

@SCADA+[®]



Supervisory Control and Data Acquisition System





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A. Product Overview

@SCADA+® is a solution to supervisory control and data acquisition, managing system operation on a real-time basis. The solution is developed entirely on Client-Server architecture.

MAIN FEATURES

- ◆ Full features of Supervisory Control and Data Acquisition (SCADA) system for transmission and distribution.
- ◆ Truly open system architecture through the use of standard hardware and software:
 - * Intel-based hardware
 - * Identical and interchangeable versions which run on Windows Server
 - * Relational Database using standard procedures such as OCBC and SQL for remote access;
 - * De facto Historical Information System (HIS) in popular use world-wide
 - * Standard local networks, such as FDDI (Fiber Distributed Data Interface) and Ethernet, supporting TCP/IP protocol
 - * User-friendly human-machine interface based on Microsoft Windows and SmartHMI Studio
 - * Multi-communication link: Leased line, Satellite, GSM/GPRS, Corporate WAN, Public Internet/ADSL
 - * Multi-protocol speaking: IEC-60870-5-101/104, IEC-61850, IEC-61850-2/IEC60870-6, DNP 3.0, Modbus, RS485/RS422 (can be extended upon users' requests)
- ◆ IEC-61970/IEC-61968 (CIM) model ready for advanced applications
- ◆ Unlimited amount of handled data points
- ◆ Modular and scalable architecture with off-the-shelf components
- ◆ Web-Service interfaces for data building and system configuration
- ◆ Access Security in compliance with Critical Infrastructure Protection (CIP) issued by NERC.
- ◆ Distribution of the tasks among several servers and workstations using extremely modular client-server architecture (This philosophy allows allocating specific tasks to different processors depending of the size and complexity of each specific implementation, thus reducing the amount of information traffic over the network and improving the system's overall performance. For critical functions that require high availability, the processors may be duplicated using hot-standby configurations.)
- ◆ A user-friendly graphic interface allowing operators to perform their tasks with minimal computer knowledge and reducing "start-up" time
- ◆ Ready for future utility interface bus integration
- ◆ 24/7 maintenance service

ADVANTAGES

- ◆ @SCADA+® is a complete system with a highly flexible platform, capable of various configuration options to suite the scope and specification of each project.
- ◆ .@SCADA+® provides an economical solution for large-scale applications. Its flexibility and compatibility with a wide range of other devices guarantees users a full and functional solution meeting the latest standards and future expansion need.



Figure 1. @SCADA+® System

1. CONFIGURATION

1.1 Hardware Structure

The hardware structure overview of @SCADA+® is illustrated as figure 2.

Such a structure supports flexible development of hardware configuration, software architecture, cyber security enhancement, internal and external data exchange. Users may alter and upgrade parts of the system during operation as well as further development.

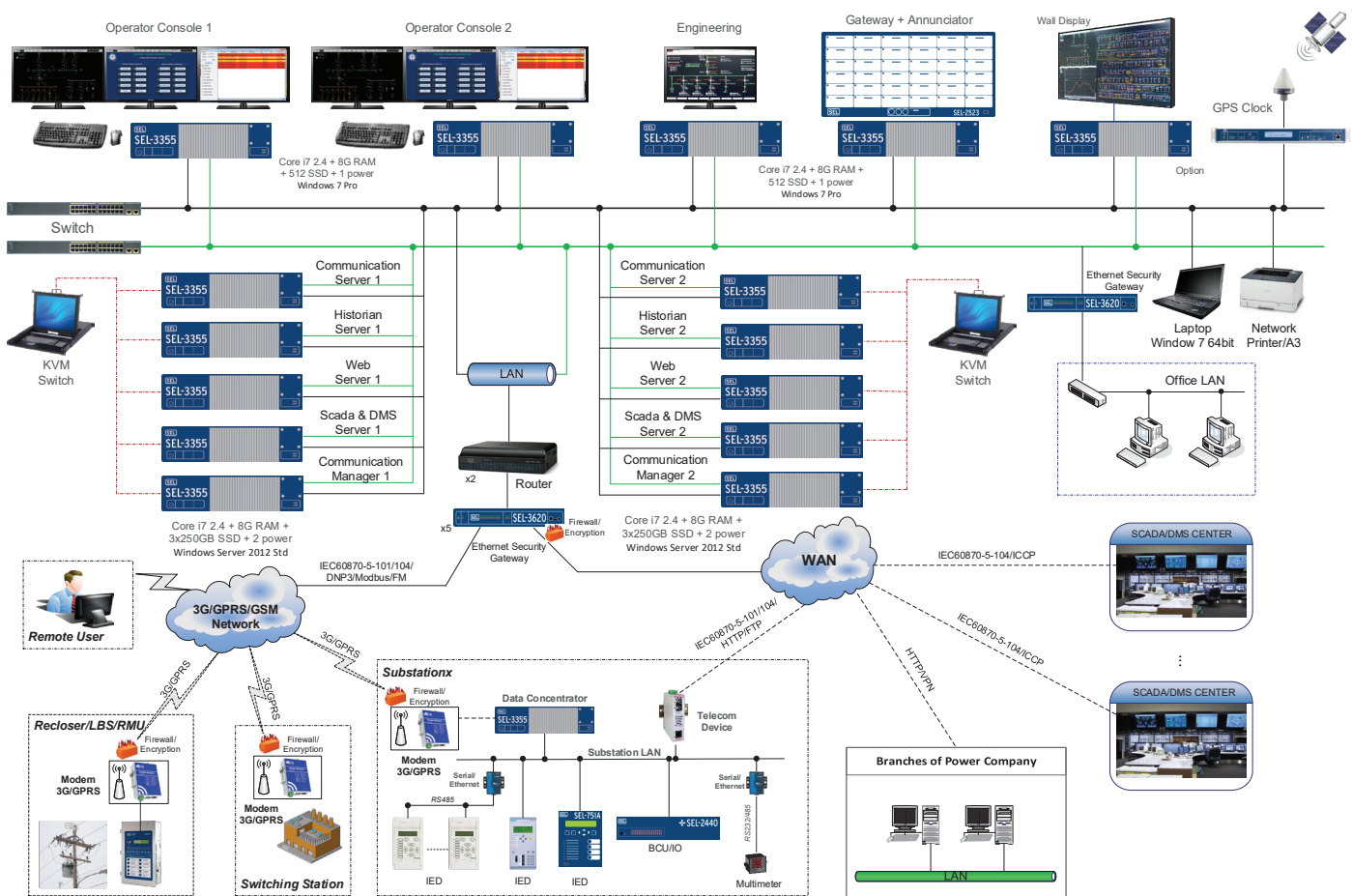


Figure 2. Hardware structure overview

B. Technical Highlights

1.2 Software Structure

1.2.1 General characteristics

- ◆ The solution is developed in MS Windows and support international standards and protocols, including IEC-60870-5-101/-104, IEC-60870-6/ICCP, IEC61850, Modbus, DNP, RP570, DDE and OPC,....
- ◆ The solution can be installed on a number of application servers to ensure redundancy. Data in these servers may updated automatically. Failure of any of servers does not affect operation of the whole system.
- ◆ Module structure and open design complied with IEC, ANSI/IEEE, ISO as well as industrial standards (OPC, DDE, ODBC, XML, SQL, HTTP, etc.) allow users to manage, upgrade, expand an integrate thirds-party applications on the need.
- ◆ CIM-based (Common Information Model) database with capability for data exchange to SQL, Oracle, etc.
- ◆ Integration capacity of at least 128 connection channels to Data Concentrators with IEC-60870-5-101/-104, DNP, OPC Server/Client, and minimum 16 connection channels to control centers with IEC 60870-5-104 or ICCP.
- ◆ More than 20 Workstations can be managed with shared database and applications.

