UTM

UNIVERSITI TEKNOLOGI MALAYSIA

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SECR 1213 NETWORK COMMUNICATIONS
SECTION 02
PROJECT TASK 2
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GROUP FOUREVER

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1. **What specific networking devices are required for teaching purposes?**

   Routers are essential devices of every network lab, as they manage data transit between several networks. In education, routers allow students to interact with IP addressing and routing protocols such as Routing Information Protocol (RIP) and Open Shortest Path First (OSPF), which help them understand how data moves between networks [1]. Besides, **switches** enable learning about VLANs, data flow and network organisation by connecting devices within a network. They are needed for debugging and managing LANs.

   By monitoring data traffic, **firewalls** protect networks and give students the ability to set up VPNs, access control and security settings. **Wireless Access Points (APs)** enable students to explore wireless networks setup and security. They are necessary to understand wireless networking.

2. **How should network connectivity be distributed within each lab, given the presence of 30 workstations per lab?**

   In general, wired connectivity is more suitable for a lab with 30 workstations. Unlike wireless networks, which can be affected by congestion and signal strength, it offers steady speeds and fewer interference. Using ethernet cables and switches provides all workstations with stable, high-speed connectivity. It is more suitable for handling large network loads and provides better security. Wireless networks are flexible and convenient, but they might not have enough bandwidth for 30 workstations, especially in a busy environment. It can result in increased security issues and slower speeds. Wireless connectivity can be employed for flexibility in smaller, but **wired connectivity** is usually the best option for networks labs because of its reliability,speed and security.

3. **What are the backup requirements for the network, especially for the labs and video conferencing room?**

   It is possible to implement backup systems for labs and video conferencing rooms, although the costs and complexity vary. First, using cloud or offsite storage for **data backup** is both cost-effective and simple to set up, but regular backups of network device configurations are required. Uninterruptible Power Supplies(UPS) for **power backup** provide continuity during blackouts, however the upfront cost can be high and require frequent maintenance. For **video conferencing**, implementing Quality of Service(QoS) and cloud-based platforms ensures reliable service, but specialist equipment might require additional costs. Overall, these solutions are useful, but must be modified to the specific needs and budget of the network setup.

4. **What kind of security measurements will be required for the deployment of the network plan both physically and digitally?**

The digital security measurements taken are **firewall protections.** Firewall should be installed at the network entry points to monitor and control both incoming and outgoing networks, blocking students from accessing unauthorised websites such as online games by application-based blocking [2]. A **Virtual Private Network (VPN)** should be deployed to encrypt the data that faculty students and staff send and receive to make sure the data are secure from external threats. A **Secure Authentication Method** should be implemented to let only the authorised users access the network. It should include a username and password given to all faculty students and staff, that requires login every 12 hours.

For the physical security concerns, network devices such as router, server and switches should be placed in a secured, well ventilated place away from humidity or direct sunlight, that are inaccessible to unauthorised individuals, to prevent damage of the network devices from water exposure or overheating. Each network device should be equipped with uninterrupted power supply to protect against power outage, thus preventing data loss.

5. **What bandwidth and performance requirements are expected?**

   Bandwidth and low latency are critical for high-performance networks, especially for cloud computing and real-time applications. Applications such as online video streaming require fast data transfer (typically hundreds of Mbps to Gbps) to keep connections smooth and avoid delays. Browser-based video conferencing solutions [3], however, can adapt to available network bandwidth at both ends of a call, adjusting quality to maintain stability.

6. **How can we allocate Internet bandwidth effectively across the faculty? (Yi Ya)**

   High-Capacity Links should be set up such as a 10 Gbps main Internet link, and 2 more backup links to handle the extra demand in the faculty of computing and provide high speed access for every student and staff. A **Gigabit fibre-optic backbone** should be used for the building in the Faculty of Computing to ensure fast data transfer and Internet communication between the new building and N28, N28a building. Lastly, use a **network monitoring system** to keep track of the traffic, identify issues, and adjust network usage as needed. **Bandwidth shaping** can be applied to prioritise important traffic, ensuring smoother and fair access for everyone in FC.

7. **How to maintain Internet uptime?**

   To maintain Internet uptime, routine **maintenance** should be scheduled to troubleshoot the network, ensuring security and minimising risk that could lead to downtime. For example, network hardware and software should be compatible with the latest standards. Network administrators should be hired to manage and solve problems as the on-call support service, to reduce downtime of a sudden Internet down.

