Capstone Proposal Project Name: Network Installation and Implementation for ABC Sensors

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Capstone Proposal Summary

For any sized company, moving to a new location is a daunting prospect, and one that has many considerations, one of these considerations is ensuring that productivity is not lost because of technical oversights after the move. This project proposal details the planning, configuring, and installation of an internet-connected LAN (local area network) for a small business moving to a new location. ABC Sensors is a manufacturing company that designs custom floating-sensor devices that gauge liquid levels in devices; due to the past years' increase in sales, the company has decided to move from their current office space to a larger suite in a new complex. The project will entail installing and configuring most aspects of ABC Sensors' LAN, as well as the ordering and configuring of an internet connection and networking hardware. The timeline for completion will be no longer than two months from the onset date of October 1st, 2012, per ABC Sensors' requirements. Alex, the company's owner, proposed that I head the project due to our past business relationship related to IT services; I accepted the offer knowing I could meet ABC Sensors' technical requirements and deadline.

Before the project could formally begin, I needed to take inventory of any existing network equipment in use, and gather the requirements and expectations of the new network. I met with all employees, in a single meeting, to discuss the technical goals of this move; I also set a date with Alex, to visit the new office space and determine the physical layout required for the network envisioned. During our initial meeting, Alex and I discussed the companies' requirements for an internet connection, the needs for the LAN, an estimated timeline for all objectives, and finally the deliverables and budget required for the project. Beyond the obvious goal of moving to a new location, ABC Sensors will require a reliable business-class internet

connection, with minimum outage or repair times; the company does not require a large amount of internet bandwidth, due to using local file backups on the LAN itself, rather than remote backups. They will also require connectivity for at least six personal computers directly after the move, but need the ability to increase the number of network devices on the LAN without requiring additional hardware. On my visit to the new office, I created a map of the space's physical layout and examined existing cabling runs and terminations, it was determined that at least five additional cable drops would be required to meet Alex's requirements. The project has an estimated time-to-completion of forty days from onset, any extra time allows for possible delays in acquiring the planned deliverables, or completing individual objectives.

ABC Sensors' current network equipment includes only a DSL (digital subscriber line) internet modem, and an 8-port 100 Megabit consumer-grade switch. These two items work well in a small or home-office scenario, but are inadequate for the requirements of the new network design. ABC Sensors' requested at least two choices for both the internet connection and networking hardware proposed. For the internet connection, I proposed the following options: a bonded T1 Data-connection or a business-class cable internet connection. I also proposed two different vendors for the routing devices, Cisco and Sonicwall, both companies have small-office product lines. Lastly, I proposed two different 24-port switches, with the choices being between Cisco and HP. The decision between the internet and hardware choices comes down to a comparison of features and function contrasted with upfront and maintenance costs. This project dictates the need to perform analysis on these deliverables and then present the best choice to ABC Sensors.

The ultimate goal of the project is to have a LAN and internet connection installed at ABC Sensors' new location, that meets or exceeds all requirements laid out by Alex, and to

complete these goals at minimal cost and within the two-month project timeframe. Completion of this project will require finishing any necessary wiring for the new office location, choosing an internet connection type, and properly configuring a 24-port switch and firewall. Beyond the physical deliverables, I will generate and compile all documentation and manuals, so that future maintenance, expansion, or support is easily accessible in one location.

Review of Other Work

The network structure used for ABC Sensors will be a basic design; it will consist of only a single switch, a single router, and the endpoints (computers and peripherals) that connect to the switch. The topology of the network will be a 'Star' type, "In [a] Star topology every node (computer workstation or any other peripheral) is connected to [a] central node called [a] hub or switch" ("Star network," 2012). In this project, the central node will be a switch with at least twenty-four physical RJ-45 ports to allow for future additions to the LAN; because the switch will interconnect all devices with Category 5e (Gigabit Ethernet) cabling, it is worthwhile to obtain a switch that has Gigabit port capabilities. ABC Sensors' has three deliverables that require comparison, these include a 24-port switch, a small-office firewall, and a WAN connection provider.

