

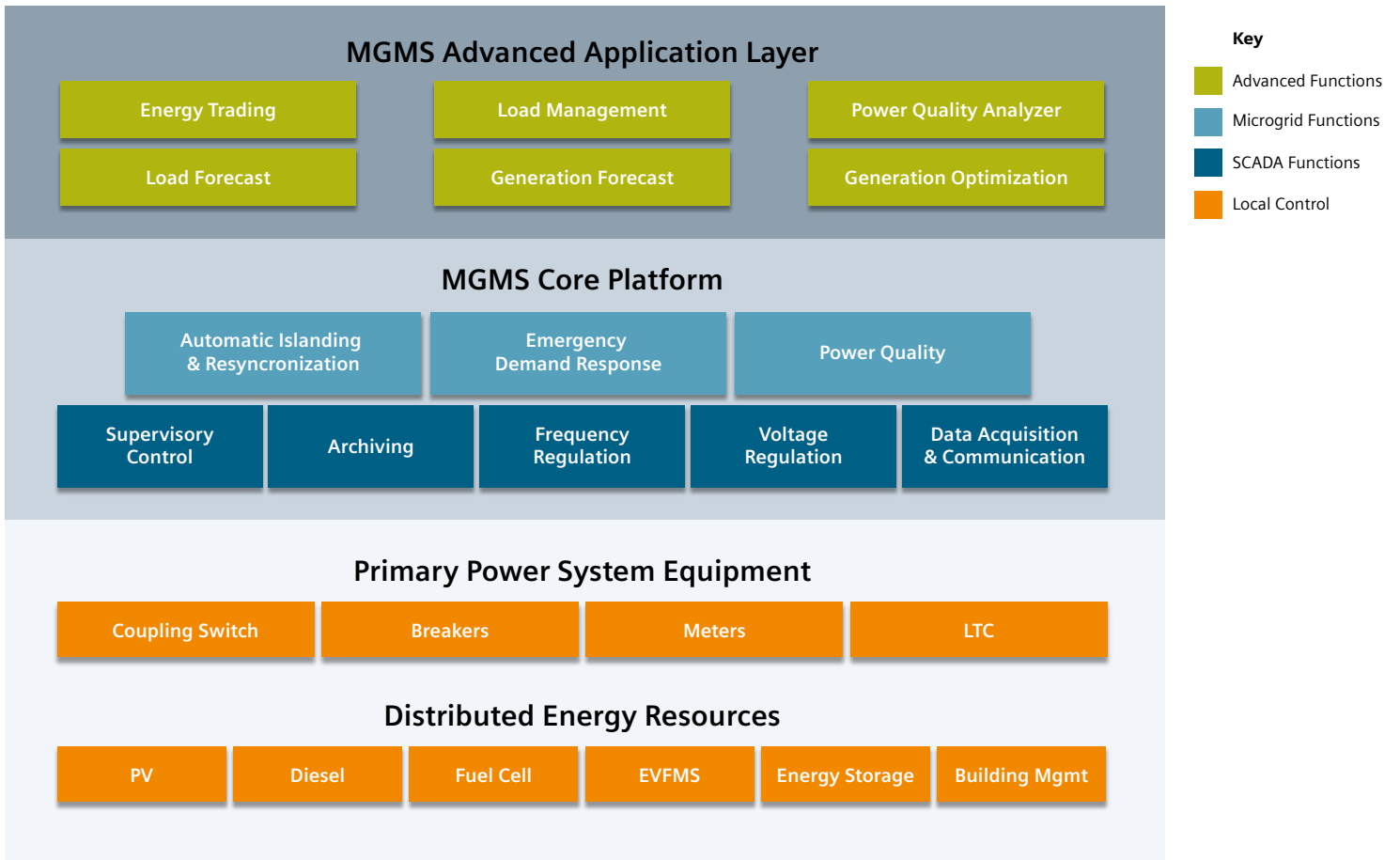


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Advanced Microgrid Management System

Spectrum Power™ MGMS



Microgrid Control Solution Architecture

Spectrum Power MGMS

The Siemens Spectrum Power Microgrid Management System (MGMS) is a powerful control platform with layered, modular architecture. This design provides the flexibility and extensibility to tailor MGMS for any operational demand. Model-based applications support advanced optimization of the entire microgrid energy infrastructure system.

Integration with existing solutions

With its standards-based interfaces the MGMS integrates seamlessly with existing IT systems applications and power system assets. The Siemens Service-Oriented Architecture (SOA) Adapter Framework (SAF) provides web services-based APIs and configurable patterns to Spectrum Power components and other applications which can be used to transmit and receive data using an Enterprise Service Bus. Standard telecontrol communications capabilities include IEC 60870-6 TASE2 (ICCP), IEC 60870-5-101, IEC 60870-5-104, MODBUS, and DNP.

