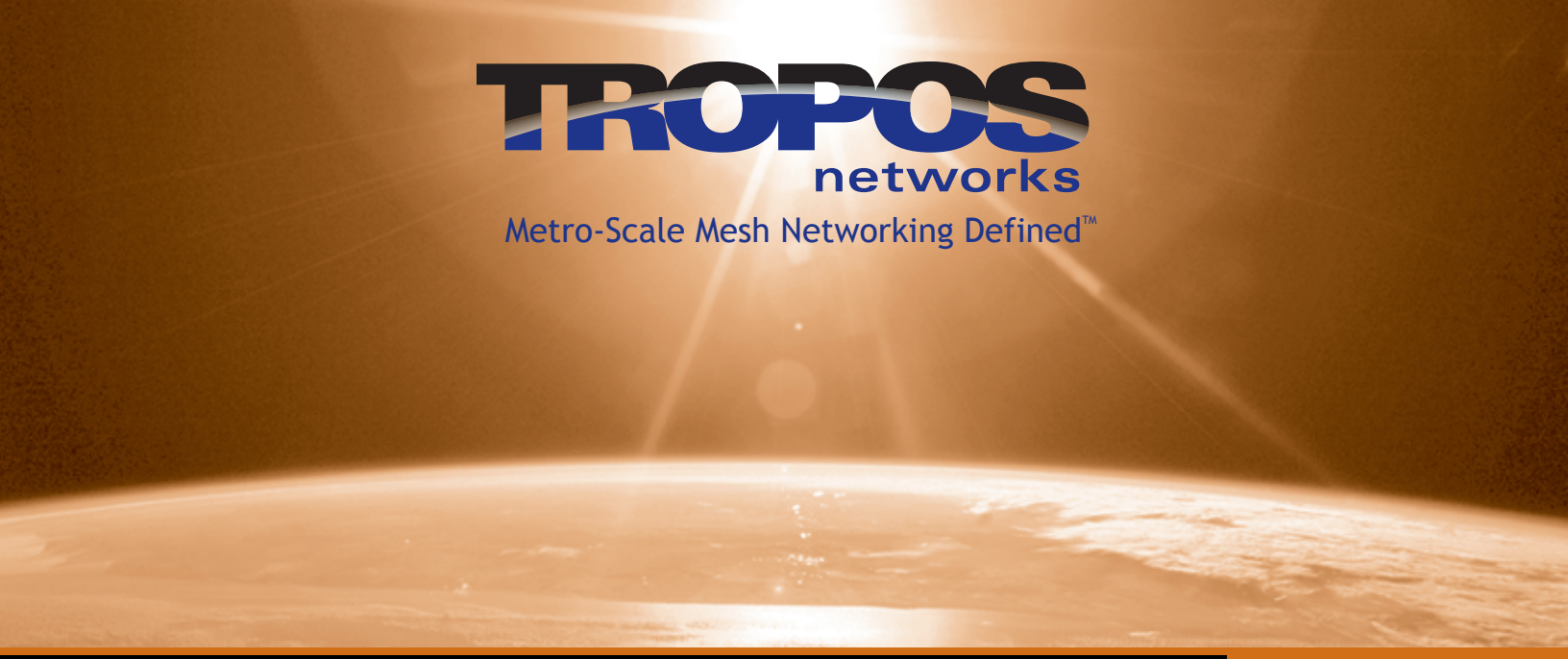

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Outage Management: The Electric Utility's No.1 Headache

A Technology Brief
July, 2007

A system outage is a crisis that is always just around the corner for an electric utility, which provides a mission-critical, life-or-death service with a high degree of reliability, but which is generally only really noticed when it becomes unavailable in an outage. At that moment, all eyes turn to the utility as it works to restore power. It is a very stress-filled situation. Typically stormy weather is the cause of disruptions to the physical electric grid that result in an outage. It is always an unplanned event and there is always pressure to restore service as soon as possible.

