Proposal to Upgrade the Network Infrastructure for the City of Hastings, Kentucky

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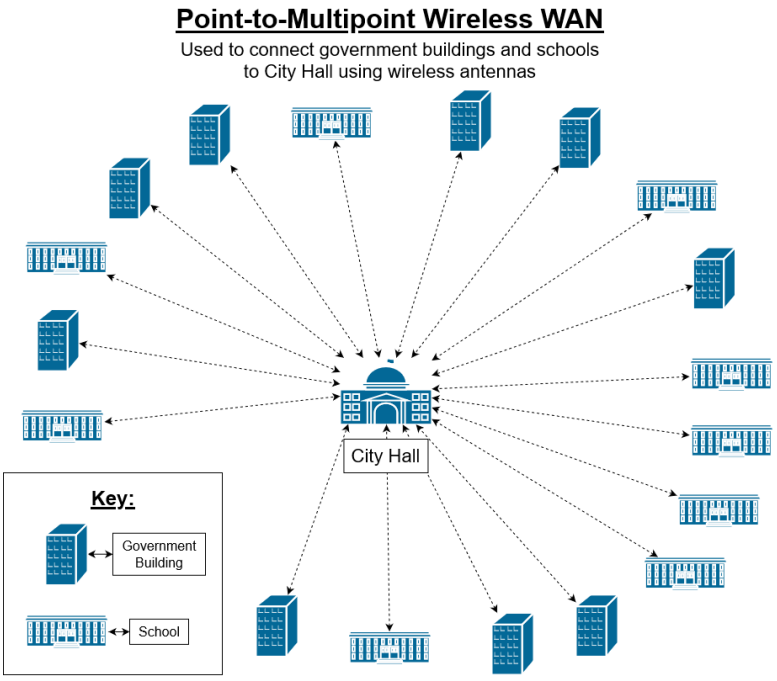
1. Introduction

The purpose of this proposal is to propose a network upgrade of the current network infrastructure of the city that is severely outdated. The city of Hastings, KY seeks to establish a secure WAN to connect all government buildings and provide free and secure wireless access to residents within the downtown city limits. The new wireless access should enable residents to access local government services and the internet at large. The city currently uses leased lines through the local phone company to connect the 10 government buildings, and they want to provide access to 5 elementary schools, 2 middle schools, and 2 high schools with a total student population of approximately 9,600.

2. Proposed Layout

2.1 Point-to-Multipoint Site Connections:

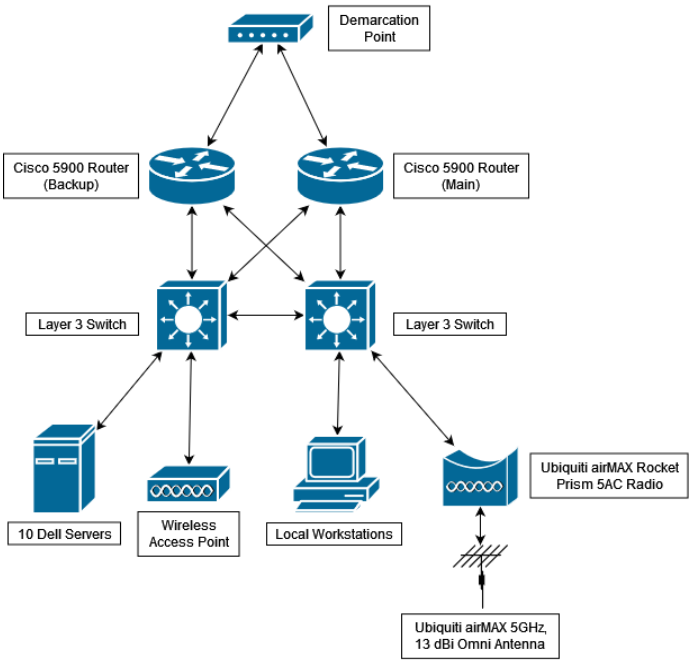
Our plan to replace the leased T1 lines and connect the government buildings to City Hall is to use a point-to-multipoint wireless network. We chose this because the next best alternative, laying fiber, would be extremely cost prohibitive for this project at the distances we would have to lay it. We also didn't do point-to-point wireless, as that is both not scalable and not reliable, as each building would need multiple antennas and one site or connection going down would cascade down the line, making a much larger outage. Our point-to-multipoint connection is reliable and easily scalable. Because of this scalability, this will also be how we



allow access from the local schools to the network; they will be getting the same wireless antennas as the government buildings.

