
Which department do you work in?

59 responses



Which branch office are you located in?

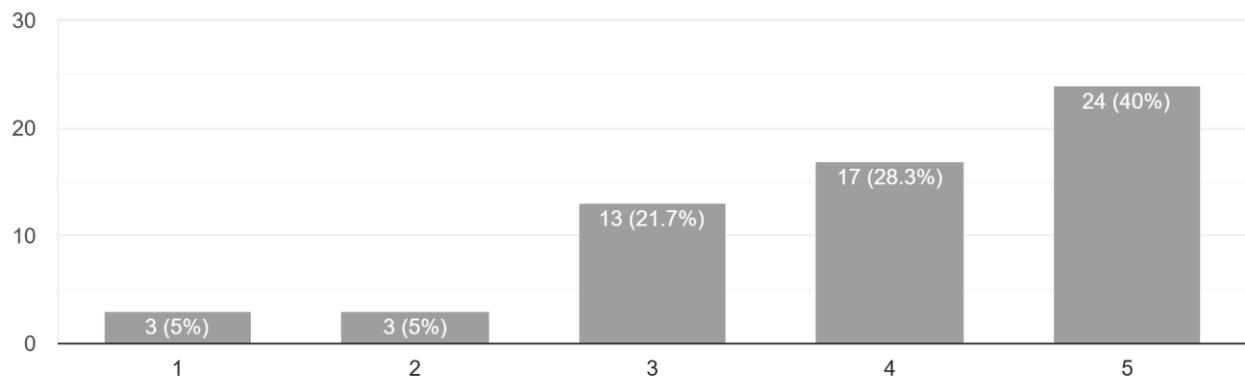
57 responses



Source: (Author, 2025)

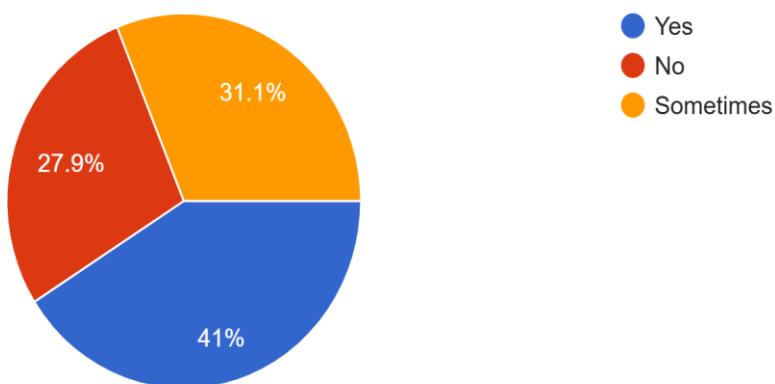
How would you rate the overall quality of your network connection?

60 responses



Do you experience frequent disconnections or lag while using the internet or network services?

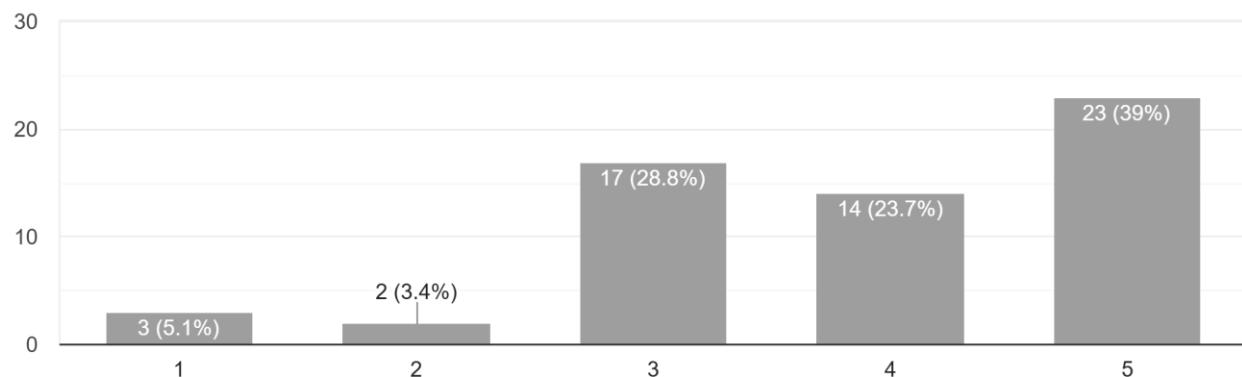
61 responses



Source: (Author, 2025)

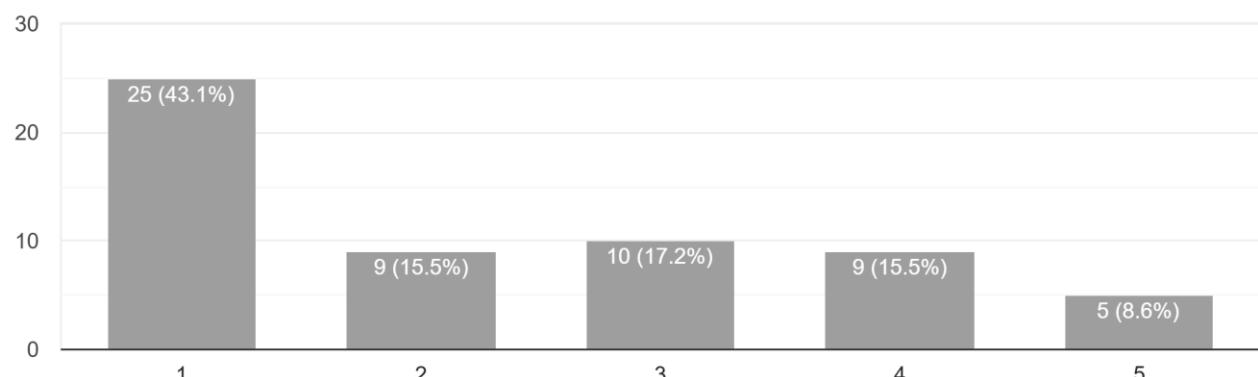
How satisfied are you with the speed of the Wi-Fi in your area (if applicable)?

59 responses



How easy was it to connect to the Wi-Fi network in your department?

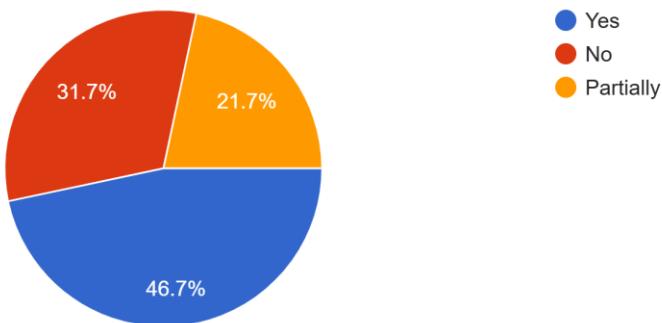
58 responses



Source: (Author, 2025)

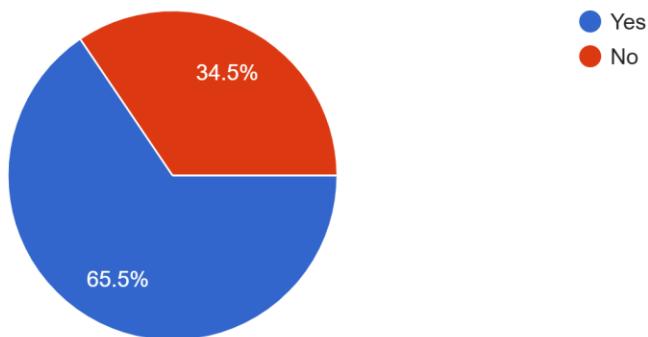
Do you have access to the network resources you need (shared drives, printers, servers, etc.)?

60 responses



Have you faced any issues accessing or using the smart devices (e.g., auto lighting, smart gates, IP cameras)?

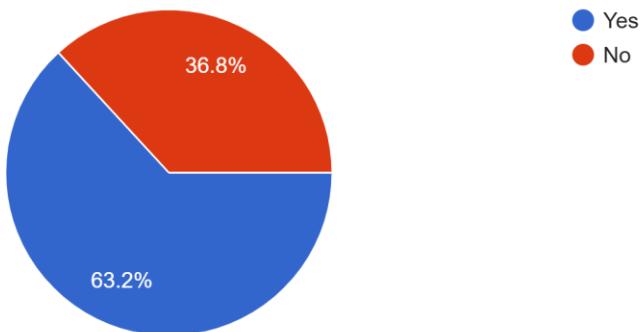
58 responses



Source: (Author, 2025)

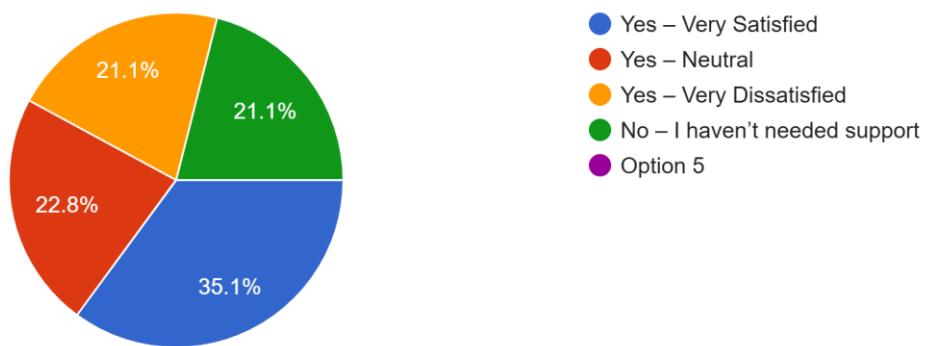
Do you feel the network is secure and safe to use (passwords, firewalls, no unauthorized access, etc.)?

57 responses



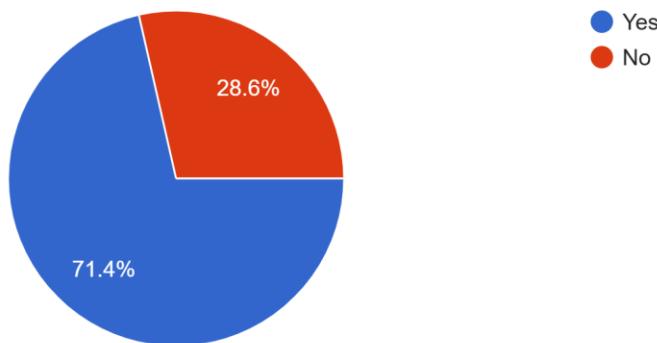
Have you contacted IT support for network-related issues? If yes, how satisfied were you with the support received?

57 responses



Source: (Author, 2025)

Are the video conferencing and ERP systems working smoothly without delays or interruptions?
56 responses



Any suggestions or feedback to improve the network performance or features?

9 responses

Allow employees to report network issues through a quick online form.

great

The Wi-Fi password should be updated regularly for better security.

The smart gate is a bit slow to respond. A system check might help.

More training on using ERP features would be helpful.

Consider providing a short guide on connecting to printers or shared drives.

I love hello kitty

More IP cameras in key areas could improve security.

Sometimes the Wi-Fi signal is weak in the corners of the office maybe add more access points.

Source: (Author, 2025)

98

3.2 Evaluation of Proposed Design Based on User Feedback

After reviewing and analysing the user comments and responses it seems as if most the users were satisfied with the network performance and its systems but however, there are several items to review if Redco wants to improve:

- 1. connectivity issues:** The users who submitted feedback that experienced disconnections or lagging which means that approximately 55% of these users had such issues and this needs to be considered and resolved, so we need to potentially upgrade hardware to help end users with more stability in connectivity.
- 2. Wi-Fi Coverage and speed:** 60% of users provided good to very good in Wi-Fi speed but still there were 15% other responses that were not satisfied the Wi-Fi speed at all. So we should help them with proper wifi solutions and even add additional access points
- 3. Access to network resources:** people said that they had only some access to areas of network resources or were unable to gain access to common users network resources and it is very important the permissions is configured properly for users to have an easy access to shared drives, printers, servers, etc (Cisco, 2023).
- 4. Smart devices:** Some users said that Smart Devices such as auto light, smart gates systems were having performance issues so we need to integrate each potential wireless device, so that the company can benefit from them as well

3.3 Other Improvement Recommendations

check infrastructure: take a look at the network infrastructure to isolate the any bottlenecks and issues

Access points: we could place the access points at different locations so that we can cover the poor wifi areas and improve the connection issues with WiFi 6

Increase IT support training: by providing additional IT support and training will imporve IT teams ability to address and fix errors in the network (CompTIA, 2024).

In conclusion to that, by correcting these areas and issues Redco Developments can improve the reliability and efficiency of its network infrastructure as this can improve the overall user satisfaction and support the company's future goals as well

3.4 Network Devices Selected and Their Uses

Device Type	Packet Tracer Model	Use in Redco Network Design
Core Router	cisco 4331 ISR	This is used for branch communication between Kandy and Galle branch
Layer 3 Switch	cisco 3650-24PS	Does Inter VLAN routing and segmentation.
Access Switch	cisco 2960-24TT	Gives port level connectivity to PCs, IP phones, APs, etc and so on (Cisco, 2024)
Wireless Controller	cisco 2504 WLC	helps to manage wireless Access Points
Access Points	cisco Aironet 1140	Provides Wi-Fi access to mobile users in Redco
Server	server-PT	Hosts DHCP, DNS (Cisco, 2024)
IP Cameras	IP Phone (as Camera)	This is used for physical security purposes in the Galle branch of redco

Table 6: Network Devices

3.5 VLAN Configuration and IP Settings for departments

For security and like segmentation purposes VLAN are used in each department additionally a Inter-VLAN routing is done by the layer 3 switch in each branch of Kandy and Galle (KANDY-L3SW-01

100

& GALLE-L3SW-01) these VLANs can improve the traffic efficiency and help in to enforce a good access policies

Example VLANs:

Department	VLAN ID	Subnet	Gateway IP
developers	10	200.100.10.0/27	200.100.10.1
sales and marketing	20	200.100.10.32/28	200.100.10.33
reception	30	200.100.10.48/30	200.100.10.49
customer service (WiFi)	40	200.100.10.52/28	200.100.10.53
director suites	50	200.100.10.68/29	200.100.10.69
boardroom (WiFi)	60	200.100.10.76/29	200.100.10.77
admin dept	70	200.100.10.84/28	200.100.10.85

Table 7: VLAN configuration and IP Settings

3.6 Assumptions in Redco Subnetting

- Each department will receive a dedicated and assigned subnet and VLAN
- IP address range 200.100.10.0/24 is used for Kandy branch of Redco
- IP address range 200.100.20.0/24 is used for Galle branch of Redco
- 200.100.50.0/24 will be reserved for any server infrastructure and static IP address applications.
- Wireless users and devices with hybrid roles will be added to the host requirements when needed for example sales with wifi.
- Inter-VLAN Traffic will be routed and performed by the L3 switch with SVI (Switch Virtual Interface)

3.7 IP Subnetting Scheme Calculation

For each subnet:

- Host required will be calculated.
- next closest size subnet will be selected and choosed
- Network Id, usable range, broadcast address and subnet mask will be defined and determined as well.

Example; Developer's Department (25 Hosts)

- Need: 25 IPs.
- Closest Subnet: /27 (32 IPs total, 30 usable).
- Subnet: 200.100.10.0/27.
- Usable IPs: 200.100.10.1 - 200.100.10.30
- Broadcast: 200.100.10.31.

3.8. VLAN & IP Subnetting Scheme for Kandy Branch

Department	Hosts Needed	VLAN ID	Subnet Address	Subnet Mask	Gateway IP	Usable IP Range	Broadcast Address
Developers	25	10	200.100.10.0/27	255.255.255.224	200.100.10.1	200.100.10.2 – 200.100.10.30	200.100.10.31
Sales & Marketing	15	20	200.100.10.32/28	255.255.255.240	200.100.10.33	200.100.10.34 – 200.100.10.46	200.100.10.47
Reception	2	30	200.100.10.48/30	255.255.255.252	200.100.10.49	200.100.10.50 – 200.100.10.50	200.100.10.51
Customer Services	10	40	200.100.10.52/28	255.255.255.240	200.100.10.53	200.100.10.54 – 200.100.10.66	200.100.10.67
Director Suites	3	50	200.100.10.68/29	255.255.255.248	200.100.10.69	200.100.10.70 – 200.100.10.74	200.100.10.75
Boardroom	5	60	200.100.10.76/29	255.255.255.248	200.100.10.77	200.100.10.78 – 200.100.10.82	200.100.10.83
Admin	15	70	200.100.10.84/28	255.255.255.240	200.100.10.85	200.100.10.86 – 200.100.10.98	200.100.10.99

Figure 24: VLAN and IP subnetting scheme-Kandy Branch

3.9. VLAN & IP Subnetting Scheme for Galle Branch

Department	Hosts Needed	VLAN ID	Subnet Address	Subnet Mask	Usable IP Range	Broadcast Add
Developers	25	10	200.100.20.0/27	255.255.255.224	200.100.20.1 – 200.100.20.30	200.100.20.31
Sales & Marketing	15	20	200.100.20.32/28	255.255.255.240	200.100.20.33 – 200.100.20.46	200.100.20.47
Reception	2	30	200.100.20.48/30	255.255.255.252	200.100.20.49 – 200.100.20.50	200.100.20.51
Customer Services	10	40	200.100.20.52/28	255.255.255.240	200.100.20.53 – 200.100.20.66	200.100.20.67
Director Suites	3	50	200.100.20.68/29	255.255.255.248	200.100.20.69 – 200.100.20.74	200.100.20.75
Boardroom	5	60	200.100.20.76/29	255.255.255.248	200.100.20.77 – 200.100.20.82	200.100.20.83
Admin Department	15	70	200.100.20.84/28	255.255.255.240	200.100.20.85 – 200.100.20.98	200.100.20.99

Figure 25: VLAN and IP subnetting scheme-Galle Branch

3.10 How to Calculate a VLAN.

1. Identify logical groups based on departments and functional units.
2. Assign each group a unique VLAN ID, for example, 10 for Developers, 20 for Sales
3. Configure VLANs on Layer 3 switches:

```
vlan 10
  name Developers
vlan 20
  name Sales
```

3. Assign switch ports to VLANs by:

```
interface GigabitEthernet0/1
  switchport access vlan 10
```

4. Configure SVIs for inter-VLAN routing:

```
interface vlan 10
  ip address 200.100.10.1 255.255.255.224
  no shutdown
```

3.11 How to Calculate the Network ID

The Network ID will always be the first IP in a subnet block. For example, for the subnet 200.100.10.32/28;

- Binary Block = 200.100.10.00100000 (32)
- Network ID = 200.100.10.32

3.12 How to Calculate the Broadcast ID

The Broadcast Address is always the last IP in a subnet block. We calculate it using:

1. Take the Network ID of a subnet block, and its size, and add to the Network ID and subtract 1
2. Example /28:

- Network: 200.100.10.32
- Subnet Size: 16 IPs
- Broadcast = 200.100.10.47

3.13 How to Calculate IP Range

- Usable IP range = Network ID + 1 to Broadcast Address - 1

- Example:

Network ID = 200.100.10.32

Broadcast = 200.100.10.47

Usable IPs = 200.100.10.33 to 200.100.10.46

Importance of VPN (Virtual Private Network)

VPN is important for Redco network since it provides a secure connection between the Kandy and Galle branches through the internet and services, the VPN for Redco development is like creating an encrypted tunnel between the two sites in two different cities allowing them to exchange data and information without being subject to eavesdropping or interception (Cisco, 2023). This is very important for Redco because they have sensitive mobile company data such as ERP access, file transfers, internal communications between departments and branches that is entering and leaving an organisation's infrastructure and therefore needs to be securely transferred between the two physically separate locations Galle and Kandy, and also using a VPN is a cost effective which can help to achieve a secure private communications

The Cisco 4331 ISR routers at the two sites will be used in order to easily configure this VPN. These routers support a number of VPN protocols ,IPsec for example which can help to encrypt and protect the all traffic as it travels between branches and gives management the assurance of secure WAN communications this also gives the Redco employees in both branches the ability to communicate and

work as if they are on the same local network and can help support the idea of centralised resource access by employees at both site.

Importance of VLAN (Virtual LAN)

Using VLANs the Redco developments can logically separate each department such as Developers, Admin, Sales, Customer Service and still use the same physical network hardware like switches by allowing the department to be their own logical network (Cisco, 2023).

This segmentation of these departments will improve the security and the network performance as well for example the Developers department can be placed in VLAN 10, sales in VLAN 20 and so on as each VLAN will contain and have its own broadcast traffic, thus this will not congest the overall network and access can be controlled for instance, Sales should not be able to access Sales files in the Admin VLAN without a permission.

Redco will use Layer 3 switches like Cisco 3650 to route network traffic between the VLANs as routing between VLANs or inter-VLAN routing, happens using Switch Virtual Interfaces (SVIs). The SVIs act like a gateways for the VLAN therefore this allows communication between Departments when it is necessary and needed. Moreover, by using VLANs the networks becomes easier to manage and grow as the new departments and floors are added, the new VLANs can be created easily without having to do the entire network setup again (Cisco, 2024).

Conclusion

In conclusion to that a virtual private network (VPN) is necessary and needed for safe a communication between Redco's Galle and Kandy offices in two different cities of Srilanka enabling the safe transfer of private information and data over the internet also within each branch. Additionally VLANs are similarly important as well because they guarantee security and safety and effective traffic management across various departments of Redco therefore both technologies work together to create a secure network for Redco Developments and its branches.

D2 Critically reflect on the implemented network, including the design and decisions made to enhance the system.

critically analyse the impact of network structure in Redco

The network design used for Redco Developments is an important part of handling Redco Developments day to day, future projects and growth with the new movement in Galle infrastructure, the solution is designed to help the company grow and maintain information flow as well for a mobile development company.

By separating their departments with their own identified subnets will help to improve security and traffic control and reduced broadcast traffic onto the network and as well offers some isolation to individuals or departments in case something goes wrong should there be a known security risk, moreover with Inter-VLAN routing the employees in Galle and Kandy can speak to each other across departments while maintaining some degree of ownership across communication boundaries of the organisations data. The centralization of services like DHCP and Active Directory located in the server rooms of both facilities allows for improved usability and control of devices and users (CompTIA, 2022). Also by each assigning of an end device automatically takes care of license keys, user access, user passwords, and assigning IP address allocations. While using static IPs for servers should both security and access policies relatively simple to navigate when the two subnets were allocated within (Microsoft, 2023).

It even allows for the use of Wi-Fi in public areas like the shared conference room or customer services giving access to connection specifically designed to keep mobile with the Sales and Marketing team.

The IP subnetting based on the given ranges provided earlier (200.100.10.0/24 for Kandy and 200.100.20.0/24 for Galle) shows good to plan for eventual growth as each department has their own subnet which will make it more manageable to add more devices easily in the future without having to redo the entire scheme. The addition of smart devices such as IP cameras, smart gates, lighting systems in Galle makes the network more modern without increasing the network traffic too much

Recommendations for Future Enhancements

1. Implement a centralized monitoring and management system

A network monitoring system such as SolarWinds or PRTG allows teams to gain understanding of performance, fault availability, and provides insights into who is consuming bandwidth as well as trends over time to help avoid a serious incident before it becomes a service issue (Paessler, 2023).

2. Upgrade to redundant links and high availability

As the business expands business continuity will rely on redundancy in the connections between Kandy and Galle such as VPN failover or duplicate ISP links particularly for accessing cloud services or central databases.

3. Hybrid architecture and cloud integration

A Cloud hosting can lower server maintenance and improve accessibility for some services such as email, ERP systems, also a hybrid model ensures a backups and cost effectiveness and this can save money for Redco Developments.

4. Enhanced security measures

Redco Developments can prevent cyberattacks if intrusion detection systems (IDS), firewalls, and frequent patch management are used at both branch levels to ensure good safety of clients information as the firm has holds sensitive data that can put peoples live to threat therefore is highly recommended for a mobile development company.

Critical Reflection on the Implemented Network

The network was designed to be secure, fast, and to be able to grow in the future and we used VLANs and RIP routing so Kandy and Galle branches can communicate well. Moreover, DHCP was used to give IP addresses automatically and we tested everything in Cisco Packet Tracer and it all worked

correctly and successfully. However supporting both Wi-Fi and wired users was a big challenge so we used Ethernet for strong connection and Wi-Fi where needed (Stallings, 2022).

Also, servers were given fixed IPs to avoid issues and make management easier. Adding IP cameras in Galle was a smart choice but needed careful plan for speed and security so we used subnetting to manage this while leaving room for future devices as well.

Conclusion

The state of the current network architecture at Redco shows and provides the ability for scalability, security, and operational efficiency. The design can help and support the current operational requirements as well as any future developments for growth, also allowing for any future increases in devices, workload, staff that a growing development company may face and help it achieve its future goals

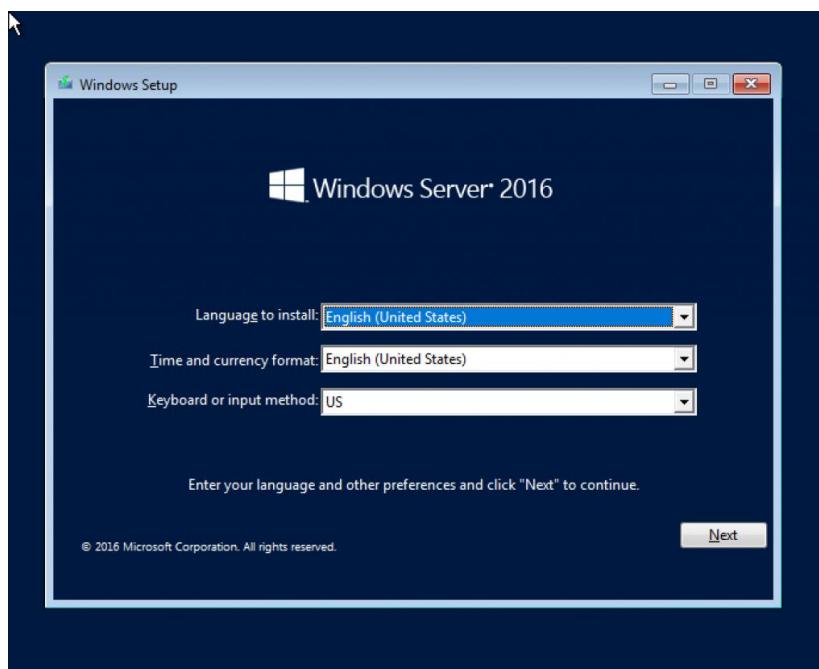
Screenshots showing the following steps for configuration

Figure 26: Server installation – choose of language

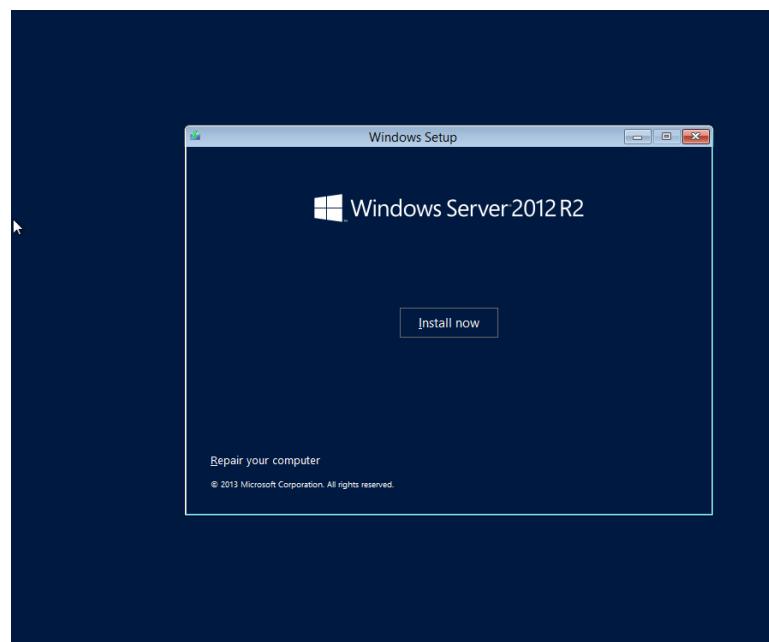


Figure 27: Windows setup Server 2012 R2

Source: (Author, 2025)

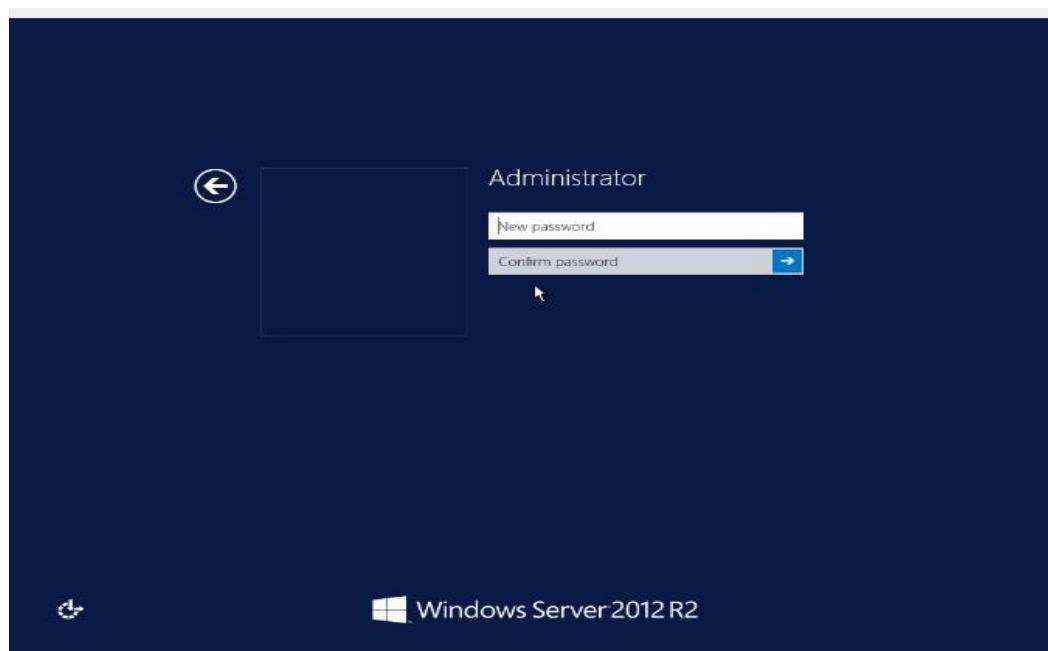


Figure 28: Server Installation - Administrator password configuration

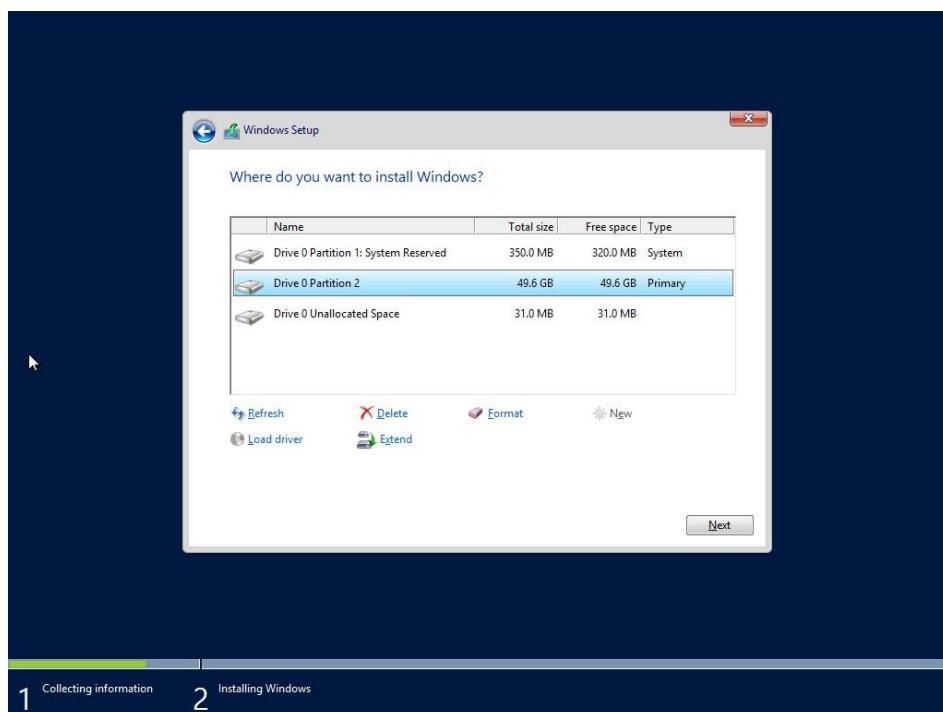


Figure 29: windows setup collecting information

Source: (Author, 2025)

