Smart Grid Initiatives White Paper

Revision 1.1
OSI-555-107-MRK

DISCLAIMER

Information presented within this document is intended to describe OSI's general posture towards the Smart Grid requirements. It is not meant to serve as comprehensive information or the wholesome compliance of OSI System to Smart Grid requirements. Suitability of any System in the Smart Grid Structure needs to be individually verified and discussed to ensure proper operation.

Table of Contents

Table of Figures

Chapter 1 Understanding the Smart Grid

1.1 Introduction

As the world enters a new era of energy consciousness, utilities face unprecedented challenges. Stringent regulations, environmental concerns, growing demand for high-quality, reliable electricity, and rising customer expectations are forcing utilities to rethink electricity generation and delivery from the bottom up. Internally, utilities are struggling with aging assets, departing expertise and a lack of information about their customers and the state of the grid.

At the same time, a plethora of new opportunities are open to those utilities that are dynamic, innovative and ambitious enough to take advantage of them. The availability of low cost computing and telecommunications technologies, new generation options, and scalable, modular automation systems are changing the name of the game.

Driven by the dynamics of the new energy environment, leading utilities, technology vendors and government organizations have created a vision of the next generation of energy delivery systems: the Smart Grid.

1.2 Defining the Smart Grid

Traditionally, power is generated at remote, centralized plants and then transmitted to load centers over high-voltage transmission lines before being distributed to the consumer. Designed and deployed over half a century ago, our grid infrastructures, and the systems that monitor and control them, are severely outdated and incapable of meeting tomorrow’s energy needs.

The Smart Grid is a multi-faceted solution to the problem of modern energy delivery. It represents a shift toward a more flexible network topology that encourages two-way power flow between the grid and small-scale distributed energy resources. It encourages increased cooperation between consumers and utilities to reduce peak loads and optimize resource allocation and efficiency. The Smart Grid will also bring about an exponential increase in the amount of information coming from the grid and being fed to network operators, utility executives and consumers for increased visibility and control. Fundamentally, the Smart Grid is the vision of a more reliable, environmentally friendly and economically viable power grid.

OSI (Open Systems International, Inc), a premier supplier of automation systems to the utility industry, defines the Smart Grid as “an efficient, reliable and economic energy delivery network that incorporates distributed energy resources, encourages consumer participation, and relies on advanced automation systems for intelligent network monitoring and control.”

Automation systems are the backbone of intelligent electric power transmission and distribution systems. OSI’s mission is to develop and deliver innovative automation system solutions that support an evolving and complex power grid, and enable our clients to successfully manage a growing Smart Grid portfolio.

Chapter 2 Smart Grid Structure

Environmental and economic sustainability are essential variables in the 21st century's energy equation. But existing infrastructure and systems lack the flexibility to evolve to meet higher demands for efficiency and reliability.

The Smart Grid will return balance to this "cost-benefit" paradigm by introducing intelligent response into the interaction between supply availability and demand. With the help of markets and real-time system information, utilities will be able to work in unison with consumers to produce the most cost-effective and efficient supply mix.

But before we look at the benefits inherent to the Smart Grid, we need to first understand its underlying structure, components and characteristics.

2.1 An Interactive Grid

Similar to the internet (a dynamic network), the Smart Grid will be interactive for both power generation *sources* and power consumption *sinks* (loads). Soon, utilities will enable end-users to produce their own electricity and participate in demand-side management (DSM) programs. Supported by a high-speed, two-way communication infrastructure, intelligent metering and electronic control technologies represent the gateway for access to the grid of the future. Already, utilities are investing an enormous amount of money in Smart Meters and Advanced Metering Infrastructure (AMI) in the first step towards implementing the Smart Grid.

At the utility level, Information and Communication Technology (ICT) and business process integration will be valuable tools in the real-time management of the value chain across suppliers, active networks, meters, customers and corporate systems.

The transmission and distribution infrastructure of the Smart Grid will be a web-like network of interconnected nodes with no "beginning" or "end". Consumers and generators of all sizes will be tied together with new grid components, such as energy storage units and intermittent renewable supplies. Like a living organism, the grid will control energy flow to dynamically balance changes in supply and demand. IT and automation systems will act as the central nervous system by collecting and processing the massive amounts of sensory data coming in from the extremities and control system elements.

Refer to Figure 2.1 for a visual representation of the Smart Grid structure.

