With the widespread adoption of IEC 61850 applications, fully digital substations are being deployed worldwide, particularly in South America, with Brazil standing out, as well as in Europe and Asia.

PACS has been evolving rapidly in recent years. Considering that digitized current and voltage values are published in Sampled Values (SV) frames, trip and logical signals between IEDs are published in GOOSE frames, substation time synchronization is carried out via the Precision Time Protocol (PTP), and communication between IEDs at the bay level and SCADA at the station level is handled through the Client/Server (MMS) protocol, it is clear that the direction of this technological evolution increasingly points toward the virtualization of electrical system protection, known as Virtual Protection, Automation, and Control Systems (vPACS). As a result, specialized tools for protection testing, network diagnostics, and monitoring are evolving in parallel to meet new market demands.

As more and more digital substations are deployed, the need for specialized tools for protection testing, network diagnostics, and monitoring grows in proportion to this demand. This is the main enabler for these tools to gain an increasing market share in the power sector. Another important factor to consider is the testing and simulation conditions defined in IEC 61850-7-4, as well as the specific IEC 61850 Logical Nodes related to monitoring, such as LGOS (GOOSE monitoring), LSVS (SV monitoring), and LTMS (time synchronization monitoring).

Figure 1 below illustrates some examples of specialized tool models.

Figure 1 - Example of Specialized Test Tools for Protection Testing, Diagnostics, and IEC 61850 Network Monitoring

Regarding potential obstacles to the specialized tools market, the initial costs of acquisition and training are a concern; however, these can be reduced with a large-scale, long-term strategy. Another possible obstacle relates to the inherent conservatism, which brings hesitation in adopting new technologies.