Week 5 Assignment: Final Project-Network Design Proposal and Design for Anthony's Potato Chip Company

Alicia Piavis

INT 301 Computer Networking

Dr. Nazila Safavi

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INT301 Network Design and Design Proposal for Anthony's Potato Chip Company

Author: Alicia Piavis
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Requirement Analysis

Data Types:

Data types that the network needs to support include reports, accounting information, personnel files, web pages, inventories, emails, text files, and a customer database with client and order information. Most of the data will be text, but the network also needs to support graphics, audio, and video, since employees at the new Sales Office in Escondido may be video conferencing in.

Data Sources:

Data will be created at all locations on the network: 1) the Headquarters Office (in San Diego) ; 2) the Production and Warehouse facility (in Alpine); and 3) the Sales Office (in Escondido). Data will be created in Windows 10 Pro primarily through applications such as Word, Excel, PowerPoint, Outlook, Publisher, Access, and Skype. Data may also be created on secondary applications such as internet browsers, PhotoShop, Media Player, and Notepad.

Numbers of Users and Priority Levels:

The users of the network will be the 500 employees of Anthony's Potato Chip Company. This is intended to be an internal network accessible only by employees, not customers. The users will require access from three different geographic locations: 1) the Headquarters Office (in San Diego); 2) the Production and Warehouse facility (in Alpine); and 3) the Sales Offie (in Escondido). Three network priority levels will be supported: 1) Management (network management tasks will receive the highest priority); 2) Users (user requests will receive mid-level priority; and 3) Background Processes (tasks such as back-ups, file transfers, etc. will fall under the category of low-priority) (University of Wisconsin- Eau Claire, n.d.). Often, items that fall under the category of background processes can run overnight in order to reduce network traffic during peak hours (FitzGerald, Dennis, & Durcikova, 2017).

Transmission Speed Requirements:

Users should not be able to notice the speed of connectivity across the network. According to *Business data communications and networking (13th ed.)* (2017), it is better to overbuild LAN's and BN's in order to allow for scalability in the future, as it is less costly to overbuild during the initial installation of the network than to upgrade a network after it is built. In most cases, users on a LAN do not need to send files greater than 1Gbps, so 1Gbps will be the ciruit requirement

for the wired LAN's (wireless connections usually provide slower speeds) (University of Wisconsin- Eau Claire, n.d). Regarding the transmission speed on the building backbone, 1Gbps is fairly slow and may cause a bottleneck. It is also recommended to increase the building backbone speed one level above the LAN, so the circuit requirement for the backbone network in this case should be set to 10Gbps (FitzGerald, Dennis, & Durcikova, 2017). Transmission speed requirements for the WAN and internet access should be as high as possible, since the technologies for these components of the network have much slower connection speeds to begin with, and are actually the limiting factor for connection speed (FitzGerald, Dennis, & Durcikova, 2017). I suggest a transmission speed for the WAN of at least 50 Mbps over an Ethernet connection, which will be the foundation for the VPN.

Load Variation Estimates:

Network traffic will vary throughout the day and week due to differences in user numbers during regular work hours, versus evening hours and weekends when the offices are closed and there are little to no users on the network. In addition, Anthony's Potato Chip Company may experience differences in network traffic throughout the year due to sales trends and consumer fluctuations. Peak traffic will likely occur Monday through Friday from 8:00 am to 11:00 am and from 2:00 pm to 6:00 pm (accounting for users on lunch throughout the middle of the day). Based on a similar network design proposal, the average required throughput on a LAN during regular work hours will be about 0.2 mbps, and the average required throuput on a WAN during regular work hours will be about 0.04 mbps, the peak traffic load on a LAN will be about 10.4 mbps, and the peak traffic load on a WAN will be about 6.4 mpbs (University of Wisconsin-Eau Claire, n.d.). The network should be designed based on peak traffic so as users do not notice a network slowdown during these times (FitzGerald, Dennis, & Durcikova, 2017).

Storage Requirements:

The servers will need to be able to store all employee, customer, and order data (for internal employee access only). Although employees will also have local storage space on their PC's, some user data may need to be accesible through the network in order to share files. Based on information regarding the infrastructure of the data center building at Indiana University, their servers can store 50 petabytes of data (FitzGerald, Dennis, & Durcikova, 2017). Since the number of users at Indiana University is about 40,000 (rounded up from information provided on their website) (Indiana University Bloomington, n.d.), this means that the Anthony's Potato Chip Company network would need 625,000 GB of storage ((500/40,000)*50,000,000 GB). This is equivalent to 625 TB of data. However, Indiana University likely devotes much of that storage space to databases serving the library, research facilities, and each of the colleges that the University supports. Therefore, I estimate that the storage space required by Anthony's Potato Chip Company would be considerably less. In a different scenario provided by the University of Wisconsin-Eau Claire (n.d.), which describes a network design proposal that connects a State Office of Education with two of its school district administrative offices, it is estimated that the maximum amount of server storage a user requires is 1GB. The network operating system will also require about 500 MB of storage space per server (University of Wisconsin-Eau Claire, n.d.). So considering the maximum estimated storage requirement per user (1GB), multipled by 500 users, and adding an estimated 3,500 MB total to account for the NOS on each LAN server (7 LAN servers total * 500 MB of storage each), this would come to 500GB + 3.5GB, or a total of 504 GB of storage space required on the network. Considering the fact that the prior calculation gave me an estimate of 625 Tb of storage required, and the University of Winsconsin-Eau Claire example gave me an estimate of 504 GB storage required, I recommend settling somewhere in the middle at 100 Tb of total storage space on servers for Anthony's Potato Chip Company.

