Digital Power

By Peter M. Curtis

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Getting Connected and Staying Connected

Energy, information, and smart grid technology

For the first time in history, technology allows us to interact with virtually any device or application that is connected to the internet, from anywhere, at any time; and it's mainstreamed to half the planet, and growing out of control … or better yet, in control. A large percentage of the energy we use today goes toward moving information (ecommerce, social networking, trading, cloud computing, etc.). There is now a growing societal cost that needs to be clearly defined and addressed so that we can design and phase in the best energy system to meet our exponentially growing digital applications, data processing, and storage requirements. We need to get connected and stay connected. To be successful, advanced monitoring of our existing and future grid is imperative. This will allow us to improve reliability as we transition the Smart Grid into our evolving utility of the future.

What is the cost of moving information? What are our vulnerabilities? What is the cost of being too digitally dependent? As we shift in this direction, we need to be wary of excessive reliance on technology. When something does go wrong, and it certainly will, whether it's with the grid or something internal to our mission-critical infrastructure, proper response is required. We need to respond effectively, efficiently, and safely, with experienced personnel equipped with the proper problem solving skills and with advanced technology so that we can visualize what is going on around us.

Fortunately, we have the technology to improve situational awareness by integrating SCADA and GIS systems for electric and water utilities and then integrating data inputs from multiple feeds including BMS systems, camera networks, and even the drawings and procedures that are required to troubleshoot quickly. With these vast data resources and the rate at which refreshed information streams, the problem becomes information overload. Today, we have the processing power to analyze this abundance of data and merge it into a common operating environment (COE) that provides a complete picture and accurate perspective of energy issues that can take down the system and also affect the reliability of our critical infrastructures.

First responders really benefit from these advanced tools. Not just the energy industry but also the mission-critical industry, which we all know is extremely dependent on continuous uninterrupted

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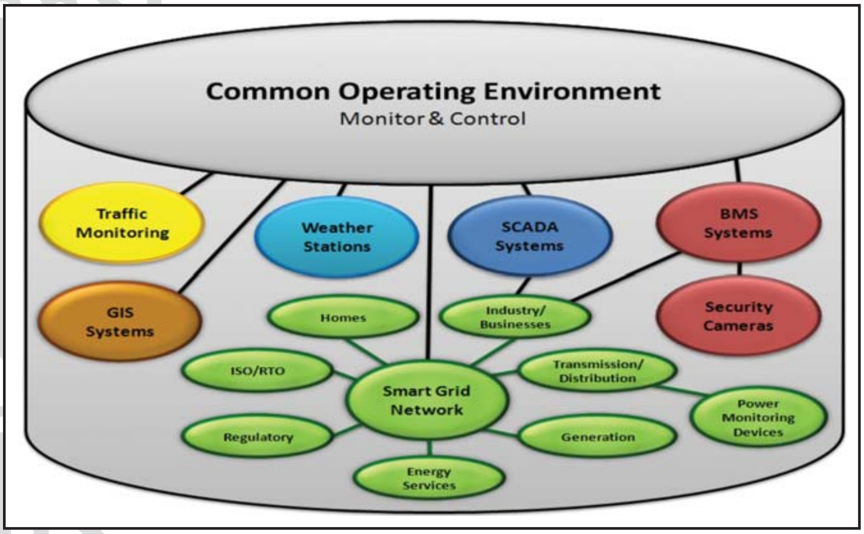

Ideas like the common operating environment help coordinate responses in emergency situations.

power. Mission-critical infrastructure has various levels of redundancy based on risk tolerance, and we can get through a week or two with our back-up systems, but what happens after that? What if the proper supplies and fuel can't be delivered or there are system-wide outages that take out larger regions of the country, thereby affecting our disaster recovery plans?

With improvements also come challenges. In this case they involve securing information necessary to function efficiently and operate no matter what is occurring outside of the processing walls. In other words, we can't have a 'five nines' availability of our electrical infrastructure, and have a 'six nines' availability of our software applications. They need to be equivalent, or we need absolute certainty that the applications can be rerouted.

The smart grid, being a digital system, is vulnerable to cyber attacks. To defend against this, an intelligent system that integrates all systems necessary for uninterrupted functionality would have to be able to detect intrusions and bypass affected nodes to keep electricity and information flowing. This capacity to "heal" through the use of installed "smart switches" and automated situational awareness throughout the network would create a grid that is more resilient to both deliberate attacks and natural disasters.

Also, organizations lack accurate and up-to-date information systems to provide first responders with detailed grid outage information. Keeping personnel trained and ready to respond to emergencies is a challenge. For example, the main circuit breaker at a power plant or substation could be fitted with sensors to monitor its temperature, voltage, amperage, and electrical signature. These sensors could then be monitored to understand the characteristics of the circuit breaker prior to a failure. This will allow necessary repairs to be scheduled before there is a catastrophic failure of the equipment. Monitoring the trends of these data can also help predict when other equipment is on the verge of failure.

A COE enables decision-makers to evaluate specific populated areas as events are unfolding, using sensors, monitors, and cameras that provide a constant stream of information to first responders to ensure that the appropriate decisions are made and assets are deployed where they are needed most. The difference here is all the systems are integrated and algorithmically tuned to take into account all possible scenarios. This technology is available today and can be easily implemented to improve our responsiveness, with the main benefit being lives saved and catastrophes averted.

We can also leverage the COE to work for our power grid to help reduce system demand just by controlling and conserving. Since devices can be monitored and controlled remotely, and even have built-in decision-making capabilities, the end-user now has the ability to reduce energy usage to a fraction of normal. Technology enables us to quickly remove electrical load from the grid during emergencies. This can strategically reduce load in one area and allow that freed up capacity to be redirected to where it's needed more.

The result is reduced capital expenditures for grid reinforcement or the construction of new power plants. In this way, technology and conservation efforts have multiple advantages and really do have a trickle-down effect when compared to the life-cycle cost of building new power plants. Think about all the different levels of efficiency we can leverage by just conserving due to the integration of smart grid technology that is aligned with a COE. This technology can be taken advantage of both at home and in the workplace, with "always on" monitoring, sensing, and adjusting responding to normal or emergency conditions. If we are experiencing weather-related problems during the day or a cyber attack during the night, we stand a better chance of staying connected to our "always-on" environment.

Our electric infrastructure was designed and built without today's needs for energy security, reliability, and efficiency. The smart grid will be designed to address the modern needs of our digital society. Essentially, it will evolve into the vast network that will join millions of new devices with the trillions already on the web. The end-user will be able to better monitor and control their energy usage and first responders will benefit from the COE during critical events. ■

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