UTM

UNIVERSITI TEKNOLOGI MALAYSIA

SECR1213 - TASK 6: MAKING A GROUP REPORT

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GROUP NAME: ELEVEN-NINE

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INTRODUCTION

This final report is a compilation and reflection of the work accomplished by group Eleven-Nine for the Network Communication project for semester 1 - 2024/2025. The goal of this project is to design a robust and scalable network infrastructures for a new two-story building which will be allocated by the Faculty of Computing for the purpose of its upscaling. This facility will contain four laboratories (2 multipurpose labs, one Cisco Network lab, and an Embedded lab), a hybrid classroom, a video conferencing room, and a student lounge. The facility will be provided with cutting-edge technologies to support the needs of 1,800 students and 140 staff members. This project required meticulous planning, technical knowledge and expertise, extensive research, and teamwork to accomplish optimally.

PROJECT BACKGROUND

The Faculty of Computing of Universiti Teknologi Malaysia (UTM) is expanding to meet the increasing technological demands of modern education and research efforts. To support this growth, UTM management allowed the building of a new two-story building with a primary goal of fostering a cutting-edge method of learning which is aligned with the Fourth Industrial Revolution (4IR) principles.

The new building will house several facilities, which are: four specialized laboratories, a hybrid classroom which supports face-to-face and online learning simultaneously, a video conferencing room for seamless and uninterrupted communication, and a Wi-Fi supported student lounge to support the students' academic needs.

This new network infrastructure facility has to be robust, secure, and future-proof to sustain the increasing demands of the future. The Faculty of Computing was provided with a total budget of RM1, 000, 000 (1 Million Malaysian Ringgits) for the entire development and setup process. Due to the limited budget, the project emphasized cost-effectiveness without compromising on performance.

TASK 1: FLOOR PLAN DESIGN(UPDATED)

The goal of Task 1 is to design and allocate the physical layout for the new two-story building to support the needs of the Faculty of Computing. The aim was to create a realistic, practical, and accessible layout that facilitates the learning process. The design incorporated all the required facilities as per the rubrics of the task, which were: multipurpose labs, a Cisco Network lab, an IoT Embedded lab, a hybrid classroom, a video conferencing room, and a student lounge.

Floor 1 Layout

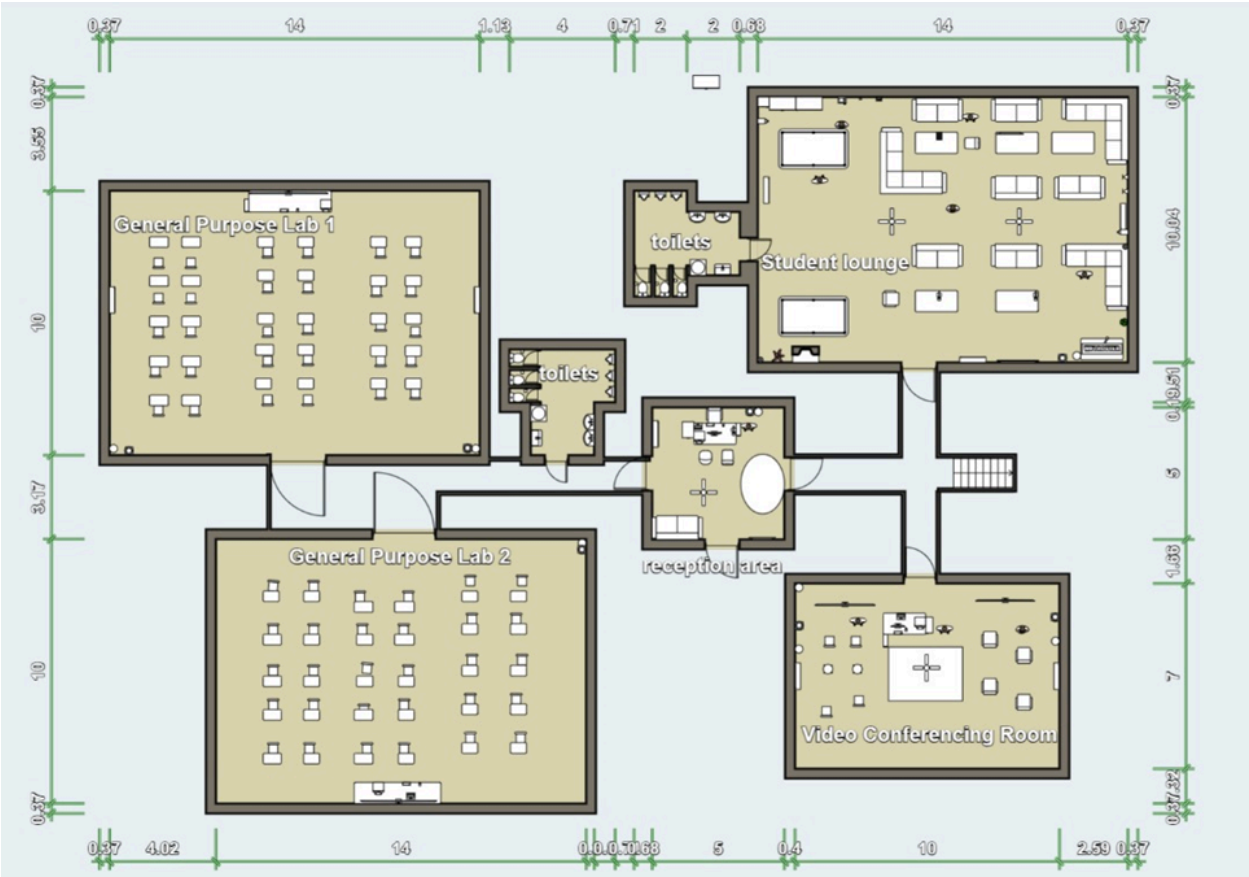


Figure 1.1: Floor 1 Layout

Room Distribution:

1) Student Lounge (14m x 10m): Placed near the entrance to provide easy access for students for relaxation and study.

