

# InService SmartGrid: Embracing the Technology Trends for Intelligent Electric Networks

A White Paper

Security, Government & Infrastructure, a division of Intergraph





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# 1. Managing Electric Networks

SmartGrid embodies the concept of the “self healing” and the “intelligent management” of electrical transmission and distribution systems. These networks are both radial and grid systems that have common areas for improvement. Utilities can realize enhancements in network performance and reliability with the addition of “smart” devices, communications, and software applications. Combining these three components enables utilities to improve operational responses, reducing outage impacts and frequencies.

Beyond cost savings and operational efficiencies, the pressures of utilities to become “carbon neutral,” incorporate renewable energy, and limit or eliminate new plant building compel both customers and energy providers to manage power loads more effectively. Load management is perhaps the defining element and principle goal of implementing smart grid.

The Intergraph InService SmartGrid solution provides the system operator with a unified command-and-control environment to quickly detect and address outages and potential problems with the electrical network. This application is called the InService SmartConsole. InService receives real-time input from network devices, smart meters, and other sensors that provide more information to make better decisions. Moreover, the system operator can control and operate network devices to re-route power flows, adjust voltage levels, and re-configure the network to support restoration activities. The SmartGrid solution can also automate many processes typically handled manually. Some of the automation included in the Intergraph InService SmartGrid solution includes automatic generation of switching steps for load transfers, disabling of automated devices for manual switching, and fault isolation and field order generation. Additionally, the system shows advanced alarm displays on the system monitor, indicating overloads and other network problems.

A further extension of the Intergraph SmartGrid solution is the OneMobile Field Automation component. OneMobile provides real-time communication between field crews and the system operator, which optimizes restoration activities by getting the right resources to the right location with the right equipment. OneMobile and its specialized field applications are particularly important during storm restoration activities. Field damage assessment is a OneMobile application designed to capture equipment damage information. Field personnel can quickly assess storm damage with a mobile computer and send the information back to the operations center to expedite service restoration.

Combining traditional field automation with distribution outage management results in significant benefits with regard to service resiliency and faster restoration. When real-time electrical system status information including supervisory control and data acquisition (SCADA) and distribution network applications (DNA) is integrated with outage management systems (OMS), utilities attain yet another level of operational benefits. Intergraph SmartGrid is initially being offered in conjunction with SCADA and DNA systems provided by Siemens AG.

The integration of multiple systems is the basis of a smart grid. The smart grid will evolve rapidly as more devices are introduced and improved. Also, system applications are being enhanced to optimally use all the data to more automatically maintain continuous electrical service and reliability.

## 2. The Need for an Intelligent Network

During the last several years, reoccurring outages have affected consumers all across North America. The outages include non-preventable instances such as storm damage, but often are the result of aging equipment and loading problems. In some cases, outages can have drastic effects on the local and national economy. In 2000, a one-hour power outage at the Chicago Board of Trade disrupted trading for an hour. The brief outage prohibited nearly \$20 trillion worth of trade.

There are numerous examples of outages impacting business and personal lives. Following these events, several obvious questions arise. Why did this outage happen? Why did it take so long to restore power? How can we become more proactive and prevent unplanned outages? All of the questions can be addressed with the deployment of a smart grid network management solution.

### 2.1 Smart Grid Network Management

Most industry experts will agree that technology can improve reliability of power delivery systems. A modern grid can become more secure, efficient, safer, and less costly to maintain using advancements in technology. To meet specific energy standards for reliability, utilities are actively seeking out technologies that will address these concerns.

The technologies required to improve utility performance can be understood by reviewing the conceptual goals of a smart grid. This network management solution should be capable of detecting abnormal conditions, analyzing the magnitude and extent of network problems, and automatically reacting. Each step requires modern technologies. In some cases, these technologies are partially in place and have been used for decades. One example is field devices that can operate to protect other network components. Some emerging technologies, like automated meter reading, also can be used as a technological component of a smart grid.



*Figure 1: Smart grid systems are capable of detecting abnormal conditions, analyzing the magnitude and extent of problems, and automatically producing plans to respond effectively.*

