IEC 61499 System Model

Definitions

The IEC 61499 standard defines a distributed model for splitting different parts of an industrial automation process and complex machinery control into functional modules called function blocks. These function blocks can be distributed and interconnected across multiple controllers.

System: A collection of DEVICES interconnected and communicating with each other by means of a communication network consisting of segments and links.

Device: An independent physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces.

Resource: A functional unit having independent control of its operation, and which provides various services to applications including scheduling and execution of algorithms.

Application: A software functional unit that is specific to the solution of a problem in industrial-process measurement and control. An application may be distributed among devices and may communicate with other applications.

Function block: A software functional unit that is the smallest element of a distributed control system. It utilizes an execution control chart (ECC) state machine to control the execution of its algorithms.

Overview

A system model represents parts included in a measurement and control system. Figure 1 shows the parts of this system model. Many devices (configurations) are connected together with a communication network. The device is a self-contained hardware capable of executing a control loop. The device is a controller having a processor and memory devices and may also contain a communication network when used in a distributed application. The devices are PLCs solving the control logic and are seen in intelligent actuators such as valves and in sensors such as flow meters. Any field bus can do for the communication network; Industrial Ethernet, Profibus, DeviceNet among others are often used. Some communication networks are faster while others are more deterministic, therefore, network selection depends on the process to control. Hard real-time and soft real-time applications require specialized communication networks to meet time-critical behaviors.

An automation and process control application either runs on a single device or splits the load across many devices to use the special features of each device.

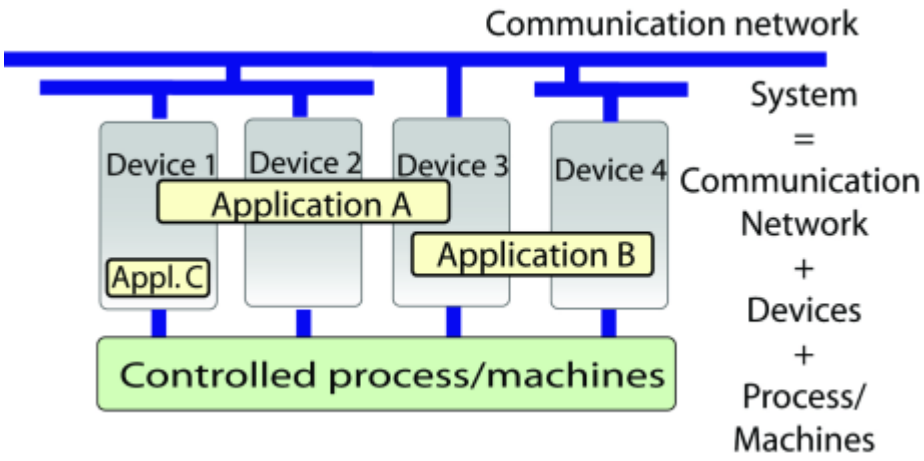

Figure 1: The IEC 61499 system model

An application may consist of one or more control loops where the input sampling is performed in one device, control processing is performed in a second device, and output conversion is performed in a third device. These cooperative control loops share data in a predictive and deterministic way explicitly detailed in the IEC 61499 standard.

In **ISaGRAF**, each program can be a distributed application. Figure 2 shows distributed applications across multiple devices. This is the System Model displayed by the **ISaGRAF** toolset. All function block bitmaps (in yellow) at the right of the application name indicate the distribution across devices. A bitmap below a device means that the program has a running part in that device. No bitmap displayed below a device means the application has no running part in that device. For each program built with the **ISaGRAF** toolset, the System Model viewer quickly displays the distribution of the application. Each device is represented with either a bitmap or a standard box.

The communication network connects the devices making up a distributed system. Many communication networks are displayed when configured this way in the system. Some devices may use one communication network while other devices may be connected to another.

A distributed application exchanges data across the communication network. The **ISaGRAF** elements use the communication network transparently. Building and compiling the application generates all required link parameters. Each distributed element of an application is connected to the others across the communication network. Upon building an **ISaGRAF** application, the distributed application generator automatically links these distributed elements together.

Figure 2 shows the devices, the communication network, the applications making up the system as well as the distributed relationship between devices and applications. Application_A has parts running on the first, second, and third device. Application_B has parts running on the last two devices of the system. Application_C runs only on the first device. Each part of distributed Application_A exchanges the proper information across the communication network. The same information exchange applies for Application_B.

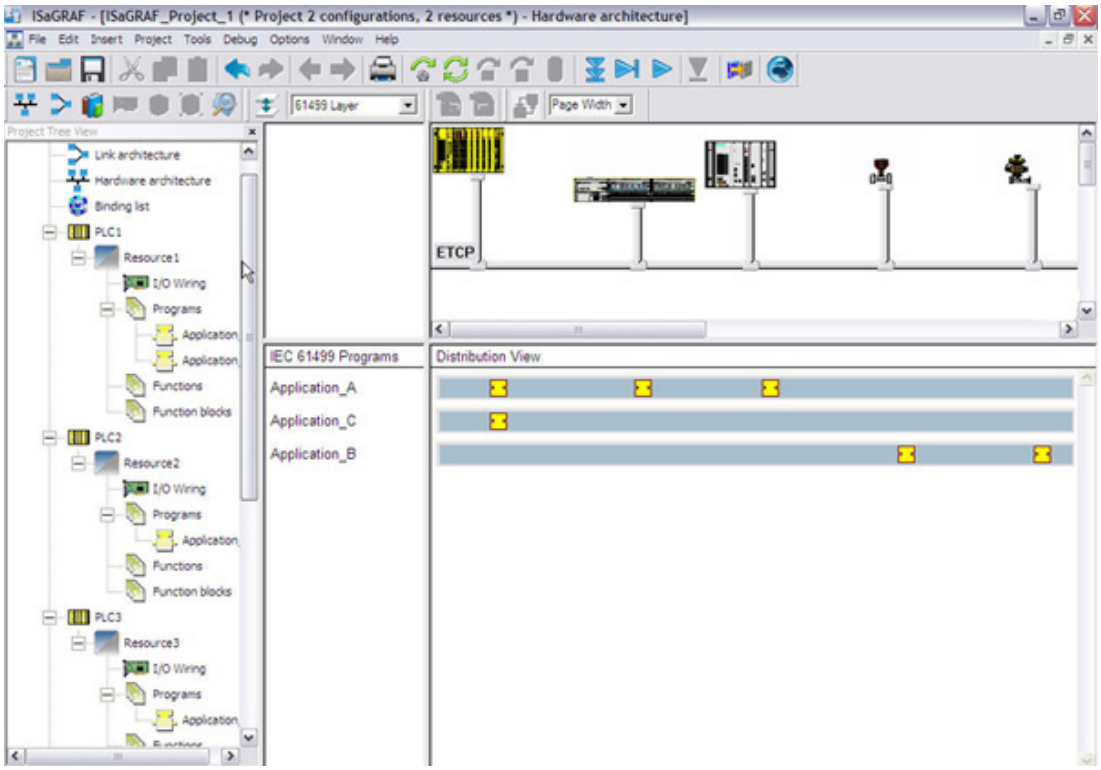

Figure 2: **ISaGRAF** system model viewer

References

International Electrotechnical Commission: Function Blocks Part 1 - Architecture (61499-1 © CEI:200X).

ICS Triplex ISaGRAF Inc.: ISaGRAF User's Guide. November 2005.