NHP

Technical News

Distribution Substation Case Study - Monitoring, evaluation and intelligent management

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This Technical News will present a detailed case study of a distribution substation installation located in a major capital city high-rise development. In order to achieve the successful delivery of this substation, the Alstom DAPserver (Distributed Automation Platform) was selected as the platform technology to enable the desired automation and control capability.

Within this expertly designed digital substation, primary equipment and secondary electronics from major manufacturers in Asia, Europe and North America were integrated to provide the asset owner with the necessary tools to monitor, evaluate and intelligently manage the distribution substation.

With the flexibility to adapt it's features to the specific needs, risks and network configuration of particular applications, throughout this white paper we will discuss the varied DAPserver functionalities that were implemented for this particular project. These particular features were specifically selected to reflect the needs identified by the customer and ultimately reduce the risk of network outages and failed equipment along with increased reliability and visibility to enable early detection of any system issues.

Within this discussion, we will also cover the details of the application and the benefits of the DAPserver including integration with varied IEDs, data concentration, condition monitoring, DAPview HMIs, remote access and tunnelling.
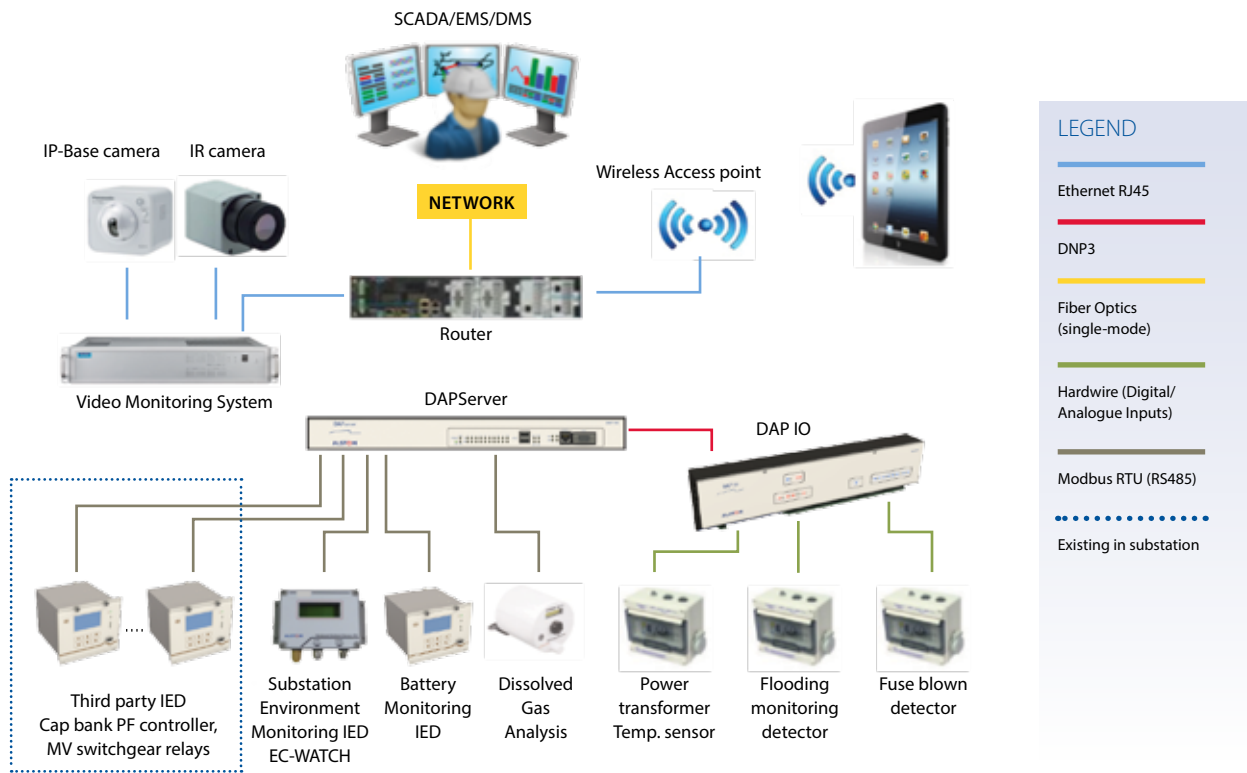
DAPSERVER BENEFITS

Traditionally, asset management is carried out by performing regular maintenance and estimating the end life of an asset based on the manufacturer's recommendation. Within this approach, asset owners and operators are granted little visibility of the plant status and therefore potential issues are often identified too late if not by a disaster itself.

