Active Network Management Platform
ANM Platform Components

The ANM Platform consists of a centralised and decentralised component. This enables the autonomous coordination of highly variable resources across a geographic area, whilst accommodating the variability of communications. The central component of the ANM platform is made up of a communications gateway (sgs comms hub) connected to an application host (sgs core) via a real time data manager (based on an open standard - Data Distribution Standard (DDS) for real time systems). Physically these can be located to meet the needs of the individual network operator, e.g., at electricity substation level, or at a regional level, such as a control room or a data centre.

The decentralised component of the ANM platform (sgs connect) is located at each DER under active management, and performs a number of local control and fail-to-safe functions. As a modular solution, the ANM platform can be scaled to the needs of individual customers and projects, while remaining tightly aligned with the smart grid applications. All of our products undergo extensive design, build and testing to ensure seamless integration with customers’ existing technology infrastructure, and adherence to industry standards and principles.

Introduction

Active Network Management (ANM) is a crucial component of modern electricity networks that have a high penetration of Distributed Energy Resources (DER). ANM has repeatedly achieved an increase in DER hosting capacity, saving electricity network operators, and their customers, many tens of millions of pounds in the form of deferred or avoided grid reinforcement. ANM is delivering quicker and cheaper connections and contributing to a low carbon economy.

Unlike a Distribution Management System (DMS), ANM is a unique solution for the following reasons:

• ANM provides fast-acting, reliable, repeatable and time-bounded control of DER, while performing coordination and control actions
• ANM is founded upon distributed control principles and as such requires a platform approach that supports these
• With ANM, intelligence is distributed closer to the DER being actively managed, and works in concert with intelligence at the substation or control room
• ANM can be deployed gradually, per DER connection, per feeder, per substation, or at a regional level due to the modular architecture and support for many different types of devices and integration options
• Due to the sophisticated technology stack and performance characteristics of ANM, the power system can be operated beyond previously employed limits, in some cases achieving a 200% increase in DER hosting capacity

ANM integrates with DMS and other network management systems, becoming the modular and scalable automation layer within the array of systems being used to manage the distribution grid. But crucially, it accesses key operational data faster and acts on it quicker than these existing systems are able to do.
**sgs core** is the application host for the power system algorithms and associated control logic, that continuously monitors and manages the power system within scope of one or more ANM schemes.

**sgs core** has been designed specifically to address the real time and event-driven nature of cyber-physical systems where deterministic, time-bounded actions are predictable and can be guaranteed against service-level requirements.

Our patented methods for managing distribution network constraints are realised using the application host to maintain the integrity of the physical assets of the operational power system. **sgs core** can be built on a variety of physical infrastructure elements to include:

- Commodity server-grade computers
- Dedicated substation processors
- Ruggedised industrial computer systems

**Key Characteristics:**
- Proven, industrial grade operating system that is typically pre-existing in the customer’s IT/OT systems
- High performance computing engine that ensures low and predictable latency (RHEL 6 MRG)
- Seamless integration with standard RHEL packages and infrastructure
- Real time Java virtual machine, optimised for intelligent systems and critical applications
- Dedicated user-defined logic capability

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**sgs connect** is the runtime host for field data collection and transfer combined with the localised control logic needed to ensure autonomous, fail-to-safe operation of the DER asset to which it is directly connected. **sgs connect** is deployed as a logical instance that appears exactly the same to the higher level system elements, no matter which physical device it is built into. This allows deployment on a wide array of automation and control devices such as:

- Programmable automation controllers
- Remote terminal units
- SoftPLC Runtimes

**sgs connect** fully supports the majority of electricity network field data exchange standards and can be configured to converse upstream or downstream using the following:

- Modbus
- DNP3
- IEC61850

**sgs connect** also supports hardwired sensor and control interfaces to the physical plant, including:

- Analogue input/output channels
- Digital input status channels
- Digital output channels (solid-state or opto-coupled)
- Volt-free contact/interpose relay output channels

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**sgs comms hub** is the integration host that manages and distributes field data between the algorithmic logic on the application host and the dedicated measurement and control devices located at the boundaries of each ANM Scheme. Linked to **sgs core** via a real time data manager, **sgs comms hub** has a multifunctional role within the ANM Platform, enabling:

- Gateway capability to a variety of operational and analytical systems typically found within the power industry
- Protocol conversion and interfaces for an array of utilities’ field data exchange standards
- Highly configurable and extendable data model
- Localised operational data historian
- Load balancing of field data traffic
- Network Time Protocol (NTP) synchronisation with customer systems
- Physically distinct supervisor/annunciator for operational monitoring of ANM hardware and critical software services
- Dedicated data engineering and configuration tools

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Applications

Within the scope of the ANM system, ANM software applications represent the various critical constraint locations and controlled devices that identify the control actions needed to achieve power system objectives.