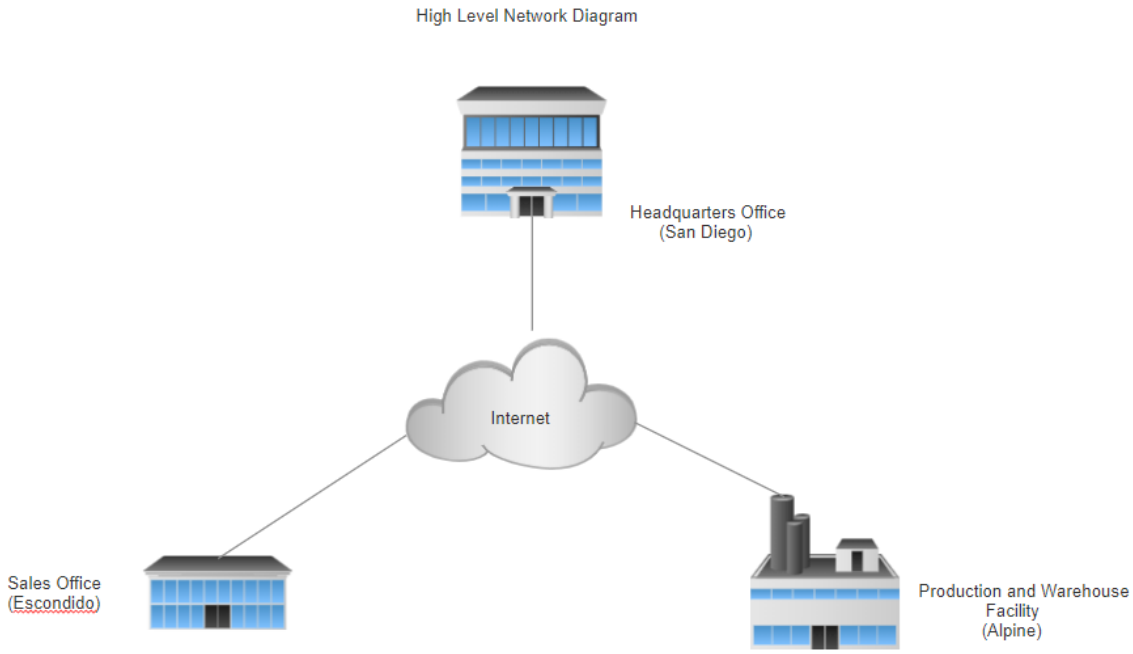
Reliability Requirements. The standards reliability requires the network to operate at following percentage rates:

Standard Operations Uptime: 99.9% (University of Wisconsin-Eau Claire, n.d.) Downtime: 0.1% (University of Wisconsin-Eau Claire, n.d.) Error rate: 0.001%

Existing Network:

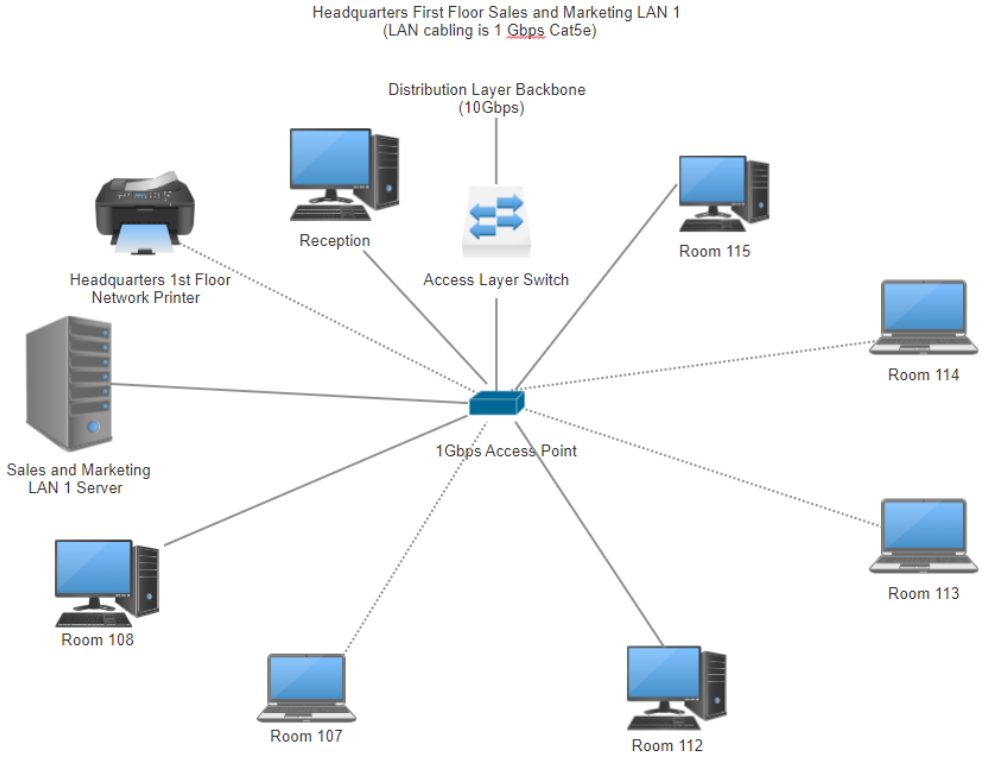
The existing network is a campus network consisting of the office headquarters in San Diego as well as the Production and Warehouse facility in Alpine (a town outside of San Diego). The headquarters building is a two-story office. The Sales and Marketing departments are on the first floor. The second floor has the same floor plan as the first except for one room dedicated for the servers (the datacenter). In addition, the second floor contains Accounting and Finance, IT/Security/Systems Administration, and HR. The Production and Warehouse facility is a single story office building, along with the new Sales Office in Escondido (a remote office). The current system at the headquarters and the Production and Warehouse facility is old and failing.