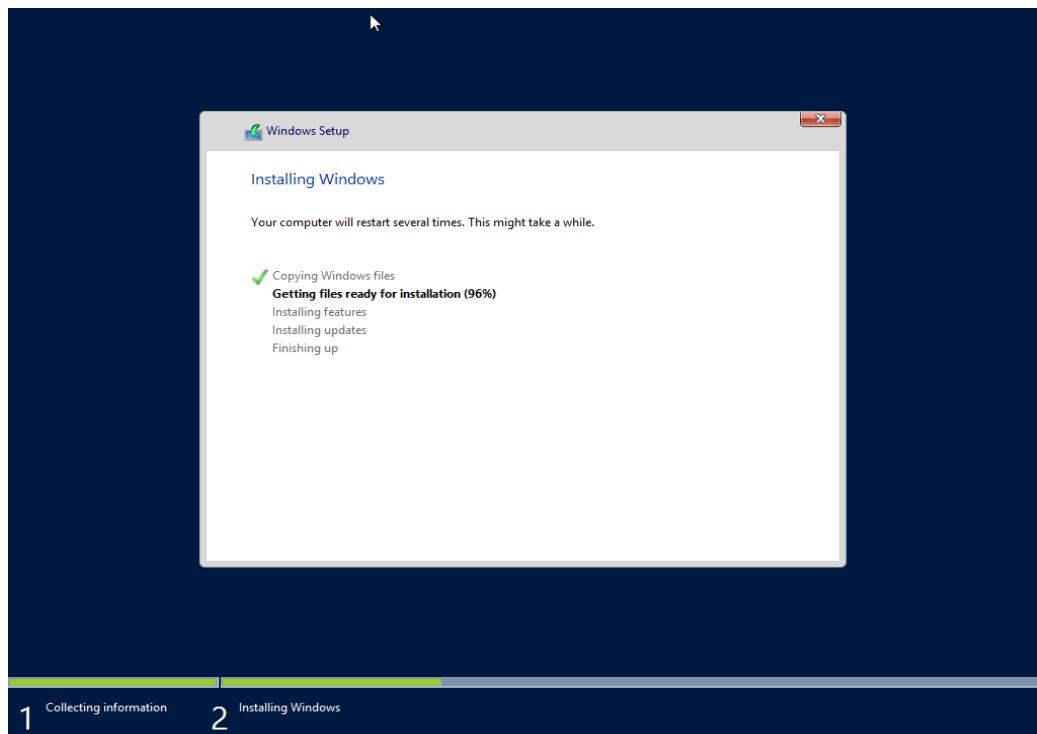


Figure 30: Installing windows

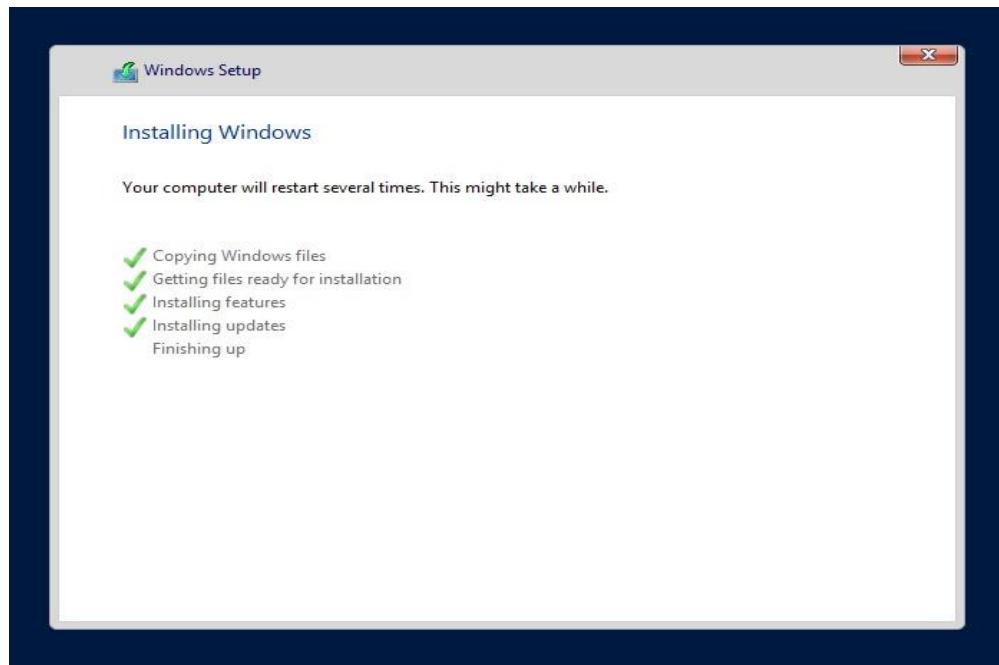


Figure 31: Windows installation in progress

Source: (Author, 2025)

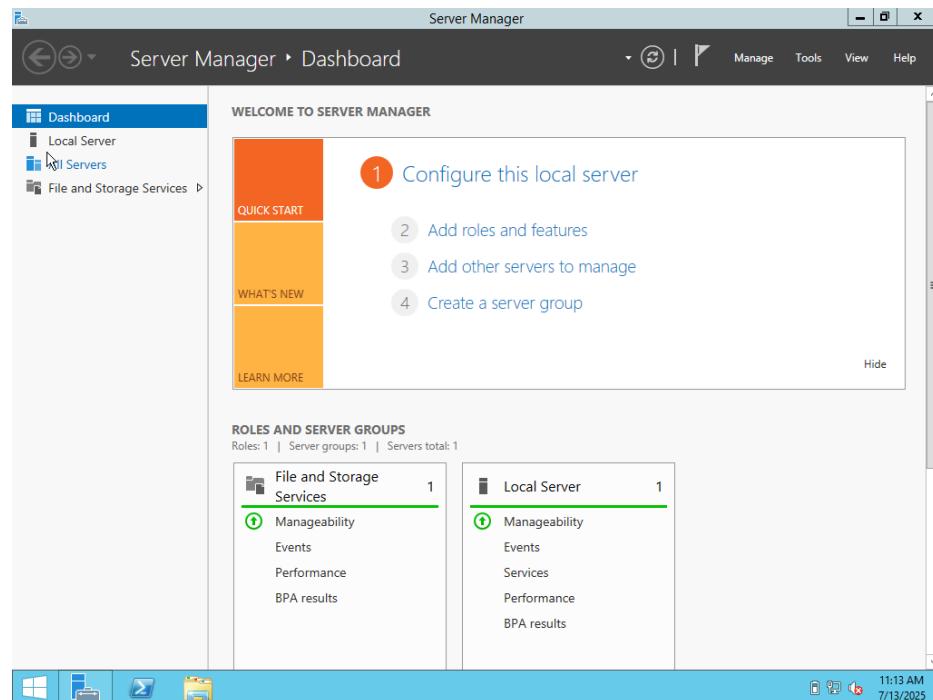


Figure 32: Server manager dashboard

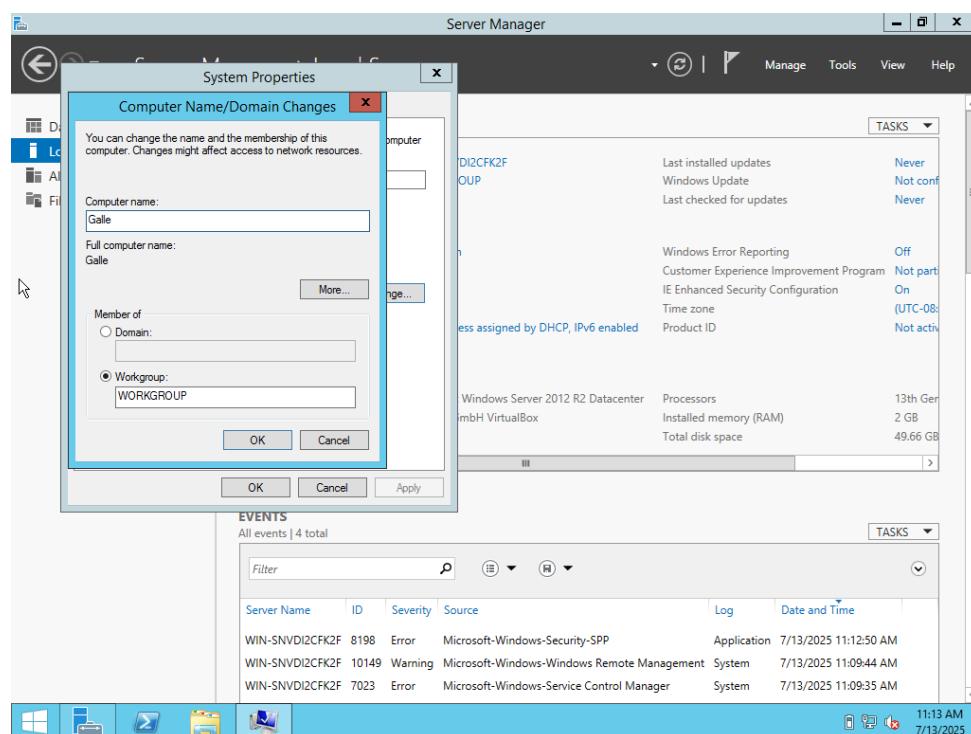


Figure 33: changing computer name in system properties

Source: (Author, 2025)

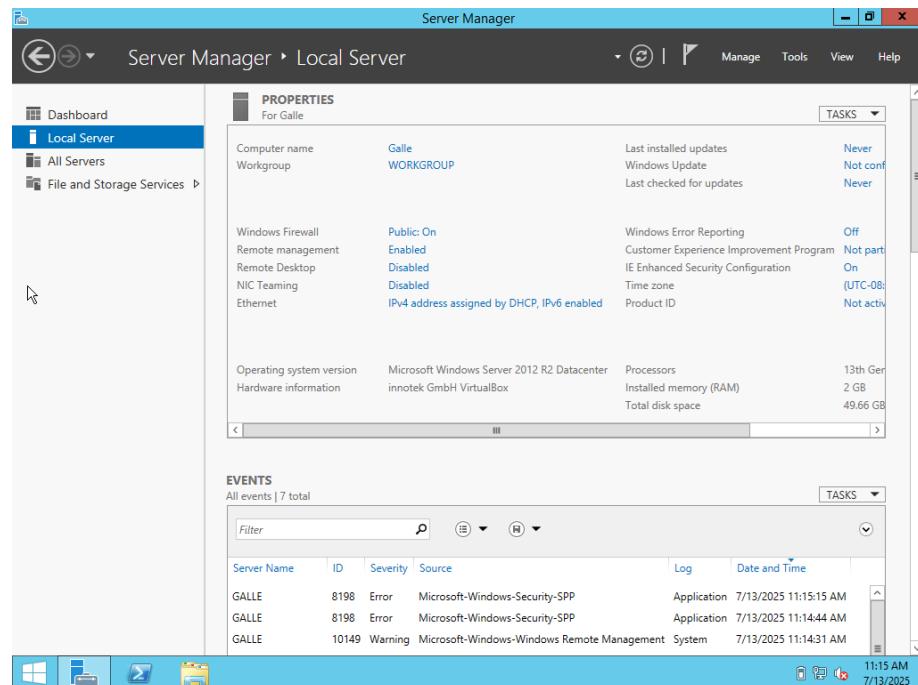


Figure 34: updated computer name

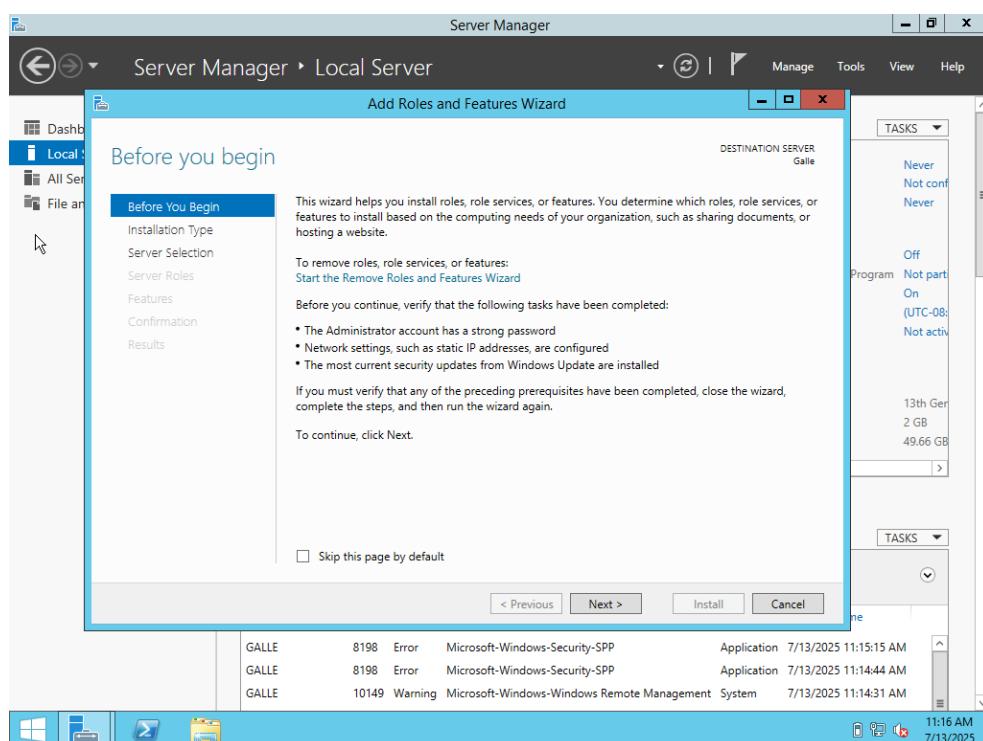


Figure 35: Adding roles and features wizard

Source: (Author, 2025)

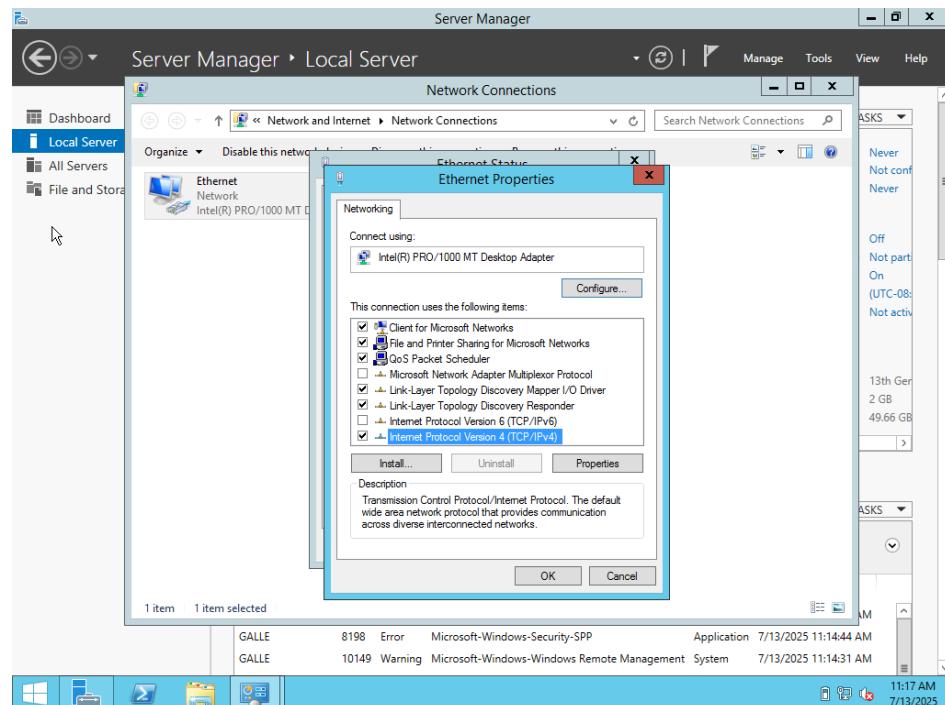


Figure 36: network protocol settings in ethernet properties

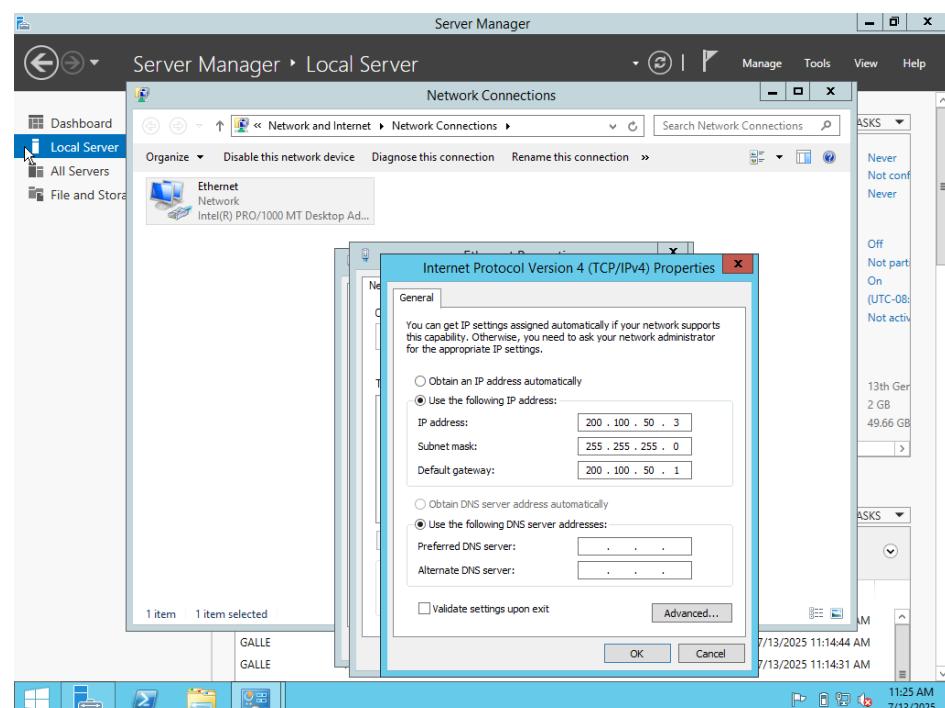


Figure 37: setting IP address, subnet masks and default gateway

Source: (Author, 2025)

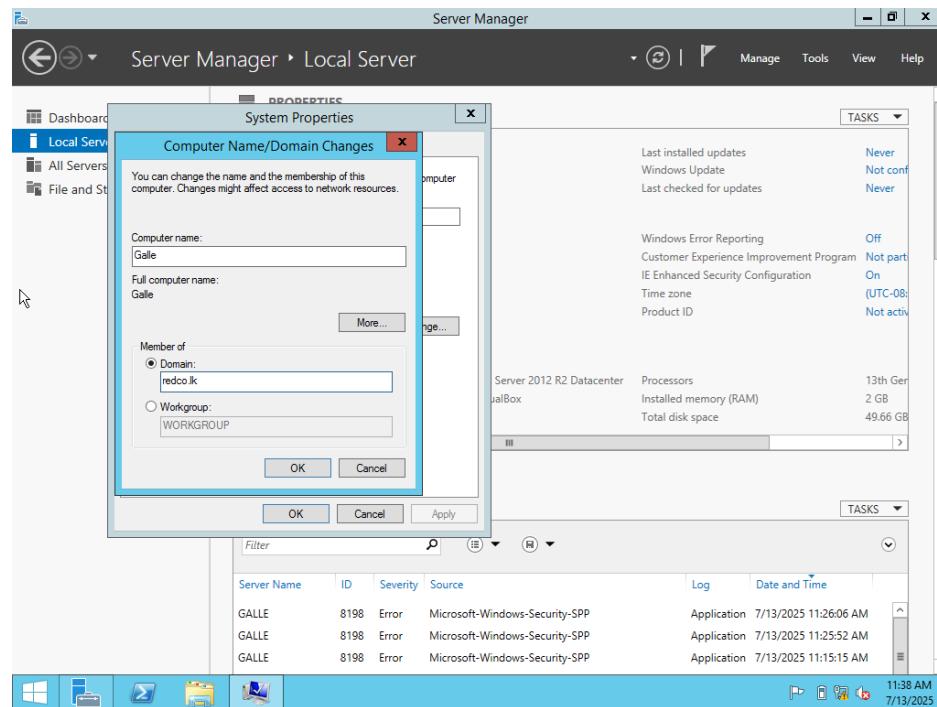


Figure 38: changing the domain name in system properties

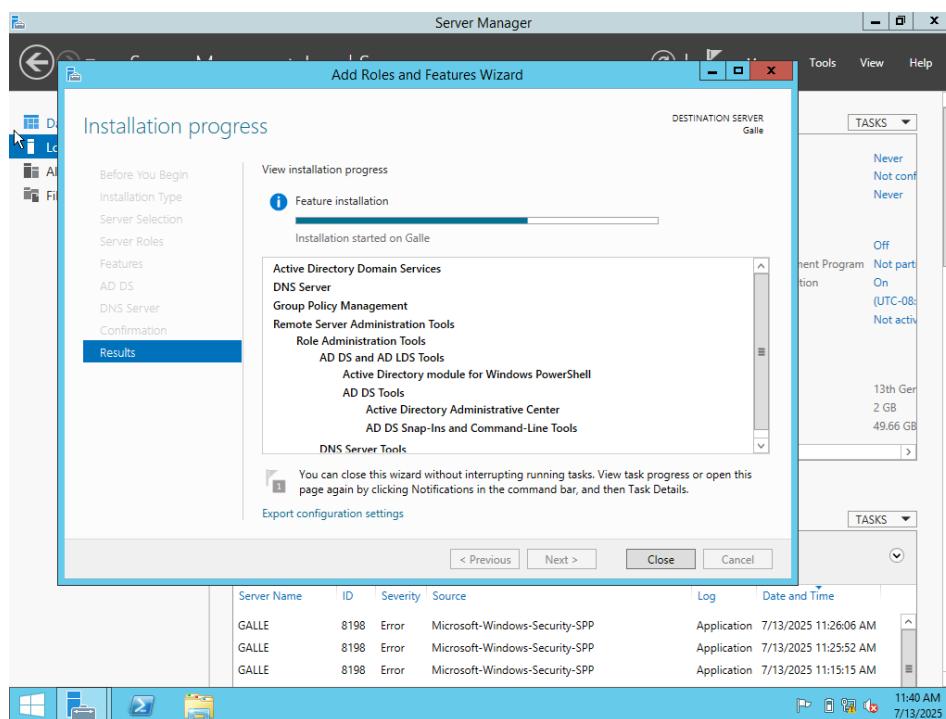


Figure 39: adding roles and features wizard

Source: (Author, 2025)

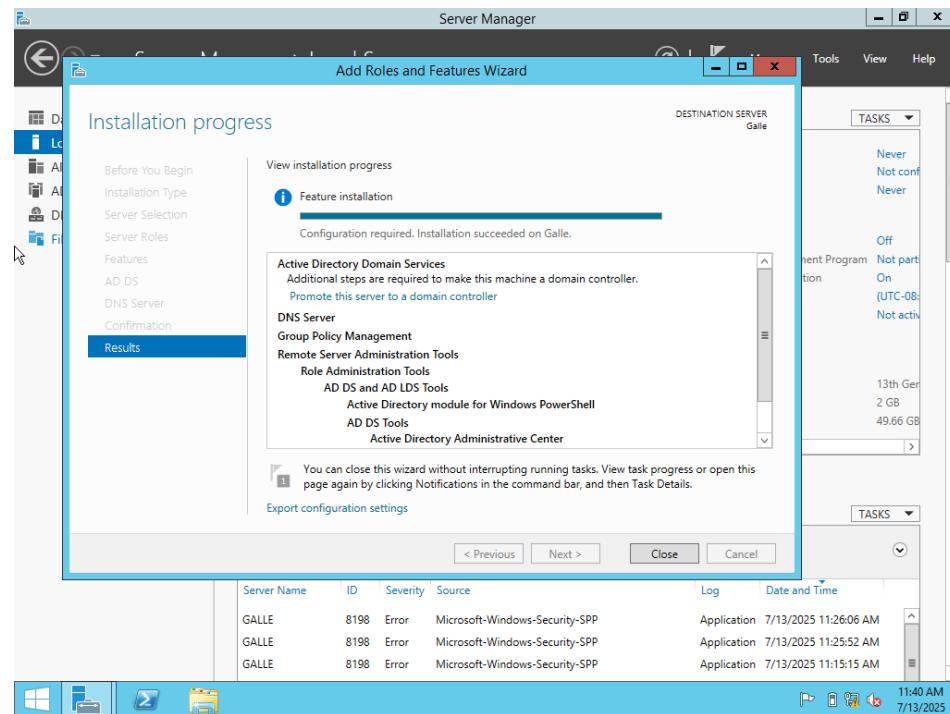


Figure 40: feature installation

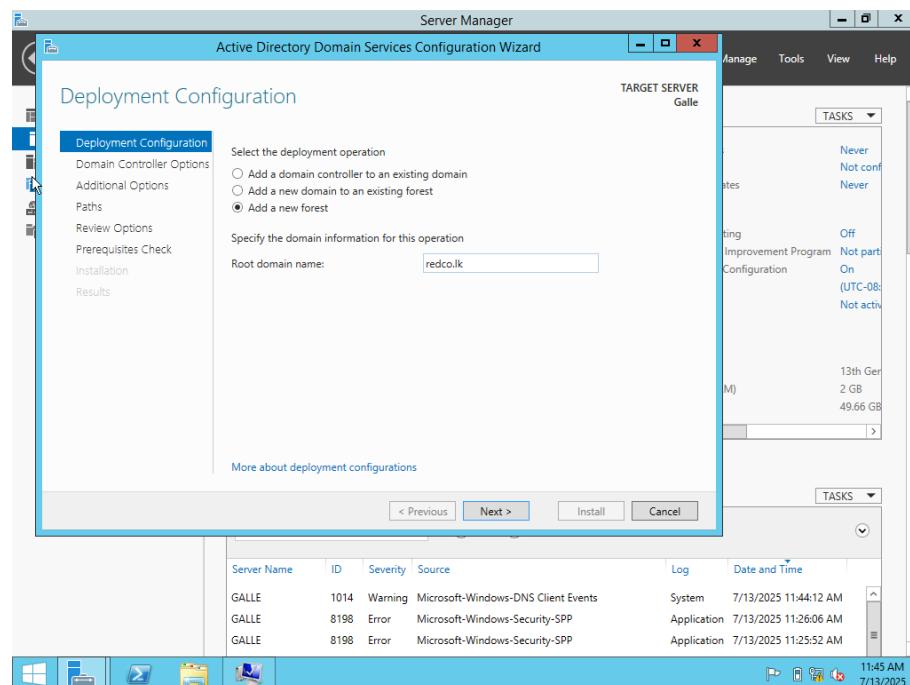


Figure 41: adding a new forest

Source: (Author, 2025)

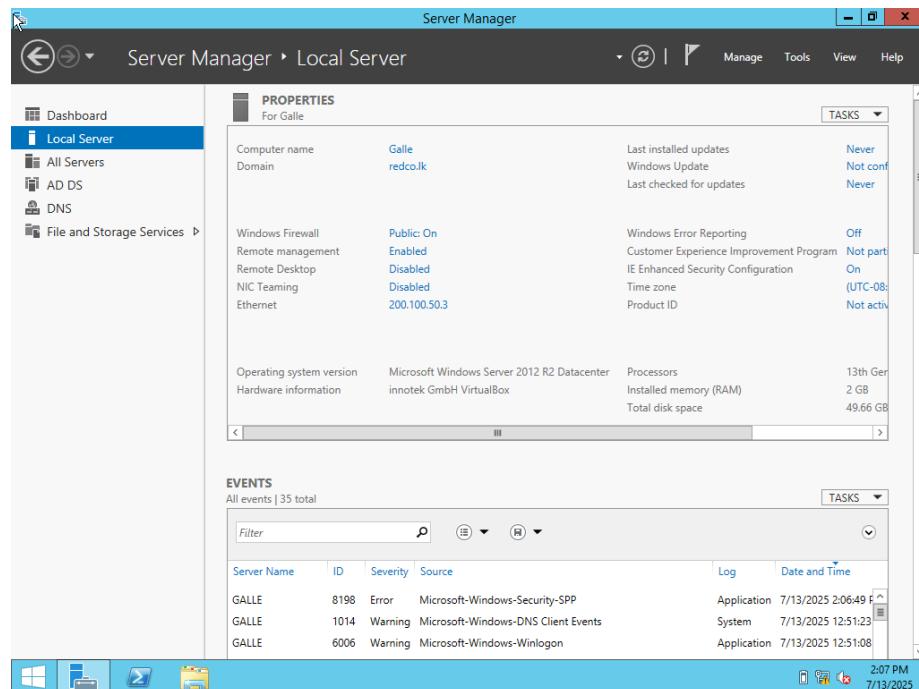


Figure 42: updated local server

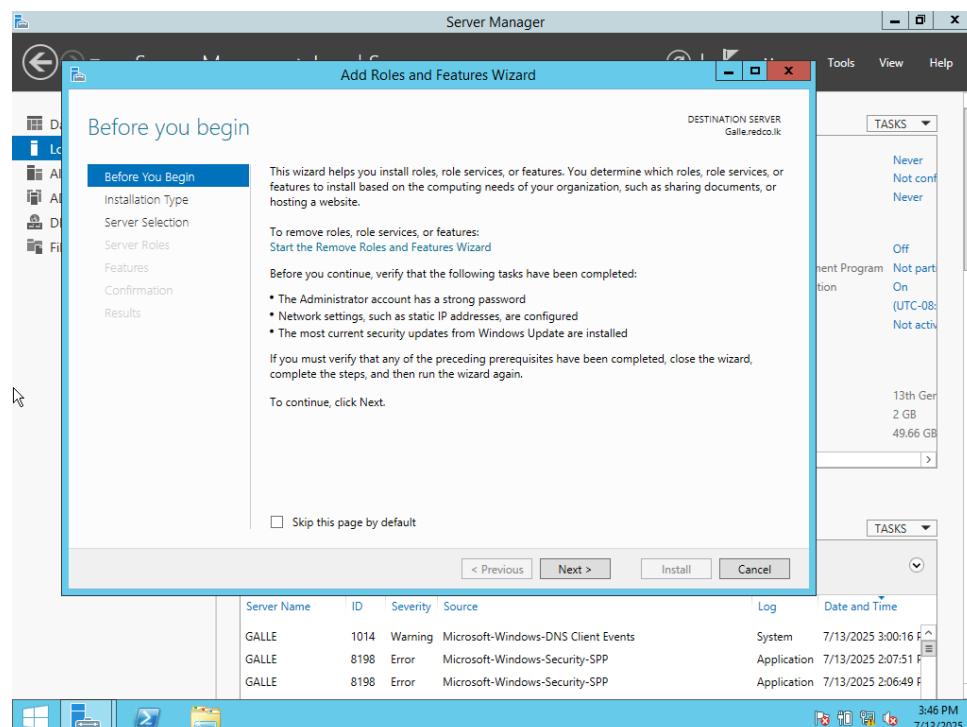


Figure 43: adding roles and features wizard

Source: (Author, 2025)

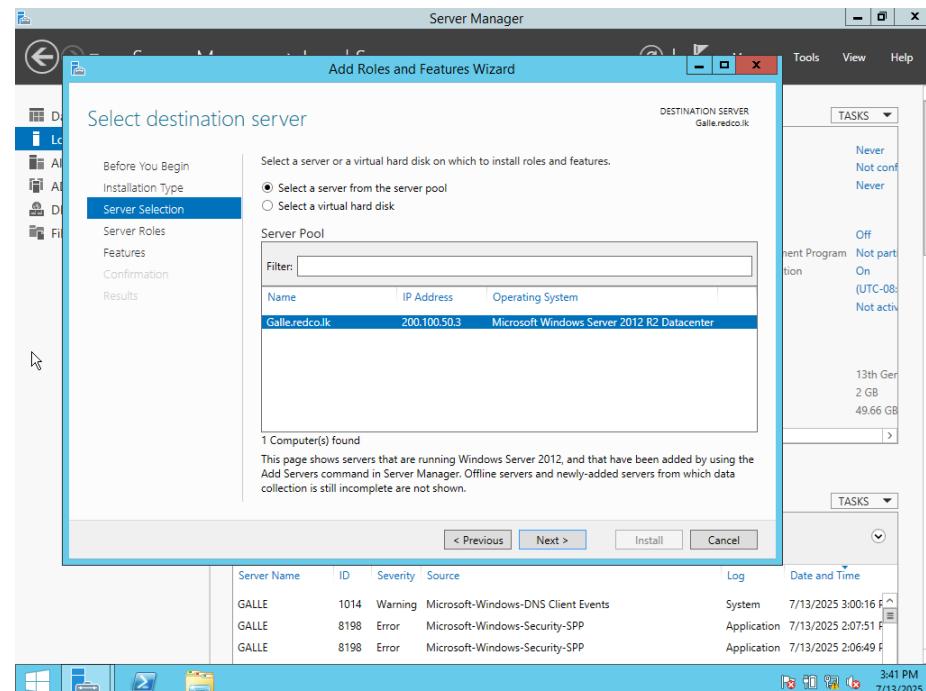


Figure 44: selecting the server from the server pool

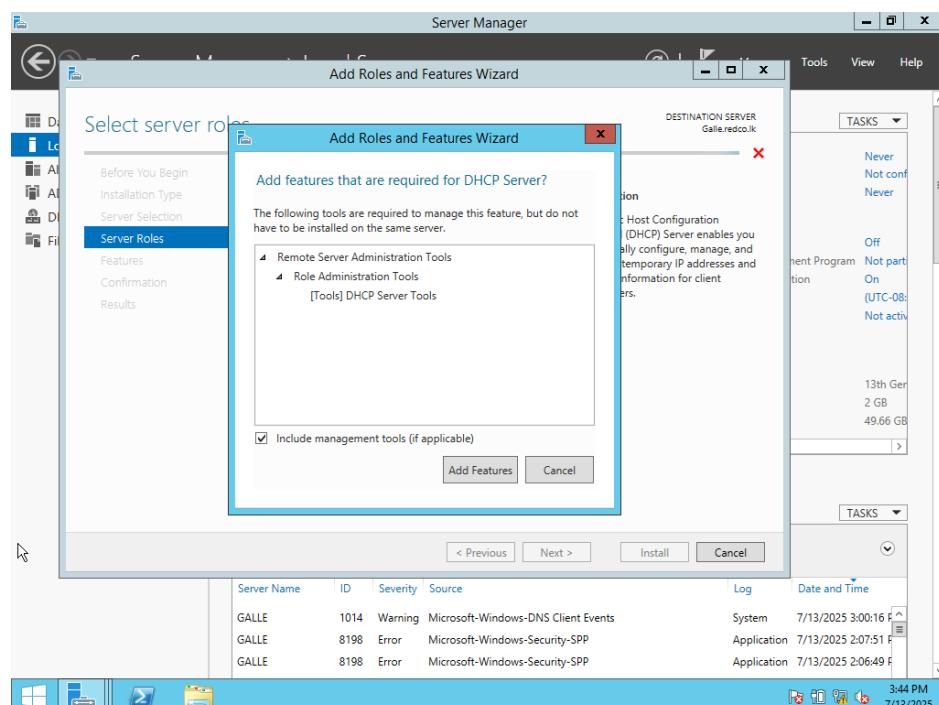


Figure 45: adding features needed for DHCP server

Source: (Author, 2025)

