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Does the Fieldbus age?

The fieldbus is beginning to establish itself in process automation. Users, who have erected a plant with Foundation Fieldbus (FF) or Profibus PA, are planning the next using the same technology. But what will happen as the equipment starts to age? The most recent investigations with modern field bus diagnostic technology offer a view of the future.

Plant downtime is usually very expensive, particularly so if it leads to unplanned interruptions in production. And with a typical lifespan for process plants of between 10 and 30 years, quite rightly, great demands are placed on high availability during the whole lifetime of the equipment. Proven in use instrumentation is nearly a must. From around 2002, as the results of the FuRIOS study were published, the use of fieldbus technology in production process plants took on new emphasis. What can we take from these few years and relate it to the well over 50 years of experience with conventional control and instrumentation signal technology. How about the operational reliability of the new technology? The question is highly-explosive! Among other things, Profibus PA and Foundation Fieldbus were introduced in order to obtain a significantly higher signal integrity compared to conventional signal transfer. Analog standardized signals can sometimes deceive, with incorrect, but plausible values, whereas digital technology offers the opportunity to detect erroneous signals. Incorrect protocols can be rejected and repeated. Errors should be corrected, but we should at least know about them.
So the technology would seem even better if it were not for the question concerning its reliability in practice: Does the field bus age?

Perhaps the field bus behaves like Mickey Mouse. It doesn't get old. Mickey has looked nearly the same for around 80 years. And yet Mickey's face, figure and character have changed from "Steamboat Willy" to the definitive Mickey.

The Rheinhold&Mahla test laboratory has critically examined the fieldbus technology that is installed in the Hoechst Industrial Park and put it under the microscope. “Diagnosis and fault investigation of the physical layer of fieldbus systems“ is the task being undertaken by Sven Seintsch. At the NAMUR main assembly in November 2006 Michael Pelz, chairman of the 2.6 Field Bus working group, was able to provide information on the tests. The results were indeed “Micky Mouse-like“: No age-related effects had been established during the tests, although there were interesting detail effects.

The project investigated what effect the environment can have on field bus networks. The question was, whether such phenomena could compromise communication to such an extent, that the transfer of data could be affected. In fact it was found that the field bus is very stable. Laboratory tests and measurements on operating plants have shown, that the communication continues, unimpeded by individual faults, so long as fatal errors are not involved. However, if for example a specific level of interference is exceeded, message repetitions occur, which can initially impair the communication and even lead to failure of the equipment.

The ageing effects were investigated, in that two fieldbus networks with different connection technologies and field devices from various manufacturers were subjected for a period of several weeks to frequent drastic temperature fluctuations and to tap water and salt water. Interference voltages were superimposed.

The test laboratory has investigated approximately 200 fieldbus networks using the Pepperl+Fuchs fieldbus diagnostic tool, to determine the correctness of the assembly and installation. It was surprising, for example, that frequently the wrong number of fieldbus terminators had been installed and unsuitable cable had been used. Often an already installed screened two-wire cable had been used, which did not satisfy the specification.

In all these rigorous laboratory tests the bus reigned supreme. Over the entire duration of testing not one field device failed and not a single message was lost.
The field bus has proved to be very stable in respect of the simulated “First faults”, such as EMC interference or installation faults, for example a missing terminating resistance. In the field it runs very robustly, provided the installation has been competently executed. It functions even when the prescribed limit values are exceeded, but is then very susceptible to interference. It is a combination of faults, which presents the bus with real problems. For the user this means that hidden first faults must be discovered and eliminated in order to ensure the necessary immunity from interference. It must be possible to prove the quality of the installation. When this elimination of faults is commenced during commissioning a reliable

fieldbus system is obtained, which can then be built upon. The necessary prerequisite is a clean and competent fieldbus diagnosis, such as that offered, for example, by the Pepperl+Fuchs Advanced Diagnostic Modules, to monitor the system during extensions and modifications. This enables the quality of the installation to be precisely verified and documented. By integrating the diagnostics in the power supply technology, e.g. in the segment coupler, it is possible to permanently monitor the system. Faults and changes to the physical layer are detectable and can be eliminated before the equipment fails. The NAMUR (Field Bus Working Group 2.6) will prepare a NAMUR recommendation for maintenance and repair of fieldbuses on the basis of the investigations and results from Seintsch.

