DS AGILE
MASTERING THE DIGITAL SUBSTATION

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ALSTOM
Shaping the future
Introducing DS Agile

DS Agile is the latest in turnkey automation solutions for digital substations. It combines cutting-edge hardware, software, communications and the highest technology engineering to IEC 61850 standards. DS Agile is a fully scalable solution, in terms of functionality, architecture and services that can be tailored either to single substations or to a harmonised system across multiple substations. This interoperable and IEC 61850-compliant solution allows operators to achieve a high level of availability and enhanced reliability of substation equipment. It also provides full integration with control room network monitoring and smart grid applications, such as network stability, wide-area automation schemes and asset management.

DS Agile, Digital Control System (DCS), offers local and wide-area situational awareness, allowing utilities a dynamic and flexible management of power flows. With the integration of condition monitoring data, it also permits to manage the substation assets’ life cycle under optimised condition-based maintenance and replacement plans.

DS Agile provides ultimate reliability through the application of fully redundant architectures. This is reinforced by unmatched cyber security, at all levels throughout the digital substation. Through advanced, expert data processing, the DS Agile digital substation has reduced cables, improved flexibility and increased reliability by preventing failures.

The new era of intelligent Smart Grids requires more sophisticated automation systems which allow energy operators to provide a secure, dependable and cost-effective power supply to meet increasing customer demands for higher standards of power automation.

As a world leader in substation automation solutions, Alstom Grid is at the forefront of developing systems which help energy operators optimise the design, operation and maintenance of digital substations to meet the demands of an ever-changing environment, through real-time intelligent digital networks.
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A - Digital instrument transformers

Instrument transformers are key components for bay protection, metering and control. Alstom’s CDSi range is a complete, innovative family of digital (optical and low-power electronics) current and voltage transformers that covers all AC and DC applications, up to 1100 kV, for:
- Air-insulated switchgear (AIS)
- Gas-insulated switchgear (GIS)

The digital instrument transformers offer many benefits compared to conventional instrument transformers (oil, SF₆), including:
- Extremely wide dynamic range
- Smart Grid ready, with direct IEC 61850-9.2 digital output
- Light weight, installation flexibility, seism proof
- Increased safety for people, substation equipment and environment friendly
- System cost savings, near zero maintenance
- Flexibility and inventories reduction

B - Data acquisition & merging units

Alstom provides a full range of flexible IEDs allowing data (i.e., measurement, control signals and condition monitoring parameters) acquisition and conversion into IEC 61850 sample values and GOOSE messages. The SCU, in particular, also allows control of switchgear. Merging units are the smart IEDs which facilitate measurement conversion in IEC 61850-9-2 process bus architectures:
- Analogue merging units, such as MU320 and AMU, interface conventional instrument transformers
- The NXMU connects digital instrument transformers using smart optical measurement technology
- XMU interfaces with the Rogowski sensing technology in GIS applications

The DS Agile SCU (Switchgear Control Unit) is designed for interfacing and controlling circuit breakers, disconnectors and any other primary switchgear equipment, processing the I/O signals as IEC 61850-8-1 GOOSE messages at process bus level.

Condition monitoring sensor units (CMU): a complete range of state-of-the-art IEDs for online condition monitoring of the substation primary equipment can be fully integrated through IEC 61850 within the DS Agile system, to provide valuable, real-time condition data for failure prevention and optimal asset management.

C - DS Agile substation bay controller

The IEC 61850-compliant substation bay controllers provide fast automation, embedded or programmable (automatic voltage regulation, synchro-check, auto-recloser, busbar transfer), IED interface for legacy protocol conversion, data concentrator, events and waveform recorder, hot standby redundancy and adaptable for individual requirements. Alstom’s DS Agile C264 bay controller is a proven solution with more than 35,000 units installed worldwide.