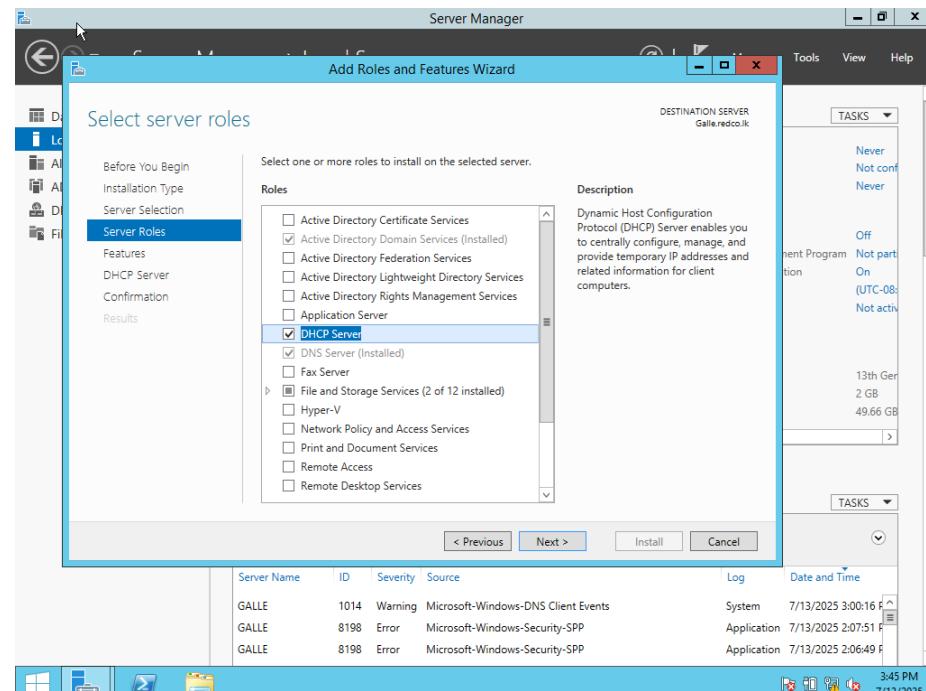


Figure 46: selecting DHCP server role

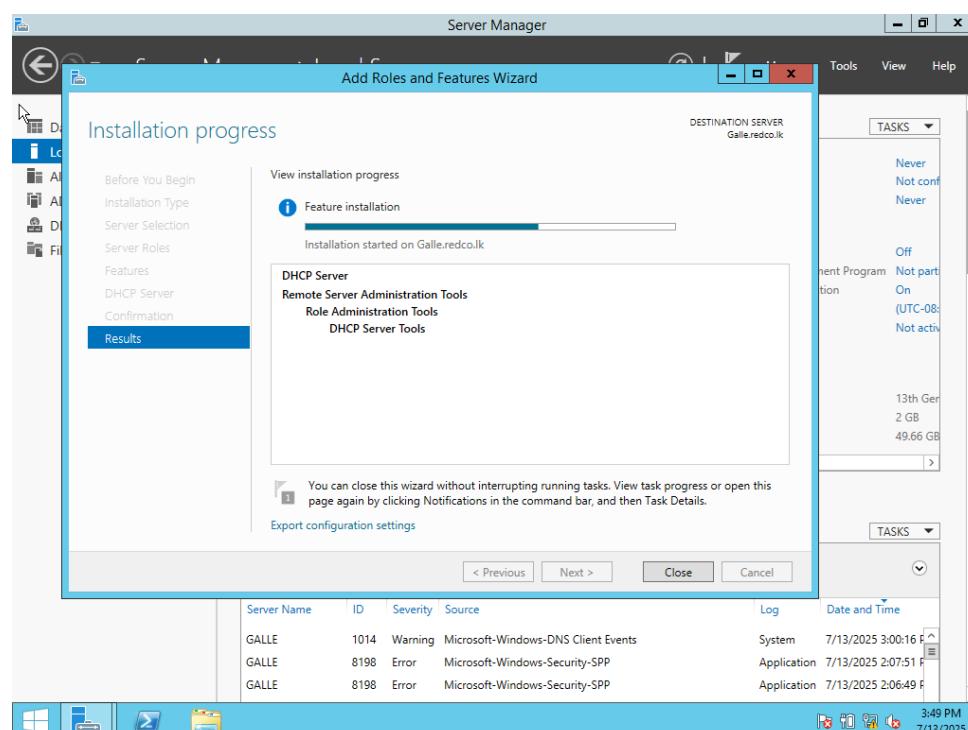


Figure 47: installing features for DHCP server

Source: (Author, 2025)

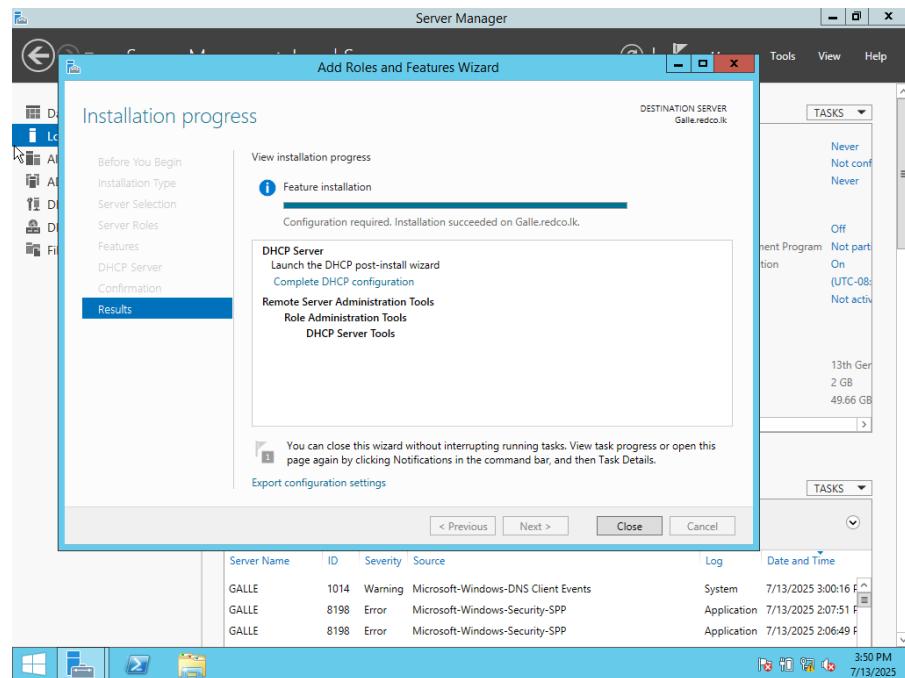


Figure 48: succeeded installation

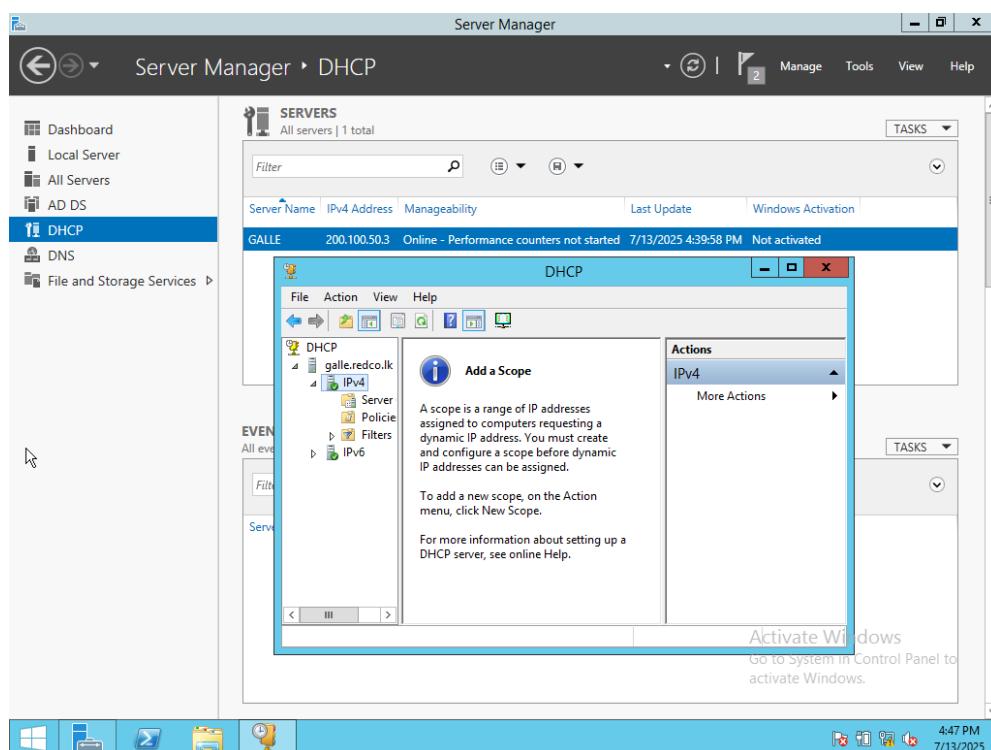


Figure 49: adding a scope

Source: (Author, 2025)

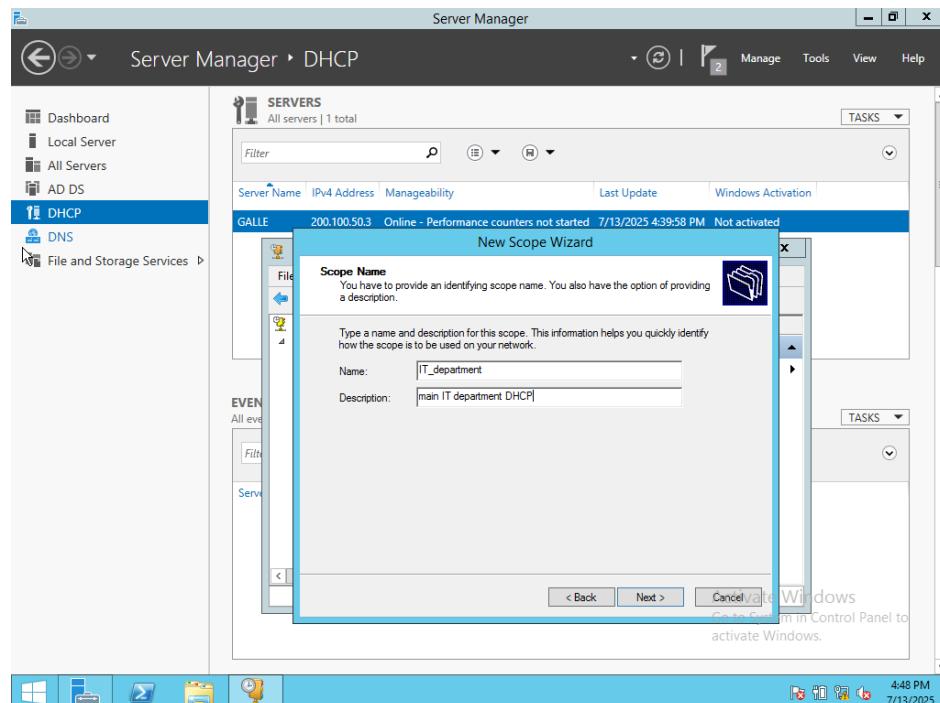


Figure 50: scope name and description

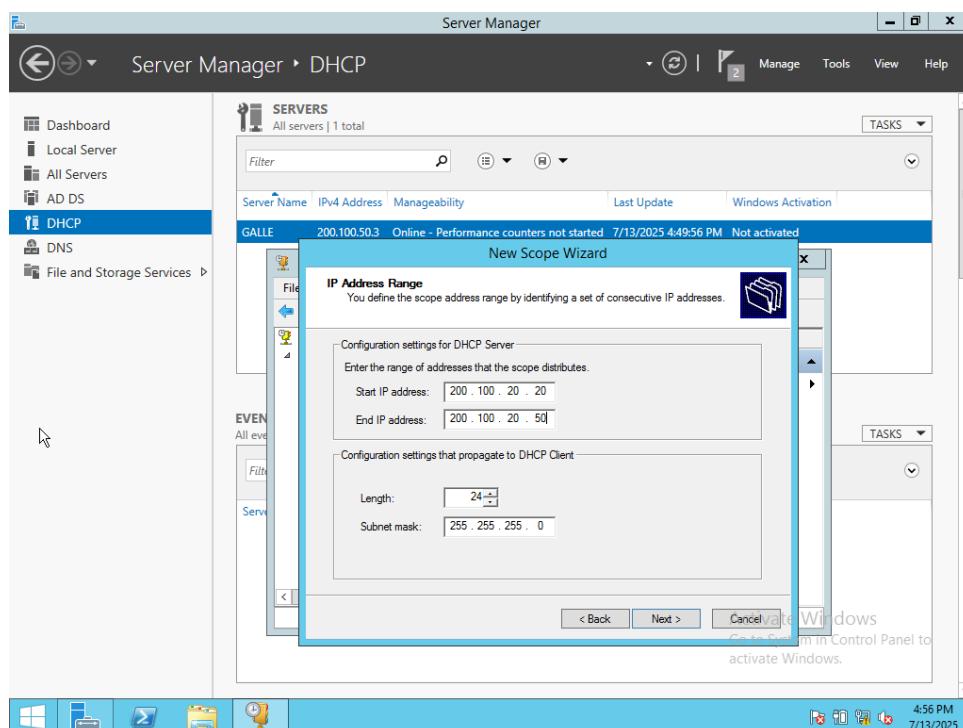


Figure 51: IP address range for the scope

Source: (Author, 2025)

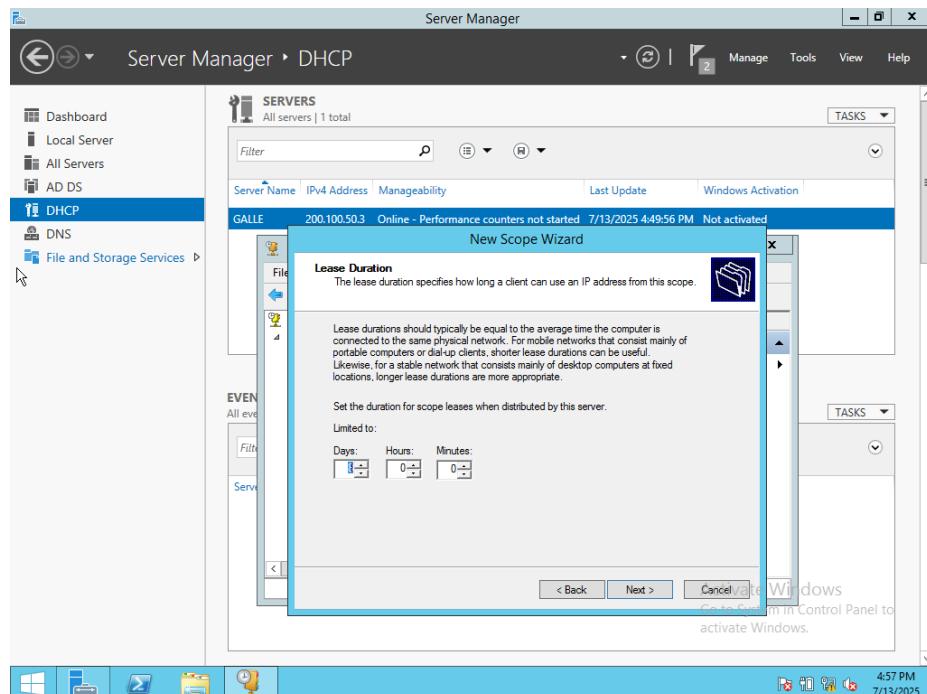


Figure 52: lease duration for the scope

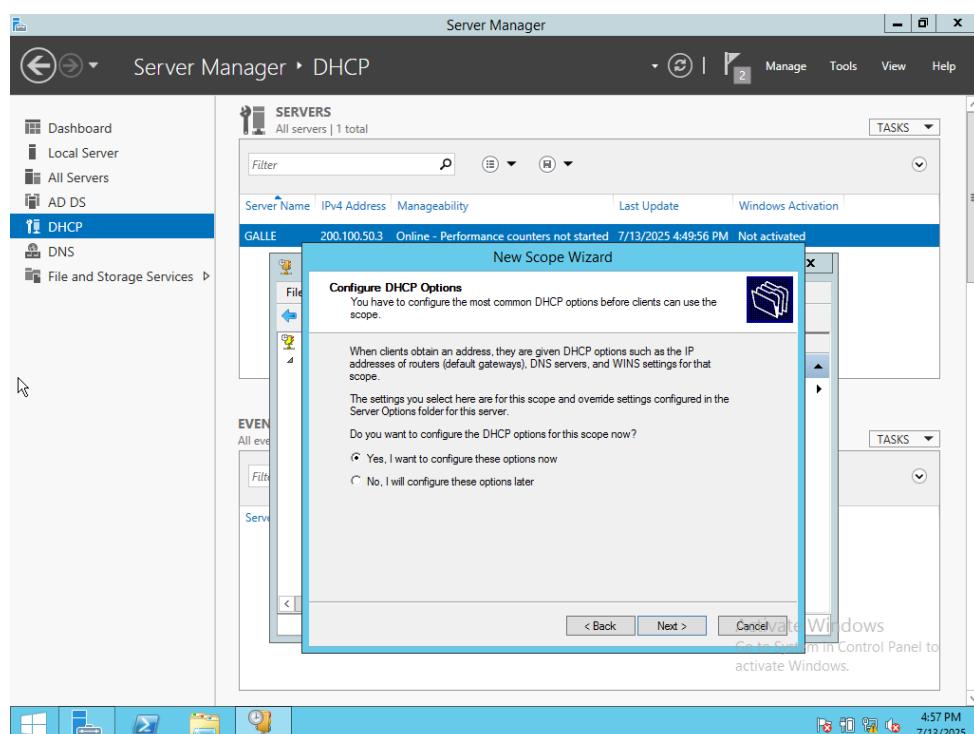


Figure 53: configuring DHCP options for the scope

Source: (Author, 2025)

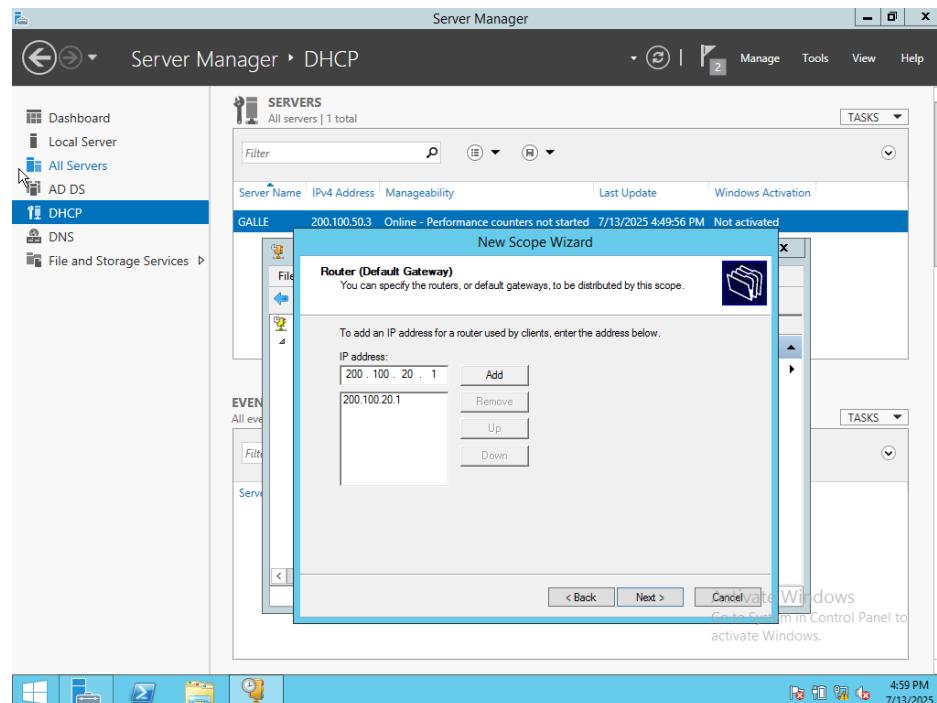


Figure 54: IP address for a router

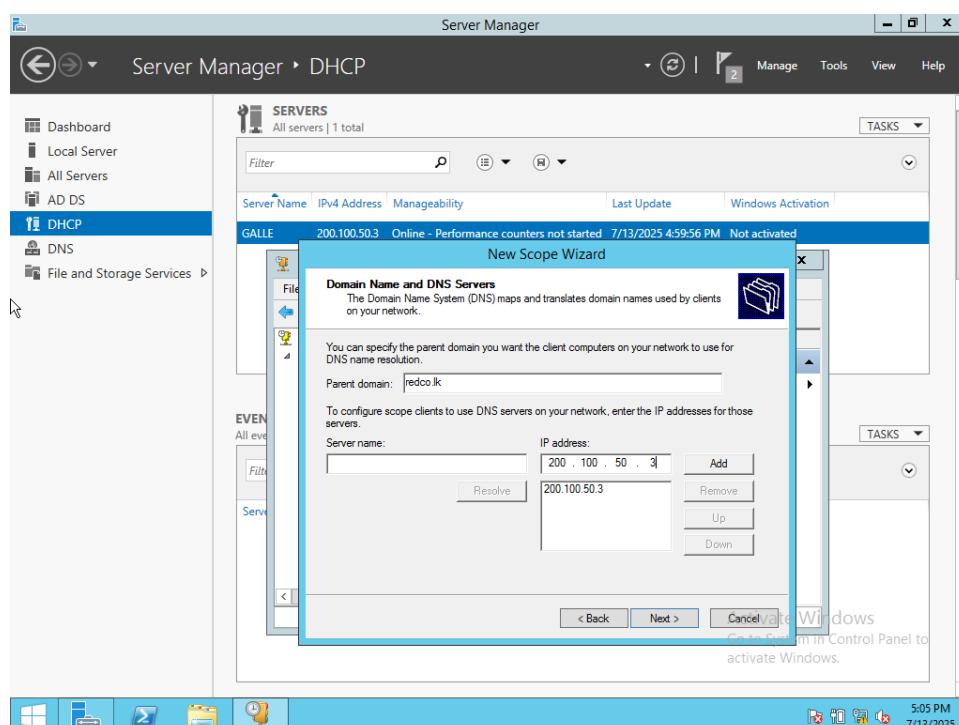


Figure 55: parent domain and IP address

Source: (Author, 2025)

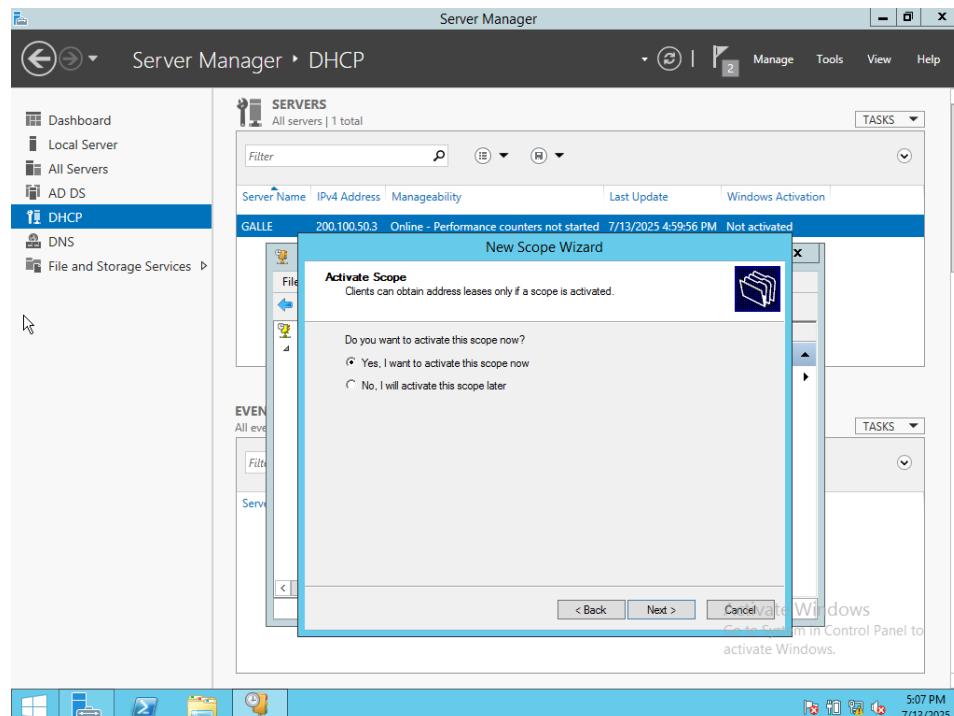


Figure 56: activating scope

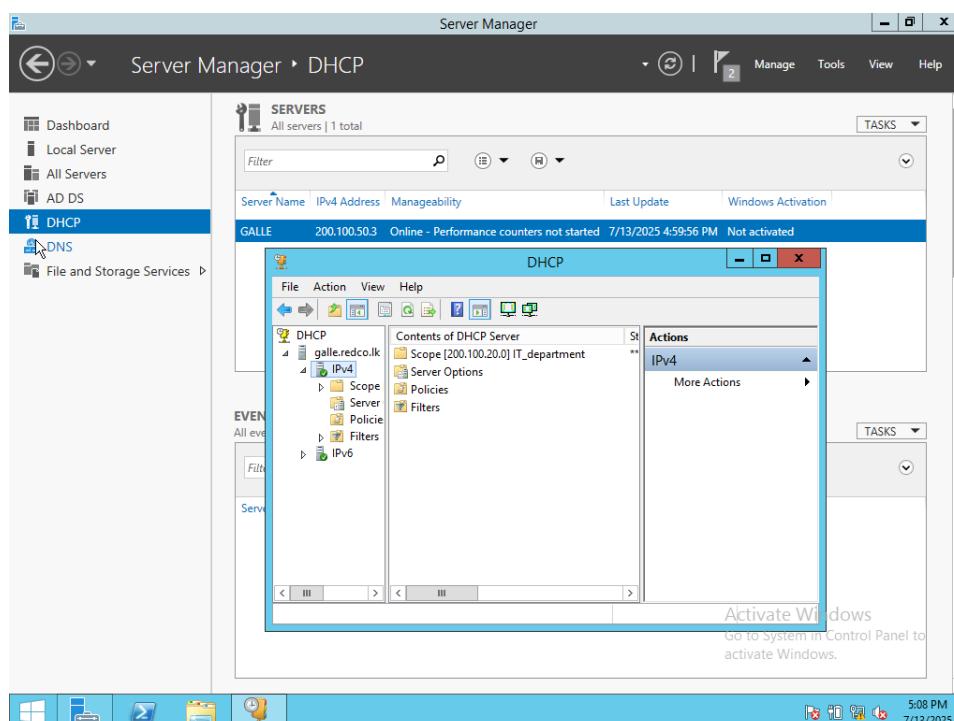


Figure 57: DHCP configuration in server manager

Source: (Author, 2025)

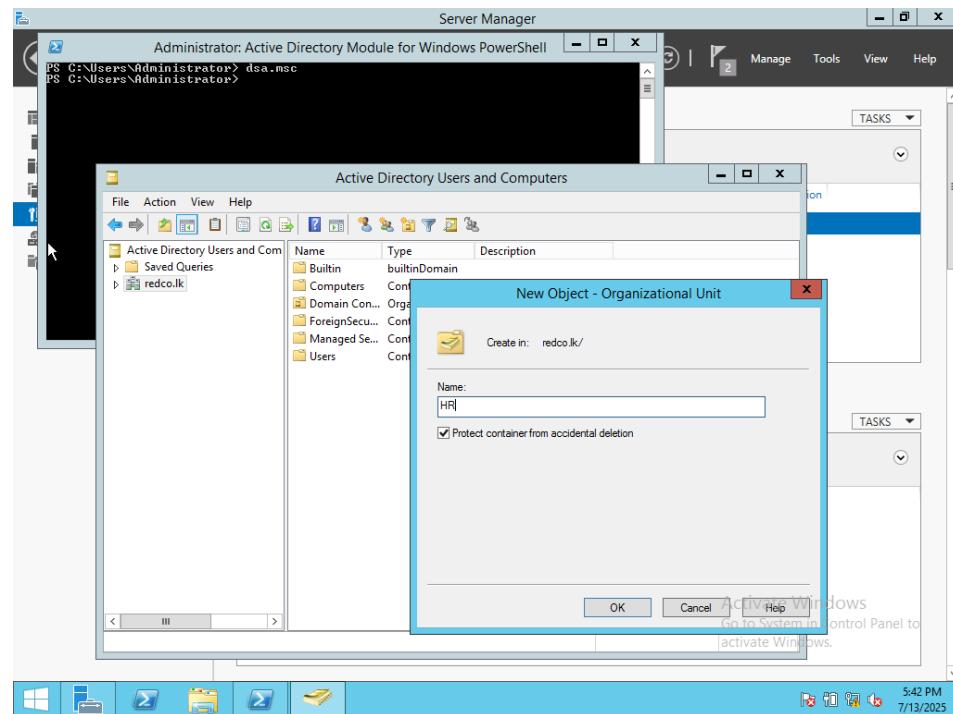


Figure 58: adding a new organizational unit

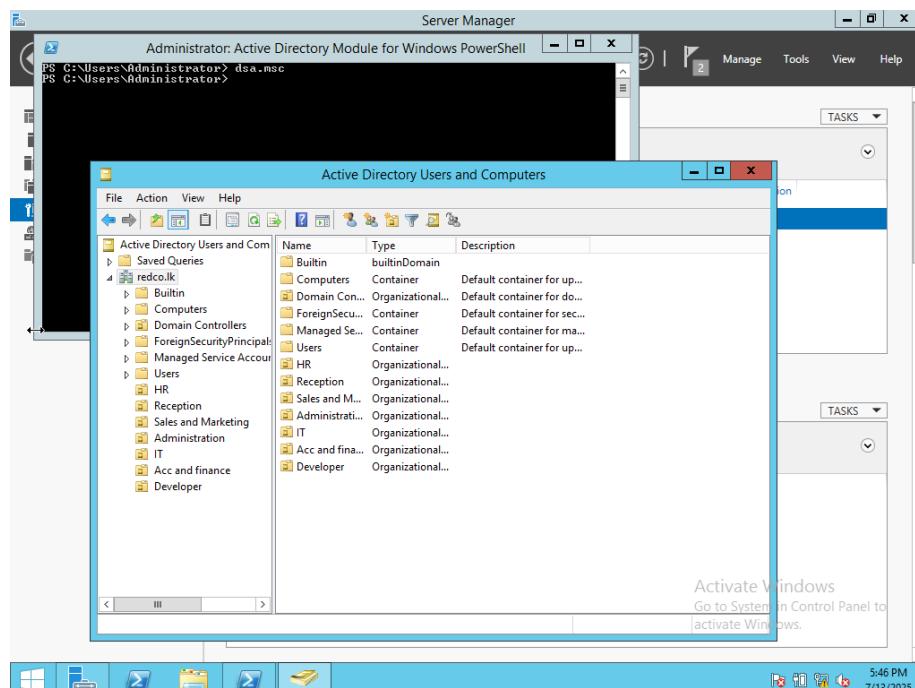


Figure 59: active directory users and computers interface

Source: (Author, 2025)