High-Level Diagram

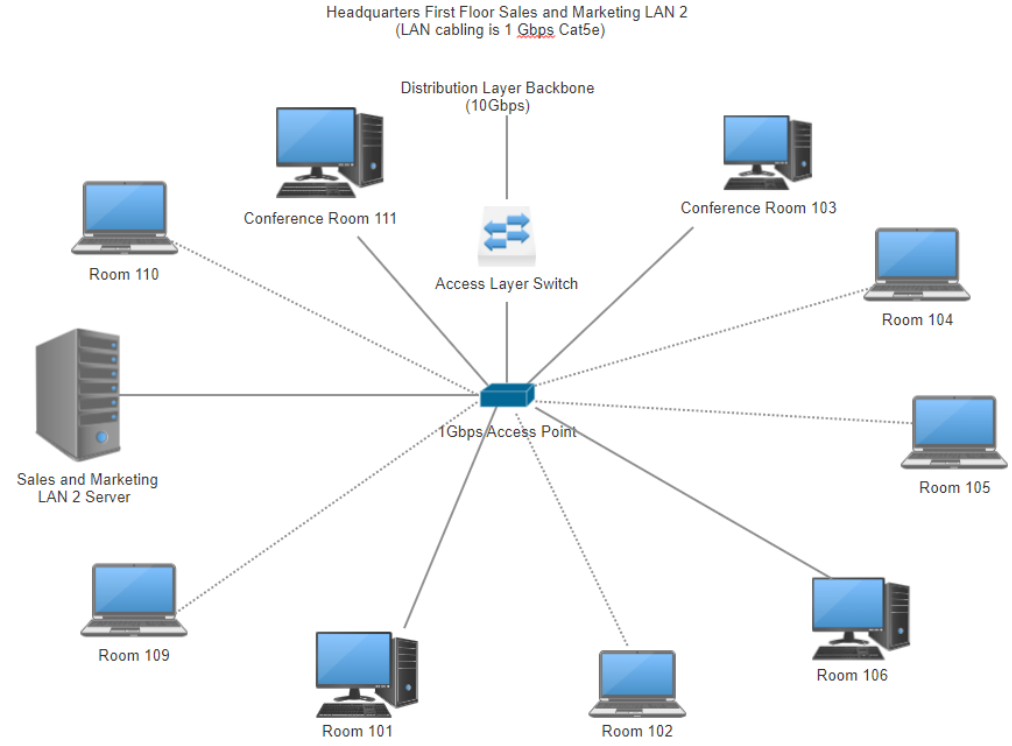


Detailed Design

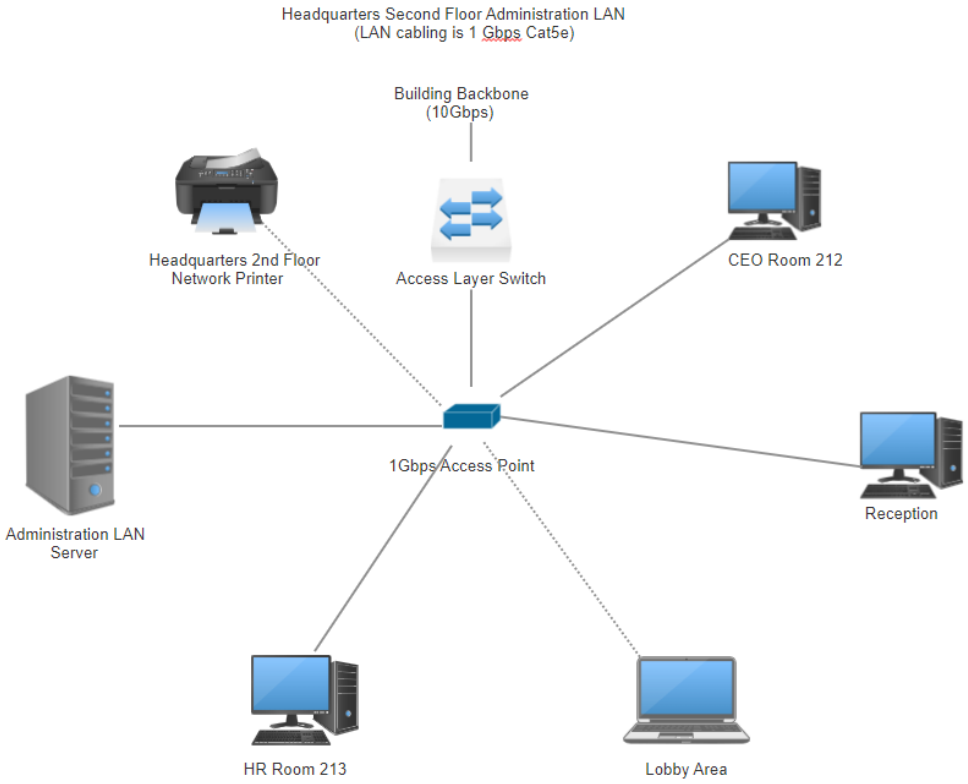
LAN Network: Headquarters 1st Floor Sales and Marketing LAN 1



