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Global Outage Management Relies on Robust AMI

For utilities worldwide, power outages are a fact of life. (Figure 1 lists percentages of production value lost for various places around the globe.)

For instance, the World Bank reports that in Thailand provinces the standard average interruption duration index (SAIDI) is 10 times higher than in Bangkok. Electricity outages are most frequent in the southern region, but duration per outage is longest in the northeast, according to World Bank data. Figure 2 shows 18 power outages occurred in 2004 and 19 in 2007. Power outages from the public grid are less severe in Bangkok than other regions. On average, they occur about 15.5 times a year, lasting about two hours each time.

Power outages are most frequent in the south, however, where interruptions occur 52 times a year and last an hour, on average. In the northeast, 20 outages occur a year on average, and each lasts about four hours. The duration is twice that in Bangkok. Outage frequency in the northeast is the same as in the east. The duration of each outage is one hour less in the east than in the northeast.

Aside from Asian countries, Europe is experiencing similar outage woes. A few years ago, an outage in Cologne, Germany, sparked a virtual European blackout. The Cologne outage triggered a domino effect that shut down parts of France, Italy, Spain and Austria, with Belgium, the Netherlands and Croatia being affected, as well.

France was among the worst affected, with 5 million people losing power mainly in the east of the country and the capital, Paris, and its suburbs. Reuters News Service reported that German utility provider E.ON said early investigations suggested the supply failures were caused by overloads in the power network in the country's northwestern section.

A year ago, EU leaders conducted initial meetings with energy experts to map a strategy to eliminate these costly outages and improve power transmission and distribution. The group agreed that Europe's power grid demands to be upgraded and equipped with strategic interconnections to create a smart power grid serving all of Europe.

OUTAGE CAUSES

Conventional outage causes include natural ones such as weather and heat, excavations, power station defects, damage to powerlines or other parts of the distribution system, a short circuit, or the overloading of electricity mains, equipment failures, cars hitting utility poles, or balloons drifting into powerlines.

While developed countries enjoy a highly uninterrupted supply of electric power most of the time, many developing countries face chronic power outages and brownouts caused by breakdowns in old, sagging power infrastructures, theft and acute power shortage as compared with the demand. Countries such as India and Pakistan have several hours of daily power cuts in almost all cities and villages, including metropolitan cities. Power outage effect on people in countries

PRODUCTION VALUE LOSSES DUE TO POWER INTERRUPTIONS — 1

Country	Percent of Loss Due to Grid Interruption
South Africa	0.9
Thailand	1.8
China	1.9
Vietnam	1.9
Turkey	2.3
Brazil	2.5
WORLD MEAN	**3.2**
Indonesia	4.2
Philippines	7.1
India	9.0

Source: World PICS (2002-2005) & Thailand PICS 2007.

where households are the largest electricity consumers accounting consumption is remarkably large. It paralyzes cities and creates food and water shortages, making life difficult for inhabitants.

The impact of power outage on the country's economy is also huge, halting major industrial, trade and economic and agricultural activities. A single event can cost commercial facilities such as banks and data centers millions of dollars over a year.

The solution to effectively manage power outages lies in either implementing a new state-of-the art outage management system (OMS) or upgrading an existing system to keep pace with rapid changes in advanced metering infrastructure (AMI) and meter data management systems (MDMS). For third-world countries suffering from chronic power shortage, however, implementing just an OMS might not fix the problem.

POWER OUTAGE INFORMATION, THAILAND 2

Region	Outages/surges Per Month	Average Duration of Outage/surge (Hours)
Thailand	1.5	2.2
Bangkok	1.3	1.9
Central	1.5	2.4
East	1.7	3.1
North	1.5	1.1
Northeast	1.7	3.8
South	3.8	1.1

Source: Thailand PICS 2007.

