Deployment of Emergency Response Networks, a Web Application for Management

Author: Neftalí Candelario Soto
Advisor: Dr. Nelliud Torres
Department: Electrical and Computer Engineering

Abstract

With every passing day, more resources become internet dependent. It's evident that as time passes the share of our daily communications that rely on the internet will only continue to grow. Banking transactions take place online, enterprises rely on Voice Over IP to communicate between workplaces, and online social media platforms are the method of choice for most individuals. While these are all welcomed commodities, it does however pose a huge drawback in the event a natural disaster renders the internet unavailable. Response efforts must be well planned and swiftly executed to ensure as little downtime as possible. Emergency Networks must be monitored and managed to ensure proper functionality until normal conditions are re-established. This paper addresses the hurdles that may be encountered during an event that cripples an existing internet infrastructure and proposes alternatives to deploy and monitor a temporary solution that provides the necessary services while intelligently safeguarding the available bandwidth.

Introduction

Puerto Rico was recently devastated at the hands of hurricane Maria. Almost eight months after the event both the power and communication infrastructures are still struggling to get back on their feet [1]. Although the re-establishment of the power grid is of the upmost importance, one can arguably claim that the hardest aspect to deal with was the lack of communication after the event. Formulating a plan to re-establish communications as soon as possible should be one of the country's top priorities. To achieve this goal, we must make optimal use of the resources at hand, including both temporary power sources and temporary network equipment. Once a site has their regular sources for power or internet connectivity back online, the emergency equipment can be moved to another site that still needs the services.

Background

Alternatives for communication are required to get relief efforts on their way. When selecting these alternatives we must take into account that existing landlines may be in bad shape and that not all sites will have the same characteristics. There are many factors that play into deciding what topology to use. Power availability, surrounding geography, and necessary bandwidth all have their influence when choosing the deployment type. At the end of the day there are 3 types of connections that are atop our options. When in a tight spot where we have no functional cell sites near the vicinity, our best option is using VSAT Technology.

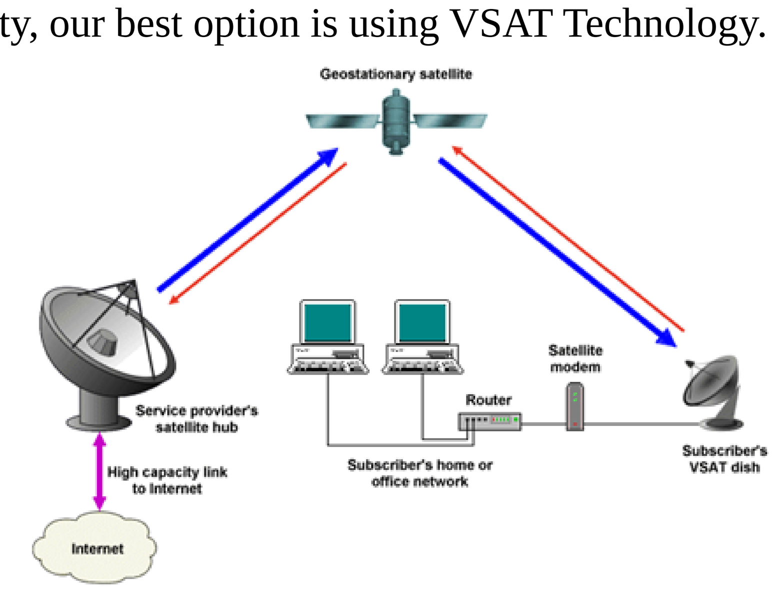

Figure 3
VSAT Technology

Background (Cont.)

A Very Small Aperture Terminal (VSAT) is a type of connection that uses a dish similar to those used for satellite television applications, a specialized Low-noise Block Downconverter (LNB), and a Block Upconverter (BUC) to achieve satellite connectivity [2]. These can be very useful when no adjacent cell sites are available. There are however other scenarios where a cell site is available, but is too far from the site to take advantage of LTE connectivity. In these instances a P2P connection may be used.