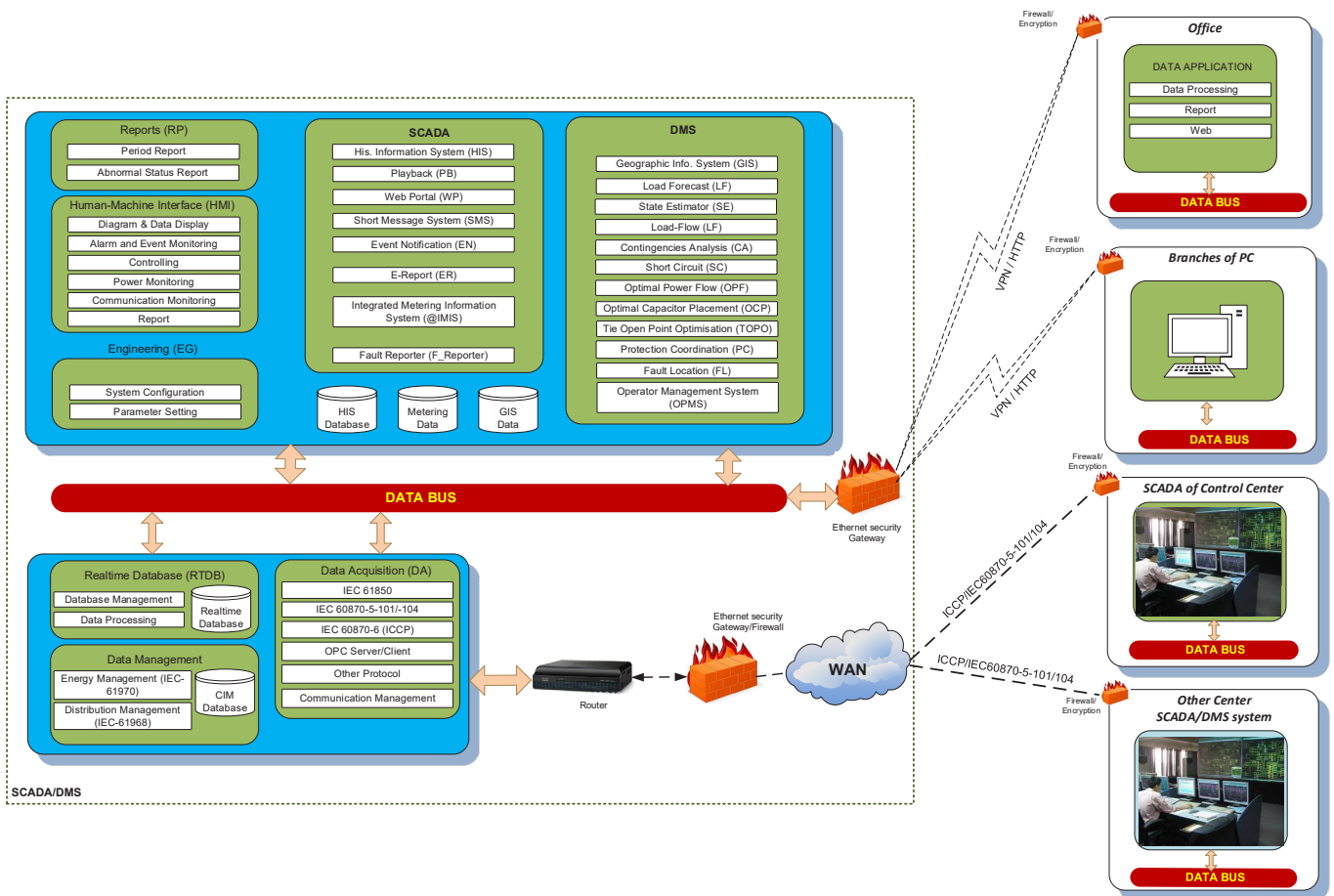


Figure 3. Software Module Connection

1.2.2 Software Structure

@SCADA+® is developed in 3-tier model as illustrated in the figure 4 below.

Data acquisition layer

- ◆ This is the first (lowest) layer that communicates with Substation Automation System as well as other data-colleting devices at the substation and control centers.
- ◆ Other functions are communication channels monitoring, data transmission management.
- ◆ Date received from RTUs with standard protocols (IEC 60870-5-101/104/RP570, DNP3, Modbus, DDE, ICCP, OPC Server/Client).is processed and converted into compatible formats for Data Server layer.

Data Server layer

- ◆ The main function of this layer is processing data from the lowest layer to make it ready for applications.
- ◆ There is a logic processing tool (type of SoftPLC – Logic processor) with IEC61131-3 to create user-selected logic diagrams.
- ◆ This layer is of great important as it serves all real-time data applications.

Application layer

- ◆ This is the highest layer which used for operator interfaces. Applications are made with HMI interfaces to display a huge amount of signals from control computers, event management systems, historical information systems.
- ◆ @SCADA+® is functioned with secured LAN to support many Client/Server access points. The Front-End Processor can handle more than 128 RTUs.
- ◆ @SCADA+® can be operated in centralized or distributed concept with a number of serves to ensure expandability and readiness.

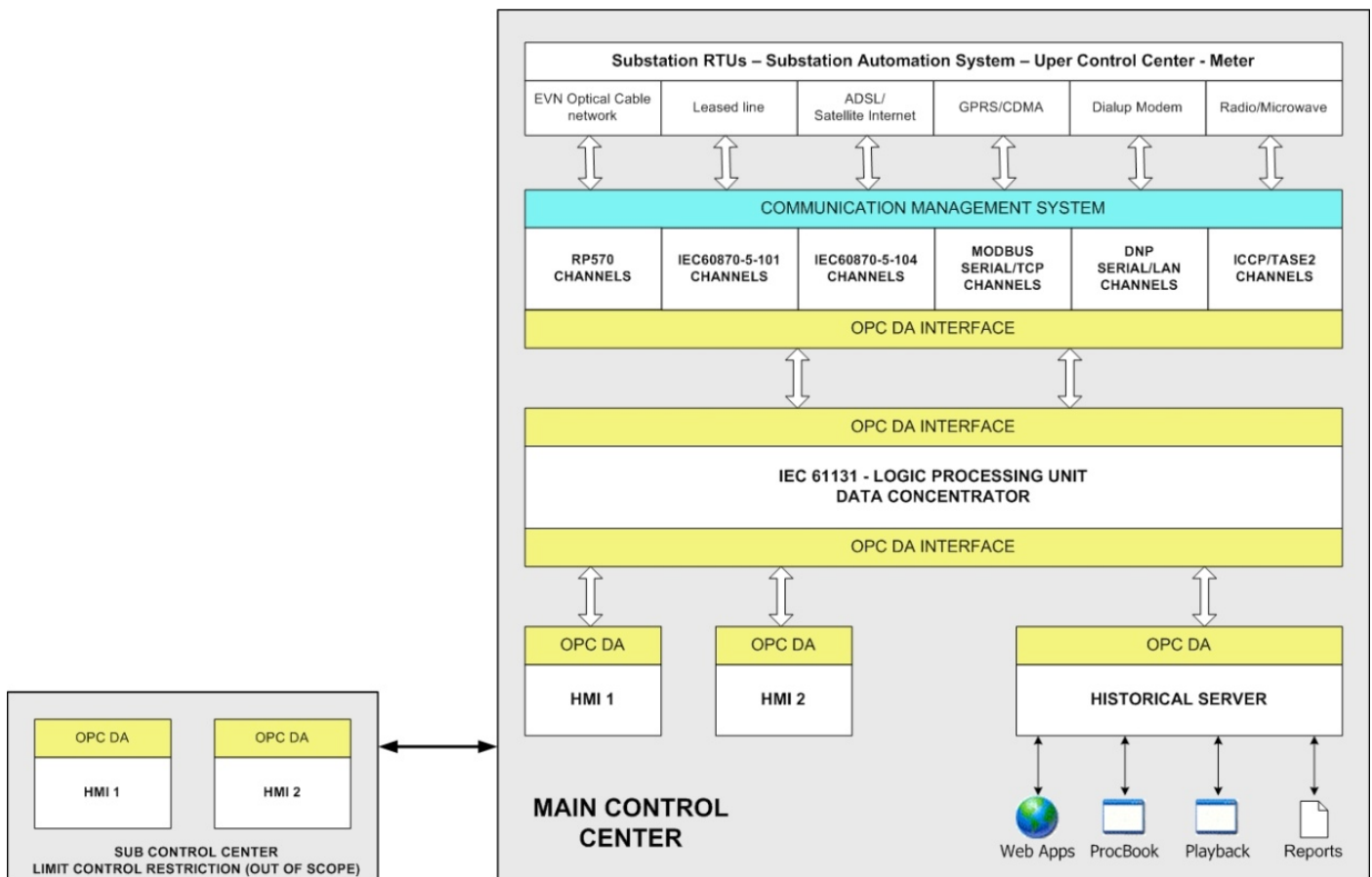


Figure 4. Software Structure

B. Technical Highlights

1.2.3 Software Modules

(1) Data acquisition (DA)

The duty of DA module is to set up and manage real-time database and data exchange with other devices and systems. This is essential part of any SCADA system

(2) Real Time Database (RTDB)

- ◆ RTDB module is the core of @SCADA+® to connect DA module with applications (HMI, HIS, GIS...) as well as manage and process all real-time data.
- ◆ RTDB module is designed with Client/Server model. Such a design allows a huge number of communication channels to serve various applications within or outside the @SCADA+®