2) General Purpose Lab 1 (14m x 10m): Positioned beside the student lounge for convenience.

3) General Purpose Lab 2 (14m x 10m): Located near the first general lab to maintain consistency in layout.

4) Video Conferencing Room (Approx. 10m x 7m): Placed near the Reception to easily access the group meetings.

5) Entrance leads to a lobby/reception area.

Floor 2 Layout

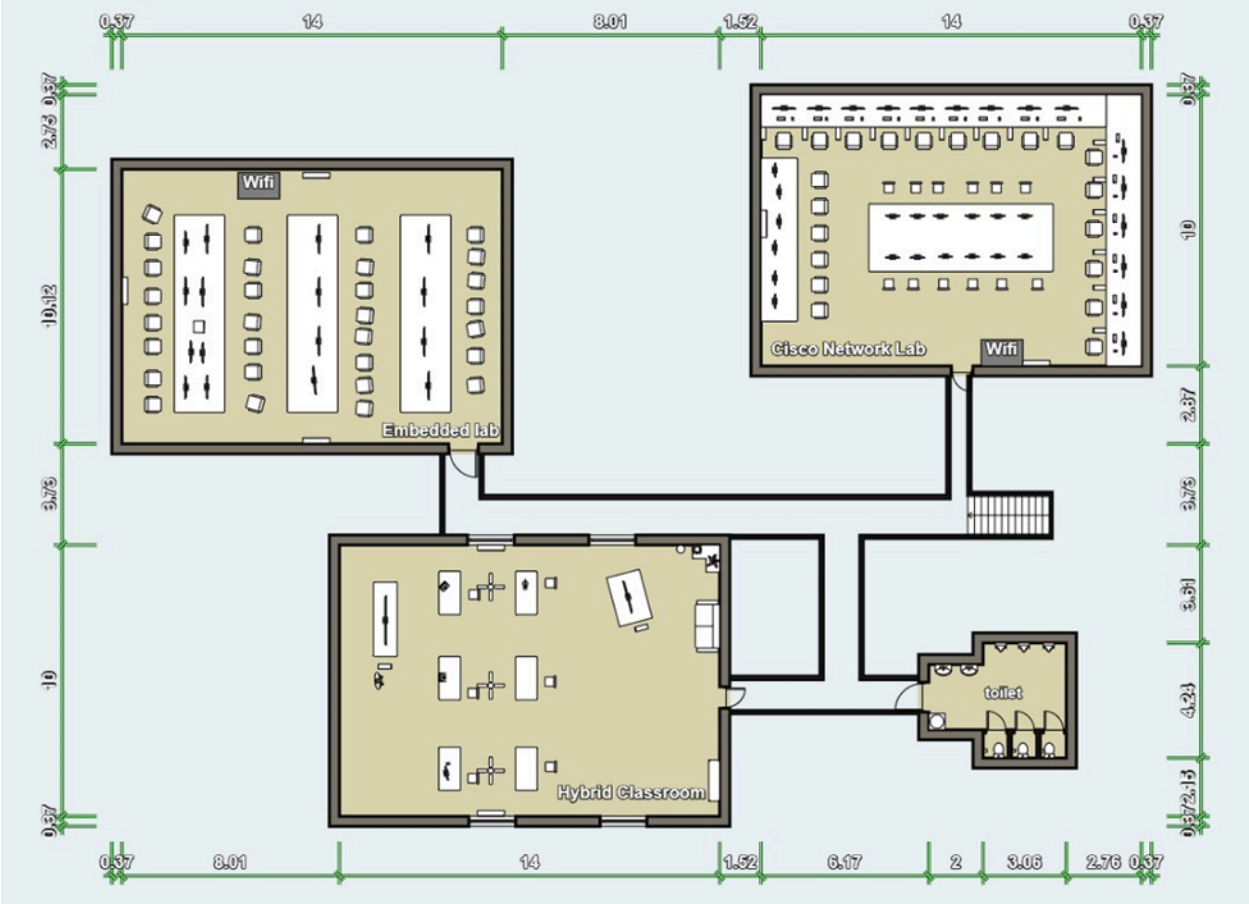


Figure 1.2: Floor 2 Layout

1) Hybrid Classroom (14m x 10m): Positioned under the two labs with access through Cisco Network Lab and stairs.

2) Cisco Network Lab (14m x 10m): Requires a dedicated space for networking equipment.

3) Embedded Lab (14m x 10m): Requires space for IoT and sensor devices.

Reflection:

Task Activities: Ensuring that the physical layout and planning process aligns with technological and functional requirements.
Soft Skills: Collaboration, Working as a team to achieve a common goal efficiently, Delegation of tasks, Creative problem-solving.

Task 1 instilled in our group the importance of spatial planning and how initial design decisions not only impact the end user experience, but also the overall success of how the rest of the project will go. Without a clear picture of the layout, it would be difficult to accomplish the subsequent tasks. The task also forced us to think prudently as to how the design will remain relevant and adaptable to future demands.