- Substation control, communication, monitoring, protection and automation functions
- Modular, IEC 61850-compliant solution
- Open platform for real-time automation schemes
- Both legacy and cutting-edge communication protocols
- LCD graphical display for local control, monitoring and maintenance
- Suitable for retrofitting and modernising existing installations

D - Legacy RTU upgrade & IED integration

DAPserver – and, in particular, the DAPmini compact version - provides utility operators with a practical, non-disruptive migration solution for bringing their legacy Remote Terminal Units (RTU) into the “smart substation” era. DAPserver allows RTU users to meet their needs and business objectives in terms of:
- Increased processing power, memory and storage capacity
- Ability to integrate new applications, with open-source Linux OS
- IP-based protocols and networking capability
- IP-based remote access for maintenance and diagnostics
- Visualisation of substation information with a full-graphical HMI
- Cyber-security enhancement to meet NERC, CIP requirements

Alstom’s DAPserver/DAPmini solutions for legacy equipment retrofit are complemented with DAP IO, the next-generation range of input/output (I/O) modules especially designed for replacing legacy RTU I/O modules with minimal field wiring change. The DAP-MIO module provides:
- 16 digital inputs, 16 analogue inputs & 8 control outputs per module
- Redundant 10/100 Mbps Ethernet switches with daisy-chain connection
- DNP3 and IEC 61850 communication

The DAP family offers the most practical, low-risk and cost effective way for substation RTU and automation upgrade and retrofit projects.
Key components

- **Agile protection relays**
  Alstom offers a complete portfolio of substation protection relays. The full range of protection functions and applications is included, from the simplest back-up device, to sub-cycle tripping main protection schemes. In a fully-digital architecture, the relays receive currents and voltages as IEC 61850-9-2 sampled values and issue trip or alarm signals using IEC 61850-8-1 GOOSE.
  The Agile comprehensive offering of protection relays includes:
  - Micon P40 Agile compact and modular relays: from MV to EHV
  - P50 Agile range for industry and self-powered applications
  - P60 Agile with distribution bay control & colour touch screen mimic
  - Solutions for transmission, distribution, generation, industry, rail...
  - Feeder, motor, generator, distance, differential, transformer, busbar, voltage and frequency
  - Interoperable solutions with IEC 61850, DNP 3.0, ModBus, and IEC 60870-5-103 protocols

- **Measuring, monitoring and recording IEDs**
  The Alstom’s measuring and recording IEDs portfolio comprises diverse product families that cover today’s most challenging substation operator needs:
  - Reason RPV311 digital fault recorder with PMU option
  - RA333 travelling wave fault location accurate to the faulted span
  - ISTAT range: accurate to Class 0.25 energy & Class A power quality
  - M87x modular measurement centres with recorder
  - Discrete and multifunction transducers
  - The ideal range of tools for analysing network faults, protection reactions, dynamic stability and long-term trends

- **DS Agile substation gateway**
  Alstom’s A-series provides powerful and ruggedized gateway solutions for interfacing bay level devices, station level devices or upper level systems. They combine full IEC 61850 compliance with hot standby redundancy and simple commissioning.
  - Protocols: IEC 61850, IEC 60870-5-104, IEC 60870-5-101, DNP 3.0 and ModBus
  - Hot standby redundancy
  - Integrated Ethernet switches, including Parallel Redundancy Protocol (PRP)

- **DS Agile operator interface (HMI)**
  An intuitive and comprehensive human-machine graphical interface is integrated into DS Agile for full substation monitoring and control. This provides efficient and secure access to information and archives, tailored to the substation environment and the end-users’ specific requirements. At any given time, substation operators and engineers have complete control of all parameters through the substation HMI, allowing for optimal operational and maintenance management.
  - Single-line dynamic diagram viewer
  - Integrated on-line condition monitoring dashboards
  - Alarm and event viewer
  - Data monitoring, logging, archiving and curve trends
  - Phasor data visualization
  - Video image integration
  - Hardened, secure access control

- **Engineering & configuration tools**
  The System Configurator Editor (SCE) provides full parametering of the DS Agile C264 bay controllers, substation gateway and the operator interface. It also includes PSL and PLC (ISaGRAF) logics editors that facilitate the creation of powerful and sophisticated automation functions.
  Access to protection and automation engineering is facilitated via the S1 Agile toolset, the truly universal PC tool for IEDs configuration and maintenance.
  - Integral data creation for system coherency
  - ISaGRAF editor IEC 61131 standard
  - PSL editor for fast automation
  - Graphical editor
  - Reference templates library
  - Configuration file creation following substation topology
  - Event and disturbance record extraction and viewing (S1 Agile)
  - S1 Agile supports all MiCOM & Agile ranges, K-series and Modulenex
  - Automatic settings conversion from older numerical relays
The complete digital substation solution