In this particular high-rise distribution substation, the DAPserver was selected to improve this situation through the increased monitoring of various plant conditions including statuses, events and trending to remote SCADA for data analysis.

Taking the site's particular application factors into account, the automated control logic was configured in DAPserver to provide an instantaneous alarm to the asset owners to allow for a quick response. This configuration also enabled proactive management and better asset utilisation to avoid outage costs, prevent plant failure and loss of production.

System Architecture

SCADA/EMS/DMS

IP-Base camera   IR camera

Wireless Access point

NETWORK

Router

Video Monitoring System

DAPServer

DAP IO

LEGEND

Ethernet RJ45

DNP3

Fiber Optics (single-mode)

Hardwire (Digital/ Analogue Inputs)

Modbus RTU (RS485)

Existing in substation

Third party IED Cap bank PF controller, MV switchgear relays

Substation Environment Monitoring IED EC-WATCH

Battery Monitoring IED

Dissolved Gas Analysis

Power transformer Temp. sensor

Flooding monitoring detector

Fuse blown detector

INTEGRATION

One of the leading functions that the DAPserver provides is integration with Intelligent Electronic Devices (IEDs) and the ability to seamlessly integrate relays from different manufacturers. That was brought to the fore in this specific project which required the integration of multiple brands of relays and further combine all of the data from the different IEDs and report this information to SCADA with accurate time-stamping. As the DAPserver allows different protocols to be converted and concentrated waiting for remote SCADA to request the information, one of the strengths of DAPserver is the compatibility with current and legacy protocols.

With a vast and growing library of relay templates, the DAPserver was able to effectively communicate with the various IEDs from different suppliers used on the project. Not only can DAPserver connect to IEC 61850 devices, legacy protocols such DNP 3.0, IEC 60870-5-101, 103, 104, Modbus but also proprietary protocols (SPA-Bus, SEL, Courier… etc.) can be used.

SCADA

NETWORK

Substation LAN
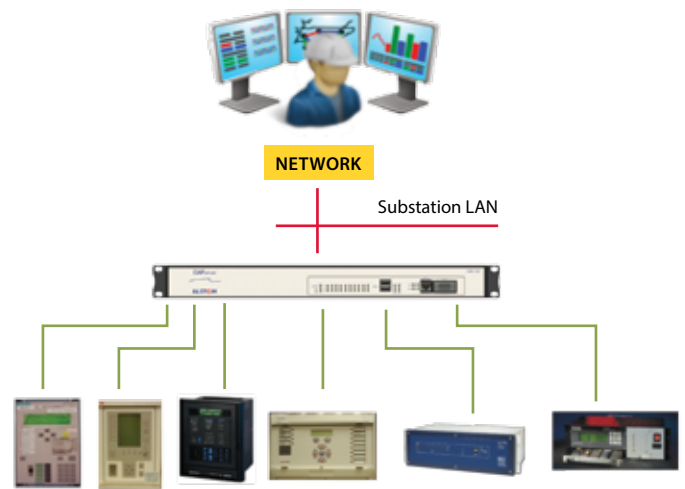
Integration of relays from different vendors into DAPServer

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DATA CONCENTRATION AND CONDITION MONITORING

Data concentration ability with the DAPserver brought several advantages to operations and management on this project. Power system information was made readily available and accessible to staff to further improve and enhance various operation and maintenance tasks, planning and management. Faster response and decision making in responding to planned situation and events were also achieved.
Operation and management efficiency has been greatly improved by having real time information available to make informed decisions and information sharing to customer, regulators, media and general public was also simplified.

The system implementation also brought major benefits to various functional groups in daily operation:

• One common single platform to access general substation information and to access different systems specific information at Substation – to simplify data presentation.

• Reduce operational complexity – allow user to access different systems with a few clicks to control and configure individual devices within Substation.