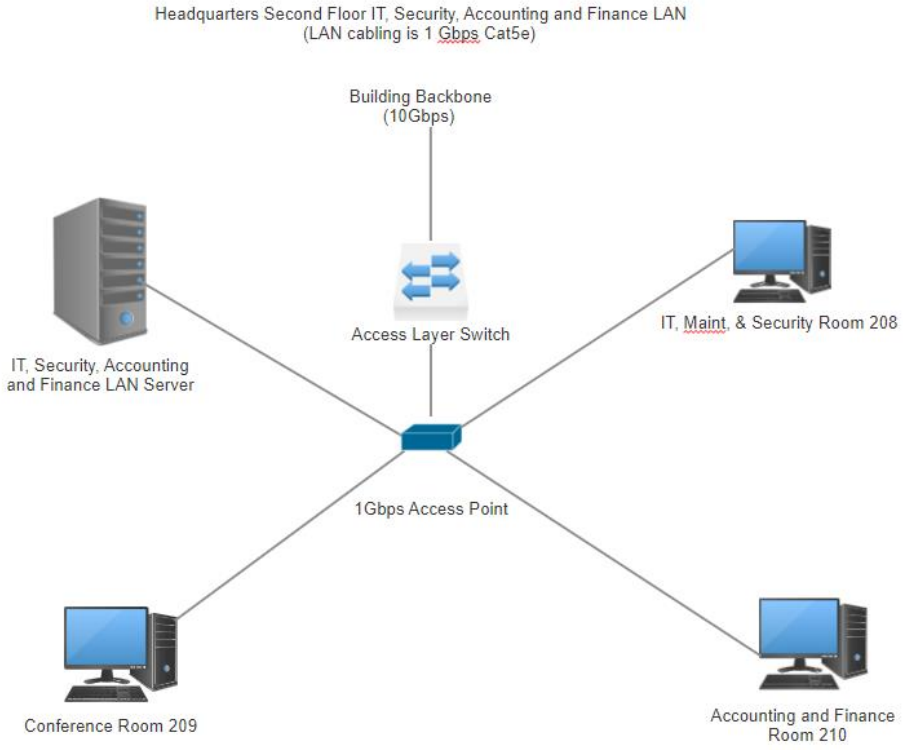
LAN Network: Headquarters 1st Floor Sales and Marketing LAN 2



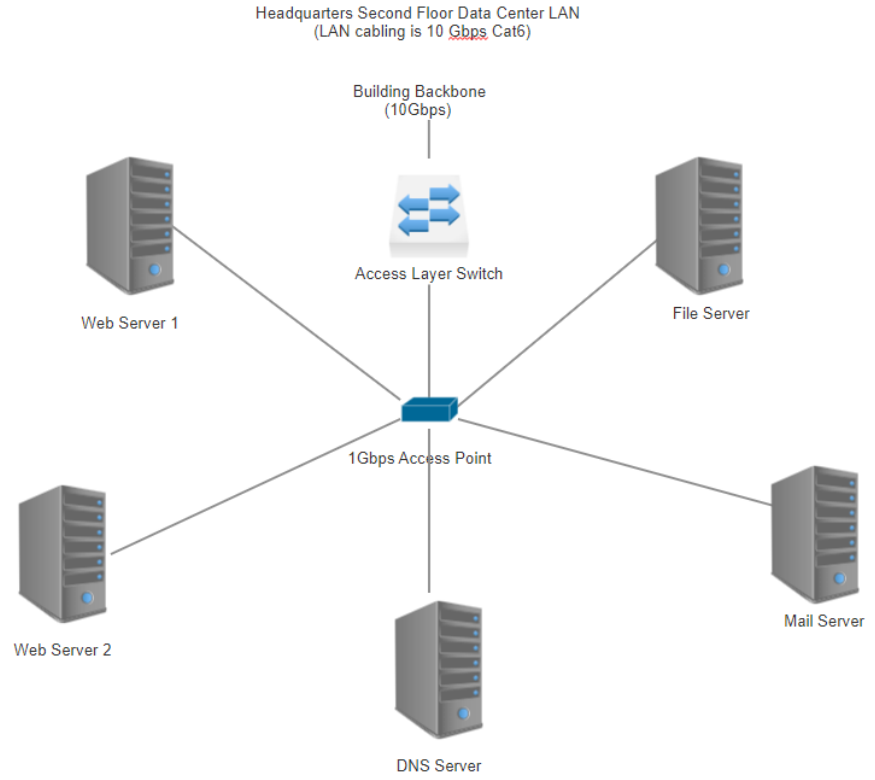
LAN Network: Headquarters 2nd Floor Administration LAN



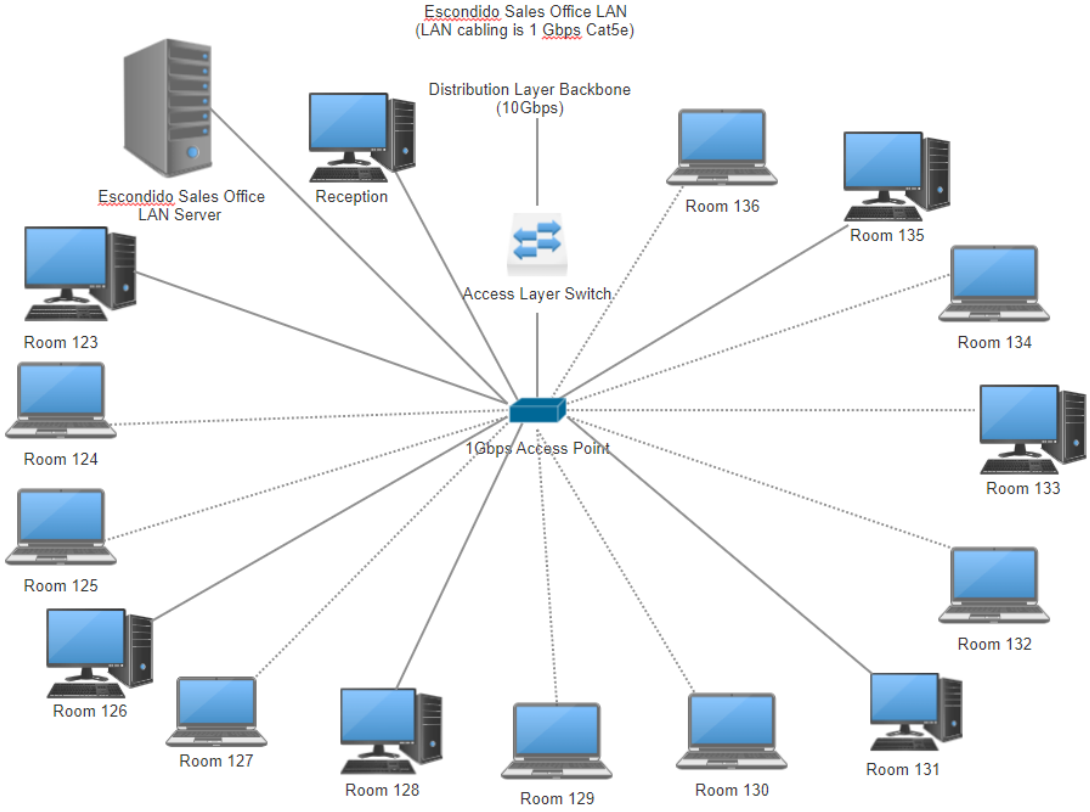
LAN Network: Headquarters 2nd Floor IT, Security, Accounting, and Finance LAN



