by Christoph Brunner

Funtional Hierarchy

During the recent IEEE relay meeting, the issue about functional hierarchy was once again raised and the question was asked, whether this will be addressed in IEC 61850, Edition 2 and if yes, how? **The short answer is yes – that will be addressed.** It is described as "management hierarchy" in the current draft of IEC 61850-7-1, Ed 2..

FOR THE LONG ANSWER, we will need to have a look at some technical details of IEC 61850. As a reminder: in IEC 61850 logical nodes are modelling functional elements or more precise, the information of functional elements that is externally visible and accessible through the communication. An example is the logical node called PDIS that is the information model of a distance element. Logical devices are a grouping of logical nodes. One purpose of that grouping is to provide the possibility to enable or disable a function that is created out of multiple logical nodes. This is possible by enabling or disabling the logical node zero (LLN0) that contains the information of the logical device. Alternately, it is possible to enable or disable individual functional elements by enabling / disabling the specific logical node.

An IEC 61850 IED can have multiple logical devices that contain multiple logical nodes. A logical device can not contain another logical device. This hierarchy is as well reflected in the mapping on MMS according to IEC 61850-8-1 and in the naming of the logical node instances. A logical device maps on an MMS domain; a logical node on an MMS named variable within that domain.

Unfortunately, real life is sometimes more complicated than models. If you take the example of a multifunctional protection relay, one function may be an overcurrent function. Within that we may find the phase overcurrent and the ground overcurrent subfunctions. these subfunctions will be implemented with multiple instances of logical nodes (e.g. PTOC, PIOC). To reflect hierarchies as described in that example, IEC 61850, Edition 2 will support a nesting of logical devices. As mentioned above, the logical node LLN0 is representing a logical device. For Edition 2, a data GrRef (group reference) will be added to LLN0. This is a pointer to another LLN0 that represents a logical device at a next higher hierarchical level.

Taking the previous example, we will have one logical device (*e.g. "gnd"*) for the ground overcurrent protection subfunction and one logical device *"phs"* for the phase overcurrent protection subfunction. We will have a third logical device *"ocp"* for the overcurrent protection function. In both LLN0 of the logical devices *"gnd"* and *"phs"*, the data GrRef will point to *"ocp"*. This means that the logical devices "gnd" and *"phs"* are a part of the higher level function *"ocp"* represented by that logical device.

As a consequence, the logical node LLN0 of the logical device *"ocp"* will control all its subfunctions. E.g., if the mode of ocp.LLN0 is disabled, this will have an impact on all logical nodes of the logical devices *"gnd"* and *"phs"*. This functional hierarchy will however not be reflected in the data structure. The name of the logical device *"gnd"* will not include *"ocp"* as its parent logical device. Also, a directory service applied on the logical device *"ocp"* will not return the logical devices *"gnd"* and *"phs"*.

The working group plans to release the major parts of IEC 61850 as Edition 2 CDV (Committee Draft for Voting) in February this year. They will be translated to French and circulated in April. Please check with your national committee or the UCA International Users Group to receive these CDVs for a review and provide your comments! Your feedback is important to make these standards such that they fulfil all requirements.