Project 2

Design a LAN for the Campus Layout

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Abstract:

Throughout history economies have had certain areas of focus. In the agricultural age, whoever had the most food was the most powerful. In the industrial age, the nations with the most advanced manufacturing were the most successful. Sometimes contemporary times are referred to as the "Information Age" because the main resource that businesses rely on is the exchange of information using computer networks. It is therefore critical that all businesses have an economic and efficient computer network to be successful.

Introduction:

The objective of this project is to design a LAN for a campus layout shown below in Figure 1:

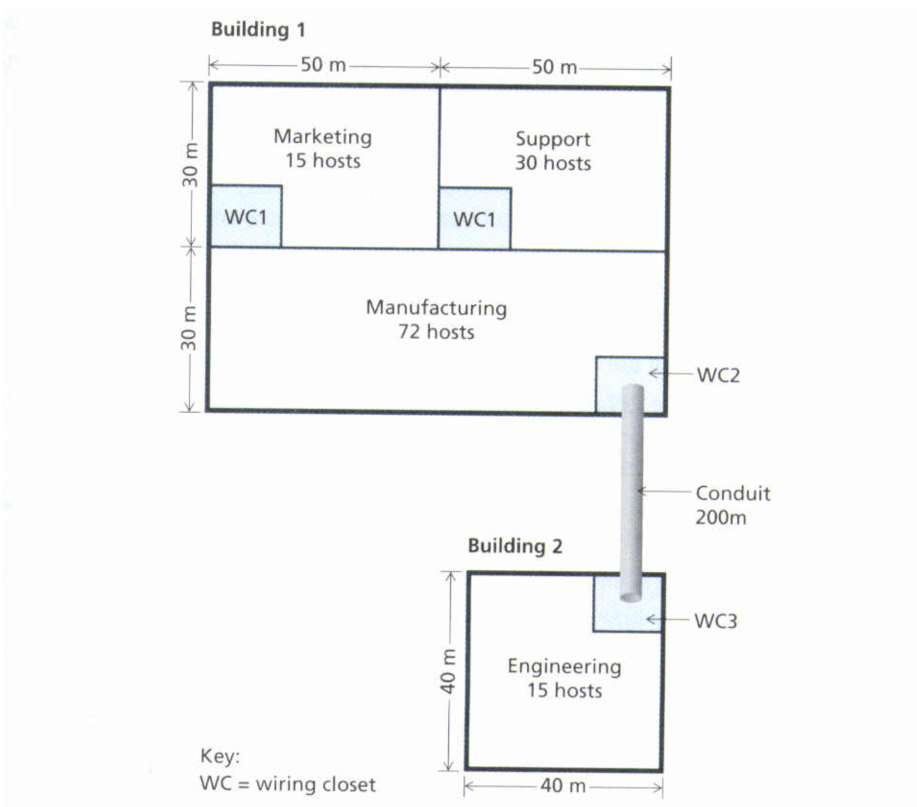

Figure 1

The project has the following design requirements:

- Each department must have access to the resources of all other departments.
- The traffic generated by the users of one department cannot affect another department's LAN unless accessing a resource on that other department's LAN.
- A file server can support only 30 users.
- File servers may not be shared by multiple departments.
- All repeaters, bridges, and hubs must reside in the wiring closets (WCs).

Thin Coax Design:

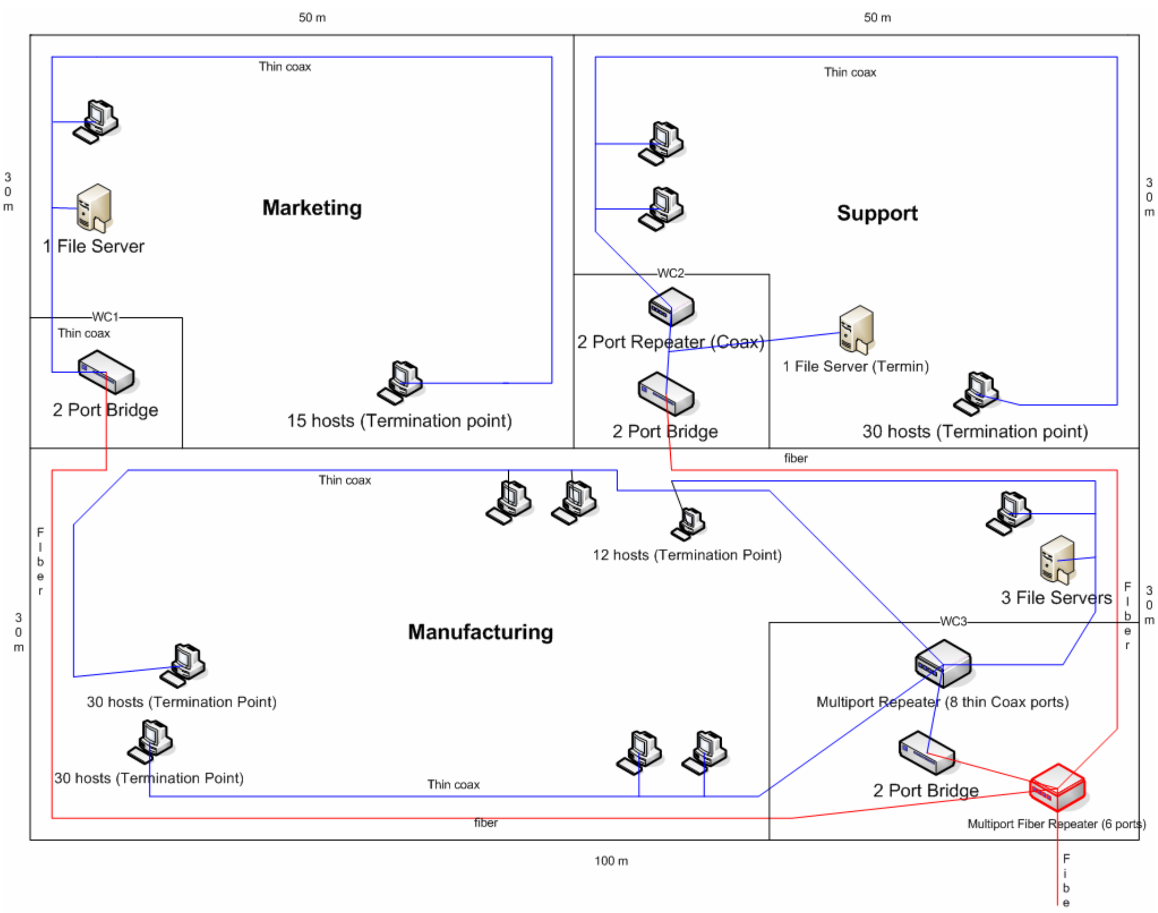

Figure 2

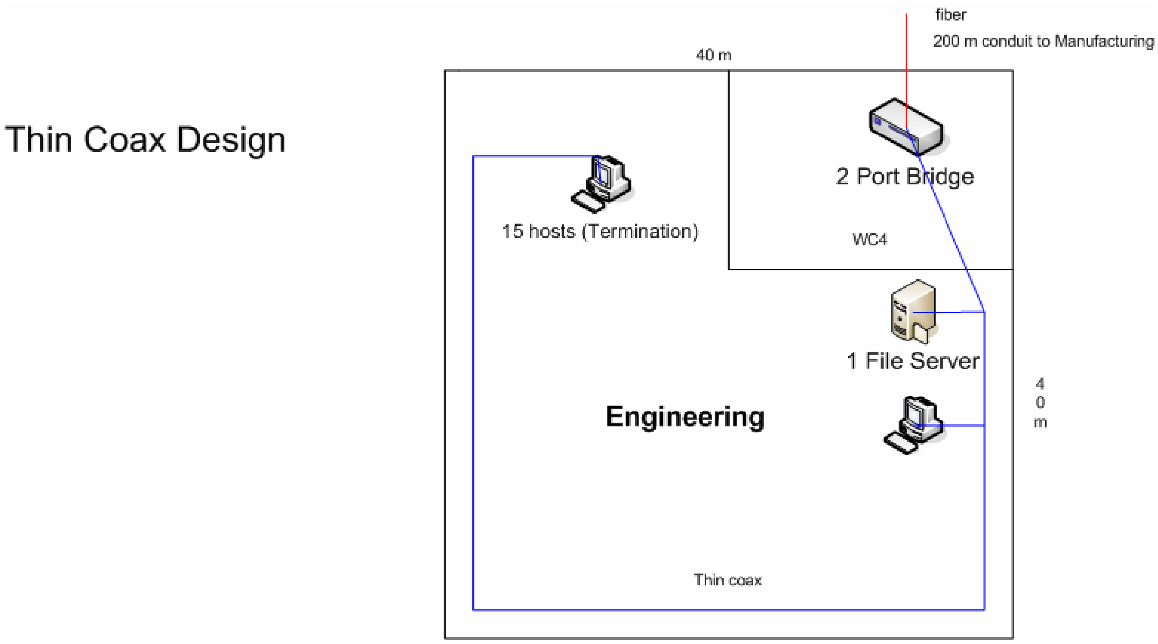

Figure 3

Thin Coax Design Description and Justification:

The design uses a fiber as the backbone between all wiring closets. In figures 2 and 3 above, fiber are the lines in red and thin coax lines are in blue. It is necessary to use fiber in the 200 meter conduit because thin coax has a maximum range of 185 meters, and because repeaters may not be placed within the conduit. While the distance between WC3 (Manufacturing) and WC1/WC2 (Support/Marketing) does not reach 185 meters, having a fiber backbone makes the network more “future-proof” because of the potential need of fiber’s high bandwidth.

The two port bridges act as a layer 2 device to separate the traffic between the campus departments, but still allow all the departments to communicate to each other. In Support (top right), the coax splits between the file server and a 2 port repeater because there is a maximum of 30 connections per coax cable, while there are 31 connections (30 hosts, 1 file server). In Manufacturing, the coax goes from the 2 port bridge to a Multiport Repeater (8 thin coax) again because of the limitations of thin coax.

Thin Coax Cost:

#	item	per item ($)	Total ($)
6	File Servers	9000	54000
138	NIC Thin Coax ports	70	9660
4	2 Port Bridge	2200	8800
1	2 Port Repeater	800	800
1	6 Port Fiber Repeater	2000	2000
1	8 Port Coax Repeater	1500	1500
450 m	Fiber	2/m	900
1059 m	Thin Coax	1/m	1059
		TOTAL =	**$ 78719**

Table 1

The Thin Coax distance:
The approximation was based on the user having enough wire to place machines anywhere in the room. Because Coax can branch off with T connectors in sort of series, the approximate sides of the rooms were added with 3 meters added per user.

