



# UTM

UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING

SECR1213 - NETWORK COMMUNICATIONS

TASK 3: CHOOSING THE APPROPRIATE LAN DEVICES

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### 3.0 Choosing the Appropriate LAN Devices

#### 3.1 Router

One or more packet-switched networks or subnetworks can be connected using a router. By sending data packets to their intended IP addresses, it manages traffic between different networks and permits several devices to share an Internet connection.

| Product       | Synology RT2600ac                                                                                                                                                                                                                                                                                                                                                                  | ASUS AX6000<br>(RT-AX88U)                                                                                                                                                                                                                                                                                                         | Cisco RV345 Dual WAN<br>Gigabit VPN<br>Router                                                                                                                                                                                                                                                                                                                  |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Specification | <ul style="list-style-type: none"><li>• With CPU Dual core 1.7 GHz</li><li>• 4x4 MIMO Omni-directional high-gain dipole (2.4GHz / 5GHz)</li><li>• 7 gigabit LAN port and 3 gigabit WAN (DUAL WAN support)</li><li>• 1 USB 3.0 port, 1 USB 2.0 port and 1 SD card reader (SDXC, SDHC)</li><li>• IEEE 802.11a/b/g/n/ac; Simultaneous dual-band Wi-Fi; Beamforming; 2.4GHz:</li></ul> | <ul style="list-style-type: none"><li>• 4x4 dual-band that provides 160MHz bandwidth</li><li>• 1 RJ45 for 2.5 Gigabits BaseT for WAN/LAN, 1 RJ45 for 2.5 Gigabits BaseT for LAN, 4 RJ45 for Gigabits BaseT for LAN, 1 USB 3.2 Gen 1 and 1 USB 2.0</li><li>• Has AiProtection Pro, powered by Trend Micro with automatic</li></ul> | <ul style="list-style-type: none"><li>• 2 WAN ports (RJ-45) for load balancing and resiliency</li><li>• 16 LAN ports for high-performance connectivity</li><li>• 2 USB ports to support a 3G/4G modem or flash drive</li><li>• 900 Mbps TCP throughput for improved productivity</li><li>• VPN functionality for secure interconnectivity, including</li></ul> |

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|           | 800Mbps; 5GHz:<br>1.73Gbps <ul style="list-style-type: none"> <li>• VPN server/client (Synology SSL VPN, PPTP, OpenVPN, L2TP/IPSec); VPN pass-through (PPTP、IPSec、L2TP)</li> <li>• Support layer 7 Qos</li> </ul>                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                    | standard IPsec, Layer 2 Tunneling Protocol (L2TP) over IPsec, and Cisco IPsec <ul style="list-style-type: none"> <li>• Support for the Cisco AnyConnect Secure Mobility Client, ideal for remote access by mobile devices</li> </ul> |
| Price     | RM2,815.00                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RM1,619.00                                                                                                                                                                                                                                                                                                                         | RM1,400.00                                                                                                                                                                                                                           |
| Reference | 1. <a href="https://www.synology.com/en-global/products/RT2600ac#availability">https://www.synology.com/en-global/products/RT2600ac#availability</a><br>2. <a href="https://shopee.com.my/%E3%80%90Hot-Style%E3%80%91SYNOLOGY-Rt2600Ac-Wireless-Router-Rt-2600-Ac-Sharing-Device-Wi-Fi-i.421915523.9056648749">https://shopee.com.my/%E3%80%90Hot-Style%E3%80%91SYNOLOGY-Rt2600Ac-Wireless-Router-Rt-2600-Ac-Sharing-Device-Wi-Fi-i.421915523.9056648749</a> | 1. <a href="https://www.amazon.com/dp/B07HM6KJN8?tag=thebalance-onsite-prod-20&amp;linkCode=ogi&amp;th=1">https://www.amazon.com/dp/B07HM6KJN8?tag=thebalance-onsite-prod-20&amp;linkCode=ogi&amp;th=1</a><br>2. <a href="https://shopee.com.my/product/58359596/2026548334">https://shopee.com.my/product/58359596/2026548334</a> | 1. <a href="https://shopee.com.my/Cisco-RV345-Dual-WAN-Gigabit-VPN-Security-Router-i.226783022.6717922179">https://shopee.com.my/Cisco-RV345-Dual-WAN-Gigabit-VPN-Security-Router-i.226783022.6717922179</a>                         |