Modern switches have many features, including: QoS (Quality of Service), VLANs (Virtual LANs), and 'Layer 3' network features, usually reserved for a dedicated routing device or firewall. VLANs, which are logical separations in a network, rather than physical, will not be required as part of the initial LAN configuration of the switch, but may be required in the future. I suggested two switches, from separate vendors that have VLAN capabilities to prolong the

usability of the switch in an updated LAN structure required by possible expansion. The two switches I compared are Cisco's SG200-26, and HP's V1910-24G, each company makes available datasheets which contain performance information, features, and other hardware characteristics. The price difference between the two models is negligible, with the Cisco model priced at $274.46, and the HP model at $275.00, the deciding factor will be between performance, feature set, and compatibility for future technologies or expansion.

Table 1 – Performance comparison between Cisco and HP switch models

	Cisco SG200-26	**HP V1910-24G**
Capacity in Millions of Packets per Second	38.69 mpps	41.7 mpps
Switching Capacity	52.0 Gbps	56.0 Gbps
MAC Address Table Size	8000 entries	8192 entries
Packet Buffer Size	512 KB	512 KB
CPU Memory (RAM)	128 MB	128 MB

("Cisco 200 Series Switches", 2012, "HP 1910 Switch Series", 2012)

The feature sets for both switches are similar, they both have the following key abilities: support for IPv6 (Internet Protocol version 6), browser-based configuration and management tools, and both models are capable of supporting 256 VLANs simultaneously. These features ensure that both switch models will allow for sufficient expansion, and will not become obsolete within the immediate future. Given the project requirements to maximize performance and features for any hardware costs I will propose the HP V1910-24G as its performance is slightly higher in three categories, as shown in Table 1.

The decision for a routing device, in this case a firewall, is between the Cisco ASA 5505 and the Sonicwall's TZ 205. Firewalls can be difficult to compare, as many vendors will support completely different types of technologies, or use different terminology for the same features. This means carefully analyzing all available documentation will be important when making a decision. The cost difference between the Cisco and Sonicwall routers is wider than that of the two switches proposed. The Cisco ASA is available for $405.40, while the Sonicwall TZ 205 is $442.16; Table 2 lists some of common features and performance statistics provided by each vendor's respective data sheets.

Table 2 – Performance comparison between Cisco and Sonicwall firewall models

	Cisco ASA 5505	**Sonicwall TZ 205**
Firewall Throughput in Megabits per Second	150 Mbps	500 Mbps
Firewall and IPS Throughput in Megabits per Second	75 Mbps (available for ~$1200 beyond base price)	80 Mbps
VPN Throughput in Megabits per Second	100 Mbps	100 Mbps
Concurrent Sessions	10,000	12,000
IPsec VPN Peers	10	10
Premium AnyConnect VPN	2	N/A
Interfaces	8 Fast Ethernet (2 PoE)	5 Gigabit Ethernet
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("Cisco ASA 5500 Series Adaptive Security Appliances", 2011, "TZ Series", 2012)

Beyond the number of interfaces or differences in throughput each device is capable of, it is important to note that both devices require annual subscription fees for the firmware and software updates, to obtain technical support, and in the case of the Sonicwall firewall, to take

advantage of all its unified threat management (UTM) features. The UTM features of the TZ 205 include hardware virus and malware protection as well as application-aware logic, which allows for blocking 'Layer 7' (e.g. IRC, games, FTP) network traffic at the application layer. These additional subscription-based features can cost upwards of $800 per feature, per year. Similarly, the Cisco device does not provide an intrusion prevention system (IPS) as part of the base cost, instead a separate hardware module is required, at the cost of approximately $1200. ABC Sensors' does not require a robust firewall with advanced configuration, instead they require a device that can grow with the company. The device chosen should handle their chosen level of internet traffic (throughput) with the option to implement security policies as they grow. The Sonicwall TZ 205, although more expensive fits these requirements better than the Cisco ASA device; the TZ 205 includes basic IPS built into the software at no extra cost, and has many more UTM subscription features should they be required in the future.

