Northern New Mexico Wireless Internet Study

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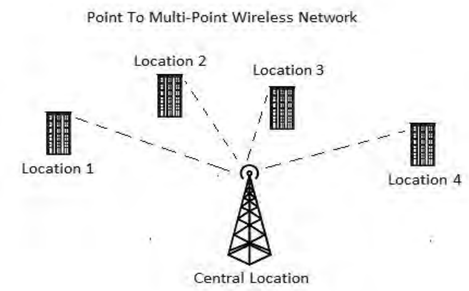
Abstract

Internet speed and bandwidth are an issue in Northern New Mexico. This is due to many factors. The tall mountains and hills make it difficult for Internet Service Providers (ISPs) to lay fiber to provide a faster connection. Another factor is the presence of Native American Reservations in the area which prohibit ISPs from laying fiber or the fact that these tribes demand more money than the ISPs can afford to pay to install these fibers. The third factor is whether or not ISPs want to invest in Northern New Mexico. Statistically, Northern New Mexico is one of the poorest areas in the United States. If an ISP decides to install faster lines, would it be worth it? If people in the area cannot afford to pay for fast internet, equipment sits nearly idle and the ISP loses hundreds of thousands of dollars. This poster provides a summary of our research on Wireless Point to Multipoint Networks as a possible alternative to the issues mentioned above. Point to multipoint communication is accomplished via a distinct type of one to many connection, providing multiple paths from a single location to multiple locations.

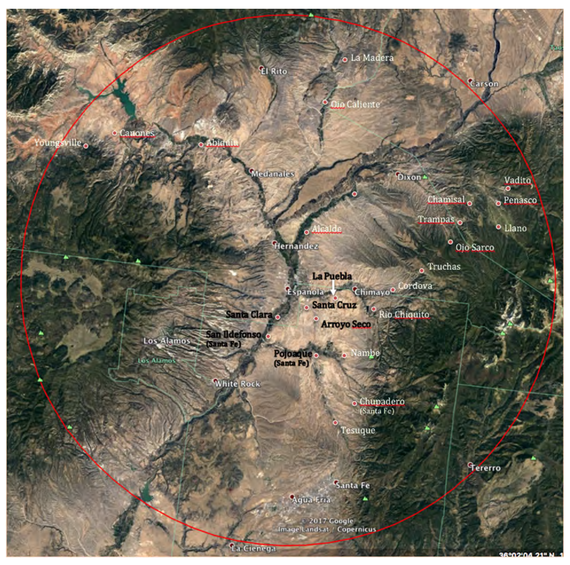
Goals/ Procedures

- The goal of the team is to conduct research on wireless networks including factors such as cost, effectiveness, possible requirements, and success rate. With this research conducted, a study within a 30-mile radius of the City of Espanola will be initiated. This study will obtain information about area ISPs, such as; maps, topology, data centers, existing networks, security protocols, and bandwidth within villages and towns.
- Conduct background research on wireless point to multipoint wireless networks.
- Survey and assess the environment within a 30 mile radius of Northern New Mexico College.
- Conduct interviews with local Internet Service Providers to gain knowledge and insight on internet networks with in a 30 mile radius of Northern New Mexico College.
- Simulate wireless point to multipoint wireless network in NS-2, Castalia, and Cambium Networks LINKPlanner.

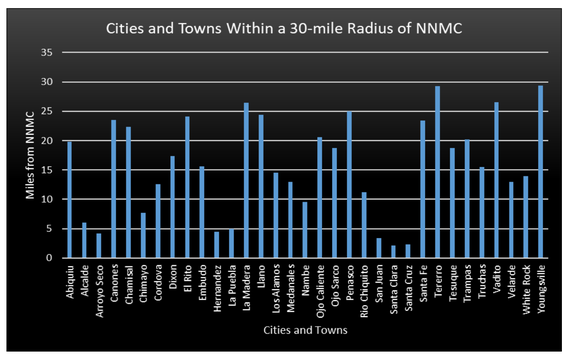
Background Research



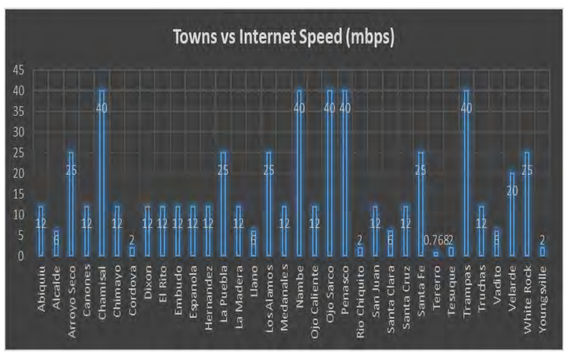
•**Figure 1**: An example of a point to multipoint wireless network.



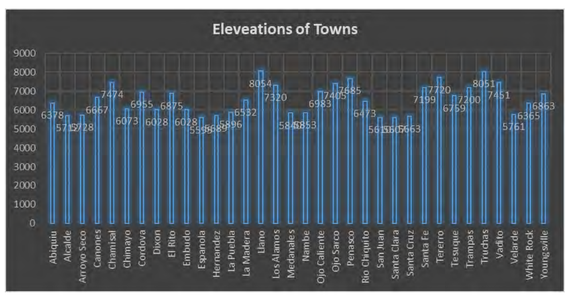
•**Figure 2:** A map of of Northern New Mexico showing the study area as well as the cities, towns, and villages within the radius with terrain features.



