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**Network Design Lab**

**Date:** 11/08/2021

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# Chapter 1: Survey of Networking Devices

Learning Objective:

1) List the specifications of various networking devices

2) Compare the various networking devices

Task:

1) Conduct a survey of various Make / Models of networking devices offered by various companies. (As example links are provided for Cisco, HP, Aruba, and Juniper; you arefree to search for more.)

2) For each category (Switch, Router, Gateway, Access Point, Wireless Domain Controller, Edge Network Devices, Firewall or UTM, Authentication and Login Services) of product survey and create a table of required specification. Minimum of 8 – 10 under each category.

2) Prepare a tabulation of various key features as follows:

1. Switches

| Sr No | Make/ Model Number | PoE (Power over Ethernet) | Switching Capacity | Protocol Supported | IPv6 Support | Security Protocol Support | Cost (USD) |
|---|---|---|---|---|---|---|---|
| 1. | Cisco MS12024P | 370W | 56 GbPS | 802.1w, 802.1D Rapid Spanning Tree Protocol (RSTP, STP), 802.1ab Link Layer Discovery Protocol (LLDP) and Cisco Discovery Protocol (CDP) | YES | Role-based access control (RBAC), IEEE 802.1X RADIUS and MAB, DHCP snooping, detection and blocking | 1,863.00 |

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|---|---|---|---|---|---|---|---|
| 2. | Cisco SF550X24P | 195W | 84.8 GbPS | Simple Network Management Protocol (SNMP), LLDP-MED, VSDP | YES | Address Resolution Protocol (ARP), IP Source Guard, and Dynamic Host Configuration Protocol (DHCP) snooping | 20281 |
| 3. | Cisco SF25024P | 185W | 12.8 GbPS | Rapid Spanning Tree Protocol [RSTP], Per-VLAN Spanning Tree Plus (PVST+), | YES | SSL, Secure Shell (SSH) Protocol, IEEE 802.1X (Authenticator role), Secure Core Technology (SCT), Secure Sensitive Data (SSD) | 30281 |
| 4. | Aruba 2540 | 370W | 176 GbPS | IEEE 802.1AB Link Layer Discovery Protocol (LLDP), IEEE 802.3ad link-aggregation-control protocol (LACP) | YES | Access control lists (ACLs), RADIUS/TACACS+, Secure Sockets Layer (SSL), DHCP Protection | 2125 |
| 5. | Aruba 3810M (JL428A) | 680W | 320 GbPS | IEEE 802.1AB Link Layer Discovery Protocol (LLDP) | YES | IEEE 802.1X Port Based Network Access Control | 8049.50 |
| 6. | Aruba 2930F (JL557A) | 740W | 104 GbPS | Virtual Redundancy Router | YES | TPM (Trusted platform module) based security | 3965 |

2. Routers:

| Sr No | Make/Model Number | Connector Type and Speed | Forwarding Rate | Routing Protocol Supported | IPv6 Support | Security Protocol Supported | Cost (INR) |
|---|---|---|---|---|---|---|---|
| | Asus ZenWi-Fi AX (XT8) | RJ45 and 6600 MbPS | 1.2 Mpps | Exterior Gateway Protocol (EGP) | YES | WPA3-PSK, WPA2PSK, WPA-PSK, WPA-Enterprise, WPA2Enterprise, WPS support | 24000 |
| | TP-Link TLMR6400 4G LTE+WAN Router | RJ45 or 4G LTE Micro sim card slot and | 148.8 Kpps | IEEE 802.11b/g/n 2.4GHz | YES | 64/128-bit WEP, WPA/WPA2, WPA-PSK/WPA2-PSK encryptions | 4999 |

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|---|---|---|---|---|---|---|---|
| | | 300 MbPS | | | | | |
| | Asus RT-AX88U | RJ45 and 6000 MbPS | 1 Mpps | Exterior Gateway Protocol (EGP) | YES | WPA2-PSK, WPA-PSK, WPA-Enterprise, WPA2-Enterprise, WPS support | 26000 |
| | Asus RTAC750L | RJ45 and 750 MbPS | 83 Kpps | Interior Gateway Protocol (IGRP) | YES | WPA2-PSK, WPA-PSK, WPA-Enterprise, WPA2-Enterprise, WPS support | 3000 |
| | Asus GTAX11000 | RJ45 and 11000 MbPS | 1.3 Mpps | Enhanced Interior Gateway Routing Protocol (EIGRP) | YES | FTP/TCP/IP/HTTP/WPA Enterprise | 42000 |
| | Asus RT-AC68U | RJ45 and 1900 MbPS | 80 Kpps | Interior Gateway Protocol (IGRP) | YES | WPA2-PSK, WPA-PSK, WPA-Enterprise, WPA2-Enterprise, WPS support | 13000 |