The final deliverable that requires research is the WAN (internet) connection type. For this project, I am proposing two options: (a) a dedicated (bonded T1) connection through the local ILEC, Century Link; (b) a cable-based internet connection through Comcast, both providers have existing facilities at ABC Sensors' new office address. There are several points of consideration for a business internet connection, including bandwidth (upload/download), SLA (service level agreement) parameters, contract length, and any support terms, including guaranteed repair-time windows. Price will also be a factor in this consideration, as internet service is an ongoing monthly cost.

Through calls to each provider, it was determined that Century Link and Comcast have similar support and repair times for business class services; both guarantee repair within four hours, and both have telephone support 24 hours a day, 365 days a year. Comcast explained

during our conversation that as a company they are shortening their repair windows to two hours in some markets, and plan to make the policy a standard nation-wide in the near future. Although the service terms are similar, the delivery method for the internet connection is not. T1-type connections are delivered by a telecommunications provider as a dedicated-circuit, which consists of copper wiring (local loop) that connects the service address with the service provider's central office. This means the connection is dedicated solely to the customer, and bandwidth provided can be guaranteed ("T-carrier", 2012) – this is a service Century Link can provide. Cable internet access, as provided by Comcast, is a shared-bandwidth technology, which means that multiple subscribers within an area share the same physical medium that connectivity is delivered on, bandwidth delivered is more likely to fluctuate because of this ("Cable Internet Access", 2012). Both companies do have adequate SLA terms that contractually guarantee the bandwidth delivered.

The last points of comparison between the internet service providers are between bandwidth (connection speed) and pricing. Comcast provides a 50/10 Mbps (download/upload) for $199.95 a month with a one-year contract, Century Link provides a bonded (two) T1 service for $349.99 a month at speeds of 3.08/3.08 Mbps, with a three-year contract. This price difference is due the delivery method, dedicated (T1) versus shared (cable) bandwidth. The higher bandwidth speeds and lower pricing for the Comcast connection means I will be proposing the cable internet connection for this project.

Rationale and Systems Analysis

One of the core questions that must be addressed before undertaking any project is the question of "why", without understanding the needs that initiated a project, there will be no way to determine whether an undertaking is worthwhile, or after completion, if it has been a success. In the case of ABC Sensors, the need to move was initiated by steady growth in sales, which in turn means as a company, they will require expansion in many areas to meet the demand of their customers. One of the expansions includes more office space, so that more employees can share the same workspace. Moving to a new location has many considerations beyond the scope of this proposal, however a major aspect, for which this document concerns itself, is the requirement for internet access, and an internal network for intra-office connectivity.

The goal of a network is to provide connectivity between nodes, in the case of this project, to provide connections between computers, peripherals, and also a connection to the internet. There is no single correct design for a network, instead the best design is one that best fits the people using it. Even though there are many types of networks, many vendors and network engineers agree upon some general guidelines for constructing a network, based upon the size of an intended network. Following best practices during the design of a network is essential to facilitating the future growth of a LAN. A good design allows for performance predictability, hardware configuration compatibility, and eases administration needs, especially aspects involving third-party technical professionals. For these reasons, consideration will be given in the choice of all deliverables in this project.

Before the project could begin, an examination of existing hardware was required; the currently used components in the existing LAN, including an 8-port switch and DSL modem

were determined to be inadequate for the new location. The switch cannot be used in the new LAN because it lacked the number of physical ports required to connect all the expected devices in the new office. The currently used DSL modem/router is only compatible with DSL services, although DSL is a possible choice as a WAN technology, it was not proposed because it is uses a standard POTS (plain old telephone service) loop, and is considered less stable than either a cable or leased-circuit internet connection. For these reasons, new networking hardware would be required as part of new LAN. My proposal includes a comparison of two vendor choices for each of these deliverables, this is to compare costs and features on the current market.