Spectrum Power MGMS: Advanced Microgrid Management System

Software Overview

The Siemens Spectrum Power Microgrid Management System (MGMS) is a software solution for optimal microgrid management and control. MGMS is based on our world renowned utility grid control center, Spectrum Power 7 platform, ensuring the power and performance to handle any microgrid application. Some of the advanced functions include seven-day load and generation forecasting, unit commitment optimization, load shed, seamless transition to and from island mode, and market participation tools. The MGMS platform is applicable to all microgrids, whether they are grid-connected or islanded, market participants or not. MGMS can be deployed with implementation of a new microgrid or as an enhancement in an existing microgrid.

Is MGMS for you? Are you requiring any of the following:

- Integration of distributed generation and renewables
- Higher power quality
- Increased reliability and availability
- Effective demand response capability
- Peak shaving capability
- Increased resiliency in case of grid outages
- Revenue opportunity through market participation

Advantages

- Fully integrated system that includes robust SCADA and full suite of communication protocols
- Advanced cyber security design
- Seamless integration with the grid control center
- Flexibility to deploy at control center or remote site
- Backed by Siemens service, providing expertise in control center solutions, substation automation solutions, and building automation solutions
- Microgrid planning services provided by Siemens

Reliable

- Outage plan based on load criticality
- Supports any size/type of generation
- Utility standard-based islanding and resynchronization capabilities
- Reserve monitoring and enforcement

Efficient

- Optimal dispatch and unit commitment
- Renewable generation forecast based on external weather data
- 15 min, hourly, 7 day ahead load forecasting for optimal generation scheduling

MGMS

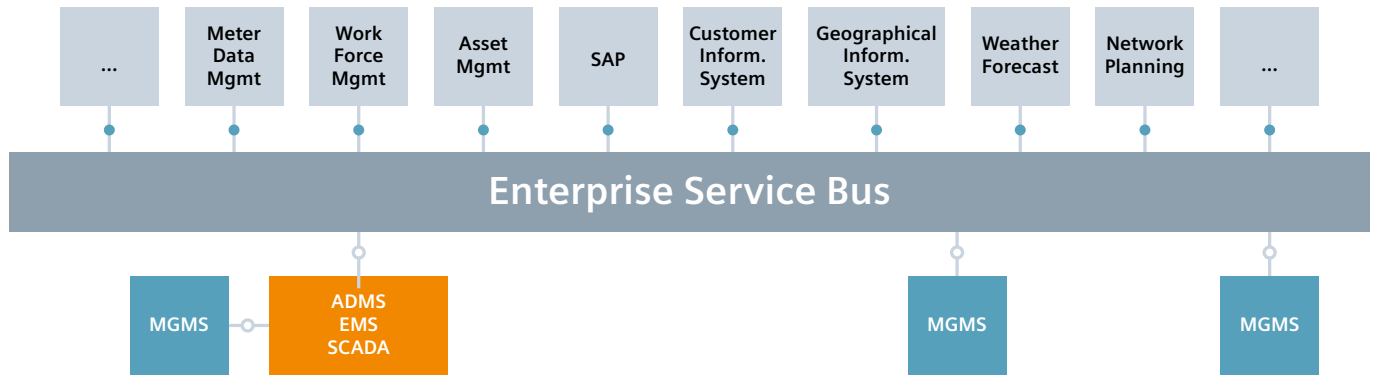
Sustainable

- Economically optimize emission (CO₂), cost, performance variables
- Tailor prioritization of variables based on the needs of each Microgrid customer
- Integrate renewables safely and securely into the grid while coordinating with the local utility

Secure

- Compliant with both utility and Microgrid industry regulations
- Strong, centrally controlled solution
- Based on a proven utility SCADA software platform

System Integration



Functional Highlights

SCADA

MGMS provides complete SCADA functionality for secure, reliable and efficient operation. The user interface provides a clear and easy-to-operate user environment including:

- A common look and feel for control centers, offices, remote, and mobile workplaces using web-based technology.
- Webstart technology assures minimum start-up times of the user interface and provides zero installation clients
- Intuitive operation based on windows, menus, tooltips, toolbars, context menus, drag & drop, context-sensitive help
- Powerful search, filter and sorting functions in all lists
- Easy data export to spreadsheets for reporting and further evaluation
- Task-oriented views including advanced visualization, for example, contouring.

Generation and Load Management (GLM)

The GLM module regulates the real power output of the generating units within the microgrid to maintain the desired frequency when in island mode and to maintain net interchange with the external grid when in grid connected mode. GLM uses an optimal Unit Commitment function to satisfy system economic and regulating requirements in the most economic manner consistent with the operating capabilities of the microgrid.