TASK 2: INITIAL DESIGN - PRELIMINARY ANALYSIS

Task 2 focused on important questions pertaining to the new requirements for the network, characteristics of the new devices, and the general advisability of the new infrastructure. The purpose was to come up with informed recommendations for countering the expected challenges and making the project realistic and compatible with 4IR technologies. The summary of the questions and answers are as below:

1. **Research Questions and Answers:**

    a. **Growth Impact**: Probably consists of a balanced number of undergraduate and graduate students, which raises the demand for adaptable lab and classroom layouts.
    b. **Networking Devices for Cisco Lab**: Requires firewalls, switches, SD-WAN, and routers that meet the most recent Cisco training requirements.
    c. **Bandwidth Requirements**: A fiber optic backbone that is fast enough to support video conferences, large downloads, and several labs— Bandwidth required = 7 Mbps × number of users.
    d. **Hardware for IoT Embedded Lab**: Oscilloscope, Logic Analyzer, Multimeter, Hardware Debugger, Power Supply, and Soldering.
    e. **Hybrid Classroom Technologies**: The hybrid classroom will support in-person and remote students with interactive tools and cloud storage. Many tools can be used such as Projectors, Smartboards, Laptops, tablets, phones, and more.
    f. **Network Security**: Calls for many security measures, such as Employee Education, Remote monitoring, Firewalls, anti-virus software, and anti-spyware software.
    g. **Seamless Transition**: Equipment upgrades should be done gradually, beginning with less important areas to save downtime. Identifying and defining a clear reason, effectively communicating all associated benefits, and involving stakeholders and users in the evaluation process and actively listening to feedback.
    h. **Budget Considerations**: Cost-balancing strategies could include leasing expensive gadgets or implementing scalable alternatives like cloud services. The budget of this project is 1 million Malaysian Ringgits.
    i. **Power and Cooling Requirements**: laboratory plug loads can range from 2.0 to 20.0 W per ft^2 . For the cooling requirements, we will use: Air blast coolers, Indoor chillers, Heat exchangers,Outdoor chillers.
    j. **Backup Systems**: Uninterruptible Power Supply (UPS) and cloud-based data backups.
    k. **Future-Proofing**: Wi-Fi 6 and fiber optic infrastructure provide a foundation for upgrades to Wi-Fi 7 or 5G.

l. **Network Management**: SDN (Software-Defined Networking) ensures remote management and scalability.
m. **Estimated Users:** 30 workstations per lab with additional students using Wi-Fi, implying high bandwidth and multiple access points to maintain reliable connectivity for all users.

2. Feasibility Analysis

- **Demand and Capacity**: The planned infrastructure will address the growth estimates for both undergraduate and postgraduate students.
- **Technical Compatibility**: Devices conform with Cisco requirements and 4IR guidelines
- **Budget and Resources**: The project remains within the budget through effective choice of devices.
- **Management**: A phased upgrade approach keeps disruptions at a minimum.
- **Future-Proofing**: Wi-Fi 6, SDN, and fiber optic systems ensure the network's longevity and scalability

Reflection:

Task Activities: The network planning process and its intricacies, which includes discussion regarding bandwidth, device specifications, security details, and overall scalability
Soft Skills: Critical thinking, Independent Researching, Problem-solving, "compare and contrast" technique

Task 2 emphasized the importance of research and critical thinking as a pre-project planning step, to ensure success in future endeavours. Several skills were involved such as strategic research and quantity analysis to ensure that design decisions are informed, practical, feasible, and aligned with all the requirements. This task also showcased the importance of iterative communication with stakeholders and staff members to retrieve relevant information crucial to the completion of this task.

TASK 3: CHOOSING THE APPROPRIATE LAN DEVICES(UPDATED)

The goal of Task 3 was to select the optimal networking devices required in the implementation of the Faculty of Computing's new two-storey building. The task emphasized the identification, research, and comparison of devices to ensure that the most cost-effective and high-performance ones were chosen for this project. Group Eleven-Nine also prioritized scalability and robustness to ensure longevity of the devices.

1. Devices and Quantities

Device Types	Model / brand	Quantity (units)	Purpose
1. Router	Cisco ISR 4331	1	Access and manage router traffic through- out different networks
2. Core Switch	Cisco Catalyst 9300 Series	1	Connects to all of your switches and guids traffic between them
3. Access Switches	Cisco Catalyst 2960-X Series	4	It connects devices to the network
4. Wireless Access Points	Cisco Aironet 2802i	6	It is a networking devices that connects wireless devices to wired networks
5. Patch Panels	24-Port Cat6 Patch Panel	4	It allows you to manage ports and organize cables.
6. Ethernet cables	Cat6 Ethernet Cables (1m)	150	It provides internet connections to devices via a wire
7. End- User Devices	Dell OptiPlex 7080 Desktops	120	End-user devices enable interaction with systems, facilitate programming, data analysis, and application testing, ensuring efficient workflows in IoT and embedded labs.
8. IoT Kits	1. Raspberry Pi 4 Model B 2. Arduino Uno 3. ESP32 Dev Kit	10 10 10	1. Offers versatility for prototyping and learning IoT applications 2. A user-friendly microcontroller for embedded system design. 3. Provides Wi-Fi and Bluetooth capabilities for IoT experiments.
9. Embedded Lab Devices	1.Development Boards 2. Debugging and Programming Tools and 3. Software Tools	30 10 30	**Development Boards**: Provide a platform to design, program, and test embedded systems. **Debugging and Programming Tools**: Help identify and fix errors in hardware and software designs. **Software Tools**: Enable coding, simulation, and debugging of embedded systems.

Figure 3.1: Device Information Table

1. **Device Selection Rationale**

    - **Performance**: Devices like Cisco Catalyst switches and Aironet access points are known for high reliability and compatibility with modern networking standards.
    - **Scalability**: The chosen devices can support future upgrades, ensuring the infrastructure remains relevant.
    - **Cost-Efficiency**: While premium brands like Cisco have higher costs, their long-term benefits, including durability and dependability, justify the investment.
    - **Compatibility**: All devices align with 4IR requirements, providing seamless integration with advanced technologies.

