

City Park Wireless and Security

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Submitted to
the Faculty of the Department of Information Technology
in Partial Fulfillment of Requirements for
the Degree of Bachelor of Science
in Information Technology

University of Cincinnati
College of Education, Criminal Justice, and Human Services

April 2013

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4-15-13

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4-15-13

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4/17/13

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Acknowledgements

We would like to give special thanks to Robert Bemmes, the Mayor of Reading, Ohio, and Patrick Ross, the Administrative Services Director for the city of Reading, Ohio for letting us use Koenig Park for testing of our project. Matt Oswalt with IP Versant for his guidance through implementing the network was tremendous. Also, thanks to Professor Russ McMahon for his guidance and help throughout the entire senior design process. Without all of you this project would not have been possible.

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Abstract

The City Park Wireless and Security project came about to provide public wireless Internet access at a city park while also providing security for the park due to recent vandalism and arson at the city parks in Reading, Ohio. This project has set up a wireless network at Koenig Park for the city of Reading, Ohio. This network provides Wi-Fi access across the entire park to people who visit the park for leisure, sporting events, festivals, or rent out the shelters for personal events. For network security purposes there are two separate Virtual Local Area Networks (VLAN's) that have been set up to separate the public and private network traffic. There are also four security cameras strategically placed in the park to prevent future crimes and also to protect all visitors. These cameras have a monitoring system based on the open source iSpy Connect software. The cameras record video when there is movement detected in the viewing area. A Wi-Fi network management software has been installed for the City of Reading to manage the wireless network upon completion. This project came to completion and has a great wireless Internet connection throughout the entire park for all visitors to use. Also, there is an up and running video surveillance system to help protect the visitors to the park. This can be implemented by the City of Reading to attract more visitors to their city parks.

Introduction

In this senior design project a wireless network was implemented that provides Internet access throughout an entire city park including two shelters that are used for multiple functions. Wi-Fi that is available while enjoying the outdoors is very appealing to visitors, and now it is possible. On the network security cameras have been implemented and placed throughout the park, mainly around the shelters and basketball courts. Not many parks have wireless networks in place and if they do, they are mostly in certain areas and not throughout the entire park. The plan for this project implemented a new network that has wireless access points along with security cameras watching the premises. A sense of security while visiting the park will likely draw more visitors and help the residents lose any fears of going to parks with their children.

Problem

The main problem is that there is a city park that is used by many residents and they would like to have Internet access while they enjoy the outdoors. Also, the city of Reading, Ohio has experienced several thefts and arson at their parks in the last year. There are several questions to be answered. What is the best topology for a wireless network of about 50 users? How should the access points be set up to give the long range signal throughout the entire park? How should the cameras be managed on the network? What equipment is necessary to start a new network of the scope desired? What is the most cost efficient setup that will entail the current infrastructure at the parks? Preparing the best solution is a very important step in managing this project so that it can support all the functions that are desired and also leave room for growth in the future.

Solution

This project allows anyone who works or lives in the local community to enjoy the parks provided to them and use the Internet at the same time to complete tasks that used to be only accomplishable at home. The environment can be healthy for people who are stuck inside the same place day in and day out. The plan used a router, switch, and server to set up the network and then added access points to the network. This allows Wi-Fi access throughout the entire park. Furthermore, cameras were added to this network for security monitoring. There is a camera monitoring system that records video streams when it notices movement in the view of the cameras. The system that is being used is called iSpy connect. This will help the city monitor the park and keep it safe. The camera system and the wireless access points are on separate Virtual Local Area Networks (VLAN's) for security purposes. Therefore, no one accessing the public wireless Internet can access the camera monitoring system to see video feed or alter it.

Deliverables

What was expected of this project are the following:

- Physical and virtual servers running Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) services.
- Switched network with two Virtual Local Area Networks (VLAN's).
- Wireless Distribution System access points on each Virtual Local Area Network (VLAN) that will provide access throughout all of the grounds of the park.
- Surveillance cameras set up wirelessly that will capture all activity that happens at the city park.
- A camera monitoring system to manage the video captured from the cameras.

