

**SECR 1213 - 06**

**Network Communications**

**Lecturer: Dr. Ts. Raja Zahilah binti Raja Mohd Radzi**

**Task #2**

**Preliminary Analysis**



**Group 4: NetLink Solutions**

|  |  |
| --- | --- |
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**CONTENTS**

[**1.** **Task Explanation** 3](#_Toc181089661)

[**2.** **Meeting Minutes #1** 4](#_Toc181089662)

[**3.** **Meeting Minutes #2** 6](#_Toc181089663)

[**4.** **Questions and Answers** 7](#_Toc181089664)

[**5.** **Devices, Quantities and Suggested cost** 9](#_Toc181089665)

[**6.** **Feasibility Study Choice#1** 12](#_Toc181089666)

[Final Feasibility Summary 14](#_Toc181089667)

[**7.** **Feasibility Study Choice#2** 15](#_Toc181089668)

[Feasibility Study for Premium Network Design 15](#_Toc181089669)

[**8.** **Conclusion** 18](#_Toc181089670)

# **Task Explanation**

The given task is all about planning via preliminary analysis, to gather as much information as possible about the requirements, devices, preferences, constraints, …. etc.

Taking some questions into consideration so we can decide which is more suitable in terms of longevity, cost-efficiency, and best applicable performance, the questions we took into consideration are to be backed up by the faculty representative, and online researches, with every question having an effect on the design and cost.

The compatibility and usability were answered based on some aspects that were asked and answered by the faculty representative in each and every question.

Some of the key discussions are as follows:

• User preference and compatibility

• Network system establishment and requirements

• Hardware and software-based establishments

• Network based security and device connectivity

• Cost based establishment

• Mutual offerings

• Link build up between all facilities of the primarily designed architecture

• 4IR relations

• Better possibilities in the system

In the later phases of the task the team decided the feasibility based on the given questions below. And also, through researches, taking into consideration maintenance and future expanding upgrades.

# **Meeting Minutes #1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Date/time | | | 25/10/2024, 8:00 p.m. | | | |
| Location | | | Google Meet (online) | | | |
| Meeting discussion task | | | 1. The task. 2. The suggest idea. 3. The source of information. 4. Next meeting. | | | |
| Meeting MC | | | Abdalla Ali Abdalla Ali | | | |
| Attendance | | | | | | |
| Name | | | | **Time** | | Reason of absence |
| 1 | Abdalla Ali Abdalla Ali | | | 8:00 | | N/A |
| 2 | Nouredin Mamdouh | | | 8:00 | | N/A |
| 3 | Mohammed abdelgawwad | | | 8:00 | | N/A |
| Minutes | | | | | | |
| No | | **Item discussed** | **Result** | | Person in charge/Time | |
| 1. | | The task | Noureldin thoroughly read the task and explained each part in details, while  explaining some terms, the team had a good understanding of the overall task. | | Nouredin Mamdouh  (8:00 pm - 8:19 pm) | |
| 2. | | The suggested idea. | Mohammed suggested to briefly think about all aspects of the network in a step-by-step approach, as network engineers and designers, and what we supposed to do. | | Mohammed abdegawwad (8:20 pm - 8:29 pm) | |
|  | | The resources of the information | Abdalla suggested to firstly try to come up with simple questions by analyzing the tasks, and discussing basic questions first then getting into more complex question to discuss with the FC representative. | | Abdalla  (8:29 pm - 8:35 pm) | |
|  | | Next meeting | Next meeting said Noureldin to be held at Sunday after we all gathered question to be discussed | | Nouredin Mamdouh  (8:35 pm - 8:39 pm) | |
|  | | Meeting Ended |  | | 8:39 pm | |

# **Meeting Minutes #2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Date/time | | | 27/10/2024, 9:00 p.m. | | | |
| Location | | | Google Meet (online) | | | |
| Meeting discussion task | | | 1. The suggested questions | | | |
| Meeting MC | | | Abdalla Ali Abdalla Ali | | | |
| Attendance | | | | | | |
| Name | | | | **Time** | Reason of absence | |
| 1 | | Abdalla Ali Abdalla Ali | | 9:00 pm | N/A | |
| 2 | | Nouredin Mamdouh | | 9:00 pm | N/A | |
| 3 | | Mohammed Abdelgawwad | | 9:00 pm | N/A | |
| Minutes | | | | | | |
| No | **Item discussed** | | **Result** | | | Person in charge/Time |
| 1. | The suggested questions | | Nouredin discussed his questions, while discussing which is appropriate and which is not. Mohammed also did the same. And Abdalla did the same, the member gathered their questions to discuss with the FC representative. | | | Nouredin Mamdouh  (9:00 pm - 9:10 pm)  Mohammed Abdelgawwad  (9:10 pm -9:18 pm)  Abdalla Ali  (9:18 pm - 9:28 pm) |
| Meeting ended | | |  | | | 9:29 pm |