2. **Reflection on Pricing and Cost Management**

    While the cost of high-quality networking devices is substantial, careful selection balanced performance and budget constraints. Cost-saving strategies, such as prioritizing essential devices and considering scalable technologies, were applied.

Reflection:

Task Activities: Evaluation and determination of various networking devices based on performance, scalability, robustness, cost, and technical requirements.
Soft Skills: Budget management, critical-thinking, Independent and thorough researching, prudent thinking.

Task 3 emphasized the importance of technology assessment, thorough research, and decision-making. The task highlighted the importance of proper research and understanding of technology to ensure the most reliable and future-proof devices were selected for a sustainable network infrastructure.

TASK 4: MAKING THE CONNECTIONS – LAN AND WAN(UPDATED)

The purpose of Task 4 was to measure and calculate the cabling infrastructure for the new building, as well as identifying the types, quantities, and placements of the various types of cables and connections. The task emphasized a meticulous overview of the floor plan's measurements to ensure accurate cabling and pricing.

1. **Work Area Analysis**

    - **Floor 1:**
        - General Purpose Labs (2): 30 devices each, requiring 60 ports in total.
        - Video Conferencing Room: 12 ports for conferencing equipment and spare capacity.
        - Student Lounge: 1 port for Wi-Fi Access Point.
        - Reception: 2 ports for a PC and Wi-Fi Access Point.
    - **Floor 2:**
        - IoT Embedded Lab: 16 devices, with 20 ports allocated to allow spare capacity.
        - Cisco Network Lab: 33 devices, with 35 ports allocated.
        - Hybrid Classroom: 10 ports for a mix of wired connections and a Wi-Fi Access Point.

          Total Required Ports: 140
          Total Patch Cords: 140

2. **Cable and Device Selection**

    - **Ethernet Cables:**
        - Type: Cat6
        - Quantity: 140
        - Purpose: High-performance wired connections supporting up to 1 Gbps.
    - **Fiber Optic Cables:**
        - Used to connect core switches across the two floors for high-speed backbone connectivity.
    - **Switches:**
        - Cisco Catalyst 9200 Series (5x 48-port and 2x 24-port) for flexibility and scalability.