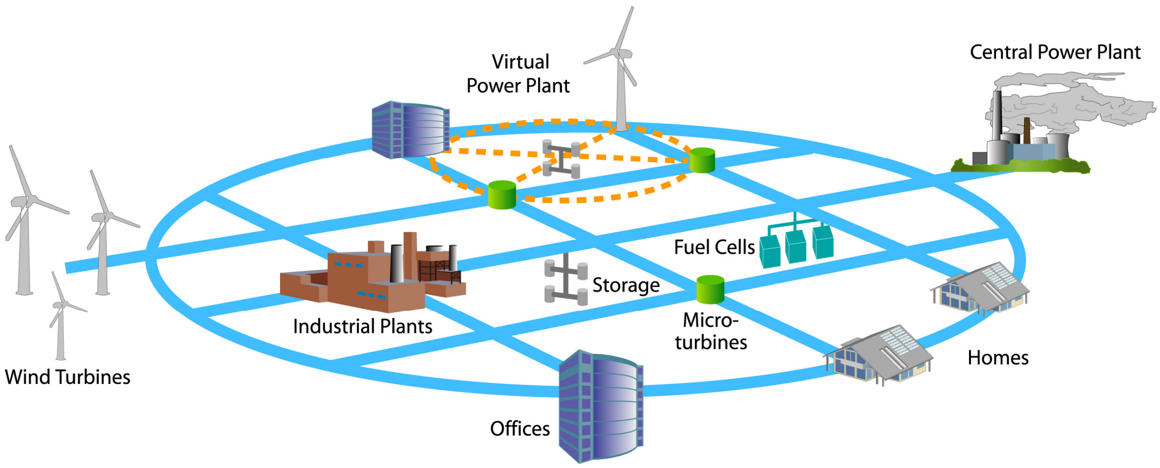

Figure 2-1: Smart Grid Structure

2.2 Smart Grid Components

At the physical level, the Smart Grid is comprised of five fundamental components:

New Grid Components

Distributed Generation (DG), such as residential-scale CCHP (Combined Cycle Heat and Power) units, PHEV (Plug-in Hybrid Electric Vehicles), micro-turbines, solar photovoltaic cells, wind turbines, and grid energy storage units enable increased bi-directional power flow between power distributors and end-users.

Sensing and Control Devices

Sensors, intelligent electronic devices (IEDs) and smart meters gather information from the physical layer of the network.

Communications Infrastructure

Communication networks based on fiber-optics, microwave, infrared, power line carrier (PLC), and/or wireless radio networks such as GSM and CDMA, transfer massive amounts of data.

Automation and IT Backend

High-end servers, middleware, data storage, and data management systems process and manage incoming data from the grid.

Advanced Analytics

Advanced applications with increased functionality and versatility allow grid operators, project managers and business executives to analyze and extract useful information from the grid.

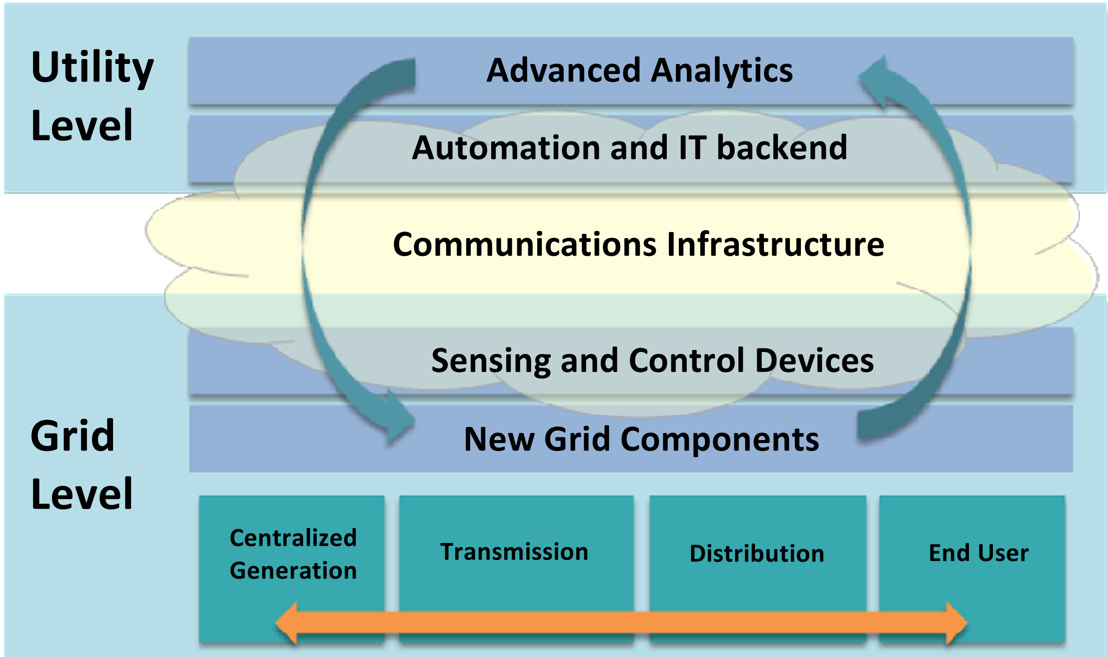

Figure 2-2: Smart Grid Components

2.3 Smart Grid Characteristics

With an understanding of the five components listed above, consider the following characteristics of the Smart Grid:

National Integration

The national integration of all levels of the transmission and distribution network will be one of the greatest engineering projects of this century. Once geographically dislocated, electric power grids are now being expanded and transformed into millions of interconnected nodes. Grid integration enables utilities to deliver a highly secure and efficient electricity supply with reduced environmental impact by allowing for interregional power transactions, added capacity, and network redundancy.