- Filter the network traffic on the public Wi-Fi with Open DNS.
- A Wi-Fi network manager to control access to the public wireless network.
- Data testing to ensure all aspects are working as planned.

User Profiles

There are three primary users for this system, customers, employees, and administrators. The customers are the primary users of the system. Customers can only use the network to connect their personal devices. Employees would be the next group of users. They would use the network to provide security keys to customers that want to access the Wi-Fi. Administrators are the final group. They can create, modify, and delete objects on the network. They also have the ability to override states for any object preventing users from making changes. The user profiles diagram can be found in Figure 1 on the next page.

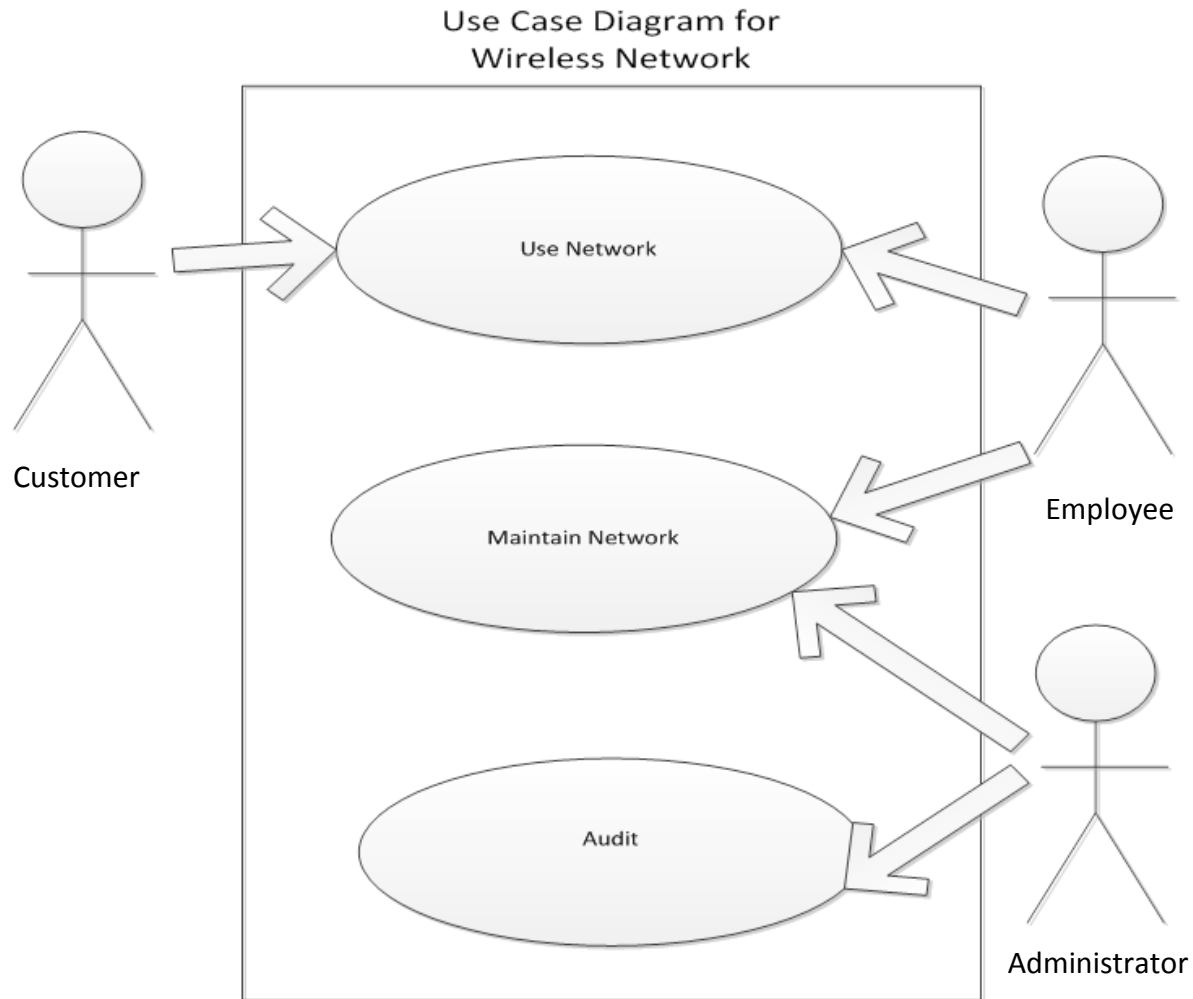


Figure 1: Use Case

Technical Elements

For this project to be completed there was a physical network set up and this is the technical aspect of the project. At Koenig Park there was a network set up that starts with an Internet connection through a Time Warner cable modem. Then, a Linksys WRT54G router was used to connect to the Internet modem. This router was programmed to release a default gateway along with two other address spaces for the two separate Virtual Local Area Networks (VLAN's). Next, there is a Cisco Catalyst 3750 switch. This switch has two clusters of ports that have access to separate Virtual Local Area Networks (VLAN's). The first port on the switch

is trunked to the two Virtual Local Area Network (VLAN) sections of ports to give them Internet access. This also splits the two IP address spaces to the separate Virtual Local Area Networks (VLAN's). Next is the server which is a Dell Power Edge 2950 with 1346 gigabytes of storage. There are two network interface cards on the server and from these there is a connection to the two separate Virtual Local Area Networks (VLAN's). The physical server is hosting the network that will manage the security cameras since it will run smoother with more storage for the video feed. On the physical server there is a virtual server which is using the second network interface card on the physical server and managing the public Wi-Fi. The operating system on the two servers is Microsoft Server 2008 R2, provided by the MSDN alliance between Microsoft and the University of Cincinnati. On the virtual server for the Wi-Fi network there are two different services implemented to block access on the network that is unwanted from an administrative standpoint. These are OpenDNS and IM Lock. These two applications help to block sites in categories that are unwanted like pornography and also block specific sites if needed. McAfee security has been installed on both of the servers to prevent from viruses and attacks on the servers. This is the backbone of the infrastructure.