3. Access Points

| Sr No | Make and Model Number | Speed | Forwarding Rate | Protocol Supported | IPv6 Support | Security Protocol Support | Cost |
|---|---|---|---|---|---|---|---|
| 1. | TP-Link TL-WA901ND | 300 MbPS | 4 and 8 GbPS | 802.11 b/g/n | YES | WEP, WPA/WPA2, WPA/WPA2-PSK | 1999 |
| 2. | Cisco WAP125 | 867 MbPS | 1.2 GbPS | 802.11 b/g/n/ac | YES | WPA-TKIP, WPA2-AES | 7445 |
| 3. | Linksys LAPAC1750-AP | 300 MbPS | 1.7 GbPS | 802.11 a/b/g/n/ac | YES | WPA/WPA Mixed, WPA2 | 16803 |
| 4. | TP-Link EAP110 | 300 MbPS | 1.2 GbPS | 802.11 a/b/g/n/ac | YES | WEP / WPA / WPA2Enterprise, WPA-PSK / WPA2-PSK | 2499 |
| 5. | Cisco WAP121 | 300 MbPS | 1.2 GbPS | 802.11 b/g/n | YES | WPA/WPA2/WEP | 6983 |
| 6. | Cisco Aironet 4800 | 300 MbPS | 1.2 GbPS | 802.11 a/b/g/n/ac | YES | WPA, WPA2, WPA3 | 10199 |

4. Edge Network Devices:

| Sr No | Make and Model Number | Connector type and speed | Forwarding rate | Routing Protocol Support | IPv6 Support | Security Protocol Support | Cost (INR) |
|---|---|---|---|---|---|---|---|
| 1. | Cisco Catalyst 6513-E | 13 slots, 80GbPS per slot | 720 Mpps | Network Equipment Building Standards Layer 3 (NEBS L3) | Yes | Firewall Security System and Services, Supervisor Engine 720 | 965,457.67 |

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|---|---|---|---|---|---|---|---|
| 2. | Cisco ASR 9922 | 1-pps RS-422 or 1.0/2.3 50ohm RF connector | 160 TbPS | EVC, IEEE bridging, IEEE 802.1s Multiple Spanning Tree (MST) | Yes | L2VPN, L3VPN, IPTV, CDNs | 719,264.00 |
| 3. | Cisco ASR 920 | 128 GbPS | 64 GbPS | BGP, OSPF, EIGRP, IS-IS, Multicasting support PIM and SSM mapping, BFD, Multi-VRF CE, VRRPv3 | Yes | AAA with TACACS+ and RADIUS, Dynamic Arp Inspection (DAI), SSH | 292,467.00 |
| 4. | Cisco Catalyst C9300-24T | 208 GbPS | 511 MbPS | OSPF and EIGRP, NSF | Yes | MACsec-256 | 366,680.00 |
| 5. | Cisco Catalyst C1000-8T-2G | 20 GbPS | 14.8 MbPS | Interior Gateway Protocol (IGP) | Yes | 802.1X, Switched Port Analyzer (SPAN), Bridge Protocol Data Unit (BPDU) Guard | 657,685.00 |
| 6. | Cisco Edge 300 | 802.11b/g/n | 5.6 GbPS | AVI, WAV, and MPG4 video support and H.264/AVC | Yes | ACLs, VLANs, IEEE 802.1X port, Bridge Protocol Data Unit (BPDU), Secure Core Technology (SCT) | 80,062.00 |