Self Healing and Adaptive

The Smart Grid will perform continuous self assessments to monitor and analyze its operational status. For problems that are too large and too fast for human intervention, it will automatically restore grid components or network sections after abnormal events via "self-healing" mechanisms. The Smart Grid will also be capable of predicting potential failures and future outages by mining data from past events.

The self-healing grid will employ modern technologies to minimize disruption of service by acquiring data, executing decision-support algorithms, averting or limiting interruptions, and dynamically controlling the flow of power. For example, probabilistic risk assessments based on historical data will identify the equipment, power plants and lines most likely to fail. Likewise, real-time contingency analyses will determine overall grid health and trigger early warnings of trends that could result in grid failure. Communications with local and remote devices will help analyze faults, low voltage, poor power quality, overloads and other undesirable system conditions.

Acting as an "immune system," the grid's ability to intelligently monitor, diagnose and repair itself will help increase the overall reliability, security, affordability, power quality and efficiency of the network.

Interaction with Consumers

The Smart Grid will motivate end-users to actively manage their energy consumption. For instance, price signals and DSM programs (also known as Demand Response) will encourage consumers to modify consumption based the electric system's capacity to meet their demands. New cost-saving, energy efficiency products will plug consumers back into the network and make them active participants in the grid.

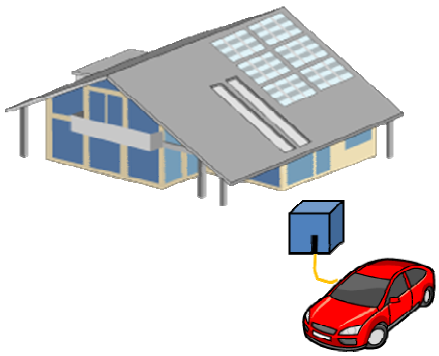

Figure 2-3: Smart Home

For example, one type of consumer may live on a fixed income and desire the monthly energy bill to be $60. The utility would provide this service by controlling certain end-user appliances, such as the thermostat, to limit consumption. Another type of consumer may have personal carbon footprint goals and wish to purchase 100% of their power from renewable sources, thus reducing their impact on the environment and supporting green energy.

Enhanced Cyber Security

Society is increasingly aware of the criticality of energy delivery infrastructure and the need for defense against malicious attack and disruption. For this reason, enhanced security is an essential characteristic of the Smart Grid.

Built into its architecture from conception, the Smart Grid's integrated security systems will reduce physical and cyber vulnerabilities and improve the speed of recovery from disruptions and security breaches. Smart Grid security protocols will contain elements of deterrence, prevention, detection, response and mitigation, and a mature Smart Grid will be capable of thwarting multiple, coordinated attacks over a span of time. Enhanced security will reduce the impact of abnormal events on grid stability and integrity, ensuring the safety of society and the economy.

Improved Quality of Power

Designed and constructed over a half a century ago, existing grid infrastructure cannot meet the demands of today's digital economy for reliable, high quality electric power. As part of the Smart Grid, new power quality standards will enable utilities to balance load sensitivity with power quality, and consumers will have the option of purchasing varying grades of power quality at different prices. Additionally, power quality events that originate at the transmission and distribution level of the grid will be minimized, and irregularities caused by certain consumer loads will be buffered to prevent propagation.

Integration of a Wide Variety of Generation Options

The Smart Grid will accommodate a diverse range of generation and storage options. Residential and commercial users will increasingly adopt distributed energy resources such as roof-top solar panels and advanced batteries as economically viable options for meeting on-site energy needs, and reducing their carbon footprint as good stewards of the environment.

Improved grid-tie standards will enable interconnection at all voltage levels. And improved communications protocols and grid intelligence will allow distributed generation resources to seamlessly integrate with the grid in a “plug-and-play” fashion, where users can sell excess power back to the grid at peak-hours based on real-time market pricing. At the same time, large central power plants, including environmentally-friendly sources such as wind farms and advanced nuclear plants will continue to play a major role in the grid of the future.

Interaction with Energy Markets

The Smart Grid will enable energy markets to flourish, exposing and mitigating resource allocation inefficiencies. For instance, parameters such as total energy, capacity, congestion, and environmental impact may be most efficiently managed through the supply and demand interactions of markets.

Market participation will be encouraged through increased transmission paths, aggregated demand response initiatives and the rise of distributed energy resources as discussed above. And, by reducing congestion, the Smart Grid also expands markets by bringing more buyers and sellers together. Real-time pricing will allow consumers to respond dynamically to price increases, spurring lower-cost solutions and technology development. For consumers wishing to reduce their carbon footprint, they will have the option to purchase new, clean energy products from a mix of renewable sources.

Increased Grid Visibility

The Smart Grid’s ubiquitous sensing infrastructure and backbone communications network will enable network operators to have greater grid observability into the grid’s operational status, particularly with respect to the historically “blind” spots of the distribution networks. Aided by advanced visualization tools, operators will be able to quickly and accurately identify critical information, allowing them to provide essential human oversight to automated processes.

