IEC 61131 on IEC 61850 platform

By Fahid

IEC 61131 and IEC 61850

IEC 61131 / 61499 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 defines the same for centralized I/O based architecture while IEC 61499 is a related standard which caters to decentralized & distributed communication 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 softwares 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 reusability, 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 adopted 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 communications 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 / 61499 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 Substation Configuration Language (SCL) and defines variants of SCL that is needed for the complete system

Limitation of IEC 61131 and IEC 61850

- IEC 61131 / IEC 61499 do not define a suitable data model for the substation / Wind power plants/ Hydro power plants / Distributed Energy Resources. Normally, programmer defines the data and gives the name for IEC 61131 / 61499 variable accordingly leading to a lot of inconsistency between various IEC 61131 / 61499 implementations.
- IEC 61131 / IEC 61499 lacks standard communication services
- IEC 61850 lacks specification of functions that need to be performed on the data models / attributes.

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

By merging the functionalities of both these protocols and incorporating it into a single platform, the user is able to tap into the key advantages of both IEC 61850 and IEC 61499 / 61131. This merging involves the following steps

- Use of IEC 61850 modeled data (LN, DO & DA) in the 61131/ 61499 tools for creating respective functional 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 etc)

- Execution of the function blocks with respect to the available data

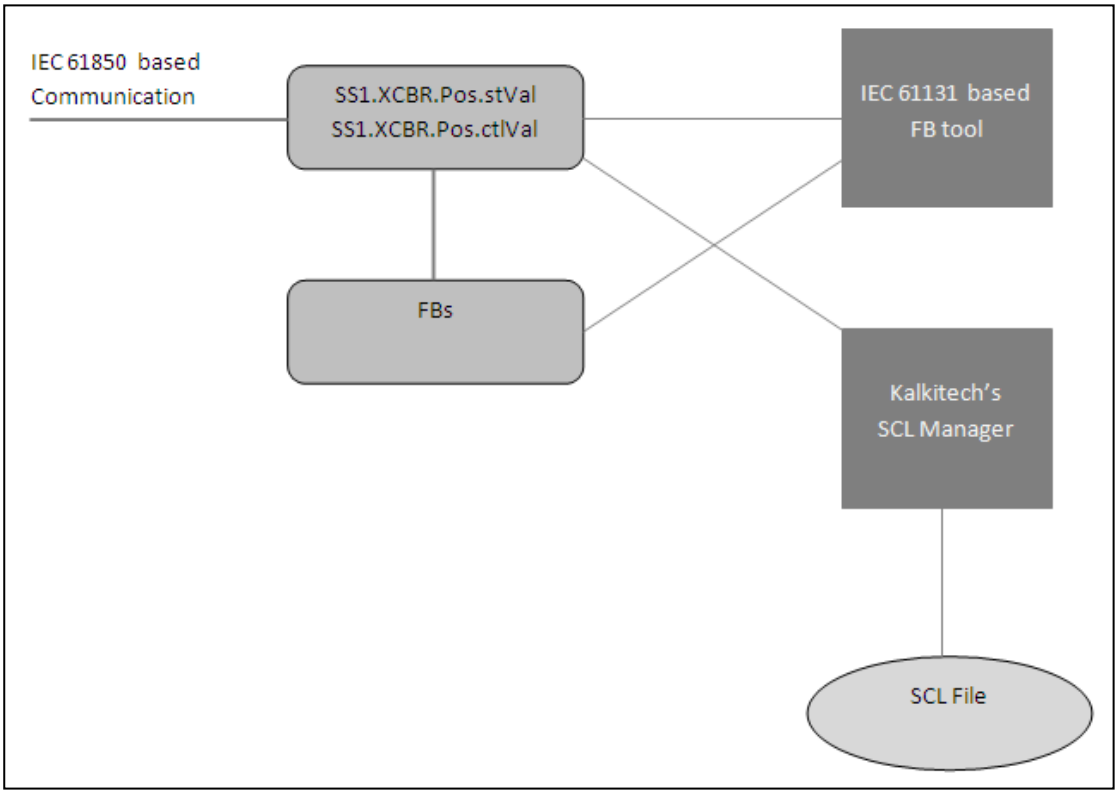

Figure-1: Combination of IEC 61850 & IEC 61131 on a same platform

Process Description

- Creating SCL file – Identify the device logical nodes and create and SCD file for the entire system. If it is a protocol gateway / data concentrator (not OEM), the ICD files can be obtained for various devices and need to combine the same using Kalkitech SCL Manager for creating the complete SCD of the system. In OEM, the vendor should have an ICD file for the device which contains functional modules (logical nodes) which the device is taking care of. This SCD / ICD file will be the input for the 61131 / 61499 based logic build system.