• Easy demonstration of system performance, using less keystroke and screens for fast presentation in the Substation.

• Enabling system access from remote location.

• Fast problem diagnosis – to combine different systems data to support full view of present status

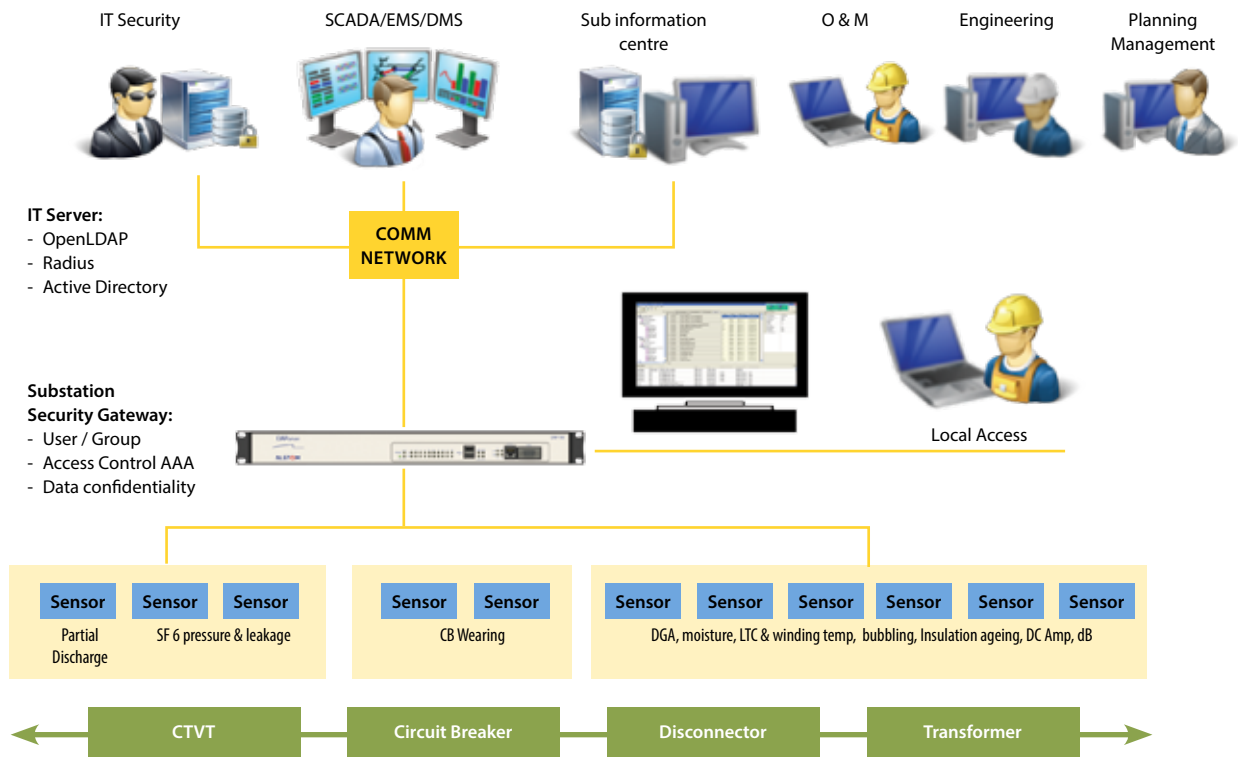• Protect investment – legacy and new systems co-exist

Condition monitoring has become more widely deployed in substations because of the benefits it brings to end users. By monitoring the on-line information of devices and conditions in the substation, accurate decisions can be made depending on the information available.

In relation to this project, the following devices were installed and integrated with DAPserver:

• Battery monitoring IED – For monitoring trend of cell voltage, temperature and resistance. Alarms can be initiated from the battery monitoring IED and captured by DAPserver via Modbus communication. This allows early detection of abnormal condition or battery failure.

• Substation Environment IED – Provides ambient temperature, humidity, flooding and dust monitoring around the substation.

For example, high levels of dust over extended periods can penetrate switchgear and lead to possible busbar faults and extended outages.