Smarter Grid Solutions has two principal applications available for constraint management problems: sgs power flow and sgs voltage.

sgs power flow delivers real power control of multiple DER to multiple grid constraints. It works by characterising each constraint location and DER as an object within the software. Each constraint location is then linked through associative relationships to the DER units that contribute to, and can relieve, that constraint. Each associative relationship applies sensitivity factors, calculated during the off-line connection planning studies, with timers and deadbands, to define the control response from each individual device to a breach of any constraint. sgs power flow does not rely on network models and iterative mathematical techniques, such as optimal power flow algorithms. sgs power flow guarantees fast acting, time bounded and repeatable control responses, in line with fast rate of change events, e.g. topology changes and intermittent renewable energy export.

Critical to any constraint management application is the need to minimise curtailment of any DER. sgs power flow incorporates, at each constraint location, a series of escalating control actions. sgs power flow has been deployed to manage generation export and demand import constraints. It integrates many different DER technologies including PV, wind, biomass, hydro, gas and diesel, ranging from tens of kWs to 50 MWs. sgs powerflow has also been used to manage electric vehicle charging and to integrate storage and demand aggregators.

sgs voltage operates using the same principles as sgs power flow, but it also incorporates reactive power and tap changer control. It has foot room as well as head room thresholds and, due to the variance in methods for voltage control, it allows the user to configure the sequence of control actions.

Platform Features and Benefits

Integrated Platform

AUTONOMOUS OPERATION
No operator intervention is required to facilitate remote device control. This allows time bounded operation to address fast delivery and unexpected events.

FAIL-TO-SAFE
Our ANM Platform provides standard fail-to-safe features for the failure of ANM system components, communications links or the generator control systems.

SYSTEMS INTEGRATION
Comprehensive systems integration capabilities ensure compatibility with all of our products, and alignment with the customers’ existing and future technology.

INTEGRATION WITH DNO TECHNOLOGY
ANM uses technology elements that specifically align and comply with customer architectures and roadmaps.

RELIABLE, AVAILABLE AND RESILIENT
Design principles are based on high redundancy and operational integrity. Multi-instance software and a robust operating system are deployed on industrial-grade hardware.

HOST MULTIPLE SMART APPLICATIONS
Extensible platform capable of hosting multiple ANM applications and orchestrating control actions for multiple forms of grid constraint, in real time or ahead of time. More applications can be added as the grid evolves and/or more devices connect.

FLEXIBLE, SCALABLE PLATFORM
Cost-effective hardware and software elements enable flexible expansion and upgrading of sgs core to incorporate new or multiple controlled devices and associated smart grid technologies. Alignment with current and future industry standards and technology prevents platform obsolescence.

FIELD DATA AGGREGATION
Reduces reliance on multiple devices or equipment for protocol translation and data handling. Extensible design allows additional protocols and devices to be supported as required.

DEVICE COORDINATION
sgs comms hub directly addresses controlled devices on the grid, reliably transferring monitored variables and control instructions to support ANM.

LOCALISED CONTROL OF GRID CONNECTED DEVICES
Acts as the ANM end-node that interfaces directly with the controlled devices on the grid. Hosts logic, data and communication capabilities to ensure ANM control is consistently enforced.

MULTIPLE DEVICE TYPES
Interacts dynamically with generation, load or dual-mode devices, enabling consistent ANM operation across all grid constraints.

DEVICE COORDINATION
Controlled devices on the grid are subject to deterministic instructions by the smart applications running on sgs core. These applications operate concurrently, taking the necessary actions that maintain the grid within operating limits.

CONTROL SYSTEMS INTEGRATION
Our advanced control systems integration capabilities ensure that sgs connect offers compatibility with the customers’ existing and future controllable power system devices, technologies and modes of operation.

FLEXIBLE, SCALABLE PLATFORM
Cost-effective hardware and software elements enable flexible expansion and upgrading of sgs core to incorporate new or multiple controlled devices and associated smart grid technologies. Alignment with current and future industry standards and technology prevents platform obsolescence.
**Flexible Architecture**

The ANM Platform can be hosted on a number of hardware architectures, such as dual redundant commodity servers and non-redundant ruggedised computers.

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**Our Approach to Active Network Management**

**Proven.** Our approach to autonomous Active Network Management is the only proven approach for controlling multiple devices against multiple constraints.

**Repeatable.** Our approach has proven itself repeatable in different types of networks, at different voltage levels, and for different customers.

**Bumpless fail-over.** Our ANM platform provides bumpless fail-over for any issues with the ANM system and its operating environment, be they software or hardware related.

**Predictable.** Our part-distributed approach is designed to respond predictably and reliably to events on the power system, within specified and guaranteed time windows.

**Transparent.** Our approach to ANM is transparent, making the operation of the system user-friendly for planners, control room staff and developers.