8. **Are there any environmental factors or physical layout considerations?**

   Yes, certain features of UTM's buildings can affect network performance. For instance, concrete walls and reinforced structures in older buildings can block Wi-Fi signals, creating dead zones where extra routers or repeaters are needed to maintain coverage. Tall glass windows in some of the newer buildings may reflect signals and cause interference, so placing routers carefully is important.

   The mix of building heights and green spaces between old and new buildings in the Faculty of Computing also affects network planning. Tall trees and high humidity can weaken outdoor Wi-Fi signals between buildings, and temperature changes near server areas need monitoring to prevent overheating. For reliable and more complete coverage, careful cabling and shielding in busy areas, such as student lounges or labs with a lot of equipment, can help keep connections smooth.

9. **Are there any specific data storage or server requirements?**

   To accommodate the rapid development of technology and research and development purposes, a server is required to anticipate high-performance computing (HPC). Both the Cisco Network Lab and Embedded Lab may involve HPC workloads. Thus, a high-speed data storage system is required to handle large datasets for simulation, programming and analysis. The Cisco Network Lab requires dedicated servers for simulating network traffic, running network simulations, and supporting virtual labs. On top of that, the Embedded Lab would require servers that can support Iot devices and simulation software.

10. **What is the power requirement for the building?**

In the hybrid classroom, there will be one desktop PC and audio-visual equipment.

Item	Power Consumption	Quantity	Sum
Desktop PCs	300 W	1	300 W
Wi-Fi Router	30 W	1	30 W
Audio-visual equipment - Camera for video conferencing - Ceiling-mounted mics - Speakers - Interactive whiteboard	 10 W 5 W 30 W 100 W	 2 6 1 1	 20 W 12 W 30 W 100 W
Projector	200 W	1	200 W
Lighting	15 W	16	240 W

Air Conditioning	2000 W	1	2000 W
		Total	2932 W

In the video conferencing room, there will be one desktop PC and audio-visual equipment.

Item	Power Consumption	Quantity	Sum
Desktop PCs	300 W	1	300 W
Wi-Fi Router	30 W	1	30 W
Audio-visual equipment - Camera for video conferencing - Lapel mics - Speakers - Interactive whiteboard	 10 W 5 W 30 W 100 W	 2 10 1 1	 20 W 50 W 30 W 100 W
Projector	200 W	2	400 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	3170 W

In the student lounge, there are 4 workstations with a standard desktop PC for students.

Item	Power Consumption	Quantity	Sum
Desktop PCs	300 W	4	1200 W
Wi-Fi Router	30 W	1	30 W
Ethernet Switch	30 W	1	30 W
Projector	200 W	1	200 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	3700 W

In each general purpose lab, there are 30 workstations and a lecturer's workstation. Assuming each workstation is a standard desktop PC. There will be 62 workstations in both the general purpose labs.

Item	Power Consumption	Quantity	Sum
Desktop PCs	300 W	31	9300 W
Wi-Fi Router	30 W	1	30 W
Ethernet Switch	30 W	1	30 W
Projector	200 W	1	200 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	11800 W

In the Cisco Network Lab, assuming that students will be working in pairs, there will be at least 16 sets of hardware including the hardware for demonstration purposes. According to the layout, the lab has 17 PCs. Besides, there will be 16 routers, 16 switches and up to 5 virtual servers.

Item	Power Consumption	Quantity	Sum
Routers (Cisco 2900/4000 Series)	150 W	16	2400 W
Switches (Cisco Catalyst 9200 Series)	120 W	16	1920 W
Firewalls (Cisco ASA 5500 Series)	100 W	1	100 W
Desktop PCs	300 W	1	300 W
Wi-Fi Router	30 W	1	30 W
Ethernet Switch	30 W	1	30 W
Projector	200 W	1	200 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	7220 W

In the Embedded Lab, assuming that students will be working in pairs, there will be at least 16 sets of hardware including the hardware for demonstration purposes. There will then be 16 Arduino Uno boards, 16 PCs, sensors and peripherals and power supply.