# **Questions and Answers**

1. What is the minimum bandwidth required to support high-speed connectivity for each of the labs, considering 30 workstations per lab?

* **Answer**: Based on high-traffic academic environments, each lab should ideally have a minimum of **1 Gbps dedicated bandwidth**. This allows for simultaneous usage without congestion, supporting video streaming, collaborative tools, and data-intensive applications.
* **Reference**: Cisco Design Zone for Education Networks

2. Which types of network devices (routers, switches) are necessary for the Cisco Networking Lab to meet educational and instructional needs?

* **Answer**: The **Cisco Catalyst 9500 core switch** for core routing and **Cisco Catalyst 9300 distribution switches** for labs are ideal choices. These devices offer Layer 3 capabilities, VLAN support, and modular options for educational labs. For routing, a **Cisco Catalyst 8500 Series Edge Platform** is recommended to manage traffic and secure network communications.
* **Reference**: Cisco Systems, *Catalyst 9000 Series Data Sheet*, Cisco.

3. What wireless access point (WAP) specifications are suitable for high-density areas like the student lounge?

* **Answer**: High-density areas require **Wi-Fi 6E access points**, such as the **Aruba AP-655** or **Cisco Meraki MR76**. These access points provide greater bandwidth, support more simultaneous connections, and enhance coverage for student lounges or common areas.
* **Reference**: Aruba Networks, *Wi-Fi 6E in Higher Education*.

4. What specific AV and networking equipment is required to support seamless video conferencing in the designated room?

* **Answer**: For high-quality video conferencing, a **Poly Studio X70** with 4K capabilities and a **Sony VPL-FHZ85 laser projector** are suitable. This combination provides high-definition audio and video quality, with the Poly Studio supporting Teams or Zoom integration, ensuring smooth operation.
* **Reference**: Poly, *Poly Studio X70 Specifications*.

5. What firewall and intrusion prevention systems are recommended to secure the network from potential security threats?

* **Answer**: The **Palo Alto PA-3220** firewall is recommended for its advanced intrusion prevention, malware detection, and application-level threat protection. This firewall offers a comprehensive solution to protect the network from cyber threats common in educational environments.
* **Reference**: Palo Alto Networks, *Next-Generation Firewall Product Line*.

6. Should VLANs (Virtual Local Area Networks) be used to segment the network in each lab and student area? If so, why?

* **Answer**: Yes, VLANs are highly recommended. They separate traffic across different areas, improving both security and performance. For example, the Cisco and Embedded Labs can each operate on separate VLANs to protect sensitive instructional data and enhance lab performance.
* **Reference**: Interview with FC Network Representative.

7. What type of cabling is most suitable for ensuring high-speed data transmission in labs and common areas?

* **Answer**: **CAT8 cabling** is recommended for lab and workstation connections as it supports speeds up to 40 Gbps over shorter distances. For backbone connections, **single-mode fiber optic cabling** provides a reliable, high-speed backbone with minimal latency between the server and critical areas.
* **Reference**: Ethernet Alliance, *CAT8 Cabling Standards*.

8. What centralized network management solution will provide efficient network monitoring, configuration, and troubleshooting capabilities?

* **Answer**: **Cisco DNA Center** is an ideal choice for network monitoring and management. It enables software-defined networking, centralized control, and real-time troubleshooting, which is especially beneficial in complex academic network environments.
* **Reference**: Cisco, *Cisco DNA Center Overview*.

9. What power backup options are essential for maintaining network stability during power interruptions?

* **Answer**: A **redundant UPS system** in the server room (APC Symmetra 8kVA) and additional smaller UPS units (APC Smart-UPS 2200VA) in each technical room are recommended to maintain critical network functionality during outages.
* **Reference**: Interview with FC Facility Management Representative.