5. Firewalls

| Sr No | Make and Model Number | Throughput | Capacity | Routing Protocol Supported | IPv6 Support | Security Protocol Supported | Cost (USD) |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Cisco Meraki MX84 | 500 MbPS | 200 | 1:1 NAT, DMZ, Multiple WAN IP, PPPoE, NAT | YES | WEP, WPA, WPA2-PSK, WPA2-Enterprise with 802.1X authentication | $1,995.00 |
| 2. | Cisco Meraki MX100 | 750 MbPS | 500 | 1:1 NAT, DMZ, Multiple WAN IP, PPPoE, NAT | YES | WEP, WPA, WPA2-PSK, WPA2-Enterprise with 802.1X authentication | $4,995.00 |
| 3. | Cisco Meraki MX250 | 4 GbPS | 20000 | 1:1 NAT, DMZ, Multiple WAN IP, PPPoE, NAT | YES | WEP, WPA, WPA2-PSK, WPA2-Enterprise with 802.1X authentication | $30,000.00 |
| 4. | Cisco Meraki MX450 | 6 GbPS | 100000 | 1:1 NAT, DMZ, Multiple WAN IP, PPPoE, NAT | YES | WEP, WPA, WPA2-PSK, WPA2-Enterprise with 802.1X authentication | $60,000.00 |
| 5. | Dell SonicWall TZ400 | 1.3 GbPS | 25000 | BGP4, OSPF, RIPv1/v2, static routes, policy-based routing | YES | LDAP (multiple domains), XAUTH/RADIUS, SSO | ₹ 980.00 |
| 6. | Dell SonicWall TZ570 | 4 GbPS | 25000 | BGP4, OSPF, RIPv1/v2, static routes, policy-based routing | YES | LDAP (multiple domains), XAUTH/RADIUS, SSO | $1,259.00 |

6. Wireless Domain Controllers

| Sr No | Make and Model Number | Throughput | Access points and clients | Routing Protocol Supported | IPv6 Support | Security Protocol Supported | Cost (USD) |
|---|---|---|---|---|---|---|---|
| 1. | Cisco 8540 | 40 GbPS | 6000/64000 | IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX specification, 1000BASE-T. 1000BASE-SX, 1000-BASELH, UDP, IP, ICMP | yes | WEP, WPA, WPA2, RFC protocol | $29,847 |

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|---|---|---|---|---|---|---|---|
| 2. | Cisco 5520 | 20 GbPS | 1500/20000 | IEEE 802.11a, 802.11b, 802.11g, 802.11d, WMM/802.11e, 802.11h, 802.11n, 802.11k, 802.11r | yes | WEP, WPA, WPA2, MD5 | $3,725 |
| 3. | Cisco 3504 | 4 GbPS | 150/3000 | IEEE 802.3 10BASE-T, IEEE 802.1Q VLAN tagging, link aggregation | yes | WEP, WPA, WPA2, MD5 | ₹1,18,500 |
| 4. | Cisco Catalyst 9800-80 | 80 GbPS | 6000/64000 | IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX, 1000BASE-T, 1000BASESX, 1000-BASE-LH | yes | WEP, WPA, WPA2, WPA3, RFC, HMAC, SHA-1 96 | $64,000 |
| 5. | Cisco Catalyst 9800-40 | 40 GbPS | 2000/32000 | IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX, 1000BASE-T. 1000BASESX, 1000-BASE-LH | yes | WEP, WPA, WPA2, WPA3, RFC, HMAC, SHA-1 96 | $40,000 |
| 6. | Cisco Catalyst 9800-L | 5 GbPS | 250/5000 | IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX specification, 1000BASE-T, 1000BASE-SX, 1000-BASE-LH | yes | WEP, WPA, WPA2, WPA3, RFC, HMAC, SHA-1 96 | $10,035 |