Through the comparison between these three routers, we have decided to choose the **Synology RT2600ac** as this router has the best specification. Even though the Synology RT2600ac has lesser ports compared to Cisco RV345 Dual WAN Gigabit VPN Router, Synology RT2600ac supports layer 7 Qos which enables the routers to perform with better performance. At the same time, Synology RT2600ac also up to 800 Mbps and 1733 Mbps on the 2.4 GHz and 5 GHz radios, respectively. Synology RT2600ac also provides VPN which makes the security of the network more secure.

### 3.2 Switch

A network switch is defined as a hardware component which is responsible for relaying data from a computer network to the destination endpoint through packet switching, MAC address identification, and a multiport bridge system. A network switch connects and transmits data packets to and from devices on a local area network (LAN).

| Product       | <b>S5850-48T4Q, 48-Port Ethernet L3 Switch, 48 x 10GBASE-T, with 4 x 40Gb QSFP+, Support MLAG</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>S5860-20SQ, 24-Port Ethernet L3 Switch, 20 x 10Gb SFP+, with 4 x 25Gb SFP28 and 2 x 40Gb QSFP+, Support Stacking, Broadcom Chip</b>                                                                                                                                                                                                                                                                                                                                                 | <b>S3910-24TS, 24-Port Gigabit Ethernet L2+ Switch, 24 x Gigabit RJ45, with 4 x 10Gb SFP+ Uplinks, Stackable Switch, Broadcom Chip</b>                                                                                                                                                                                                                                                                                                                |
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| Specification | <ul style="list-style-type: none"><li>● 48x 100/1000M/5G/10G Multi-gig RJ45 with 4x 40G QSFP+(split to 4x 10G)</li><li>● Support MLAG (Multi-Chassis Link Aggregation) for Uninterrupted Services</li><li>● 1+1 AC Hot-swappable Power Supplies and 2+2 Smart Fans</li><li>● Support Data Center Features (PFC, ECN etc.) to Build a Lossless and Low-latency Network</li><li>● Support CLI/WEB/SNMP/SSH/OVSDB/RPC-API for Flexible Operation</li><li>● Network Monitoring through Sampled Flow</li></ul> | <ul style="list-style-type: none"><li>● Broadcom BCM56170 Chip, All 10G/25G/40G Ports Support Stacking</li><li>● 1+1 Hot-swappable Power Supplies, Smart Fans</li><li>● Support QoS, DHCP, BGP, VRRP, QinQ, etc.</li><li>● Support WEB/CLI/SNMP/SSH for Flexible Operation</li><li>● Network Monitoring through Sampled Flow (sFlow)</li><li>● Support SSH, ACL, AAA, 802.1X, RADIUS, TACACS+, etc. for Security</li><li>● IPv4/IPv6 Dual-Stack for Future Network Expansion</li></ul> | <ul style="list-style-type: none"><li>● Broadcom BCM56150 Chip, Support Up to 4 Units Stacking</li><li>● 1+1 Hot-swappable Power Supplies, Smart Fan</li><li>● Support SSH, DHCP, RIP, OSPF, VRRP, etc.</li><li>● Support WEB/CLI/SNMP/SSH for Flexible Operation</li><li>● Network Monitoring through Sampled Flow (sFlow)</li><li>● Support SSH, ACL, AAA, 802.1X, RADIUS, TACACS+, etc. for Security</li><li>● ≥8KV Lightning Protection</li></ul> |