OUTAGE MANAGEMENT SYSTEMS

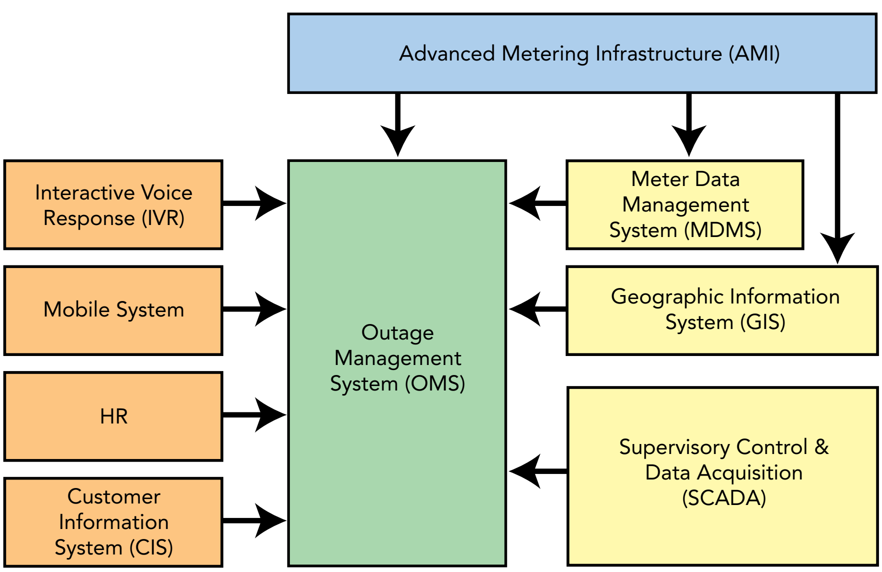
An OMS uses information from various systems to prioritize restoration efforts, manage crews assisting in restoration and calculate estimated time to restore power. The OMSs used by most utility companies around the world typically provide information along the lines of predicting location of breaker, extent of outages and number of customers impacted.

The supervisory control and data acquisition (SCADA)—one of the systems used to gather information for the OMS—notifies the utility control center that a breaker is open and an outage has occurred. The information it provides is limited, however, when it comes to assessing extent of damage and number of meters affected.

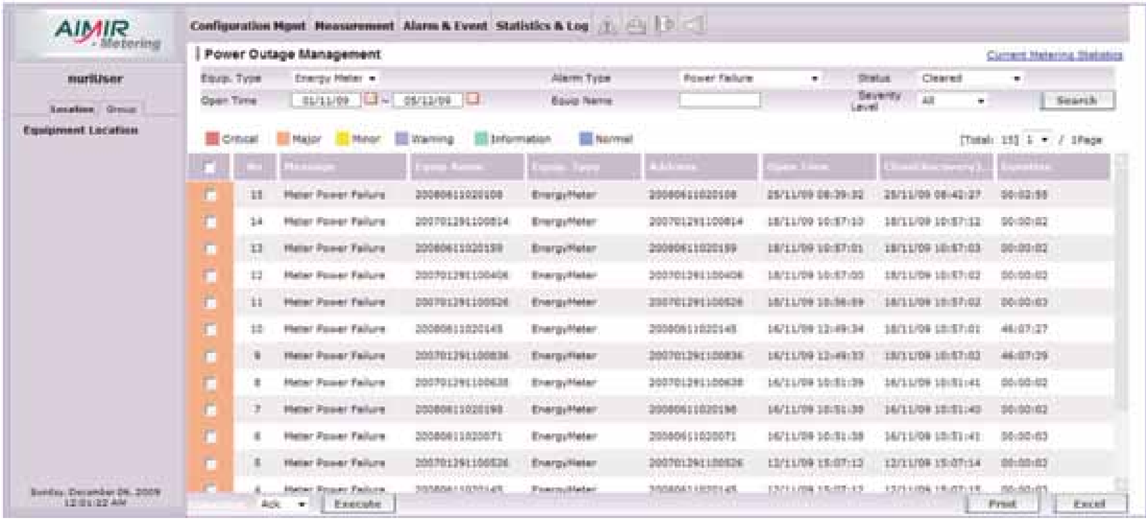
In most third-world countries, data for outage addresses provided by SCADA and outage calls by customers are logged manually into an OMS database. The OMS software analyzes the event and determines which distribution circuits, devices or both are out. This results in the utility control center's dispatching field crews to visually inspect the outage area and fix the problem.

While the system works, it is limited to the reach of the SCADA system and cannot identify actual

OMS USING AMI AND MDMS TECHNOLOGY 3



POWER FAILURE NOTIFICATION SAMPLE 4



customer addresses impacted by the power outage or when power is restored if the customers are back online.

NEW OMS—EXPLOITING AMI AND MDMS TECHNOLOGY

Utilities in developed countries are upgrading their OMS systems by integrating and linking varied operational systems such as AMI, geographical information systems (GIS), customer information systems, (CIS) interactive voice response (IVR) systems and mobile data systems to provide near real-time dynamic data from the field as shown in Figure 3. As a result, these systems allow utilities to accurately pinpoint power outages, which then are sent automatically to field crews. At the same time, crews can update the OMS with information such as estimated restoration times without requiring radio communication with the control center.

In Sweden, Goteborg Energi AB, one of Sweden's largest energy companies, is implementing an OMS centered on an AMI system provided by Nuri Telecom and integrated with other systems to support its 240,000 customers.