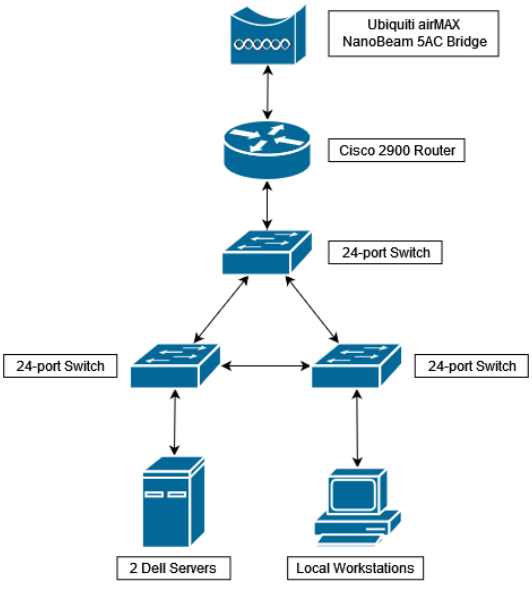
City hall's networking equipment is mostly still acceptable, so we will leave what they have intact. However, in order to facilitate being the hub of this network, we need to add a radio and omni-directional antenna to communicate with all the sites. We will be installing a Ubiquiti UISP airMAX Rocket Prism 5AC Radio to the network connected to a UISP airMAX 5 GHz, 13 dBi Omni Antenna to connect with the other sites. This antenna will be supported by antenna pole mounts and large poles meant to add height and avoid interference with buildings or other tall objects. We also have come up with a layout for the current equipment that meets industry redundancy standards.

Hub (City Hall) Layout:



For each government building, we will also keep almost all equipment intact. We will, however, replace the connection with the T1 line with a Ubiquiti UISP airMAX NanoBeam 5AC Bridge connecting back to city hall. These will also be installed using an antenna mount and a large pole to ensure a good connection with the hub. This allows us to connect with City Hall from almost anywhere, meaning that we can also use this hardware on all of the listed schools to also allow them to access the network.

Secondary Site Layout:



2.2 Downtown Wireless Access:

To accomplish our goal of creating a WiFi network across downtown, we've come up with a plan to use an array of 3,800 Ubiquiti U6 Mesh Access Points. These access points have a range of approximately 300 feet, so we will attach them to buildings approximately 300 feet away from each other in a mesh configuration. This style of network is scalable, requiring little setup to add additional nodes to the network, and resilient, since mesh networks are naturally self-healing and different routes can be taken if connections to a given node are unavailable. These will be attached to the sides of buildings, powered by PoE injectors from the nearest outlet. The city may have to work with local businesses on a minor repayment plan for the energy used for this project.

2.3 Software Updates:

Our plan is to modernize the computers on this network by updating their operating systems and setting up a modern Active Directory system. We will set up a network imaging system so we can image the computers concurrently over the network to Windows 11. All the computers on the network have Windows 7 keys already, so they will be able to reuse those for Windows 11 at no cost. For our servers, we will have to purchase Windows Server 2022 licenses to modernize them and get all the security fixes and new features that come with it. As we image the PCs, we will add them to one centralized Active Directory tree to streamline the process of managing and troubleshooting the computers on the network.

3. Cost Estimate

3.1 Hard costs

Name	Brand	Model Number	Count	Cost per Unit	Total Cost
UISP airMAX Rocket Prism 5AC Radio	airMAX	RP-5AC-US	1	249	249
UISP airMAX 5 GHz, 13 dBi Omni Antenna	airMAX	AMO-5G13	1	165	165
UISP airMAX NanoBeam 5AC Bridge	airMAX	NBE-5AC-US	18	99	1782
Philips Universal Adjustable TV Antenna Mount	Philips	SDW1220/27	19	17.5	332.5
Gauge Swaged End Antenna Mast Pipe	RUIYUXIN	EZ 5-16SW	19	31	589
Access Point U6 Mesh	Ubiquiti	U6-Mesh-US	3800	179	680,200
Windows Server 2022 Standard Edition	Microsoft	WS-2022SE	28	1069	29,932
Total Hard Cost	713,429.5				

A Wide Area Network (WAN) will require various hardware and software components,

with City Hall serving as the primary hub. The total cost for City Hall upgrades, including a USIP airMAX Rocket Prism 5AC Radio and 5GHz 13 dBi Omni Antenna, is $414. Upgrading nine government buildings requires UISP airMAX NanoBeam 5AC Bridges, antenna mast pipes, and universal adjustable TV antenna mounts costing $147.50 per site for a total of $1,327.5. Connecting nine schools requires the same hardware at $147.50 per site for an additional total of $1,327.50 for the schools. Providing free Wi-Fi for all residents will by far be the greatest cost, requiring the installation of about 3800 Ubiquiti Access Point U6 Meshes costing $680,200. The cost of licenses for the most recent Windows Server version for all our servers will cost $29,932. In total, the estimated cost of setting up the WAN is $713,429.50.