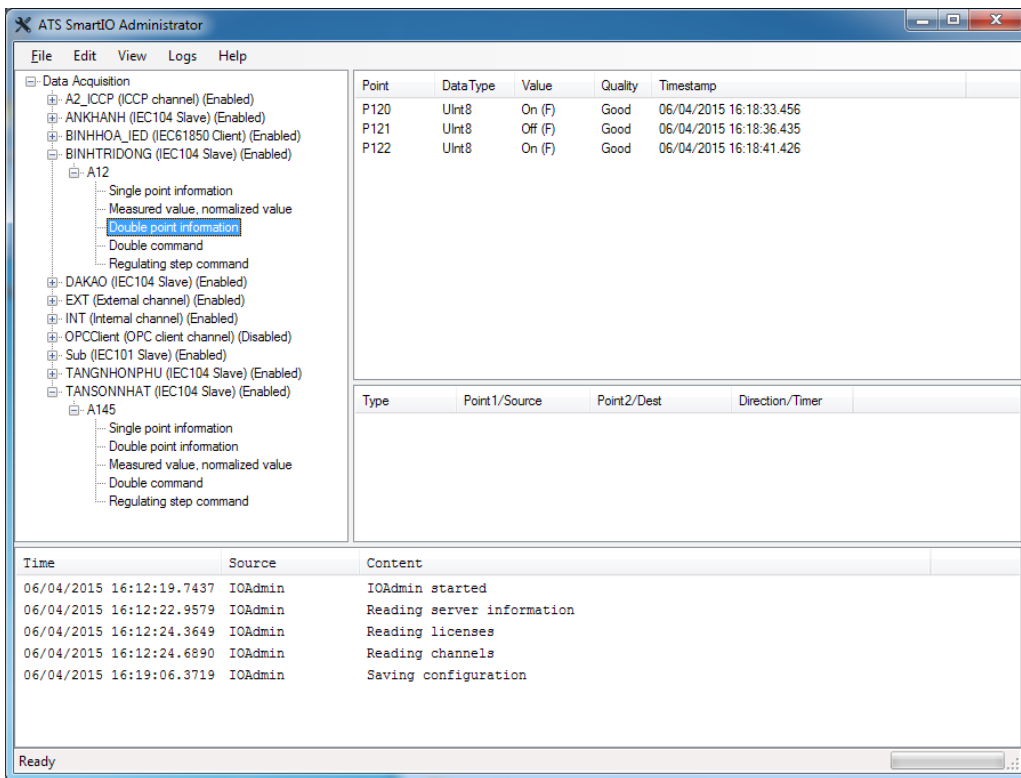


Figure 5. SmartIO™ for Data Acquisition

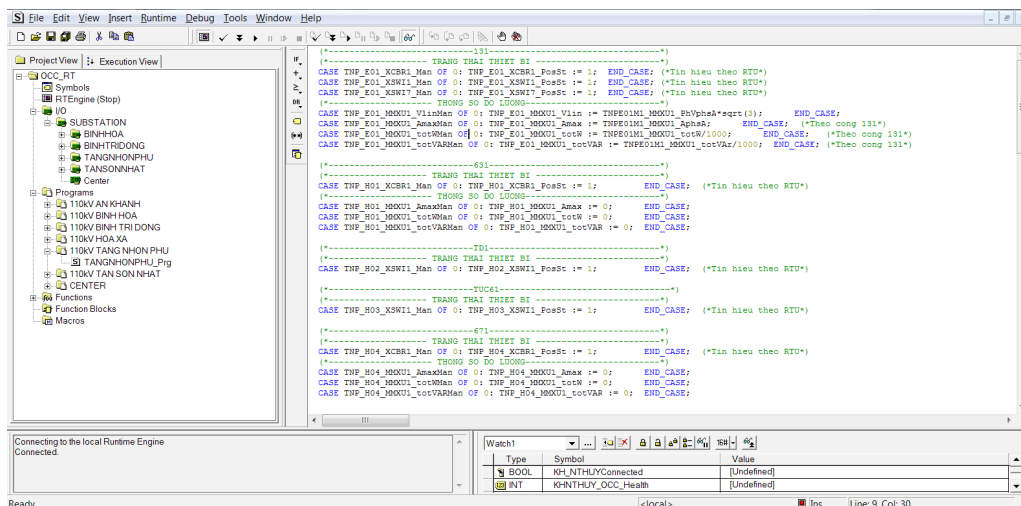


Figure 6. Real Time Database Interface

(3) CIM Database (SmartCIM™)

SmartCIM™ facilitates power system data management. SmartCIM™ is a Common Information Model with unique definitions and structure for Object-Oriented data.

SmartCIM™ helps maintain physical structure representation of power system while allocates data into layers, groups, packages with identical attributes so that data could be easily exported for operational purposes.

SmartCIM™ supports visual data input based on power system single diagrams.

(4) Historical Information System (SmartHIS™)

Historical Information System (SmartHIS™) is a data storage of the information during operation of the system and is built upon client-server technology.

SmartHIS™ is capable of storing all data coming from Real-time system. Data is then stored with a set interval which depends on the capacity of storage hardware). Various data types are supported, including integer, 16-bit float, 32-bit float, 64-bit float, Boolean, Digital state (definable). User access is verified to prevent unauthorized operations.

SmartHIS™ uses super compression and storage algorithm with data access frequency of one per to save storage capacity while sequence-of-even (SOE) data can be stored with 1 millisecond accuracy.

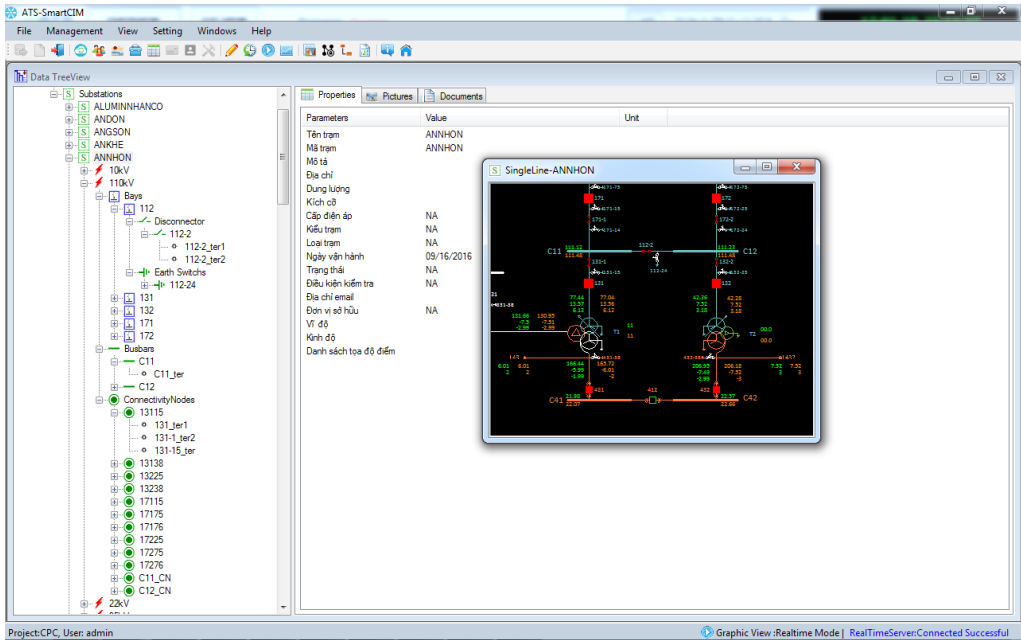


Figure 7. SmartCIM™ Interface

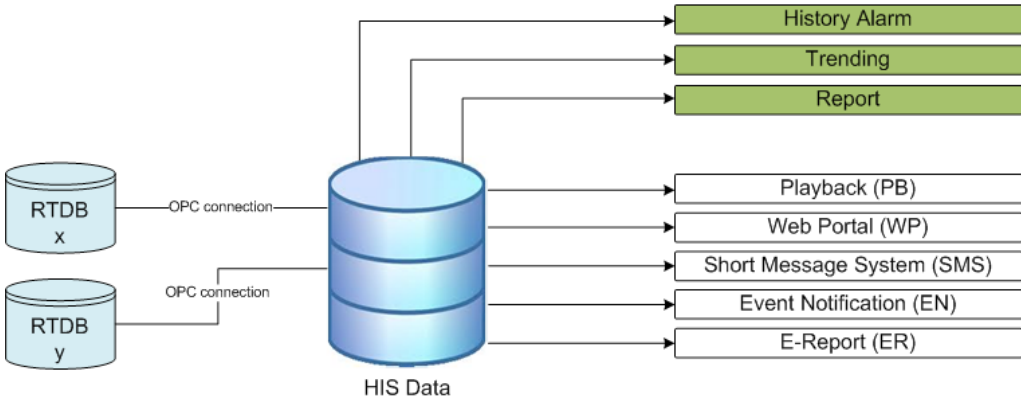


Figure 8. SmartHIS™ Structure

B. Technical Highlights

(5) Human-Machine Interface Module (HMI)

HMI allows operators to communicate with @SCADA+® applications and access to database smoothly.

- ◆ Light and voice alarms are used to indicate operators actions.
- ◆ Displays can be customized for specific usage, such as data acquisition, monitoring / control, application selection / activation, etc.
- ◆ Data can be exported and commands may be triggered using cursor with “look-and-feel” and “point-and-click” tasks.
- ◆ Security is enhanced with controlled user-access levels and related activation codes.
- ◆ Changing devices status or data in the database shall be executed in sequence with verification at each step.
- ◆ Controlling commands are triggered with “select and check before operate” (SBO) concept. Incorrect actions are alarmed with error messages and the command cannot be executed. At any stage the users may escape the command procedure by pressing allocated function button.
- ◆ All actions are recorded in “Alarm” and “Event file” for related users with time and date of actions. For example, breaker may either successfully opened or not after issuance of command but all these events are recorded. Authorized or unauthorized changes can be recorded as well.

