

REDUCING THE NETWORK LOAD IN DIGITAL SUBSTATIONS

With configurable datasets in Sampled Values according to IEC 61869-9

Following two decades of increasing acceptance and application, the IEC 61850 standard is now well-established, and network operators are increasingly deploying relevant devices in substations around the world. The prevalence of Sampled Values (SV) in the process bus of digital substations was significantly increased by the IEC 61850-9-2 Light Edition (9-2-LE). This guideline makes the configuration and interoperability of devices more accessible. This article explains how the IEC 61869-9 standard enables you to optimize the network load in the process bus.

Although the 9-2-LE guideline defines the process bus communication methods, it provides few options for changing the SV in the process bus. This guideline provides a fixed SV dataset for current and voltage values. This definition always contains four currents and four voltages. The current and voltage values for the phases and the neutral conductor of a three-phase system are sampled at 80 samples per cycle for protection applications and 256 samples per cycle for power quality applications. The data packet in 9-2-LE is understandable at first glance. However, it generates unnecessary data traffic if all the variables aren't used. Depending on the application, significant unused data volumes may arise that unnecessarily load the data network and the connected IEDs.

In 2016, the IEC 61869 standard superseded the previous IEC 60044 standard as the definition of current and voltage transformers. Section IEC 61869-9 provides a digital interface compatible with 9-2-LE. Further SV variants are also defined that enable multiple sampling values (ASDU – application service data unit) in a network packet. Having several ASDUs per package saves on bandwidth as the ratio of the payload to the header is optimized and the package rate on the network is reduced.

This interface also allows datasets to be configured such that only individual currents or voltages are transferred. It also enables multiple current and voltage systems to be combined into one SV dataset. The following is an example of how significant the overall savings can be.

One example is a 1½ circuit breaker system. This system transfers eight currents and four voltages via sampled values for one feeder. Suppose these eight currents and four voltages are sent using 9-2-LE datasets. In that case, two 9-2-LE SV streams are required as only four currents are possible for each 9-2-LE SV stream dataset. However, if it is implemented as an IEC 61869-9 dataset, a single SV stream containing the eight currents and four voltages

Transformer type	Fixed Dataset 4 × Current + 4 × Voltage (9-2 LE)			Flexible Dataset		Reduced Data Rate compared with 9-2 LE	
	Number of MU/Streams	Data rate 50 Hz (Mbit/s)	Data rate 60 Hz (Mbit/s)	Number of MU/Streams	Data rate (4,800/2 ASDU) (Mbit/s)	with 50 Hz (4,000/1 ASDU)	with 60 Hz (4,800/1 ASDU)
3-Winding	3	3 × 5.4 = 16.2	3 × 6.5 = 19.5	1	6.5	60%	67%
5-Winding	5	5 × 5.4 = 27.0	5 × 6.5 = 32.5	1	9.0	67%	72%

Table 1: Reduction in data rate in a transformer with three and five windings



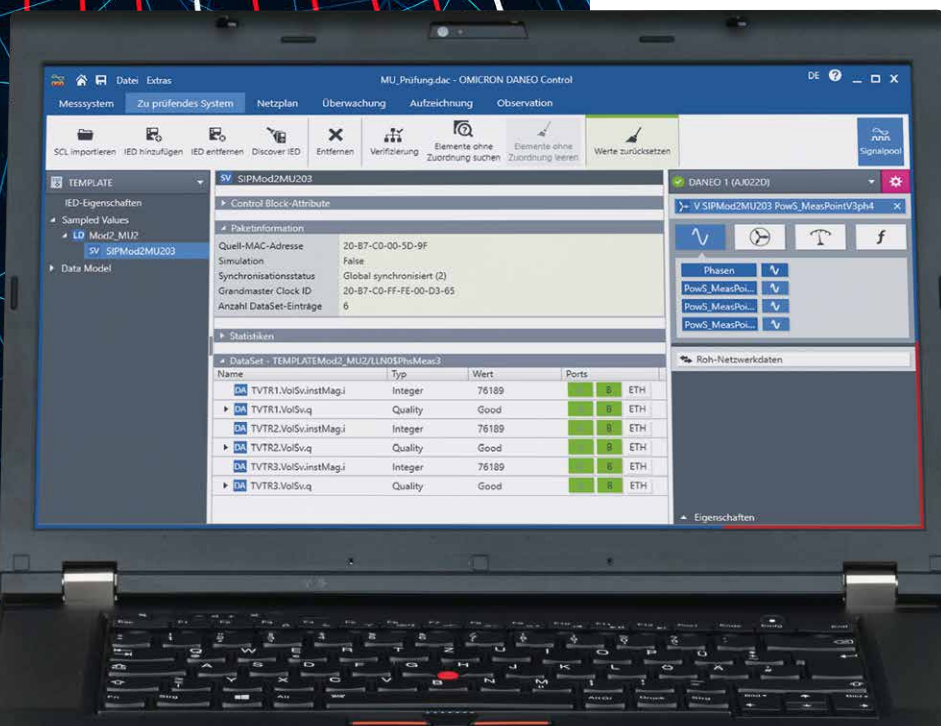
is sufficient. This reduces the load on the network by about 40%.

Power transformers result in even more significant savings in network load. For example, when using a three-winding transformer, the data rate can be reduced by 60% at 50 Hz or 67% at 60 Hz (Table 1). In addition, only one merging unit (MU), as opposed to three, is required. The more windings a power transformer has, the more the flexible datasets help reduce the network load. With a five-winding transformer, a 67% reduction in data rate can be achieved at 50 Hz or a 72% reduction at 60 Hz.

SIEMENS SIPROTEC 6MU85 are the first MUs to offer configurable datasets according to IEC 61869-9. This new generation of MUs loads the process bus network more intelligently, reducing the load in the network. It's compatible with all the standards referred to above. Depending on their application, network operators will decide whether they should use datasets subject to 9-2-LE or configurable with IEC 61869-9.

OMICRON offers the relevant testing solutions that support publishing and subscribing to SV streams of this type. CMC test sets using RelaySimTest or Test Universe allow MUs to be simulated and protection testing to be carried out. DANEO 400 now allows these new SV variants to be analyzed. It can also visualize and

record the signals along with all protocol details. 🟡



DANEO 400 dataset with three voltages