SECR1213 NETWORK COMMUNICATION

20242025 – SEMESTER 1

PHASE 3

CHOOSING THE APPROPRIATE LAN DEVICES

FACULTY OF MJIIT

GROUP A&C

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Overview of Budget:

Our allocated budget for the entire project is RM 1.3 million. From project part 2, we estimated that all the furniture together would cost us a maximum of RM 150000. So, deducting that price, we have an allocation of RM 1,150000 for the network devices and end user devices we are going to list out in this part of the project.

LAN devices appropriateness:

LAN devices were selected in order to meet differing requirements of different applications and budgets while providing reliable and efficient performance. Each lab and area have been equipped with tailored devices:

• **Cisco Lab**: Such equipments include, expensive Cisco Integrated Services Routers –ISR ,Cisco Catalyst switches and firewalls for complex networking and training on Cisco certified network associate- CCNA , High end PCs for usage, Category 6 Ethernet cables and any other related accessories.

• **IoT Lab**: Cost-effective equipment such as Raspberry Pi and STM32 boards, sensors, mid-range desktop and 24-port gigabit ethernet suitable for IoT development.

• **General Purpose Labs**: Mid-range Lenovo PCs, D-Link switches for educational and basic computing tasks and HP LaserJet printer.

• **Conference Room**: HD VC equipments such as Logitech PTZ cameras, Bose Conferencing speakers & microphones, large format display Samsung and Control system Crestron touch panel.

- **Hybrid Classroom**: These are the high tech tools such as 4 k PTZ Cameras, ceiling microphones, the SMART Board to incorporate the concept of blended learning and Barco Clickshare CX-20 for wireless presentations system.

- **Student Lounge**: Basic desktops and wireless routers for casual use.

- **Service Areas**: Basic HP Desktops, Compact and efficient networking solutions, including MikroTik routers and Netgear switches.

- **Server Setup**: High-performance Dell PowerEdge servers and APC UPS units for centralized management and scalability.

The choice of LAN devices is conscious and optimizes functionalities in terms of performance and cost impacts within different areas at the institution. Internet facing Cisco routers, switches, and firewalls support sophisticated learning facilities such as the Cisco Lab to deal with high-level networking and security demands, which are perfect for career-focused education. Likewise, the IoT Lab deploys affordable yet efficient recording instruments like Raspberry Pi microcontrollers and STM32 development boards which promote innovation in IoT. The general-purpose labs and the student lounge more mid-range PCs and switches for easy and average to complete tasks while not having to overspend too much. This purposely achieved condition guarantees that each area is suitable for its use while considering the issue of the budget.

It is quite efficient since it prepares the infrastructure for modern requirements, at the same time avoiding building in future changes into the system. The network constructed through integrated scalable and modular devices for learning is capable to meet modern demands of education and adapt to further development – it is long-term perspective. Despite the careful distribution of the devices, there is an emphasis on the construction of a more effective, elastic, and resistant learning environment

2. Characteristics of LAN Devices and Structure

Characteristics of LAN Devices:

- **Routers (Cisco ISR 4321, MikroTik hex)**: Provide WAN aggregation at high speeds, support for VPN, upscale security.

- **Switches (Cisco Catalyst, TP-Link TL-SG1024, D-Link DGS-1024D)**: Enable Layer 2 management, lower cost high-speed links and scalability especially for huge configurations.

- **Firewalls (Cisco ASA 5506-X)**: Provide intrusion prevention and malware protection for any Network.

- **Servers (Dell PowerEdge R750)**: Efficiency based management, pipelining, large memory for dependability and expandability.

- **Computers**: We are talking about systems with different configurations from Intel i3 to Intel i7 processors suitable for primary compute and hardcore networking environments correspondingly.

  Structure of the LAN:

- **Segmented Design**: Some areas designated for special uses, for instance, laboratories, services sections, and study rooms.

- **High-speed Backbone**: Gigabit Ethernet is used to make switches that enable devices to be connected and work as one system.

- **Centralized Management**: Servers and network monitoring tools facilitate and provide oversight on traffic on their networks.

- **Scalability**: The fact that conventional modular switches and high-capacity routers are being used ensures that the system can easily be expanded in the future.

- **Reliability**: UPS units and backup systems ensure uninterrupted operations.

It is significant to see the LAN design being progressive where it has focus on high speed and reliable connectivity all across the institution. Every single device starting from Layer 2 managed switches which are necessary for only Layer 2 operations up to those complex routers used in an individual setting is chosen with precision for the level of performance they offer in their specific arena. For example, while Cisco Catalyst is used to manage traffic flow in innovative labs, D-Link and TP-Link switches guarantee solid and affordable connectivity in common use zones. Security instruments including the Cisco ASA firewall protect the network; on the other hand, high-quality servers enhance organization of data, size, and trustworthiness. These choices lay the building blocks of a network, which is protected, performant, and suitable to handle a variety of tasks.