Optimized Asset and Resource Management

Increased asset life and optimized operations are a major objective for the Smart Grid. Advanced information technologies will provide a vast amount of data and information to be integrated with existing enterprise-wide systems, giving utilities the power to significantly enhance their operations and maintenance processes. This same information will allow engineers to improve equipment design, and give network planners the data they need to improve their processes. As a result, O&M and capital expenses will be more effectively managed.

2.4 Smart Grid Benefits

The goal of the Smart Grid is to use advanced information-based technologies to increase grid efficiency, reliability and economy. Consumers, utilities, the environment and society as a whole will benefit from better use of new and existing energy delivery infrastructure.

See figure 2.4 for a graphical representation of potential Smart Grid benefits.

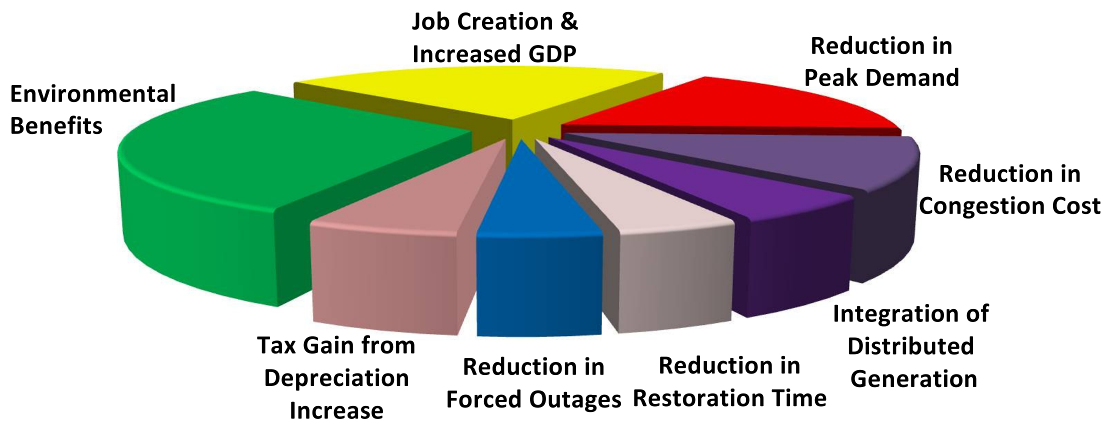

Figure 2-4: Smart Grid Benefits

2.4.1 Improved System Reliability

The Smart Grid will provide dynamic, real-time monitoring, control and optimization of grid operations and resources in a number of ways:

- Advanced network visualization, distribution applications and outage defense systems will give utilities the capacity to detect, analyze and restore system faults before they jeopardize system integrity.
- Greater coordination among all participants in the system will trigger better price signals and a more efficient balance between demand and supply.
- Increased physical and cyber security, as well as special protection systems, will warn of security threats before they escalate.
- Significant reductions in residential peak demand energy consumption will be achieved by providing real-time pricing and environmental signals in conjunction with advanced in-home and distributed generation technologies.
- Advanced outage management systems and distribution automation schemes will result in fewer blackouts and local power disruptions along with faster recovery times.

2.4.2 Increased Consumer Participation

As an integral part of the Smart Grid, homeowners will have the tools and information to actively manage their power consumption. Through the use of smart meters and in-home automation, utilities will be able to provide their consumers with the next generation of energy services. DSM programs in particular will satisfy two basic consumer needs: the need to understand the cost of one's consumption habits, and the need for greater choice in energy services. At the utility end, DSM programs allow utilities to reduce or shift peak demand, minimizing capital expenditures and operating expenses. Peak shifting also translates to substantial environmental benefits in terms of reduced line losses and improved dispatching of generation units. Over time, DSM will also encourage consumers to replace inefficient end-use devices such as incandescent lighting and embrace emerging products such as plug-in hybrid electric vehicles.

2.4.3 Increased Efficiency

Improving the operational efficiency of the electric power system is one of the greatest potential benefits of the Smart Grid. Advanced power electronics will improve the quality of the power supply by allowing for variable-speed operation of electric generators and motors, controlling reactive power. Utilities may also extend the application of High Voltage Direct Current (HVDC) lines to reduce line losses in long-distance, interregional power transmission. Broadband communications will be used connect power producers and loads at every voltage level at a very low cost, permitting utilities to implement new strategies, such as virtual power plants or power markets for small producers or consumers.

2.4.4 Environmental Benefits

The threat of global warming, air pollution and resource degradation are forcing government policy makers, the general public and the utility industry to question the sustainability of our present energy infrastructure. The Smart Grid will allow modern society to address these challenges as they become ever more pressing. In particular, greater efficiencies in the grid will help alleviate the need for new generation, transmission and distribution facilities, and result in massive amounts of avoided emissions. The mass deployment of Advanced Metering Infrastructure (AMI) adopted by leading utilities has already shed light on the ability for Smart Grid technologies to reduce consumption. Likewise, improved integration of smaller generators in the distribution system will increase the role of renewable energy supplies in meeting regional demand.