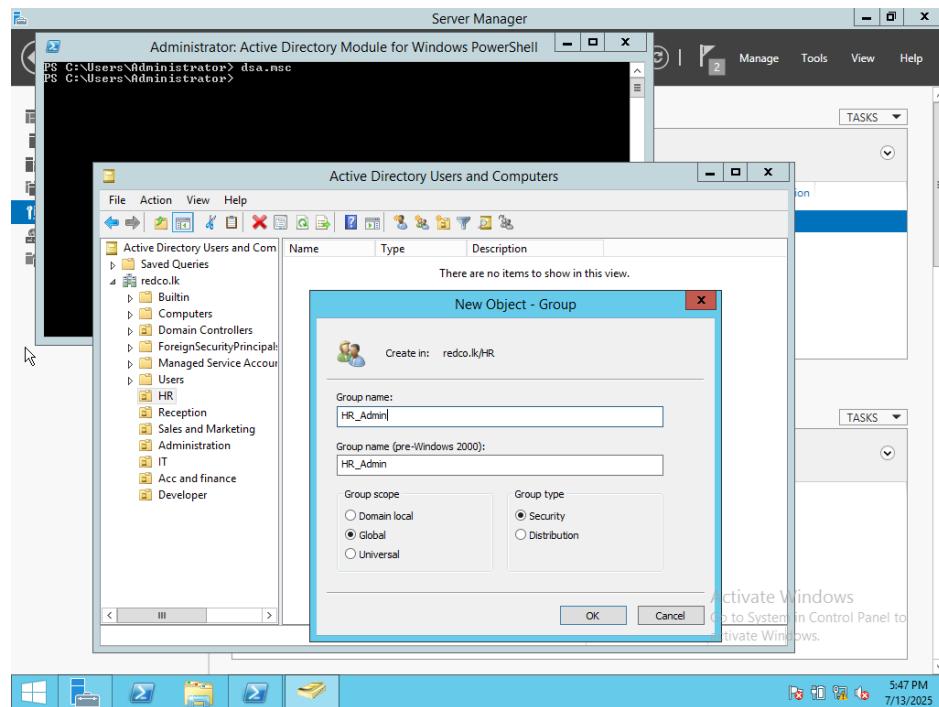


Figure 60: creating new group

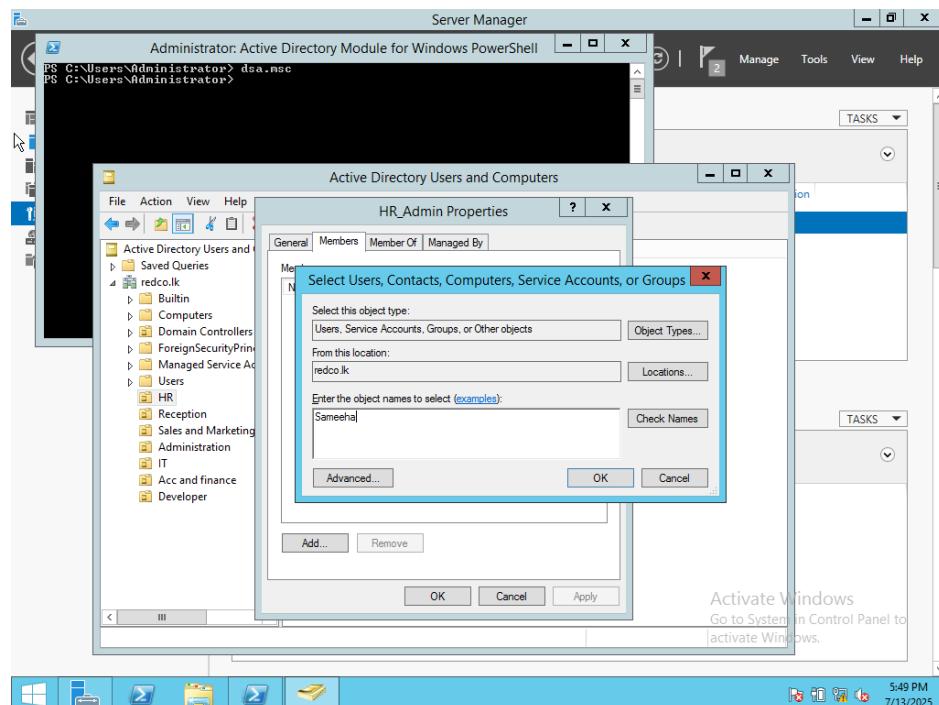


Figure 61: entering object name

Source: (Author, 2025)

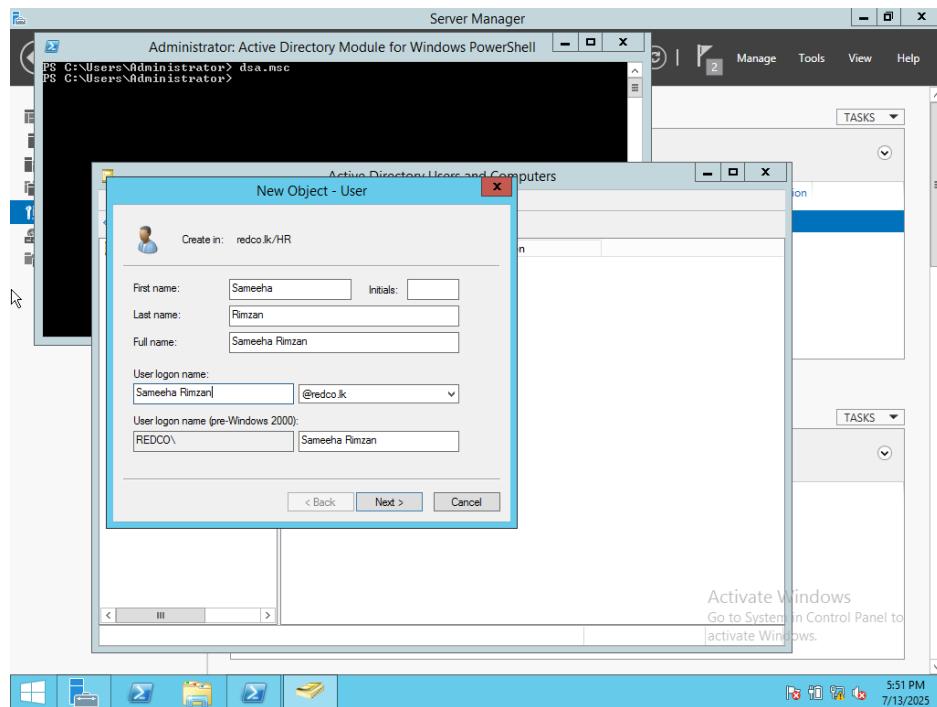


Figure 62: new user information

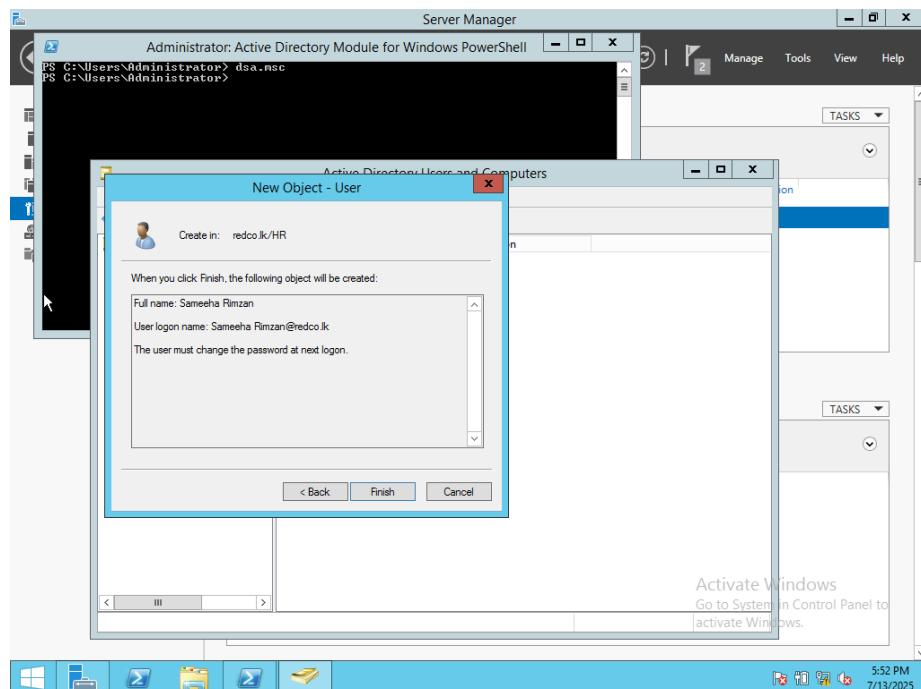


Figure 63: creating new user

Source: (Author, 2025)

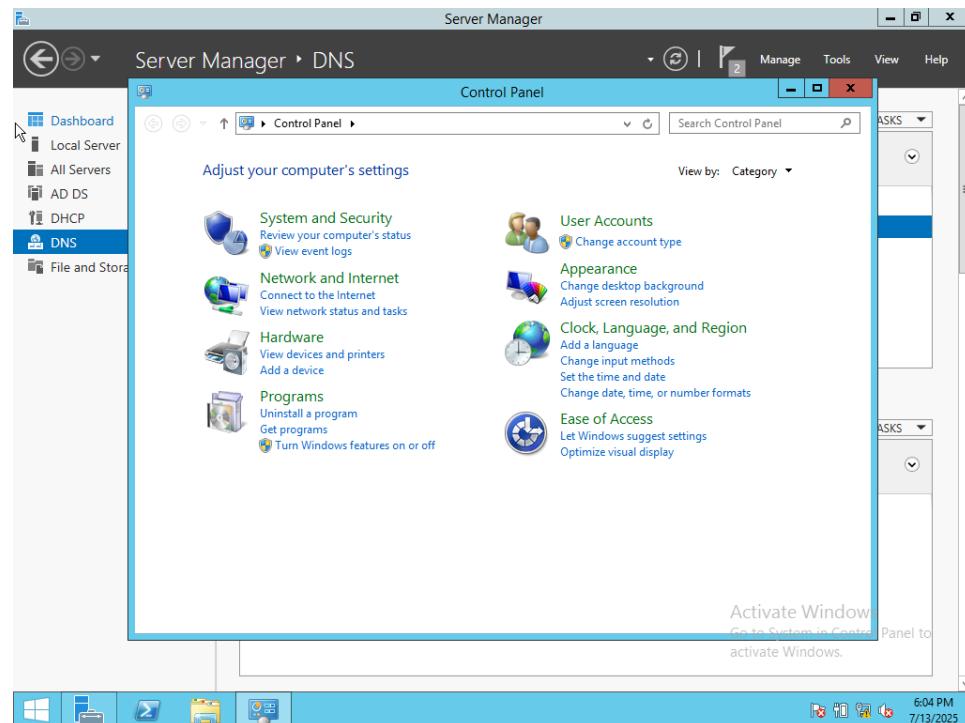


Figure 64: control panel

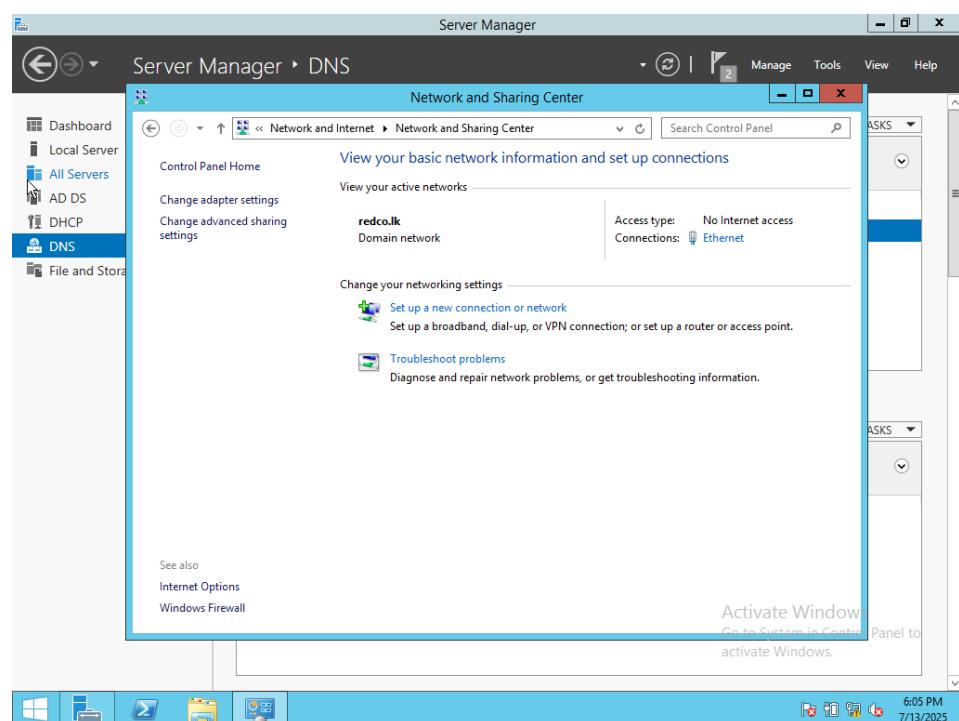


Figure 65: network and sharing center

Source: (Author, 2025)

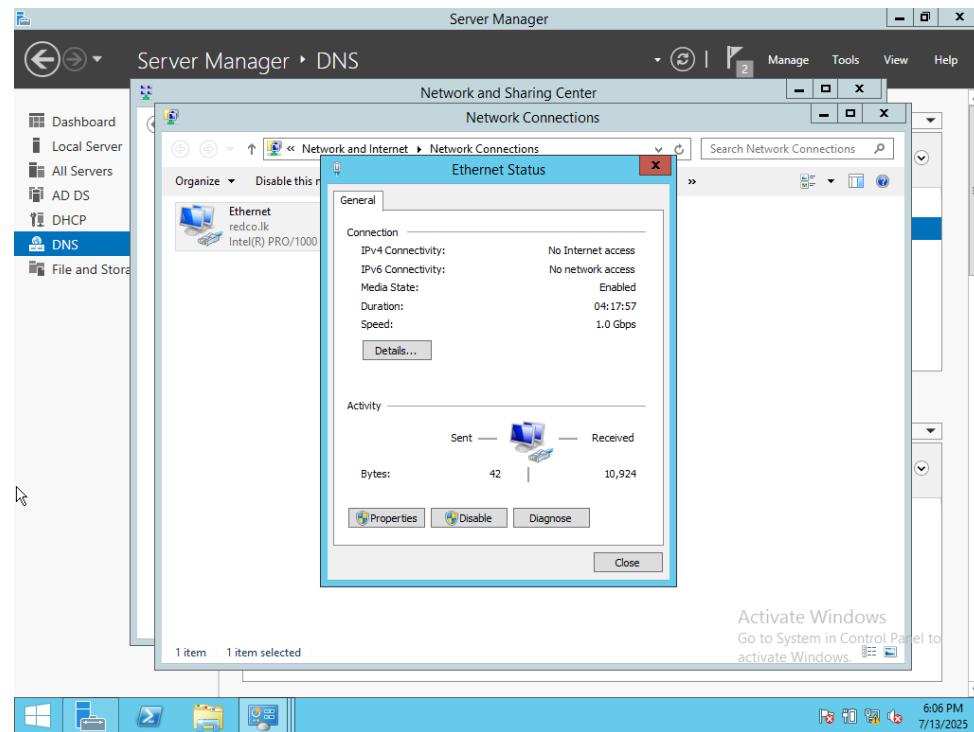


Figure 66: ethernet status

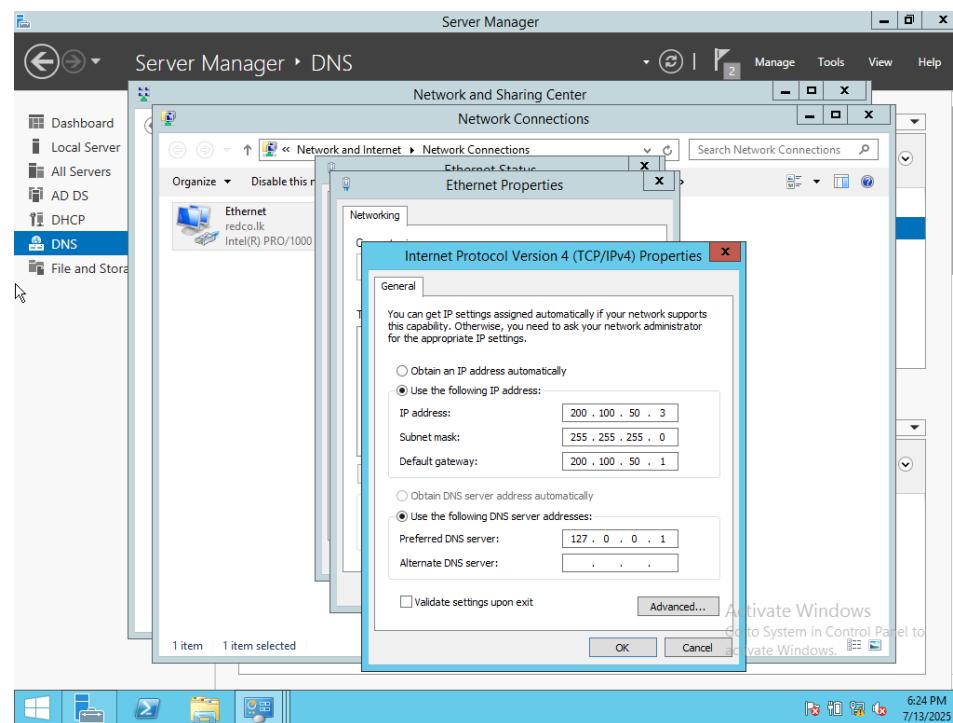


Figure 67: configuring IPv4 setting in ethernet properties

Source: (Author, 2025)

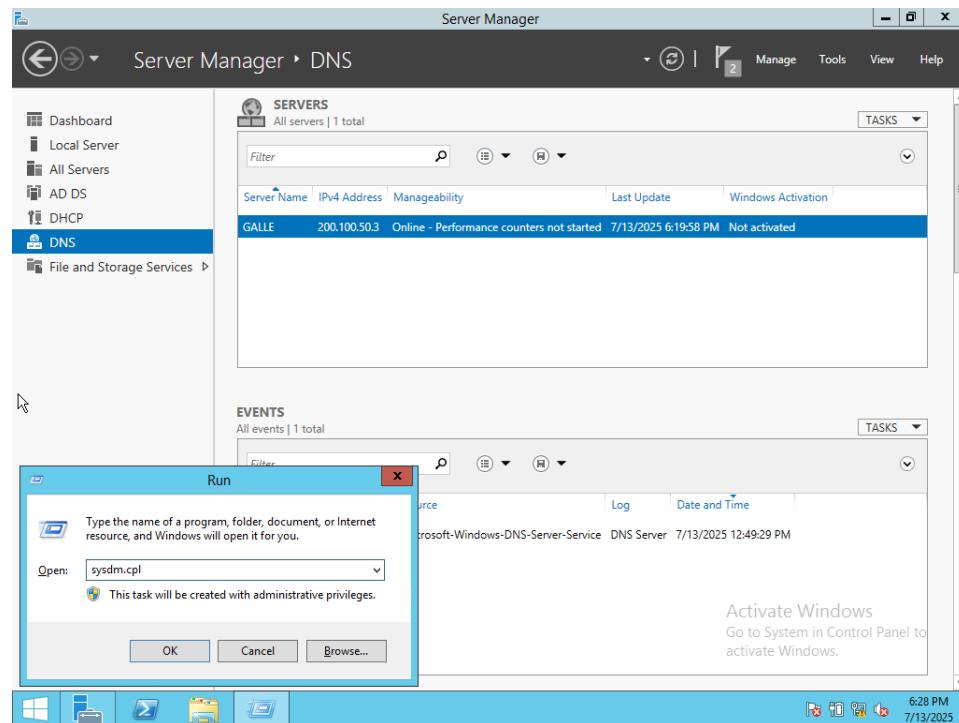


Figure 68: system properties window opened via sysdm.cpl

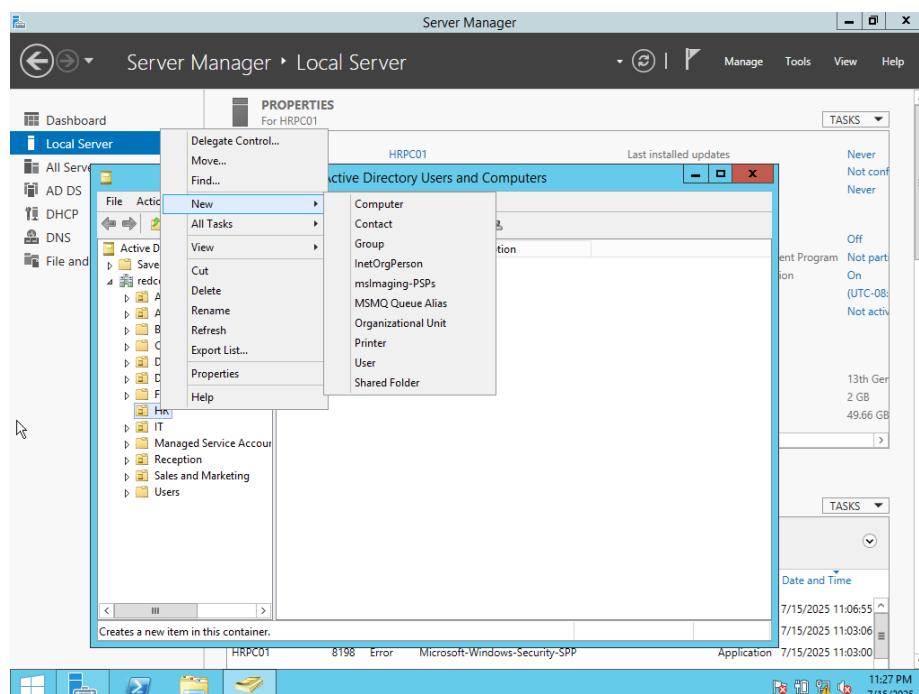


Figure 69: creating computers, users and group

Source: (Author, 2025)

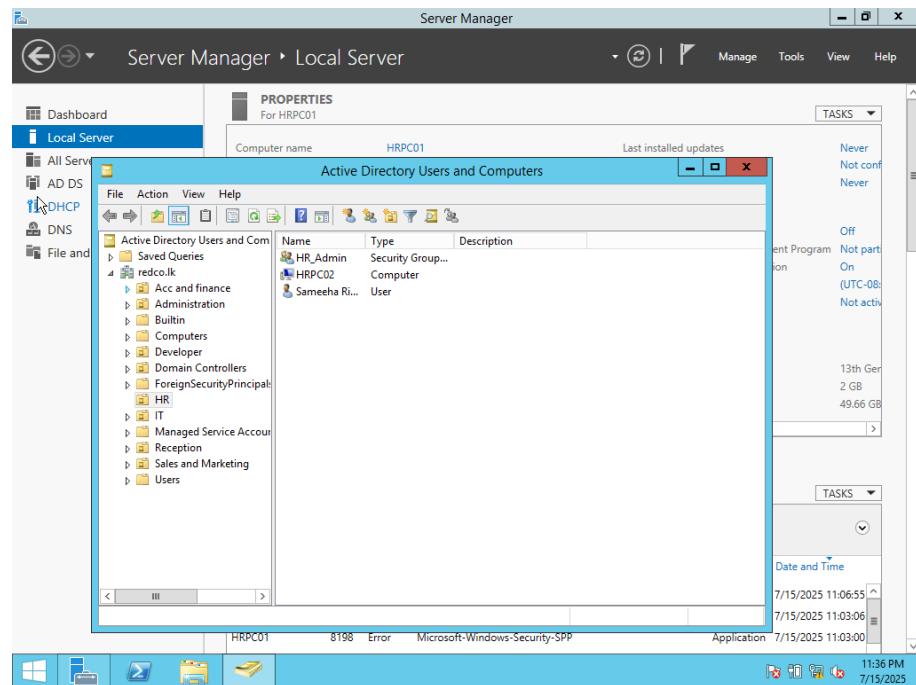


Figure 70: active directory users and computers in HR

Source: (Author, 2025)

Activity 04

Cisco Packet Tracer Implementation (Screenshots and Configuration Results)

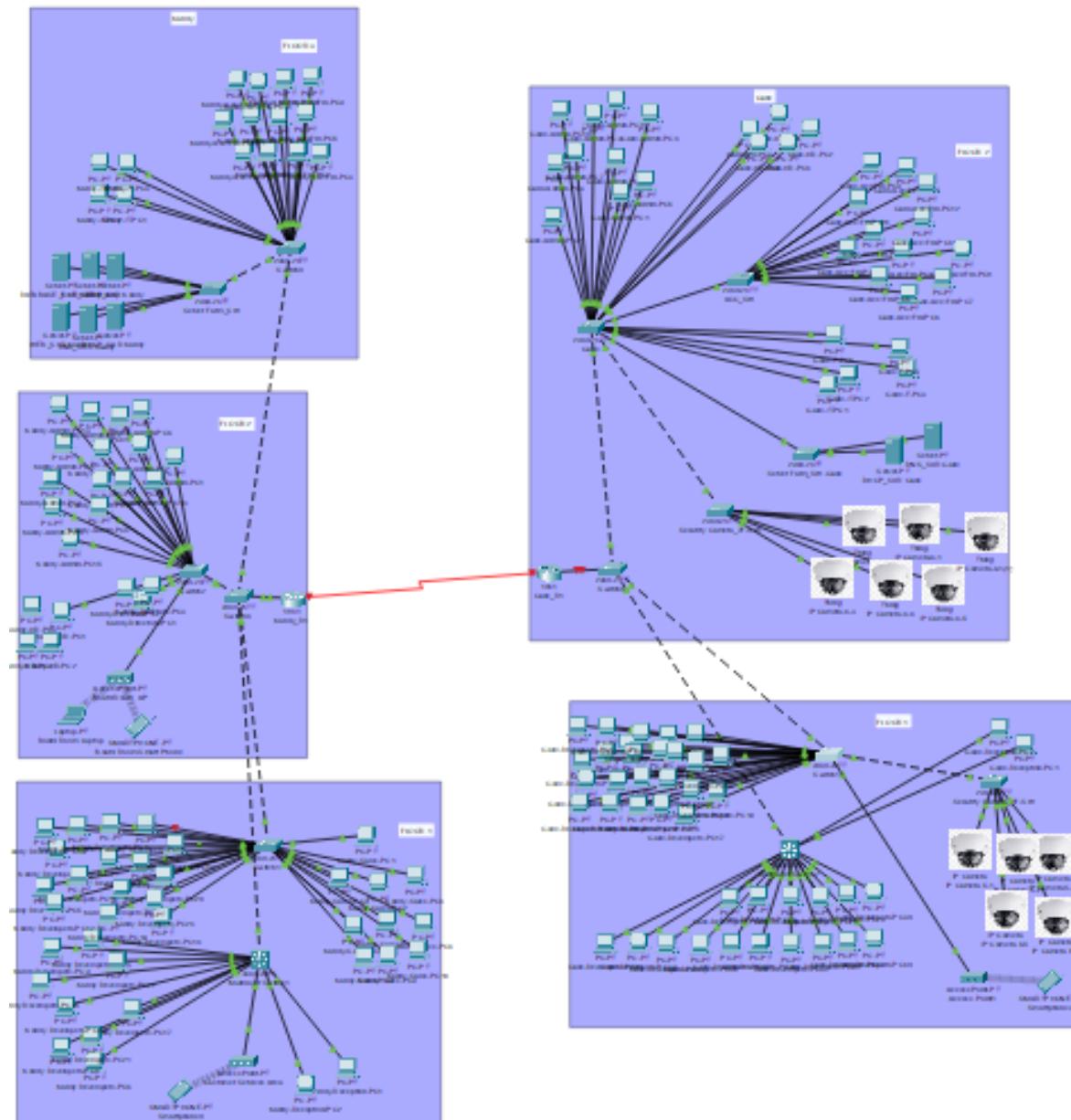


Figure 71: Network diagram in Cisco Packet Tracer

Source: (Author, 2025)

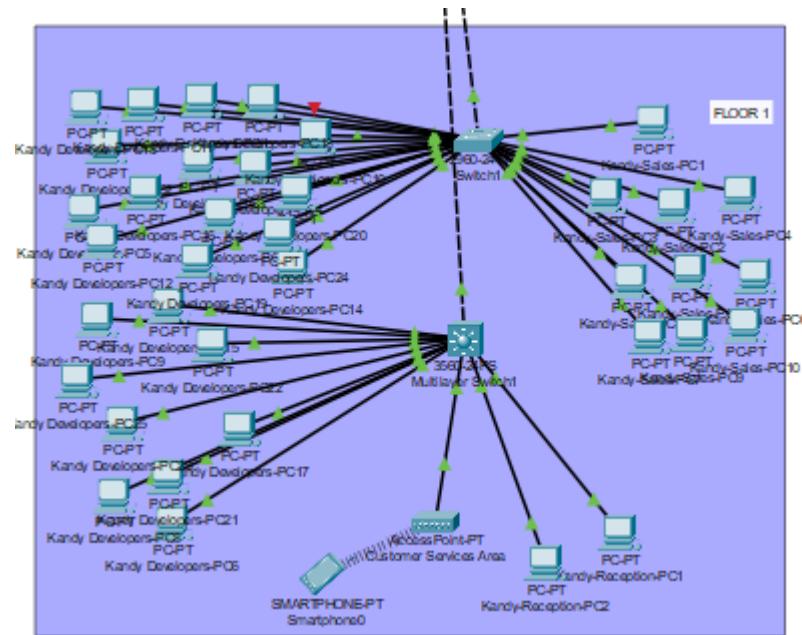


Figure 72: Kandy Branch – 1st Floor Network

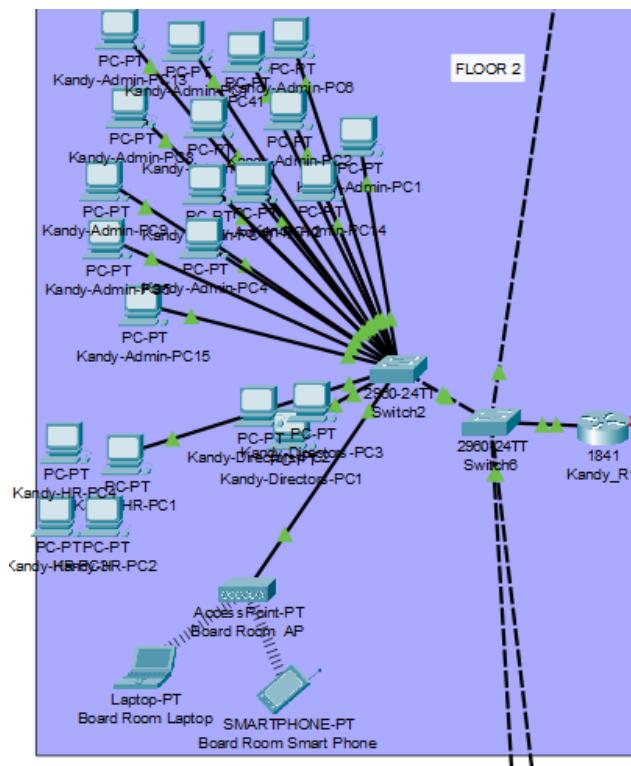


Figure 73: Kandy Branch – 2st Floor Network

Source: (Author, 2025)

