ITEC 3210 C
Fall 2023
Assignment 1

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PART 1: Mini Case

1) (i) A "structured design" means designing a network or a system by following a systematic approach. The three essential components of a structured design are Core, Distribution, and Access. It arranges the network components using a hierarchical top-down approach.
   (ii) The main benefits of a structured design are:
   - Easy Maintenance, simplifies troubleshooting because changes may be made locally without affecting the system.
   - Organized, due to its systematic and hierarchical approach.
   - Efficient, by breaking down complex systems into modular components.

   (iii) Structured architecture, ensuring a well-managed and expandable network infrastructure in the context of GSE's network, making future troubleshooting and scalability easier.

2) It is advised to use a client-server architecture for GSE's network applications. This guarantees centralized control, effective resource use, and simpler network service management.

3) (i) Each type of hardware component needed – routers, switches, cables, power back up, and firewalls.
   (ii) Purpose:
   Routers – To facilitate connection to external networks and inter-departmental communication.
   Switches – To connect equipment inside each department so that LAN access and data transfer can be provided.
   Cables - To ensure that the devices' physical connection are secure.
   Power Backup – In the event of a power outage, hardware devices will have a backup.
   Firewall – To manage network traffic and ensure network security.
   (iii) Quantities:
   1 Router, **4 Switches**, different lengths of **Cables** are required for connecting devices inside each department, **Power Backups** depending on the number of devices being used (refer to answer 7), and **1 Firewall**.

4) **Access Layer – Local Area Network (LAN):** Relevant. Essential for guaranteeing effective local network access by establishing LAN connectivity for specific devices inside each department of GSE.
   Data Centre: Relevant. It is here that servers store and process data, assisting with the processing needs of applications and enhancing network functionality.

Enterprise Edge – WAN Access, Internet Access, e-Commerce Edge: Relevant. Used for establishing a connection between GSE and external networks, supplying WAN access, enabling internet connections, and assisting with e-commerce activities. This is essential for enabling connectivity outside of the local network and enabling interactions between GSE and the larger digital environment.

5) (a) The various ethernet kinds that are now in use are defined in Fig. 7-6 on page 193. It lists their names, the fastest data rate that they can support, and the maximum network coverage distance.
(b) Three technical goals:
1. **Scalability** – It is improved by higher numbers which offer quicker data transfer rates, can accommodate growing network demands, and will support future GSE growth.
2. **Reliability** – Increased reliability can be achieved by assuring effective data transfer at higher rates. However, infrastructure changes and compatibility may be required.
3. **Performance** – Greater data transfer rates considerably enhance network performance by enabling faster data transfers and supporting bandwidth-demanding GSE applications.

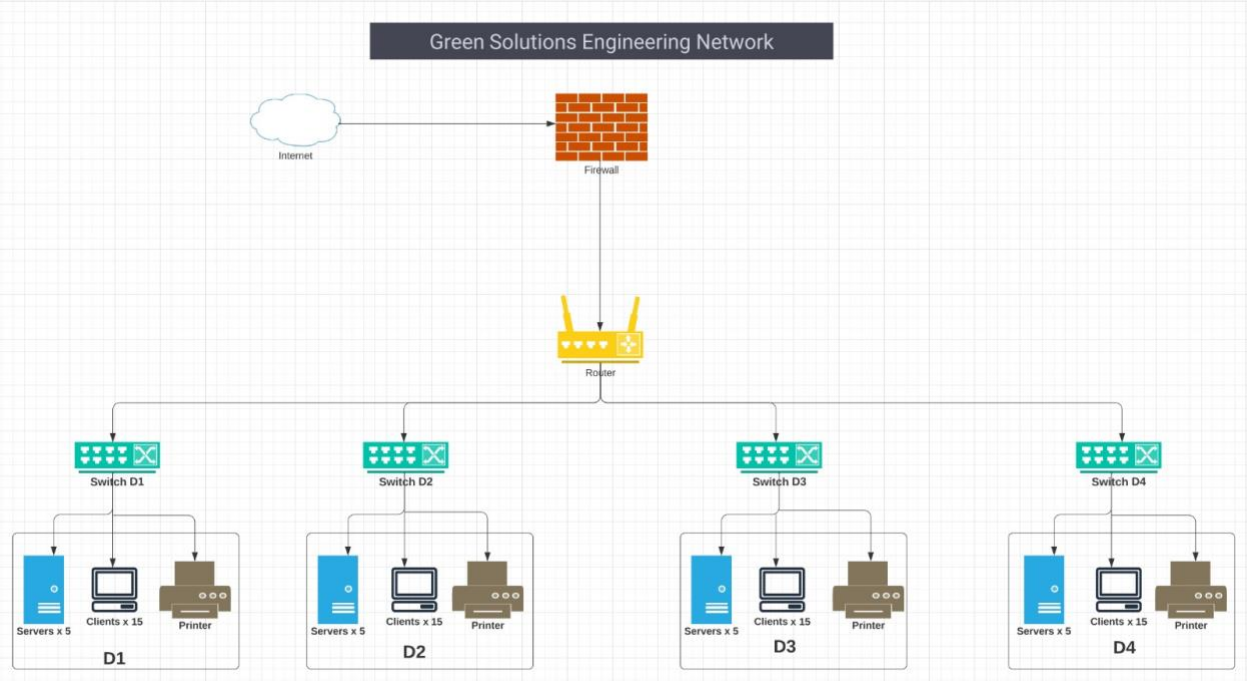
6) (a) Managed network is a network that is monitored and regulated continually to maintain optimal performance, security, and dependability when transferring data between sites, both internally and externally.
(b) Components of a managed network include **routers and switches** that are essential for managing and directing data traffic, **firewalls** that ensure security by monitoring traffic, **servers and data centers** that provide centralized resources for data processing and storage, and **network monitoring tools**. Additionally, **management software** configures and monitors network devices, **security protocols** use encryption and access control, and **clear documentation** direct network operations.
(c) Effects of using a managed network:
1. Enables centralized network component monitoring, which improves network performance. (**Performance**)
2. Adjusting the parts required to support a managed network increases scalability. (**Scalability**)
3. Improves usability by using the most recent technology and software to guarantee efficient functioning. (**Reliability**)