2.4.5 Economic Benefits

Improved load estimates and reduced line losses will improve asset utilization and translate to long-term avoidance of capital expenditure for generation, transmission and distribution projects. Operationally, the advantages of automated operations, predictive maintenance, self-healing mechanisms and reduced outages will bring about major reductions in labor costs, particularly those associated with maintenance and outage recovery. From a macroeconomic perspective, the wide-scale implementation of the Smart Grid will create new jobs, spur competitive technology development and revitalize a sector of the economy that is traditionally slow to change.

2.5 Smart Grid Roadmap

The Smart Grid will not be created all at once. It will be realized through the incremental deployment and coordinated integration of various systems over many years. Depending on the type of the utility company and where they stand, there will be different starting points, drivers, rates of deployment and paths to implementing a true Smart Grid.

Figure 2.5 represents one possible approach to implementing a Smart Grid.

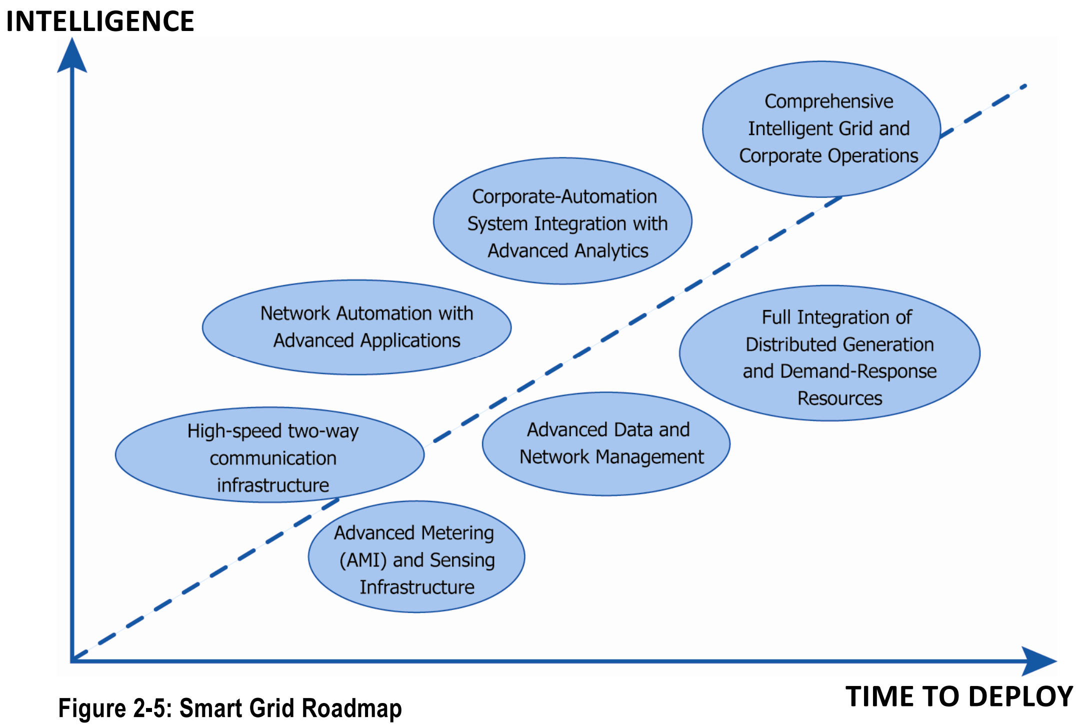

Figure 2-5: Smart Grid Roadmap

2.5.1 Partnering together

For a successful transition to a modern and sustainable energy system, all the relevant parties must be involved: governments, regulators, consumers, generators, traders, power exchanges, transmission companies, distribution companies, power equipment manufactures and information technology and automation systems providers.

In recent years, government's organizations, such as the US Department of Energy and the European Union, and certain industry groups, such as the Gridwise Alliance and IEEE's Intelligrid Architecture Council, have spearheaded the Smart Grid movement, laying down a coherent vision and space for collaboration. Given the scale of the industry shift towards the Smart Grid, these consortiums will be increasingly important to ensuring the mutual benefit of all stakeholders.

Chapter 3 OSI's Smart Grid Initiatives

OSI's vision of the Utility of the Future is an agile and progressive enterprise that embraces modern technology and end-to-end integration with suppliers and customers. It is an enterprise that maintains a substantial renewable energy portfolio, offers consumer-friendly DSM programs, and is engaged in pragmatic Smart Grid initiatives.

The Utility of the Future will require powerful and super-scalable automation systems to flexibly manage growth and maintenance of real-time operations. This has created a demand for a new generation of intelligent systems, operating platforms and application software that proactively manage grid reliability, grid security and consumer initiatives.

In response to this demand, OSI has created the ideal software platform for supporting Smart Grid initiatives: **monarchSGP™** (**monarch** Smart Grid Platform). This secure, high performance platform is designed to process and analyze millions of data points in real-time from all levels of the electric power supply chain, whether it's generation or consumption. In addition to SCADA, EMS, GMS and DMS applications, **monarchSGP** supports standard interfaces (such as MultiSpeak®) and third party solutions such as Advanced Metering Infrastructure (AMI) and Outage Management Systems (OMS). At the same time, system administrators can flexibly manipulate and develop their own tools with the use of the industry's most common Application Programming Interfaces (APIs) and Service Oriented Architecture (SOA)-based APIs.