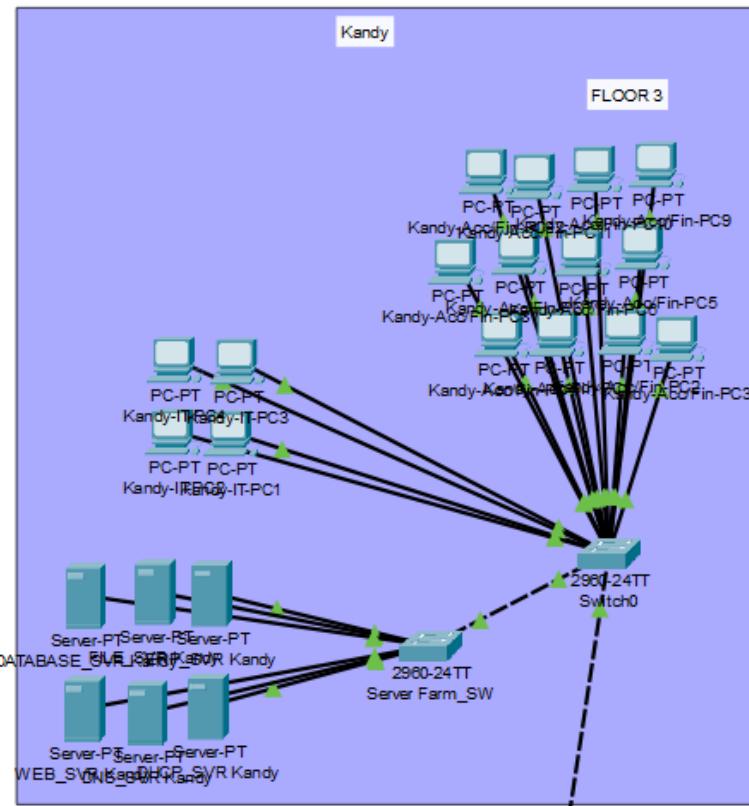


Figure 74: Kandy Branch – 3rd Floor Network

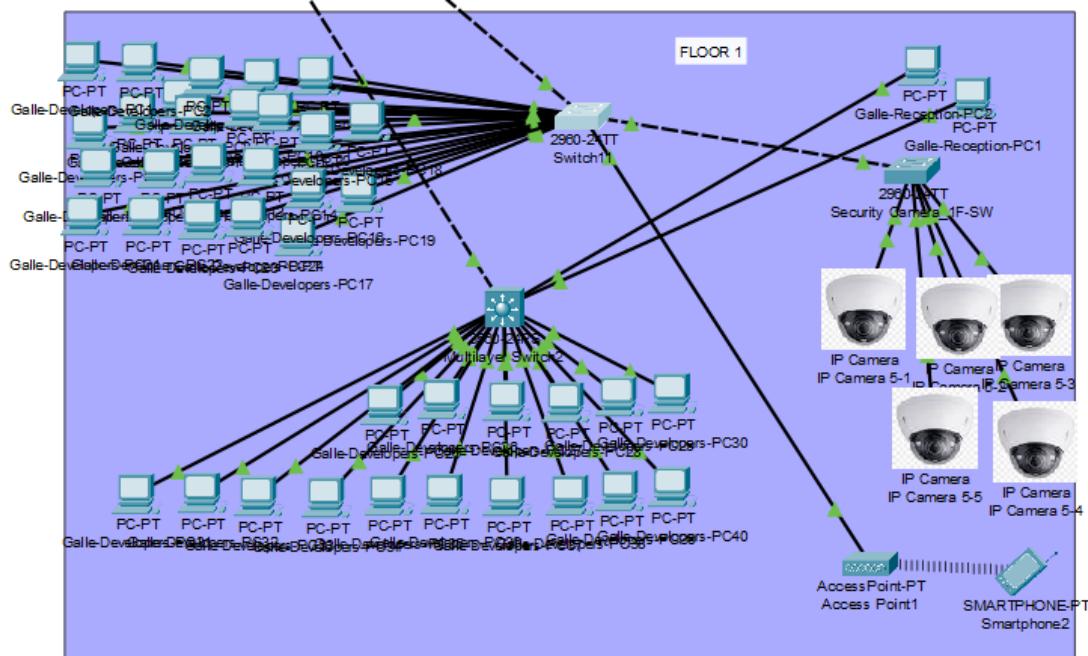


Figure 75: Galle Branch – 1st Floor Network

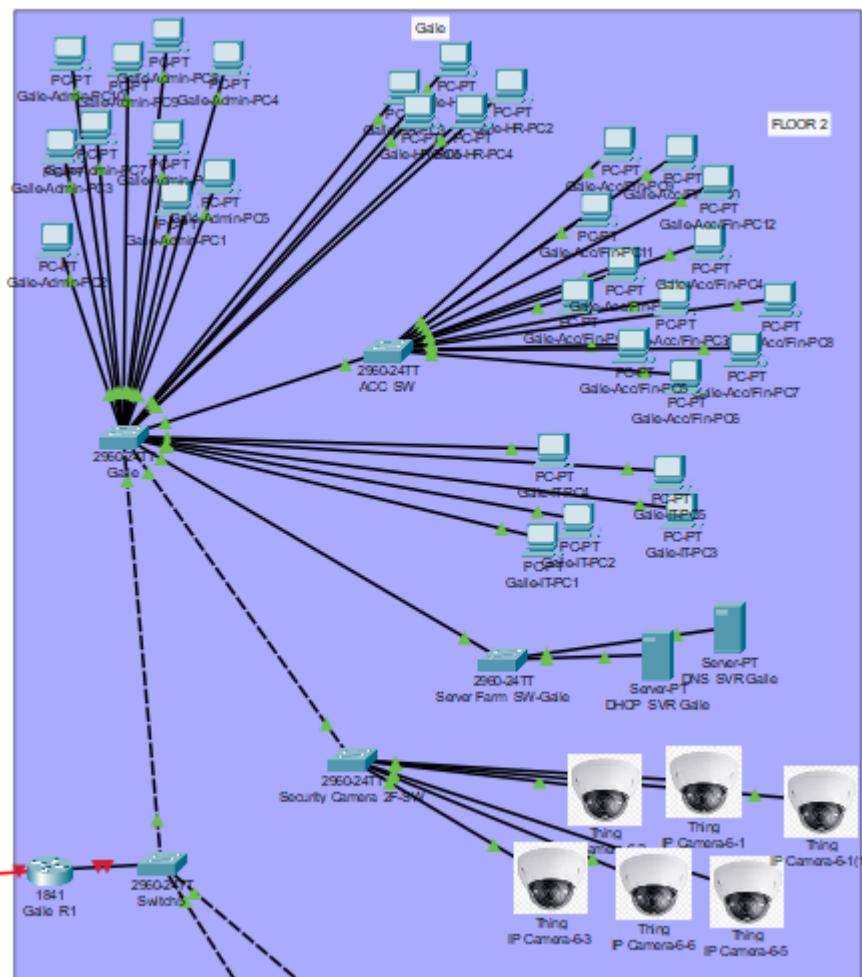


Figure 76: Galle Branch – 2nd Floor Network

Source: (Author, 2025)

Galle Servers DNS & DHCP

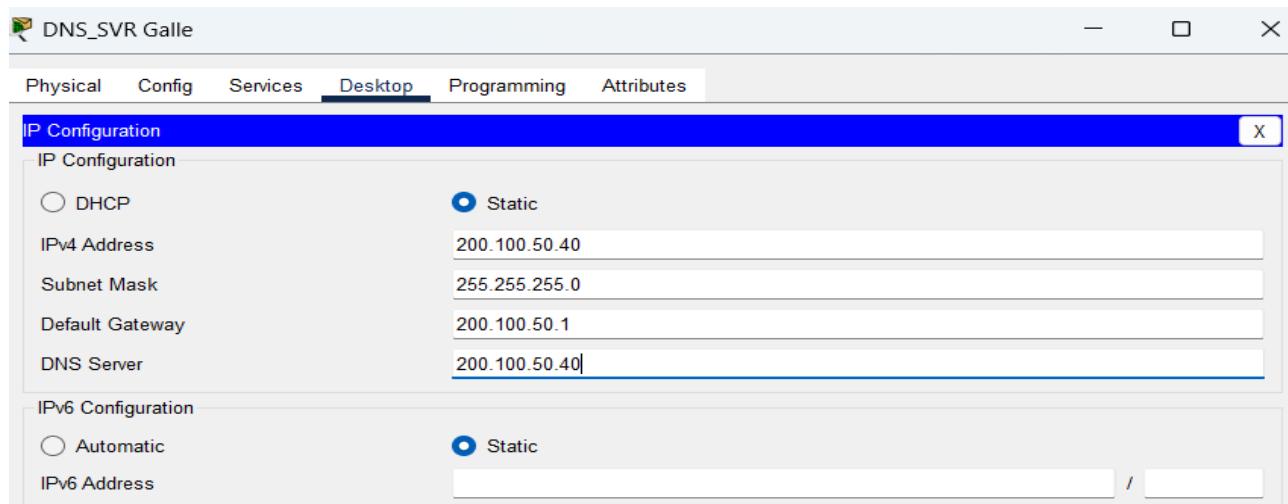


Figure 77: DNS Server configuration – Galle branch

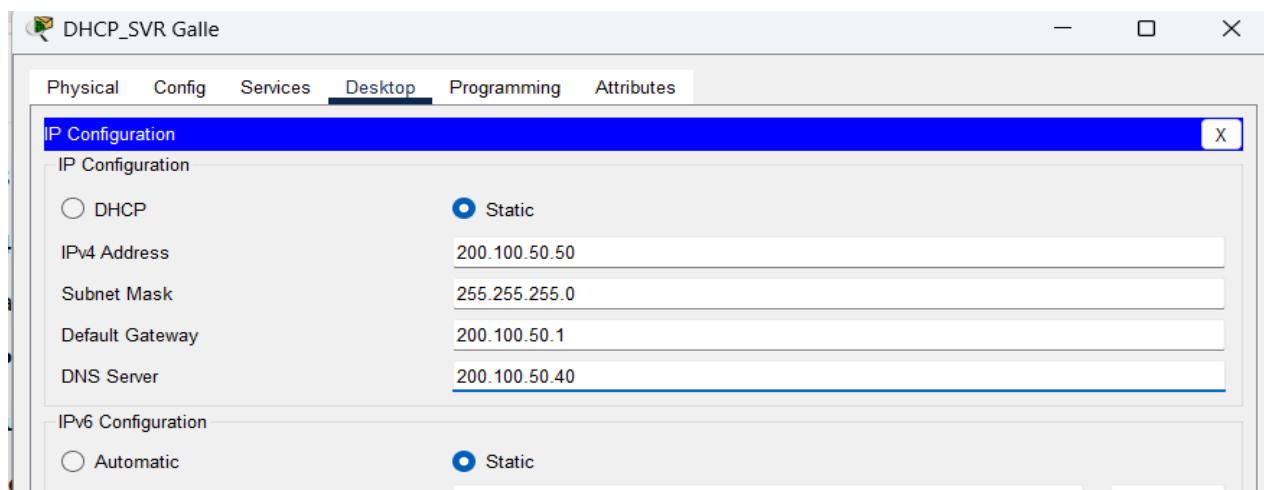


Figure 78: DHCP Server configuration – Galle branch

Source: (Author, 2025)

Kandy Servers DNS & DHCP

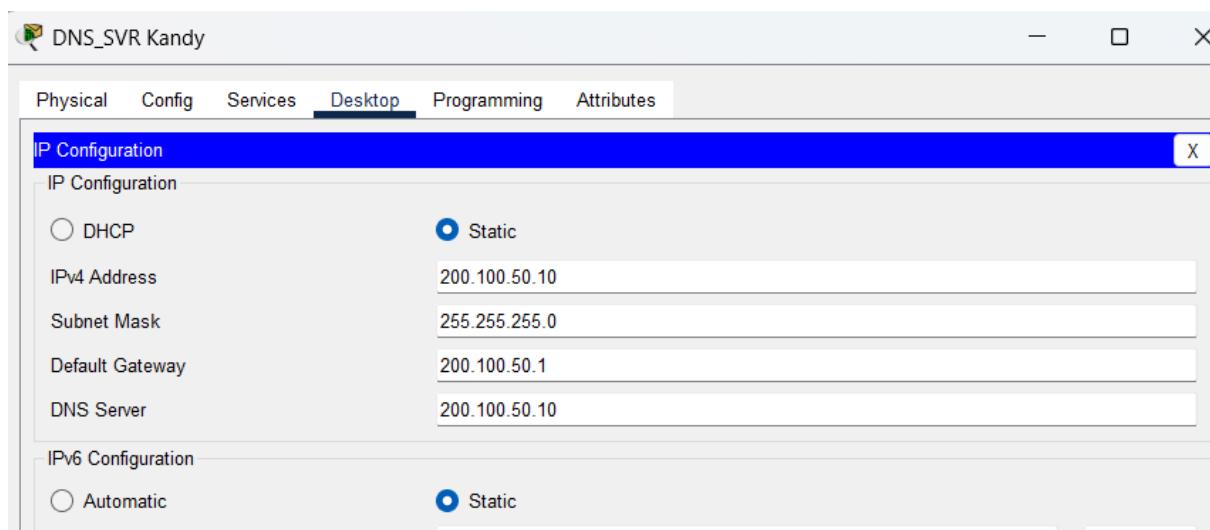


Figure 79: DNS Server configuration – Kandy branch

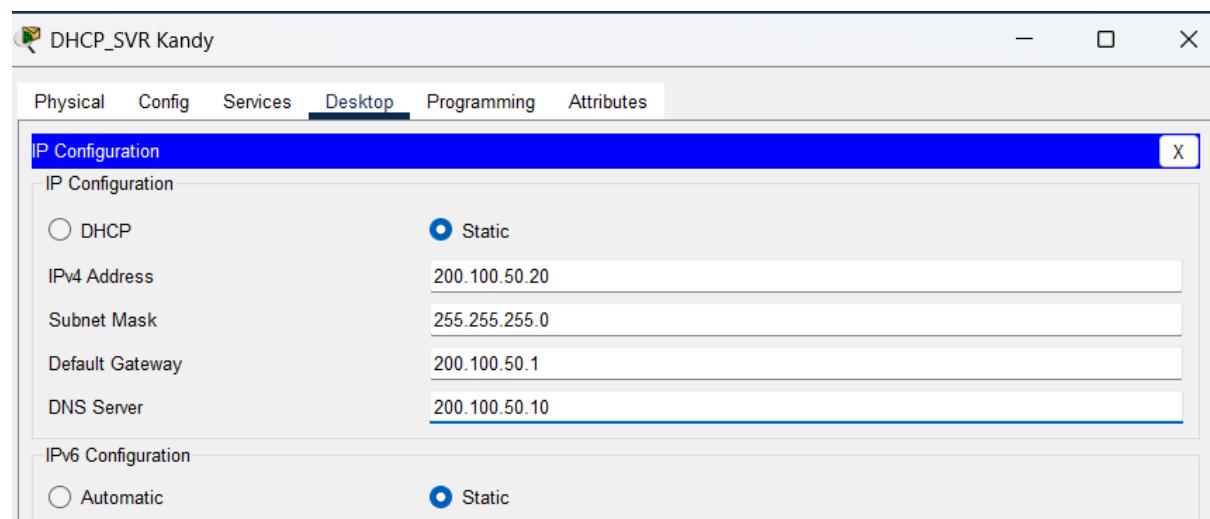


Figure 80: DHCP Server configuration – Kandy branch

Source: (Author, 2025)

Configuring DNS Records on Kandy and Galle Servers

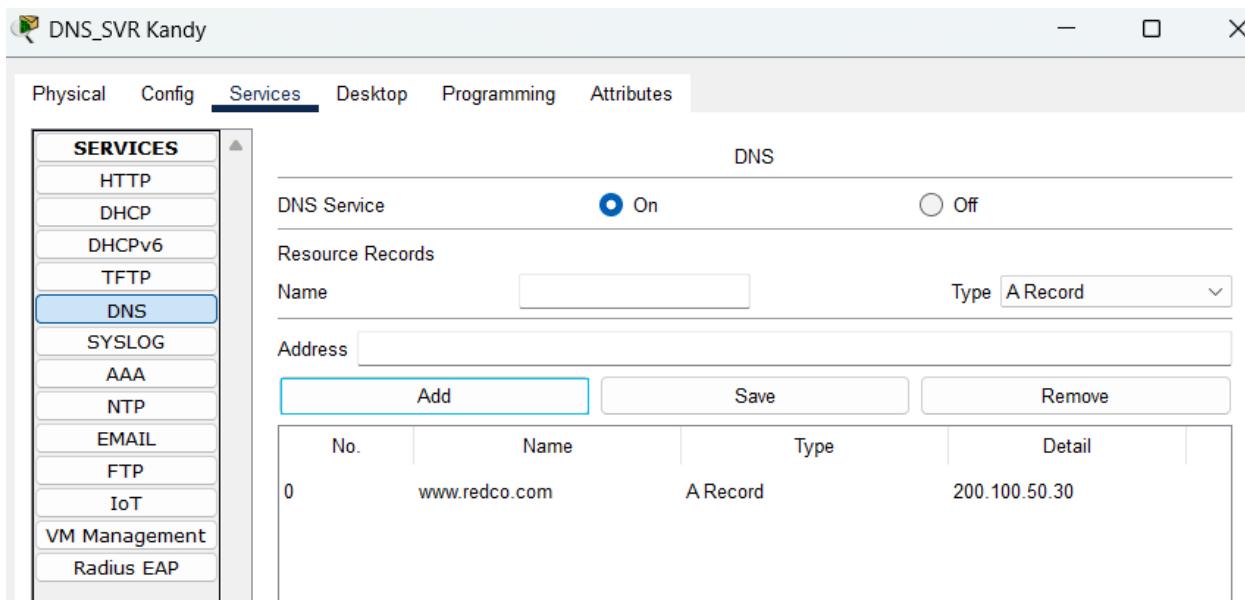


Figure 81: DNS service enabled on Kandy server with DNS record for www.redco.com pointing to 200.100.50.30.

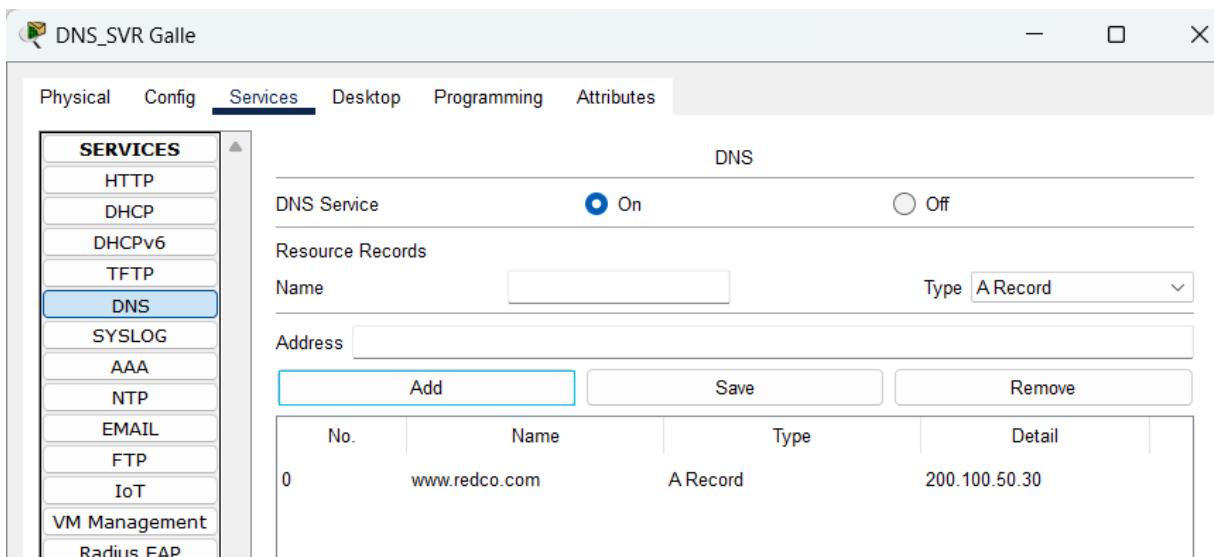


Figure 82: DNS service configured on Galle server for www.redco.com to resolve to 200.100.50.30.

Source: (Author, 2025)

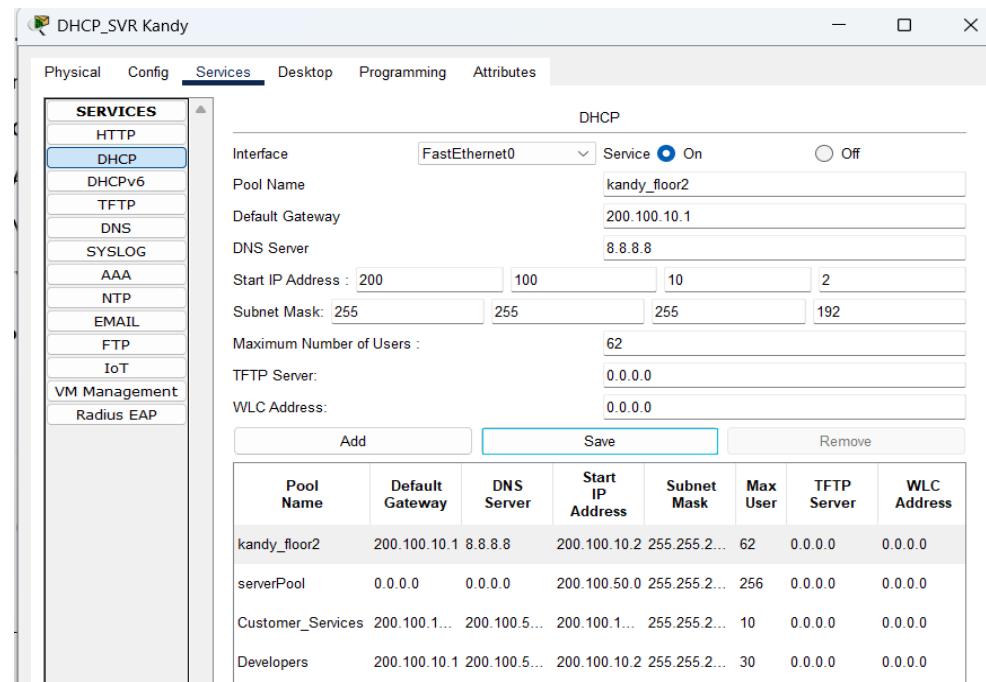


Figure 83: DHCP Server Setup – Kandy Branch

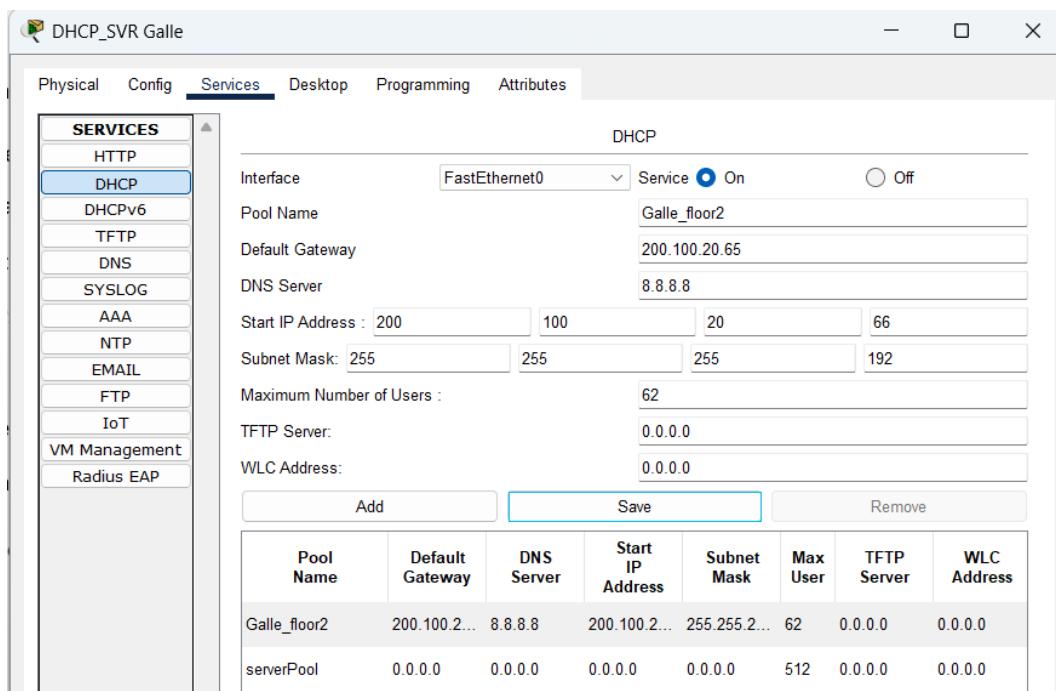


Figure 84: DHCP Server Setup – Galle Branch

Source: (Author, 2025)

Router Interface Setup in Cisco Packet Tracer

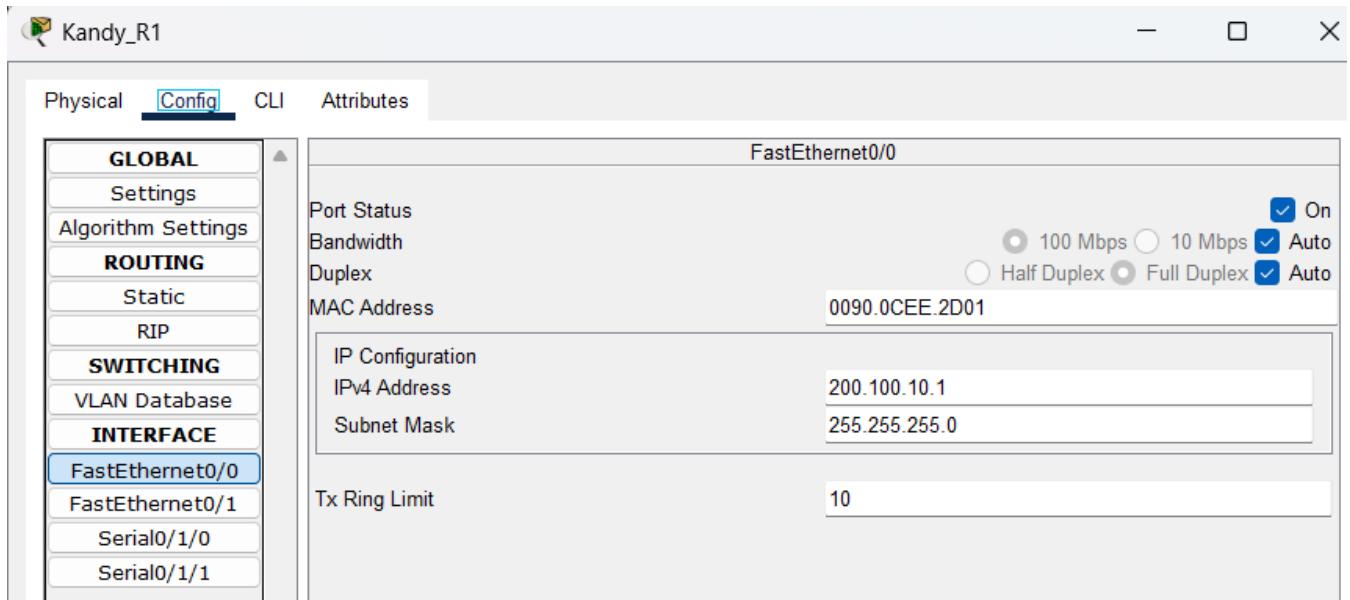


Figure 85: configuration of FastEthernet on Kandy router

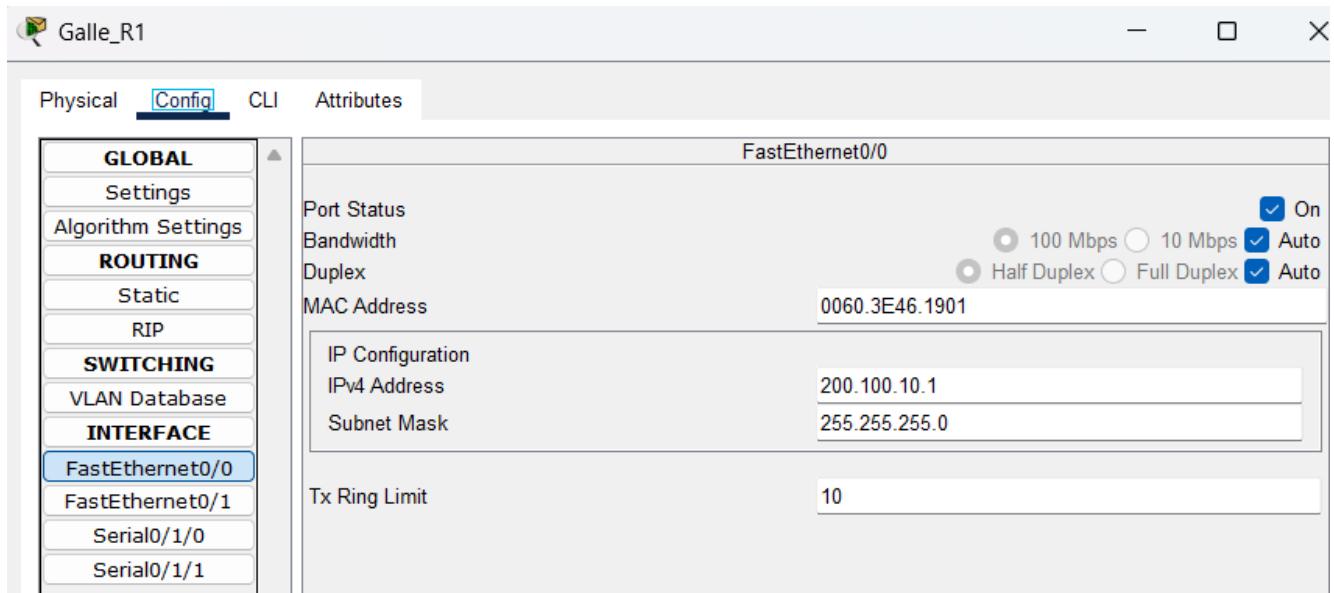


Figure 86: configuration of FastEthernet on Galle router

Source: (Author, 2025)

Kandy Branch- DHCP Setup and Connectivity confirmation

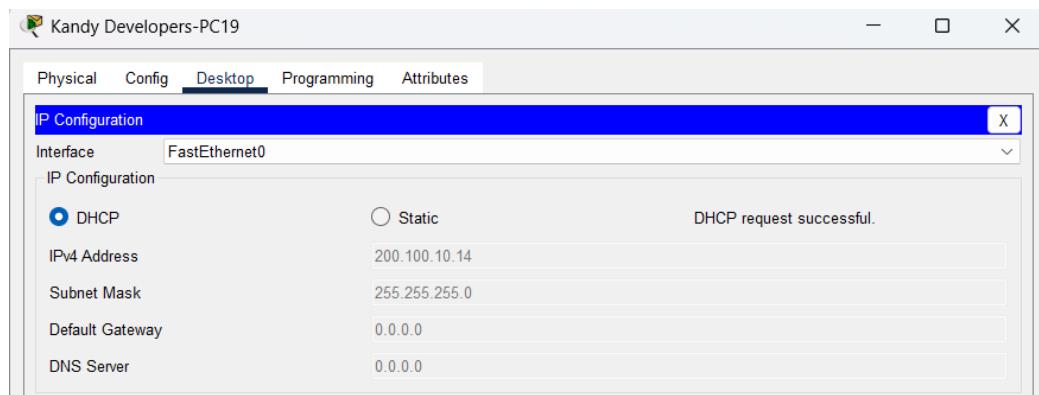


Figure 87: pc-19

```
Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.14

Pinging 200.100.10.14 with 32 bytes of data:

Reply from 200.100.10.14: bytes=32 time=24ms TTL=128
Reply from 200.100.10.14: bytes=32 time<1ms TTL=128
Reply from 200.100.10.14: bytes=32 time=11ms TTL=128
Reply from 200.100.10.14: bytes=32 time=10ms TTL=128

Ping statistics for 200.100.10.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 24ms, Average = 11ms

C:>|
```

Figure 88: pc-19

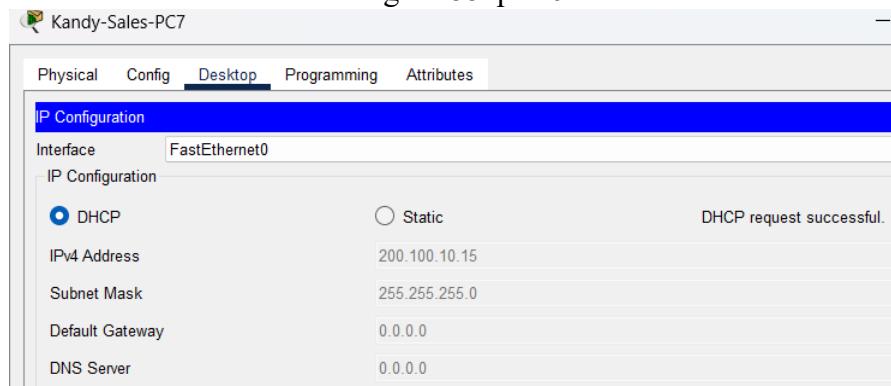


Figure 89: pc-7

Source: (Author, 2025)

Kandy-Sales-PC7

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.15

Pinging 200.100.10.15 with 32 bytes of data:

Reply from 200.100.10.15: bytes=32 time=1ms TTL=128
Reply from 200.100.10.15: bytes=32 time<1ms TTL=128
Reply from 200.100.10.15: bytes=32 time=1ms TTL=128
Reply from 200.100.10.15: bytes=32 time=1ms TTL=128

Ping statistics for 200.100.10.15:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:>|
```

Figure 90: pc-7

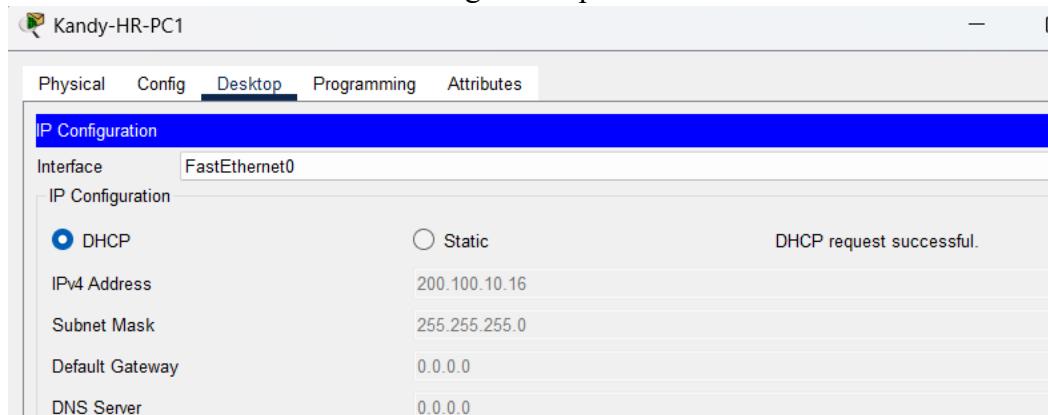


Figure 91: pc-1

Kandy-HR-PC1

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.16

Pinging 200.100.10.16 with 32 bytes of data:

Reply from 200.100.10.16: bytes=32 time=4ms TTL=128
Reply from 200.100.10.16: bytes=32 time=7ms TTL=128
Reply from 200.100.10.16: bytes=32 time=9ms TTL=128
Reply from 200.100.10.16: bytes=32 time=5ms TTL=128

Ping statistics for 200.100.10.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 9ms, Average = 6ms

C:>|
```

Figure 92:pc-1

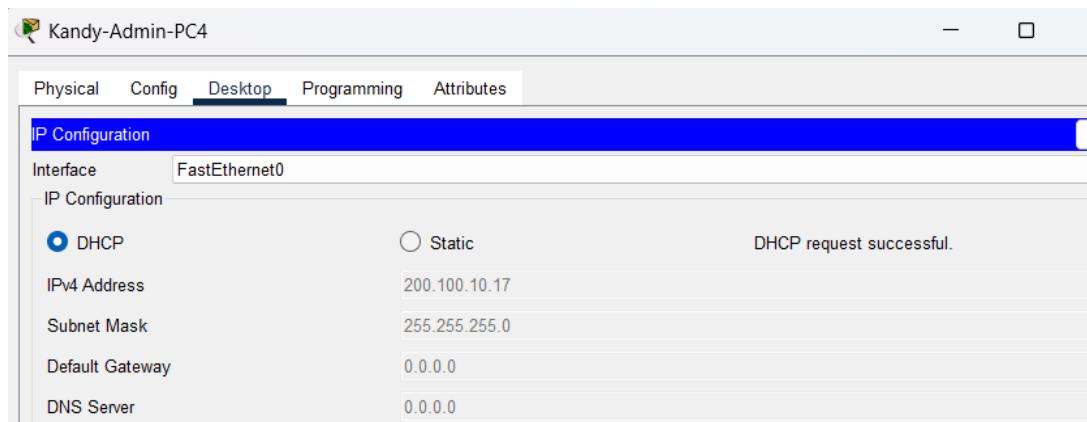


Figure 93:pc-4

Kandy-Admin-PC4

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.17

Pinging 200.100.10.17 with 32 bytes of data:

Reply from 200.100.10.17: bytes=32 time<1ms TTL=128
Reply from 200.100.10.17: bytes=32 time=4ms TTL=128
Reply from 200.100.10.17: bytes=32 time<1ms TTL=128
Reply from 200.100.10.17: bytes=32 time=2ms TTL=128

Ping statistics for 200.100.10.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 4ms, Average = 1ms

C:\>
```

Figure 94: pc-4

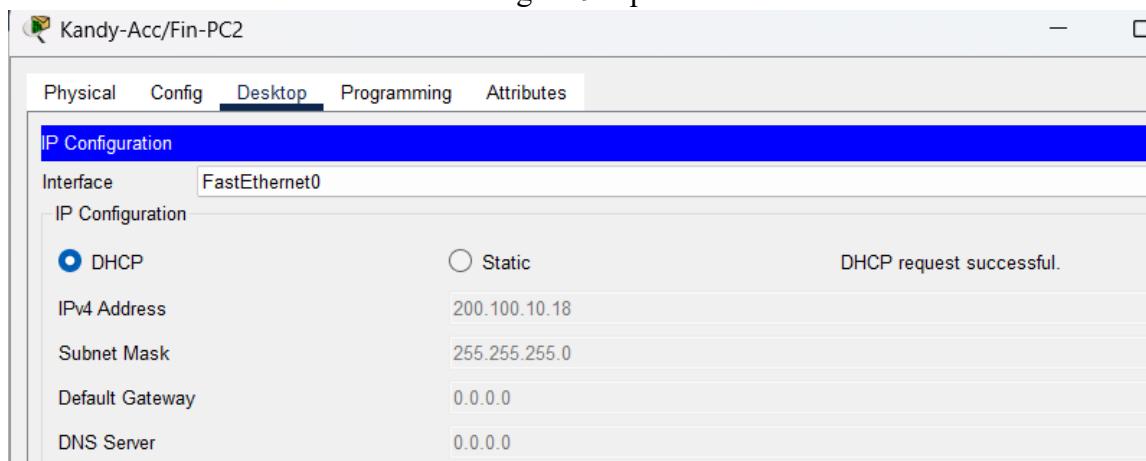


Figure 95: pc-2

Source: (Author, 2025)

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.18

Pinging 200.100.10.18 with 32 bytes of data:

Reply from 200.100.10.18: bytes=32 time=4ms TTL=128
Reply from 200.100.10.18: bytes=32 time<1ms TTL=128
Reply from 200.100.10.18: bytes=32 time=4ms TTL=128
Reply from 200.100.10.18: bytes=32 time=1ms TTL=128

Ping statistics for 200.100.10.18:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 4ms, Average = 2ms

C:\>

```

Figure 96: pc-2

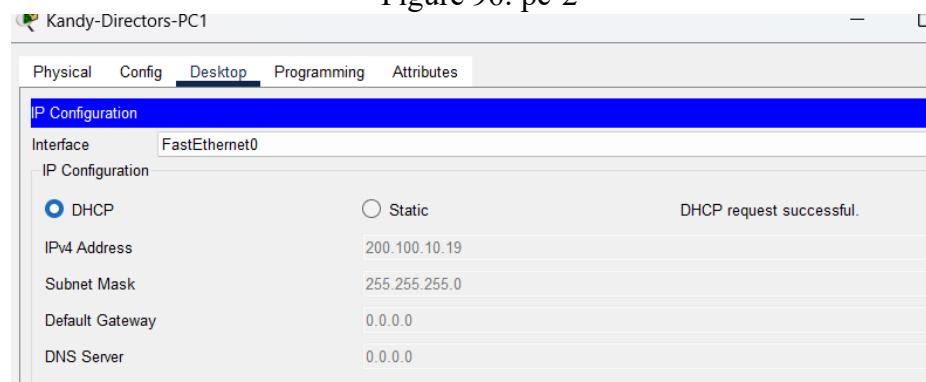


Figure 97: pc-1

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.19

Pinging 200.100.10.19 with 32 bytes of data:

Reply from 200.100.10.19: bytes=32 time=19ms TTL=128
Reply from 200.100.10.19: bytes=32 time=2ms TTL=128
Reply from 200.100.10.19: bytes=32 time=8ms TTL=128
Reply from 200.100.10.19: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.19:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 19ms, Average = 7ms

C:\>

```

Figure 98: pc-1

Source: (Author, 2025)

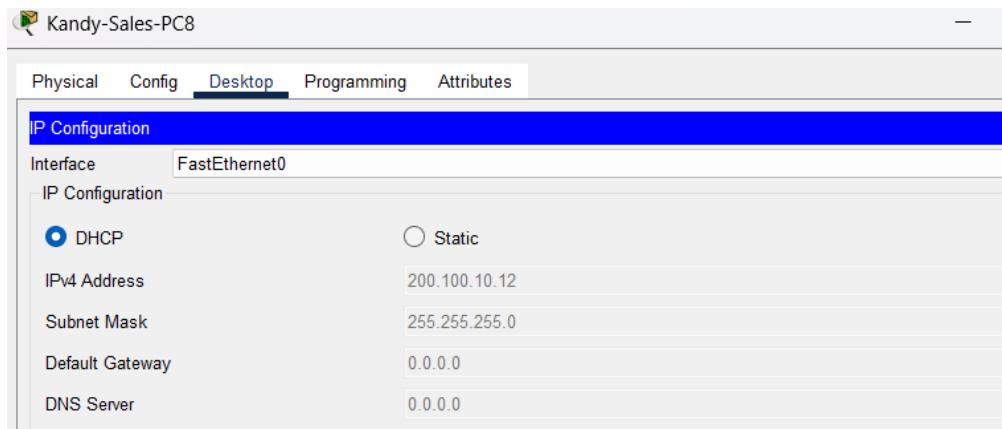


Figure 99: pc-8

Kandy-Sales-PC8

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.12

Pinging 200.100.10.12 with 32 bytes of data:

Reply from 200.100.10.12: bytes=32 time=4ms TTL=128
Reply from 200.100.10.12: bytes=32 time=12ms TTL=128
Reply from 200.100.10.12: bytes=32 time=1ms TTL=128
Reply from 200.100.10.12: bytes=32 time=11ms TTL=128

Ping statistics for 200.100.10.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 12ms, Average = 7ms

C:\>
```

Figure 100: pc-8

Source: (Author, 2025)

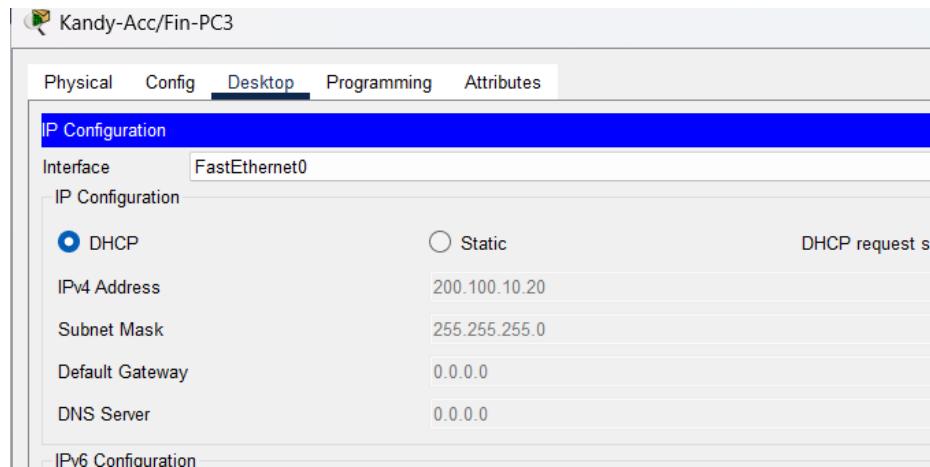


Figure 101: pc-3

```
Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.20

Pinging 200.100.10.20 with 32 bytes of data:

Reply from 200.100.10.20: bytes=32 time<1ms TTL=128
Reply from 200.100.10.20: bytes=32 time=2ms TTL=128
Reply from 200.100.10.20: bytes=32 time<1ms TTL=128
Reply from 200.100.10.20: bytes=32 time=8ms TTL=128

Ping statistics for 200.100.10.20:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:>
```

Figure 102: pc-3

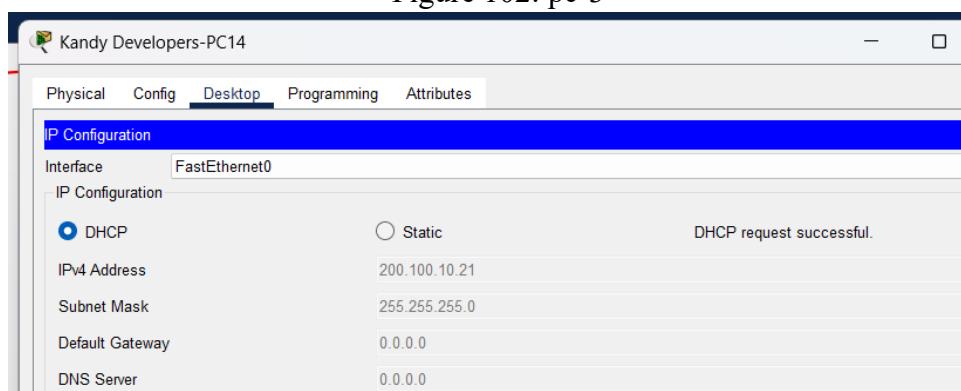


Figure 103: pc-14

Source: (Author, 2025)

Kandy Developers-PC14

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.21

Pinging 200.100.10.21 with 32 bytes of data:

Reply from 200.100.10.21: bytes=32 time<1ms TTL=128
Reply from 200.100.10.21: bytes=32 time=2ms TTL=128
Reply from 200.100.10.21: bytes=32 time=2ms TTL=128
Reply from 200.100.10.21: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>|
```

Figure 104: pc-14

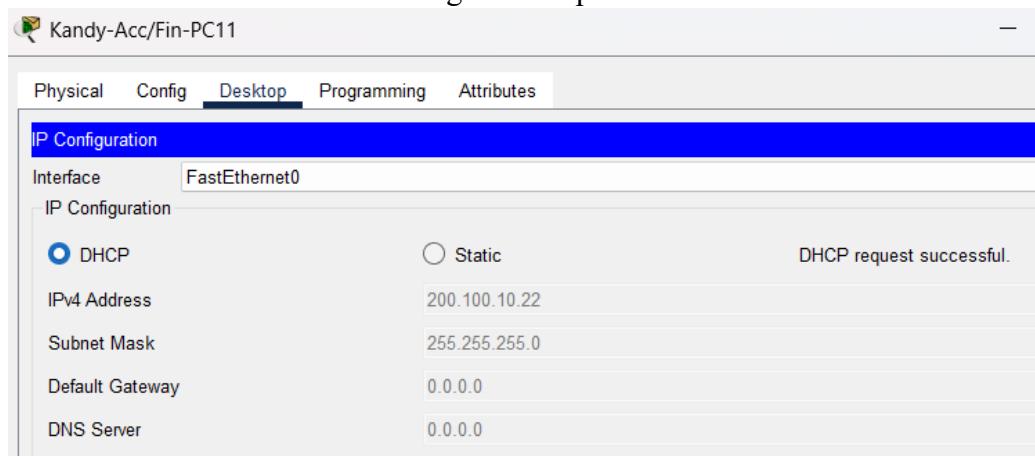


Figure 105: pc-11

Kandy-Acc/Fin-PC11

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.22

Pinging 200.100.10.22 with 32 bytes of data:

Reply from 200.100.10.22: bytes=32 time=12ms TTL=128
Reply from 200.100.10.22: bytes=32 time<1ms TTL=128
Reply from 200.100.10.22: bytes=32 time<1ms TTL=128
Reply from 200.100.10.22: bytes=32 time=4ms TTL=128

Ping statistics for 200.100.10.22:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 4ms

C:\>|
```

Figure 106: pc-11

Source: (Author, 2025)

Galle Branch- DHCP Setup and Connectivity confirmation

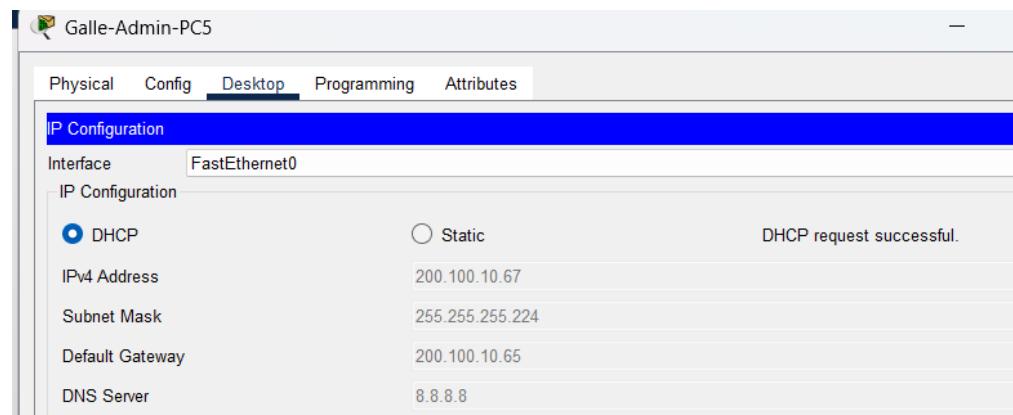


Figure 107: pc-5

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.67

Pinging 200.100.10.67 with 32 bytes of data:

Reply from 200.100.10.67: bytes=32 time=4ms TTL=128
Reply from 200.100.10.67: bytes=32 time=11ms TTL=128
Reply from 200.100.10.67: bytes=32 time=2ms TTL=128
Reply from 200.100.10.67: bytes=32 time=20ms TTL=128

Ping statistics for 200.100.10.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 20ms, Average = 9ms

C:\>

```

Figure 108: pc-5

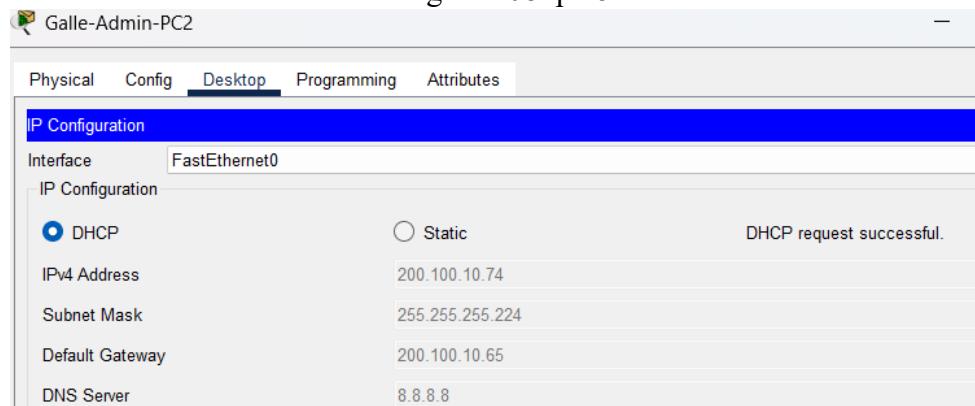


Figure 109: pc-2

Source: (Author, 2025)

```

Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.74

Pinging 200.100.10.74 with 32 bytes of data:

Reply from 200.100.10.74: bytes=32 time=2ms TTL=128
Reply from 200.100.10.74: bytes=32 time<1ms TTL=128
Reply from 200.100.10.74: bytes=32 time=2ms TTL=128
Reply from 200.100.10.74: bytes=32 time=4ms TTL=128

Ping statistics for 200.100.10.74:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 4ms, Average = 2ms

C:>

```

Figure 110: pc-2

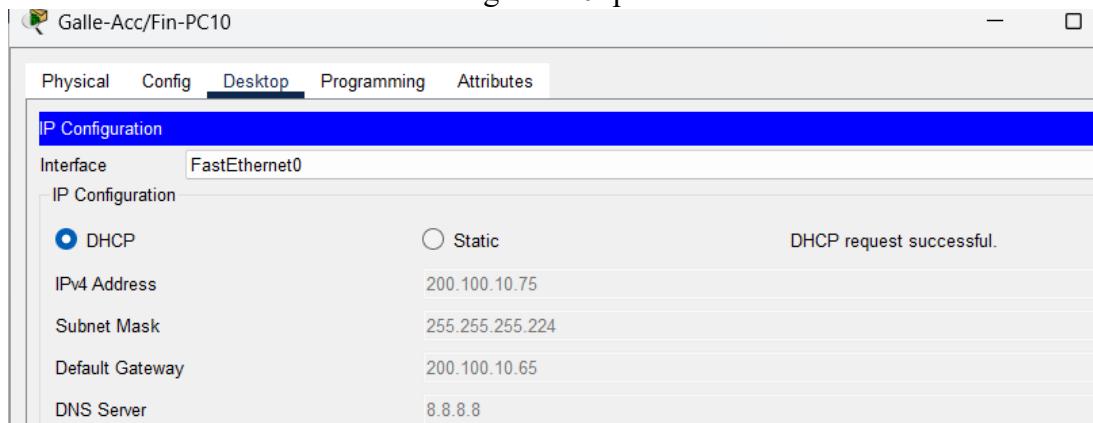


Figure 111: pc-10

```

Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.75

Pinging 200.100.10.75 with 32 bytes of data:

Reply from 200.100.10.75: bytes=32 time=12ms TTL=128
Reply from 200.100.10.75: bytes=32 time=9ms TTL=128
Reply from 200.100.10.75: bytes=32 time=2ms TTL=128
Reply from 200.100.10.75: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.75:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 5ms

C:>

```

Figure 112: pc-10

Source: (Author, 2025)

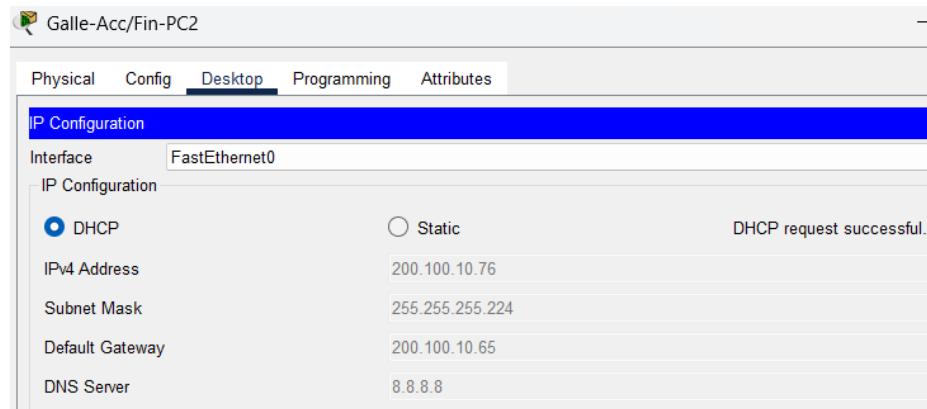


Figure 113: pc-2

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.76

Pinging 200.100.10.76 with 32 bytes of data:

Reply from 200.100.10.76: bytes=32 time=2ms TTL=128
Reply from 200.100.10.76: bytes=32 time=4ms TTL=128
Reply from 200.100.10.76: bytes=32 time=3ms TTL=128
Reply from 200.100.10.76: bytes=32 time=4ms TTL=128

Ping statistics for 200.100.10.76:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 4ms, Average = 3ms

C:\>
```

Figure 114: pc-2

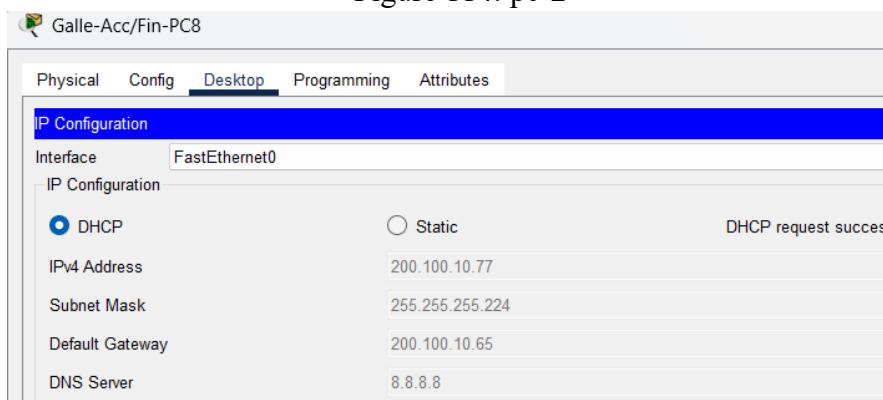


Figure 115: pc-8

Source: (Author, 2025)

Galle-Acc/Fin-PC8

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.77

Pinging 200.100.10.77 with 32 bytes of data:

Reply from 200.100.10.77: bytes=32 time=12ms TTL=128
Reply from 200.100.10.77: bytes=32 time=3ms TTL=128
Reply from 200.100.10.77: bytes=32 time=2ms TTL=128
Reply from 200.100.10.77: bytes=32 time=2ms TTL=128

Ping statistics for 200.100.10.77:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 12ms, Average = 4ms

C:\>
```

Figure 116: pc-8

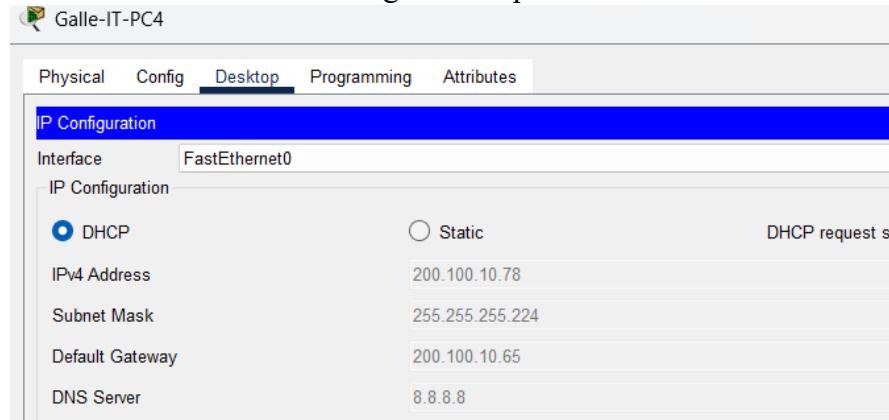


Figure 117: pc-4

Galle-IT-PC4

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.78

Pinging 200.100.10.78 with 32 bytes of data:

Reply from 200.100.10.78: bytes=32 time=4ms TTL=128
Reply from 200.100.10.78: bytes=32 time=8ms TTL=128
Reply from 200.100.10.78: bytes=32 time=4ms TTL=128
Reply from 200.100.10.78: bytes=32 time=6ms TTL=128

Ping statistics for 200.100.10.78:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 8ms, Average = 5ms

C:\>
```

Figure 118: pc-4

Source: (Author, 2025)

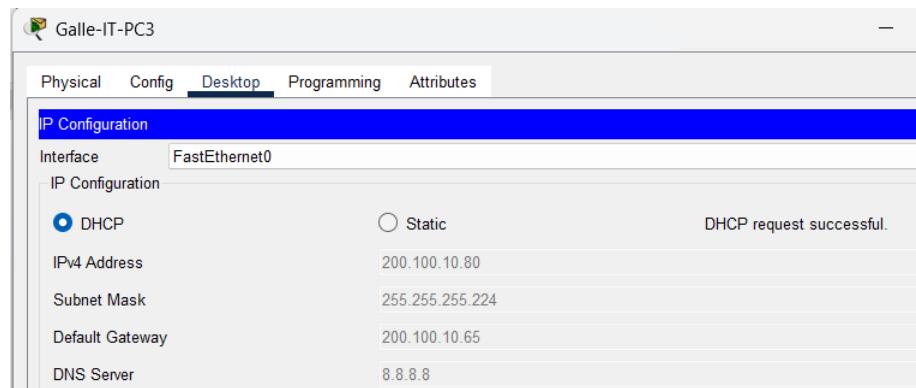


Figure 119: pc-3

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.80

Pinging 200.100.10.80 with 32 bytes of data:

Reply from 200.100.10.80: bytes=32 time=lms TTL=128
Reply from 200.100.10.80: bytes=32 time=10ms TTL=128
Reply from 200.100.10.80: bytes=32 time<lms TTL=128
Reply from 200.100.10.80: bytes=32 time=11ms TTL=128

Ping statistics for 200.100.10.80:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 5ms

C:\>|
```

Figure 120: pc-3

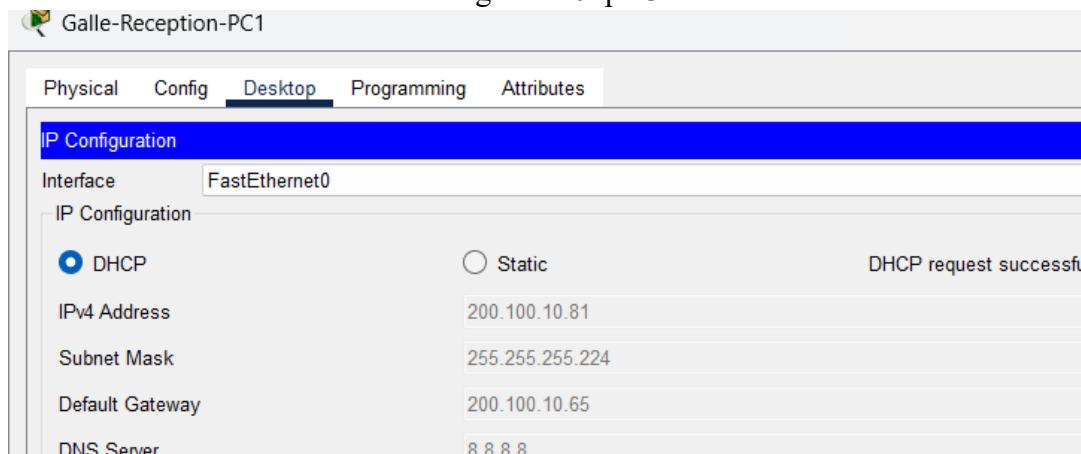


Figure 121: pc-1

Source: (Author, 2025)

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.81

Pinging 200.100.10.81 with 32 bytes of data:

Reply from 200.100.10.81: bytes=32 time=8ms TTL=128
Reply from 200.100.10.81: bytes=32 time=6ms TTL=128
Reply from 200.100.10.81: bytes=32 time=9ms TTL=128
Reply from 200.100.10.81: bytes=32 time=4ms TTL=128

Ping statistics for 200.100.10.81:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 9ms, Average = 6ms

C:\>

```

Figure 122: pc-1

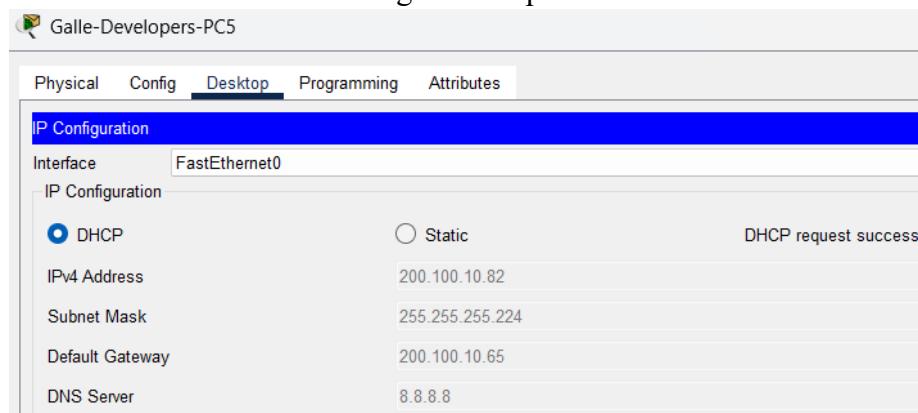


Figure 123: pc-5

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.82

Pinging 200.100.10.82 with 32 bytes of data:

Reply from 200.100.10.82: bytes=32 time<1ms TTL=128
Reply from 200.100.10.82: bytes=32 time<1ms TTL=128
Reply from 200.100.10.82: bytes=32 time=2ms TTL=128
Reply from 200.100.10.82: bytes=32 time=3ms TTL=128

Ping statistics for 200.100.10.82:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 3ms, Average = 1ms

C:\>|

```

Figure 124: pc-5

Source: (Author, 2025)

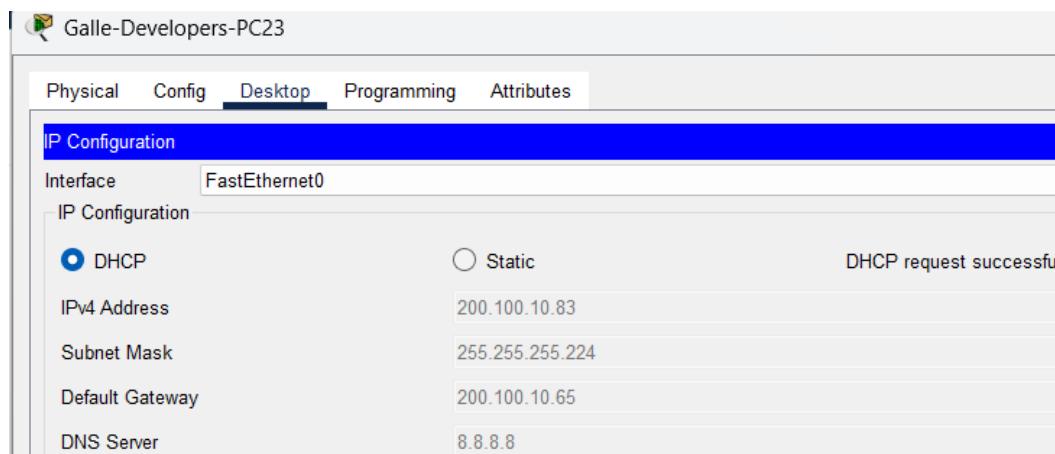


Figure 125: pc-23

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.83

Pinging 200.100.10.83 with 32 bytes of data:

Reply from 200.100.10.83: bytes=32 time=15ms TTL=128
Reply from 200.100.10.83: bytes=32 time=4ms TTL=128
Reply from 200.100.10.83: bytes=32 time=7ms TTL=128
Reply from 200.100.10.83: bytes=32 time=5ms TTL=128

Ping statistics for 200.100.10.83:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 15ms, Average = 7ms

C:\>

```

Figure 126: pc-23

Source: (Author, 2025)

Test Cases – Kandy Branch

Test Case	Device used	Destination IP	Expected Result	Actual Result	Pass/Fail
Kandy-Acc/Fin-PC12	Kandy-Acc/Fin-PC11	200.100.10.23	Reply received with 0% loss	Reply received with 0% loss	Pass
Kandy-Acc/Fin-PC3	Kandy-Acc/Fin-PC2	200.100.10.18	Reply received with 0% loss	Reply received with 0% loss	Pass
Kandy-Directors-PC1	Kandy-Directors-PC2	200.100.10.8	Reply received with 0% loss	Reply received with 0% loss	Pass
Kandy Developers-PC11	Kandy Developers-PC18	200.100.10.26	Reply received with 0% loss	Reply received with 0% loss	Pass
Kandy-Reception-PC2	Kandy-Reception-PC1	200.100.10.24	Reply received with 0% loss	Reply received with 0% loss	Pass

Table 8: DHCP and Ping Test Cases – Kandy Branch

The screenshot shows a Cisco Packet Tracer interface titled "Kandy-Acc/Fin-PC11". The "Desktop" tab is selected. A "Command Prompt" window is open, showing the following output:

```

Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.10.23

Pinging 200.100.10.23 with 32 bytes of data:

Reply from 200.100.10.23: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.23:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:>

```

Figure 127: Kandy test case-1 (Author,2025)

Kandy-Acc/Fin-PC3

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.18

Pinging 200.100.10.18 with 32 bytes of data:

Reply from 200.100.10.18: bytes=32 time=10ms TTL=128
Reply from 200.100.10.18: bytes=32 time=13ms TTL=128
Reply from 200.100.10.18: bytes=32 time=2ms TTL=128
Reply from 200.100.10.18: bytes=32 time=4ms TTL=128

Ping statistics for 200.100.10.18:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 13ms, Average = 7ms

C:\>
```

Figure 128: Kandy test case-2 (Author,2025)

Kandy-Directors-PC1

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.8

Pinging 200.100.10.8 with 32 bytes of data:

Reply from 200.100.10.8: bytes=32 time<1ms TTL=128
Reply from 200.100.10.8: bytes=32 time=8ms TTL=128
Reply from 200.100.10.8: bytes=32 time=4ms TTL=128
Reply from 200.100.10.8: bytes=32 time=2ms TTL=128

Ping statistics for 200.100.10.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 3ms

C:\>
```

Figure 129: Kandy test case-3 (Author,2025)

Kandy Developers-PC11

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.26

Pinging 200.100.10.26 with 32 bytes of data:

Reply from 200.100.10.26: bytes=32 time<1ms TTL=128
Reply from 200.100.10.26: bytes=32 time=9ms TTL=128
Reply from 200.100.10.26: bytes=32 time=1ms TTL=128
Reply from 200.100.10.26: bytes=32 time=7ms TTL=128

