IEC 61131 on IEC 61850 Platform

Application Note

IEC 61131 and IEC 61850

IEC 61131 is regarded as the first vendor-independent standardized programming language for Industrial Automation, and is being used in a variety of applications which requires advanced logic computations. IEC 61131 is quite popular in Europe, as well as in North America and Asia.

IEC 61131 is defined for centralized I/O based architecture. IEC 61131 and its sub-section IEC 61131-3, reduces the development lead time of systems that are today increasingly centered around complex software for control and automation. Being vendor independent, IEC 61131-3 supports multiple languages within a control program. Moreover, the programming is completely independent of the hardware platform, thus providing a greater degree of flexibility and re-usability, as well as better pricing and reduced maintenance costs.

IEC 61850 is a widely accepted international standard for power system communication. IEC 61850 and its related standards have been adapted to substations, hydro power plants, wind energy networks and distributed energy resources, mainly because of the superior interoperability capabilities. The protocol, with ongoing enhancements on security and communications, is aligned to Smart Grid developments across the world.

IEC 61850 includes several Ethernet-based communication protocols, along with standardized naming and object modeling. It also includes an XML-based Substation Configuration Language (SCL), which enables the exchange of configuration data between tools. SCL is used to design, document and exchange both device level and substation level configurations. IEC 61850 is a more comprehensive approach in integration standards than previous efforts in substation integration. IEC 61850 uses advanced communications techniques to address data management and simplify integration of applications.

Key Advantages of IEC 61131 and IEC 61850

- IEC 61131 enables the user to define functions that need to be performed on data elements.
- In IEC 61850, complete data models are available for Substation, Wind power plants, Hydro power plants, Distributed Energy Resources based on the communication structure that are available in the respective areas.
- Abstract communication service interfaces are defined in IEC 61850 for the data models and specific communication service mapping is now available for MMS.
- IEC 61850 also defines methods of storing the configured data using SCL and defines variants of SCL that is needed for the complete system

How can IEC 61131 be enabled on an IEC 61850 platform?

By merging the functionalities of both these standards and incorporating them into a single platform, the user is able to tap into the key advantages of both IEC 61850 and IEC 61131. This merging involves the following steps:
- Use of IEC 61850 modeled data (LN, DO & DA) in the 61131/ 61499 tools for creating respective Function Blocks (FB)
- Representing the configured data using SCL and FB representations
- Obtaining IEC 61850 modeled data (LN, DO & DA) through IEC 61850 communication services (Reports, GOOSE, Control blocks, logs)
- Execution of the function blocks with respect to the available data

ISaGRAF is an industrial automation software technology used for IEC61131 based programming of controllers. ISaGRAF consists of two main components:

- The Application Workbench
- The Runtime Target

The Runtime Target is an execution engine that runs the applications developed on the Workbench whereas the Application Workbench is a complete programming environment, that completely supports all five of the IEC 61131-3 languages. This flexibility enables developers to choose the language that best suits their knowledge, style and the nature of the application. Also IEC 61131-3 saves time for programming and debugging as one can reuse readymade functions and function blocks.

Kalkitech SYNC 200 enables equipment manufacturers the capability to have the IEC 61850. SYNC 200 modules are suited for high performance IEC 61850 requirements, and can be used for GPIO – GOOSE based high-speed messaging as well. SYNC 200 modules are specifically designed for power industry applications, with its superior processing capabilities as well as numerous interfacing options. SYNC 200 modules are tested to stringent temperature and environmental levels, and has proven experience in a variety of industry segments. Numerous products using Kalkitech SYNC 200 modules have been certified at KEMA and CPRI test labs by various customers. It had a proven 32-bit ARM based processor, 256MB Flash and 32 MB SDRAM with several General Purpose Input/Outputs (GPIOs).

With the ever increasing demand for sophisticated control logics on IEC61850 IEDs, it has become essential to have IEC61131 supported on IEC61850 platform. Moreover, many of the IEDs want interoperability with other substation protocols like DNP3, IEC50870-101/103/104 and Modbus. Advanced features like GOOSE and large GPIO support is also on increasing requirement for IED manufacturers in the Substation Automation space.

These customer issues can now be met using join efforts by the respective leaders in IEC61131 and IEC61850 embedded solutions. The Runtime Target for the ISaGRAF workbench will be running on SYNC 200 interfaced with IEC61850 stack. The SYNC 200 provides the available GPIOs with 61850 modeling and converts to 61850 variables for the ISaGRAF workbench. Equipment manufacturers can thus use SYNC 200 to build controllers with built-in IEC61131 and IEC61850 support, as well as added support option for other protocols, all in a single embedded module measuring as small as 4sq.cm. This effectively saves time and effort in R&D development on the protocol firmware, as well as reduced net maintenance costs on the protocols (which is covered by a Kalkitech AMC).