7) Costs:

Switches = 4 x HPE Aruba switch 52 ports switch = **$24,211.96**
Routers = 1 x Cisco 4331 Cisco Integrated Services router = **$3019.99**
Firewall = 1 x Cisco 1120 Firewall 1120 = **$3959.99**
Cables = 80 x Cat5e - StarTech Cat 5e = **$2960**,
16 x Cat 6 - Cat 6 Tripp = **$78**,
6 x Fiber Optic - Tripp fiber optic 15M = **$210**
UPS Battery backups = 84 x APC UPS = **$6719**,
4 for switches and 1 for router x APC High power = **$1035**

Total Price = $42,193.94

8) Network Architecture Diagram:



PART 2: Subnetting

1) To accommodate 180 subnets, we need to calculate the next power of 2 which will be more or equal to the required subnets.
   2^x >= 180
   2^7 = 128, which is less than 180 (required subnets)
   2^8 = 256
   So, we need to borrow 8 bits to accommodate 180 subnets.

2) The subnet mask for the Class B network 180.180.0.0 will have the first 16 bits fixed (due to the Class B address), and we will borrow 8 bits for subnetting since we require 8 bits for subnetting. In binary, the subnet mask will appear as follows:
   (Class B mask, 16 bits) 11111111.11111111.11111111.11111111
   (8 bits for subnetting) 11111111.11111111.11111111.11110000
   Let's now Convert this binary subnet mask to decimal:
   255.255.255.240

3) We must locate the remaining bits in the subnet mask (32 total bits - 16 bits fixed for the Class B address - 8 bits borrowed for subnetting = 8 bits remaining) to estimate the number of hosts per subnet. The formula 2^n - 2 can be used to determine the number of hosts, where n is the total number of remaining bits.
   = 2^8 - 2
   = 256 - 2
   = 254
   So, each subnet can have 254 hosts.

4) The subnetting scheme that borrows 8 bits may accommodate 256 subnets (2^8 = 256).

5) With 256 subnets, each of which can accommodate 254 hosts, this subnetting solution offers plenty of flexibility for growth. However, fixed 8 bits used for subnetting result in decrease in number of hosts' addresses available per subnet as number of subnets rises.

PART 3: Protocol Efficiency

1) VoIP codec used = G.711 (64,000 bps) = 64,000/8 = 8000 * 0.01 sec = 80 (1byte = 8 bits)
   RTP headers = 12 bytes => 12 + 80 = 92 bytes
   UDP headers = 8 bytes => 8 + 92 = 100 bytes
   IPv4 headers = 20 bytes => 20 + 100 = 120 bytes
   Ethernet frames = 38 bytes => 38 + 120 = 158 bytes

   Maximum Efficiency:
   = Size of Data / Ethernet Frame Size * 100
   = 80 / 158 * 100
   = 50.63%

2) Data sent instead every 20 ms instead of 10 ms:
   Voice Data = 8000 * 0.02 sec = 160
   RTP headers = 12 bytes => 12 + 160 = 172 bytes
   UDP headers = 8 bytes => 8 + 172 = 180 bytes
   IPv4 headers = 20 bytes => 20 + 180 = 200 bytes
   Ethernet frames = 38 bytes => 38 + 200 = 238 bytes

   Efficiency = 160 / 238 * 100
   = 67.22%

3) With a G.729 Annex A codec:
   Overhead remains same = 78 bytes
   Voice Data = 8,000 bps / 8 => 1000 * 0.01 s = 10 b (voice data per frame)
   RTP headers = 12 bytes => 12 + 10 = 22 bytes
   UDP headers = 8 bytes => 8 + 22 = 30 bytes
   IPv4 headers = 20 bytes => 20 + 30 = 50 bytes
   Ethernet frames = 38 bytes => 38 + 50 = 88 bytes

   Efficiency = 10 / 88 * 100
   = 11.36%

References

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