Generation Forecast

The MGMS advanced optimization model allows each microgrid owner to determine at an aggregate level whether to optimize generation dispatch based on economics or emissions or a combination of the two. A variety of robust weather forecasting systems are supported to forecast renewable generation production while interfaces to local building automation, metering systems, or SCADA systems provide the data for on-site generation needs. Based on

demand forecasts, MGMS will optimize the mix of energy produced between all forms of generation, both electrical and thermal. MGMS provides day-ahead and week-ahead generation forecasting of resources such as solar, wind, storage, diesel, combined heat and power (thermal) and more to support advanced economic and emission optimization.

Load Forecast

MGMS utilizes historical load data as well as seasonal weather conditions to forecast load profiles within the microgrid over hourly and weekly intervals. This forecast is then used to optimize the mix of energy generation, which results in the generation forecast. MGMS collects load data from a variety of sources including building automation systems, sub-meters and more to obtain a detailed view of the entire microgrid system. When loads are adjusted, MGMS makes automatic corrections to ensure system stability. System stability is continually measured by metrics such as current, voltage, power, total harmonic distortion, and frequency.

Load Shed

MGMS performs the shedding or disconnecting of loads when requested by an operator or automatically during disturbance conditions (such as islanding) to maintain system stability. The function has a modular design that can be adapted to meet specific requirements. The loads are virtually ordered according to predetermined priority schemes. Thus the sequence of events can be controlled and the most important loads remain connected.

Archiving

The Spectrum Power Historical Information System (HIS) provides a solid and reliable archive to store power system historical data. Features include periodic and spontaneous data collection, integrated data reduction and compression, a calculation engine, manual update capability, disturbance data collection, replay, easy integration with external tools, and an energy accounting module.

Standard and Optional Features

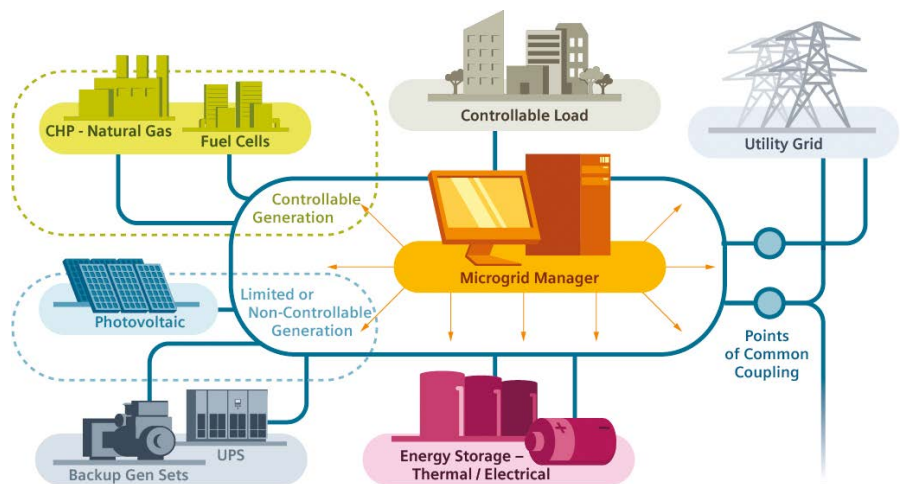
The MGMS platform includes a rich complement of standard features that are vital to operation of a microgrid. In addition to these standard features, there are optional features that allow MGMS to be applicable to any type of microgrid.

Standard Features

- Generation and load control
- Renewable generation forecasting
- Frequency and voltage control
- Generation optimization
- Emissions vs. energy cost optimization
- Renewable generation integration and control
- Energy storage systems integration and controls
- Compatible with NERC-CIP cyber security standards
- Consolidated easy-use interface

Optional Features

- Market participation
- Fast load shed
- Control center redundancy
- Advanced cyber security



Why MGMS by Siemens?

- Centralized control system with more advanced functionality (forecasting, generation optimization)
- Industry-proven market participation tools
- Control software applicable to both grid-connected and islanded microgrids
- Strong security, platform based on utility-grade system (compatible with NERC-CIP security features)
- Scalable, monitor and control as many DERs as necessary
- Easy to use HMI that consolidates all necessary information
- Optional software packages to meet any customer's needs
- Integrated system that supports DNP3, MODBUS, IEC 60870-5 protocols
- Seamless integration with network control center software through IEC 60870-6 (ICCP) protocol
- Flexible deployment at the control center or other sites
- Siemens expertise in areas from planning all the way to building automation and end to end integration

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