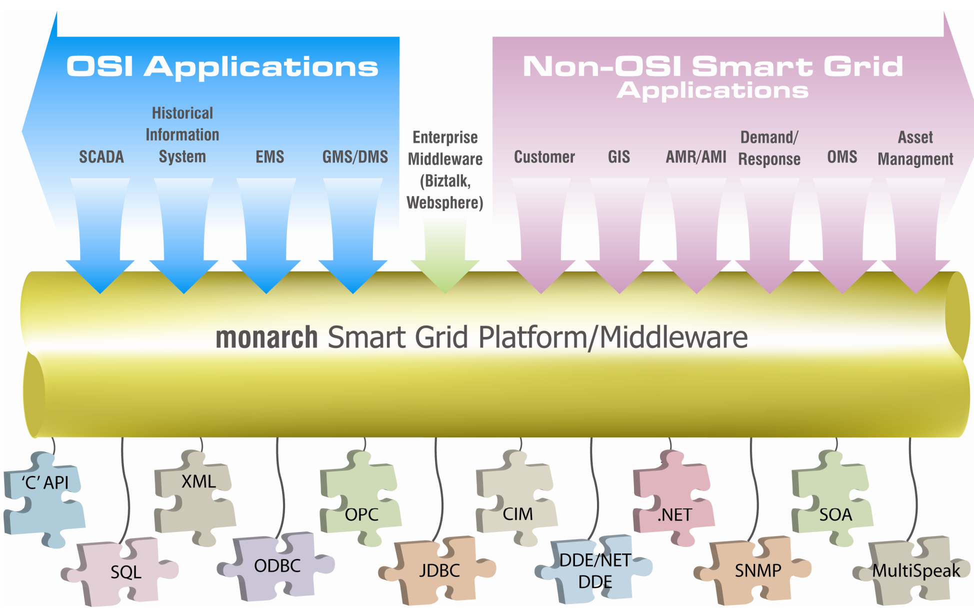

Figure 3-1: monarchSGP Overview

In addition to providing the real-time platform for the Smart Grid, OSI's Smart Grid solution leverages **OSIRIS™**, a flexible and multi-functional Remote Terminal Unit (RTU), and a powerful suite of software modules including: Outage Management System (OMS), Phasor Measurement Units (PMU), Security Shield, Advanced Intelligent Analytics, and third-party system interfaces.

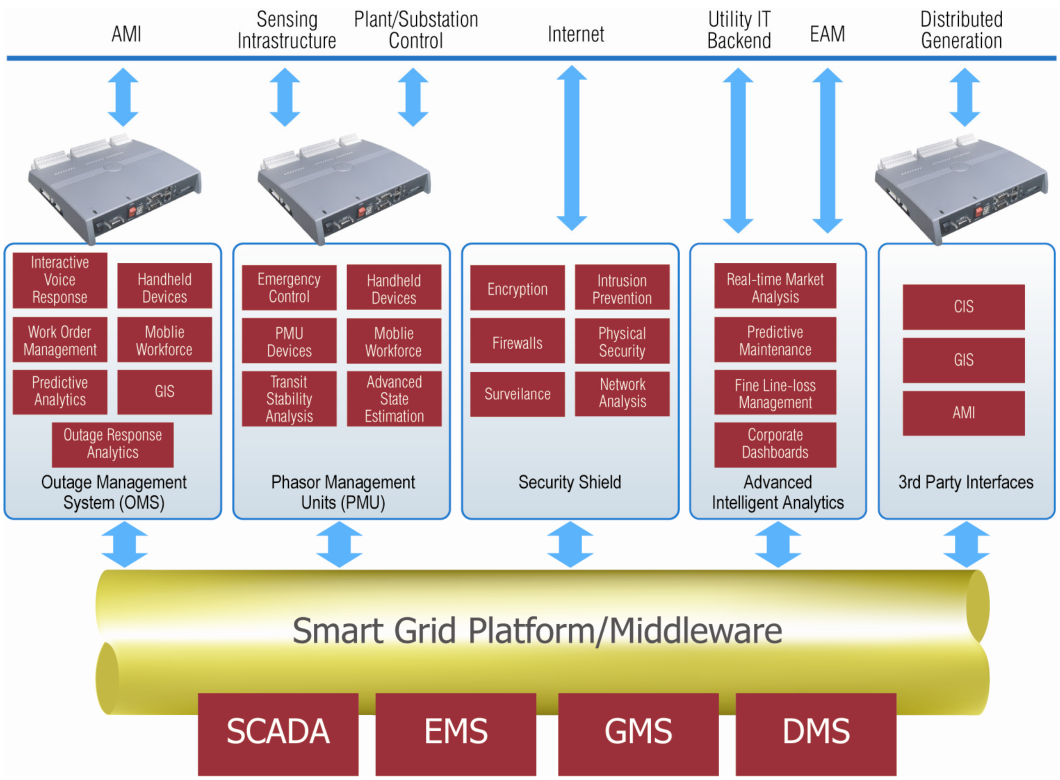

Figure 3-2: monarchSGP Modules

3.1 Hyper Scalable Open Architecture Platform

A Smart Grid platform must be hyper scalable and elastic, with the ability to handle orders of magnitude larger point counts than the traditional automation systems. It must have extremely high throughput for processing grid events and alarms and be capable of controlling thousands of control points simultaneously.