Key components
A typical DS Agile Digital Control System (DCS) will incorporate different Intelligent Electronic Devices (IEDs), such as protection relays, measurement and monitoring devices, bay controllers, Ethernet switches and gateways. All key components are designed for optimal interoperability, data retrieval, control capability and remote settings.
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K - Monitoring processing units

On-line condition monitoring functions are essential for the correct management of the life cycle of all primary switchgear and power transformers in the substation.

Alstom has the most complete range of state-of-the-art systems for online condition monitoring of the primary substation equipment, which can be fully integrated within the DS Agile system through standard protocols, including IEC 61850.

- PTWatch M53000 - Power transformer condition monitoring
- BWatcH - GIS bay condition monitoring
- PDWatcH - Partial discharge condition monitoring for GIS
- GISWatcH - Integrated bay and partial discharge condition monitoring for GIS
- CBWatcH - Circuit-breaker condition monitoring
- DWatcH - Disconnector digital control and condition monitoring

L - Phasor measurement and analysis (PMU)

Phasor Measurement Units (PMU) measure and communicate real-time power system vector quantities (phasors) for use in stability and wide area automation schemes. Both Reason RPV311 and MICOM P847 from Alstom provide high-quality synchrophasor measurement and communication.

- Analogue (P847) or IEC 61850-9-2LE digital (RPV311) measurement inputs
- Transmitted synchrophasor data, compliant with IEEE C37.118 standard
- Highly scalable solution by means of additional acquisition units (RPV311, RA33x)
- Software tools for PMU management
- Additional control and recording functions incorporated

M - Wide Area / Microgrid controller (WACU)

Inter-substation and inter-voltage level automation is made possible thanks to the Wide Area Control Units (WACU), which exchange fast GOOSE messages between the different interconnected sub-systems, permitting logic selectivity, automated on-line setting of relays, service restoration sequences, etc.

The wide area automation and communication capabilities of the WACU allow for introducing new smart grid and microgrid solutions, to fulfill the utilities’ increasing needs that come along with the integration of distributed energy resources and more open and flexible energy management models.

- IEC 61131 PLC automation
- IEC 61850-compliant
- Hot stand-by redundancy

N - IEC 61850 Ethernet network

DS Agile’s complete architecture consists of an IEC 61850 Ethernet network that links all components together and with the operator interface (HMI). The network can be local to the substation or can interconnect several dispersed substations.

Architectures can be set up as self-healing ring or parallel redundant star, both of which are fully redundant, eliminating outages. All architecture configurations are linked to the grid control room.

- International standard protocol
- Allows interoperability between IEDs from different vendors

P - GPS precision time synchronising

Substation GPS clocks: precision time references across a power grid, used to synchronise the devices which protect, and control the stability of the system. The Reason RT range interoperates with the latest Precision Time Protocol (PTP) and likewise legacy IRI-G-B solutions.

The Reason RT430 provides the substation grandmaster clock function.

- Synchronisation of IEDs and merging units
- GPS clock server 1 PPS, IEEE 1588
Key components

R - Remote access tools
DS Agile provides the capacity for full remote access to the substation data and IEDs, enabling on-line setting and maintenance capability around the clock. The communications are tunnelled through secure Virtual Private Network (VPN) and the substation firewall, which acts as an authentication proxy, protecting the control system against unauthorised intrusion.
- Remote desktop
- IED engineering, diagnostics and maintenance
- Cyber-secure web access to substation