To determine which deliverables will best meet the needs of the business, I met with Alex and others from ABC Sensors, and visited the new location. It was determined that although there was enough Ethernet cabling at the new address for the existing employees, additional cabling would be needed in offices for any new hires. The new space had four rooms that did not have Cat5e cabling run to jacks, and an additional cable-run to a jack was requested for a networked printer. After investigating the hardware and internet deliverables, I met with Alex again and provided recommendations, based on cost and feature sets, for the switch, router, and WAN connection. I concluded that based on the comparison in features, the HP V1910-24G switch was a better value, and better fit the goals of the project. For the same reasons I chose the Sonicwall firewall over the Cisco ASA device after comparing the value for the cost of the hardware. Finally, the choice to use Comcast for the internet connection was decided based on bandwidth availability and ongoing cost concerns.

Goals and Objectives

During my initial meeting with ABC Sensors, the following goals were defined:

1. Verify or install adequate Ethernet cabling at new office location
2. Create a LAN with ability to connect 15 networked devices, and the Internet
3. LAN should be as fast as possible to facilitate local file transfers, at minimal cost
4. Order and install internet connection with 3 Mbps download speeds (minimum)
5. Procure any new hardware required, purchases must not exceed $1,500
6. All equipment should allow for LAN expansion
7. Create and compile documentation for the LAN
8. Network and Internet connection must be tested and installed by 11/30/12

The above list represents the goals of the project as a high-level overview, many of the goals have objectives that are technical in nature that must be completed before the item can be considered as met. The overarching goal of the project is to have a workable LAN and internet connection available at the new office location within the sixty-day timeframe of the project's onset. To accomplish these goals, a project plan was created with projected timeframes for each portion of the project. The project plan is split into four distinctive phases: Initiation, Planning, Execution, and Closing. This proposal is a part of the planning phase that includes gathering all the necessary information and details so that the execution phase can be completed as planned, and the timeframe for the project is kept on track. The objective list below along with the project timeline allows for monitoring each individual requirement for every goal.

Verify/Install Adequate Ethernet Cabling at new Office Location

The following objectives are required to meet this goal:

- Visit office suite to verify existing cable type
- Determine if additional cabling is needed to meet company expectations
    - If additional cabling is required, contact building management for permission to install, obtain necessary documentation if required
    - Contact wiring technicians, set installation date for additional wiring before 11/30/12

Verifying the completion of this goal requires visiting the office suite after the wiring installation date and examining any work performed.

Create a LAN with Ability to Connect 15 Networked Devices, and the Internet

This goal contains many objectives, which have requirements outlined in other identified goals; the following objectives will be required to meet this goal:

- Research network switches with 24 ports
- Research routing devices for LAN to Internet connection
- Purchase network switch with 24 ports
    - Install switch at new office
- Purchase routing device
    - Install routing device at new office
- Determine amount and length of any Cat5e cabling required for all connections
    - Purchase any Cat5e cabling required
    - Connect all equipment to expected endpoint (RJ45 jack)

Verifying the completion of this goal will require testing each individual endpoint for LAN connectivity. Verifying connectivity to the internet requires the connection to be installed, and is functional to the routing device and switch. The goal will not be complete until all networked devices on the new LAN are installed and wired to the switch.

LAN Should be as Fast as Possible to Facilitate Local File Transfers, at Minimal Cost

This goal is a general consideration that controls the requirements for other deliverables. Keeping the LAN "fast", at minimal cost requires that the switch and cabling purchased be Gigabit Ethernet compatible, and use Cat5e grade cable or higher. Cat5e cable has a maximum transfer rate of 1000 Mbps (1000BASE‑T, also known as IEEE 802.3ab) as long as individual cable spans are less than 100 meters in length. Upgrading the existing Cat5e cabling to either Cat6 or fiber optic connections would be prohibitively expensive, and is not being considered.