(6) Report Module (RP)

This module in @SCADA+® can:

- ◆ Periodically report operational parameters (U, I, P, Q, kW, kVAR, etc.), meter data, power losses, fault statistic, reliability index and other abnormal notification
- ◆ Support web-access via PC, tablets, smart phones to facilitate co-ordination of various users with security.
- ◆ Authorize access for users account individually.
- ◆ Support bi-directional communication manipulation so that users may read / download / print the reports while authorized users can upload the reports into the system.
- ◆ Support users to revise / upgrade report templates with Microsoft Excel.
- ◆ Export reports in Excel, pdf formats
- ◆ Support users to edit report templates to match individual operational and management requirements

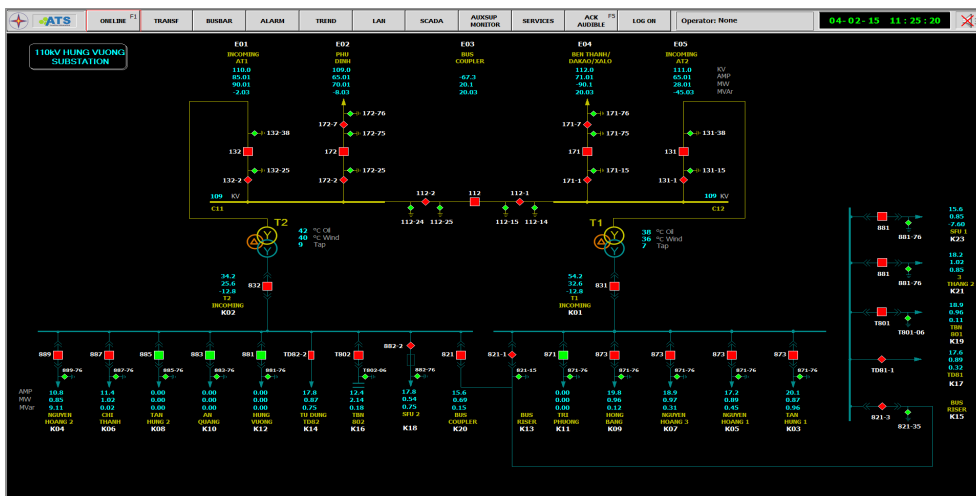


Figure 9. HMI of a 110kV Substation

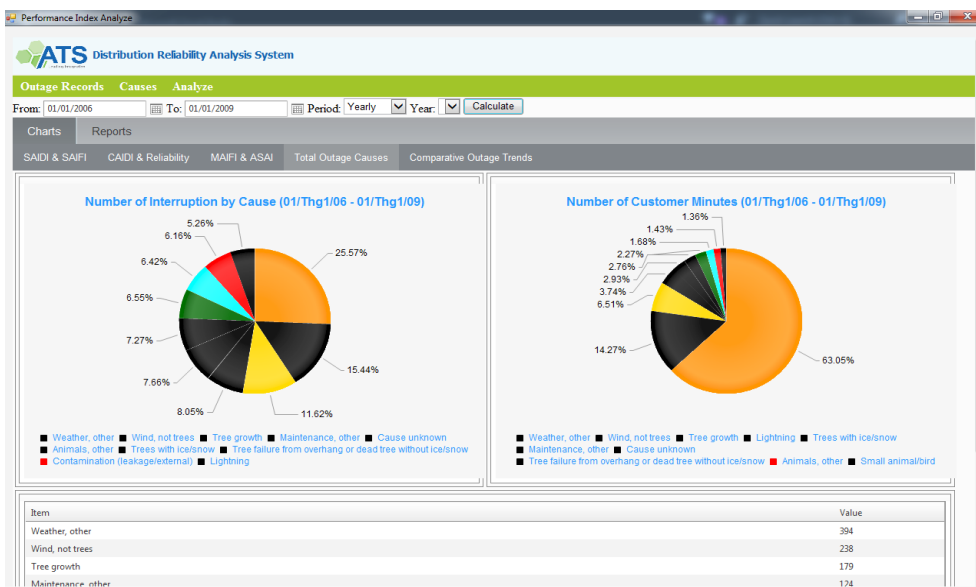


Figure 10. Outage Report

(7) Engineering Module (EG)

EG module allows operational and maintenance tasks. It can be configured in a separate PC or set up in computers of the system.

Main functions:

- ◆ Support to IT personnel
 - * Software module functions can be verified during system operation.
 - * Setting modification, error fix and data configuration can be made without interruption of system operation.
- ◆ System maintenance
 - * Save time for system maintenance / upgrade / update by using built-in library.
 - * Source code may be modified for upgrade / expansion

(8) Smart Application

Smart Applications may be supplied with @SCADA+® to make use of available data.

a) Play Back Module (PB)

This application may:

- ◆ “Re-play” recorded information at various instance
- ◆ Be used for training or operational purposes
- ◆ Facilitate fault analysis
- ◆ Support action review and selection
- ◆ Simulate past events

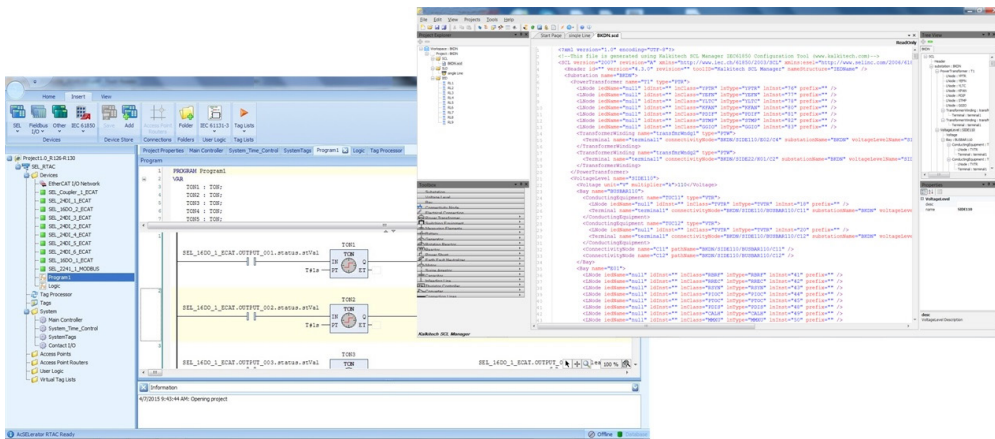


Figure 11. System Configuration Application

Date/Time control

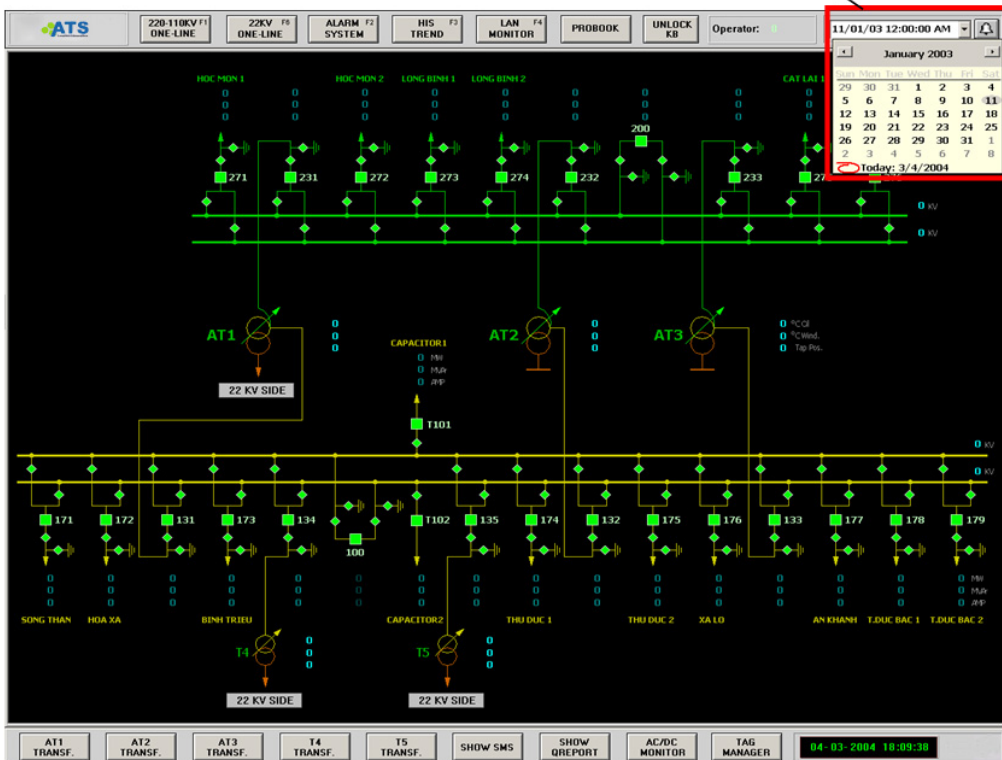


Figure 12. Substation HIS Play Back

B. Technical Highlights

b) Web Portal Module (Realtime Portal™)

Realtime Portal™, a real-time data portal system, is a set of applications built upon the Web platform and environment, the function of which is to provide users with simultaneous access to a large amount of real-time information and historical data. All of these data are collected, achieved, and maintained, always ready for operation, planning, and maintenance activities as well as large-scale applications such as power market operation and GIS. The system is designed for quick access to data via a highly reliable security mechanism .

The system allows for the transmission of system data to users as well as the feeding of input data to applications. The system will also allow you to flexibly customize data according to your personal need; you will have complete control over the data to which you are authorized to access through a common tool such as the web browser.