The layout of the network is no less intentional, containing many segmented designs for the efficient flow of traffic and avoidance of congestion. Other advantages include that central management utilities enable better control and issue identification, and built-in modularity that enables future expansion. Super-fast backbone connectivity thus guarantees continuity and backup power solutions also provides for the reliability. This great incorporation of advanced technology and well-organized planning leads to the efficient and protected network, and makes LAN academics' structure perform as a healthy foundation and the backbone for the flexible, creative educations in the future.

LAN Devices List (with price calculation)

1. Cisco Lab

Purpose: To facilitate hands-on training for CCNA and advanced networking courses.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
Router	Cisco ISR 4321	A reliable integrated services router with advanced security features, suitable for handling multiple network protocols and ensuring smooth lab operations. It supports WAN aggregation, VPN, and has 4 Gigabit Ethernet ports	8000	4	32000
Switch	Cisco Catalyst 2960X	A 24-Port Gigabit Ethernet switch with LAN Base image, providing high-speed connectivity and Layer 2 management capabilities for seamless device integration	5000	6	30000
Firewall	Cisco ASA 5506-X	A next-generation firewall designed to provide network protection and monitoring. It includes advanced intrusion prevention and malware defense features, ideal for securing lab environments	10000	1	10000
Computers	Dell OptiPlex 7080	High-performance desktop PCs equipped with Intel i7 processors, 16GB RAM, and 512GB SSD storage, ensuring smooth performance for complex networking tasks	4000	30	120000

Network Cables & Accessories	Various	Ethernet cables, patch panels, and other necessary accessories.	100	30	3000

Subtotal for Cisco Lab: RM 195,000

2. IoT Lab

Purpose: For IoT device development, embedded programming, and data collection projects.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
Microcontroller	Raspberry Pi 4 Model B	A versatile microcontroller with 4GB RAM and a quad-core Cortex-A72 CPU, capable of running IoT applications and integrating with various sensors	300	30	9000
Embedded Board	STM32 Nucleo-F446RE	A development board featuring STM32F446RE MCU, ideal for real-time data processing and IoT prototyping	100	15	1500
Sensors	Various	Assorted sensors including light, temperature, and motion sensors for comprehensive IoT project development and environmental monitoring	50	30	1500

Computers	HP ProDesk 400 G6	Mid-range desktop PCs equipped with Intel i5 processors, 8GB RAM, and 256GB SSD, suitable for IoT development and data analysis	3000	30	90000
Network Switch	TP-Link TL-SG1024	A 24-Port Gigabit Ethernet unmanaged switch providing cost-effective and high-speed connectivity for lab devices	500	3	1500

Subtotal for IoT Lab: RM 103,500

3. General Purpose Labs (2 Labs)

Purpose: For basic computing courses and general use.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
Computers	Lenovo ThinkCentre M720	Desktop PCs with Intel i5 processors, 8GB RAM, and 256GB SSD storage, optimized for general computing tasks and educational use	2500	60	150000
Network Switch	D-Link DGS-1024D	A 24-Port Gigabit Ethernet unmanaged switch that ensures reliable connectivity for the labs	400	4	1600
Printer	HP LaserJet Pro M404dn	A monochrome laser printer with duplex printing capabilities, providing efficient	1200	2	2400

		document printing for lab users			

Subtotal for General Purpose Labs: RM 154,000

4. Conference Room

Purpose: For video conferencing and meetings.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
PTZ Camera	Logitech PTZ Pro 2	An HD 1080p PTZ camera with 10x optical zoom, designed for capturing high-quality video during meetings	5000	1	5000
Audio System	Bose Professional	An integrated audio system featuring high-quality speakers and microphones for clear and immersive sound in conference settings	8000	1	8000
Display	Samsung 75" 4K UHD	A large-format display with 4K resolution, ideal for presenting visual content during meetings	10000	1	10000
Control Panel	Crestron TSW-1060	A 10.1" touch screen control panel for managing audio, video, and lighting systems in the conference room	6000	1	6000

Subtotal for Conference Room: RM 29,000

5. Hybrid Classroom

Purpose: For blended learning (online and offline).