3. Floor Plan Sketch

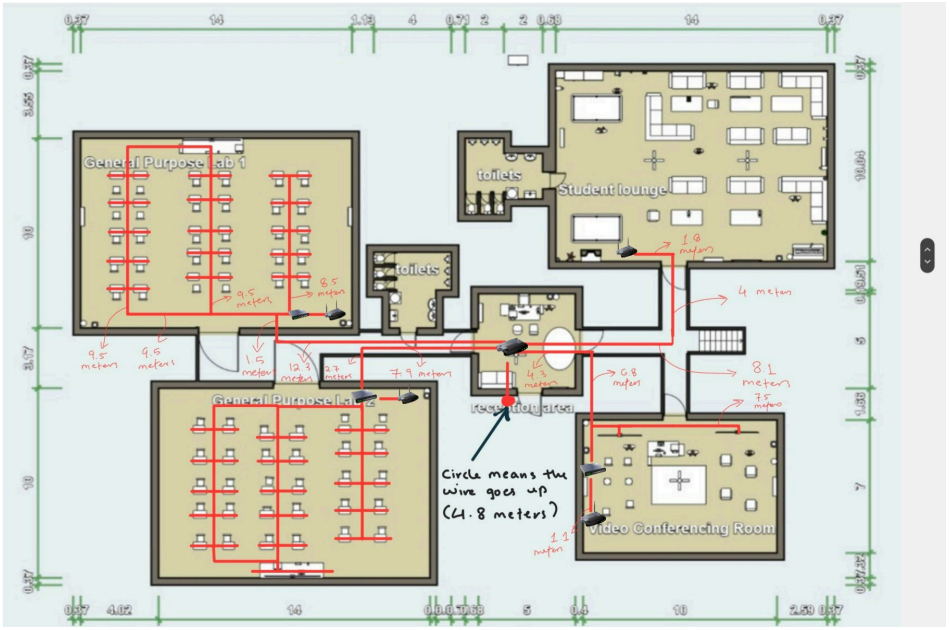


Figure 4.1: Floor 1 sketch

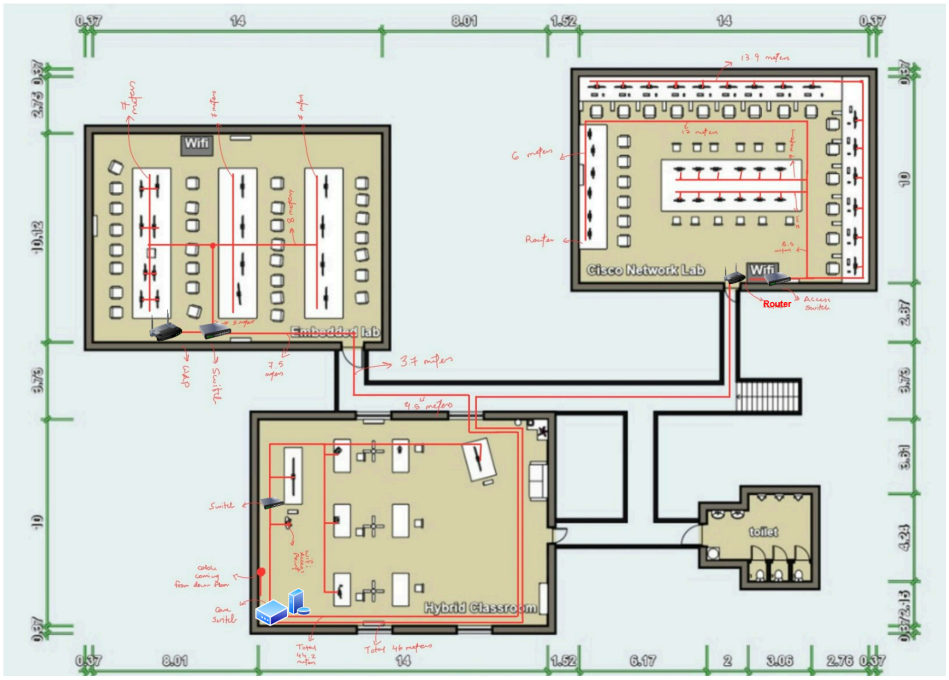
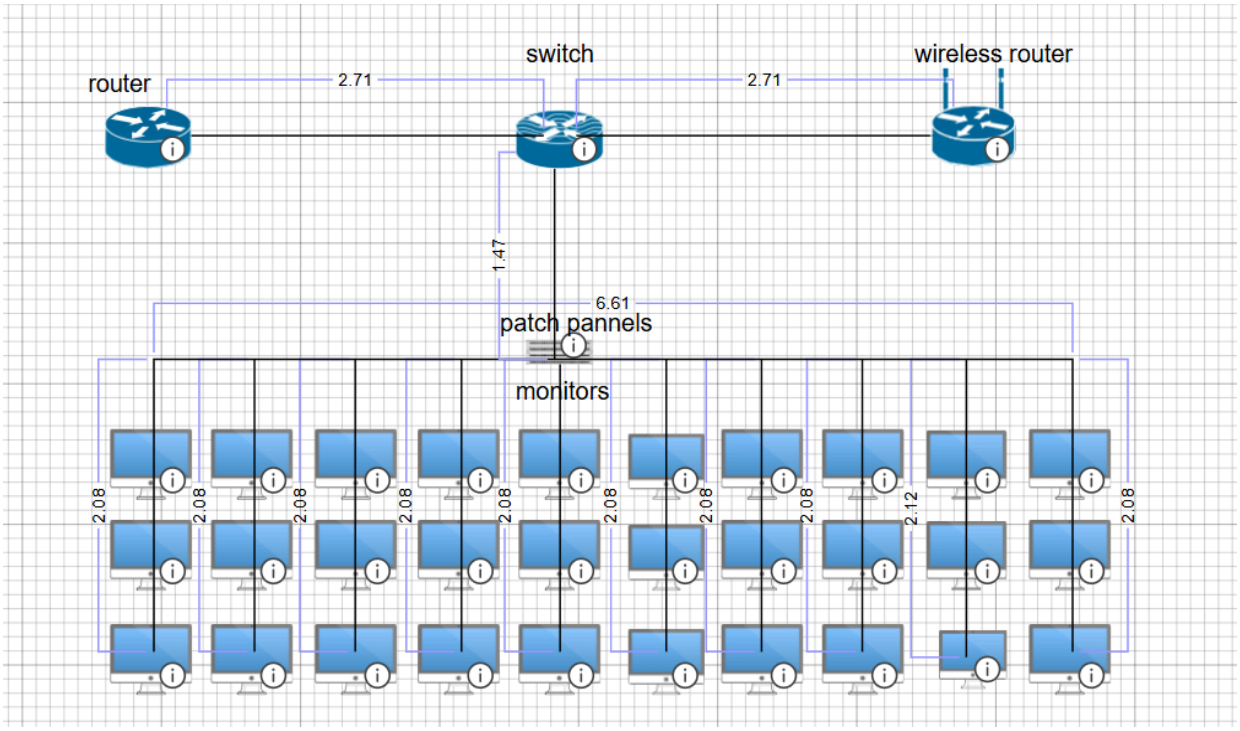