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|                   | (sFlow)<br><ul style="list-style-type: none"> <li>Support SSH, ACL, AAA, 802.1X, RADIUS, TACACS+, for Security</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Highlights</b> | <ul style="list-style-type: none"> <li>S5850-48T4Q features an advanced hardware design combined with 48x 100/1000M/5G/10G BASE-T ports and 4x 40Gb ports.</li> <li>This 10GBASE-T switch offers backwards compatibility with installed Ethernet cabling and standard RJ-45 connectors.</li> <li>The switch comes with the complete system software with comprehensive protocols and applications to facilitate the rapid service deployment and management for traditional Layer 2 and Layer 3 networks.</li> <li>Offering high-performance, high port density, and low latency, S5850-48T4Q is well-suited to both the core and aggregation layers,</li> </ul> | <ul style="list-style-type: none"> <li>24-Port Ethernet L3 Switch, 20x 10Gb SFP+, with 4x 25Gb SFP28 and 2x 40Gb QSFP+, Support Stacking, Broadcom Chip</li> <li>The S5860-20SQ 24-port 10Gb Ethernet layer 3 switch features 20x 1G/10G downlinks, 4x 10G/25G SFP28 and 2x 40G QSFP+ (can be split into 4 x 10G SFP+) uplinks that all support virtual stacking.</li> <li>This managed enterprise switch adopts cutting-edge Broadcom chips to deliver 760 Gbps switching capacity and 565 Mpps forwarding rate.</li> <li>It is packed with redundant hot-swappable power supplies, dual hot-swappable smart fans and hardware-level dual-flash chip for superior processing performance and</li> </ul> | <ul style="list-style-type: none"> <li>The S3910-24TS gigabit Layer 2+ stackable managed switch features 24x 10/100/1000BASE-T and 4x 10Gb SFP+ uplinks that is best for complex environment deployment, which resists corrosion, dust and moisture, supports -10°C ~ 60°C operation and 8KV lightning protection.</li> <li>The 24-port gigabit managed switch equipped with 1+1 hot-swappable dual power supplies, supports 4 units physical stacking to deliver redundancy, simple management and resilience of network capacity.</li> <li>Further, with Broadcom BCM56150 switch chip, S3910-24TS can provide 128 Gbps switching capacity and 96 Mpps forwarding rate to deliver</li> </ul> |

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|                   | <p>enabling it to meet data centers, careers and enterprise network requirements.</p> <ul style="list-style-type: none"> <li>Multi-interface speeds switch with VXLAN, MLAG for Enterprises, Data Centers and ISPs</li> </ul>                                                                                                                                                                                                                                                                                     | <p>network reliability.</p> <ul style="list-style-type: none"> <li>FS agile S5860-20 SQ managed switch is ideal for large-scale campus network aggregations, small and medium-sized network cores to meet the needs of high-speed, safe, intelligent enterprise networks.</li> <li>Most cost-effective switch with 25G/40G uplinks for SMBs and Enterprise</li> </ul>                                                                                                                                                                                                     | <p>higher network performance.</p> <ul style="list-style-type: none"> <li>Besides supporting IPv4/IPv6 and rich layer 3 routing features (static routing, OSPF, RIP, RIPng and etc.), the gigabit switch enables flexible deployment for diverse networking demands.</li> <li>High-reliability switch with OSPF, VRRP, DHCP Server features for SMBs, Enterprise Edge</li> </ul>                                                                                                                                      |
| <b>Price</b>      | RM21,901.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>RM7,405.00</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | RM3,561.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>References</b> | <a href="https://www.fs.com/sg/products/69378.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_GlBPkiah98qsjLSB7ldbrbTugRqRMPo5stfRuYsVwhzYYzOBjCJ0xoCKe0QAvD_BwE">https://www.fs.com/sg/products/69378.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_GlBPkiah98qsjLSB7ldbrbTugRqRMPo5stfRuYsVwhzYYzOBjCJ0xoCKe0QAvD_BwE</a> | <ul style="list-style-type: none"> <li> <a href="https://www.fs.com/sg/products/108710.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_GmH8UUn1N02a8S9FPe3jMJ5oU9Md-mRCsypWieOhVBZChmRQ4twtkRoCttwQAvD_BwE">https://www.fs.com/sg/products/108710.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_GmH8UUn1N02a8S9FPe3jMJ5oU9Md-mRCsypWieOhVBZChmRQ4twtkRoCttwQAvD_BwE</a> </li> </ul> | <a href="https://www.fs.com/sg/products/108712.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_Gjkyov4KOkGif95G-VC1vpVAJje2C62O2RuNPAP1ejD28nMQtrqCEhoCWi8QAvD_BwE">https://www.fs.com/sg/products/108712.html?country=my&amp;currency=MYR&amp;languages=English&amp;paid=google_shopping&amp;utm_country=9066744&amp;gclid=CjwKCAiAhqCdBhB0EiwAH8M_Gjkyov4KOkGif95G-VC1vpVAJje2C62O2RuNPAP1ejD28nMQtrqCEhoCWi8QAvD_BwE</a> |

Based on these comparisons, **S3910-24TS, 24-Port Gigabit Ethernet L2+ Switch** has been chosen as the first and right choice due to its specifications and features. First of all , the price for this switch is budget friendly and affordable which is RM 3,561.00 compared to

S5850-48T4Q, 48-Port Ethernet L3 Switch and S5860-20SQ, 24-Port Ethernet L3 Switch.