10. How can the network design be scaled to accommodate future growth in users and technological demands?

* **Answer**: The **modular Catalyst switches and Cisco DNA Center** allow for scalable additions, such as extra switch modules, WAPs, and enhanced security features. This setup can be scaled up as student enrolment increases or new technology is adopted.
* **Reference**: Cisco, *Scalable Networking Solutions for Education*.

Research and Citation

**Interviews with FC Representatives** provided insights on network segmentation, power requirements, and security preferences, particularly on the preference for VLAN segmentation and backup power options.

# **Devices, Quantities and Suggested cost**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Device/Component | Model/Type   |  | | --- | |  | | Quantity | Estimated Cost per Unit | Total Cost | Placement on Floor Plan |
| 1. High-End PCs | Dell Precision 3460 Workstation | 120 | $2,000 | $240,000 | 30 in each Lab (4 Labs Total) |
| 2. Core Router | Cisco Catalyst 8500 Series Edge Platform | 1 | $30,000 | $30,000 | Server Room |
| 3.Core and Distribution Switches | Cisco Catalyst 9500 Series (core), 9300 Series (distribution) | 6 (1 core, 5 distribution) | Core: $20,000, Distribution: $7,000 | $55,000 | One in Server Room for core, one per lab for distribution |
| 4. Advanced Wireless Access Points (WAPs) | Aruba AP-655 or Cisco Meraki MR76 Wi-Fi 6E | 10 | $2,500 | $25,000 | Student Lounge (2 WAPs), Hybrid Classroom, All Labs |
| 5.Next-Gen Firewall | Palo Alto Networks PA-3220 | 1 | $25,000 | $25,000 | Server Room |
| 6. High-End Projectors | Sony VPL-FHZ85 Laser Projector | 2 | $6,000 | $12,000 | Video Conferencing Room and Hybrid Classroom |
| 7. Premium Printer/Copier | Canon image RUNNER ADVANCE DX C5860i | 4 | $4,500 | $18,000 | One per Lab and Admin Area |
| 8. Advanced Video Conferencing System | Poly Studio X70 with 4K Camera | 1 | $10,000 | $10,000 | Video Conferencing Room |
| 9. Interactive Display for Hybrid Classroom | Microsoft Surface Hub 2S | 1 | $12,000 | $12,000 | Hybrid Classroom |
| 10. Structured Cabling - CAT8 | CAT8 Cable for high-speed connections | 3,000  meters | $5.00 per meter | $15,000 | All labs, student lounge, hybrid classroom, technical rooms |
| 11. Backbone Cabling - Fiber Optic (Single Mode) | Premium Fiber Optic | 500 meters | $10.00 per meter | $5,000 | Between Server Room and Each Lab/Technical Room |
| 12. Data Center-Grade Patch Panels | CAT8 Patch Panels | 10 | $500 | $5,000 | Server Room and Technical Rooms |
| 13. UPS - Redundant (Server Room) | APC Symmetra LX 8kVA | 2 | $12,000 | $24,000 | Server Room for redundancy |
| 14. UPS - Technical Rooms | APC Smart-UPS 2200VA | 3 | $1,200 | $3,600 | One in each Technical Room |
| 15. Network Management Platform | Cisco DNA Center for SDN | 1 | $50,000 | $50,000 | Server Room - Software |
| 16. Environmental Monitoring | NetBotz Rack Monitor 750 with sensors | 3 | $5,000 | $15,000 | One in Server Room, one in each Technical Room |
| 17. Maintenance & Service Contracts | 5-Year Premium Support for all devices | N/A |  | $60,000 | All devices, includes replacements, upgrades |
| 18. Installation and Configuration |  | N/A |  | $60,000 | Full system installation and setup |
| Total Estimated Budget |  |  |  | $624,600 |  |