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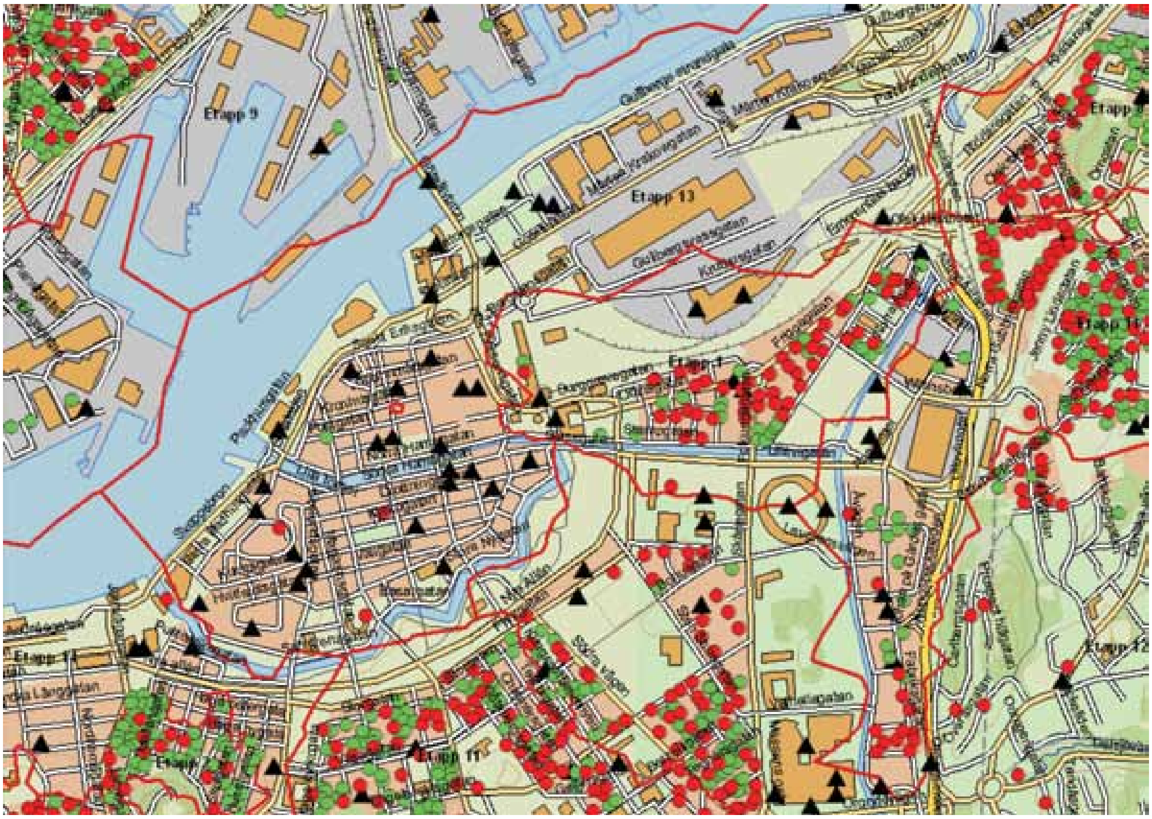
Meters connected in the network report power outages to the AMI server at the Gotenborg Energi control facility. Three types of outages are reported: unplanned power outage, power restoration efforts and planned outages. No action is taken by the OMS for planned outages. (Figure 4 shows a screen shot of power outage information.)

As shown in Figure 5, GIS working with AMI allows utilities to pinpoint outage areas. The colored dots represent meters connected via the network. If a meter experiences an outage, AMI provides the event notification, and the color of the dot changes. Let's say fully operational meters are represented by green dots, but once an outage occurs, the dot color changes to red.

Ideally, the concentrator in an AMI system ensures 100 percent meter communication and specifically targets outage and associated problematic areas. At the same time, it maintains minimal wide-area network (WAN) costs for transmitting data back to the AMI server at the utility control site.

Concentrators from various AMI suppliers differ in how they communicate power outage information from the meter network to utility companies. In most systems, intelligence is built into the concentrator device, and

GIS MAP DISPLAYING METER OUTAGE LOCATIONS 5



outage information is reported by meters. The repeaters in the network talk to the concentrator, communicating which meter or group of meters experiences a power outage.

In most cases, concentrators consecutively and individually report a meter's information. Hence, the AMI server receives one report after another in a sequential manner, often jamming up the entire AMI system. Delivering outage information like this proves expensive in the WAN cost of transmitting data back to the AMI server and only escalates with more meters in the loop.

It's best to collect all vital information, store it in the concentrator and at a fixed, programmable time, report it to the utility. The advantage is twofold: Network traffic jams are avoided when serially sending outage reports, and it dramatically cuts air time and, thus, is considerably less expensive to the utility.

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