Order and Install Internet Connection with 3 Mbps Download Speeds (minimum)

The following objectives are required to meet this goal:

- Research WAN connection types with downstream bandwidth of 3 Mbps or greater
- Select internet service provider based on rationale and systems analysis
- Order internet connection installation
- Test installed internet connection before 11/30/12

Verifying the completion of this goal requires being on location at the time of internet installation to allow technician access to office's demarcation point. After the ISP technician completes their work, a test needs to be performed to confirm internet access; this test needs to

include bandwidth verification to determine that downstream rates match the service being purchased.

Procure any new Hardware Required, Purchases must not Exceed $1500

This goal controls the purchase costs of the switch and routing devices needed for LAN and internet connection. When research on vendor options is taking place, no two combinations of the hardware required should exceed this budget limit. Verifying this goal has been met requires totaling the cost of the switch and routing device, making sure the total is under budget.

All Equipment Should Allow for LAN Expansion

This goal is a general consideration that controls the requirements for other deliverables. Allowing for future networking expansion is an important forward-thinking goal; this business requirement affects the decision process for the switch and routing device deliverables. Any switch considered will require VLAN features to allow for LAN partitioning in the future, and will require a physical port count beyond the immediate requirements of the business. Any routing device considered will require throughput that exceeds the internet bandwidth delivered, and requires that the device have sufficient session capabilities.

Create and Compile Documentation for the LAN

This goal requires that a logical LAN diagram is created, and that all other device manuals, configuration parameters, and credentials are compiled or available in a single folder. The logical network map defines all devices on the network, and contains the IP addressing scheme for each device in a clear manner. Meeting this goal requires that all documentation,

manuals, warranty information, and generated documents related to this project be stored in a secure location, and delivered to Alex at the closing phase of the project.

Network and Internet Connection must be Tested and Installed by 11/30/12

This goal is the final benchmark of the project, it defines the timeline requested by ABC Sensors, and requires that all other goals be completed and tested as working before November 30th, 2012.

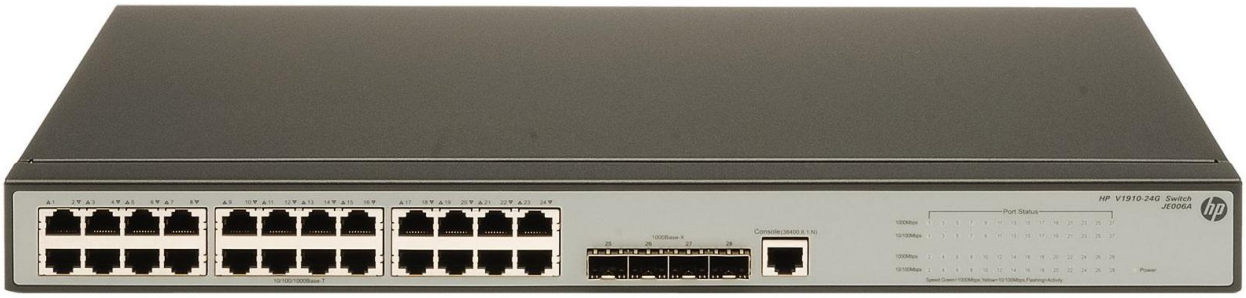
Project Deliverables

The deliverables for the configuration and installation of a network for ABC Sensors includes both tangible and intangible objects, however all objects are verifiable, and fit into the following categories: hardware, networking services, systems, and documentation. The hardware products include the HP 24-port switch, and the Sonicwall TZ 205 firewall. Networking services include the configuration aspects of the LAN, the internet service required for internet access, and finally the cabling service required to connect all devices. The LAN itself is a system of networked devices that can communicate on the network. The documentation deliverable will include logical LAN map, with relevant networking information included, and finally the formal project report defines the project and goals themselves.