Figure 4.2: Floor 2 sketch

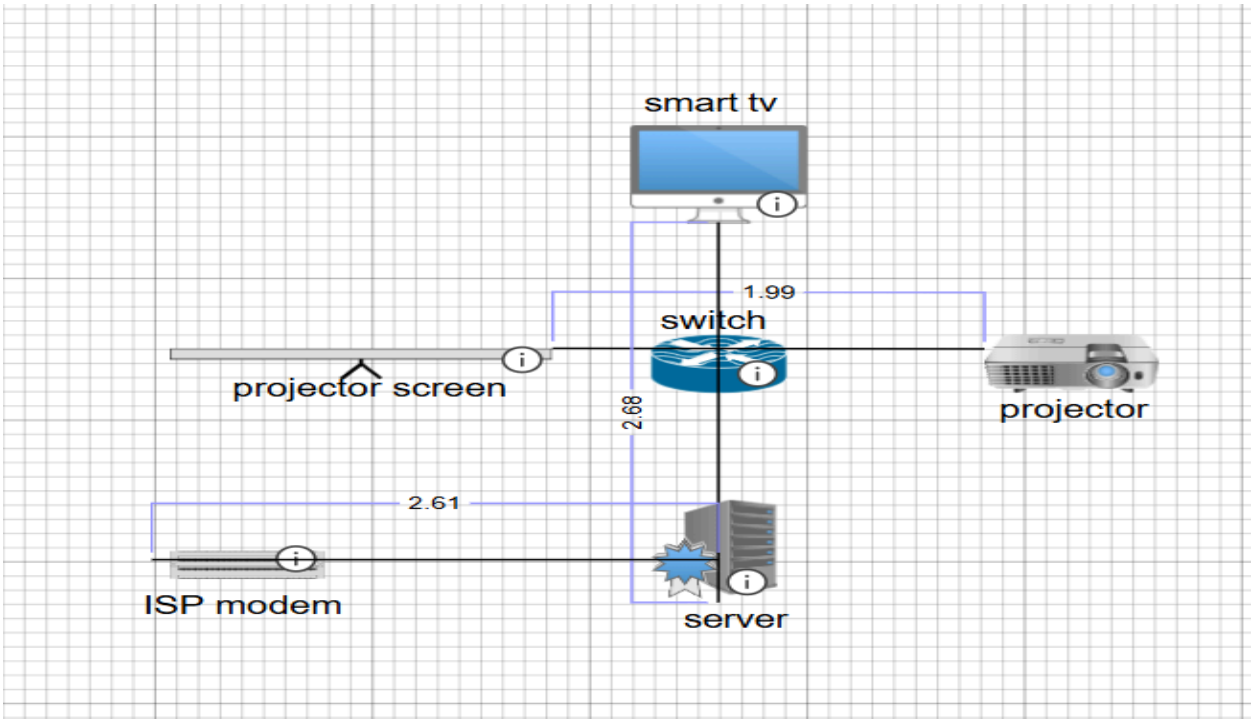
4. Logical Diagrams

Floor 1

- **For general purpose lab 1 and 2**



- **Video conferencing room**



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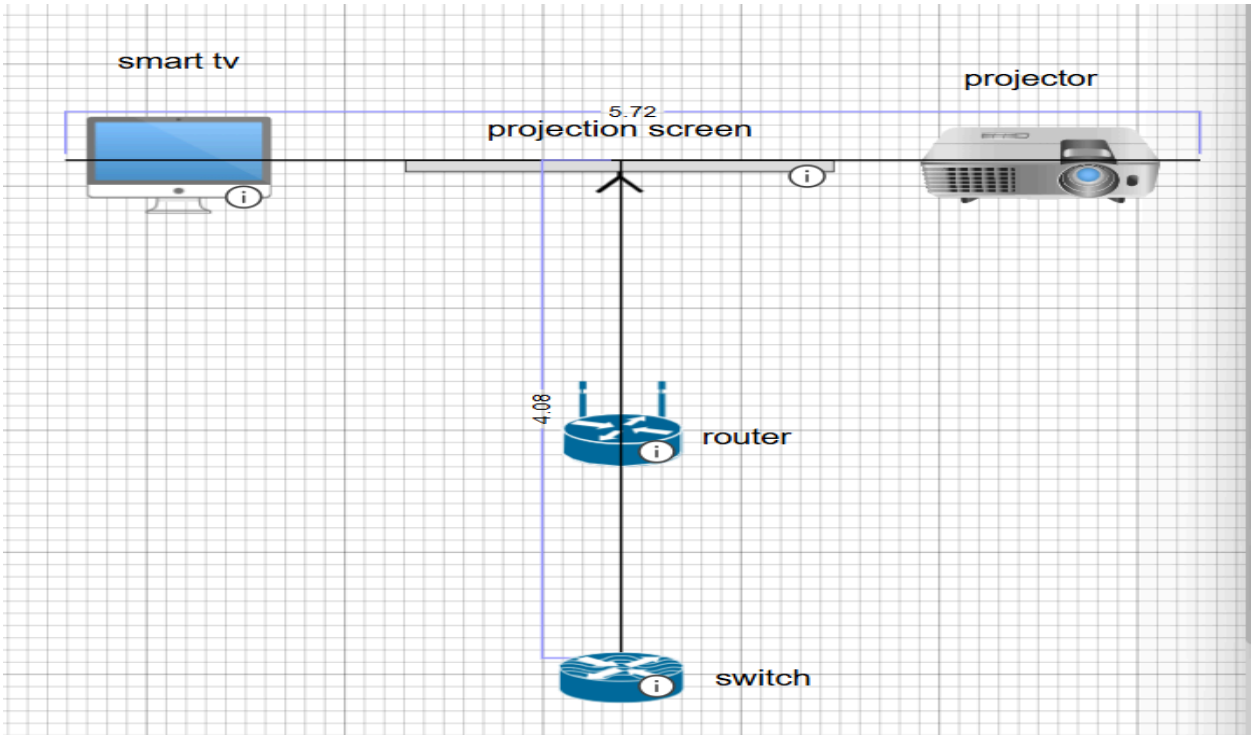
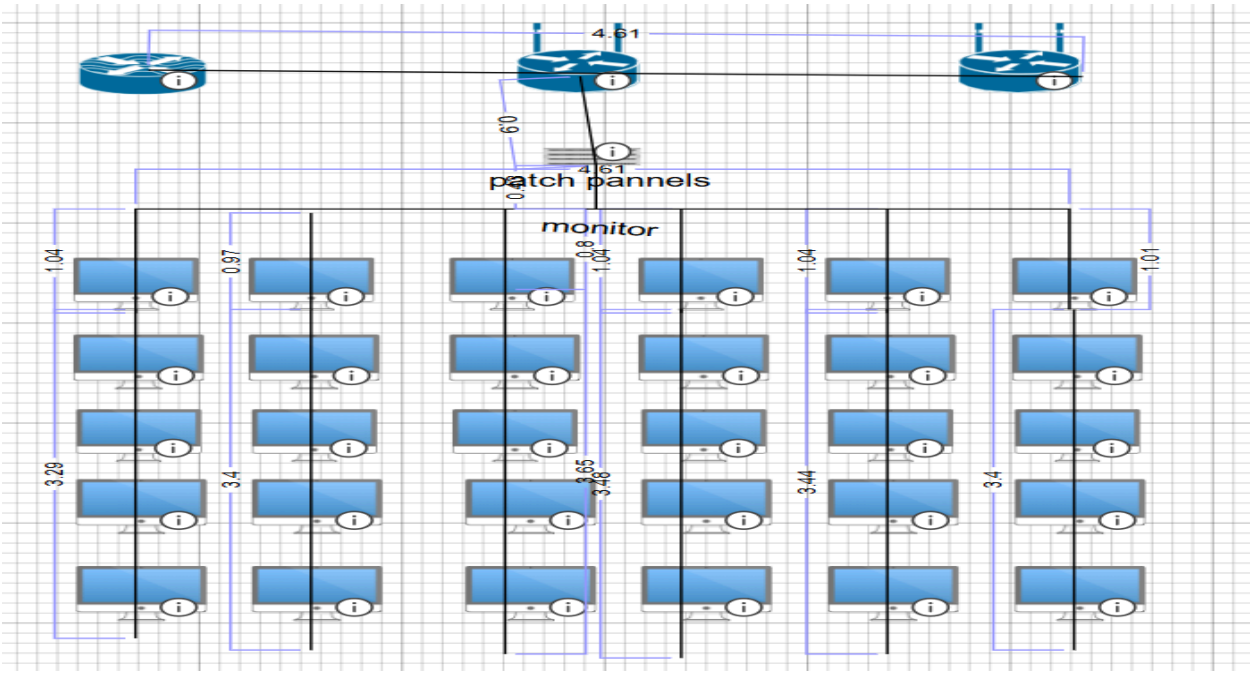
- **Student lounge**