Less frequently is an outage caused by a short-circuit to the grid, should a tree branch or other object happen to make contact with a power line and connect it to the ground. Thus, basic utility outage management is a time-tested routine of system maintenance via tree trimming programs and outage recovery planning and drills meant to ensure that utility personnel are prepared and well trained in the event of an emergency outage.

In an outage situation, it is critical for utility personnel to communicate with ratepayers, immediately isolate which circuits are down, pinpoint the cause of the outage, fix the problem, restore service, and communicate with ratepayers. An outage situation is one of the most bedeviling issues that utilities face: not only is it a difficult issue from a perception and public relations perspective, but it also results in lost revenue when the electricity is not flowing, and depending on the extent of the outage, the amount of revenue lost can be considerable. Accordingly, in the details below, note the importance of utility-ratepayer communications at the beginning and end of the process, communications between utility personnel during outage restoration, and access to system data throughout. Voice and data communications are vital components of a successful outage restoration, and the communications infrastructure thus plays a critical role in outage detection, notification, and recovery.

New wireless broadband network technology such as the mesh router system by Tropos Networks provides a utility with a valuable new tool to address this traditional utility management headache and customer service crisis point. With such a new tool, an entirely new perspective on outages becomes possible, and that's the focus of this whitepaper.

The Current Role of Telecommunications in Outage Management Scenarios

The role that communications technology currently plays in an outage event is partly analog, partly digital, as follows:

1. **Outage Realization / Outage Detection**
    a. The SCADA[1] System notifies the Energy Control Center (ECC) that a breaker is open and that an outage has occurred OR the affected customers telephone the utility call center or their key account representatives when they experience an outage. In the case of a significant outage with more incoming call volume, an automated call intake process is triggered. Data for outage addresses is generally logged manually or by the system. In some instances, an estimate for system restoration is provided.

b. Key Account customers often have a separate call-in number to ensure that special attention is paid to them in the event of an outage.

2. Outage Data

a. The address data for outages derived from outage calls and/or SCADA system data is fed into an electronic database, which triggers special software to analyze the event and makes an estimate on probable cause, i.e., which distribution circuits and/or devices are out. In the case of key accounts, the data may be logged based on the feeders that align with each key account.

3. Outage Discovery

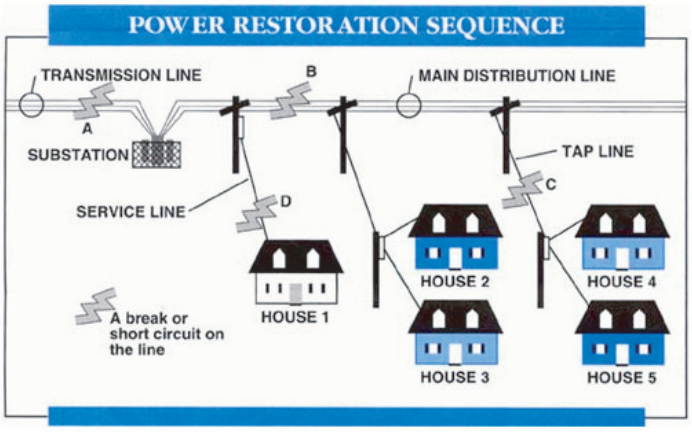
a. Using the special power outage software and estimated outage areas, the control center dispatches field crews to visually inspect the outage area, analyze the situation, and confirm a cause for the event.

b. Field crews communicate via voice with the Control Center using mobile radios and use laptops with access to preloaded utility distribution infrastructure data that employs a GIS application. If this data is in error or outdated, the crew will need to call the control center, in lieu of returning to the office, to get more accurate data.

c. After a field inspection, field crews are able to provide a better estimate and time for system recovery – "estimated time of recovery" or "ETR" - and communicate that verbally back to the control center, which becomes the resource for any future estimates on recovery. To ensure good coordination, the control center will generally update the Call-Taking Application (CTA), which will provide an update for Customer Care and Key Account personnel.