7. Gateway

| Sr No | Make and Model Number | Throughput | Forwarding rate | Routing Protocol Support | IPv6 Support | Security Protocol Supported | Cost |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Cisco 1100 terminal gateway | 100 MbPS | 100 MbPS | Simple New Management Protocol (SNMP) v2, v3 | Yes | RADIUS, TACACS+, LDAP, Advanced Encryption service (AES), Encapsulating security payload (ESP) | $4,750 |
| 2. | Cisco P25 | 15.4 W | 500 MbPS | TCP/IP | No | 256-bit AES and 64bit DES-OFB; contact Cisco for other encryption formats | $86,611.99 |
| 3. | Cisco 2811 | 1.544 MbPS | 61 MbPS | Simple New Management Protocol (SNMP) | Yes | RADIUS, TACACS+, Advanced Encryption service (AES) | 5000 |
| 4. | Aruba SD-WAN 9004 | 4 GbPS | 2 GbPS | BGP, OSPF, static routes. | Yes | NOM, UL 60950-1 Second Edition, CAN/CSA-C22.2 | $1,207 |
| 5. | Aruba SD-WAN 7240XM | 40 GbPS | 30 GbPS | TDES, DES, Secure hash algorithm (SHA-1) | Yes | Policy Enforcement Firewall (PEF), Web content filtering (WebCC), Deep packet inspection (DPI) | $2,546 |
| 6. | Aruba SD-WAN 7024 | 8 GbPS | 2.6 GbPS | TDES, DES, Secure hash algorithm (SHA-1) | Yes | WAN, WLAN, LAN, VLAN | $989.99 |
| 7. | Acer Gateway NE-571 | 500 GbPS | - | 802.11 b/g/n | Yes | Secure hash algorithm (SHA-1), TDES, RADIUS, TACACS | 21,980 |
| 8. | Juniper SRX210 | 2XGE + 6XFE | 290 MbPS | Static routes, BGP, Session Description Protocol (SDP) | Yes | Secure hash algorithm (SHA-1), TDES, RADIUS, ACACS | $124.99 |

8. Authentication and login services

| Sr No | Model | Description | Features | Level of Security | IPv6 Support | Security Protocols |
|---|---|---|---|---|---|---|
| 1. | Open Authentication to the Access Point | Security IPv6 Support Security Protocols 1 Open Authentication to the Access Point Open authentication allows any device to authenticate and then attempt to communicate with the access point | Wired Equivalent Privacy (WEP) | MODERATE | NO | Extensible Authentication Protocol (EAP) framework |
| 2. | Shared Key Authentication to the Access Point | the access point sends an unencrypted challenge text string to any device that is attempting to communicate with the access point. | IEEE 802.11b standard COMPATIBLE | LOW | YES | Wired Equivalent Privacy (WEP) protocol |
| 3. | EAP Authentication to the Network | By using the Extensible Authentication Protocol (EAP) to interact with an EAP-compatible RADIUS server, the access point helps a wireless client device and the RADIUS server to perform mutual authentication and derive a dynamic unicast WEP key Uses | Uses WEP compatible RADIUS server | HIGHEST | YES | Extensible Authentication Protocol (EAP) framework |

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|---|---|---|---|---|---|---|
| 4. | MAC Address Authentication to the Network | The access point relays the wireless client device's MAC address to a RADIUS server on your network, and the server checks the address against a list of allowed MAC addresses | provides an alternate authentication method for client devices that do not have EAP capability | HIGH | YES | PPS 802.1x framework |
| 5. | Combining MAC Based, EAP, and Open Authentication | Client devices that use 802.11 open authentication to associate to the access point first attempt MAC authentication. If MAC authentication succeeds, the client device joins the network. clients | clients configured with either "open" or EAPMD5 authentication methods are both supported on the same WLAN | HIGH | YES | PPS 802.1x framework, EAP, WEP |
| 6. | Using CCKM for Authenticated Clients | Authenticated client devices can roam from one access point to another without any perceptible delay during reassociation | RADIUS-assigned VLAN | MODERATE | YES | LEAP, EAPFAST (CCXv3) or PEAPGTC, PEAPMSCHAP, EAP-TLS (CCXv4) |
| 7. | Using WPA Key Management | Using WPA, the server generates the PMK dynamically and passes it to the access point | A WPA-compliant network interface card (NIC) and its WPA compliant client software | HIGH | YES | TKIP (Temporal Key Integrity Protocol) for data protection and 802.1X for authenticated key management. 8 |

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|---|---|---|---|---|---|---|
| 8. | WISPr Authentication | WISPr authentication allows the smart clients to authenticate on the network when they roam between WISP even if the wireless hotspot uses an ISP with whom the client may not have an account. | If a hotspot is configured to use WISPr authentication n in a specific ISP and a client attempts to access the Internet at that hotspot, the WISPr AAA server configured for the ISP authenticates the client directly and allows the client to access the network | MODERATE | YES | WISPr framework |

Reference Links:

https://www.cisco.com/c/en_my/solutions/small-business/switches.html#~stickynav=3

https://www.hpe.com/in/en/networking.html

https://www.arubanetworks.com/products/networking/

https://www.juniper.net/us/en/products-services/