Secondly, it has L2 features which is Layer-2 switches perform the switching function to rearrange the data frames from the source to a destination end by learning the MAC address of the destination node from the address table of the switch. This is because we do not need any L3 capacities for a computer lab. Thirdly, 10Gbps fiber link is enough to campus core router where **S3910-24TS, 24-Port Gigabit Ethernet L2** has 4x 10Gb SFP+ uplinks that is best for complex environment deployment, which resists corrosion, dust and moisture, supports -10°C ~ 60°C operation and 8KV lightning protection. In conclusion, **S3910-24TS, 24-Port Gigabit Ethernet L2+ Switch** is the best choice in terms of high-reliability switch and most cost-effective switch.

### 3.3 Patch Panel

A patch panel in a local area network (LAN) is a mounted hardware assembly that contains ports used to connect and manage incoming and outgoing LAN cables. Patch panels provide a way to keep large amounts of cables organized, enabling flexible connections into network hardware located in data centers or access or wiring closets. Each of these ports contains wires that go to a different location.

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| Product       | <b>IWILLINK Patch Panel 48 Ports, Cat6 / Rj45 Patch Panel, 2u Network Patch Panel Utp 19-Inch, Black</b>                                                                                                                                                                                                                                                 | <b>Cable Matters UL Listed Rackmount or Wall Mount 48 Port Network Patch Panel (Cat6 Patch Panel / RJ45 Patch Panel)</b>                                                                                                                                                                                             | <b>AMPCOM Supreme Series CAT6 48 Ports Patch Panel, Rack Mount - 2U, 19 inch, RJ45 Ethernet 568A 568B, 50u Gold Plated, with Rear Cable Management Bar</b>                                                                                                                                             |
| Specification | <ul style="list-style-type: none"><li>● Install this Ethernet patch panel effortlessly in universal 19" racks, cabinets, or wall mount brackets with 2U (3.5") standard height</li><li>● Heavy duty network patch panel 48 port supports Ethernet, made for Cat 6 cabling, compatible with Cat 5e /Cat 5</li><li>● Gold plated contacts ensure</li></ul> | <ul style="list-style-type: none"><li>● Heavy duty 48 port patch panel supports 10G Ethernet and is backwards compatible with Gigabit Ethernet. Made for Cat 6 cabling, but backwards compatible with Cat 5e and Cat 5 cabling</li><li>● Future-proof your network connection for 10-Gigabit Ethernet with</li></ul> | <ul style="list-style-type: none"><li>● Cat6 48 port 50u patch panel for 100/1000 Mbps networking, Cat6/Cat5e/Cat5 compatible, accept 22-26 AWG solid and stranded UTP cables</li><li>● T568 A&amp;B Wiring color coding, written-on label and numbered ports on the back and front for easy</li></ul> |