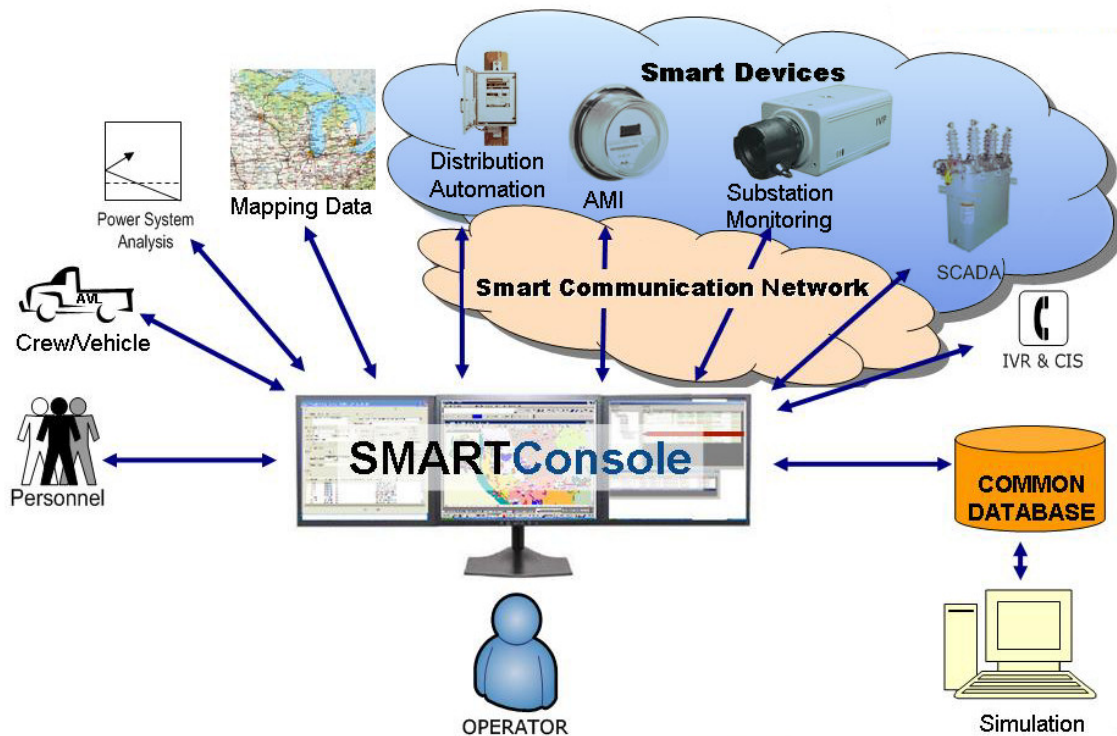
Smart grids will integrate communication networks with the power grid to create a real-time view of the electric network capable of monitoring its own health at all times. It will alert officials when problems arise and automatically take corrective action. Monitoring and detection technologies will use bi-directional communication to maintain this healthy network. The sensing technologies will communicate status of analog and telemetry data from the field devices to monitoring systems. These monitoring systems will analyze the data and automatically generate switch plans, work orders, or take immediate actions to self-heal grid components or network sections.

## 2.2 Smart Grid Technologies

Achieving a modern grid with all the necessary principal characteristics will require the application of well-chosen technologies. Some of these more advanced technologies, though new to electrical power distribution, have been implemented in other industries and have a critical role in an intelligent grid solution. These technologies include:

- **Smart Communication Networks** – Integrated communication networks capable of supporting high-speed and large volumes of data in a bi-directional flow between the operational centers and the electric infrastructure.
- **Smart Devices** – Utilizing the latest sensors and automated devices, these more intelligent devices will supply more data to the operations center. Measurement information will aid operations and software applications in making better decisions.
- **Smart Operator/Console** – Improvements in outage and distribution management systems will provide a single user-interface that communicates SCADA, DNA, OMS and mobile workforce management (MWM) data to system operators. These traditionally stand-alone applications will be interconnected to provide a more complete view of the entire operational conditions.

The combination of smart devices with a smart communication network will supply massive amounts of new data to an operator. The addition of load and voltage information, video surveillance, access alarms, trouble calls, and field reports can certainly provide a complete picture of the network. However, all of this data can also overwhelm software systems and their operators.



**Figure 2:** Smart grid technologies include devices in the field, software applications in the operations center, and a smart communication network which enables real-time network management and monitoring.

