Case Study

Monitoring and Managing Generators in a Wireless Telecommunications Network

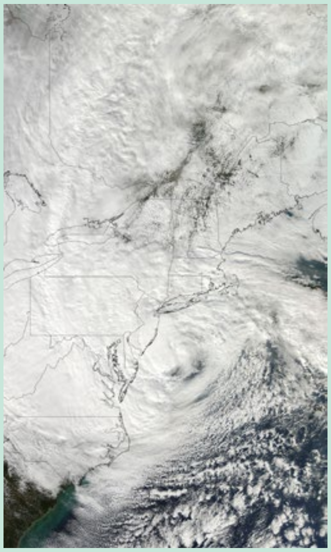
Asentria®

Monitoring and Managing Generators in a Wireless Telecommunications Network

Executive Summary

Recent weather-related disasters have illustrated both the public's reliance on cell phones for communicating in emergency situations, as well as the effect of widespread power outages on the cellular network itself. Cellular phones are no longer considered an additional method of communication for many people, instead they are their only means of communicating. The cellular network can be considered an important part of the public safety infrastructure.

This paper describes what occurred to the cellular network in the northeastern United States during recent hurricanes, and the subsequent steps taken by one wireless network operator to improve the management of the backup generators and related systems on their network.



The Challenge

On October 29th, 2012, Hurricane Sandy made landfall over the most densely populated areas of the northeastern United States causing massive damage to property, as well as key infrastructure related to power, transportation, and communication. Large numbers of cell sites over a vast area were inoperative immediately after the storm due to flooding, high winds, or main electrical grid power outages. The Federal Government made disaster declarations in 12 States and the District of Columbia, and cell site outages were estimated at up to 25% across a ten state area.[1] Hurricane Sandy was the 2nd largest hurricane, behind Hurricane Katrina, in US history in terms of financial loss, with damages estimated at almost $66 billion dollars.[2]

In the aftermath of the storm, some cell site locations were forced to operate on backup power sources and generators for up to several weeks. As power was initially lost, generators started as expected, but were forced to run beyond their fuel storage capacity. Refueling was difficult and slow, and because the actual fuel tank level was not known at the mobile network operator's (MNO) network operation center (NOC), sites were not visited in the most efficient order. A fuel truck might arrive at a site with ample fuel, while nearby, another cell site might be on the edge of running dry.

There were also problems related to the deployment of mobile communications vehicles commonly referred to as cell-on-wheels (COW's), cell-on-a-light truck (COLT's), and generator-on-a-truck (GOAT's), which are intended to supplement the existing fixed wireless infrastructure. While these vehicles could report on their own location when operational, it was challenging for the NOC to know the location of these vehicles when they were not deployed, or when they were en route to a disaster site. Once deployed, they could report on where they were located, but then suffered from the same problems as the fixed wireless sites in reporting back on their own generator fuel levels.

Hurricane Sandy was the second of three natural disaster events; Hurricane Irene in 2011, Hurricane Sandy in 2012, and Winter Storm Nemo in 2013, all of which impacted the northeastern US within a short time span. In 2012, there were 11 separate weather or climate related events in the US, each totaling more than $1 billion in damages.[3] While the variety of these events impacts a wireless network in different ways, it was clear that they could not be written off as "once a century" events.

It is an ongoing trend in the US for people to forgo a wireline phone in favor of a cellular phone only. These widespread disasters emphasized the extent to which this trend has also become a public safety issue. With up to 25% of cell sites down at a single time, large numbers of the population's only means of accessing 911 services were affected. This began to draw the Federal Government's attention to these issues as a matter of public safety. Proposals such as extensive battery arrays were recommended but never adopted.

During weather events such as Hurricane Sandy, the NOC functions as the MNO's headquarters for coordination of field resources while trying to restore the network. At the NOC, the Network Management System (NMS) displays the communications network's health. NMS software functions by communicating with equipment through a standard protocol called the Simple Network Management Protocol (SNMP). Many equipment manufacturers support this protocol, which means a wide variety of equipment can have their status represented in a single view within an NMS showing the health of an entire network. The NMS may also be tied to other operational software to handle trouble ticketing for maintenance of sites.

MNO's began to search for solutions of their own that would help them manage their networks. Some of the obvious problems that required immediate attention were the loss of main grid power, the use of generators, and the lack of visibility of fuel levels at sites that were running on generator power. An ideal solution would be to integrate the generators directly into the existing NMS so that they could be monitored alongside the rest of the network.

