Building Tomorrow's Enterprise

White Paper

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Enabling a Smarter, Sustainable Energy Platform

Enhance Predictability, Efficiency with Smart Integrator

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Abstract

North America alone has seen five massive blackouts in the past 40 years, three of which struck in the last decade. The reasons were the slow response of mechanical switches, lack of automated analytics, and "poor visibility" or a "lack of situational awareness" on the part of operators. Blackouts have far broader implications than thousands of domestic consumers waiting for the lights to come on. Widespread economic and human loss often includes impact on industrial production as plants come to a halt, spoiling of perishable foods, accidents due to failure of traffic lights, incomplete credit card transactions, and disruption during emergency situations in a hospital. Such are the effects of even a short regional blackout. More often than not, in many parts of the country, the only way a utility realizes there is an outage is when a customer calls in to report it.

Electric utilities are struggling – in proactive or reactive mode – to ensure sustainable power supply, while attempting to adapt to changes driven by the need for energy conservation and concerns around climate change.

This paper focuses on defining energy platforms for utilities by breaking them into categories or "blocks", starting from the point of generation in the power plant, power flows from a transmission (high voltage) network to a distribution (low voltage) network, and into the home or business and connecting these blocks in a smart way to predict unexpected changes.

Another focus area that supports upcoming change is the interoperability between systems – not only must computer applications or systems exchange information, but they must also be able to understand that information.

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Why Smarter, Sustainable Grid

The various challenges that energy utilities face today include:

1. Manual restoration during breakdown
2. Centralized generation of electricity
3. Low tolerance to security attacks
4. Limited control and transparency
5. Reactive response
6. Fixed pricing and power usage prediction
7. One way communication
8. Low transparency of usage to customer
9. Archaic regulatory framework

For any upgrade to the current infrastructure for applications and tools that were built decades ago, most utilities work on an ad-hoc basis. However, in the electric power system there is significant preparation needed for utilities to enable smartness in system interaction.

Various systems such as Customer Information System, Outage Management System, Geographical Information System, and Meter Data Management are the key enablers. They help implement these standards using various tools for increased connectivity and coordination to achieve automation between customers, suppliers and the network supporting this infrastructure. As a critical step towards enabling a smart grid, utilities must take the lead in defining their business process requirements, and in specifying and testing the resulting standards of their operations. Application and system vendors may support and lead the technology front, but the utilities have the crucial knowledge of their own requirements.