4. Outage Recovery

a. Outage recovery is a delicate process, that requires extensive coordination between the control center and the field. With damage and cause assessed, the crews make plans for restoration by order of priority, working on main lines first and then on remote feeders, and finally to individual accounts that still lack power.



b. Field crews make necessary repairs to restore the system, after having identified needed repairs and addressed the cause of the outage.

c. The control center updates the outage management application with the new information on outage cause, times, etc.

d. Customer Care and Key Accounts call the customers to confirm that power is back on, which is generally routine, but does also serve as a check in the case where power has not been fully restored and certain accounts remain out.

e. If power is discovered to still be out for particular accounts, that information is communicated back to the control center and out to the field crew, who focus on addressing the remaining outage issues.

The Potential Role of Advanced Telecommunications in Outage Management Scenarios

The review above of the outage identification, management, notification, and restoration processes provides insights into possible avenues for process improvement with a communications network based on the Tropos wireless mesh equipment. When combined with special wireless equipment like wireless laptops, PDAs, and VoWiFi handsets, as well as field sensors like an AMR system, the Tropos wireless mesh network becomes a vital tool for the utility in recovering from an outage, as detailed below.

1. Outage Realization / Outage Detection

a. **AMR meters as a "trip wire" system.** For those utilities that have an AMR system, the meters can act as a trip wire to indicate the loss of power at an end point. The smart meters can be programmed to give a "last gasp" message that they have lost power, providing the utility with pinpoint accuracy on the power outage. The AMR system uses the wireless network to push messages back and forth to and from the field.

b. **Communication between the control center and field crews.** Because such communication is currently based on radio traffic and verbal communications that indicate routing of the crew, slower response times are a significant risk. Improved communication with wireless laptops, PDAs and VoWiFi handsets would facilitate reprioritization and rerouting of field crews in a dynamic outage scenario.

2. Outage Data

a. **Data v. Voice Communication.** Moving to more reliance on integrated data communications over the wireless network, with automated updates based on dynamic situational data, should result in improved response times as well.

b. **Circuit data systems.** GIS system relies on static data and does not always present a true picture of actual system status (for instance, work on a distribution substation may cause power to flow differently). On the other hand, outage management software relies on near real-time, dynamic data. The discrepancy between these two systems can be a potential cause of confusion. Working to

leverage a wireless broadband communications network to integrate field and enterprise data could make the difference between a rapid, successful outage recovery and a problematic outage recovery.

3. **Outage Discovery**
   a. **Communication back from the field to the control center and to the Call Center.** With mobile data enabled by a wireless system, field crews can file estimated times of restoration (ETRs) immediately upon visual inspection. Waiting for data or attempting to access data without the benefit of broadband speeds can slow down recovery times considerably.
4. **Outage Recovery**
   a. **Communication between the field and the control center and the Call Center.** Field crews make final inspections and provide assurances of power restoration back to the control center. Often, field crews may discover after returning that one or more customers still do not have power restored. Such individual restoration as a last step is greatly facilitated when field crews have immediate communication with customer account representatives.

Conclusion

Management of any distributed infrastructure is greatly facilitated with the combination of processes, solutions, equipment, and manpower that is enabled by a ubiquitous wireless broadband network that overlays the infrastructure. Such a system consists of digitally automated processes, high-powered computers, specialized software applications, mobile communication gear, an integrated wired/wireless broadband network, and highly skilled crews. The critical component, the broadband network, is now available to utilities to an extent that it was never available before, thanks to affordable and highly capable wireless technology.

Tropos enables such a system to come to life, resulting in improvements that are most noticeable in a crisis situation like a power outage. When every second counts, it pays to have the best that technology can provide, and these days, that means a wireless broadband mesh network powered by Tropos gear.

Endnotes

[1] SCADA – (Supervisory Control and Data Acquisition) system used to control distributed systems from a master location, with most operator interaction driven by alarms, which automatically detect abnormal conditions, and may require operator intervention (mostly used for high-voltage transmission systems).

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