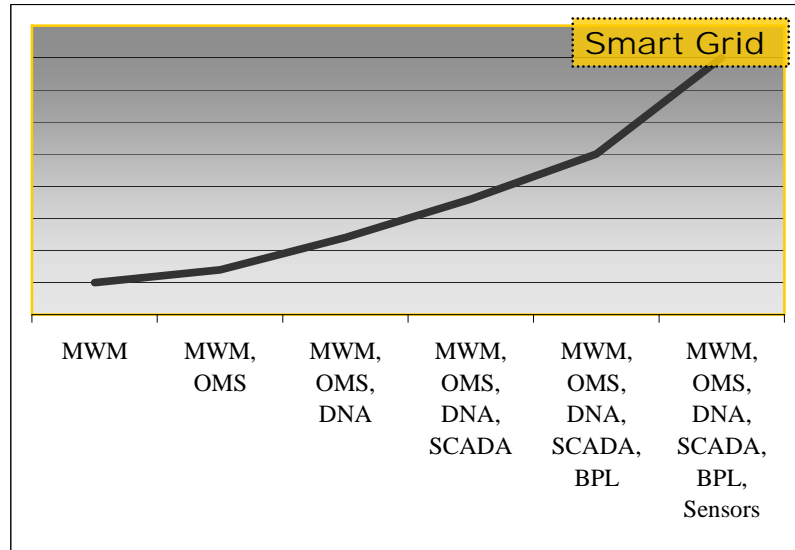
Currently, no single vendor has a complete solution for addressing smart grid. Utilities must use a combination of technologies from wireless carriers, such as field hardware and software. It is also unlikely that a single vendor will ever be able to provide all components of this solution. As mentioned before, some of these technologies already exist today. Therefore, using similar technologies for utilities can greatly improve initial deployments because they have been tested thoroughly. For example, intelligent video surveillance has been used in security applications to monitor secure areas for years. This same technology can be applied to substation and generation facilities, allowing operators to proactively ensure the security of high-voltage facilities. With a full smart grid solution, major transmission and distribution lines can be monitored with video and intelligent alarms can be activated to alert the operators when threats are detected.

In addition to video monitoring, load management and monitoring applications have also been in place for decades. These tools can be combined with outage management to improve network management. Various vendors have stand-alone tools that have the capability of integrating with other applications. Since smart grid operators need a single user-interface, these network analysis tools can feed the results of their analysis to system operators. System operators, using a smart console, can visualize overloads, perform power flow analysis, detect fault locations and generate service restoration steps.

## 2.3 Smart Grid Challenges

A major challenge for utilities today is ensuring low cost and reliable power to their residential and industrial customers. Smart grid solutions will aid utilities in achieving their goals by monitoring and managing network conditions. The real-time management can support more proactive network changes when devices are communicating their health to the system operators. Smart devices are field equipment integrated with sensors providing both analog and telemetry data from the installed location to the system control rooms. However, several challenges exist that must be overcome to take full advantage of smart grid network management systems.

The primary challenge is determining what technologies will be combined to support the smart grid vision. Since smart grid combines various existing technologies, the return on investment is directly related to the extent of integration and the scope of implementation. Figure 3 on the following page depicts the various application solutions required for a smart grid. As utilities begin to integrate and implement key operational solutions, the grid and the utility provider become “smarter.”



**Figure 3:** Smart grids are composed of multiple application systems working together to provide a more complete view of the operational condition. Combining these systems yields a "smarter" electric network operations environment. The more components to the system, the smarter the grid can become.

The components of a smart grid system should provide more flexibility and increased success in obtaining utility operational goals. Many utilities will begin combining MWM with OMS and recognize some added benefits. With the addition of DNA, utilities can move one step closer to a smart grid. And, with SCADA, broadband over powerline (BPL), and video/sensors, these added features can be combined to result in full smart grid.

A fundamental requirement is managing all these applications in an easy-to-use operator console. The complex nature of any one of these solutions by themselves is daunting. Trying to manage the network, field resources, monitor alarms, and communicate orders will be the ultimate responsibility of the smart grid operator. These multi-tasking individuals are going to be the heartbeat of the utility company. Supplying quality power to paying customers is the goal.

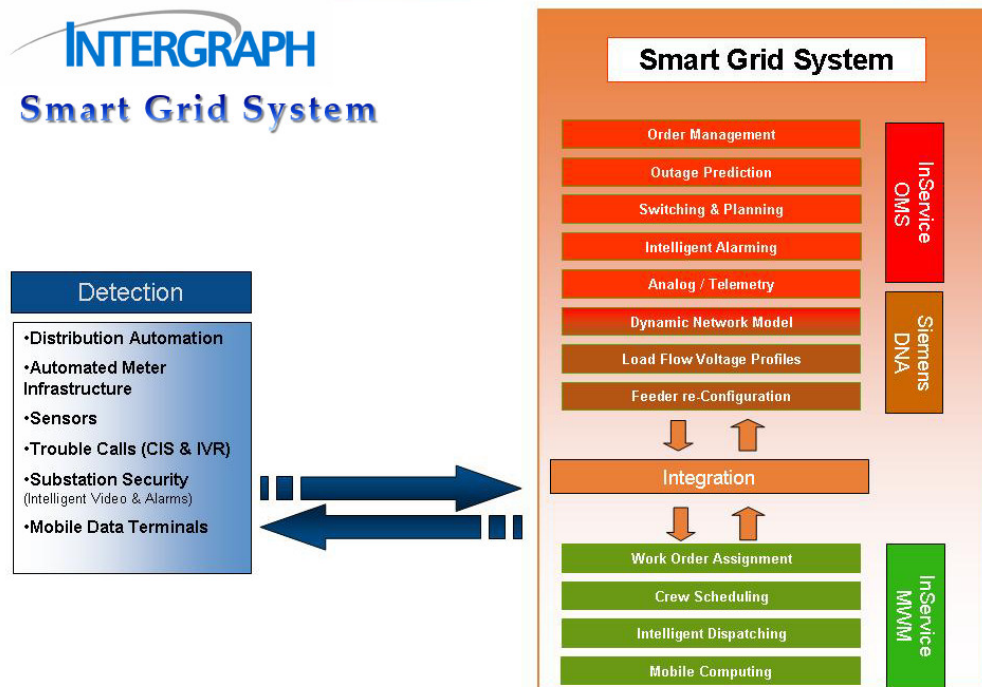
### 3. What will the Smart Grid Application Look Like?