•**Figure 3**: A chart showing the cities and towns within a 30-mile radius of NNMC and their distance from NNMC.

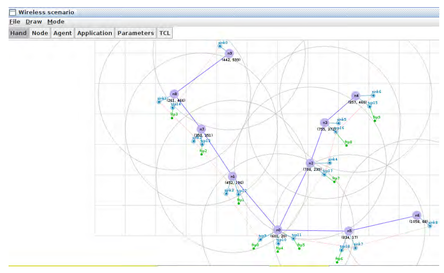


•**Figure 4**: A chart showing the cities and towns within a 30-mile radius of NNMC and their average internet speed (mbps).

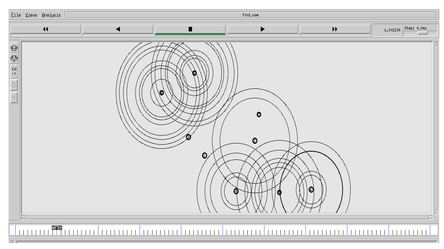


•**Figure 5**: A chart showing the cities and towns within a 30-mile radius of NNMC and their elevation.

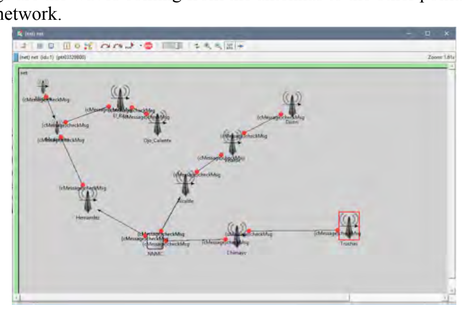
Past Simulation



•**Figure 6:** The graphical user interface of NSG2.1 with the wireless point to multipoint network that the team will simulate.

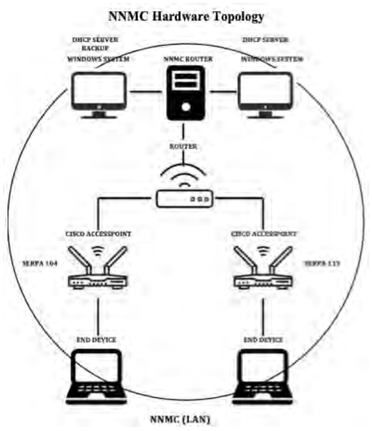


•**Figure 7:** The network paused during a wireless simulation in NS-2. Rings are the waves coming from the antennas to the other points within the network.



•**Figure 8:** A screenshot of a running simulation of a 30-Mile radius in Omnet++ Castalia.

•**Figure 9**: A screenshot of a running simulation of NNMC campus in Omnet++ Castalia.

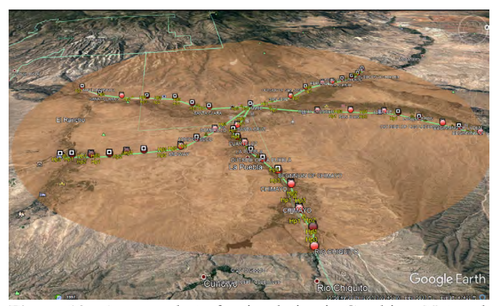


• **Figure 10:** A topology of equipment borrowed from NNMC IT Staff and implemented on NNMC campus.

• **Figure 11:** A Cisco Aironet 2602e that was borrowed from NNMC IT Staff and implemented on NNMC campus.

Current Simulation

•**Figure 12:** A screenshot of a simulation in Cambium Networks LINKPlanner at NNMC Campus.



•**Figure 13:** A screenshot of a simulation in Cambium Networks LINKPlanner at NNMC Campus.

Challenges

- Establishing line of sight between wireless equipment. Due to many different types of terrain, establishing line of sight has been proven to be difficult.
- Cisco Packet Tracer does not support the simulation of Wireless Point to Multipoint networks. Because of this, the team had to learn NS-2, Castalia, now LINKPlanner.

Materials

- Ubuntu OS
- Windows 10
- NS-2: An event simulator targeted at networking research.
- NSG-2.1: A TCL script generator that generates scripts for simulations in NS-2.
- Vim Text Editor: Used to edit TCL scripts generated by NSG-2.1.
- Google Earth
- Omnet++ Castalia: Simulator that is more user friendly than NS-2.
- Cambium Networks LINKPlanner: Simulator that lets you use actual devices provided by the company.

Acknowledgements

The team would like to thank Dr. Sadia Ahmed for her guidance and assistance while research was conducted on this project. The team would also like to recognize Jimi Montoya and Juan Gallegos for their advisement throughout this project. The team would also like to extend a special thanks to the Internet Service Providers (Windstream, REDI Net, and Black Mesa) for providing detailed information regarding their networks.

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