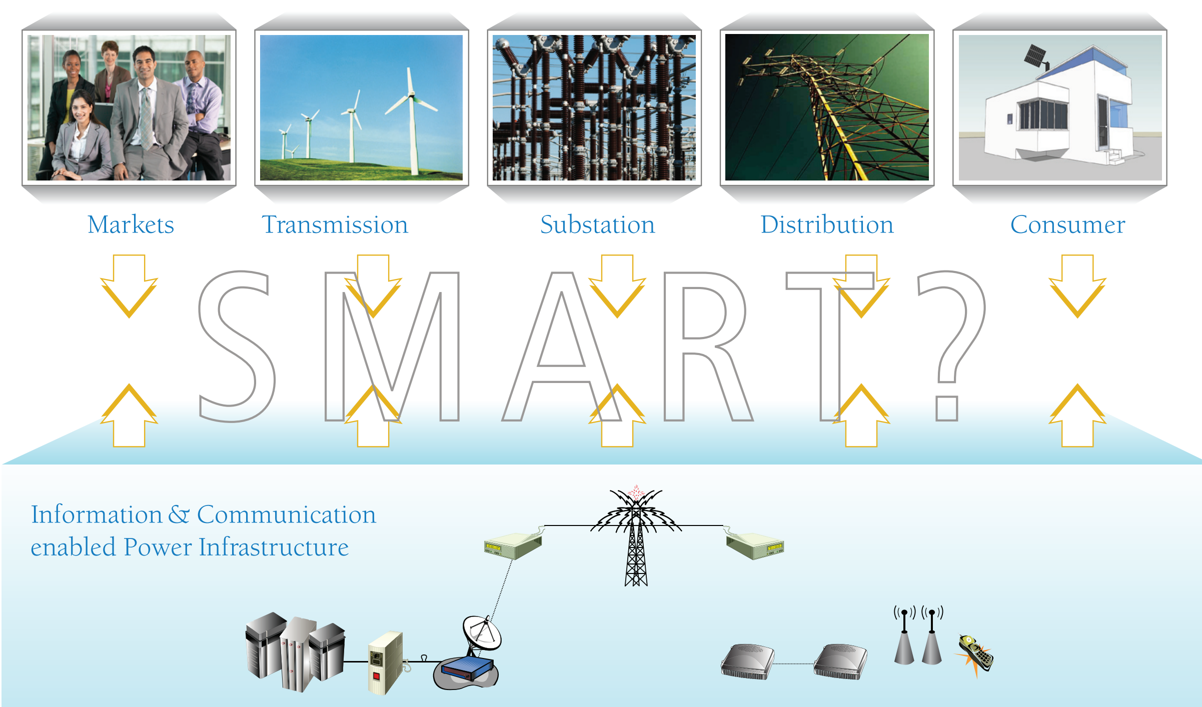
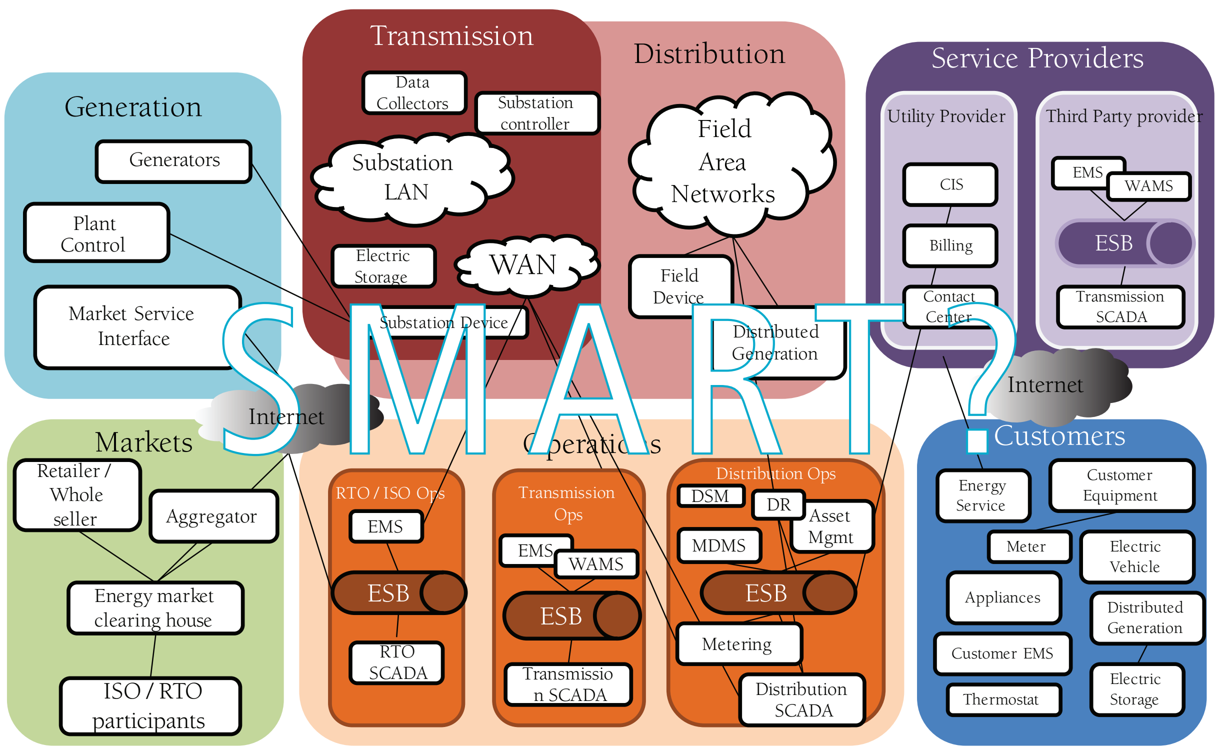


Figure 1

In order to maximize the benefits from this initiative, prepared thorough assessment is needed to be able to cost-effectively leverage the enabling technologies, standards-based interoperability, communication technologies, and state-of-the-art electronics to increase automation and deliver greater reliability. Real-time monitoring and complete control of system elements such as substations, intelligent devices, power lines, capacitor banks, feeder switches, fault analysers and other physical facilities have been on the utilities' wish-list for a long time. Automation of distribution systems, illustrated in Figure 1, is the key to multiple direction communication between these elements, as well as to identifying and isolating faults, and restoring service.

Enabling Smart Grid applications and system integration through a broad-based implementation requires a holistic approach across business units in utility. The main driving factors for Smart Grid are efficiency gains in operations, retaining workforce, satisfied customers, higher reliability of power, and resilience in infrastructure that supports the technology. The aim is to reduce the manual operations and implement more intelligent processes through system interoperability and system Integration.