Item	Power Consumption	Quantity	Sum
Arduino Uno	0.5 W	16	15.5 W
Desktop PCs	300 W	16	4800 W
WiFi router	30 W	1	30 W
Ethernet Switch	30 W	1	30 W
Sensors and Peripherals - LEDs - Small motors - Sensors	 1 W 1 W 1 W	 16 32 32	 16 W 32 W 32 W
Power Supply for Arduino Uno	5 W	16	80 W
Projector	200 W	1	200 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	7475.5W

In the technician office, there are 4 PCs.

Item	Power Consumption	Quantity	Sum
Desktop PCs	300 W	4	1200 W
Wi-Fi Router	30 W	1	30 W
Ethernet Switch	30 W	1	30 W
Lighting	15 W	16	240 W
Air Conditioning	2000 W	1	2000 W
		Total	3500 W

Other than the closed area, the corridors, common area, toilets and surrounding of the building also require lighting and fans.

Item	Power Consumption	Quantity	Sum
Lighting - Ground floor - First floor - Toilet - Outside of building	15 W	 10 10 16 4	600 W
Fan	75 W	2	150 W
		Total	750 W

Total power consumption

Room / Area	Power Consumption
Hybrid Classroom	2932 W
Video Conferencing Room	3170 W
Student Lounge	3700 W
2 General Purpose Lab	11800 W
Cisco Network Lab	7220 W
Embedded Lab	7475.5W
Technician Office	3500 W
Others	750 W
Total	40547.5 W

As power supply efficiency usually ranges from 60% to 95% [5]. By assuming an efficiency of 80%, the adjusted power requirement is adjusted as follow:

$\frac{40547.5W}{0.8} = 50684.375W \approx 51kW$

To ensure the building can handle power fluctuations and additional loads, 20% buffer is added above the estimated power requirement.

$51kW \times 1.2 = 61.2kW$

Feasibility

1. Technical Feasibility

The building layout includes General Purpose Laboratory, Cisco Network Lab, Embedded Lab, Hybrid Classroom, Video Conferencing Room and Student Lounge, each equipped with multiple end systems and network devices. The building provides a great learning environment, as well as a network-based laboratory for practical sessions.

To support stable, high-speed connections, wired connectivity via Ethernet cables and switches is required in each lab. Wired connections reduce interference and maintain high speeds, which are essential for handling lab activities without interruption. The deployment of a 10 Gbps primary internet link, supplemented by two backup links and a Gigabit fibre-optic backbone, further ensures that the network can handle high data transfer demands and provide seamless connectivity throughout the building.

2. Operational Feasibility

The building is supported by the setup of secure authentication measures, firewall protections, and VPNs, to take control over network access and ensure data security. Regular monitoring and maintenance, aided by a network monitoring system, can track traffic, identify bottlenecks, and facilitate bandwidth shaping to prioritise essential traffic across the faculty. This structured approach allows effective bandwidth allocation, providing all students and faculty with smooth, reliable access.

Backup systems, such as cloud storage and uninterruptible power supplies (UPS) for network devices, also support operational continuity. Although implementing UPS for every device involves upfront costs, it prevents data loss and network disruptions during power outages. The QoS setup for video conferencing rooms also ensures steady connections by adjusting resources dynamically based on network demand. The overall operational plan is, therefore, practical and sustainable for the faculty's educational and administrative needs.

References

[1] Network+ Guide to networks, 8th ed., https://file.fouladi.ir/courses/compnetlab/books/ [MindTap Course List] Jill West, Jean Andrews, Tamara Dean - Network+ Guide to Networks (2018, Cengage Learning).pdf (accessed Nov. 6, 2024).

[2] M. H. Razali, R. Hassan, and R. Salleh, "Next Generation Firewall for Improving Security in Company and IoT Network," *2020 IEEE Conference on Open Systems (ICOS)*, 2020, pp. 58-63. Available: https://ieeexplore.ieee.org/document/8937145.

[3] "What Internet Speed do you Need for Video Conferencing?," MegaMeeting, Jan. 29, 2021. https://www.megameeting.com/news/what-internet-speed-for-video-conferencing/

[4] Kompulsa, "Computer Power Consumption: How Much Energy Computers Consume," *Kompulsa*, Mar. 06, 2024. https://www.kompulsa.com/much-power-computers-consume/

[5] J. Madsen, "Power Supply Efficiency: What is the Typical Efficiency Rating for a Power Supply?," *Bravo Electro*, Feb. 24, 2023. https://www.bravoelectro.com/blog/post/power-supply-efficiency (accessed Nov. 08, 2024).