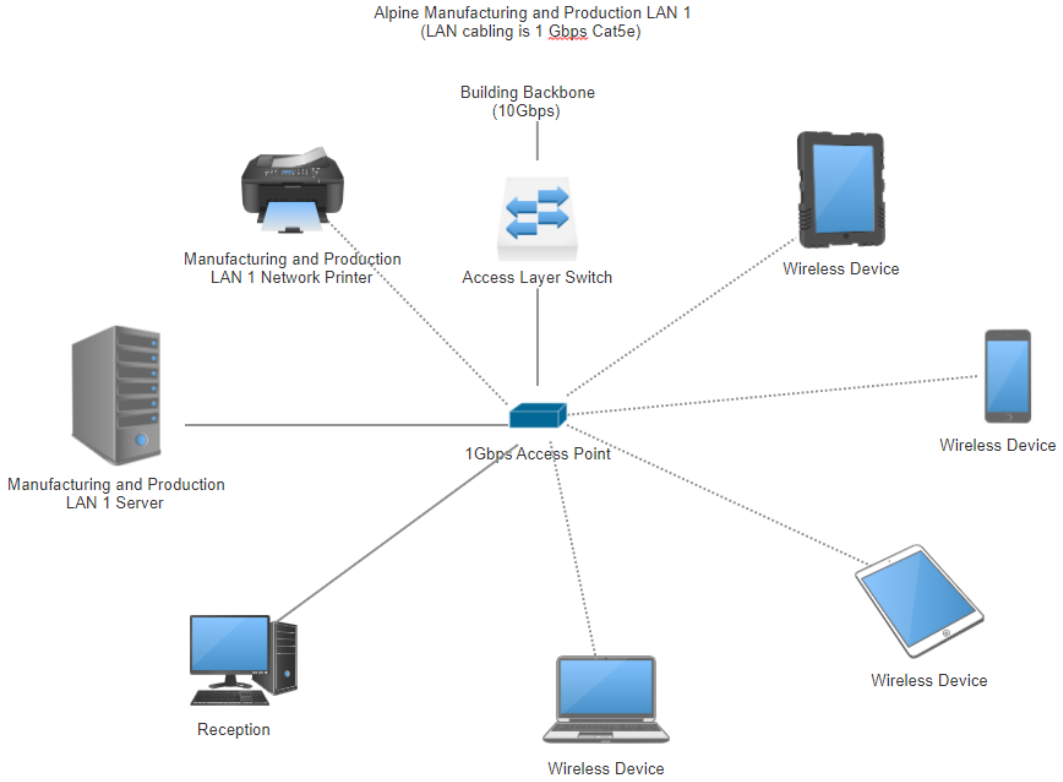
LAN Network: Headquarters 2nd Floor Data Center LAN