One of the challenges with this solution was the wide variety of generators that were deployed, most without an inherent ability to communicate via SNMP. Additionally, MNO's have strict security parameters related to their own maintenance networks. This meant that even if an IP-based controller was directly available on the generator, it would have to address the MNO's security restrictions, an undertaking unlikely to occur without unreasonable effort.

Further challenges related to the variety of back-up generators deployed within a Tier 1 MNO were the differences in the generators themselves, including the differences in the potential fuel types to be measured – diesel primarily, but also liquid propane (LP) or hydrogen cells, as well as issues related to variations in existing gauges and fuel tank shapes.

The Solution

Fixed Cell Sites

As Asentria began looking at the problem of how to manage fuel levels for a single MNO, it became clear that there were a number of different challenges that required attention.

1. Across diesel, LP, and hydrogen fuel cells, the MNO had seven varying potential gauges at their sites. Each type of gauge had differences on how it needed to be replaced, or how to integrate with it. Asentria determined appropriate methods of handling each of the situations, either through the provisioning of a new gauge or fuel sensor, or by determining a means of integrating to the existing gauge. In some cases, it was possible to interface directly to an intelligent generator controller using an RS485/MODBUS interface.

2. A variety of tank sizes were also possible, falling into three general categories:

    a. A "Linear", or rectangular tank
    b. A "Vertical Oval"
    c. A "Horizontal Cylinder"

What the MNO originally desired was a small piece of hardware that could monitor the fuel levels and report them back to an existing NMS via SNMP. As the project to monitor fuel level continued, it became clear that there were other things that Asentria would be able to help with to increase the value of the solution. As integration progressed, the top-of-the-line Asentria SiteBoss S550 emerged as the clear choice within the Asentria product line.

The following items were also addressed in the scope of the project:

1. Generator Exercising – Periodically running generators to ensure they are working correctly is a function commonly performed by the Automatic Transfer Switch (ATS). Using the S550, it was possible to take the generator exercising function away from the ATS, and give more direct control to the NOC personnel. In some locations, this helped avoid conflict and fines with the Environmental Protection Agency for running the generators during times of poor air quality. The SiteBoss enabled the NOC to choose when to cycle, or not cycle, segments of their diesel generator network based on the relative air quality. The SiteBoss was also able to report the success or failure of the generator exercising, as well as other variables, to the NOC. Asentria interfaced the SiteBoss to five common ATS devices: ASCO 300L, ASCO 7000L, Generac, Kohler, and Onan. This functionality was fully integrated with NMS vendor C Squared's SitePortal software to offer increased control over how generators are exercised.

2. Network Security Concerns – Because Asentria's SiteBoss units have passed numerous security audits, it required considerably less effort to put the SiteBoss unit on the MNO's management network to query other less-secure intelligent controllers, than to have the other controllers go through the lengthy security audits. The SiteBoss was integrated to multiple:

    a. Rectifiers
    b. HVAC controllers
    c. Battery Monitoring sub-systems
    d. MCPA amplifiers

    An additional benefit to using the SiteBoss as a security gateway is the SiteBoss' ability to collect and alarm on elements of power, security, and environment in a format that was common to the NMS.

3. Dry Contact Alarms – The Asentria SiteBoss was integrated with a variety of existing contact closure alarms to provide additional alarm data on many variables related to the environment, generator, batteries, tower lighting, HVAC, etc.

4. Remote Door Access – The Asentria SiteBoss can be integrated with a PIR wireless door access controller to allow the NOC to remotely change settings regarding who can enter a particular site, in addition to manually "toggling" the door strikes to allow entry to the site directly from the NOC.

The Solution

Mobile Communication Vehicles

With the adoption of Asentria's SiteBoss units at the fixed sites, another generator application was identified. During periods of crisis, like Hurricanes Irene and Sandy, MNO's deploy different types of mobile generators to help extend the life of the network. These mobile generators could be part of a mobile cell site on the back of a truck (COLT or COW), or simply as a mobile generator (GOAT). The mobility of these generators adds complexity to the standard monitoring and management issues of a stationary generator. In addition to the NOC wanting to know the fuel level in their mobile generator, they also wanted to monitor where the mobile generator was located. Asentria designed a compact product particularly suited to monitoring the fuel level and location of mobile commercial generators. The SiteBoss S350 has both a GPS modem to determine the location of the generator, and a GSM (HSPA or EDGE) or CDMA (LTE) modem for communicating the location and fuel level to the NOC. Intelligence regarding the location and fuel level of these mobile generators informs the NOC where best to place these resources when a natural disaster presents widespread threat of network outage.