The Realtime Portal™ system consists of the following:

- ◆ Report: displays system reports that can be printed or downloaded for further processing
- ◆ Views: display diagrams of system operation; displayed data can be real-time or historical.
- ◆ Data input: allow operators to input data directly from web interface

c) Short Message System Module (SMS)

- ◆ Module SMS provides operational parameters and incidences via mobile network to subscribed accounts, the list of which can be modified on the need.
- ◆ These messages originated from RTDB may be customized by the users.
- ◆ The module may send SMS with user request and related responses

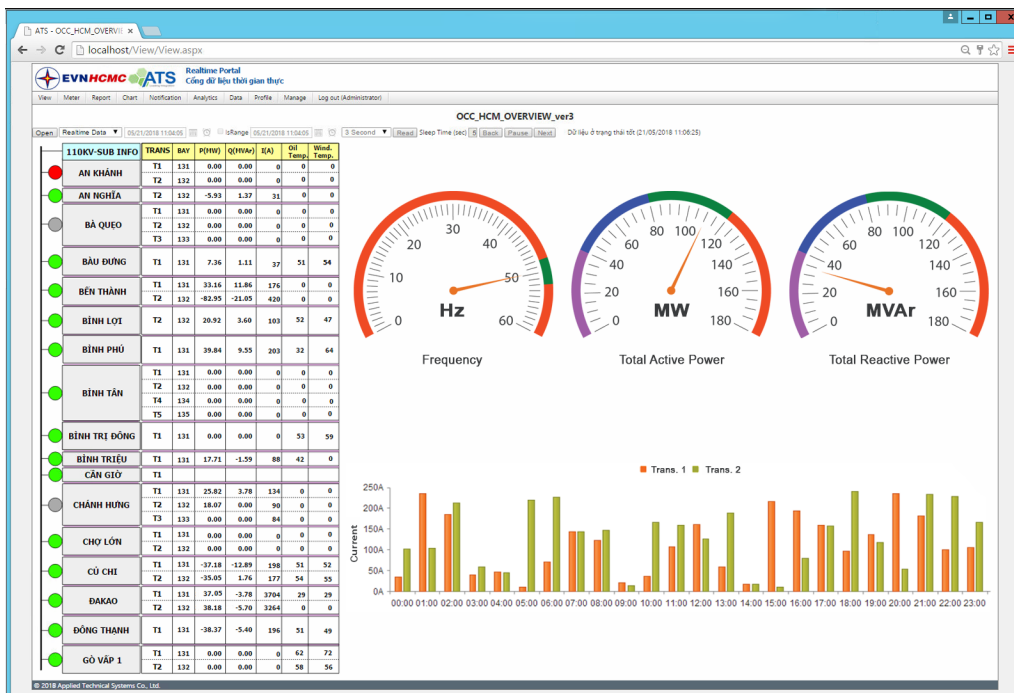


Figure 13. Monitor on Realtime Portal™

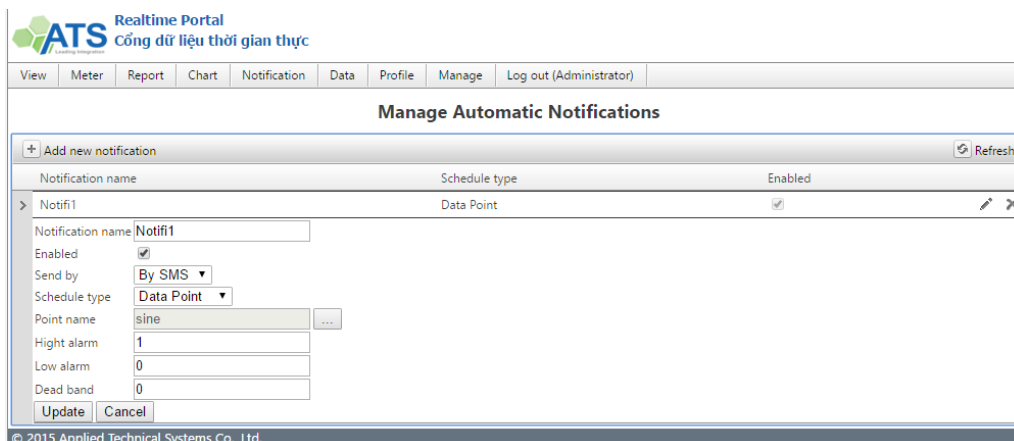


Figure 14. Short Message System Module for Notification

d) Event Notification Module (EN)

- ◆ Module EN displays operational notices automatically with internet browsers.
- ◆ These messages from RTDB is sent to pre-defined email accounts, the list of which can be customized. Some notices and alarm thresholds can be selected and configured individually.

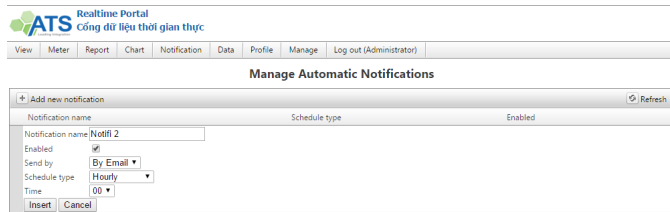


Figure 15. Event Notification Module

e) E-Report Module (ER)

- ◆ ER Module creates reports automatically with templates and send to pre-defined email accounts.
- ◆ The module uses operational parameters and alerts from RTDB.
- ◆ Based on information of the reports authorized people can make decisions wherever internet connection is available.

f) Fault Analysis Module

The module supports fault analysis with graphical presentation of recorded data and measured values in accordance to IEC 60255-24.

g) GIS Module (SmartGIS™)

SmartGIS™ displays power network graphically for monitoring and supports asset management for power utilities.

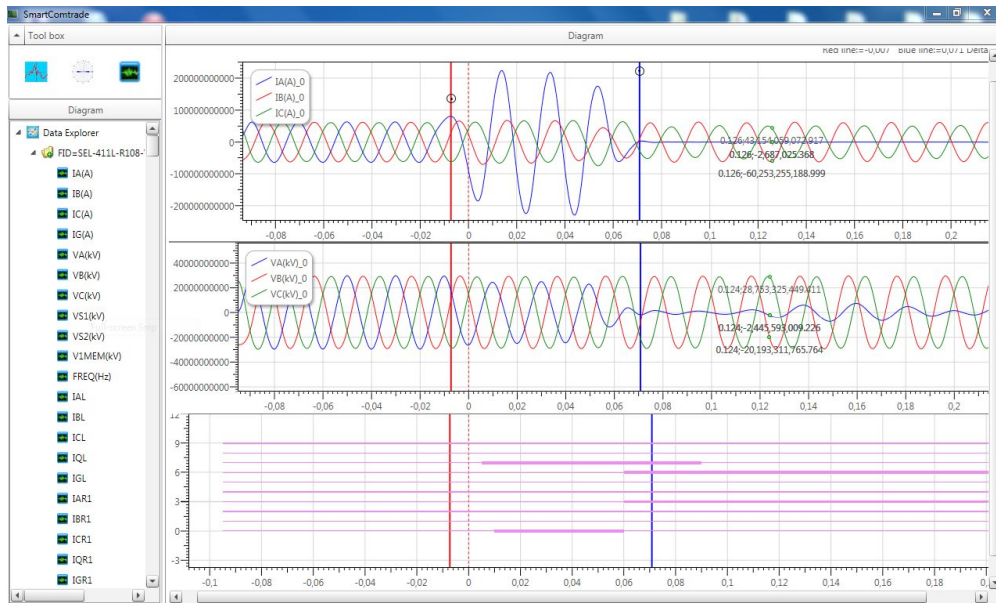


Figure 16. Fault Analysis Module

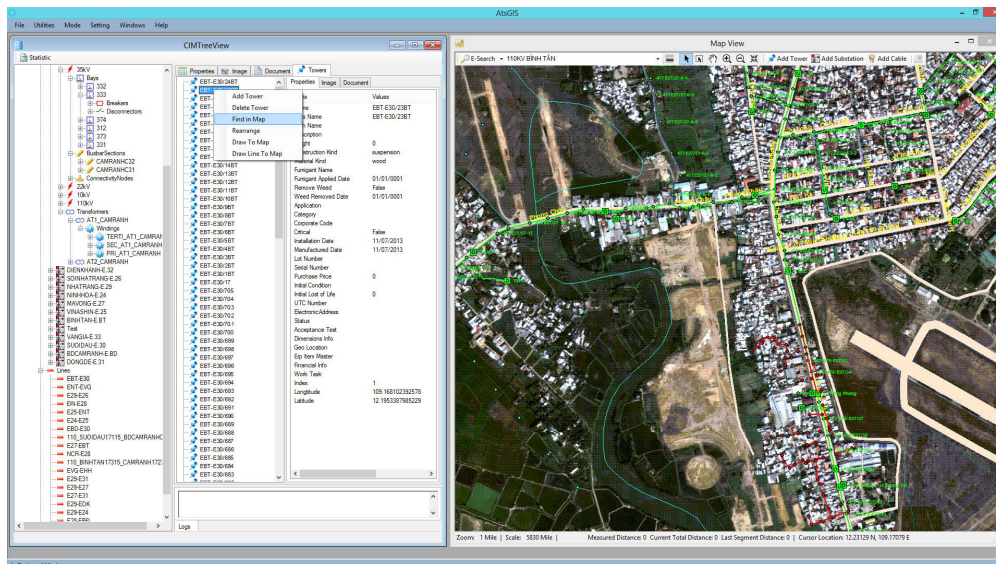


Figure 17. CIM-Based Database for SmartGIS™

B. Technical Highlights

(9) Integrated with DMS Applications

DMS applications uses modules that enable operators to evaluate the operating status of power system, and provide optimal operating practices to operate power grid more safely, reliably and economically.

DMS modules can be integrated comprehensively with @SCADA+® to provide an optimal engineering solution for power companies.

DMS applications:

- ◆ States Estimation, Load Allocation
- ◆ Load-flow Analysis
- ◆ Contingencies Analysis
- ◆ Short-Circuit Analysis
- ◆ Optimal Power Flow
- ◆ Optimal Capacitor Placement
- ◆ Tie Open Point Optimization
- ◆ Power Restoration
- ◆ Automatic Feeder Reconfiguration
- ◆ Load Forecast
- ◆ ...