For example, look at the Engineering section in Figure 3. The thin coax line exits WC4 and travels downward. This section was estimated to be 40 meters because while the wiring closet consumes space, there still needs to be wire between the bridge and the hosts. Then 40 meters for the bottom and the left side of the square were used. There were no computers allotted in the top section. The wire going to the last host was just for graphical representation. The distance between the main thin coax line and each host/server was estimated to be 3 meters.

Support and Marketing follow a very similar calculation. The exception is that support requires an additional 5 meters for the file server.

For Manufacturing, there needs to be 100 meters for the bottom part that has 30 hosts. The section that has 3 file servers and 12 hosts needs roughly 30 m for the right side, and 50 m for the right half of the top side, totaling 80 meters. The line that has 30 hosts on the top left needs about 40 m to get to the first host, and then 50 meters for the top right, and 30 m for the left side, totaling 120 meters.

Engineering: 40+40+40 + 3*16 = 168 m
Support: 50+30+30 + 3*31 + 5 = 208 m
Marketing: 30+50+30 + 3*16 = 158 m
Manufacturing: 100+80+120 + 3*75 = 525 m
Total = 158+193+148+515 = 1059 m

<u>The Fiber Distance:</u>
The fiber distance is found by taking the distance on the side of the walls with additional distance for slack.
Conduit: 220 meters (20 slack)
WC2 to Marketing: 105 (5 slack) + 35 (5 slack) = 140 meters
WC2 to Support: 35 (5 slack) + 55 (5 slack) = 90 meters
Total = 450 meters

UTP Design:

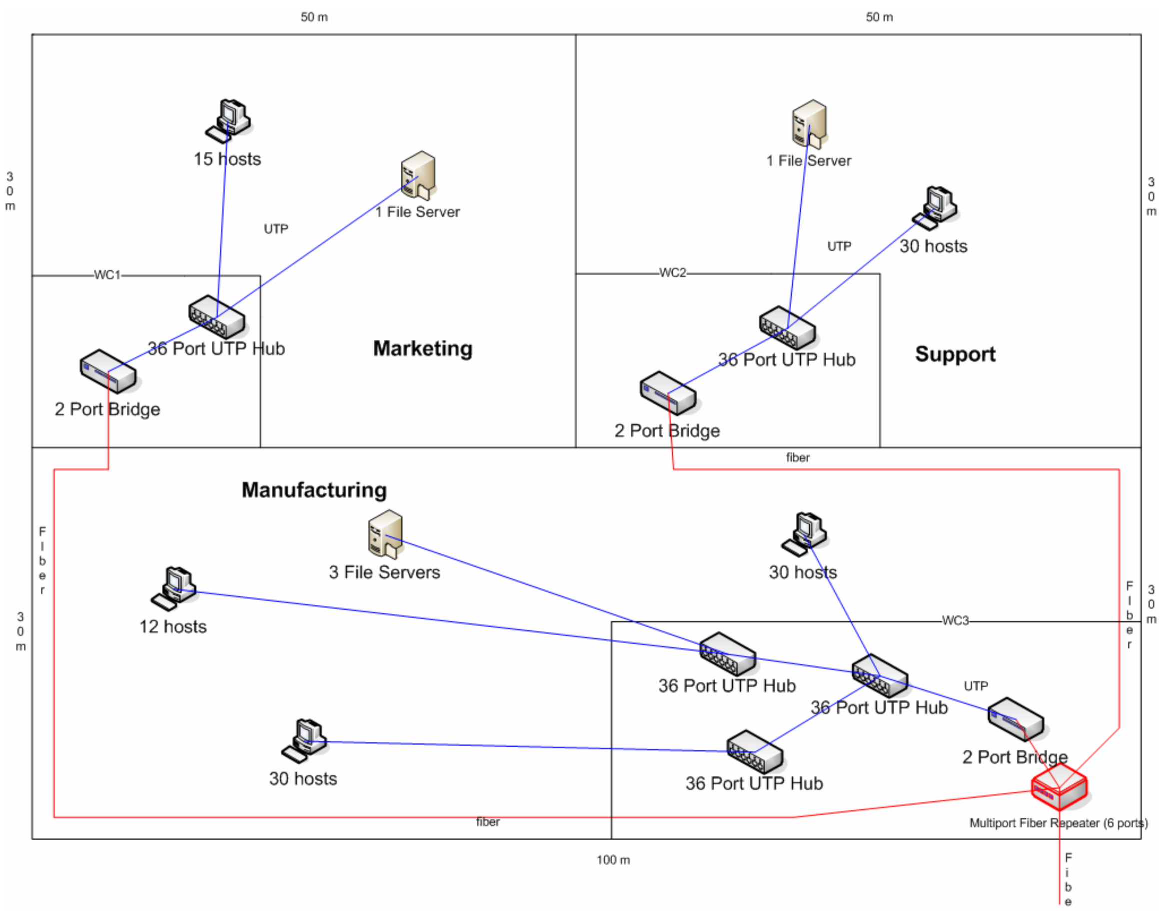

Figure 4

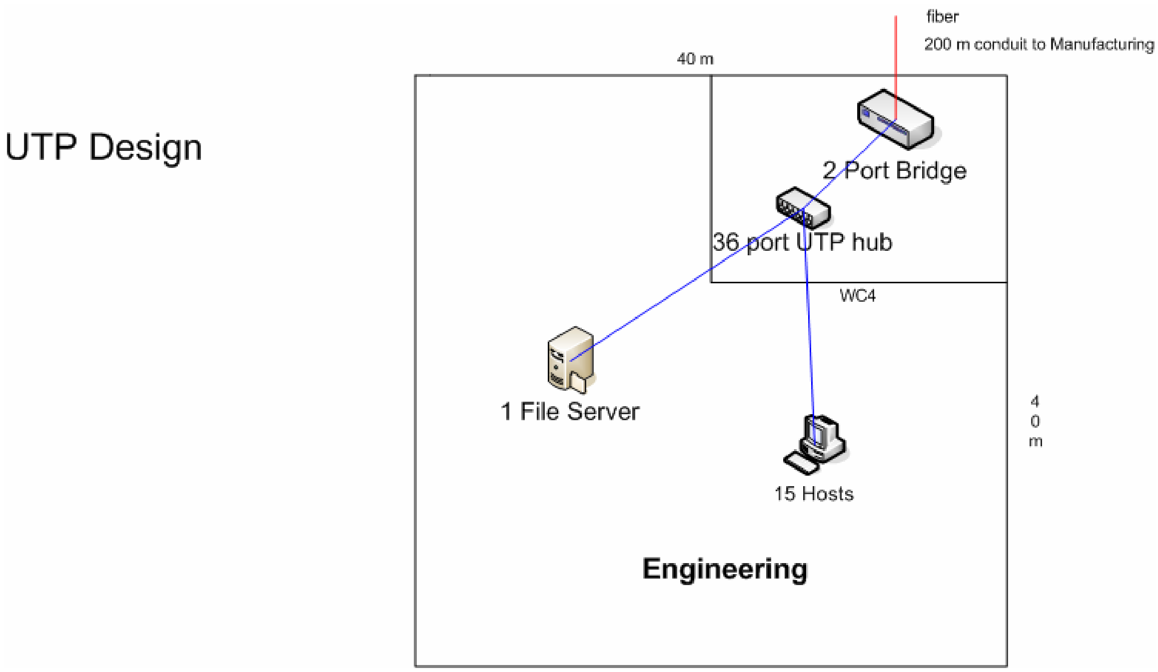

Figure 5

UTP Design Description and Justification:

The UTP design in similar to the Thin Coax in that it relies on a fiber backbone. In figures 4 and 5 above, blue lines are UTP while red lines are fiber. The positioning of the hosts are not as explicit in this design because each host has it's own physical connection to a hub, and so I estimated that the average UTP cable length is equal to the distance to the center of the room. Thus, the hosts are roughly uniformly distributed and so explicit positioning was not possible. The maximum distance of UTP is 100 meters, and so a fiber backbone is even more necessary. All fiber lines connect to 2 port bridges that convert to UTP. After the conversion all lines connect to a 36 max connection UTP hub. In the Manufacturing sector, there are 3 UTP hubs because 75 connections are needed for 3 file servers and 72 hosts.

UTP Cost:

#	item	per item ($)	Total ($)
6	File Servers	9000	54000
138	NIC UTP ports	70	9660
4	2 port bridge	2200	8800
1	6 Port Fiber	2000	2000
6	36 Hub	4000	24000
450	Fiber	2/m	900
5739	UTP	1/m	5739
		TOTAL =	**105099**

Table 2

The calculation for the fiber length is the same. However, the UTP cable length is much higher. This is because every user has a dedicated line to the hub, which must be in the wiring closet. I calculated the distance by finding the distance to the center of the room, and reasoned that the average length would be towards the center if the computers were uniformly scattered throughout the room. Even if the computers are not, this scenario is future proof to most reorganization of hosts. There would only be insufficient UTP cable if the room had most of its hosts toward the opposite corner of the wiring closet.

Manufacturing: sqrt($50^2 + 15^2$) * (75 connections) = 3915 m
Engineering: sqrt($20^2 + 20^2$) * (16 connections) = 453 m
Support: sqrt($25^2 + 15^2$) * (31 connections) = 904 m
Marketing: sqrt($25^2 + 15^2$) * (16 connections) = 467 m
Total = 5739 m

Summary:

Comparing the two layouts, the thin coax layout is significantly cheaper at $78,719 when compared to the UTP layout at $105,099. However, thin coax is an outdated and slower technology. It would be much wiser to invest in the UTP layout because it is future proof, and while it is $25,000 more, the cost to remove an old network and install a new network would surely be more costly. It may also be prudent to order much more cable than in this report, because it would also more flexibility to the host layout and have cable ready to replace any defective cable. Having to wait several days for a shipment of cable to restore a network could be costly. Furthermore, Ethernet cables are available at much cheaper prices than what the project instructions list, making it even more desirable to order more cable.