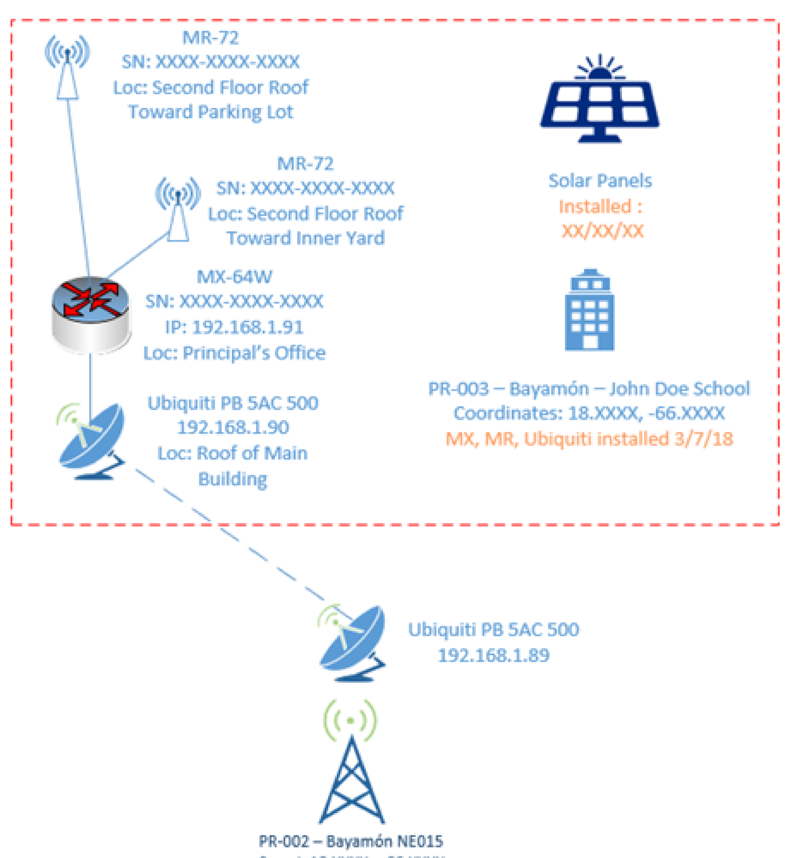

Figure 5
Point to Point (P2P) Technology

In other instances where a cell site is in proximity of the location we're trying to connect, an LTE modem could be used to allow LTE connection. While the previously mentioned topologies are some of the most practical options, there are also other ways to achieve connection through more unorthodox methods which may even include utilizing technologies such as TV Wide Space which utilize unused television spectrum frequencies and are able to achieve connection without a line of site.

Problem

The response to a catastrophic event should be as swift as possible. Establishing reliable communications is one of the top priorities during such and event and we must ensure that all available resources are being used as best as possible. To achieve this we need a single platform capable of tracking resources and providing the most current information to all team members. The development of an application for these purposes will ensure relief efforts are successful.

Methodology

The focus of this project was the development of a Web Application to keep track of all project assets to maximize the potential of the limited resources available after such an event. After preparing an ERD diagram for the proposed database, it was implemented using MySQL. An interface was developed using PHP and the resulting files were hosted using an Apache server.

Methodology (Cont.)