The industry has already initiated pilots and small-scale implementation of smart grid. One example of multi-sided communication is outage management with consumers and electricity companies as two sides and middleware providers making up the other sides. A well-integrated outage management system brings in the functionality for information from customer, trouble calls, and network connectivity as geographical information and operated field data.



However, legacy processes and technology pose a challenge to automation. With the increase in information availability in terms of frequency and accuracy, new technology layers are needed which must be supported by people, processes, technology and organizational capabilities.

Application Landscape

Infosys' Smart Integrator is a Common Information Model-based (CIM-based) integration platform that utilizes powerful event-centric building blocks to generate, predict, deliver, integrate, query and visualize information across MDM, CIS and Core Distribution Systems (SCADA/DMS, Outage Management System, WAM, Geographical Information System). The solution provides a comprehensive integration platform which can predict future events based on real-time event correlation and available historical data. It can support high volumes of transactions in the growing AMI/ Smart Grid ecosystem. The predictive analytics feature of the solution makes decision support systems more effective. The component-based architecture reduces the time to market and delivers cost benefits to utilities.

The heterogeneous landscape of applications in the IT ecosystem of utilities can be is classified into the following categories based on their line-functions.

1. Customer Care Systems
2. Distribution Systems
3. Regulated Retail
4. Supply Chain
5. Graphical Information System

Based on technology, these applications can be classified into:

1. Legacy applications
2. Open Systems-based applications
3. COTS (Commercial-off-the-shelf) applications

Enabling Grid Intelligence

The first step is to automate all business functions end to end into a Business Process Modeling process. This gives the process a graphic "look and feel" ensuring that the Business and IT are both aligned in their understanding of the process.

The principal characteristics of the smart grid can be identified as:

1. Self-healing
2. Empowering and involving the consumer
3. Tolerant toward security attacks.
4. Accommodating a wide variety of generation options via natural sources
5. Providing enhanced power quality
6. Fully enabling electricity markets
7. Optimizing asset utilization and minimizing operations and maintenance costs

All services are linked to process models enabling loose coupling between the Business function and the IT function, giving both the teams the agility required to respond to market dynamics. All services are integrated via adapters and/or web-services from various heterogeneous applications. This also enables orchestration of various services toward business needs and ensures that data flow is in sync with the end-systems.

Thus the solution can provide the inputs needed for Business Intelligence like

1. Predictive outages
2. Correlation of events and business rules
3. Analysis of events with historical data

Integration Approach

The integration approach of a Smart Integrator involves the following:

- Enterprise Interface

  The Enterprise Interface interconnects applications using a common interface based on CIM. It defines the service bus that connects applications using a common messaging language. This allows loose coupling of applications and ensures management of application interfaces with minimal impact on core applications.

- Orchestration

  Orchestration helps aggregate the master data to create information that can be queried and displayed on the dashboard. The CIM allows multiple application access with XML being the common link between various applications. Also, workflow can be defined and configured for various scenarios.

- Predictive Event Correlation

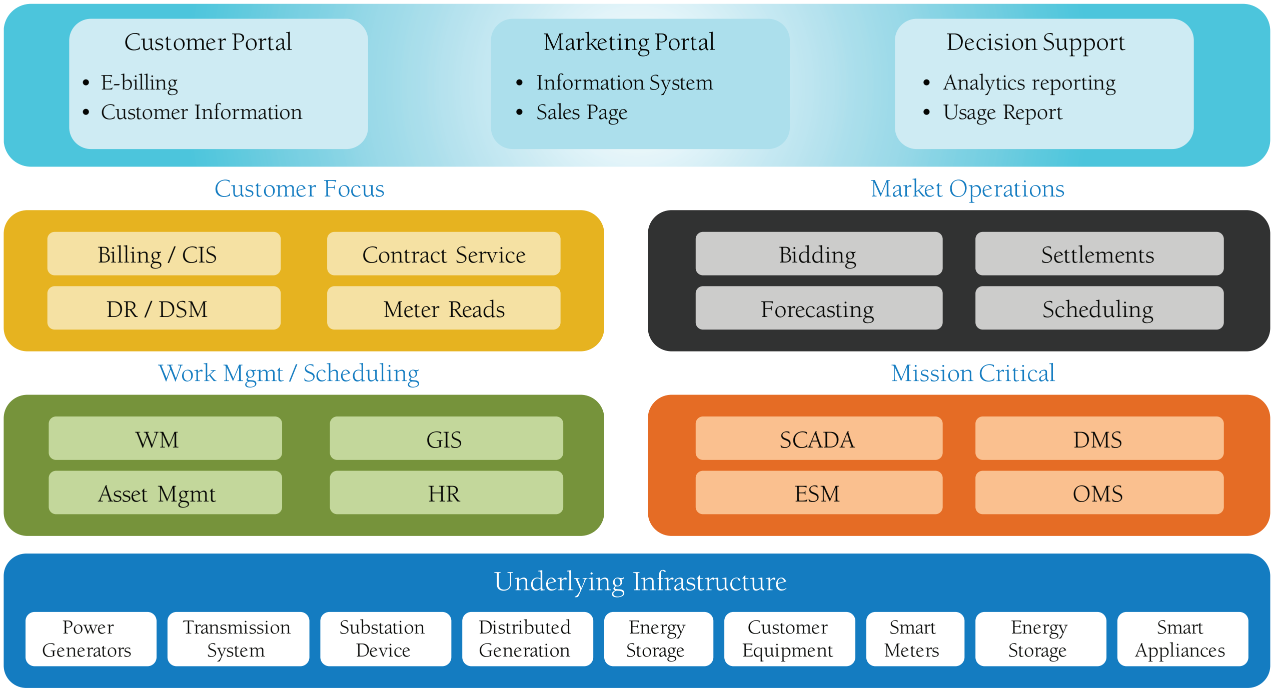
  Predictive Event Correlation captures and compares real-time events against past base-lined events to predict future events leveraging a Learning Model. This requires master data residing in data warehouse infrastructure.