Hardware

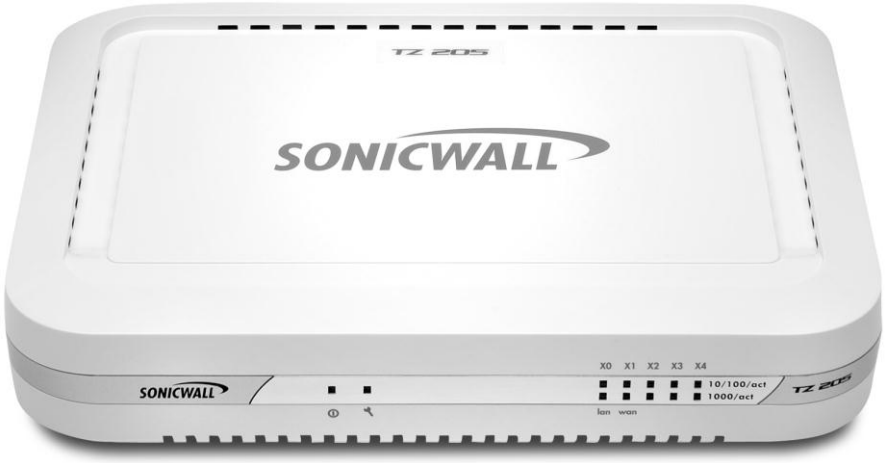
The first hardware deliverable required to meet this projects goals is a network switch. Examining the business needs and networking goals helped to define the necessary features and

attributes required for the switch. The model that will be installed as a major component of the network is the 24-port HP V1910-24G.



The V1910-24G model has VLAN support, which will allow for network segmentation should the network grow in capacity and require it. It features 24 Gigabit ports, which maximizes the throughput speed on the Cat5e cabling used within the office, and will allow for intra-office file transfers at rates up to 1000 Mbps. The 24-port count was important to allow for all initial installed endpoints, including PCs, servers, and printers to be wired to the switch ports, but will also allow additional networked devices to be added to the LAN without the purchase of an additional switch. Beyond the specified goals, the switch also contains some additional ease-of-use features that give it additional value, these include secure web management (HTTPS), port mirroring, and cable diagnostics. The cost of the switch at $275.00 does not exceed the hardware budget total of $1,500 set by ABC Sensors.

The next hardware deliverable required for the project is a routing device. In this case, the Sonicwall TZ 205, which is a firewall, was chosen, as it provides sufficient routing capabilities and includes security features beyond that of a traditional pure router.



The TZ 205 has five Gigabit Ethernet ports, which means its connection to the switch will allow throughput up to 1000 Mbps additionally the Sonicwall has an intrusion prevention throughput of 80 Mpbs, this far exceeds the total internet bandwidth that will be used on the device. The firewall does not have a node limitation limit, meaning any number of connected devices can talk to the internet through the device. Some additional features that allow for LAN growth include licensable security services, unified thread management capabilities, and WAN failover. The TZ 205 is available for $442.16, which combined with the switch cost of $275.00, totals $717.16, which is only 47.8 % of the total $1,500 budget allocated for new hardware devices.

Networking Services

The second deliverable category required as part of the project is networking services; one of the service that is required, is the network cable wiring service. The least-expensive wiring contractor will provide this service, which is to include wiring Cat5e cabling runs to five new locations, and terminating the runs with jacks installed into the wall. The wiring will also

need to be terminated into an existing patch panel on the opposite side of the run, to provide connectivity into the switch.

The second service required for the completion of this project is the business-class internet service. Comcast, an ISP that offers internet connectivity through a RG-6 cable medium will be the provider of this deliverable. Comcast offers a range of bandwidth levels, I chose the 50/10 Mbps level for $199.95 for ABC Sensors, which far exceeds the business requirements of 3 Mbps downstream speed. This level of bandwidth will meet the needs of the growing business for the foreseeable future, and will allow for remote backup over the internet and several other high bandwidth services should they be required in the future.

