SCADA Systems using IEC 61850

Differences to IEC 60870 in Relation to Command Processing

zenon®

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Differences to IEC 60870 in command processing

The topic of IEC 61850 has been discussed many times by COPA-DATA. In this paper, we will look at specific topic area: a comparison between IEC 61850 and IEC 60870 in relation to command processing.

In comparison with other industry sectors, the topic of command processing is relatively complex in the Energy industry. However, if you consider that, as a result of entering a command, a device with a value of many thousands of Euros is switched, which then in turn switches thousands of kilowatts of electrical energy on or off, you can imagine that considerable value is placed on carrying out this process with the highest degree of safety possible.

For this reason, there are special communication protocols in the Energy industry; a command variable and response variable and double commands and double responses are always required. Double commands and double responses are so called because they display their value in two bits. For example, ON = 10 and OFF = 01. This results in a Hamming distance of two, which is understood to give a certain degree of data security.

The use of response variables also contributes to improved safety. Using response variables, it is confirmed that the command given has had an effect in the live process. All these factors inform the way zenon's command processing operates. However, discussing command processing, most secrets are concealed in using the communication protocol:

IEC 60870 Command processing

Under IEC 60870 there are two command processing options: "direct execute" or "select and execute". In zenon, the choice of command mode is configured by means of parameters. Each command variable can be defined using a checkbox. By selecting one of the two available switch settings using the checkbox, zenon knows whether a response is required from the hardware or not.

"Direct execute" is used if a value is written directly to the hardware. "Select and execute" is used if a response from the hardware (for instance, a bay control unit) is required. The command element automatically checks the corresponding response from the hardware, depending on the setting.
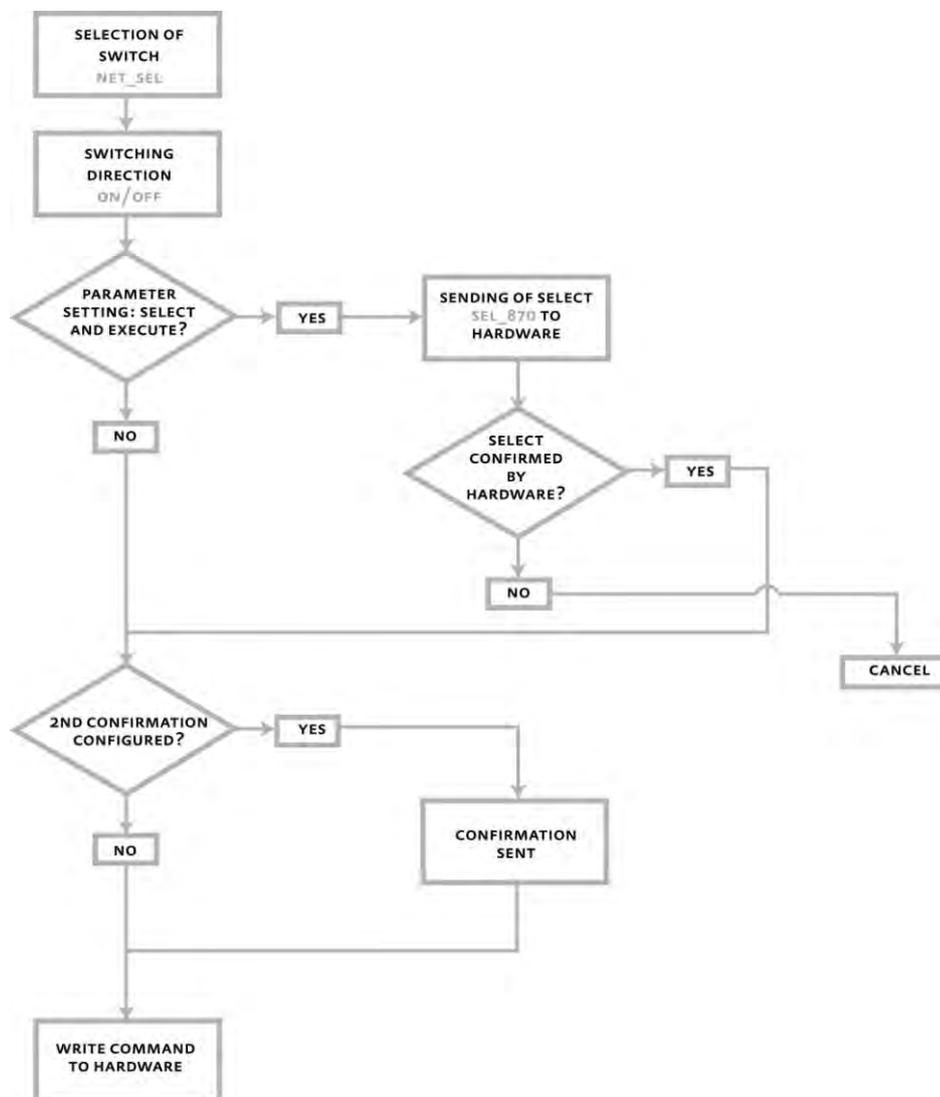

Figure 1: Schematic diagram of command processing under IEC 60870

IEC 61850 Command processing

Under IEC 61850, there are four different options for command processing:

- Direct control with normal security
- SBO control with normal security
- Direct control with enhanced security
- SBO control with enhanced security

SBO stands for "select before operate" (and is similar to "select and execute" in IEC 60870). The selection of the type and manner of command processing is determined by the control model of the logical node (for example, in a circuit breaker or a disconnecting switch). This means that the IEC 61850 server stipulates the form in which it expects command telegrams.

Importantly, when inputting commands using IEC 61850, the previously described checkbox for "select and execute" must NOT be used. This checkbox only applies for the IEC 60870 and DNP3 protocols. In IEC 61850 communication, the SBO sequence is processed directly at protocol level and is therefore not taken into account when configuring command processing.

To comply with IEC 60870, the command and response variables are defined primarily by selecting the type ID. For example: T03 = dual message; T46 = dual command. With IEC 61850, it is commonly understood that no numerical addresses are used. Instead, the addressing is displayed in an object model, i.e. it is symbolic. In doing so, the above-mentioned command and response variables are displayed in the form of the CDC attributes stVal and ctlVal.

For example:
Server1!KSGL1/XSWI1/Pos/stVal[ST] and
Server1!KSGL1/XSWI1/Pos/Oper.ctlVal[CO].

These are the essential differences between command input in IEC 60870 and IEC 61850 and need to be taken into account when configuring zenon.

You can find further details in the zenon help pages.

Would you like to have an expert advise you on this topic? Please contact energy@copadata.com.