Furthermore, the access points, shown in Figure 2, that are being used for the wireless IP cameras and public Wi-Fi access are EnGenius ENH202 access points. These are outdoor access points that will work in all normal weather conditions in the Cincinnati, Ohio area. They are using the wireless distribution system (WDS) access point mode to bridge a connection between each other. There is one access point physically connected to the server and the others are connected by their unique MAC (Media Access Control) addresses. These access points are being managed by software called Manage Engine Wi-Fi Manager. This allows all of the access points to have the access code changed at once instead of logging into each one individually.

The cameras used for this project, shown in Figure 3, are manufactured by Wanscam and they are being managed with the open source software called iSpy. These cameras are wireless IP (Internet Protocol) cameras and are connected to a separate set of access points coming from the camera Virtual Local Area Network (VLAN).



Figure 2: EnGenius ENH 202 Access Point



Figure 3: Wanscam Wireless IP Camera

Difficulties

There were a few difficulties that occurred during the implementation of this project. During the setup of the switch it was known that the switch was operating on layer three of the network. Therefore, it was also known that there could be routing done on the switch itself. The router was initially only releasing one address space and then the switch was trying to trunk the address space into two local area networks. This was not working and it was found that the router must release the address spaces needed. The router was then set up to release the default gateway address along with two other address spaces. Once this was completed the switch could separate the traffic of the two Virtual Local Area Networks (VLAN's) to the two address spaces that the router was sending out.

Another issue that came about during the project was how to manage the access points on the public Wi-Fi sector of the network. The Wi-Fi network is set up so that anyone within the park boundaries can have access. However, the City of Reading only wants to allow Internet access to those that rent out the shelters and hold events at the park at this time. Therefore the passwords can be managed with the Manage Engine Wi-Fi Manger. If or when the city wants to offer access to anyone visiting the park, whether it is free access or pay per use Wi-Fi, it is suggested that they purchase the Antamedia controller. This is a controller that will manage accounts for each person that accesses the wireless network and keep track of their use. It also has the functionality to take payments and manage what usage time is left with the credit on each users account. This access point controller would meet all the needs for the City of Reading. It was not in the budget for this project, therefore it was not implemented.