Systems

The LAN as a construct is a deliverable, it is a system that allows for the connectivity between hosts and peripherals within the office, and beyond that a connection to the internet. The LAN is a system made up of the hardware deliverables, the configurations on the hardware, and the Cat5e cabling allowing all devices to be wired to the switch. The local network with internet connectivity encompasses the first three layers of the OSI model, including the physical, data-link, and network layers.

Documentation

The first documentation deliverable is a single page Logical LAN Diagram. This diagram maps the network and internet connection logically, and includes device names, IP address assignments, and the DHCP scope for the networks devices. This document will ease in network troubleshooting, especially should an outside technical party need an overview of the network layout (see Appendix 3). The last deliverable included is a formal report of the project, including details on all phases, deliverables, and a final analysis of the project.

Project Plan and Timelines

Initiation	Estimated Duration	Start Date	Estimated End Date
Project Scope Meeting	.5 Day	10/1/12	10/1/12
Planning			
Information Gathering	5 Days	10/2/12	10/7/12
Budget Review Meeting	.5 Day	10/8/12	10/8/12
Research Hardware Vendors	2 Days	10/9/12	10/10/12
Research WAN Connections	2 Days	10/11/12	10/12/12
Proposal Meeting	.5 Day	10/15/12	10/15/12
Execution			
Network Cabling Installation	1 Day	10/17/12	10/17/12
Order Network Hardware	.5 Day	10/18/12	10/18/12
Order WAN Service	.5 Day	10/18/12	10/18/12
Configure Hardware	1 Day	10/25/12	10/25/12
WAN Installation	.5 Day	10/26/12	10/26/12
Hardware Installation	.5 Day	10/29/12	10/29/12
LAN Testing	1 Day	10/30/12	10/30/12
Create Network Documentation	1 Day	10/31/12	10/31/12
Project Review Meeting	.5 Day	11/1/12	11/1/12
Closing			
Documentation Handoff	.5 Day	11/1/12	11/1/12

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Appendix 1: Competency Matrix

Domain/Subdomain	Competency	Explanation
Leadership and Professionalism	Leadership	This proposal required utilizing leadership methods, for the advancement of the project, specifically by scheduling meetings and making recommendations based upon technical knowledge.
Upper Division Collegiate Level Reasoning and Problem Solving	Analysis and Interpretation of Information/Data	This project required synthesizing information to understand the projects' technical complexities and potential solutions, specifically by documenting the rationale and systems analysis for the project.
Language and Communication	Evaluating Information	This project required accurate evaluation of hardware requirements based on business needs in the deliverables chosen.
Quantitative Literacy	Interpreting and Communicating Quantitative Information	This project required the interpretation of data sheets and materials containing quantitative information and required analysis in presenting said information into a project proposal.
Upper Division Collegiate Level Reasoning and Problem Solving	Planning and Information Gathering	This project required gathering information from the business owner related to the projects' goals. It also required gathering technical information for analysis.
Quantitative Literacy	Constructing Arguments and Reasoning	This project required several decisions relating to hardware and services which then had to be proposed using reasoning, and by matching the choices with the project goals
Leadership and Professionalism	Performance Evaluation	This projects' Goals and Deliverables section outlines evaluation criteria for each goal and objective.
Networks	Network Devices	This project required the planning and configuring of several networked

		devices.
Language and Communication	Writing as a Process	This proposal required writing and creating documentation for the needs of ABC Sensors.
Language and Communication	Inquiry and Research	This proposal contains several electronic references to illuminate the decision process, and explain the reasoning for them.
Project Management	Project Planning	This document contains several sections that outline and expand upon the planning process for this project.
Upper Division Collegiate Level Reasoning and Problem Solving	Identifying the Role of Critical Thinking in the Disciplines and Professions	This project required using critical thinking in the creation of this project document as part of a business project.

Appendix 2: Tables

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Appendix 3: LAN Diagram (Logical)