DISCUSSION CONTRIBUTION

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This application of Process Bus fascinates ones and frightens other member of our community, just because this standard topic is a paradigm shift from the traditional method of using secondary current and voltage obtained from conventional instruments transformers that has been used for decades.

In order to make the Sampled Value a reality it is necessary using non-conventional CT´s and VT´s and / or Merging Units (MU) or SAMUs (Stand Alone Merging Units). Depending on the technology applied exists different ways to do it. These different forms are treated on the new standard IEC 61869-9 that is a complementary standard of the IEC 61850-9-2.

Indeed, the evaluation of the process bus under loading condition is of upmost importance since the overall performance of the protection depends of the sampled values that must arrive at time for the correct operation of the IED. In this way many people in the world is paying attention to this subject.

About tests made on paper 209, firstly the IED was tested by using just one MU (Merging Unit) providing samples of Currents and Voltages to the IED through the LAN (Local Area Network). These samples were used by IED to measure the line impedance in order to decide about to trip or not. After exhaustive tests made with this arrangement the number of Merging Units connected to the LAN was increased, and the tests were repeated to investigate the effects of the loading to the system behavior (Up 10 MU´s was connected together). The faults were carried on using a relay test set, and the trip time was measured for each case condition.

The evaluation of the IED was made by promoting the relay operation under different zones, different faults types and for each condition the overload of the LAN was changed by adding more MU´s sending messages. Each test condition was repeated 20 times, and the IED operation time was monitored under all tests conditions.

Results were used by a statistical analysis, to verify the maximum, minimum, average and standard deviation of the trip time.

Results and Learned lessons:

Once the user's starts to apply the SV messages in theirs installations and with good results in field it will increase the reliability of this new technology. Thus is expected that in a near future the use o sampled values messages over the Process Bus can substitute the cooper wire on the secondary of the power system installations.

On the paper 209, the system was exhaustively evaluated with more 1000 tests and no problem was detected in all conditions of Ethernet loading. The results founded with these tests were very satisfactory and lets us to conclude there isn't no relationship between the number of the MUs and the trip time.

The worst observed change on the trip time was 1.38 ms for a specific condition, and this change represents less than 1/10 of 60Hz cycle. Therefore this paper opens new paths to others investigations concerning the use of sampled values to power system protection.

Limits of 9-2LE:

When the first edition of IEC 61850 standards was published, about a decade ago, the part 9-2 defined the Sampled Value, however, some implementation definitions were let open. So, a group of manufactures met and established some condition in order to guarantee the interoperability.

The result of this effort was published the "IMPLEMENTATION GUIDELINE FOR DIGITAL INTERFACE TO INSTRUMENT TRANSFORMERS USING IEC 61850-9-2", also popularly called Light Edition. Since it was released, the Guide starts to be a reference to the application of Process Bus. Sometimes, due so to its popularity, the implementation guide is confused with a standard, but it isn't.

On 9-2LE it was defined that: for protection will be used 80 samples per cycle and each message will carry one sample. The normal packed size will be around 127 bytes.

Thinking in a 60Hz system we have: 60 * 80 = 4800 messages / second on the network. The time between two frames is only 208 micro seconds.

On a switched network there are four sources of latency: store and forward, switch fabric processing, wire line transmission, and frame queuing.

Considering a 100 Mbps Switched LAN, that is the normally used, just analyzing the store and forward and the processing latency the limit of MUs, using 9-2LE, will be around 14 on the same network.

The use of more than 14 is not advisable we have considered that due to physical limitations of the network, and some samples can be delayed or lost.

So, for a 9-2LE Bus Bar Protection (on a 100Mbps) we have a limit that 14 MUs, in other words, 14 three-phase feeders can be protected together.

With the new upcoming standard IEC 61869-9, the SV frame can be modify, and each message for protection purposes will carry two samples. So the amount of MU´s connected will probably increase. This is very important issue for complex protections that need measure many MU´s at same time.