S - DS Agile and Reason Ethernet switches
The DS Agile H-series Ethernet switches combine interoperable redundancy protocols (PRP/HSR) and fibre-optic connections for ultimate reliability of the substation communication networks. They maintain the flexibility to connect to standard Ethernet networks for substation upgrades or refurbishments.
The full range of switches is completed with Alstom’s Reason T-series, particularly for applications where larger numbers of ports are required.
Overall, the range meets the most exacting substation standards, including those with precision-time requirements such as IEEE 1588 PTP.
The Alstom range of switches covers all Ethernet redundant architectures: ring, multi-ring, star, double-star.
- Interoperable protocols (PRP/HSR)
- Gigabit switches
- Full compliance with electrical installation constraints (IEC 61850-3)
- Internal PC and bay controller switches
- External switches for rack mounting

T - Teleprotection & telecommunication
Designed upon proven protection and communication applications and up-to-date technologies, the e-terra gridcom range of teleprotection and telecommunication solutions ensures critical message transmission between substations, establishing an adaptable bridge between the electrical installations and the telecom network.
- Wide range of teleprotection and telecommunication products
- e-terra gridcom DIP.net interoperable, IEC 61850-compliant teleprotection
- Embedded cyber-security features
- Solutions for MV & HV networks

U - Asset management solutions
e-terra assetcare is Alstom’s advanced software platform for Asset Health Management, which provides key diagnostics of the substation equipment, such as Asset Health Indices (AHI) and end-of-life predictions, that allow establishing condition-based, reliability-centred maintenance plans and building long-term strategic investment plans.
- Data collection services feeding an asset-based repository
- Content management system for documents, inspection files, reports
- Calculation engine for analytics
- Business intelligence layer (dashboards)
- Reporting
- Stand-alone or connected system

V - Network management solutions
e-terra platform is the leading SCADA/EMS system in the world, running the systems in 10 out of 14 of the largest Power Grid Operators: 170 systems in the USA, 70% of the Middle East Utilities, and 70% of Africa.
Alstom’s network management portfolio is completed with additional tools for monitoring the grid’s reliability in real-time, like Pysemrix’s Phasorpoint Wide-Area Monitoring System (WAMS) for network stability and UISIO’s Demand Response (DR) solution, DRBizNet.
- Network management systems (EMS/DMS)
- Market managements systems (MMS)
- Wide area management schemes (WAMS) and defence plans
- Demand response solutions
Reliable redundant architectures
DS Agile provides ultimate reliability through the application of fully redundant architectures. Thanks to the complete range of Alstom Grid’s manageable switches, both self-healing redundant ring or bumpless redundant star network architectures can be built, avoiding communication outages throughout the substation’s LAN.

Interoperability: industry standardisation
DS Agile offers topology-orientated automation protecting, controlling and monitoring installations to ensure continuity and reliability of electrical networks. Based on IEC 61850 communication standards, DS Agile enables complete integration between devices and therefore ensures optimum use of information.

IEC 61850 interoperability
This interoperable and IEC 61850-compliant solution allows operators to achieve a high level of availability and enhanced reliability of substation equipment. It also provides full integration with control room network monitoring and smart grid applications, such as network stability, wide area protection plans and on-line condition monitoring.

Cyber security
DS Agile incorporates specific solutions - driven by NERC, NIST, IEC, IEEE and generic IT recommendations - to increase the cyber security level in the substation. The Alstom Grid’s hardening strategy for automation systems includes:

- Reduction of the substation’s attack surface (limit the number of access points)
- Remote communication to substation through VPN and LAN firewall
- Remote maintenance access through ‘jump box’ for controlling the traffic to IEDs
- Improved user Authentication, Authorisation and Accounting (AAA) in all subsystems
- Intrusion protection: anti-virus and whitelisting
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**Key features**

Alstom Grid has one clear mission: to develop innovative solutions for a flexible, reliable, affordable and sustainable electrical grid throughout the world.

**Power generation**

Active in power transmission and distribution, Alstom Grid designs, manufactures and services the products and systems that empower the planet’s low carbon economy. It ranks among the top three players in the electrical transmission sector, with an annual sales turnover of more than €4 billion.

With over 130 years’ experience, Alstom Grid has become a trusted partner for all of its customers, from source to smart city.

**Electrical grid**

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**Rail transport**

Alstom bases its success on the principles of ethics being rigorously implemented by its 93,000 employees, who work closely with the community of stakeholders that make up the Group’s ecosystem. These shared commitments are expressed in products and services that bear the stamp with Alstom.

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