Secure Digital Substation Automation Solution from Alstom Grid and Cisco

Highlights
- Validated enhanced secure digital substation architecture
- End-to-end security and management architecture
- Multi-service bus extension (IP voice, video, data)
- Standards (IEC 61850) and interoperability compliance

Today’s electric transmission and distribution networks face a variety of new challenges:
- Ensuring grid reliability and improving network stability to prevent outages in the growing numbers of grid interconnections
- Enhancing end-to-end security in grid operations while supporting increased penetration of distributed energy resources
- Reducing environmental impact through secure and optimal integration of renewable energy sources
- Improving asset utilization and grid efficiency for utilities to reduce operation and maintenance costs

Increasingly, utilities are responding to these challenges by implementing smart grid network solutions equipped with digital controls, IT systems, and telecommunications capabilities. These solutions enable real-time monitoring and control of electrical grid operation that is no longer limited to centralized generation models, unidirectional power flow, and static protection schemes. The resulting intelligence is distributed not only at the central control room but also across substation control rooms, field equipment and smart devices across the network. This new level of visibility and control is helping utilities to become more reactive and flexible to deal with the growing complexity of grid systems.

Solution Overview
The Alstom Grid and Cisco® Secure Digital Substation Automation Solution combines the capabilities and knowledge base of two leaders in the utility and network industries. This unique collaboration takes full advantage of both Alstom’s expertise in electrical grid technology innovations and Cisco’s leadership in connected grid solutions and IP communication technologies. The result is a solution designed to support large-scale grid modernization initiatives.

The digital substation provides a flexible communications infrastructure that reduces the limitations of point-to-point wiring and allows two-way information and device status to be shared in near-real time. This capability supports substation automation applications such as remote monitoring and control of geographically distributed substations, which enable predictive and preventive maintenance of substation equipment. It also supports optimization of load capacity, allowing equipment to be operated closer to design limits.

New substation architectures require visibility into this communications infrastructure to understand network paths, proactively manage security threats, and provide secure management access regardless of operator location. Also, remote engineering access to operational information requires deeper knowledge of how
devices are functioning and communicating. To meet this need, Alstom Grid and Cisco offer a validated substation solution that will improve asset utilization, increase grid operational efficiency and provide end to end security integration.

Solution Architecture
The solution architecture is built on a multi-layer architecture beginning with a central control room followed by substation control room, substation switch yard and local controls for smart devices. (See Figure 1)

This layered approach across both the station bus and the process bus allows easy design and integration of communication infrastructure with the critical protection and control, asset monitoring, and grid management equipment.

The joint solution, which integrates the Cisco ruggedized, substation-grade Connected Grid routers and switches with communications and cybersecurity functions into Alstom’s substation automation solutions, creates a new level of IP-based communication performance for integrated security, distributed monitoring, and control. This multi-service network, integrated with Alstom’s next-generation intelligent electronic devices (IEDs), provides utilities with the flexibility to deploy multiple applications over a unified power and communications infrastructure. This will allow asset managers to optimize preventive maintenance extending equipment life. Alstom intelligent systems optimize the grid substation operation by supporting dynamic model updates, bi-directional power flows and dynamic protection schemes.

Using this solution, substation operators can closely monitor all assets in terms of operational conditions, effective load capacity, and asset health indicators. Intelligent systems analyze the data and provide recommendations on maintenance and repair actions. Dynamic load analysis also permits operation of lines, cables, transformers, and other grid equipment closer to their limits.

Solution Systems
The Alstom DS Agile™ system is the latest turnkey automation solution for digital substations to support IEC 61850 standards. The DS Agile system typically incorporates different

Figure 1. Solution Architecture for Secure Digital Substation Based on Alstom DS Agile Control System
IEDs (such as Alstom Micom P40 protection relays, measurement devices and monitoring equipment), Alstom C264 bay controller units, gateways, interoperable redundant switches, condition monitoring units and merging units.

DS Agile links all components together and with the operator interface (HMI). The network can be local to the substation or can interconnect several dispersed substations. To help achieve full redundancy, the system is designed as a high availability seamless ring (HSR) or dual homing star, or as a Parallel Redundancy Protocol (PRP). All architecture configurations are linked to the grid control room.

Cisco 2500 Series Connected Grid Switches (CGS 2500) provides the communications connectivity for the station bus and process bus interconnecting the various bay systems. The Cisco 2010 Connected Grid Router (CGR 2010) enforces substation-level security policy as well as remote control network access and authentication, threat detection, and secure WAN communications. The Cisco Access Control Server (ACS) is an access policy control platform that manages authentication, authorization, and accounting functionality using RADIUS or TACACS+ protocols. Additionally, the Cisco ACS optionally uses the utility’s directory services through standards-based access for seamless companywide policy management.

Securing the Substation Network

The integration of power delivery and control with substation communications must be secure, flexible, and reliable to meet critical infrastructure standards. Cisco technologies interoperate with either approach, as well as providing additional levels of redundancy with Resilient Ethernet Protocol/Rapid Spanning Tree Protocol (REP/RSTP) and other features. Primary features include:

- Intrusion detection and prevention systems (IDS and IPS) supporting SCADA signatures
- Intrusion and virus attack protection integrated into the communications network
- Advanced firewall feature set to create an electronic security perimeter across critical assets

At the same time, Cisco technology ensures that only devices that should participate in the substation communications infrastructure are allowed through authentication protocols such as 802.1x. Advanced cybersecurity functionalities provide protection against unauthorized access to equipment, and unauthorized transfer, modification, or destruction of data—deliberate or accidental. Such measures are essential to utility customers, particularly where WANs extend beyond the traditional substation perimeter (for example, security procedures, controls, firewalls, and role-based access).

Solution Benefits

The Alstom DS Agile control system for substation automation, coupled with Cisco Connected Grid products and security technology, offers utility operators numerous benefits, including:

- Enhanced security: The joint solution allows utility operators to utilize defense in-depth to address security policies, manage user access to critical resources, and detect and mitigate possible cyber attacks across the grid infrastructure. The security capabilities are designed into the Cisco Connected Grid router and switches, which provide the most advanced portfolio of VPN, encryption, access control, and threat detection in the industry. Comprehensive security controls are based on National Institute of Standards and Technology (NIST) and International Electrotechnical Commission (IEC) recommendations.

- Increased operational efficiency: Today’s utilities are looking for a phased approach to evolving infrastructure to extend the useful life of current technology investments. Alstom Grid and Cisco provide a validated digital architecture that delivers an optimal deployment for substation automation. This layered architectural approach across both the station bus and process bus allows easy design and integration of communication infrastructure with the critical protection and control, asset monitoring, and grid management technology.

- Reduced operations and maintenance costs: The joint digital substation solution provides utilities the flexibility to deploy interoperable protocols over common network infrastructure. Asset managers now have a critical tool that, with less wiring and fewer commissioning tests, optimizes preventive maintenance and can extend equipment lifetime of the full substation, including third-party plan items. The solution allows substation operators to closely monitor all substation assets in terms of operational conditions, effective load capacity and asset health indicators. Secure remote access can generate additional savings by reducing the number of resources needed in the field.

Conclusion

The combined industry-leading expertise and technologies of Alstom Grid and Cisco offer a solution that enhances security integration across electric grid substations. The joint solution increases grid efficiency while reducing operation and maintenance costs through improved asset utilization. The solution architecture enables a phased deployment of substation automation systems. The unified power and communication infrastructure supports both today’s utility needs and tomorrow’s applications and growth.