3.2 Soft costs

Type	Hours	Cost per Hour	Total Cost
Consultation	20	150	3,000
Installation	3,600	50	180,000
Configuration	390	50	19,500
Active Directory Setup	10	50	500
Total	4,000		203,000

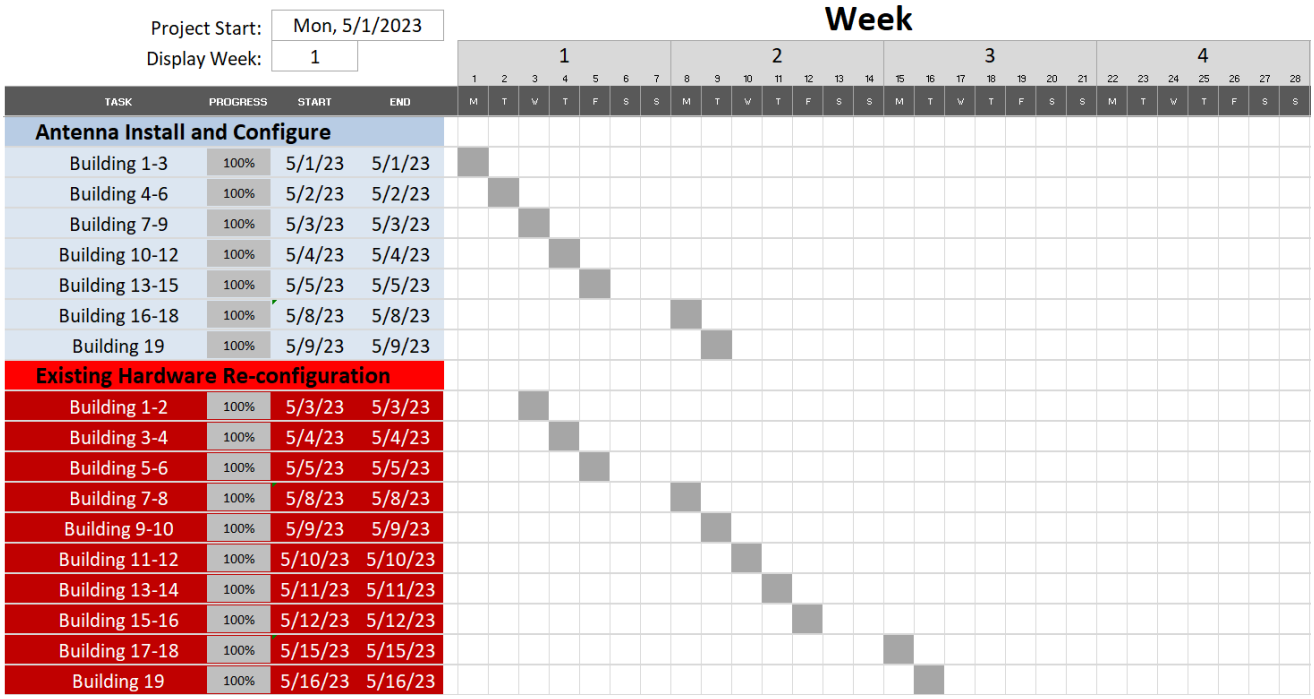
It is estimated that a total of 4000 hours will be required for hardware installation and setup, with a group of five people working on the project. The group would be divided into two pairs and one individual. The first pair would begin installing access points. This task is projected to take the longest and must start the earliest. Once the other workers finish their responsibilities, they will also begin installing access points. The worker by themself would start setting up an active directory, group policy, image creation, administrator accounts, domain policies, the DHCP server, and the DNS server. This work is done first so that the old hardware can be reconfigured en masse. Once this is done, the solo worker will go building by building making sure everything is up to date. The other pair would arrive at a building, install the mounting hardware, and install the antenna. After that, that pair would configure the antenna and finish verifying the connection. With that, the pair moves onto the next building with the goal of three buildings a day.