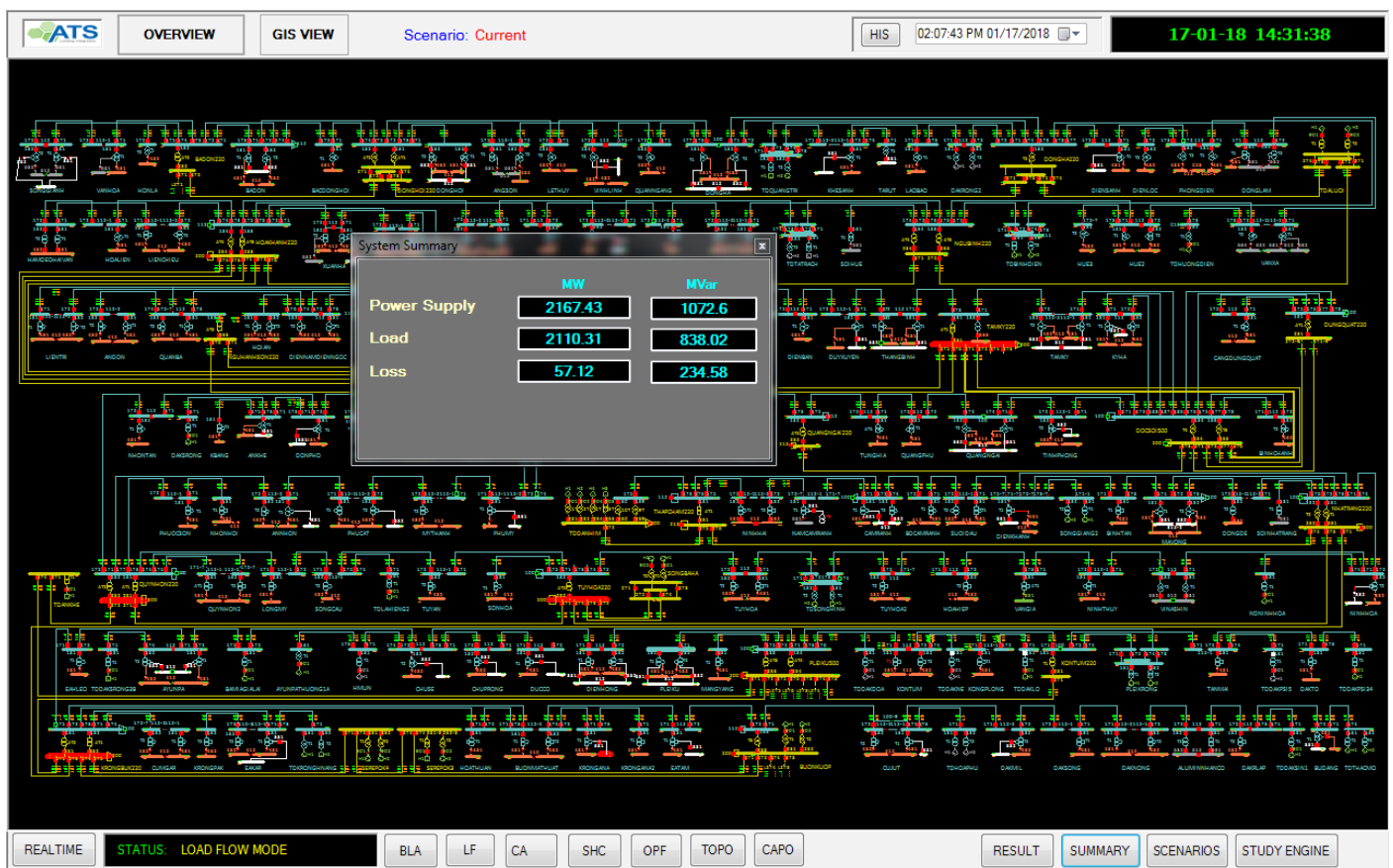


Figure 18. Integrated SCADA/DMS System

2. HUMAN MACHINE INTERFACE

2.1 SmartHMI Studio™

SmartHMI Studio™ is a software designed for the development of HMI (Human-Machine Interface) for real-time supervisory control systems used in various industries, national security sector, public transport, financial market, etc. which require fast responses, management of large amounts of data, high level of security, and diverse communication methods.

SmartHMI Studio™ is especially fit for use in the power industry as part of Supervisory Control and Data Acquisition systems (SCADA), Substation Automation Systems (SAS), and Operation Control Centers (OCC)

2.2 HMI Module

Module HMI supports users communication to various applications including monitoring, control as well as other system applications.

HMI displays are arranged in layers with more details in deeper levels. Users can define which layers are shown on the screen.

HMI allows access to RTDB and HIS in a simple way with Microsoft Windows-type menu.

System status, metered data, alarms, etc. are shown in HMI graphical screens using tags. Users can interact with the application via HMI graphical symbols. Any interaction is performed by executing relevant script under HMI.

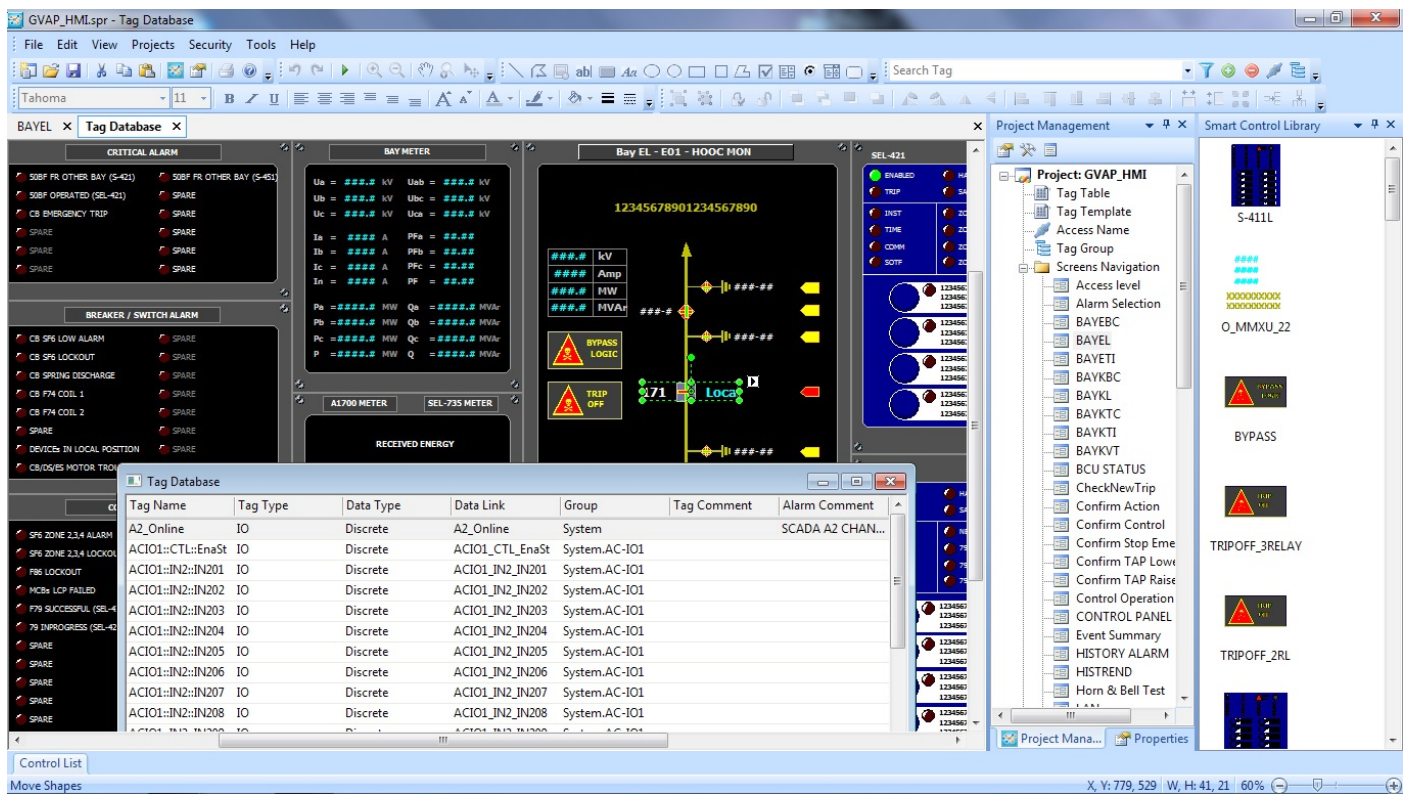


Figure 19. SmartHMI Studio™ for HMI Development

B. Technical Highlights

Main HMI functions are described below :

(1) System access management

All input commands and output data are verified at user level with relevant action code to ensure security, including:

- ◆ User's name/password control for unlimited number of accounts.
- ◆ Access level control of related User's name.
- ◆ User's name is tagged to all actions in access session Control Centers

(2) Monitoring

- ◆ Operational parameters, devices status displayed in full or partial network diagrams.
- ◆ Power flow monitoring for the whole system or its regions.
- ◆ System communication network monitoring.
- ◆ Graphical displays of operational parameters including real-time and historical data.