Ping statistics for 200.100.10.26:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 9ms, Average = 4ms

C:\>
```

Figure 130: Kandy test case-4 (Author,2025)

Kandy-Reception-PC1

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.24

Pinging 200.100.10.24 with 32 bytes of data:

Reply from 200.100.10.24: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.24:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 131: Kandy test case-5 (Author,2025)

Test Cases – Galle Branch

Test Case	Device used	Destination IP	Expected Result	Actual Result	Pass/Fail
Galle-Acc/Fin-PC11	Galle-Acc/Fin-PC12	200.100.10.88	Reply received with 0% loss	Reply received with 0% loss	Pass
Galle-Admin-PC2	Galle-Admin-PC10	200.100.10.78	Reply received with 0% loss	Reply received with 0% loss	Pass
Galle-Acc/Fin-PC6	Galle-Acc/Fin-PC8	200.100.10.91	Reply received with 0% loss	Reply received with 0% loss	Pass
Galle-IT-PC1	Galle-IT-PC4	200.100.10.92	Reply received with 0% loss	Reply received with 0% loss	Pass
Galle-Reception-PC1	Galle-Reception-PC2	200.100.10.75	Reply received with 0% loss	Reply received with 0% loss	Pass

Table 9: DHCP and Ping Test Cases – Galle Branch

```
C:\>ping 200.100.10.88

Pinging 200.100.10.88 with 32 bytes of data:

Reply from 200.100.10.88: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.88:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Figure 132: Galle test case-1 (Author,2025)

Galle-Admin-PC10

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.78

Pinging 200.100.10.78 with 32 bytes of data:

Reply from 200.100.10.78: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.78:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 133: Galle test case-2 (Author,2025)

Galle-Acc/Fin-PC8

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.91

Pinging 200.100.10.91 with 32 bytes of data:

Reply from 200.100.10.91: bytes=32 time<1ms TTL=128
Reply from 200.100.10.91: bytes=32 time<1ms TTL=128
Reply from 200.100.10.91: bytes=32 time=12ms TTL=128
Reply from 200.100.10.91: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.10.91:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>
```

Figure 134: Galle test case-3 (Author,2025)

Galle-IT-PC4

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.92

Pinging 200.100.10.92 with 32 bytes of data:

Reply from 200.100.10.92: bytes=32 time<lms TTL=128

Ping statistics for 200.100.10.92:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 135: Galle test case-4 (Author,2025)

Galle-Reception-PC2

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.75

Pinging 200.100.10.75 with 32 bytes of data:

Reply from 200.100.10.75: bytes=32 time<lms TTL=128

Ping statistics for 200.100.10.75:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 136: Galle test case-5 (Author,2025)

VLAN Configuration and Verification

The screenshot shows a Cisco Multilayer Switch interface titled "Multilayer Switch3". The "CLI" tab is selected. The terminal window displays the IOS Command Line Interface. It starts with a prompt: "Press RETURN to get started." followed by the command "Switch#show vlan brief". The output lists various VLANs with their names, status, and associated ports:

VLAN Name	Status	Ports
1 default	active	Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gig0/1, Gig0/2
10 Reception	active	
20 Sales_Marketing	active	
30 Customer_Services	active	
40 Developers	active	
50 Director_Suits	active	
60 Boardroom	active	Fa0/4
70 Administration	active	
80 HR	active	Fa0/3
90 Accounting	active	Fa0/1
100 IT_Support	active	Fa0/2
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
--More--		

At the bottom right of the terminal window are "Copy" and "Paste" buttons. At the bottom left is a "Top" button.

Figure 137: VLAN configuration on switch 3 (Author,2025)

The screenshot shows a terminal window with a header bar containing "Physical", "Config", "CLI" (which is underlined), and "Attributes". Below the header is the text "IOS Command Line Interface". The main area contains the following CLI session:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 50
Switch(config-vlan)# name DS
Switch(config-vlan)#vlan 60
Switch(config-vlan)# name BOARD
Switch(config-vlan)#vlan 70
Switch(config-vlan)# name ADMIN
Switch(config-vlan)#vlan 80
Switch(config-vlan)# name HR
Switch(config-vlan)#interface fa0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 50
Switch(config-if)# exit
Switch(config)#interface fa0/2
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 70
Switch(config-if)# exit
Switch(config)#interface fa0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 80
Switch(config-if)# exit
Switch(config)#interface fa0/4
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 60
Switch(config-if)# exit
Switch(config)#interface fa0/24
```

Figure 138: VLAN configuration on switch 3 (Author,2025)

```
Switch(config-if)# exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#end
Translating "end"...domain server (255.255.255.255)
% Unknown command or computer name, or unable to find computer address

Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#no ip domain-lookup
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief

VLAN Name                      Status    Ports
----- 
1   default                     active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                         Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                         Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                         Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                         Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                         Gig0/1, Gig0/2
50   DS                         active    Fa0/1
60   BOARD                       active    Fa0/4
70   ADMIN                        active    Fa0/2
80   HR                          active    Fa0/3
1002 fddi-default               active
1003 token-ring-default         active
1004 fddinet-default            active
1005 trnet-default              active
Switch#write memory
Building configuration...
[OK]
Switch#
```

 Top

Figure 139: VLAN configuration on switch 5 (Author,2025)

```
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#write
Building configuration...
[OK]
Switch#show vlan brief

VLAN Name                               Status      Ports
---- -----
1    default                             active     Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                         Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                         Fa0/14, Fa0/15, Fa0/16, Fa0/17
                                         Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                         Fa0/22, Fa0/23, Fa0/24, Gig0/1
                                         Gig0/2
90   ACC                                active     Fa0/1
100  IT                                 active     Fa0/2
110  SERVERFAM                          active     Fa0/3
120  DNS                                active     Fa0/4
130  DHCP                               active     Fa0/5
1002 fddi-default                       active
1003 token-ring-default                 active
1004 fddinet-default                   active
1005 trnet-default                     active
Switch#
```

Figure 140: VLAN configuration on switch 5 (Author,2025)

The screenshot shows a network configuration interface for a Cisco switch. The top navigation bar includes tabs for Physical, Config, CLI (which is selected), and Attributes. Below the navigation is a title "IOS Command Line Interface". The main area contains the following CLI session output:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)# name CAM
Switch(config-vlan)#vlan 40
Switch(config-vlan)# name ACCOUNTING
Switch(config-vlan)#vlan 70
Switch(config-vlan)# name ADMIN
Switch(config-vlan)#vlan 80
Switch(config-vlan)# name HR
Switch(config-vlan)#vlan 100
Switch(config-vlan)# name IT
Switch(config-vlan)#vlan 110
Switch(config-vlan)# name SERVERFAM
Switch(config-vlan)#vlan 120
Switch(config-vlan)# name DNS_GALLE
Switch(config-vlan)#vlan 130
Switch(config-vlan)# name DHCP_GALLE
Switch(config-vlan)#interface fa0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 40
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/2
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 40
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 100
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/4
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 130
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/5
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 80
```

At the bottom right of the code block are two buttons: "Copy" and "Paste".

| Top

Figure 141: VLAN configuration on switch 7 (Author,2025)

Multilayer Switch7

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch(config)#interface fa0/5
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 80
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/6
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 70
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/7
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 120
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/8
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 110
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/9
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
Switch(config-if)# exit
Switch(config)#
Switch(config)#interface fa0/10
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
Switch(config-if)# exit
Switch(config)#interface fa0/24
Switch(config-if)# switchport mode trunk
```

Figure 142: VLAN configuration on switch 7 (Author,2025)

Switch#show vlan brief			
VLAN	Name	Status	Ports
1	default	active	Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gig0/1, Gig0/2
30	CAM	active	Fa0/9, Fa0/10
40	ACCOUNTING	active	Fa0/1, Fa0/2
70	ADMIN	active	Fa0/6
80	HR	active	Fa0/5
100	IT	active	Fa0/3
110	SERVERFAM	active	Fa0/8
120	DNS_GALLE	active	Fa0/7
130	DHCP_GALLE	active	Fa0/4
1002	fdmi-default	active	
1003	token-ring-default	active	
1004	fdmnet-default	active	
1005	trnet-default	active	

Figure 143: VLAN configuration on switch 7 (Author,2025)

Multilayer Switch9

Physical Config **CLI** Attributes

IOS Command Line Interface

```

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#ip address 200.100.10.1 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 20
Switch(config-if)#ip address 200.100.10.17 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 30
Switch(config-if)#ip address 200.100.10.33 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 40
Switch(config-if)#ip address 200.100.10.65 255.255.255.192
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 50
Switch(config-if)#ip address 200.100.10.129 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 60
Switch(config-if)#ip address 200.100.10.145 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 70
Switch(config-if)#ip address 200.100.10.161 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface vlan 80
Switch(config-if)#ip address 200.100.10.177 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit

```

Copy **Paste**

Figure 144: VLAN configuration on switch 9 (Author,2025)

Web Server Connectivity Test

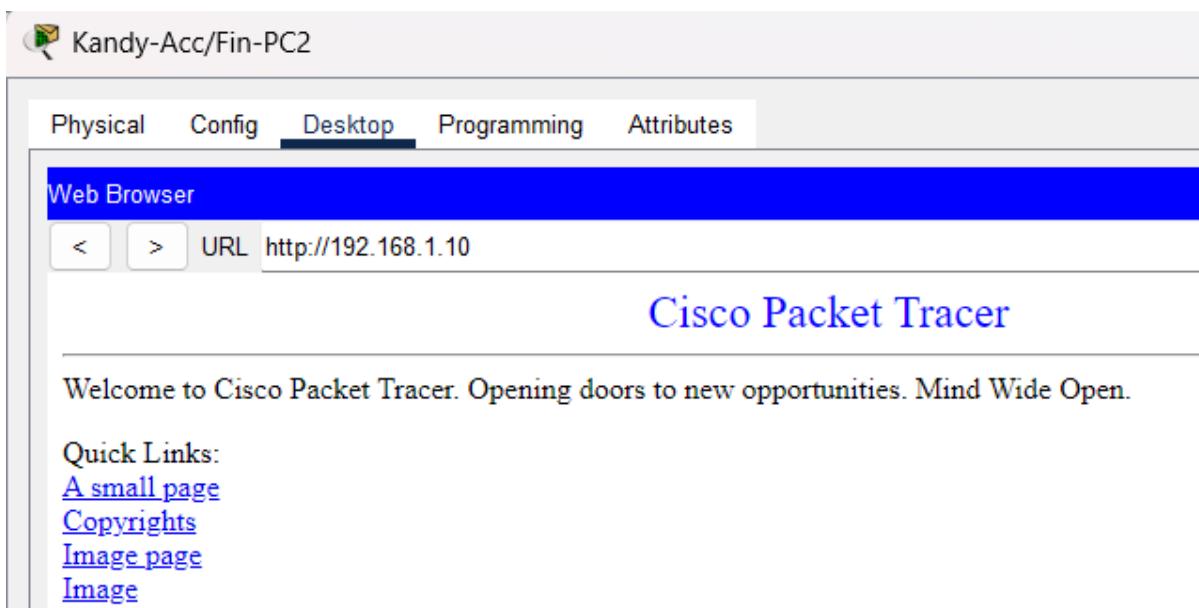


Figure 145: Web server page displayed successfully (Author,2025)

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.10

Pinging 192.168.1.10 with 32 bytes of data:

Reply from 192.168.1.10: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Figure 146: Testing the Connection so the PC can communicate with the server (Author,2025)

Traceroute Testing

The screenshot shows a window titled "Galle-Reception-PC1" with tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is selected, displaying a "Command Prompt" window. The command prompt shows the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.70

Pinging 200.100.10.70 with 32 bytes of data:

Reply from 200.100.10.70: bytes=32 time<1ms TTL=128
Reply from 200.100.10.70: bytes=32 time<1ms TTL=128
Reply from 200.100.10.70: bytes=32 time<1ms TTL=128
Reply from 200.100.10.70: bytes=32 time=6ms TTL=128

Ping statistics for 200.100.10.70:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 6ms, Average = 1ms

C:\>tracert 200.100.10.70

Tracing route to 200.100.10.70 over a maximum of 30 hops:
    1     3 ms      2 ms      2 ms    200.100.10.70

Trace complete.

C:\>
```

Figure 147: Traceroute testing for Galle branch using the IP (Author,2025)

```
C:\>tracert 8.8.8.8

Tracing route to 8.8.8.8 over a maximum of 30 hops:

 1  0 ms      0 ms      0 ms      200.100.10.65
 2  0 ms      *         0 ms      200.100.10.65
 3  *         0 ms      *         Request timed out.
 4  0 ms      *         0 ms      200.100.10.65
 5  *         0 ms      *         Request timed out.
 6  0 ms      *         0 ms      200.100.10.65
 7  *         0 ms      *         Request timed out.
 8  0 ms      *         0 ms      200.100.10.65
 9  *         0 ms      *         Request timed out.
10  0 ms      *         0 ms      200.100.10.65
11  *         0 ms      *         Request timed out.
12  0 ms      *         0 ms      200.100.10.65
13  *         0 ms      *         Request timed out.
14  0 ms      *         0 ms      200.100.10.65
15  *         0 ms      *         Request timed out.
16  0 ms      *         0 ms      200.100.10.65
17  *         0 ms      *         Request timed out.
18  0 ms      *         0 ms      200.100.10.65
19  *         0 ms      *         Request timed out.
20  0 ms      *         0 ms      200.100.10.65
21  *         0 ms      *         Request timed out.
22  0 ms      *         1 ms      200.100.10.65
23  *         0 ms      *         Request timed out.
24  0 ms      *         0 ms      200.100.10.65
25  *         0 ms      *         Request timed out.
26  0 ms      *         0 ms      200.100.10.65
27  *         19 ms     *         Request timed out.
28  0 ms      *         0 ms      200.100.10.65
29  *         0 ms      *         Request timed out.
30  0 ms      *         0 ms      200.100.10.65

Trace complete.

C:\>
```

Figure 148: Traceroute testing for Galle branch (Author,2025)

DNS Server Testing with nslookup

```

Cisco Packet Tracer PC Command Line 1.0
C:>ping 200.100.50.10

Pinging 200.100.50.10 with 32 bytes of data:

Reply from 200.100.50.10: bytes=32 time<1ms TTL=128

Ping statistics for 200.100.50.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:>nslookup kandy.com

Server: [200.100.50.10]
Address: 200.100.50.10

Non-authoritative answer:
Name: kandy.com
Address: 200.100.50.10

C:>nslookup kandy.com 200.100.50.10

Server: [200.100.50.10]
Address: 200.100.50.10

Non-authoritative answer:
Name: kandy.com
Address: 200.100.50.10

C:>

```

Figure 149: Command prompt on PC showing nslookup result (Author,2025)

No.	Name	Type	Detail
0	kandy.com	A Record	200.100.50.10
1	newpc.kandy	A Record	200.100.50.20

Figure 150: DNS Server showing the added records (Author,2025)

Wi-Fi setup and testing

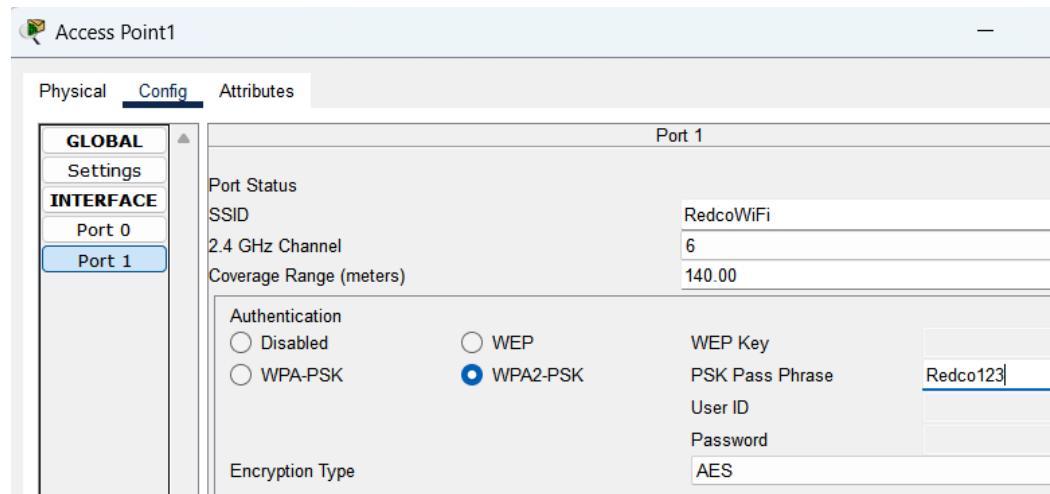


Figure 151: Access Point SSID configuration in Galle branch (Author,2025)

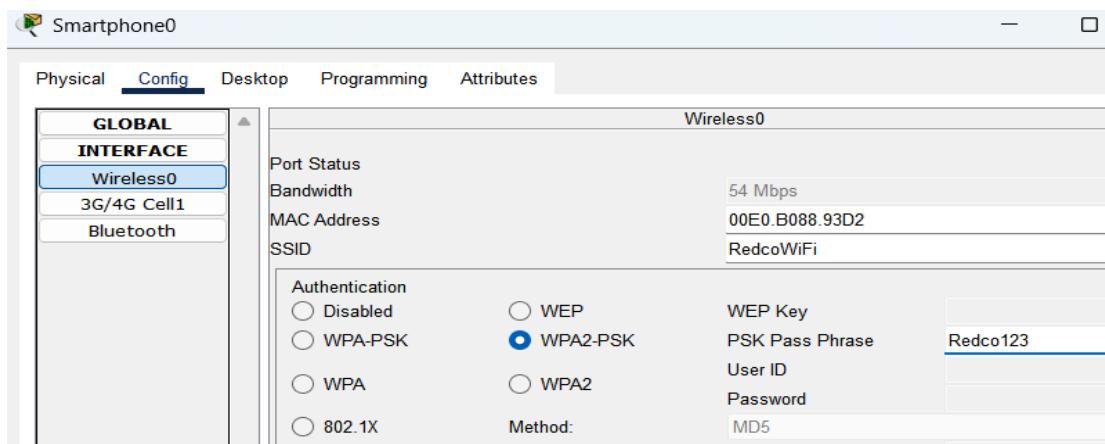


Figure 152: Smartphone Wi-Fi connection in Galle branch (Author,2025)

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.72

Pinging 200.100.10.72 with 32 bytes of data:

Reply from 200.100.10.72: bytes=32 time<1ms TTL=128
Reply from 200.100.10.72: bytes=32 time=3ms TTL=128
Reply from 200.100.10.72: bytes=32 time=10ms TTL=128
Reply from 200.100.10.72: bytes=32 time=1ms TTL=128

Ping statistics for 200.100.10.72:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 10ms, Average = 3ms
```

Figure 153: Successful ping test via Wi-Fi in Galle branch (Author,2025)

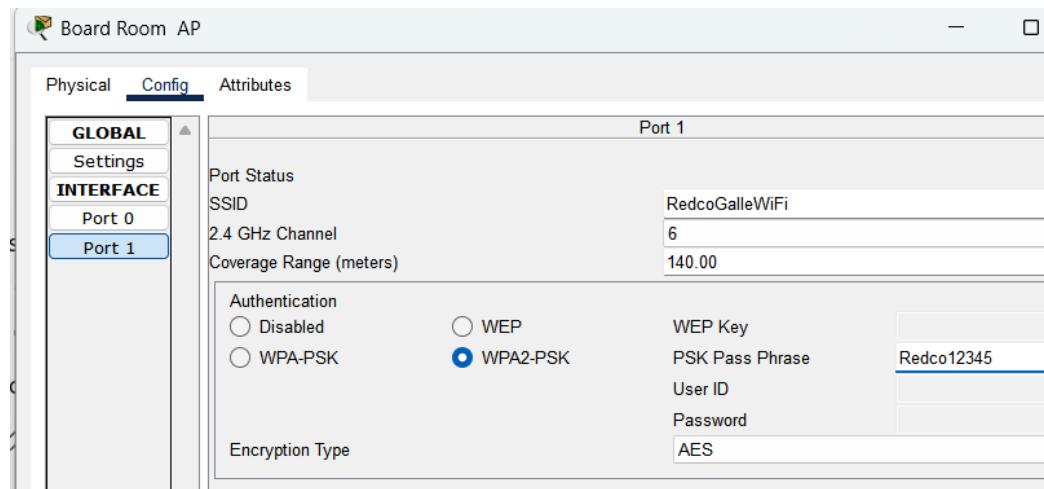


Figure 154: Configured access point in Kandy (Author,2025)

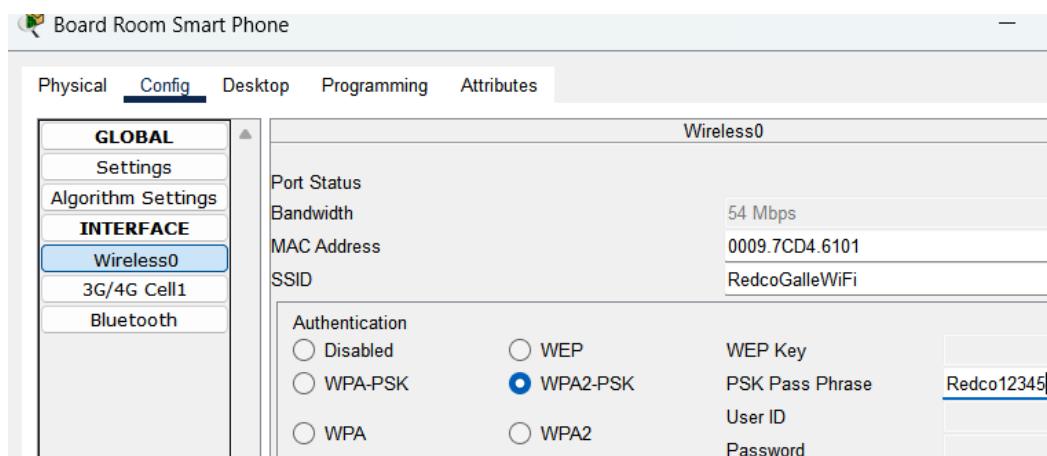


Figure 155: Smartphone connected to Kandy branch Wi-Fi network (Author,2025)

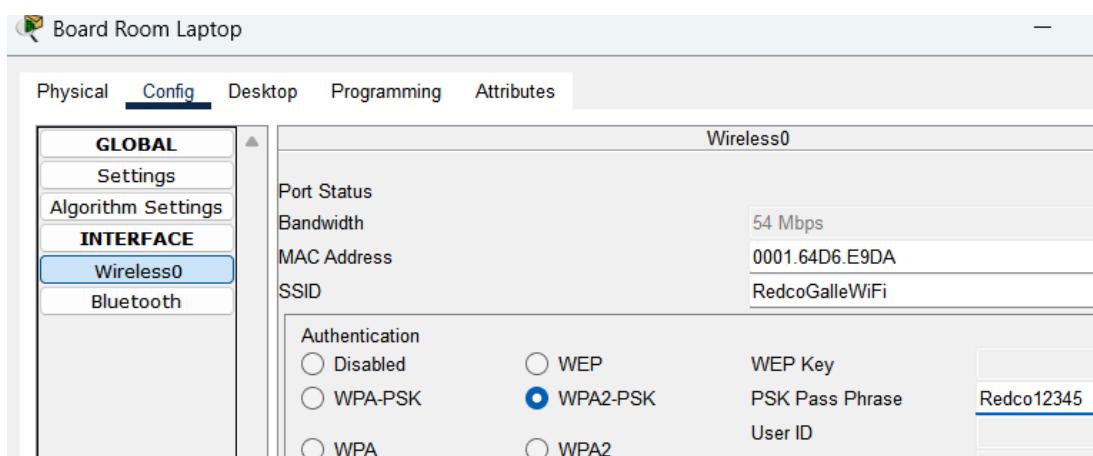


Figure 156: laptop connected to Kandy branch Wi-Fi network (Author,2025)

M4 Recommend potential enhancements for the networked systems.

Future recommendations for scalability and reliability

1. Upgrading to IPv6:

As Redco is planning to continue and grow with more and more smart devices and technologies like IP cameras, smart gates, lighting systems keeping the company high tech but however the space will be limited because of IPv4 address, which will also not be enough for its future growth. Therefore, Redco needs to switch to IPv6 address as it will provide larger space with more bandwidth so by using IPv6 it will allow devices at the Kandy and Galle branch to share information, add devices and technologies easily (Cisco, 2023).

2. Adding redundant links and failover devices:

Adding redundancy to the links between switch, router and between branches will increase the reliability of the network for example in case if one link fails or the device fails, the link will switch to different path without the need for human intervention and this is helpful for Redco company operations like ERP systems or video conferencing and other network services that needs to be run all the time for security purposes.

3. Cloud-Based backup and resource access:

Adding cloud for data backup such as OneDrive, Google Workspace will make sure that Redco's company data is secured and accessible during times of hardware failures and disasters (Google Cloud, 2025; Spanning, 2024). Also company resources and data can be accessed during travelling or even at home making it suitable for remote workers and this can improve flexibility as well, giving Redco the ability to hire employees from any part of SriLanka and even global.

Explanation of AI, Neuralink, Machine Learning, and Deep Learning:

1. Artificial Intelligence (AI):

AI is when machines or software act like human by thinking, learning and making decisions, when handling and maintaining large networks ai can be used to improve network functions. AI can also help to identify problems and fix them easily without any human intervention

2, Neuralink:

Neuralink is basically a developing brain-computer interfaces and AI, which could help tech and IT teams control systems and networks more efficiently in the future (Cisco, 2023).

3. Machine Learning (ML):

Machine learning allows systems to learn from data and get better over time, these data can be used to predict the companys growth and achieve them. At Redco, it can be used to predict maintenance needs, monitor growth and even spot problems early (IBM, 2023).

4. Deep Learning:

Like machine learning, deep learning is the more advanced version as it uses artificial neural networks to pretend and mimic the way how human brain functions and is very useful for image recognition like analyzing IP camera footages, examining network traffics, and speech recognition in the company.

Discuss the future of networking and how it should develop using your own ideas, according to the scenario

Redco developments network will need to change as it wants to expand in the future and make investments in smart technology like EPR systems and IP cameras therefore in order to ensure all these support the future plan, provide strong connectivity between branches and devices, its network needs to change to cope with the future plan.

For example the expansion of IoT and smart devices allows Redco to become a smart office with the help of IP camera, smart gates and lighting also more IoT devices like smart desks and biometric can be added in the future this will create and help to build a secure network and manage the additional data traffic. Moreover, Redco developments can increase the amount of time it spends using backups, data and file storage, even execute the ERP software as this helps to reduce the pressure on the local servers and enable a safe access of files from any location around Sri Lanka and even globally therefore provides the company with flexibility and remote work for employees as well (Coram, 2025).

Also, AI tools can be used automatically used to identify any issues, likewise suggest solutions and even monitor the network in real time thus helps to maintain smart devices like IP cameras and autolighting function properly and therefore reduces the cost for hiring tech experts and helps to save money as well (Coram, 2025).

Redco Developments can also implement a SDN (software defined networking) this helps to manage and control the whole network by using a software which means data traffics between departments and branches can be easily managed and controlled for safety, likewise the bandwidth for smart devices and EPR systems could be changed when needed as well. In conclusion to that, to support Redcos expansion for the future the network must evolve and change with modern solutions like SDN, using AI, cloud software and IoT as these will ensure that Redco remains secure and efficient while staying prepared for the future as well.

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Appendix

Appendix 1 – Presentation Slides



Figure 157: Presentation Slide-1 source: (Author, 2025)



Figure 158: Presentation Slide-2 source: (Author, 2025)

Overview of Redco

Redco Developments is a Sri Lankan-based mobile app development company with its head office in Kandy and has recently approved the opening of a new branch in Galle.

1 What is a network?

A computer network is a system where multiple computers and other digital devices are connected to share information and resources and these devices are connected using communication media like Wi-Fi (TechTarget, 2023).

2 Use and benefits of network

The main use of a computer network is to allow data to be exchanged through sharing of information such as files, applications, and hardware devices like printers, or storage devices

- Shared hardware like printers and files
- Centralized management
- Flexibility
- Easy communication



3

Figure 159: Presentation Slide-3 source: (Author, 2025)

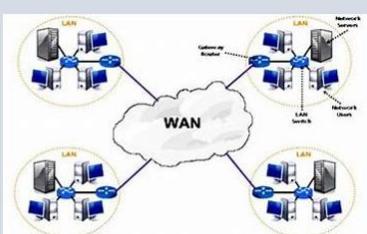
Network Type

Types of network

2.1 LAN (Local Area Network) – Covers small areas like offices or buildings, it connects PCs, printers, and servers within short distances and is very fast and affordable.



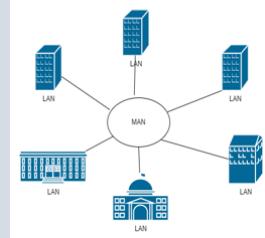
2.2 WAN (Wide Area Network)- connects networks over long distances, like department in Galle and Kandy. The biggest example of WAN is the internet.



4

Figure 160: Presentation Slide-4 source: (Author, 2025)

2.3 MAN (Metropolitan Area Network) – It's commonly used in places like universities or campus across a city (Cisco, 2023).



2.4 PAN (Personal Area Network)- connects devices over a short distance, such as phones, smartwatches even Redco's smart lighting and gates.



5

Figure 161: Presentation Slide-5 source: (Author, 2025)

Network Topology

What is Network Topology?
The layout or structure of how devices are connected in a network

Types of Network Topology

- **Bus** – Single cable backbone
- **Star** – Devices connected to a central switch or router
- **Ring** – Devices form a circle and data pass in one direction
- **Mesh** – Devices are interconnected with each other
- **Hybrid** – Mix of different topologies

BUS Topology

STAR TOPOLOGY

Hybrid Topology

Mesh topology

Ring topology

6

Figure 162: Presentation Slide-6 source: (Author, 2025)

Devices and Tools Used in Redco Project

Network Devices:

- **Cisco Routers** – are used to connect the Kandy and Galle branches. This helps both offices share data safely.



- **Layer 3 Switches** – is a network device used for inter-VLAN routing and core switching, and it can also send data between networks



- **Access Switches (Layer 2)** – For connecting PCs, printers, devices to the Redco network (Cisco, 2024).



7

Figure 163: Presentation Slide-7 source: (Author, 2025)

- **Cisco Access Points** – give Wi-Fi access in areas like the reception, boardroom, and customer service area. These are secured with Wi-Fi passwords.



- **Servers** – Hosting DHCP, DNS, File, ERP, and Backup services



- **IP Cameras** – are used for security purposes in Galle, as they can be viewed from anywhere in the network.

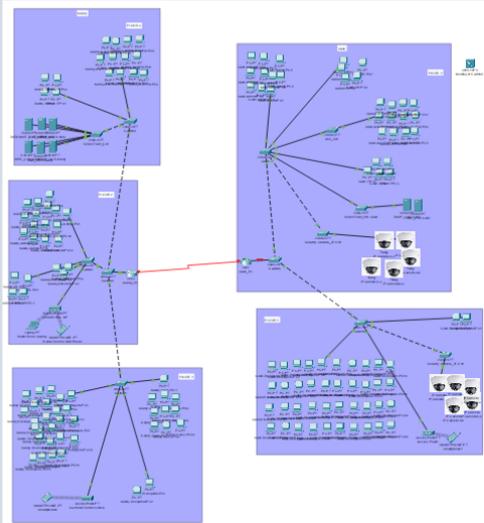


8

Figure 164: Presentation Slide-8 source: (Author, 2025)

Software Tools for Redco project:

- **Cisco Packet Tracer** – was the main simulation tool used for Network design and testing,



- **Microsoft Visio** – was used to draw the full network design clearly

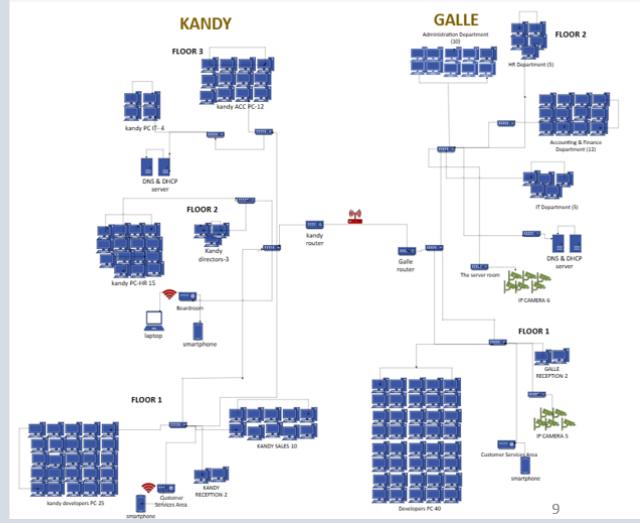
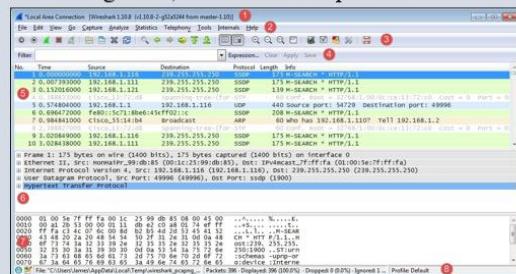


Figure 165: Presentation Slide-9 source: (Author, 2025)

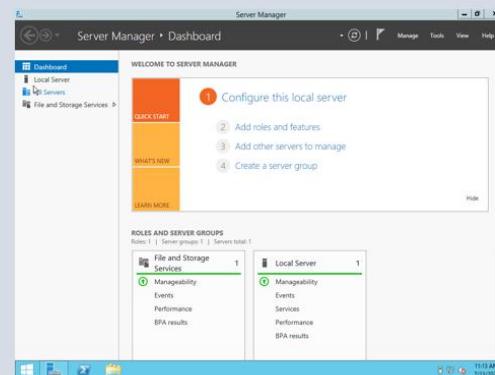
- **Wireshark** – was used for analyzing network traffic troubleshooting them, and check data packets



- **Windows Server 2012** – was used to manage users, and helps control the whole network from one place



- **VirtualBox** – was used for server roles like DHCP and DNS, and test how servers work, gives IP addresses and manages the network



10

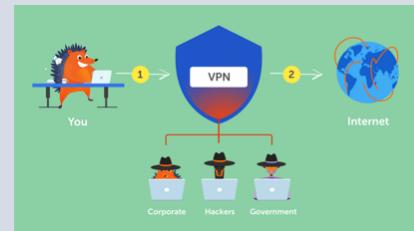
Figure 166: Presentation Slide-10 source: (Author, 2025)

Security & Access Technologies in Redco's Network

- **Firewall** – Protects the network from unauthorized access



- **VPN (Virtual Private Network)** – Enables secure remote access connection that lets employees safely access the Redco's network from home.