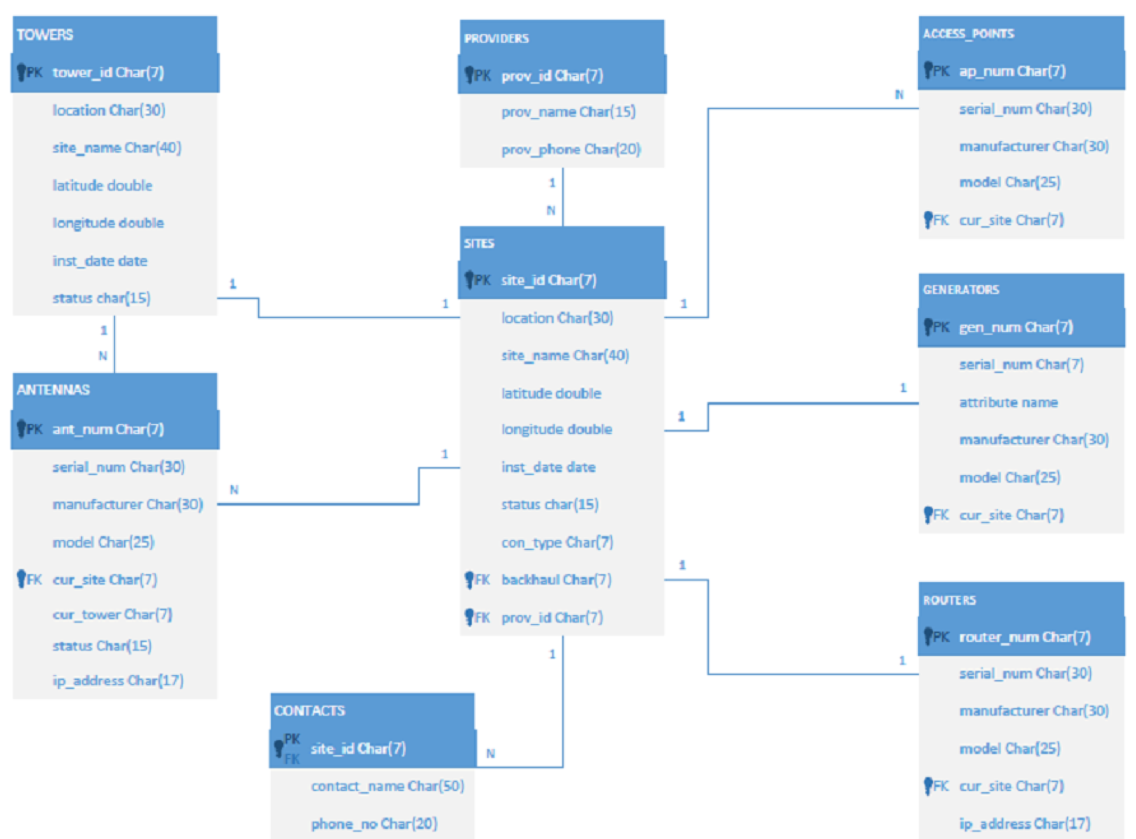

Figure 6
ERD Diagram

Results and Discussion

After implementing the database and designing the web interface, the end product is a user friendly platform where our information is available at a moments notice. Any team member with access may specify the location of newly deployed equipment, decommissioned equipment or simply register new equipment in the inventory. Decommissioned equipment can be easily marked as available so it can be considered available for future deployments as well.

Figure 8
Web Interface

Most importantly, the application accommodates any type of topology deployed in the field and keeps track of the IP space. This is particularly important. One of the most common problems during implementations was the fact that the IP space was not being tracked efficiently due to having several teams performing installations. With this feature, all teams will know what IP addresses are still available and which ones have become available due to decommissions.

Conclusions

When preparing for a natural disaster, there is no "one size fits all" solution. The conditions will vary depending on the event, and the solutions implemented in the field must adapt to any given scenario. The resources available will be shuffling between sites through the project lifecycle. This application will provide a centralized and robust tool that will keep track of the current inventory whether it's currently deployed, or it's ready for deployment at a storage site. It will also provide a live summary of the IP number space for the assigned network ID. This will avoid having issues with duplicate IP's that would otherwise cause conflicts within the network. The plans and methods discussed in this paper aim to be as flexible as possible.

Future Work

Although the base functions I set out to achieve were successfully implemented during this project, there are still several function I would like to add. First, I would like to add the ability to incorporate a site drawing to the site information. It will either be a database entry for a previously prepared sketch, or the ability to create a sketch using the webpage. Another feature I would like to add is SNMP capability. This would enable the user to see the connectivity status for any piece of equipment at a given site.

Acknowledgements

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