(3) Controlling

- ◆ Circuit breakers/isolators with interlocking check
- ◆ OLTC stepping, transformer cooling.
- ◆ Manual or automatic device status update
- ◆ Manual or automatic input of metered data

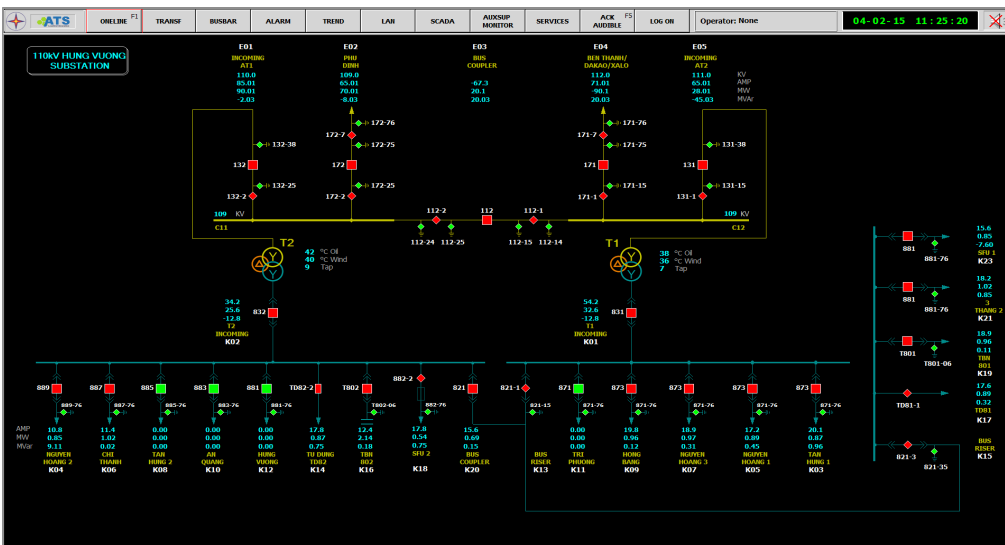


Figure 20. Status Data Acquisition and Display

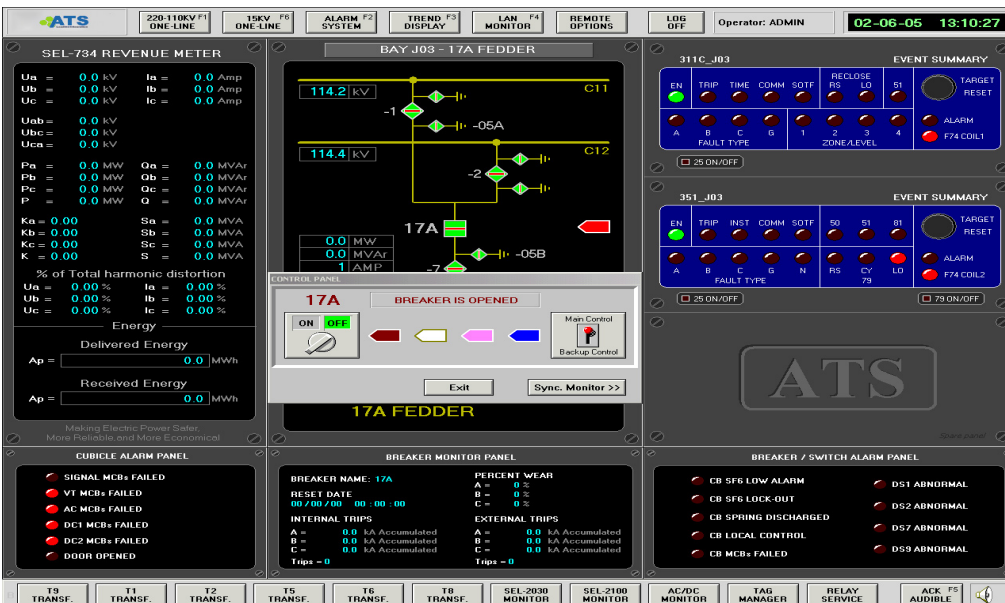


Figure 21. Bay Controlling

(4) Alarming and alarm management

- ◆ Real-time and historical alarms are separated to facilitate operation procedures.
- ◆ User-defined alarm filtering and classification
- ◆ Various voice alarms are enable depending on importance of the notices.
- ◆ Alarm acknowledgment and recording in historical data
- ◆ List of alarms can be printed out or exported to various formats.
- ◆ Re-access historical alarms with various filtering criteria Centers

(5) Reporting and report management

- ◆ Produce reports based on templates with possibility to alter scope of data to be reported.
- ◆ Report printing / exporting into file (excel, text, pdf, etc.)
- ◆ Reports are managed for further export upon request.
- ◆ Reporting scope can be managed.
- ◆ Operational parameters (line / transformer loads, bus-bar voltage, etc.) are editable with office tools when necessary.
- ◆ Reporting of power consumption and losses.

(6) Tagging and tag management

- ◆ Tag/untag and tag displaying with customized levels for each of devices during operation.
- ◆ Tagged content and tagging process made by the user can be managed for each username.

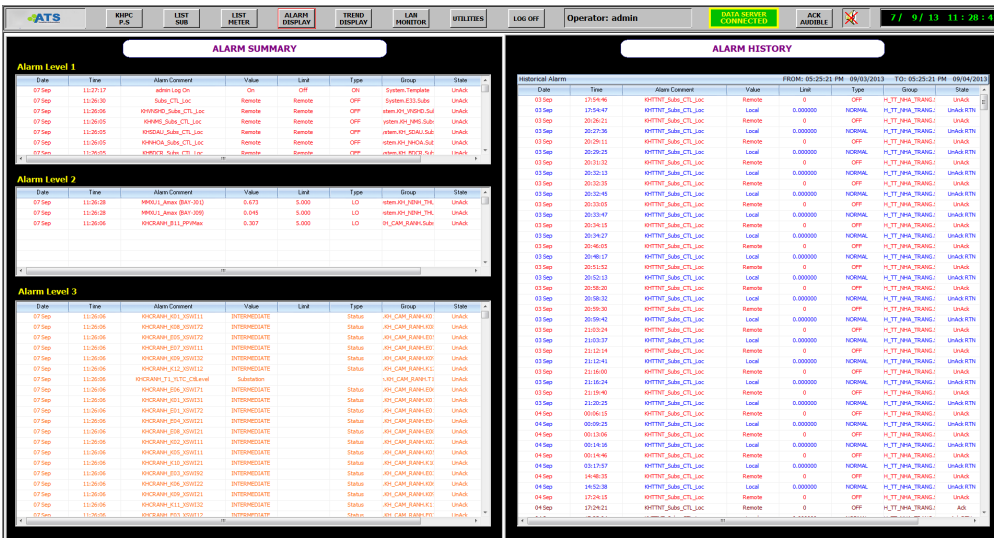


Figure 22. Alarm Management

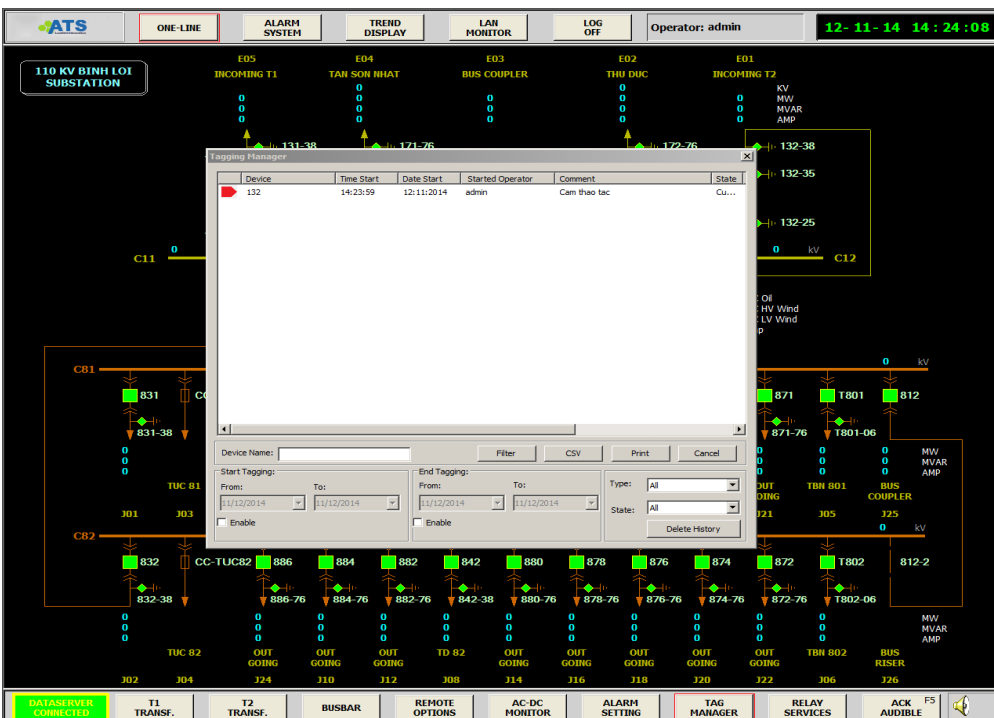


Figure 23. Tagging and Tag Management

B. Technical Highlights

(7) Trending

Trending can be plotted with @SCADA® with historical or real-time data.