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|  | <p>a correction free connection. Numbered ports and color-coded T568A and T568B wiring diagrams give quick reference. White space for easy marking and identification</p> <ul style="list-style-type: none"> <li>• This patch panel enables quick, easy cable patching. Just plug Cat6 cables into its 48 front RJ45 ports, and use a 110 or Krone punch-down tool to terminate color-coded connections in the rear</li> <li>• IWILLINK is committed to providing customers with the highest quality products and services. If you have any dissatisfaction or quality problem when you receive the item, you can always contact us and we will</li> </ul> | <p>this durable RJ45 patch panel</p> <ul style="list-style-type: none"> <li>• Install this Ethernet patch panel effortlessly in universal 19" racks, cabinets, or wall mount brackets with 2U (3.5") standard height</li> <li>• Gold plated contacts ensure a correction free connection. Numbered ports and color-coded T568A and T568B wiring diagrams give quick reference</li> <li>• Network patch panel complies with the UL fire safety requirement (E486099). Use included D-rings and cable ties for easy cable management</li> </ul> | <p>Installation and identification T568 A&amp;B Wiring color coding, written-on label and numbered ports on the back and front for easy Installation and identification</p> <ul style="list-style-type: none"> <li>• 110 type punch down termination, and can be mounted in standard EIA 19" Racks</li> <li>• Heavy duty black powder coat steel construction, 50u gold plated contacts for long term safe use</li> <li>• Package: 1 x Patch Panel, 1 x rear cable tie-down support bar, 1 x Wire Stripper, 1 x Dust Proof Cover, Screws, Cable ties</li> </ul> |
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|           | <p>give you a full refund or replacement</p> <ul style="list-style-type: none"> <li>• Network patch panel complies with the CE and RoHS. Use included D-rings and cable ties for easy cable management</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                   |
| Price     | RM 256.37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | RM 309.43                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | RM 265.04                                                                                                                                                                                                                                                                                                                                                         |
| Reference | <a href="https://www.amazon.com/Iwillink-Network-19-Inch-Compatible-Cabling/dp/B09VTKXMJZ/ref=sr_1_1_sspa?keywords=48%2Bport%2Bpatch%2Bpanel&amp;qid=1672114241&amp;sr=8-1-spons&amp;spLa=ZW5jcmlwdGVkUXVhbGlmaWVyPUEzRIUzRzI2UUIzTDRKJmVuY3J5cHRlZElkPUEwNzI0NTkxMU04UDZPMVdGTFhLSSZlbnNyeXB0ZWRBZEIkPUEwOTExMjM3UUxXRk1EU0xaQiZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU&amp;th=1">https://www.amazon.com/Iwillink-Network-19-Inch-Compatible-Cabling/dp/B09VTKXMJZ/ref=sr_1_1_sspa?keywords=48%2Bport%2Bpatch%2Bpanel&amp;qid=1672114241&amp;sr=8-1-spons&amp;spLa=ZW5jcmlwdGVkUXVhbGlmaWVyPUEzRIUzRzI2UUIzTDRKJmVuY3J5cHRlZElkPUEwNzI0NTkxMU04UDZPMVdGTFhLSSZlbnNyeXB0ZWRBZEIkPUEwOTExMjM3UUxXRk1EU0xaQiZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU&amp;th=1</a> | <a href="https://www.amazon.com/Cable-Matters-Rack-mount-Wallmount-48-Port/dp/B0072K1P8C/ref=sr_1_7_sspa?keywords=48+port+patch+panel&amp;qid=1672114241&amp;sr=8-7-spons&amp;psc=1&amp;spLa=ZW5jcmlwdGVkUXVhbGlmaWVyPUEzRIUzRzI2UUIzTDRKJmVuY3J5cHRlZElkPUEwNzI0NTkxMU04UDZPMVdGTFhLSSZlbnNyeXB0ZWRBZEIkPUEwNjgzMTIwMjhUN0lTS0hJRTIDNyZ3aWRnZXROYW1lPXNwX210ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=">https://www.amazon.com/Cable-Matters-Rack-mount-Wallmount-48-Port/dp/B0072K1P8C/ref=sr_1_7_sspa?keywords=48+port+patch+panel&amp;qid=1672114241&amp;sr=8-7-spons&amp;psc=1&amp;spLa=ZW5jcmlwdGVkUXVhbGlmaWVyPUEzRIUzRzI2UUIzTDRKJmVuY3J5cHRlZElkPUEwNzI0NTkxMU04UDZPMVdGTFhLSSZlbnNyeXB0ZWRBZEIkPUEwNjgzMTIwMjhUN0lTS0hJRTIDNyZ3aWRnZXROYW1lPXNwX210ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=</a> | <a href="https://www.amazon.com/AMPCOM-Supreme-Rackmount-Wallmount-Management/dp/B07FRDWHL2/ref=sr_1_21?keywords=48%2Bport%2Bpatch%2Bpanel&amp;qid=1672114241&amp;sr=8-21&amp;th=1">https://www.amazon.com/AMPCOM-Supreme-Rackmount-Wallmount-Management/dp/B07FRDWHL2/ref=sr_1_21?keywords=48%2Bport%2Bpatch%2Bpanel&amp;qid=1672114241&amp;sr=8-21&amp;th=1</a> |

Based on these comparisons, **IWILLINK Patch Panel 48 Ports, Cat6 / Rj45 Patch Panel, 2u Network Patch Panel Utp 19-Inch, Black** is the best option to be chosen. It is because the features and specification is almost the same as other patch panels but with the cheapest price.