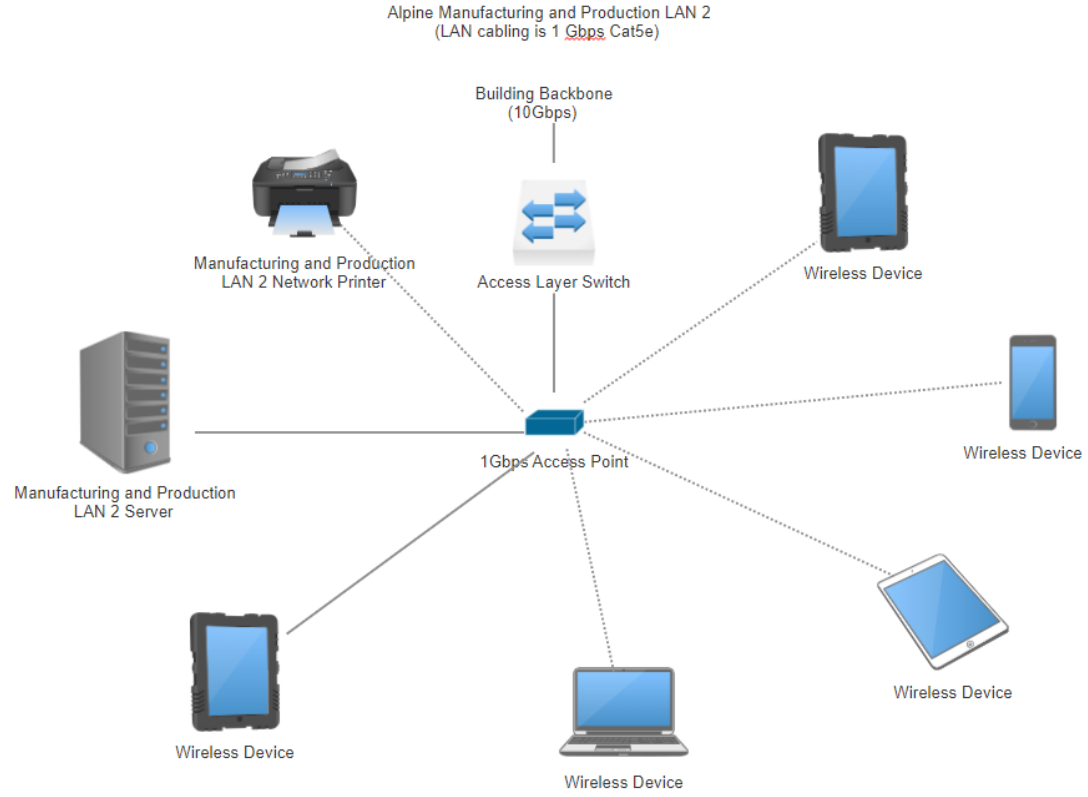
LAN Network: Escondido Sales Office LAN



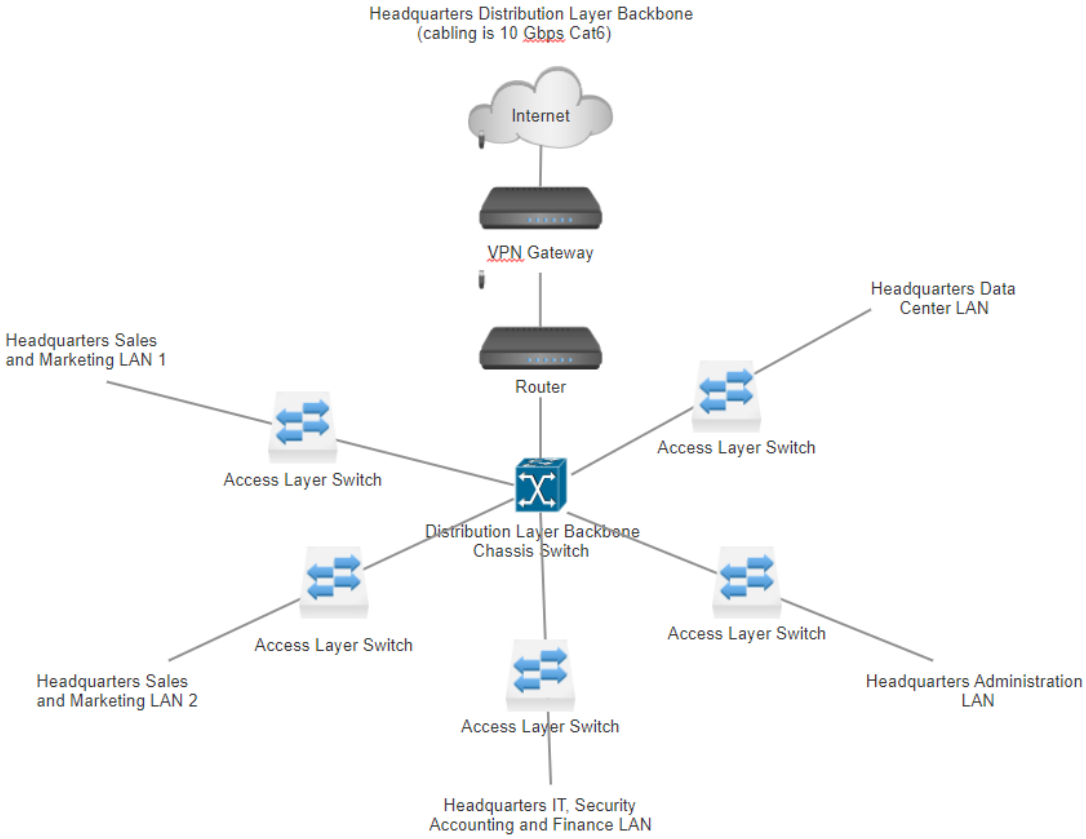
LAN Network: Alpine Manufacturing and Production LAN 1



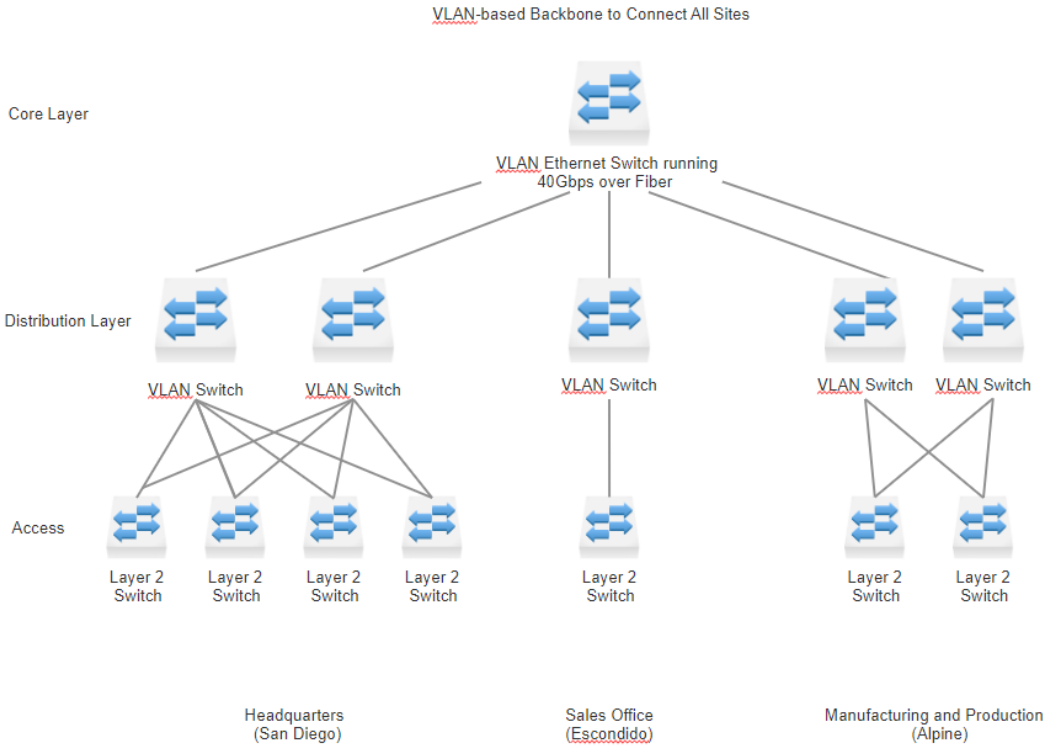
LAN Network: Alpine Manufacturing and Production LAN 2