In the past, "regular" wireless modems had been used for this purpose, but had been determined to be insufficient. Most of these modems were designed to receive power from a vehicle's 12VDC battery. If communication was not limited on the wireless modem, MNO's were discovering that when it came time to deploy the mobile communication vehicle resources, the batteries of the vehicle itself were dead. The S350 was designed with the sophistication to "sleep" during periods where the mobile communication vehicle was not in use. The S350 can then awaken through the use of an onboard accelerometer (if the vehicle begins to move), upon the generator starting, or upon a request from the NOC.

As integration continued, items beyond fuel levels were included in the scope of the project:

1. Temperature/Humidity – Measurements for both temperature and humidity internal and external to the communication shelter of the vehicle.

2. Photovoltaics (PV) Current – Current measurements from solar arrays

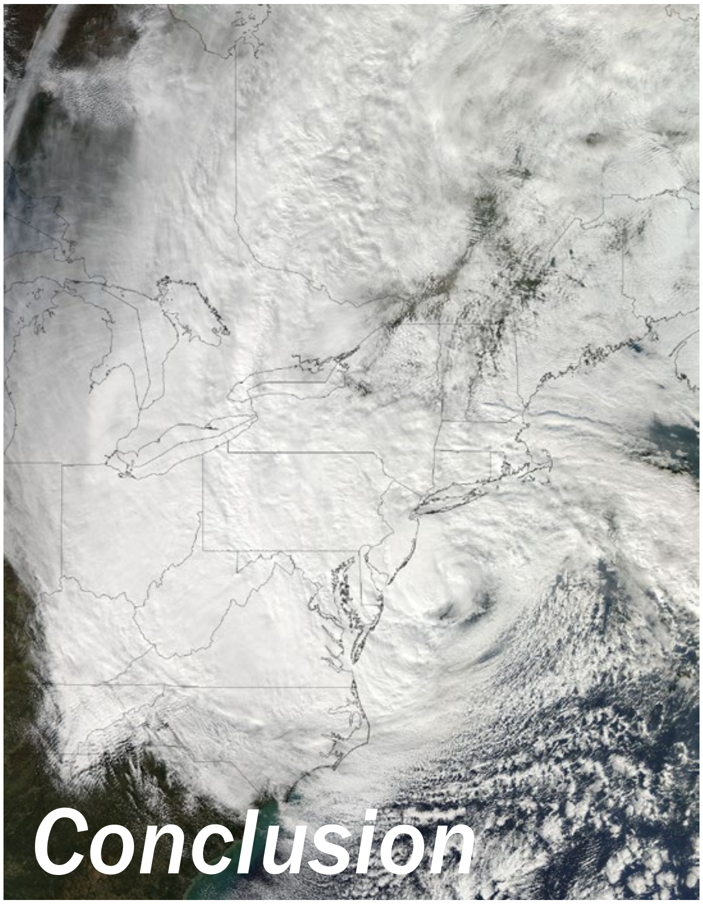
3. Inverter/Battery Voltage

4. Generator Run/Stop

5. AC/Fan Operation

6. Door Security Open/Closed

These functions were built into the S350 with the idea that the unit would communicate via SNMP to the existing NMS at the NOC.



Conclusion

Power is one of the most critical factors affecting uptime of wireless networks worldwide. Using Asentria products, MNO's and other telecommunication network operators are able to greatly increase their visibility and control of the remote locations on their network, particularly the back-up generator, the last line of defense for power outages. Weather-related adversities appear to be on the increase, bringing greater threat of widespread power outages to mobile networks. With experience from past weather events, and products that resulted from those experiences, Asentria can help network operators prepare for the next inevitable event.

If you would care to learn more, please contact sales@asentria.com or call 206.344.8800 to request our 100-page "How to Monitor a Cell Site" Document.

1 David Turetsky, Chief, Public Safety & Homeland Security Bureau, Federal Communications Commission, Remarks NENA 2013 Conference & Expo Charlotte, NC 06/18/2013, http://www.transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0621/DOC-321744A1.pdf.

2 According to NOAA, the 2013 Consumer Price Index (CPI) cost adjusted value of Hurricane Sandy was $65.7 billion. The costliest storm was Hurricane Katrina, with a 2013 CPI cost adjusted value of $148.8 billion, and the third costliest Hurricane was Hurricane Andrew, with a 2013 CPI cost adjusted value of $44.8 billion. Source: NOAA, "Billion-Dollar Weather/Climate Disasters," accessed 08/06/2013, http://www.ncdc.noaa.gov/billions/events.

3 Values represent the 2013 Consumer Price Index (CPI) cost adjusted value. NOAA, "Billion-Dollar U.S. Weather/Climate Disasters 1980-2012," accessed 07/11/2013, http://www.ncdc.noaa.gov/billions/events.pdf.

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