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
PTZ Camera	AVer CAM540	A 4K PTZ camera with 16x zoom, providing wide-angle coverage and high-resolution video for hybrid teaching setups	6000	1	6000
Ceiling Microphone	Shure MXA910	An advanced ceiling array microphone for capturing clear audio across the classroom	12000	2	24000
Interactive Whiteboard	SMART Board 7000R	A 75″ interactive display with iQ technology, enhancing engagement in hybrid learning environments	15000	1	15000
Wireless Projection System	Barco ClickShare CX-20	A wireless presentation system that allows seamless screen sharing in real-time	5000	1	5000

Subtotal for Hybrid Classroom: RM 50,000

6. Student Lounge

Purpose: For student relaxation and casual use.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
Computers	Acer Aspire TC	Basic desktop PCs with Intel i3 processors, 4GB RAM, and 1TB HDD, providing reliable performance for casual use	2000	5	10000

| Wireless Router | TP-Link Archer AX50 | A dual-band WiFi 6 router delivering high-speed internet access throughout the lounge | 500 | 1 | 500 |

Subtotal for Student Lounge: RM 10,500

7. Service Areas

Purpose: For administrative and support functions.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)
Computers	HP Pavilion Desktop	Basic desktop PCs for administrative tasks, featuring Intel i3 processors and 256GB SSDs	2000	5	10000
Router	MikroTik hEX RB750Gr3	A compact and efficient router for small-scale networking in service areas	300	1	300
Network Switch	Netgear GS108	An 8-Port Gigabit Ethernet switch, providing reliable connectivity for service area devices	250	1	250

Subtotal for Service Areas: RM 10,550

8. Server Setup

Purpose: provides centralized management, scalability, security, and reliability for the entire network infrastructure.

Equipment	Model	Description	Unit Price (RM)	Qty	Total Price (RM)

Server	Dell PowerEdge R750	A high-performance server equipped with dual Intel Xeon processors, 64GB RAM, and 4TB HDD storage, designed to centralize data management and provide scalable solutions	60000	1	60000
Server Rack	APC NetShelter SX 42U	A robust 42U server rack for housing servers and related equipment securely	5000	1	5000
UPS	APC Smart-UPS 1500VA	An uninterruptible power supply to ensure the stability and availability of the server during power outages	3000	1	3000

Subtotal for Server Setup: RM 68,000

Summary of Total Costs

Room/Area	Subtotal (RM)
Cisco Lab	195,000
IoT Lab	103,500
General Purpose Labs (2 Labs)	154,000
Conference Room	29,000
Hybrid Classroom	50,000
Student Lounge	10,500
Service Areas	10,550
Furniture Estimate	400,000
Backup Power (UPS)	50,000
Network Monitoring Tools	50,000
Server Setup	68,000

Total	1,120,550

Remaining Budget: RM 29,450

We put in mind that the furniture would cost us a maximum of RM 150000 so the budget remaining can be allocated for unexpected expenses, additional equipment, or future upgrades.

Reference：

1. Fortinet Help Desk. "How much bandwidth is needed to run a lab?" https://helpdesk.training.fortinet.com/support/solutions/articles/73000617318-how-much-bandwidth-is-needed-to-run-a-lab

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4. Kalyzee Resources. "Hybrid Classroom Equipment." https://www.kalyzee.com/en/resources/technical/hybrid-classroom-equipment/

5. Network Lessons. "Recommended Lab Equipment for Cisco CCNA." https://networklessons.com/cisco/ccna-routing-switching-icnd1-100-105/recommended-lab-equipment-for-cisco-ccna

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7. IEEE Xplore. "Network Capacity Requirements and Scalability." https://ieeexplore.ieee.org/document/8756887

8. ScienceDirect. "Backup Power Supply in Labs." https://www.sciencedirect.com/topics/engineering/backup-power-supply

9. Restorepoint. "What Are Network Security Devices?" https://www.restorepoint.com/topics/what-are-network-security-devices

10. Varonis Blog. "How to Monitor Network Traffic."
https://www.varonis.com/blog/how-to-monitor-network-traffic

11. Orient Software. "Benefits of IT Infrastructure Outsourcing."
http://www.orientsoftware.com/blog/cloud-outsourcing/

12. Antisyn. "Benefits of IT Outsourcing."

https://antisyn.com/blog/benefits-of-it-infrastructure-outsourcing/

Reflection report on network equipment and prices

1. Is the price unexpected:

Some of the prices of network equipment are expected, while others are unexpected. For example, Cisco's high-end equipment is expensive, which is in line with its reputation for reliability and advanced features, but switches like D-Link and TP-Link are relatively cheap, which is a bit surprising. This huge price difference between brands shows that brand value and functional design have a great impact on pricing.