IT Security   SCADA/EMS/DMS   Sub information centre   O & M   Engineering   Planning Management

IT Server:
- OpenLDAP
- Radius
- Active Directory

COMM NETWORK

Local Access

Substation Security Gateway:
- User / Group
- Access Control AAA
- Data confidentiality

Sensor	Sensor	Sensor		Sensor	Sensor		Sensor	Sensor	Sensor	Sensor	Sensor	Sensor

Partial Discharge   SF 6 pressure & leakage   CB Wearing   DGA, moisture, LTC & winding temp, bubbling, Insulation ageing, DC Amp, dB

CTVT   Circuit Breaker   Disconnector   Transformer

CONDITION MONITORING OF APPARATUSES IN SUBSTATION HMI - DAPview

DAPview is a graphical HMI application integrated in DAPstudio software that operates on DAPserver. It is designed for utility and industrial power system operation and maintenance. System navigation, screen layout, and information displayed on the HMI are customised with graphic tool and a library that contains a wealth of predefined IED templates. The graphic tool provides the system administrator an easy access to the database and is able to incorporate raster pictures that are created using off-the-shelf graphic software. After the system has been put into operation, the system administrator has the freedom to add, reposition and remove any display data, or change the screen layout in any order and sequence.

Logging into the system will require users to enter a valid user name and correct password. Upon login, users will be presented with the System SLD where it will provide a quick summaries status of the substation.

Data is dynamically updated periodically based on Modbus polling rate and system events. Any object that is operable can be accessed with a touch on the IPAD. For instance, tapping an IED (a bay controller for example) will bring up the detail page of the particular IED showing its relevant information. Again, page content and layout can be customised.

Additional screens can be added and designed as a consolidated page to display a combination of analog values, status, and results of a mathematical manipulation. The system can also support real-time trend diagrams. Multiple analogue data points can be selected for the trend display.

The system features a wealth of reporting functions. At any screen, users may click the icons at the left side of the page to view alarm reports or event lists. The alarm list can be duplicated to mirror those inside the subsystems' database. The system can also support independent alarm threshold on a per data point basis. Data coming from the subsystems will trigger an alarm if the values exceed their user defined thresholds.

DAPview HMI acts as an interface between the User and what DAPserver can offer, and a summary of applications used in this substation case study are listed below;

• Login authentication to prevent unauthorised access

• Graphical overview of the substation in single line diagram presentation

• Alarm annunciation from IEDs and equipment connected to DAPserver

• Customisable visual representation of data and information

• Substation distribution automation

• Protection relay management and remote access

• Online condition monitoring

• Remote maintenance and diagnostics

iPad APP screenshots

TUNNELLING THROUGH DAPserver

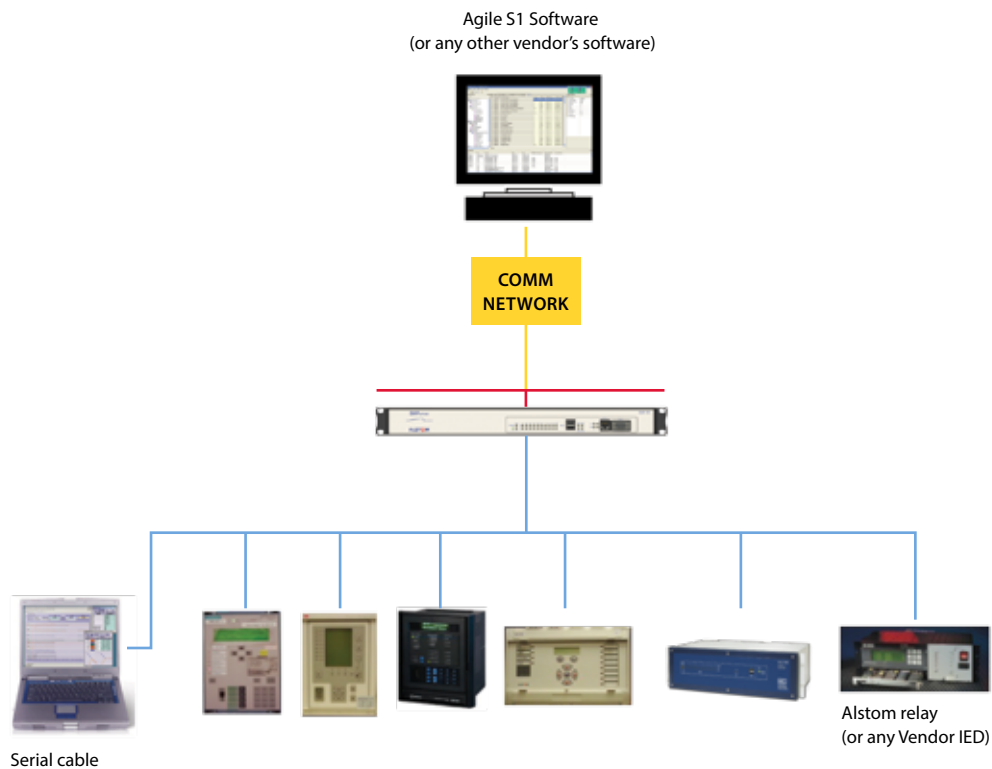Since DAPserver is proprietary protocol compatible, the tunnelling from remote SCADA is available.