Network Diagram

The diagram shown in Figure 4 is a representation of the switched network that was set up at Koenig Park in Reading, Ohio. The switch receives the Internet address spaces from the router and routes them to the appropriate ports. The physical and virtual servers are shown as two separate machines in this diagram. As they are both on one machine they are routed on completely different networks. Therefore, they can be shown as separate servers.

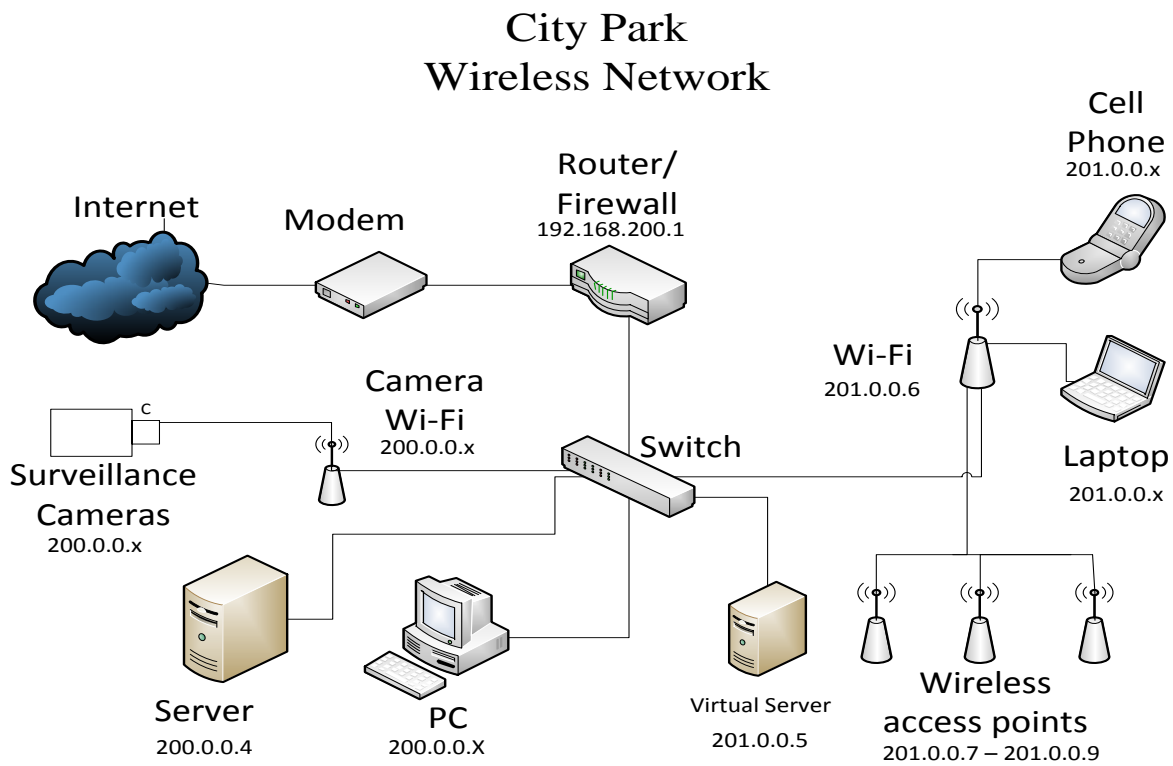


Figure 4: Network Map

Testing

For testing purposes in this project it needed to be known that the wireless network spanned across the entire park and provided good signal strength. With good signal strength it was then known that the network was more reliable than just having access in the far corners of

the park but not being able to load a website at a reasonable speed. To test the signal strength and create a heat map of the park there was free software used called Ekahau Heat Mapper. In Figure 5 it is seen what the park looks like from an aerial view. The shelter #1 is where the access points are posted and bridging the Internet connection from the access point in the house across the street labeled “Internet connection.” Figure 6 shows the heat map of the Wi-Fi signal strengths throughout the park using the same map from Figure 5 in the background. There was also physical testing done with cell phones and laptops to guarantee that websites would load in a fast manner. It was guaranteed and is shown in Figure 6 that there is a good Internet connection throughout the entire park. This park spans about 175,000 square feet.