OSI's **monarchSGP** Smart Grid solution meets all the key criteria for a truly hyper scalable system. It is expandable, upgradeable and maintainable to the highest degree possible. **monarchSGP** can be delivered on a number of operating systems, including UNIX® platforms, MS Windows® and Linux®. Hybrid configurations can also be easily supported for a "best of breed" selection of operating systems to balance performance, usability and security concerns. It supports many industry standard open interfaces including SQL, ODBC, JDBC, DDE, XML/SOAP, Web Services, OPC, CIM, as well as specific Java and .NET API's, and popular middleware adapters to facilitate enterprise information integration. It provides support for many popular RTU protocols, including legacy and open protocols such as DNP and IEC. Due to its open nature and modular product design, software upgrades are one of the simplest in the industry. You can keep up to date with all software enhancements and improvements on an annual basis with a painless and cost effective upgrade strategy offered by OSI.

3.2 Built-in Cyber Security

OSI's cyber security initiative strives to ensure that all of our systems are planned, built and managed according to the highest security standards. They are supported during their lifetime in the field via an array of security services designed to help our clients.

The following important facets of security management are an inherent part of every project we undertake:

- Secure builds of all new **monarch**™ systems staged prior to delivery
- Security-focused patch management services
- Consulting services and pre-audits for NERC CIP
- Security assessment/hardening of existing field operational systems
- Vulnerability assessment services
- Disaster recovery consulting
- Intrusion detection implementation and training
- Incident response services (consulting and training)
- Event log aggregation and correlation

Our security strategy for supporting the Smart Grid is based upon the IT industry's "best practices" and mandated guidelines from governing bodies. OSI's **monarch** platform has been deployed in government and military applications with stringent security requirements, and passed strict third party vulnerability tests. Our "best practices" approach uses a multi-layered defense strategy that limits and thwarts unauthorized access to the **monarch** domain as well as an intelligent Security Shield spanning all critical processes and applications within the monarch environment. The result is a hyper security-aware architecture that limits malicious access, thereby removing or minimizing any potential threats to your business.

3.3 System Support for Advanced Visualization Tools

OSI's state-of-the-art Graphical User Interface (GUI), **OpenView™**, is based on Microsoft® .NET technology. The Microsoft .NET Framework provides the foundation for building connected and appealing applications on a wide variety of systems from the device to the data center. The innovative graphics architecture offers many new features and functionality, including 3D visualization for increased operator efficiency.

Improved graphics management, easy point-and-click configuration and operation, drag and drop functionality, support for multiple system domains, as well as built-in routing and recovery give the new .NET GUI vastly improved capability over graphical user interfaces offered by competitors.

Advanced graphical widgets quickly convey information to the user, geographical and topographical information can be displayed alongside electrical information, and users can use drag and drop tools to create customizable dashboards. Features such as 3D rendering and network contouring show parameters in a meaningful and discernable fashion. Business intelligence objects and widgets give network operators, supervisors and executive management increased understanding of the grid's operational status.

Expanded features provide an easy way to see data with charts, gauges or graphs, not just tabular forms. The ability to customize layouts and manage how information is presented not only makes an operator's job easier, but allows the system to remain flexible as situations change.

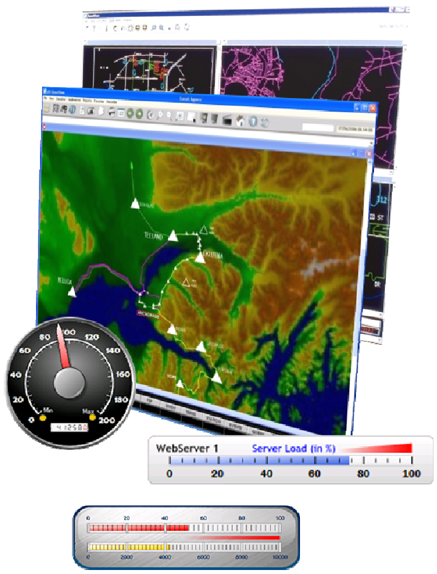

Figure 3-3: Advanced Visualization

3.4 System Support for Advanced Analytic and Business Intelligence Applications

As part of our Smart Grid offerings, OSI is integrating advanced decision making tools such as ROSE (Region of Stability Existence), Voltage Stability and Condition-Based Maintenance.