# **Feasibility Study Choice#1**

#### Device and Peripheral Placement on Floor Plan

**Floor Plan Layout Summary with Enhanced Technology**:

1. **Server Room** (First Floor):
   * Core components: **Cisco Catalyst 8500 Router**, **Core Switch (Catalyst 9500)**, **Next-Gen Firewall (Palo Alto PA-3220)**, **Cisco DNA Center**, and **APC Symmetra UPS units** (for redundancy).
   * Environmental monitoring via **NetBotz Rack Monitor** to ensure proper cooling and humidity control for sensitive equipment.
2. **Labs (Ground Floor)**:
   * Each lab includes:
     + **30 Dell Precision Workstations** for high-performance computing.
     + **Distribution Switch (Catalyst 9300)** to connect workstations and manage internal traffic.
     + **Canon image RUNNER Printer/Copier** in each lab for convenience.
     + **Aruba AP-655 WAPs** in Cisco and Embedded Labs for wireless connectivity.
3. **Student Lounge (First Floor)**:
   * **Two Aruba AP-655 WAPs** to ensure coverage and speed for high-density usage areas.
4. **Hybrid Classroom (First Floor)**:
   * **Microsoft Surface Hub 2S Interactive Display** and **Sony Laser Projector** for advanced hybrid teaching and collaboration.
   * **Aruba AP-655 WAP** to support student devices during interactive lessons.
5. **Video Conferencing Room (First Floor)**:
   * **Poly Studio X70** with 4K video capability for professional-quality virtual meetings.
   * **Sony Laser Projector** to display meeting content on a large scale.
6. **Technical Rooms (Each Floor)**:
   * **APC Smart-UPS 2200VA** for backup power.
   * **NetBotz Rack Monitor** for temperature and humidity monitoring, ensuring environmental stability.
7. **Cabling**:
   * **CAT8 Cabling** for high-speed data transmission across labs, hybrid classroom, student lounge, and technical rooms.
   * **Single-Mode Fiber Optic Backbone** for main data connections between the Server Room and other critical network locations, minimizing latency.

#### Maintenance and Future Upgrade Provisions

1. **Maintenance and Support Contracts**:
   * A **5-year premium support contract** covering all devices and systems for repairs, firmware updates, and hardware replacements as needed.
   * **Annual cost allocation** within the budget to cover specialized technicians and preventative maintenance for optimal device longevity and reliability.
2. **Future-Proofing and Scalability**:
   * **Cisco DNA Center** enables software-defined networking (SDN) for automated configurations and rapid scalability.
   * **Modular Core and Distribution Switches** allow for expansion with additional modules and enhanced throughput as needed.
   * **Palo Alto Firewall** includes scalable licenses to upgrade security measures, allowing for increased monitoring and detection capabilities.
   * **Poly Studio X70** supports advanced conferencing needs, and additional camera units or software integrations can be added.
3. **Enhanced Environmental Monitoring**:
   * **NetBotz Rack Monitors** in server and technical rooms protect critical equipment by monitoring for environmental threats like temperature spikes or moisture.
4. **Cloud and IoT Integration**:
   * **Cisco Meraki Cloud Management** allows WAPs to integrate with cloud services, supporting remote management and IoT connections for educational and operational flexibility.
   * **Microsoft Surface Hub 2S** is designed for seamless cloud-based collaboration, enabling data sharing and real-time interaction across the institution.
5. **Redundancy**:
   * **Dual UPS units in the server room** ensure uninterrupted power for all essential network devices.
   * **Backup generator integration** can be added to support longer power outages, providing continuous network access during extended downtime.

### Final Feasibility Summary

**Total Cost**: **$624,600**, maximizing the use of premium technology while staying well within the $2 million budget. This allocation allows for top-tier network performance, security, and reliability, with significant room for future enhancements.

**Device Placement**: Strategically distributed across the floorplan, premium components ensure robust network infrastructure in each lab, classroom, and common area. High-end projectors, interactive displays, and advanced WAPs facilitate immersive learning experiences.

**Long-Term Value**: High-quality devices and extensive maintenance contracts ensure this infrastructure remains effective, adaptable, and cutting-edge for years to come. Redundant power and environmental monitoring safeguard critical devices, minimizing downtime and repair costs.

With this advanced setup, the Faculty of Computing can confidently accommodate current needs and anticipate future technological advancements without major overhauls. Let me know if you’d like to explore specific alternatives or add additional configurations!

# **Feasibility Study Choice#2**

### Feasibility Study for Premium Network Design

**Objective**: To assess whether the proposed premium network design, totalling $624,600, meets the Faculty of Computing’s current and anticipated needs effectively, sustainably, and within budget.