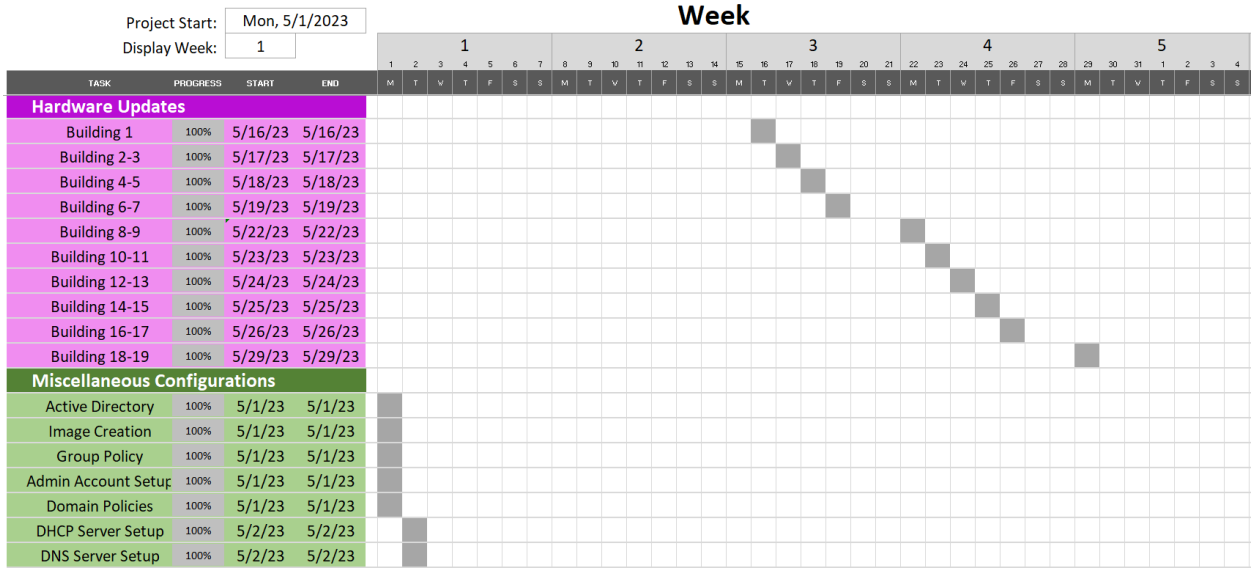
At the current rate, it should take the team 100 days (three months and a third) to complete the hardware installation and setup at the 19 buildings requiring changes. With a labor cost of $50 per hour per person, the total cost of labor would be $200,000. Additionally, there

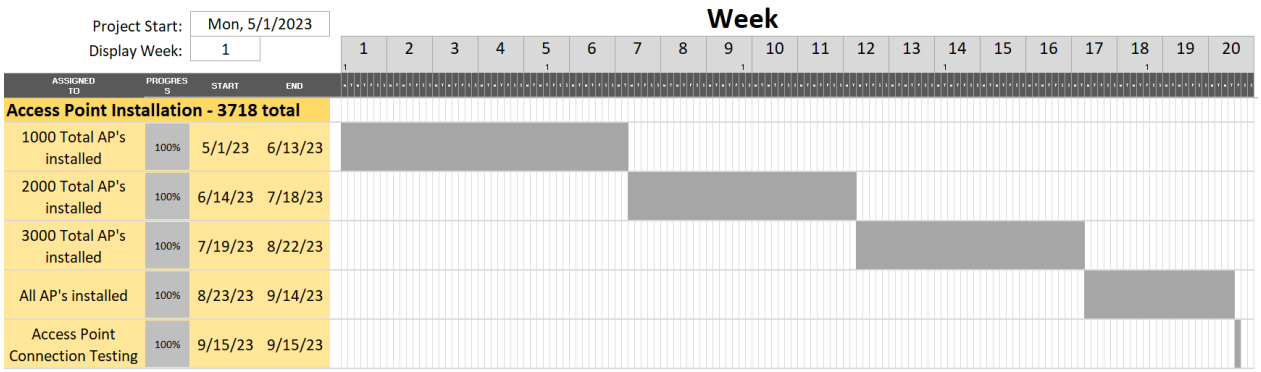
will be consulting fees charged at $150 per hour, which will depend on the number of hours required for consultation. It is estimated that there will be a minimum of 20 consultation hours, which will total $3000. The total cost for both consultation and installation fees will be $203,000.

4. Timeline

4.1 Gantt Chart







In order to provide our customer with the most necessary infrastructure, the longest projected task, installing access points, is the least important. This is because all other tasks directly relate to restoring government infrastructure. It just so happens that these tasks will take the shortest amount of time. Once this critical work is finished these workers can help install access points. The solo worker has one of the most important jobs early on. Setting up the tasks listed under "Miscellaneous Configurations" will allow one person to reconfigure and update large amounts of equipment in parallel. This leaves one pair able to begin installing and configuring antennas and the other pair able to begin installing access points. There is some time built in, for the antenna installers, at the end of each day for verifying the connections made that day. If anything comes up wrong, they take that time to fix the issue or do so the next day if time does not permit. Once the solo worker and the antenna installers have finished their responsibilities, they will join the others installing access points.

5. Conclusion

In conclusion, the proposed network infrastructure project for the city of Hastings, KY seeks to address the current network infrastructure's weaknesses and provide the necessary upgrades to meet the growing demands of the city's residents, government buildings, and schools. The project proposes the installation of a point-to-multipoint wireless network to connect all government buildings to City Hall and schools within the city will also be connected to the network infrastructure. Wireless access to residents will be provided through a mesh network of about 3800 access points. The total cost for the project will be $916,429.50 and will take approximately 3.3 months. Overall, the proposed project will lead to significant improvements in the city's network infrastructure, making it efficient, reliable, and cost-effective.