- Performance Dashboard

  The Performance Dashboard allows alerts to be generated based on conditions detected in event correlation. The dashboard displays relevant key indicators in a logical and concise manner.

- Role-Based Access

  This allows role-based privilege to users and personalized contextual information summarized and controlled by user role. Different profiles configured for different user types ensure security of information.



Value Proposition of the Smart Integrator

1. Ability to efficiently and effectively manage extended external entities or partners by quantifiable enterprise-wide standard approach
2. Ability to make informed and calculated decisions in external business entity relationship management
3. Ability to predict and cope with changing market dynamics thereby reducing time to market
4. Evolutionary approach with interim benefits in contrast with "Rip & Replace" approach. Interfaces can be transformed and / or mapped
5. Integrated and end-to-end view of all extended entities via portal. Interfaces use a common model
6. Flexibility and adaptability as per specific enterprise requirements and priorities using:
   a. Modular, plug-and-play configurable components
   b. Process-oriented (BPM) and service-oriented (SOA) architecture
   c. Extensible design

This approach requires the customer to provide the basic as well as the distributed generation layout.

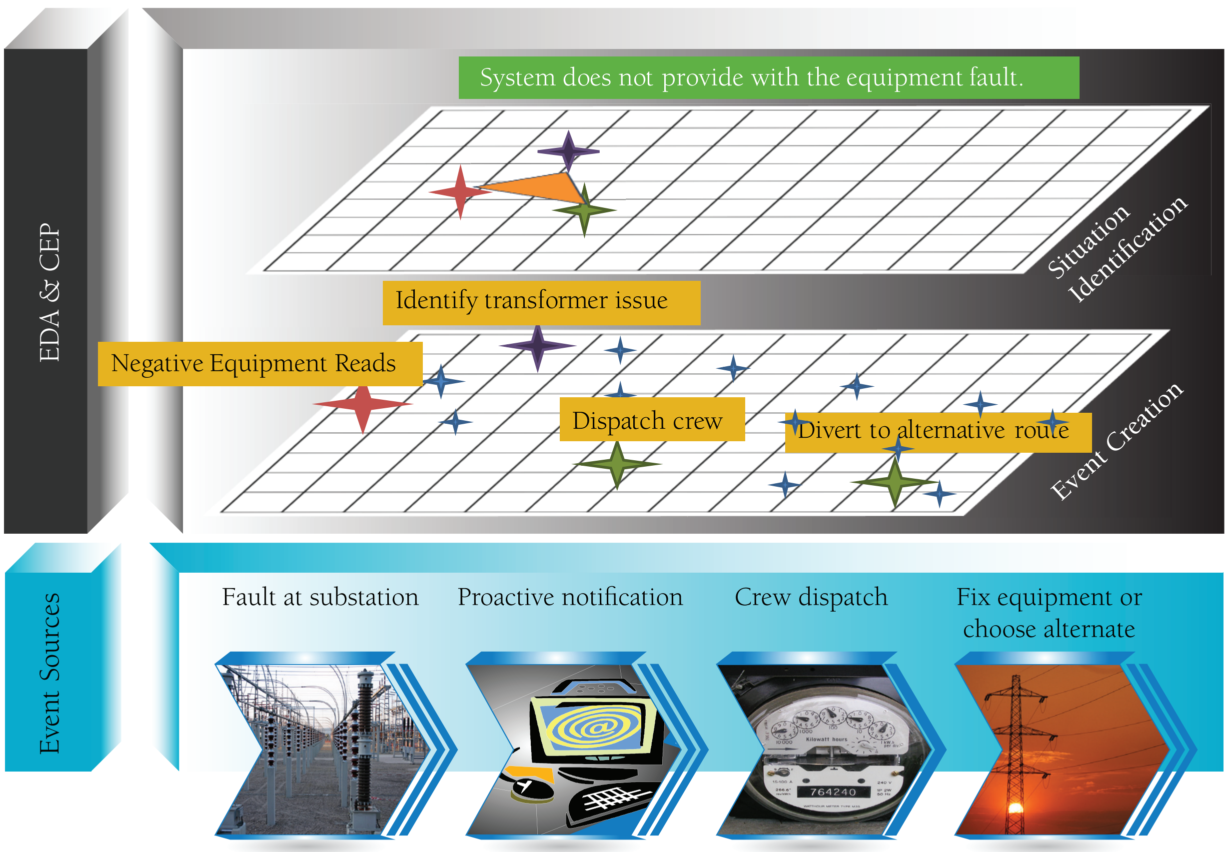
In order to enable well-coordinated decision making and process flow, it is vital to ensure that information and systems are well integrated for timely and accurate availability of data and orchestrated processes have well-defined rules. This helps enhance overall efficiency, operations and system reliability.