- **DMZ (Demilitarized Zone)** – A DMZ is a small part of the network that protects the main network from outside threats

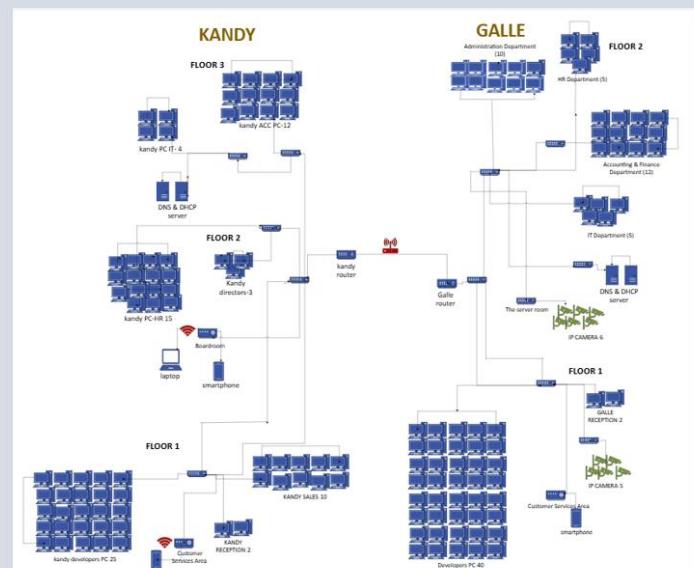


11

Figure 167: Presentation Slide-11 source: (Author, 2025)

Network Blueprint of Redco developments

- The network diagram was made using Microsoft Visio.
- It shows how the Kandy and Galle branch are linked using a WAN.
- includes:
 - Routers
 - Switches
 - PCs
 - Servers
 - Access points.



12

Figure 168: Presentation Slide-12 source: (Author, 2025)

197

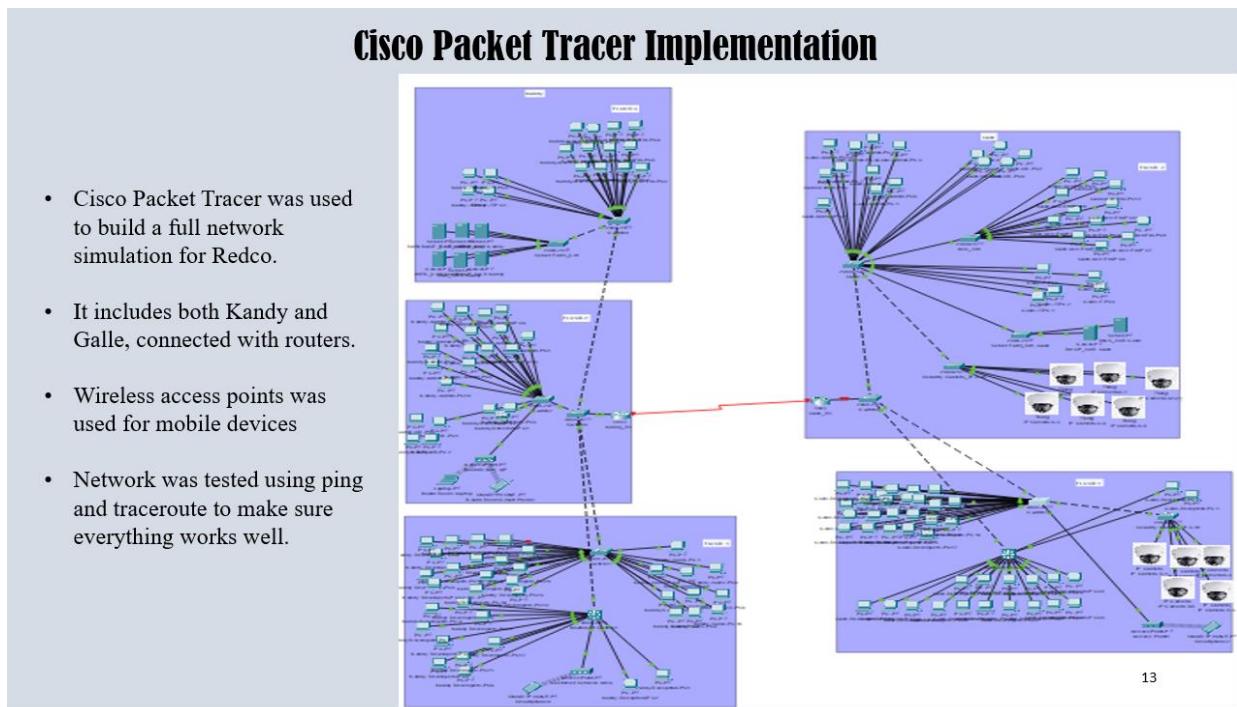


Figure 169: Presentation Slide-13 source: (Author, 2025)

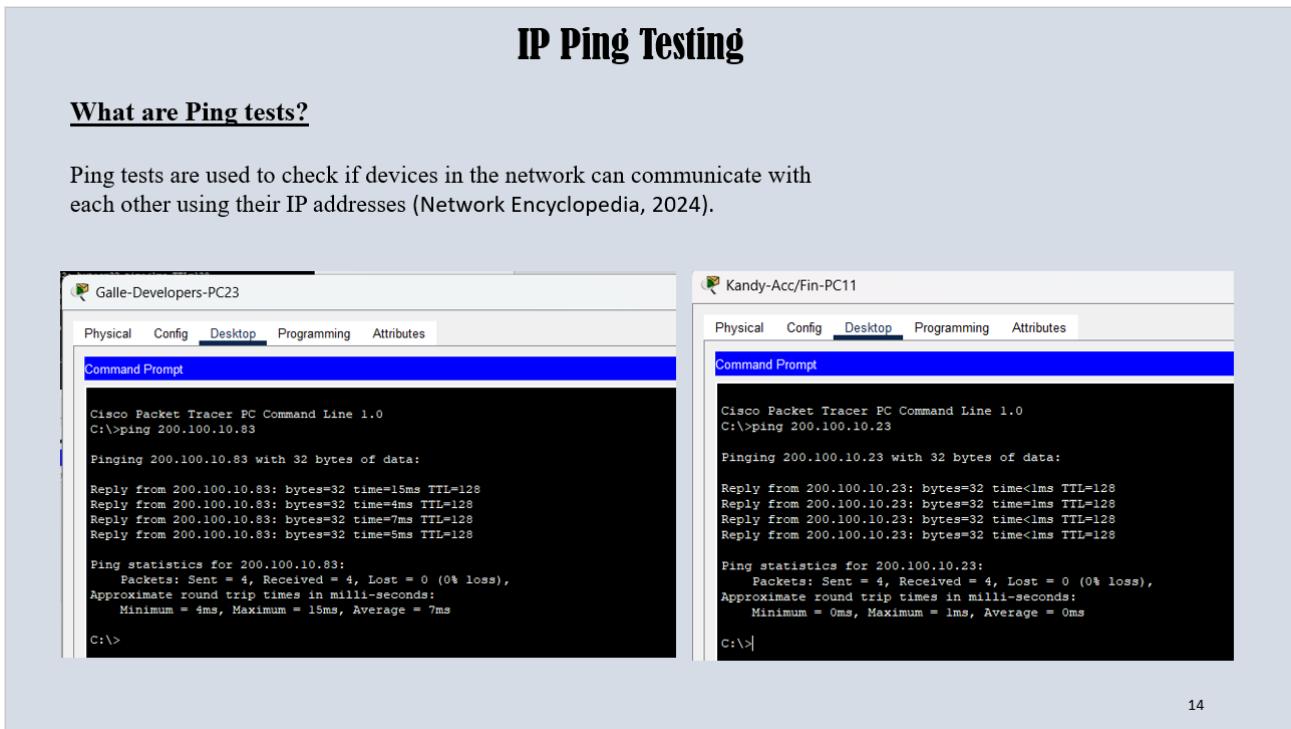


Figure 170: Presentation Slide-14 source: (Author, 2025)

- Successful replies mean the network is properly configured
- IP pinging helps verify if two devices can communicate across the network
- Used for testing both local and remote device connections.

Kandy-Directors-PC1

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.8

Pinging 200.100.10.8 with 32 bytes of data:

Reply from 200.100.10.8: bytes=32 time<1ms TTL=128
Reply from 200.100.10.8: bytes=32 time=8ms TTL=128
Reply from 200.100.10.8: bytes=32 time=4ms TTL=128
Reply from 200.100.10.8: bytes=32 time=2ms TTL=128

Ping statistics for 200.100.10.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 3ms

C:\>
```

Galle-Admin-PC10

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 200.100.10.78

Pinging 200.100.10.78 with 32 bytes of data:

Reply from 200.100.10.78: bytes=32 time<1ms TTL=128
Reply from 200.100.10.78: bytes=32 time=8ms TTL=128
Reply from 200.100.10.78: bytes=32 time=4ms TTL=128
Reply from 200.100.10.78: bytes=32 time=2ms TTL=128

Ping statistics for 200.100.10.78:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

15

Figure 171: Presentation Slide-15 source: (Author, 2025)

Packet Tracer Test Cases

What is a Test Case?

A test case is used to check if two devices in the network can talk to each other properly.

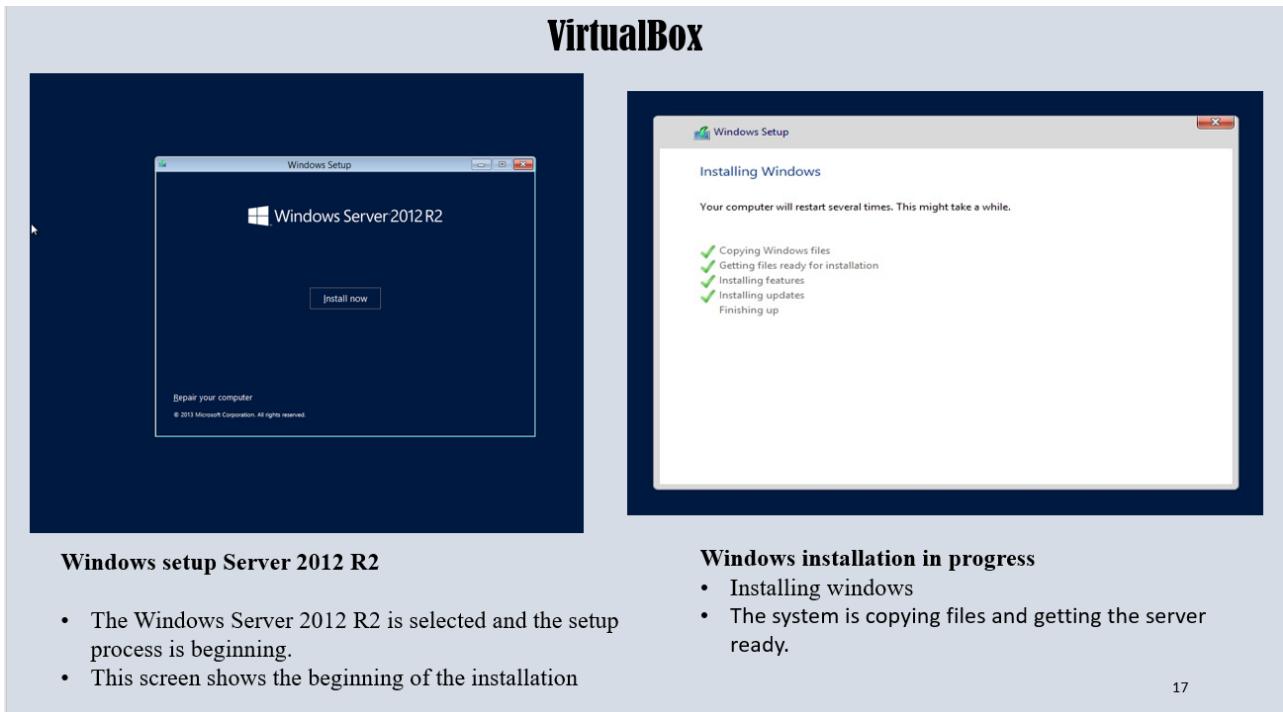
Test Case	Device used
Galle-Admin-PC2	Galle-Admin-PC10
Galle-Acc/Fin-PC6	Galle-Acc/Fin-PC8

Test Case	Device used
Galle-IT-PC1	Galle-IT-PC4
Galle-Reception-PC1	Galle-Reception-PC2

16

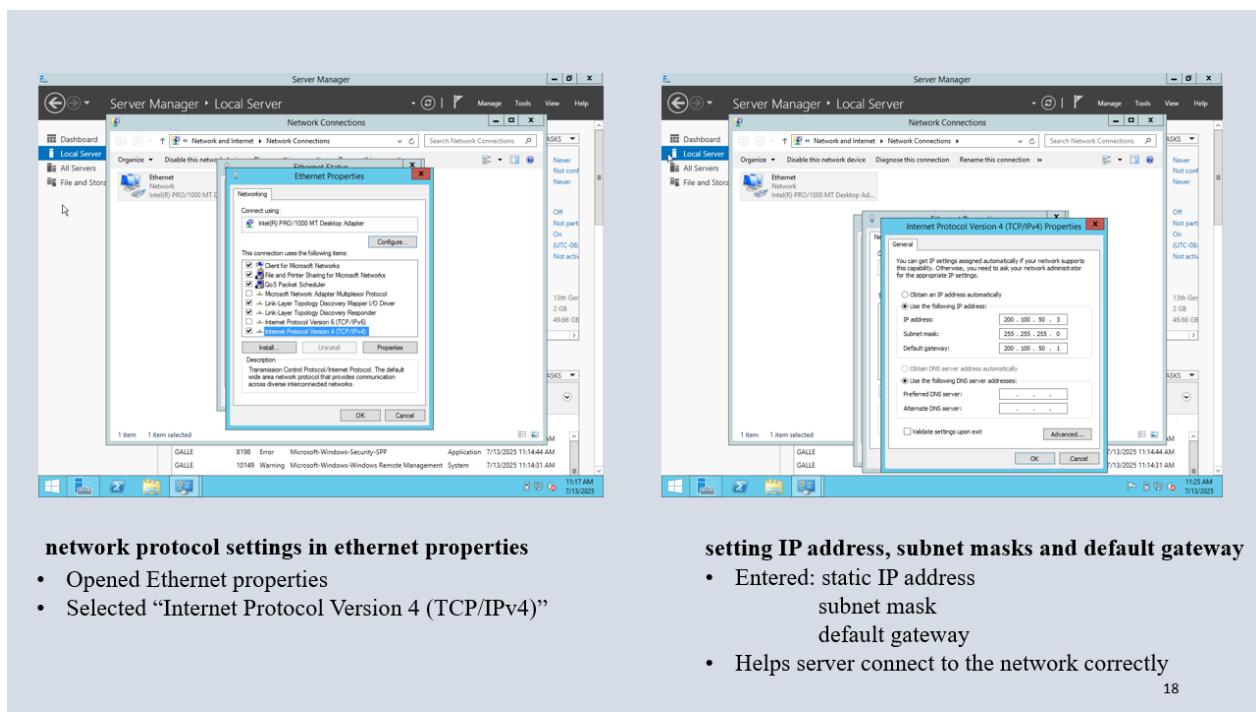
Figure 172: Presentation Slide-16 source: (Author, 2025)

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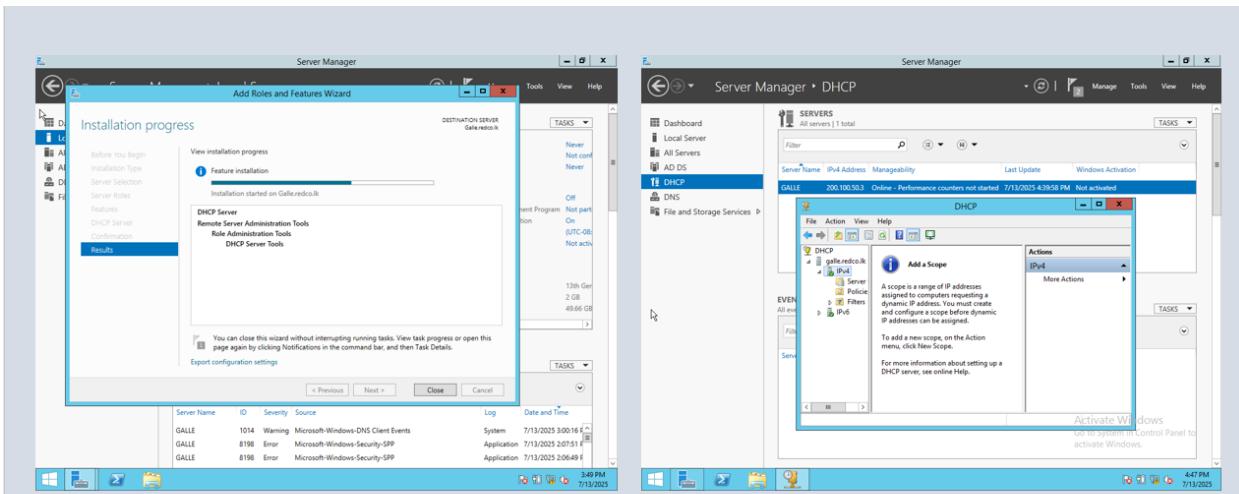
Figure 173: Presentation Slide-17 source: (Author, 2025)



18

Figure 174: Presentation Slide-18 source: (Author, 2025)

200



installing features for DHCP server

- DHCP server is being installed
- Its setting up the network service and prepares the server

adding a scope

- setting up a DHCP scope
- A scope makes IP assigning easier in the network

19

Figure 175: Presentation Slide-19 source: (Author, 2025)

Active Directory Setup in VirtualBox

1. What is Active Directory (AD)?

• AD is a **directory service** by Microsoft used to manage users, computers, and resources in a network. Using AD means we can manage all Redco's users, passwords, and devices from one location (Microsoft, 2023).

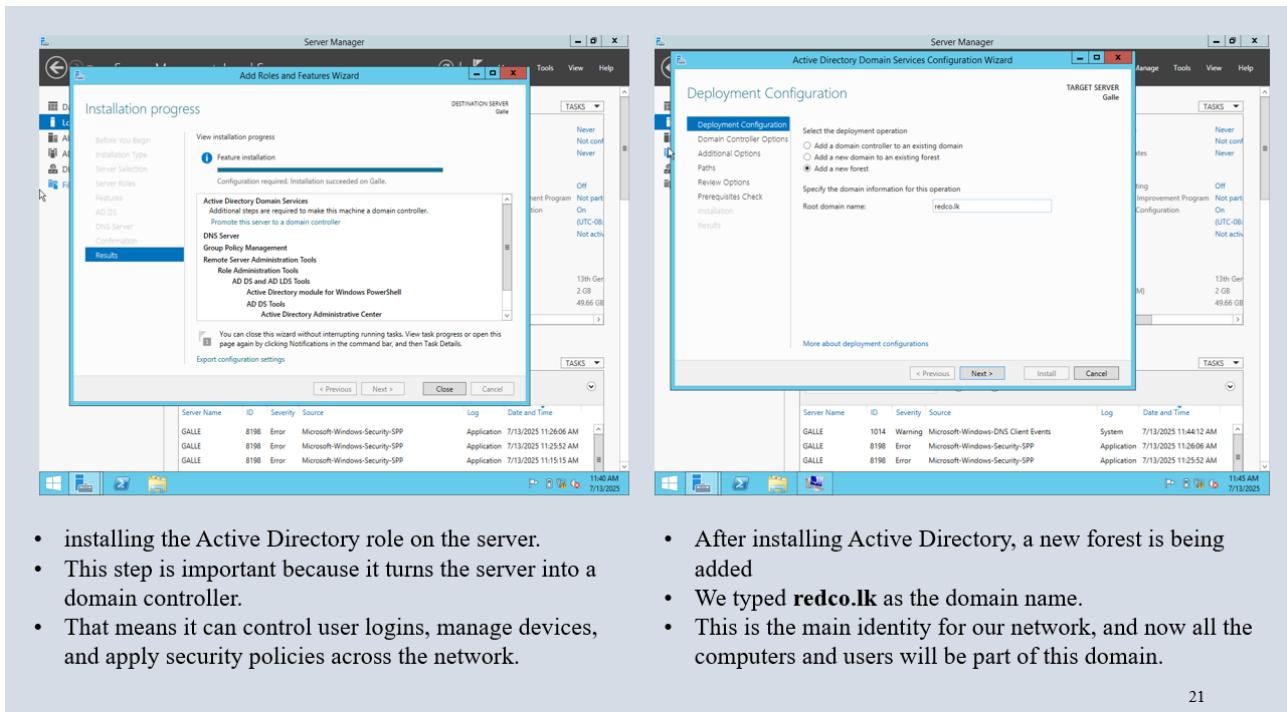
2. Installing and Setting up AD in VirtualBox

- Windows Server 2019 installed in VirtualBox
- Roles added: AD DS (Active Directory Domain Services)
- Promoted to a Domain Controller
- Domain Name Used: redco.lk



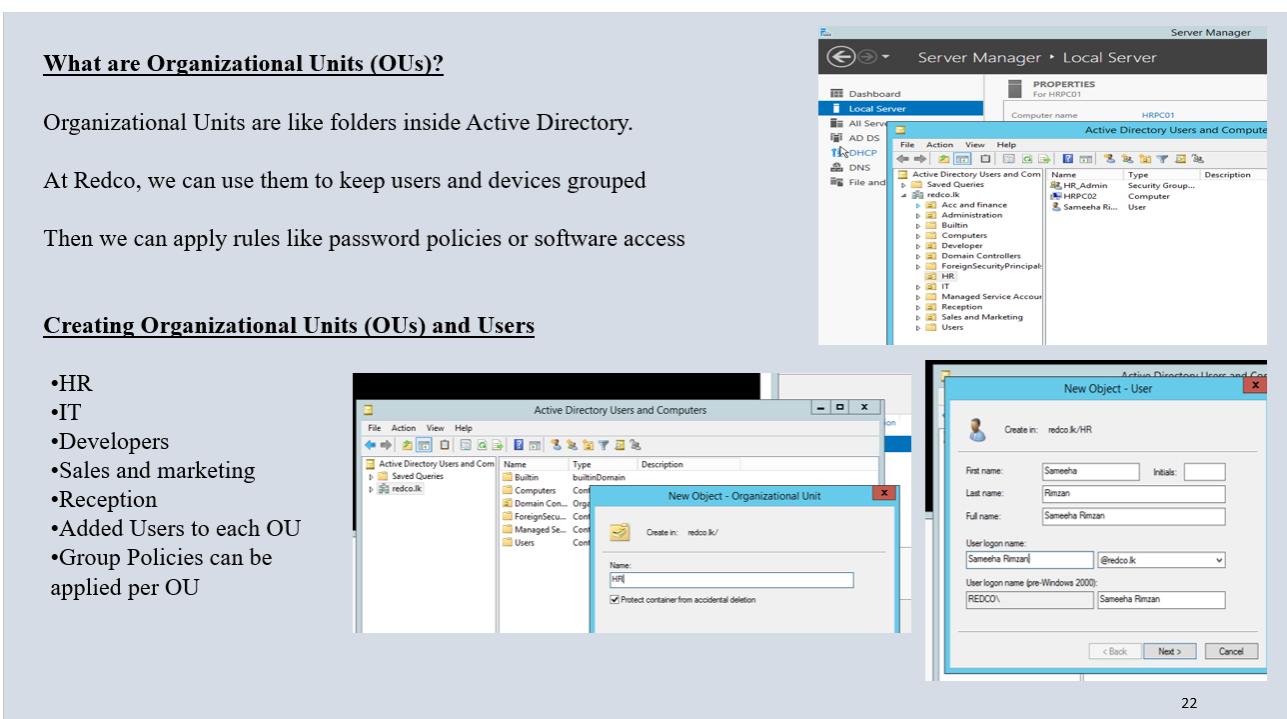
Figure 176: Presentation Slide-20 source: (Author, 2025)

201



21

Figure 177: Presentation Slide-21 source: (Author, 2025)



22

Figure 178: Presentation Slide-22 source: (Author, 2025)

202

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23

Figure 179: Presentation Slide-23 source: (Author, 2025)

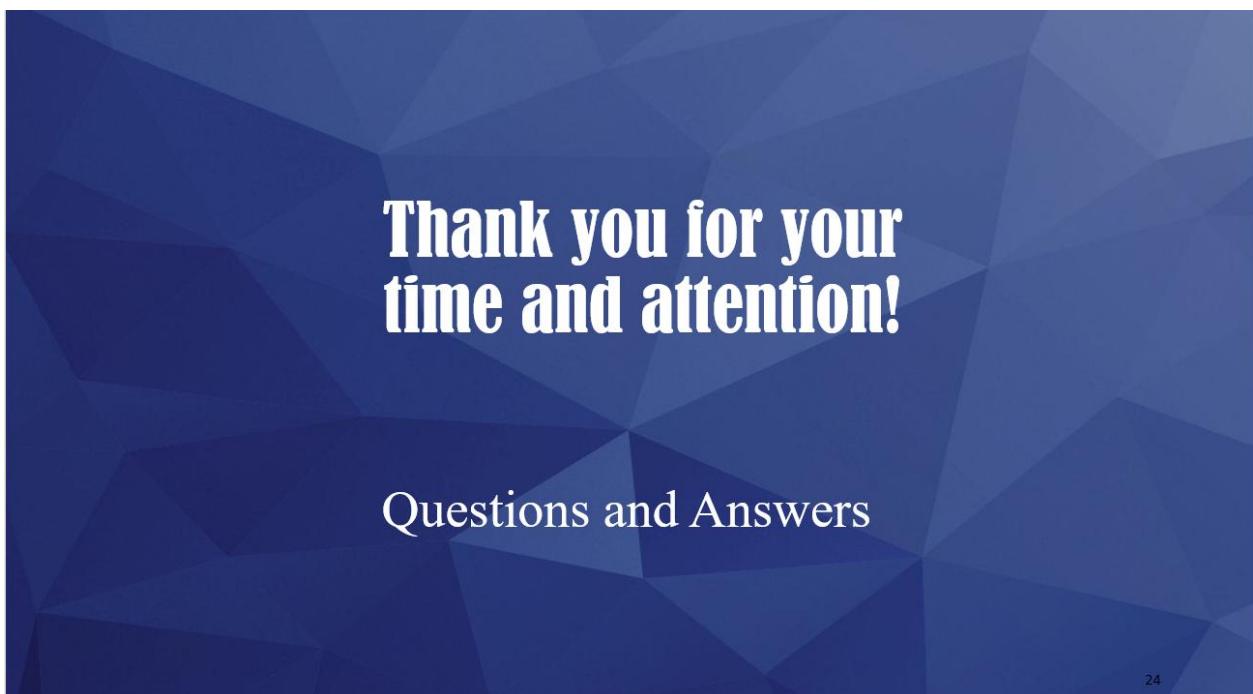
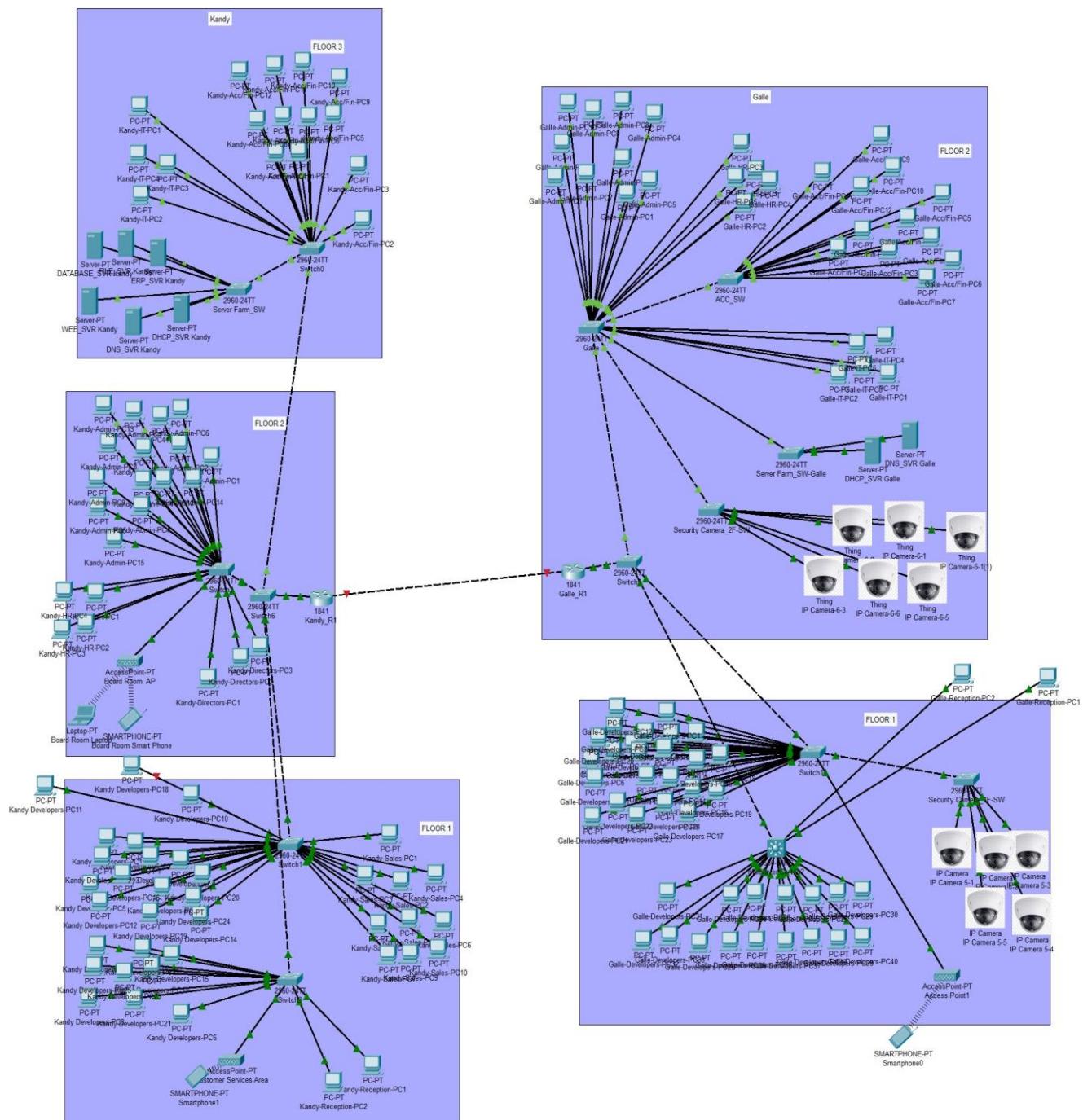


Figure 180: Presentation Slide-24 source: (Author, 2025)

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Appendix 2 – Cisco Packet Tracer Network Diagram



Appendix 3 – Google Form link for the feedback

<https://forms.gle/AazPwb2SGrvxxwDA->

Grading Rubric

Grading Criteria	Achieved	Feedback
LO1: Examine networking principles and their protocols		
P1 Discuss the benefits and constraints of different network types and standards.		
P2 Explain the impact of network topology, communication, and bandwidth requirements.		
M1 Assess common networking principles and how protocols enable the effectiveness of		

networked systems.		
LO2: Explain networking devices and operations.		
P3 Discuss the operating principles of networking devices and server types.		
P4 Discuss the interdependence of workstation and software relevant networking software		
M2 Explore a range of server types of hardware configuration and justify the selection of a server		

for a given scenario, regarding cost and performance optimization.		
D1 Evaluate the topology, protocols and networking software selected for a given scenario and how it demonstrates the efficient utilization of a networking system.		
LO3: Design efficient networked systems		
P5 Design a networked system to meet a given specification.		

P6 Design a maintenance schedule to support the networked system.		
M3 Analyze user feedback on your designs with the aim of optimizing your design and improving efficiency of the new network implementation.		
D2 Critically reflect on the implemented network, including the design and decisions made to enhance the system.		
LO4: Implement and diagnose networked systems.		

P7 Implement a networked system based on a prepared design.		
P8 Present the network types of topologies and the blueprint to the audience with simulation testing.		
M4 Recommend potential enhancements for the networked systems.		
D2 The PowerPoint and the packet tracer demonstration fulfil the pinging, extended pinging trace root and telnet or SSH in the implementation. Document test results against expected results (ping tests and DCHP results).		

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Networking

Assignment no.1