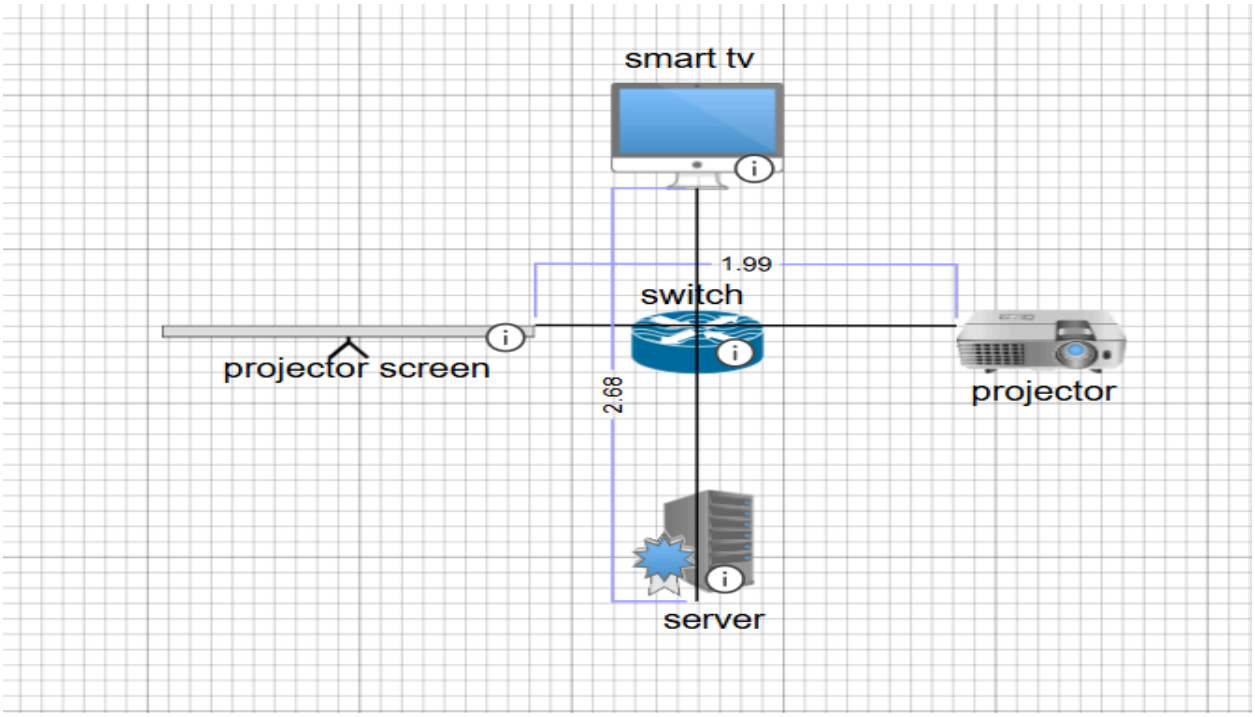


Floor 2

- **Embedded and cisco network lab**



- **Hybrid Classroom**



Reflection:

Task Activities: The importance of cable selection, proper routing, and accounting for future scalability.
Soft Skills: Attention to detail, problem-solving, and the ability to translate technical requirements into actionable plans.

Task 4 provided to group Eleven-Nine valuable insight into network infrastructure planning and the intricacies of cabling and connectivity. This task demonstrated how effective cabling can ensure network reliability and performance while minimizing costs. It further reinforced the lessons from the previous task, which is the need for thorough planning and foresight in network infrastructure design to ensure a robust and scalable system.

TASK 5: IP ADDRESSING SCHEME

Task 5 is the final task in regards to the planning of the network infrastructure system. The task involved calculation and allocating an IP addressing scheme for the building network system. The goal of the task was to allocate IP addresses to support all devices and ensure scalability.