#### 1. Budget Feasibility

* **Allocated Budget**: The total allocated budget for this project is $2 million, which comfortably accommodates the proposed network design, leaving a significant margin for any future adjustments or unanticipated expenses.
* **Total Cost of Design**: The network design, including high-end PCs, network infrastructure, AV equipment, and redundancy, costs approximately **$624,600**, utilizing about **31% of the total budget**. This leaves sufficient funds for other project needs, ongoing maintenance, and future expansions if necessary.
* **Logical Reasoning**: The design effectively leverages a premium budget to maximize performance and sustainability without exhausting the financial resources. This surplus allows the organization flexibility for further enhancements and unexpected costs, maintaining financial prudence.

#### 2. Technical Suitability

* **High-Performance Hardware**: The selected **Dell Precision 3460 Workstations**, **Catalyst 9500/9300 Series switches**, and **Cisco DNA Center** provide state-of-the-art performance suitable for high traffic and data-intensive academic and research activities. Advanced workstations in each lab allow students to run complex applications, while high-end network devices ensure consistent connectivity.
* **Logical Reasoning**: The premium quality of selected devices guarantees a high level of performance required in an academic environment. By investing in industry-leading hardware, the network will be able to support demanding applications, large numbers of simultaneous connections, and resource-intensive tasks typical in a modern educational setting.

#### 3. Scalability and Future-Readiness

* **Modular Network Infrastructure**: The **Cisco Catalyst 9500 core switch** and **9300 distribution switches** support modular expansions, allowing for future upgrades in throughput, connectivity, or additional features. Similarly, the **Cisco DNA Center** enables software-defined networking (SDN), which allows for network automation, remote management, and scalability without needing a complete overhaul.
* **Advanced Wireless Capability**: Wi-Fi 6E access points, such as the **Aruba AP-655**, support high-density environments and are backward-compatible, ensuring a smooth transition as technology advances.
* **Logical Reasoning**: The design’s modular and scalable components ensure that the network can grow alongside the faculty’s increasing student body and technological demands. This adaptability is both cost-effective and operationally efficient, as it avoids the need for complete replacements in the event of expansion.

#### 4. Reliability and Redundancy

* **Redundant Power Supply**: The server room is equipped with two **APC Symmetra 8kVA UPS units**, providing fail-safe backup power. In the event of a power outage, these units ensure that critical network operations can continue seamlessly. Additionally, smaller UPS units in technical rooms provide redundancy for localized devices.
* **Environmental Control**: **NetBotz Rack Monitors** in the server and technical rooms track temperature and humidity, preventing overheating and ensuring the long-term durability of equipment.
* **Logical Reasoning**: The high level of redundancy in power and environmental monitoring means the network is highly resilient, with minimal risk of downtime. This reliability is essential for maintaining continuous access to resources, critical for an educational institution with 24/7 operational requirements.

#### 5. Security and Compliance

* **Advanced Firewall and Intrusion Prevention**: The **Palo Alto PA-3220 firewall** provides next-generation security, including intrusion prevention, malware scanning, and VPN capabilities. This is particularly important for protecting academic resources and student data from cyber threats.
* **Network Segmentation and VLANs**: By segmenting the network with VLANs (Virtual Local Area Networks), traffic can be separated across different labs and functional areas, reducing internal security risks and improving traffic management.
* **Logical Reasoning**: Security is a critical component in educational networks that handle sensitive student and staff data. The inclusion of advanced security measures ensures compliance with data protection standards and minimizes the risk of data breaches, creating a safe and secure network environment.

#### 6. Ease of Management and Maintenance

* **Centralized Network Management**: **Cisco DNA Center** enables centralized network monitoring and management, which allows IT staff to monitor network health, troubleshoot remotely, and make real-time adjustments without physically accessing each device.
* **Premium Support and Maintenance Contracts**: The 5-year premium support contract ensures that all equipment is maintained at an optimal level, with technical support available for any troubleshooting or replacement needs. This reduces the long-term cost of maintenance.
* **Logical Reasoning**: Simplified network management and dedicated support resources help maintain the network’s integrity and performance with minimal downtime. The proactive maintenance strategy ensures equipment longevity, reducing future replacement and repair costs.

# **Conclusion**

The proposed premium network design is both feasible and highly effective for the Faculty of Computing. With a strong focus on scalability, security, redundancy, and ease of management, this design supports the faculty’s current academic activities and is well-prepared to accommodate future growth. The design maximizes the $2 million budget, providing an industry-leading network solution that enhances educational operations and prepares the institution for emerging technological needs.