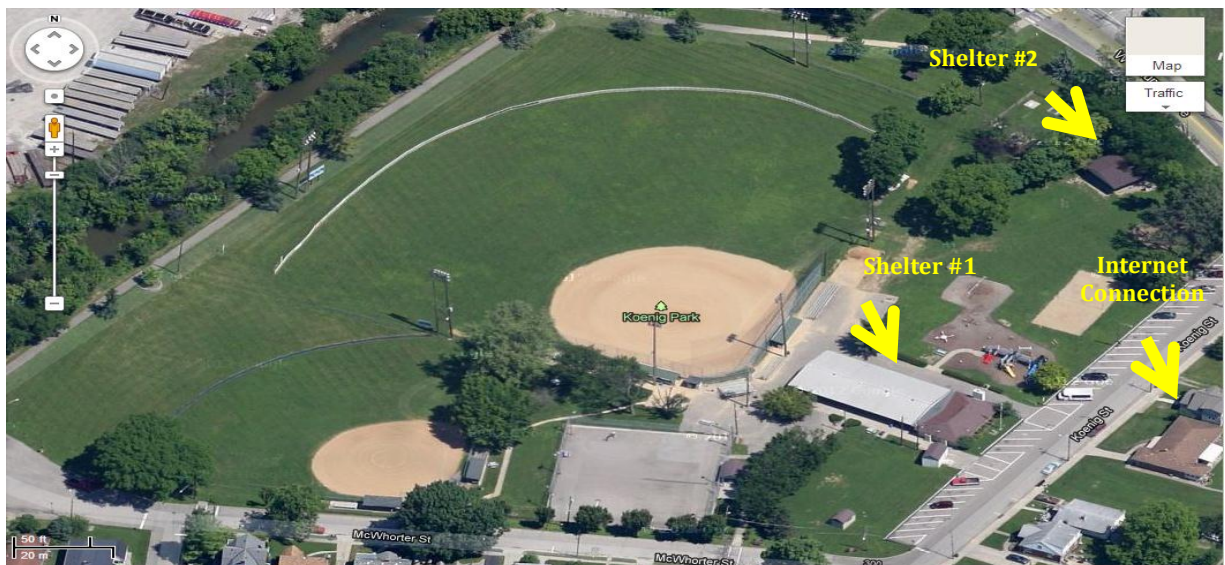


Figure 5: Park Aerial View

Budget

Below is the budget for the project. Figure 7 shows the budget of what it cost to implement this project. This included providing Wi-Fi throughout the park and having security cameras for the shelters and main entrances of the park. This also includes free software that was acquired through the University of Cincinnati and is available to students in the Information Technology program.

Hardware	Price
1 – Server	\$800
1 – Switch	\$450
1 – Router	\$50
Security Cameras	\$250
4 – Wireless Access Points	\$375
Internet Access	\$0
Camera Software	\$0
MSDN software	\$0
Total	\$1,925

Figure 7: Project Budget

If this project were to be implemented completely for the City of Reading it would cost more since there would be licensing costs for software that was free for the students at the University of Cincinnati and monthly recurring costs from an Internet service provider. Below is a chart with the cost for the City of Reading to fully implement this project for full time use.

Hardware	Price
1 - Server	\$800
1 - Switch	\$450
1 - Router	\$100
8 Security Cameras	\$500
6 Wireless Access Points	\$550
Internet Access	\$40/month
Camera Software	\$130
Windows Server 2008 R2	\$500
Antamedia Software	\$800
Total	\$3870

Figure 8: Project Budget for Reading

Timeline

A timeline was used for this project so that dates were met and the completion of the project was in a timely manner. Using a timeline or time schedule is a great action to be taken by any project manager. This gives the manager a sense of how far along a project is. Having due dates and staying on schedule keeps the people working on the project from slacking off and makes sure that the project is completed on time. This schedule was used to implement the City Park Wireless and Security project. The project met all the required dates and did not fall behind once it was kicked off.