“The physical layer is the telephone wire, over which the data flow. And if it does not function I don’t want to have to start thinking about other applications“, says a leading C&I engineer and also “Conventional analysis via current and voltage measurements do not provide further help in this case. If the fieldbus is no longer functioning one has to carry out diagnosis on a trial and error basis.” “Following major modifications or revisions I regard an examination of the system as being absolutely essential”. “One of our plants ran for over one year without problem. Despite that we found several of the named first faults using the diagnostics module”. “The user purchases the device and can avoid the need for separate measurements during commissioning, because the whole branch is monitored continuously anyway. Continuous use then also reduces the operator’s costs, because the device has effectively broken into a part of the investment costs during commissioning.” Nevertheless it can be taken for granted, that the additional costs of the diagnostic modules will be hotly discussed during the planning phase. Dr. Gunther Kegel, managing director of Pepperl+Fuchs views this very pragmatically: “I cannot define an Asset Management System (AMS), and the advanced diagnostic is a part of it, in terms of the investment costs. The question is: How much plant downtime will be prevented by the tool?“ And with that we’ve gone full circle. The focus of attention of the whole of the asset management world in the various plenary lectures at the Namur main session was the topic of life cycle costs. If the user can substantiate at an early stage, through the diagnosis of the physical layer, that he can prevent cable degradation, the ingress of humidity in the isolation and the removal of screening, then the additional investment will be quickly amortized.

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Figure 1: Fieldbus diagnosis is integrated in the Profibus Segment Coupler

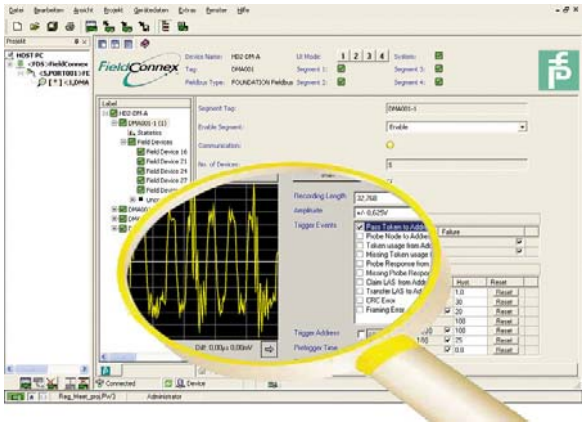

Figure 2:
The Fieldbus Diagnostic Modules disclose the state of the physical layer and the protocols

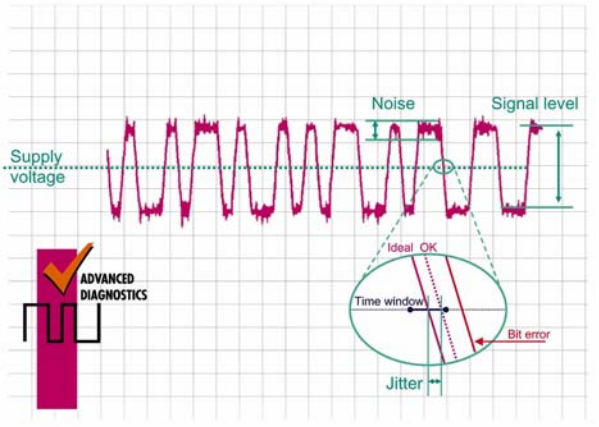

Figure 3: Noise level and jitter are the quality criteria for the field bus data transfer