### 3.4 Wireless Access Point

According to Cisco System (2022), a wireless access point (WAP) is a networking device that allows wireless-capable devices to connect to a wired network. It is simpler and easier to install WAPs to connect all the computers or devices in the network than to use wires and cables. Access Point is a central unit in an all-wireless network where it functions as a hub that links all stations together.

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|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product       | D-Link DAP-2680 Wireless AC1750 Wave 2 Dual-Band PoE Access Point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | TP-LINK EAP653 AX3000 Ceiling Mount WiFi 6 Access Point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Specification | <ul style="list-style-type: none"><li>• Supports IEEE 802.11a/b/g/n/ac Wave 2 wireless1 interface</li><li>• 3 X internal dual-band antennas</li><li>• Operates at 2.4 GHz and 5 GHz frequency</li><li>• Maximum bandwidth: 450 Mbps for 2.4 GHz and 1300 Mbps for 5GHz</li><li>• Supports WPA-personal, WPA Enterprise, WPA2-Personal, WPA2-Enterprise and WEP 64/128-bit encryption</li><li>• MAC address access control</li><li>• Network Access Protection (NAP)</li><li>• Internal RADIUS server</li><li>Network Management:</li><li>• Telnet</li><li>• Secure Telnet (SSH)</li><li>• Web (HTTP)</li></ul> | <ul style="list-style-type: none"><li>• Supports IEEE 802.11ax/ac/n/g/b/a wifi standards</li><li>• 4 X 4 spatial streams</li><li>• Maximum bandwidth: 574 Mbps for 2.4GHz and 2402 Mbps for 5 GHz</li><li>• Supports WEP, WPA Personal/Enterprise, WPA2</li><li>• Personal/Enterprise, WPA3-Personal/Enterprise</li><li>• Encryption protocols</li><li>• Mac address filtering with a maximum number of 4000</li><li>• Centralized management with cloud access and Omada application</li><li>• Provides a 2.5 Gbps Ethernet port (supports IEEE802.3at PoE)</li><li>• Easy to be installed</li><li>• Wall and ceiling mountable</li></ul> |



### 3.5 Cable

LAN cable is referred to as twisted pair cables which are able to reduce signal noise and interference. There are several categories of LAN cable which are Cat5e, Cat6, Cat6A, Cat8 cable, etc. In this context, we apply Category 6 cable to optimize performance and accommodate the size of the 23 AWG conductors. Moreover, LAN cable comes in shielded and unshielded versions. Shielded LAN cables are for EMI (Electromagnetic Interference) areas whereas unshielded LAN cables are for homes and businesses when no EMI is present. Thus, we are going to choose the unshielded LAN cable.

| Product       | PROLINK Cat6 UTP Full Copper Cable                                                                                                                                                                                                                                                                                                                                           | CK-LINK CAT6 UTP CABLE                                                                                                                                                                                                                                                                                                                                                 | Ubiquiti Cat6 UTP cable                                                                                                                                                                                                                                                                                                                                                     |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Specification | <ul style="list-style-type: none"><li>• 4-pair unshielded twisted pair</li><li>• Thicker conductor diameter</li><li>• Provide higher reliability and higher data rates</li><li>• Support transmission bandwidth 250 Mhz</li><li>• Support 10 Gbps up to 55 meters</li><li>• Uses 23 AWG solid copper conductor pairs</li><li>• Colour: Blue</li><li>• Length: 305m</li></ul> | <ul style="list-style-type: none"><li>• 4-pair unshielded twisted pair</li><li>• Thicker conductor diameter</li><li>• Support transmission bandwidth 250 Mhz</li><li>• Support speed of up to 10G Ethernet</li><li>• Support 10 Gbps in less than 50 meters</li><li>• Uses 24 AWG solid copper conductor pairs</li><li>• Colour: Blue</li><li>• Length: 305m</li></ul> | <ul style="list-style-type: none"><li>• 4-pair unshielded twisted pair</li><li>• Support the use in the plenum area</li><li>• Support transmission bandwidth 600 Mhz</li><li>• Support up to 10 Gbps (UC-C6-CMR)</li><li>• Supports speed of up to 10G Ethernet</li><li>• Uses 23 AWG solid copper conductor pairs</li><li>• Colour: White</li><li>• Length: 304m</li></ul> |