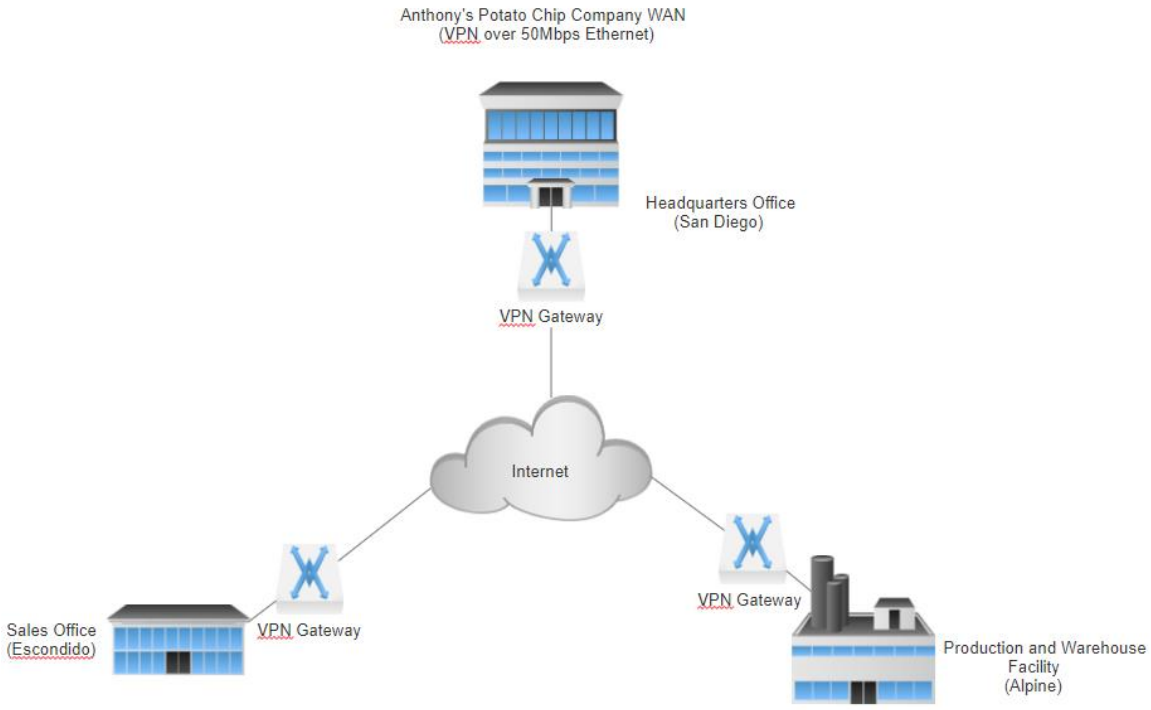
Distribution Layer Backbone: Headquarters Building



Alternative VLAN Backbone to Connect All Sites



WAN Network (VPN)



Equipment Analysis

Equipment Cost - LAN						
Tangible Costs						
Product	Model	Price	Quantity	Warranty	Maintenance	Total $$
Cisco Rack Mountable Server	C240 M5SX - rack-mountable - Xeon Gold 5122 3.6	$11,826.99	12	3 year	service and support provided by Cisco for the first three years	$141,923.88
Cisco Hard Drive	Cisco - hard drive - 2 TB - SAS 12Gb/s	$1,138.99	50	No warranty	maintained and replaced as needed (no warranty)	$56,949.50
Cisco Small Business Switch	SG110D-08	$52.99	8	Limited Lifetime Warranty	limited lifetime service and support provided by Cisco	$423.92

Cisco Chassis Switch	Cisco Catalyst 4507R 7-Slot E+ Chassis	$5,265.99	3	Limited Lifetime Warranty	limited lifetime service and support provided by Cisco, may need to be upgraded every few years or require updates	$15,797.97
Cisco VPN Gateway	1861E	$1,609.99	3	1 year	limited service and support provided by Cisco for one year, advance part replacement, may need to be upgraded every few years, or require updates	$4829.97
Cisco Small Business Wireless Router	RV130W	$139.99	3	Limited Warranty	limited lifetime service and support provided by Cisco, may need to be upgraded every few years, or require updates	$419.97
Cisco Small Business Wireless Access Point	WAP150	$129.99	8	Limited Lifetime Warranty	limited lifetime service and support provided by Cisco, may need to be upgraded every few years, or require updates	$1,039.92
Wireless Printer	HP PageWide Pro 577dw Color	$699.99	5	1 year Warranty	recommended monthly volume: 1000-6000 pages, 1 year on-sight service provided, phone consulting and technical support available	$3499.95
Cat5e cable	Tripp Lite 1000ft Cat5 / Cat5e Bulk	$109.99	2	Limited Lifetime Warranty	check cables periodically for wear and tear,	$219.98

	Cable Solid CMR PVC 350MHz White 1000'				limited lifetime warranty	
Cat6 cable	Tripp Lite 1000ft Cat6 550MHz Gigabit Bulk Solid PVC Cable Gray 1000'	$165.99	2	Limited Lifetime Warranty	check cables periodically for wear and tear, limited lifetime warranty	$331.98
50 Mbps Ethernet Internet Connection for VPN	AT&T Business Internet	$250/ month	3	n/a	customer support provided by ISP	$250/month
VPN Software	Cisco AnyConnect Plus - subscription license (3 years) + 3 Years Software A	$1.99 for 1 user	500	n/a	customer support provided by Cisco	$995/3 years
TOTAL						**$225,437.04** (not including internet through the ISP or the VPN software subscription)

Provide a rationale for your choices based on your sources.