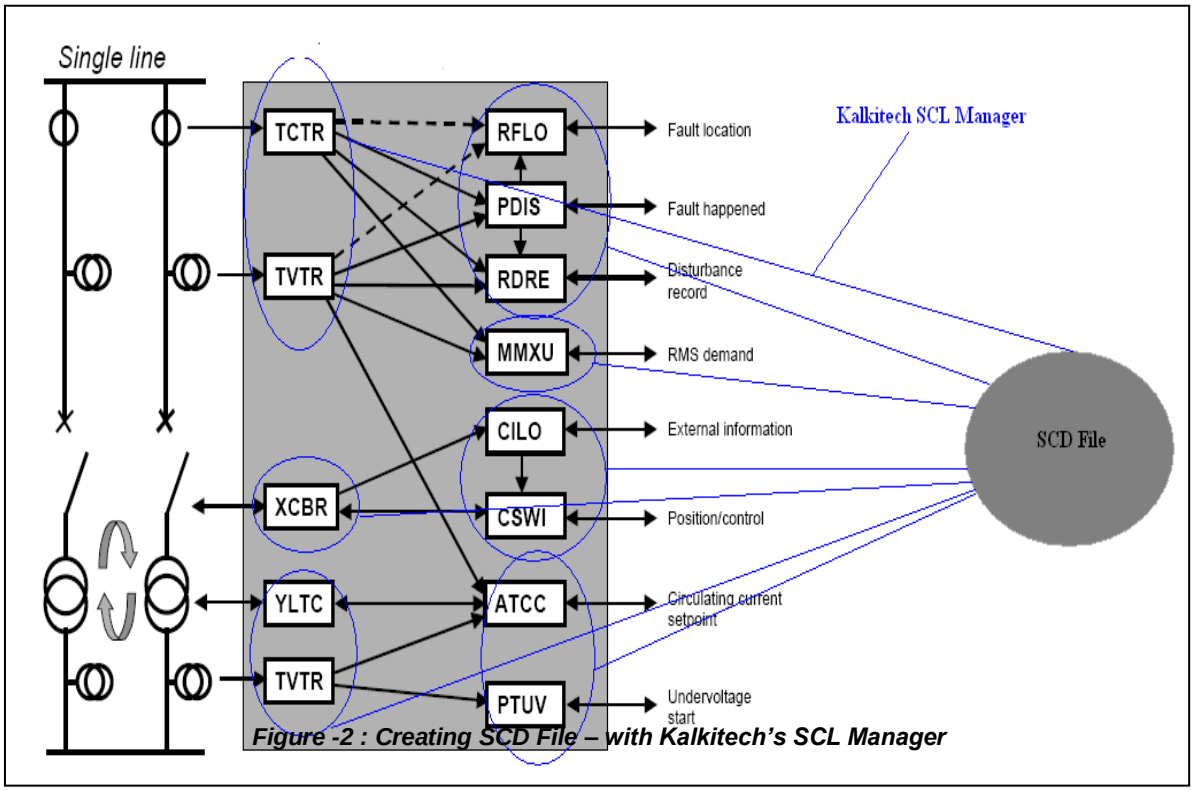

Figure -2 : Creating SCD File – with Kalkitech's SCL Manager

- Creating FB and interconnection – Load the SCD / ICD file into IEC 61131 FB Build tool and create the LN interconnections (FB interconnections) as per 61131 / 61499.

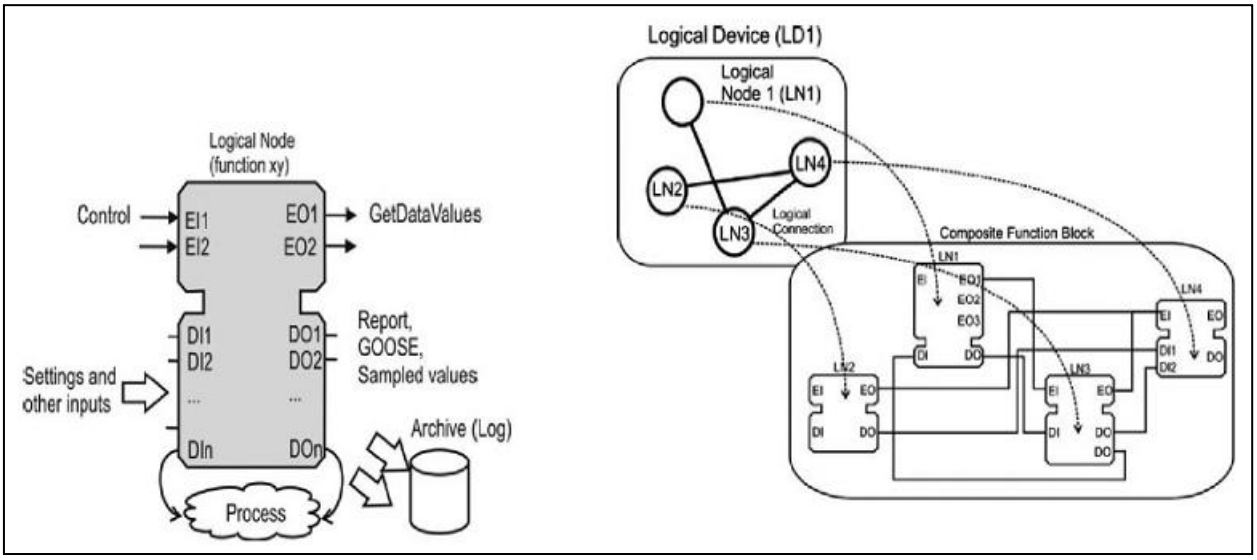

Figure-3 : Logical Node represented FB tool as a Function Block

Figure-4: Defining LN interconnectivity using

- Define mapping from master protocol – Define the master protocol mapping to IEC61850 tags (available in SCD created in step-1). This is done using Kalkitech Easyconnect configuration utility.

- Starting the device and logic execution – Download the FB interconnection file and protocol mapping file to the OEM / Protocol gateway. Restart the device to enable the logic execution.