|           |                                                                                              |                                                                                              |                                                                                              |
|-----------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|           |                                                                                              |                                                                                              |                                                                                              |
| Price     | RM 299.00                                                                                    | RM 309.00                                                                                    | RM 939.00                                                                                    |
| Reference | <a href="#">PROLiNK CAT6 / CAT5e UTP LAN Networ (end 9/20/2024 12:00 AM) (lelong.com.my)</a> | <a href="#">CK-LINK CAT6 UTP NETWORK CABLE 305M (end 9/19/2023 12:00 AM) (lelong.com.my)</a> | <a href="#">Ubiquiti UC-C6-CMR UC-C6-CMP CAT6 U (end 2/10/2023 12:00 AM) (lelong.com.my)</a> |

Through the comparisons, **PROLINK Cat6 UTP Full Copper Cable** is more suitable among these options. This is because it can support high transmission bandwidth and a network speed of 10 Gbps up to 55 meters which is indeed a suitable length for the distance between the devices in the building. In terms of price, it is the cheapest with a suitable performance.

### 3.6 Expected Cost

| No                | LAN Devices                                                                                       | Quantity | Price per Unit (RM) | Total Price (RM) |
|-------------------|---------------------------------------------------------------------------------------------------|----------|---------------------|------------------|
| 1                 | Synology RT2600ac                                                                                 | 1        | 2,815.00            | 2,815.00         |
| 2                 | S3910-24TS, 24-Port Gigabit Ethernet L2+ Switch                                                   | 4        | 3,561.00            | 14,244.00        |
| 3                 | IWILLINK Patch Panel 48 Ports, Cat6 / Rj45 Patch Panel, 2u Network Patch Panel Utp 19-Inch, Black | 4        | 256.37              | 1,025.48         |
| 4                 | TP-LINK EAP653 AX3000 Ceiling Mount WiFi 6 Access Point                                           | 8        | 629.00              | 5,032.00         |
| 5                 | PROLINK Cat6 UTP Full Copper Cable                                                                | 9        | 299.00              | 2,691.00         |
| <b>Total Cost</b> |                                                                                                   |          |                     | 25,807.48        |

## **Reflection**

### **1. Are you surprised by the prices? How were you surprised?**

Yes. This is because the total cost is really low compared to our budget of RM 3,000,000. We are also surprised by the price of the patch panel as the patch panel is not as expensive as we thought. However, we feel shocked about the price of the switch. The price of one switch is the highest which is RM 3561. Since we need 4 switches, the total cost of the switch will be RM 14, 244. After doing research, we are surprised by how different brands of products with similar functions and specifications can also have different prices. Even one product can also have a huge range between the prices.

In conclusion, it is important for us to understand our project in order for us to select the right product regarding the functions and specifications. Even though some products may be cheap, they may not reach our expectations. Vice versa, even though some products are expensive, we may not need the functions and specifications of the products.

## **2. Have you ever considered cost as a factor for choosing networking devices?**

Yes, it is because cost is also one of the factors in network planning that needs to be given due consideration to meet the needs of users. Without sufficient cost, we cannot start buying the components or devices needed to build the network. A device with many features and capabilities at a lower price is an example of good spending for network production. If we want to have a good network, we have to consider the cost as an element that needs to be taken into account because it will help us in adding any additional features in developing a better network.

Cost is usually one of the most important factors when choosing equipment for a network. The capacity and features will determine the cost of a switch or router. Device capacity includes the number and type of ports available and the backplane speed. Network management capabilities, embedded security technologies, and optional advanced switching technologies are other factors that impact cost. The expense of cables required to connect each device to the network must also be considered. Another important element that affects cost considerations is how much redundancy to include in the network. This includes the device, the port of each device and the copper or fiber optic cable. This shows the importance of cost in the networking planning even though it is just a small business networking as it acts an important factor to meet the user needs.