On-Demand and Real-Time Decision Making – An Approach

There are numerous interfaces between applications which can be scheduled and pulled or pushed on demand and some that are real time. For example, outage or usage read from AMI meters should be sent on a real-time basis. Various applications, depending on system deployment architectures and local regulatory environments, may obtain data directly from the meter or through intermediate systems. Data from smart meter energy consumption is typically needed hourly for residential customers and more frequently to support dynamic pricing and customer energy consumption management. It is required daily as an aggregation for presentment to the customer for energy consumption management, and on-demand or near real-time when a customer has called a customer care representative with a specific question. On the other hand, update of maps in GIS or work management updates to accounting can be processed in bulk.

Many distribution organizations maintain and make bulk updates to the network model in their GIS. Since DMS and OMS both require the connectivity model of the distribution system, data maintenance processes are simplified if the DMS and OMS are operating from the same model. The result is one set of processes for managing the network model, and one process for the incremental update to the DMS/OMS instead of two.

Another approach is Complex Event Processing. It analyzes data based on event triggers. This is done on a real-time basis to generate immediate insight and enable instant response to changing conditions, i.e., providing continuous intelligence versus responding to a singular event. What is meant by event data? An event can be defined as a significant occurrence. Events are taking place all around us all the time. In the context of electric utilities, meter tampering is a significant event. There are also so-called "non-events" to consider, i.e., an event that does not happen even when it was supposed to. An example of a non-event can be a scheduled interval meter reading not happening. For the sake of simplicity though, all of these are referred to as events.



For example, outage can be remotely detected / predicted in real time versus in a near real-time timeframe as explained further. A real-time interface is one where the data related to customer service point outage, voltage levels, meter readings and last gasp/ electricity messages are exchanged using events (from meter), on demand (user triggered) or periodic basis. On notification of a fault, the Outage Management System notifies the Work Force Management system. This interface in near real time allows order to book materials to jobs (crews, vehicle, tools, equipment, etc.). Another similar interface to mobile devices significantly improves the response times, labor costs, work hours tracking, and customer satisfaction.

The data asset concept is where a common data mart / repository is in place, data can be intelligently accessed by several applications based on events in order to provide actionable information. Using the right approach and road map, Smart Integrator enables appropriate data flow, well-defined processes within utility system operations, planning, and engineering and customer services.

Conclusion

Today, utilities are adding more intelligence and, thus, complexity to their distribution networks ("Smart Grids"). As the grid becomes more intelligent and more complex, the tools or applications to operate it become increasingly important. However, these tools must be fully integrated to be effective. Infosys' Smart Integrator solution provides a comprehensive integration platform that can predict future events based on real-time event correlation and available historical data. It can support high volumes of transactions in the growing AMI/ Smart Grid ecosystem. Smart Integrator's component-based architecture reduces the time to market and delivers cost benefits to utility companies as they seek more control over predicting power consumption and generation while reducing their impact on environment.

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