The smart grid software application is a single application that presents a variety of information to system operators. Consider combining all the daily activities performed by system operators today. Often these operators use the SCADA system to initiate switching procedures. It is also common within the SCADA system for users to place tags on the network to present information to other system operators. With SmartConsole, the operator will no longer perform these switching and tagging procedures in a separate application.

Since SCADA is just one of the applications a smart grid combines, consider other workflows that have once required duplicate work. Many utilities are manually creating and maintaining several network models. With a smart grid solution, there is a **single network model**. This master network model will be exposed to network analysis tools and SCADA. This is particularly useful when utilities create and execute switching procedures. The result is a single operator console that will permit network management, order creation and assignment, network analysis, and crew management.

#### 3.1 Intergraph's InService SmartGrid Solution

Intergraph has responded to the emerging market demands by creating a unique software application that combines a proven OMS and MWM product offering with network control and analysis products. The InService SmartGrid solution is capable of managing a smart grid network by integrating inputs from a variety of sources. Figure 4 below provides an example of the input (detection) sources and types.



*Figure 4: Intergraph's InService SmartGrid System manages a smart grid network by integrating inputs from a variety of sources.*

The InService SmartGrid solution was designed to be the single operations console capable of managing the entire distribution network. This command-and-control application can gather data from a variety of detection sources and convert this information into alarms, events, and work orders. The InService SmartConsole is capable of turning disparate complex data into manageable views of the same information.

The need for multiple systems with multiple user-interfaces has been eliminated. The SmartConsole has all of the same features of these other systems, such as switching and tagging. The SmartConsole is not intended to replace SCADA or network applications, rather the operator console is intended to provide a single user interface to these systems and provide one integrated, consistent user interface. These existing applications have proven themselves as a reliable solution, and the SmartConsole will extend the usability by tightly integrating them with OMS and MWM.

## **3.2 Benefits of InService SmartGrid Solution**

The fundamental benefit of the InService SmartGrid solution is the unification of several operational tools into a single command-and-control environment. Leveraging the strengths of existing SCADA, DNA, OMS, and MWM application systems will help utilities realize the greatest benefits. Integrating software systems, communication systems, and hardware systems is critical to recognizing operational improvements. Consolidation through integrated software solutions and a common user interface is the key.

A beneficial result of full network operations integration is faster response times by operational personnel. In many cases, operators can make better and faster decisions when more information is available to them in a single application. The InService SmartConsole tools provide a consolidated view of the entire network operations. System and device status can now be monitored using a single application designed to consolidate the operators' traditional view. Instead of monitoring the network in a SCADA system, making changes in OMS, using automated vehicle location (AVL) to locate a field resource, and calling the resource to assign a work order, users of the SmartConsole will have all this information presented to them in a single integrated user interface. Operators can monitor the entire network and field resource pool using a single console, which will greatly improve productivity, as well as safety.

## 4. Conclusion

In the last few years, all stakeholders have kept a close eye on the electric utilities market. Various areas of concern have drawn even greater attention to the vulnerability of our aging electric infrastructure. These issues include:

- Security threats to generation, transmission, and distribution
- Reliability of equipment in the field
- Accuracy and frequency of field data
- Emergency/outage responsiveness
- Environmental impacts
- Employee safety

The industry has acknowledged these stakeholder concerns by the adoption of a common vision. This vision has been appropriately named “smart grid” or “intelligent network.” The purpose of a smart grid is to provide more reliable power to the public using advancements in technology.

Intergraph is leading the way in providing a smart grid command-and-control environment for electric system operations personnel capable of monitoring the health of the network as well as aiding utilities in making better and faster decisions. These decisions are facilitated by using Intergraph’s InService SmartConsole application to supplement existing investments in systems such as smart meters (aka AMR), SCADA, BPL, and DNA. By combining these traditionally disparate systems into a single user environment, utilities can more effectively understand and manage electric distribution operations.

As technologies continue to evolve, Intergraph’s InService SmartConsole will prove to be a vital piece in the delivery of reliable power.



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