### **3. Differences between the same devices from different brands**

At first instance, products (devices) and brands seem the same, but by searching for the differences, we get to know their actual meanings. The fact that a product is a single entity, while a brand may include millions of products, is the primary distinction between the two. Therefore, the term "brand" is broader than "product". The brand alone is what people use to identify a product.. The main key difference between product (devices) and brand is that the product performs its general functions, but a brand offers value to the customers.

We obtained some findings by comparing between ASUS and Cisco routers. Asus routers provide a pleasant and stable networking experience, breeze to set up, have lots of options, and are very reliable. Moreover, it's only required to reboot it once or twice a year. ASUS routers tend to have 2 CPUs, one for Wi-Fi and one for cabled connections, which helps speed up Wi-Fi throughput speeds, and increases stability. Cisco routers required rebooting several times each month because it would overheat, dropout, or just randomly become unstable on some connected devices while others were fine. Cisco is often the cheapest solution, but they always use plastic casings, with poor ventilation, so you end up restarting the router from time to time as it inevitably becomes unstable.

In addition, For TP-Link Wireless Access Point has faster speed (including short distance and long distance) and wide coverage. They also have more accessories, such as smart parental controls and network security features. On the other hand, D-Link Wireless Access Point has high-gain antennas for wide coverage and Ethernet ports for wired devices.

TP-Link and D-Link are both very popular and well-reviewed brands in the Wi-Fi router market. Based on the comparison, we can conclude that TP-Link provides stable and reliable fast speed and wide coverage and it's sold at an affordable price. TP-Link is very suitable for all kinds of families, because of its simple and stylish design.

## References

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## **Group 3, The Phoenix**

### **MEETING MINUTES FOR TASK 3**

**19/12/2022 (MONDAY)**

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**19 DEC 2022 / 13:00 PM / N28 BK1**

#### **ATTENDEES**

Lee Rong Xian, Lu Qi Yan, Yusra Nadatul Alyeea, Harchana

(All the group members were present)

#### **AGENDA**

- a) Research the different network devices that we need to accomplish the objective.**
- b) Decide which LAN devices we need to accomplish the needs as mentioned in the case study.**
- c) Find information on the devices that have been chosen**

- 1. Harchana does a briefing on task 3 to make sure all of the team members understand the task.
- 2. All the group members have been do research on the different network devices for further discussion.
- 3. All of them were suggest their ideas on choosing the appropriate the right LAN devices.

During the discussion,

- a. Lee Rong Xian suggests which LAN devices is to accomplish.
- b. Yustra do a quick survey on market prices of the LAN devices
- c. Lu Qi Yan find further information on the LAN devices
- d. Harchana do search on suitable networking devices for schools or universities and how many of them are required for further use.

#### **Divide the task.**

- 1. The task is divided into 4 parts by Lee Rong Xian.
- 2. 1 person will do meeting minutes with one part of LAN device.
- 3. 1 person will do 2 part of LAN devices.
- 4. Other 2 people will do the remaining 2 part of LAN devices.

**Finish the task.**

| <b>Bil</b> | <b>Items</b>                                                 | <b>Group member</b>    |
|------------|--------------------------------------------------------------|------------------------|
| 1.         | Doing 1 part of LAN device (switch) with meeting minutes     | Harchana A/P Arulappan |
| 2.         | Doing 2 parts of LAN devices (wireless access point & cable) | Lu Qi Yan              |
| 3.         | Doing 1 part of LAN device ( patch panel)                    | Yusra Nadatul Alyeea   |
| 4.         | Doing 1 part of LAN device ( router)                         | Lee Rong Xian          |

**ACTION ITEMS**

| <b>Bil</b> | <b>Items</b>                                                                             | <b>Status</b> |
|------------|------------------------------------------------------------------------------------------|---------------|
| 1.         | Research the different network devices that we need to accomplish the objective          | Done          |
| 2          | Decide which LAN devices we need to accomplish the needs as mentioned in the case study. | Done          |
| 3          | Find information on the devices that have been chosen.                                   | Done          |
| 4          | Divide the task.                                                                         | Done          |
| 5          | Finish the task.                                                                         | Done          |