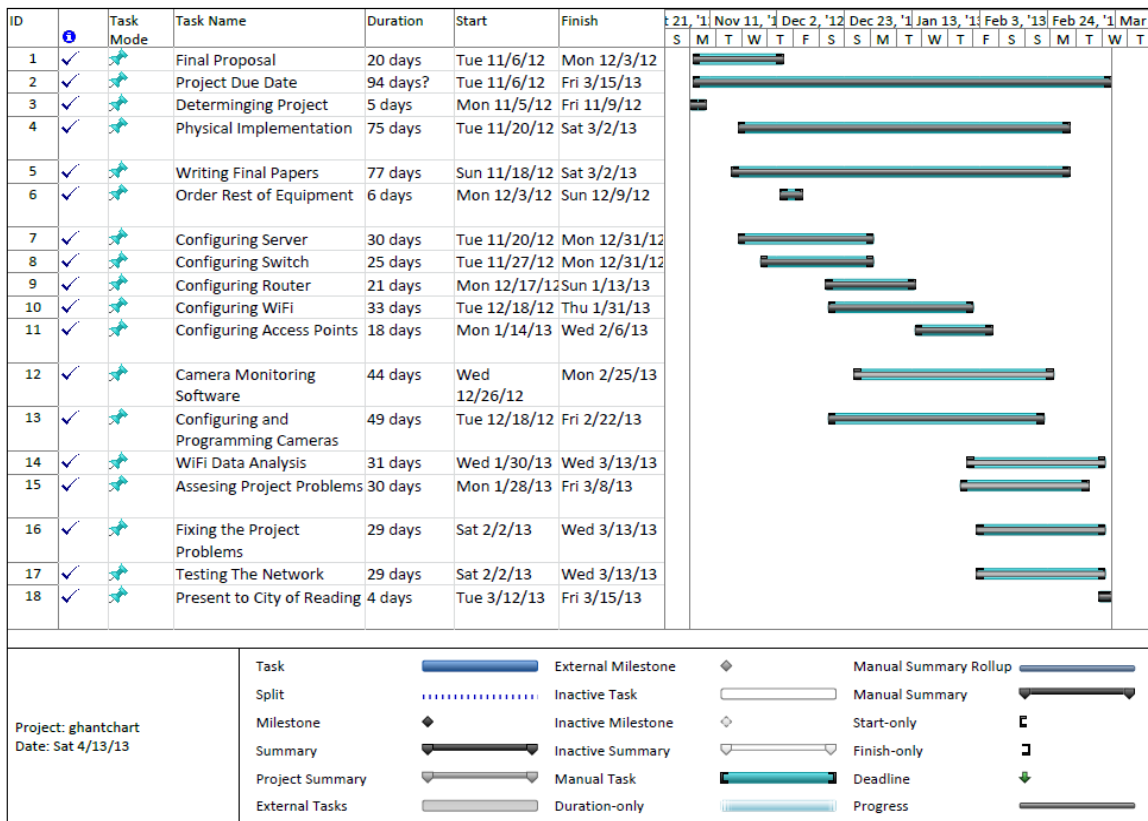


Figure 9: Gantt Chart

Conclusion

This project designed a new network with wireless Internet access that allows anyone to connect to the environment. It includes long range wireless throughout an open outdoor area, covering the entire Koenig Park in the city of Reading, Ohio. Running on this network are cameras for security of the park. There is a camera management system that records live video streams. This new Wi-Fi network and security will draw more people to the parks in the city of Reading, Ohio and give them the enjoyment of connecting to the Internet while enjoying the outdoors. The visitors will also have a sense of security due to the new video surveillance system. This project was a huge learning experience for the group that worked on it of what goes into starting a new network from the ground up. Also, it was found that nothing usually works the first time but that it is a learning experience to figure out why certain aspects do not work and what it needed to fix them. Having money to purchase all equipment needed makes a project run smoother and it is understood now what the financial crisis of most businesses is halting the upgrades and additions to their networks.

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