Tunnelling refers to when engineering and maintenance on the setting files are conducted from remote SCADA through enterprise network. The DAPvport application is able to launch IED native software such as S1 Agile and access IED data and retrieval of the following information can be accomplished by DAPvport:

• Sequence of events and fault records

• Disturbance records

• Setting files

The greatest benefit that this feature achieved on this project was the integrated operation environment where users no longer need to switch programs from one system to another. All programs can run concurrently on the platform, which significantly reduces inconvenience.

Engineers can also access the substation remotely to perform routine maintenance such as IED configuration. Such remote maintenance function does not require the engineer being physically present at the substation.

Remote access to substation data and information enhanced system operation and maintenance in many ways.
It enables decision making to be faster and more accurate when responding to unplanned events. With the availability of data and information, it allows enhanced system planning and management.

Agile S1 Software
(or any other vendor's software)

COMM
NETWORK

Serial cable

Alstom relay
(or any Vendor IED)

Tunnelling through DAPserver

VIDEO MONITORING SYSTEM INTEGRATION

Two applications are realised by the Video Monitoring System:

• Video surveillance with a VIS camera (in visible domain)

• Thermal imaging with a IR camera (in infrared domain)

DAPserver has the capability to integrated digital video and thermal video system for security, safety, and asset monitoring. While these systems shall be independent sub-systems, DAPserver shall be the user interface and access point for launching the digital and thermal video systems.

For further details refer to System Architecture diagram on page 3.

SUMMARY

As this case study highlights, the Alstom DAPserver is able to provide a secure and effective way for managing assets with the flexibility to adapt to various environments and application requirements.

Functions not only include local and remote HMI view of the whole system including control of apparatus, data concentration and protection relay management but importantly, a whole new level of visibility and control are presented to the end users in an easy to configure and user friendly way. The correct integration of IEDs and condition monitoring of primary equipment and various devices also results in significant cost saving by predicting and preventing system failure in advance.

Whilst the features of the DAPserver have been demonstrated in this Technical News, it is important to recognise that achieving these results requires a close working relationship between the customer, consultant and manufacturer/supplier – in this instance, Alstom and NHP.

Understanding customer needs and expectations, allows our skilled experts to provide the solution that enables our engineering staff to fully experience the benefits of the DAPserver.
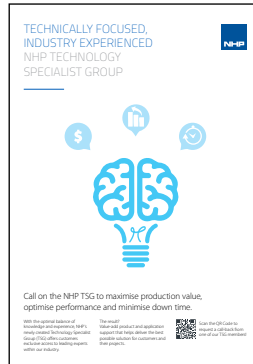
FURTHER READING

DAPserver solutions enable electricity utilities and industrial customers to leverage information to improve their operations, network efficiency and reliability. It is the perfect solution for customers planning to modernise their substations with both Remote Terminal Unit (RTU)-based and IEC 61850 standard-based architectures.

If you would like more information on how the DAPserver can help enrich your substation assets and provide a migration path to the next generation of substation automation solutions, scan this QR Code.

If you would like to speak to one of NHP's substation automation technology expects about your next project, scan this QR Code.

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