The products that I chose are all made by Cisco (with the exception of the printers, cables, internet service, and VPN software). I chose products that were all made by a single vendor to ease troubleshooting and network issues, since dealing with a single vendor allows for a more streamlined process, rather than having multiple vendors fight over whose equipment is causing the problem (FitzGerald, Dennis, & Durcikova, 2017). In addition, Cisco is a company with a reputation for high quality products. Many of the products also include a warranty, or offer an upgraded warranty for an additional cost. In researching server types, Cisco only offers blade and rack-mounted servers, but not tower servers. Rack-mounted servers were chosen over the blade servers, because they are more economical in a computing environment requiring less than 10 servers. In addition, they save space, are easy to cool, and usually come as a stand alone system that can run high end applications (Rack Solutions, 2018). Furthermore, the Cisco rack-mounted servers provide a higher number of hot-swap 2.5 inch hard drive slots allowing for the scallability of storage space in the future. I chose HP products for the printers, again due to their high standards and good reputation. AT&T was chosen as the ISP, since they provide Fiber Optic connections in San Diego, allowing

Anthony's Potato Chip Company the opportunity to upgrade their connection in the future should they so choose. AT&T also provides Business Internet Service in Alpine, CA and Escondido, CA, so that all three locations can utilize the same ISP (Broadband Now, n.d.).

Recommend additional software that Anthony's may need for ease of communication. For example: Skype, WebEx, Adobe, audio files, email, chat, and video. Provide a rationale for your recommendations using scholarly sources. (Similar to Figure 9-19 in your text).

Additional software that is recommended for use on the network includes PhotoShop (this may facilitate marketing), Skype (for video conferencing across sites), email, and chat (to promote collaboration) (University of Wisconsin- Eau Claire, n.d). These applications will allow for increased productivity and collaboration, thus increasing revenue for the company.

Reflection

Creating a network design proposal for Anthony's Potato Chip Company was an elaborate process. Not only did it require a thorough understanding of network layers and network architecture components, but it also required an undserstanding of the process of network design, communicating with management, and researching network hardware and software. This proposal employs a 5-layer approach to the network infrastructure. However, one could argue that it also reflects a 7-layer model, since the 5-layer and 7-layer models are very similar, with the 5-layer model collapsing the session, presentation, and application layers into a single layer, the application layer (FitzGerald, Dennis, & Durcikova, 2017).

A network consists of three main components- the clients, servers, and circuits. The clients are the devices at the user end. The servers store data and/or software that the user can access, and the circuit is the system of connections between components of the network. The circuit provides the pathway through which signals travel, and can be comprised of both wired and wireless connections (FitzGerald, Dennis, & Durcikova, 2017). In the case of the network design for Anthony's Potato Chip Company, the clients are the desktop and laptop computers, tablets, cell phones, and printers. The servers store data, and are found in each of the LAN's at the three sites across California, as well as within the Headquarters Data Center in San Diego.

The circuit for Anthony's Potato Chip Company is composed of Cat5e and Cat6 unshielded twisted pair (UTP) cable, as well as wireless Ethernet connections. Cat5e and Cat6 cables were chosen for the LAN's and the distribution layer backbones respectively due to their maximum data transfer rates. As this is an enterprise level business network which relies on the efficient transfer of data, especially across sites, anything lower than the 1Gbps data rate provided by Cat5e cables would be unacceptable (FitzGerald, Dennis, & Durcikova, 2017). Since Cat6 cable allows for higher speeds, these cables were chosen for the distribution layer backbone. In addition, sites are connected through a VPN that relies on the AT&T ISP providing data transfer rates of at least 50 Mbps. Wireless Ethernet connections are provided on each of the LAN's at a rate of 1 Gbps in order to allow devices to connect where wireless connections are preferred. In the Production and Warehouse environment, this may be especially beneficial when tracking orders and updating inventories while out on the floor.

Aside from cables, switches and routers are also required within the network to ensure that data gets routed to the correct site, building, floor, room, client, etc. LAN's were designed

utilizing layer 2 switches, rather than hubs in order to decrease network traffic and increase performance. When using a hub, all frames are sent to all of the clients connected to the ports on the hub, even if they are not intended for that device. In addition, all ports on a hub are on the same collision domain, meaning that only one device can be transmitting at a time. On the other hand, a switch operates differently in the sense that there are multiple collision domains, in fact, one for each port. This means that devices can transmit simultaneously, increasing performance. Traffic is also reduced, since frames are only forwarded to the computer for which they are intended, rather than to every computer connected to a port (FitzGerald, Dennis, & Durcikova, 2017). Layer three routers were implemented to route data coming from the distribution layer backbone to the each of the LAN's. Furthermore, data sent from LAN's to the distribution layer network are routed through a core router to connect to the interent, or else through VPN gateway routers to form connections across sites through the WAN.

The network for Anthony's Potato Chip Company is broken down into eight LAN's—five within the Headquarters building, one for the Sales Office in Escondido, and two at the Warehouse and Production Facility. When dividing regions of the buildings into subnetworks, the transmission of data through different media, as well as the maximum distance of transmisions were considered. For example, most LAN cables are rated for a maximum distance of 100 meters. In addition, wireless connections are best within a 50 foot radius of the access point, and decrease in performace as the distance increases. Furthermore, connectivity is reduced with the addition of devices on a LAN, so a maximum of 20 devices connected wirelessly is recommended (FitzGerald, Dennis, & Durcikova, 2017). LAN's were designed taking these factors into consideration.

Personally, there were a few steps in the process that proved more challenging for me than others. These steps included laying out the network requirements, drawing the network diagrams, and completing the cost analysis. Evaluating the network requirements was difficult given the information provided. I found that I had to do a lot of research and then calculate estimates in order to come up with educated guesses for the transmission speed and storage requirements, since these numbers were not included in the specifications of the project. The network diagrams were challenging only because they took a considerable amount of time to create. Lastly, the cost analysis was difficult, since many of the specifications for products were new to me, and I needed to research the compatability of devices. All in all, creating the network design proposal was a challenging, but rewarding process.

Resources

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