A budget of RM1.15 million was allocated for network equipment and terminal equipment in the project. This allocation method takes into account both performance requirements and cost pressures. For

example, although Cisco equipment is expensive, its cost-effectiveness is very obvious in an environment with particularly high functional requirements such as Cisco laboratories; while in student lounges or ordinary laboratories, more affordable equipment can fully meet the needs.

2. Have you considered the cost factor:

Cost is obviously a core consideration in the planning of this project. Throughout the budget allocation, it is clear that the choices made to balance the needs of high-performance equipment and saving money are:

IoT laboratory: The affordable Raspberry Pi and STM32 development boards are selected, which not only meet the needs of innovation but also save money.

General laboratory: The use of mid-range D-Link switches and Lenovo PCs can complete basic education tasks while avoiding high expenses.

Service area: The small and efficient MikroTik router is used, which is fully functional while controlling costs.

Such planning reflects that the project has achieved a good balance between performance and cost.

3. Main differences between different brands of equipment (e.g. Cisco vs Huawei routers):

When comparing similar equipment, the differences between different brands are mainly reflected in the following aspects:

Price:

Cisco equipment, such as the ISR 4321 router, is usually more expensive, mainly because of its brand reputation, comprehensive after-sales support and advanced features. Huawei's routers are relatively affordable and more suitable for projects with limited budgets.

Functionality:

Cisco's equipment performs well in enterprise-level applications, providing strong security, high-speed WAN aggregation capabilities, and better scalability. Although Huawei's functions are not weak, it may

sometimes be slightly inferior in compatibility with other brands of equipment.

User Support and Ecosystem:

Cisco has extensive training programs (such as CCNA certification), rich documentation resources, and a large user base, which makes its support system very complete. Although Huawei is growing rapidly, it is still slightly inferior in the global market.

Performance:

Both brands are excellent in reliability, but Cisco's equipment is better suited to handle complex large-scale network needs, such as dedicated Cisco labs in projects.

Summary:

The selection of equipment for the entire project fully reflects the balance between "high performance" and "high cost performance". For areas with high functional requirements, such as Cisco laboratories, top-performance Cisco equipment was selected; while for environments with lower loads, affordable brand equipment was selected. This strategy not only makes full use of the budget, but also builds a powerful and flexible network architecture that meets current needs while leaving room for future development.

Meeting Minutes

DATE/TIME	27/11/2024 10:00a.m.----12:00a.m.
LOCATION	Google meet
AGENDA	Discuss Lan Devices
MEETING MC	Abdul-Rahman Siad

ATTENDENCE		
NAME	**TIME**	**REASON OF ABSENCE**
Kahlan Sultan Mohammed	10:00am—12:00am	N/A
Abdulrahman Siad	10:00am—12:00am	
Buguoshun	10:00am—12:00am	
Liu Ruoyang	10:00am—12:00am	

MINUTES			
NO.	**ITEM DISCUSSED**	**IDEAS/SUGGESTION S AND PERSON GIVING IT**	**PERSON IN CHARGE AND DATE**
1	Research about routers, switch racks, printers, monitors, TV and equipment.	Liu suggested appropriate options for various equipment, including routers for video streaming and lab use, switch racks, printers, video conferencing monitors, a TV for the lounge, and necessary equipment for Cisco and IoT labs.	Liu Ruoyang(26/11)
2	Budget allocation for workstations and the specs that go along with it, relative to the IOT, CISCO and general lab	Because of the diversified aim and mission, there should be different distribution of requirements between the labs. To say that it would be pertinent to properly fund that said purpose to the best of their abilities while	Kahlan Sultan Mohammed (26/11) Abdulrahman Siad (26/11)

		not neglecting the grand scheme of things as well.	
3	Router and switches and their implications in order to make an interactive system	Using implications of servers and wireless internet connections and ethernet cables for the connection of router and switches.	Bu Guoshun(26/11)
4	Interactive help desk and environment	Using specific PCs in order to meet the requirements of the customers at the help desk and small additions in the conference room and lounge in order to provide nuance experience.	Everyone(27/11)
5	Meeting ended	Everyone leaving the meeting.	Everyone (27/11)

Projected Marks

Task1

ITEM	MARKS
List of devices	
Is enough research done? *Also need references	2/2
References included ; are appropriate and reputable	1/1
Does LAN devices chosen accomplish needs/requirements of FC?	2/2

Characteristics of LAN Devices chosen is explained/shown clearly	2/2
Report	
Are you surprised by the prices?	1/1
Reflect on costs of devices	1/1
What are the major differences between the same devices from different brands	1/1
Total	10/10