Region of Stability Existence (ROSE)

Region of Stability Existence (ROSE) technology uses Phasor Measurement Unit (PMU) data to calculate the state of the grid in 1D or 2D space and show regions of secure operations limited by voltage constraints, voltage instability, thermal limits and flow gate constraints. ROSE is based on the analytical expression for the region of existence of power flow solutions. The approach provides the operator with both fast and accurate information for predicting system instability and preventing wide-spread blackouts.

Voltage Stability Analysis

OSI's Voltage Stability Analysis application is used to ensure that a proper reactive margin is maintained. This module identifies the reactive deficient and instability-prone zones in a system, and creates studies to aid in developing better mitigation strategies. When performed with a conventional power flow, voltage stability analysis is difficult and inaccurate. Hence, OSI has created a modified power flow algorithm to calculate various limits such as reactive power reserve, active power transfer limit, voltage collapse point and so on. OSI's Voltage Stability Analysis package includes a stable and accurate continuation engine, enabling stability analysis on any given system.

Condition-Based Maintenance

Utilities traditionally perform maintenance based on either fault or usage information. As a result, most maintenance or repair activities take place either too late or too soon. The preferred alternative to this is Condition-Based Maintenance, where utilities monitor and analyze the ongoing condition of utility assets in real-time. This allows utilities to optimize asset utilization in both over-use and under-use situations. It also opens up opportunities to fully automate distribution operations, which results in increased reliability, reduced overhead associated with maintenance and operations, and a pro-active step towards mitigating the looming problem of an aging workforce.

Optimized Voltage Profiles

Optimized voltage profiles across both transmission and distribution nodes are another major aspect of the Smart Grid because they can be used to improve the quality of power service, as well as minimize transmission and distribution losses. Voltage reduction techniques can also be used to reduce peak demands or mitigate power shortage emergencies. Given these benefits, OSI's Optimal Power Flow, Voltage/Var Control and Voltage Reduction applications are an important part of the **monarchSGP** solution.

3.5 Support for Expanded Advanced Protocols

OSI's Smart Grid solution seeks to use standard protocols, like IEC 61850, that support interoperability among protective relays and control devices from different manufacturers. Interoperability is essential to substation-level interlocking, protection and control functions, and improving the efficiency of microprocessor-based relays applications. One of the key advantages of IEC 61850-based systems is the presence of a Substation Configuration Language that allows for "plug and play" integration of control systems. In particular, the Substation Configuration Language allows for common substation or IED configuration files to be exchanged between different configuration, coordination, analysis or testing tools in a way that significantly improves engineering processes. In addition to IEC 61850, **monarchSGP** supports legacy and modern protocols such as DNP, DNP/IP, TASE2/ICCP, IEC-870-101, IEC-870-104, as well as a range of metering protocols for Smart Grid applications.

3.6 System Support for Seamless Integration with Enterprise Systems

The Smart Grid is driving the need to have more systems integrated and running in a unified environment. In order to achieve this effectively, utilities can no longer rely on traditional point-to-point integration or customized system integration methodologies. OSI proposes a web services adaptor to bridge the gap between the automation platform and other enterprise systems. OSI also supports standard middleware adaptors for popular enterprise middleware technologies (e.g. BizTalk, WebMethods, etc.).

Chapter 4 Conclusion

Open Systems International, Inc.'s **monarchSGP** is the ideal solution for monitoring, controlling and optimizing the next generation of energy delivery networks. With its unrivaled scalability and openness, utilities can rest assured that **monarchSGP** will reliably, economically and efficiently support a growing array of Smart Grid initiatives.

We hope that this document demonstrates OSI's deep-rooted commitment to the Smart Grid vision. For any additional information, or to get a quotation from OSI on the various Smart Grid products and services, please contact info@osii.com.

OSI is a member of the GridWise® Alliance and an active participant in many Smart Grid initiatives. The GridWise Alliance advocates a vision of an electric system that integrates the infrastructure, processes, devices, information and market structure so that energy can be generated, distributed, and consumed more efficiently and cost effectively; thereby achieving a more resilient, secure and reliable energy system. Its members include utilities, IT companies, equipment vendors, new technology providers and educational institutions.

4.1 Final Remarks

A number of final thoughts and observations regarding Smart Grid are offered herein:

1. Green Energy and Distributed Generation initiatives will be the biggest drivers.

2. Reliability standards will drive transmission initiatives.

3. Transmission control is the most important and challenging technology component.

4. Distribution business drivers are not yet strong in North America. There needs to be regulatory leadership in this area.

5. Commercial communications backbones such as the cellular networks may be a viable and economical alternative and should not be ruled out.

6. Homes with broadband internet service can be readily integrated in a utility’s Smart Grid initiative.

7. Lower-tech customer/demand response solutions will work equally as well and should not be ruled out.

8. Smaller progressive utilities and cooperatives will succeed first.

9. This is the .ENERGY era, reminiscent of the .COM era of early 1990’s. There are many investment opportunities available.

10. Large projects fail, while smaller, systematic initiatives succeed. A systematic phase by phase project approach is recommended.

11. Universal consumer acceptance will be a challenge and needs to be carefully obtained.

12. Control Systems suppliers would be the ultimate wholesale contributors, not Information Technology suppliers or consultants.