Procedure

Target Definition Builder

ISaGRAF provides a dedicated tool called the Target Definition Builder for IEC 61850. Based on an XML file containing the definition of each logical node specified by the standard, it allows users to select the logical nodes they wish to implement on their IED and select mandatory or optional data for each logical node. These new data types are saved as a target definition file, which can be imported in an ISaGRAF project. A variable is created in the ISaGRAF data space for each instance of logical node used in the project.

Workbench

Once the variables are created in the ISaGRAF data space, function blocks can be created to implement the functionality of the logical nodes. The whole structure corresponding to the logical node definition can be used as input and output of the function block. The workbench also generates a Configured IED Description (CID) file containing the definition and the number of instances for each logical node.

GPIO to IEC61850 mapping on EasyConnect

Kalkitech EasyConnect is the configuration tool for the SYNC 200 embedded module, where the output CID file from workbench is loaded in Kalkitech EasyConnect tool for configuring the GPIO-to-IEC61850 conversion. The output file is downloaded to SYNC 200, where the IEC61850 interface exchange the information with the ISaGRAF run-time on user data read and write. The input values are written to run-time and output is read. This output data is available for monitoring at control center IEC61850 client or it can be used for controls from SYNC 200. Hence, an IEC 61850 client on the 61850 Network will be able to establish communication with the manufacturer equipment/IED embedded with SYNC 200 and discover properties of each logical node defined in the ISaGRAF application.
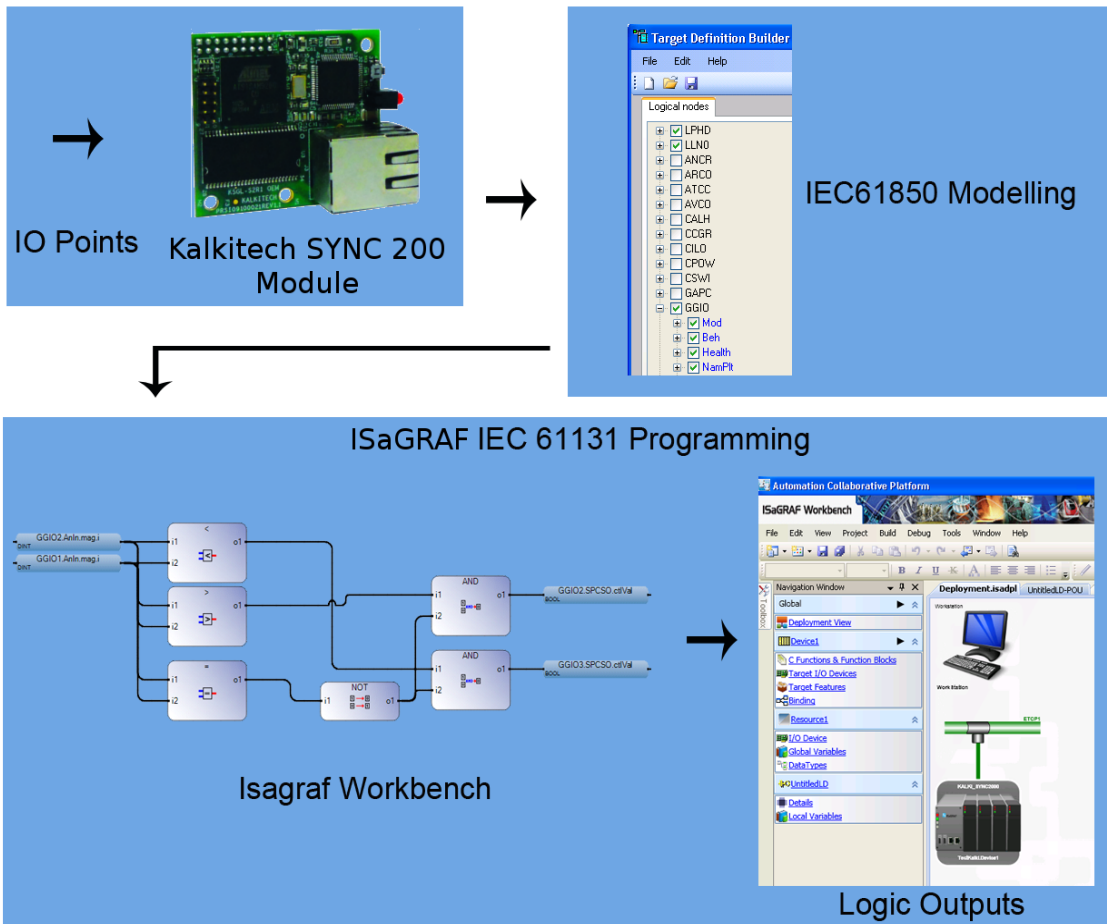
Fig 1: *Logic Configuration*

Key Features

Key feature includes the following:
- IEC 61131 compliance
- Powerful and intuitive graphical and textual editors for SFC, FBD and LD, and Text Editors for ST and IL
- IEC 61850 for the power industry
- 20+ GPIO options, Can be extended up to 64
- IEC 61850 modeling for equipment.
- Conformance to Kema IEC61850 Level A