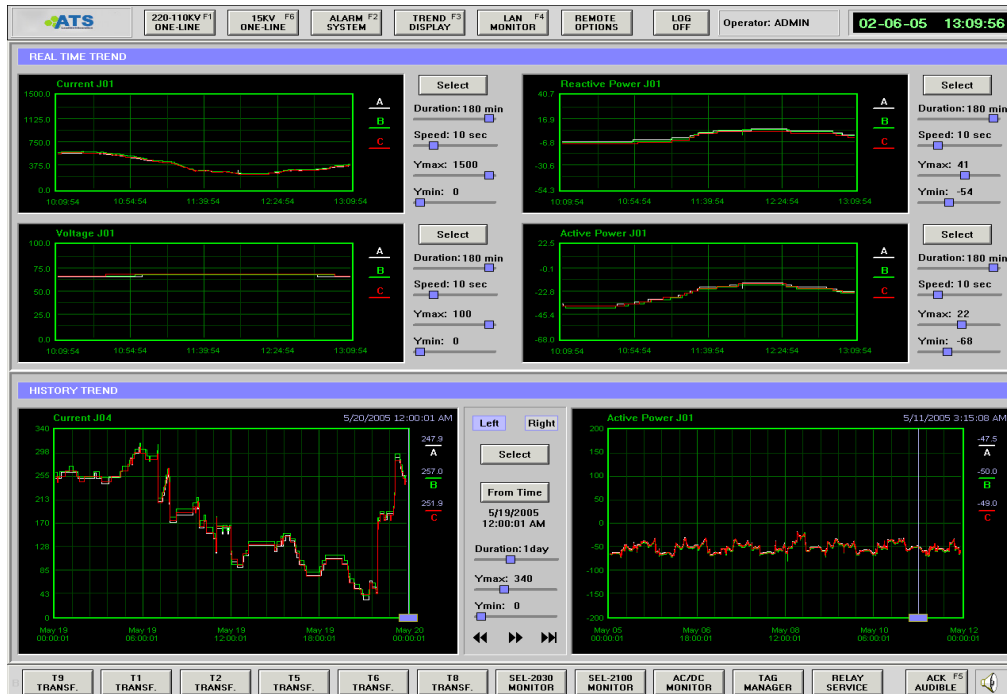


Figure 20. Status Data Acquisition and Display

(8) Communication network supervisory

This function covers the following:

- ◆ Communication network supervisory:
 - * Accessing to status information of communication devices (port switch, Router, etc.)
 - * Maintenance, updating connection parameters (IP addresses, device configuration, etc.)
 - * Connection error tracking and recovery
 - * Graphical display of network status and connected devices
- ◆ Verification of interfaces and connections
- ◆ Verification and monitoring of device communications

Operator can visually monitor communication network status, acknowledge alarms upon connecting losses or abnormal status of communicated devices.

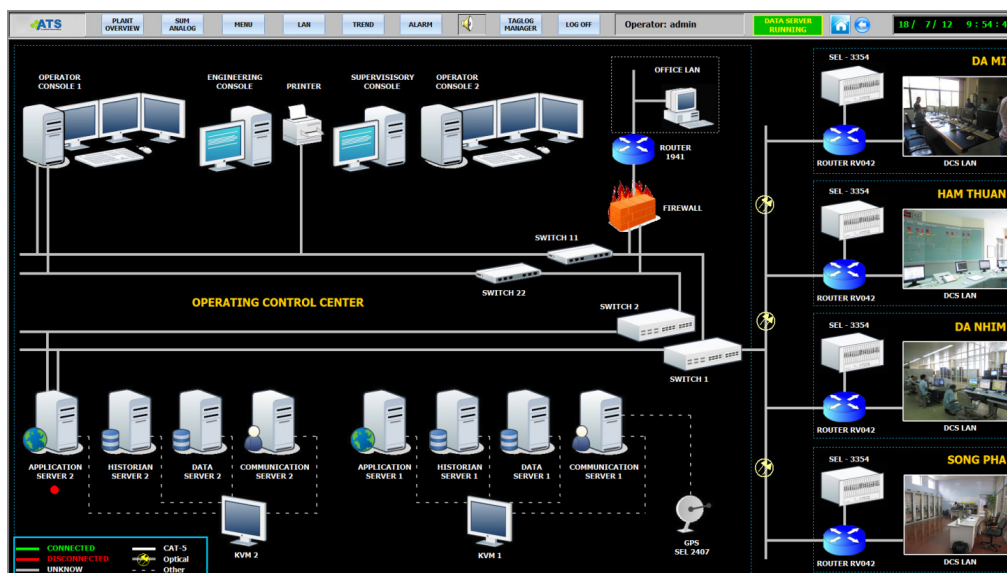


Figure 25. Communication network supervisor

3. COMMUNICATION INTERFACES

3.1 Protocol

@SCADA+® is designed in accordance to IEC 60870-5-101/104, IEC60870-6(TASE2-ICCP), IEC61850, IEC60870-5-103, IEC62056-21 and common protocols like DNP, ModbusRTU, Modbus TCP. Other manufacturer protocol, including Courier (Alstom), LON (ABB), Profibus (Siemens), FastMessage (SEL) can be supplied for specific projects.

3.2 Data Model and Data Connection

Data model and data exchange based on common standards (CIM, OPC, web service, ODBC, SQL, xml) are provide for:

- ◆ inter-database connections
- ◆ database – application connections;
- ◆ connections among applications;
- ◆ inter-center connections;
- ◆ center – user connection.

3.3 Connection Model

@SCADA+® is compatible to various communication links, including:

- ◆ IP connection over Intranet/LAN/WAN/SDH/TDMoIP with leased optic-fiber lines in accordance to IEC-60870-5-101/-104
- ◆ IP connections over data services (GSM/3G/GPRS)
- ◆ IP connections over Internet (ADSL)

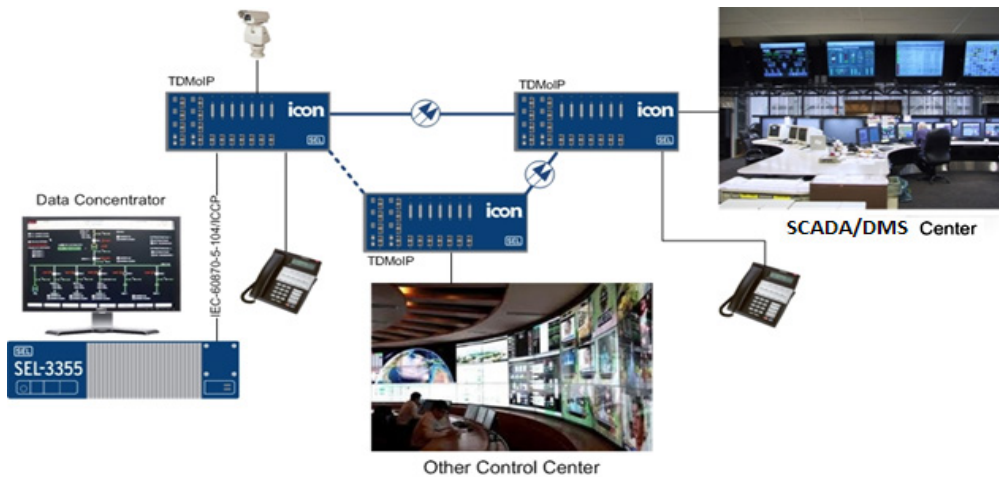


Figure 26. IP connections with WAN (fiber optic)

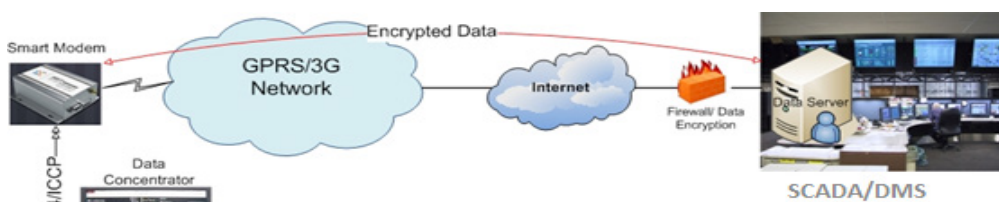


Figure 27. Communication by GSM/3G Network

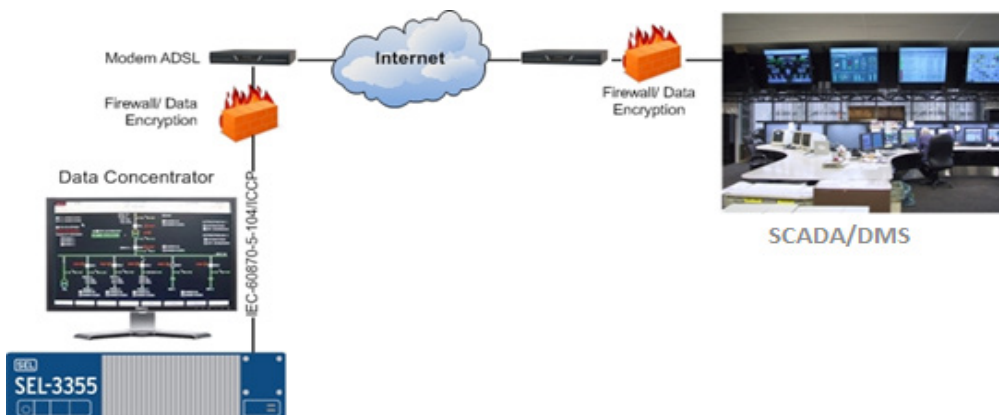


Figure 28. IP connections over Internet (ADSL)

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