1. **Network Requirements**

    - **Total Areas:** 8 (General Purpose Lab 1 & 2, IoT Embedded Lab, Cisco Network Lab Video Conferencing Room, Reception, Hybrid Classroom, and Student Lounge).
    - **Subnet Allocation:** Each area required its own subnet for better management and security.

2. **IP Addressing Plan**

    - **Assigned Network:** 192.18.0.0/8
    - **Borrowed Bits:** 3 bits borrowed to create 8 subnets ($2^3 = 8$).
    - **Custom Subnet Mask:** 255.224.0.0 (/11).
    - **Block Size:** 32 in the third octet, allowing each subnet to span 32 addresses.

3. **Subnet Details**

Each subnet was allocated a range of usable IP addresses, ensuring efficient use of the available address space. The complete IP addressing scheme is displayed in the table below:

Subnet	Area	Network address	Broadcast address	Range of Usable Addresses
1	Student Lounge	192.18.0.0	192.18.31.255	192.18.0.1 - 192.18.31.254
2	General Purpose Lab 1	192.18.32.0	192.18.63.255	192.18.32.1 - 192.18.63.254
3	General Purpose Lab 2	192.18.64.0	192.18.95.255	192.18.64.1 - 192.18.95.254
4	Video Conferencing Room	192.18.96.0	192.18.127.255	192.18.96.1 - 192.18.127.254
5	Reception	192.18.128.0	192.18.159.255	192.18.128.1 - 192.18.159.254
6	Hybrid Classroom	192.18.160.0	192.18.191.255	192.18.160.1 - 192.18.191.254
7	Cisco Network Lab	192.18.192.0	192.18.223.255	192.18.192.1 - 192.18.223.254
8	Embedded Lab	192.18.224.0	192.18.255.255	192.18.224.1 - 192.18.255.254

Figure 5.1: IP Addressing Scheme Table

Reflection:

Task Activities: Applicating subnetting principles and IP addressing schemes techniques into real-life scenarios
Soft Skills: Problem-solving, Practical exercise scenario, Analytical thinking

Task 5 was a great exercise and learning experience into how network planning and IP addressing schemes are executed. This task highlighted how thorough planning and calculation is important designing an accommodating and reliable networking network infrastructure.

Conclusion:

This paper has shown the systematic manner in which the Group Eleven-Nine has designed the Network Communication project to respond to the needs of a modern educational institution. Regarding the application of the principles of the Fourth Industrial Revolution (4IR), the team achieved the following tasks: the physical space, choice of devices, wiring, and designing of the floor plan. The emphasis on the further adjustments in the planning, resource utilization, and needed requirements ensures the infrastructural requirements are met for the growing number of students and staff and offers high efficiency and reliability. This project is not only the technical

solution for the network design, but also for the collaboration, for the problem solving and for the finding of the most practical and efficient solutions.

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MEETING MINUTES TASK 6:

DATE	5 JANUARY 2025 9AM
LOCATION	Student Lounge, MJIIT, UTM KL
AGENDA	Completing Task 6
MEETING MC	Maarof Saqr

ATTENDANCE:

Helal, Muhieddin Ibrahim (A23MJ4004)	8AM - 4:30PM
Maarof Saqr Yousef (A23MJ4006)	8AM - 4::30PM
MOHAMED G. S. (A23MJ0009)	8AM - 4:30PM
Muntasir Rahman Sirkhazi (A23MJ0013)	8AM - 4:30PM
Muhd Affiq Firdaus (A23MJ5083)	8AM - 4:30PM

MINUTES:

No.	Items Discussed	Ideas/Suggestions	Person In Charge
1	Objectives/Delegation of the task	Mohammed G.S. assigned a task to each member	Mohammed G.S.
2	Writing the Introduction and Project background	Affiq drafted and finalized the Introduction and Project background of the task	Affiq
3	Compiling Solution and reflections of Task 1	Helal was in charge of Task 1	Helal
4	Compiling Solution and reflections of Task 2	Muntasir was in charge of Task 2	Muntasir
5	Compiling Solution and reflections of Task 3	Saqr was in charge of Task 3	Saqr
6	Compiling Solution and reflections of Task 4	Mohammed G.S. was in charge of Task 4	Mohammed G.S.
7	Compiling Solution and reflections of Task 5	Affiq was in charge of Task 5	Affiq
8	Verification and Editing	The compiled solutions of the tasks were switched with the member next to him. Then. they	All members

		scanned and verified each others' tasks to ensure it was correctly compiled. Good suggestions were edited into the compilation	
10	Creation of Table of Contents and List of Figures	Affiq created the Table of Contents and the List of Figures	Affiq
11	Page numbering	Muntasir inserted the page numbering at the end of the project, and added them to the Table of Contents and List of Figures	Muntasir
12	Conclusion	Saqr analyzed the entire task, then drafted and wrote the conclusion of the task	Saqr
13	Compilation of References	Helal and Mohammed G.S. compiled all the references documented in the previous tasks	Helal, Mohammed G.S.

APPENDICES:

TASK 6A	
ITEM	**MARKS**
6A: GROUP REPORT	
Title page follows requirement	1
TOC clearly and correctly done	1
List of Figures - available, appropriate and correctly done	1
Introduction: done well, help with understanding, did not copy and paste	3 ~~4~~
Project background clearly and correctly done	3 ~~4~~
A compiled solution (all task) with reflections	5
Conclusion clearly and correctly done	2
References clearly and correctly done	2
Correctly formatted	1
Team meetings	
Team Members and responsibilities	3
Team meeting minutes (all meeting minutes MUST be informational and specific).	4
Appendices: complete with all the requirements as in Project document	2
TOTAL	28 ~~30~~

x

From the provided Rubrics, we predict to achieve a score of 28/30 points.