

Maximizing Fieldbus Availability

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Aging infrastructure, outdated technology and inefficient maintenance practices are a crippling reality in many process plants in North America. Plant managers are now given the task to reduce CAPEX and OPEX while at the same time increase productivity, safety and efficiency in order to compete on a tough global stage. To successfully complete their task, many of the plant managers are either considering or already implementing FOUNDATION fieldbus technology in combination with PAM (Process Asset Management) systems.

Fieldbus Benefits

The true long-term benefits of fieldbus technology are realized within the intelligence of its assets – meaning utilizing the additional diagnostic information from the instruments and other fieldbus components in combination with PAM systems. Digital fieldbus technology offers reduced installation and maintenance cost, faster system start-up and commissioning as well as more device information. The additional diagnostic information from fieldbus instruments in combination with PAM systems can further reduce maintenance cost by eliminating unnecessary maintenance trips to the field and allowing remote troubleshooting and calibration capabilities. Also, implementing condition-based maintenance strategies to monitor the health of the equipment better predicts when maintenance will actually be required, long before this impacts the process.

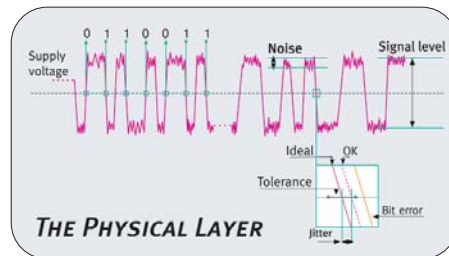
The Physical Layer

Fieldbus device diagnostics are viable to implement conditioned based maintenance strategies and reduce cost. But what about the physical layer of the fieldbus itself, the “highway” that connects all the bits and pieces together?

Theoretically, 32 fieldbus devices can communicate over the physical layer on a single FOUNDATION fieldbus segment. In practice, 8 to 12 devices reside on one segment and communicate their information to a host

system. Compared to the physical layer in a point-to-point installation, the physical layer in a fieldbus installation becomes more critical due to the increased number of devices on the same cable. The physical layer itself consists of the host control system, fieldbus power supplies, cables, distribution blocks (i.e., short-circuit protected junction boxes), terminators and instruments. In short, everything from the host down to the instruments forms the physical layer.

In order for devices to communicate error free over the fieldbus, the physical layer must run absolutely error free. Although inherently robust and fault tolerant, fieldbus networks can become more susceptible to a variety of external influences when installed incorrectly. Fieldbus commissioning and installation practices, therefore, have a significant influence on the quality of the communication and the successful implementation of a fieldbus system. Once a fieldbus system has been installed correctly, long-term degradation, like corroding terminals, aging electronic components and ailing power supplies, also poses a threat to fieldbus communication.



Physical Layer diagnostic tools make the fieldbus signals visible. Important measurements include signal level, noise, supply voltage and jitter.

Until recently, determining the quality of the fieldbus physical layer has required a high degree of technical knowledge and sophisticated electronic equipment. Loop check procedures included cable continuity checks, resistance and capacitance testing, signal level and noise analysis, and oscilloscope capture of the communication wave form for each node. All test results had to be docu-

mented manually. Executing these tasks was very time consuming and labor intense and added to the overall project cost.

Fieldbus users were looking for a more proactive and automated approach to diagnosing the physical layer itself. Not only were they looking for online physical layer monitoring capabilities for their critical loops but also for automated start up and commissioning solutions that would eliminate the old labor intense procedures.

Physical Layer Diagnostics

Installing the fieldbus physical layer properly and keeping it in top condition can help assure maximum availability. Instead of using manual, reactive physical layer tools, manufacturers like Pepperl+Fuchs now offer computer-based automated physical layer diagnostic solutions that include automated start up and commissioning support, expert knowledge and solution guidance through actionable information delivered directly to the user. Advanced physical layer diagnostic hardware and software are valuable aids that can be used to monitor the network itself and constantly check it against baseline and fieldbus specifications. Advanced diagnostic technology provides information on the health of the network and monitors its decline due to age or process conditions. This allows maintenance personnel time to correct any negative conditions before they cause shutdowns, thus keeping the system running at maximum availability.

Typically, fieldbus physical layer diagnostic information is tied in to PAM systems via Ethernet connections. All major control system suppliers support Ethernet, which makes it a natural choice also for communicating physical layer diagnostics. However, some physical layer diagnostic solutions providers promote a different approach: physical layer diagnostics on the fieldbus itself as a fieldbus node. Those types of solutions require additional H1 fieldbus interface cards and fieldbus power supplies. Diagnosing the fieldbus physical layer by communicating diagnostic information over the fieldbus takes away critical bandwidth that otherwise could be used for additional field devices. Using the node approach for physical layer diagnostics has yet another major disadvantage: Start up and commissioning procedures cannot be supported since the fieldbus must already be up and running before the node approach can start monitoring physical layer information over the bus.

Complete physical layer solutions like the ADM (Advanced Diagnostic Module) from Pepperl+Fuchs not only support start up and commissioning but also online monitoring and troubleshooting. A built-in commissioning wizard guides the user through six simple steps and automatically documents the physical layer values in a commissioning report. This can reduce start up commissioning time up to 80 percent when compared to traditional analog installations. Tools like the ADM remove the guess work from fieldbus installations. The commissioning wizard function eliminates labor intensive steps and automatically checks the network and evaluates the fieldbus signal for influences such as noise, jitter, DC unbalance and ground faults, cable continuity and proper termination. Each segment is tested for compliance to AG 181 section 11 (FOUNDATION Fieldbus System Engineering Guidelines) and IEC 61158-2 physical layer specifications. With its built-in expert knowledge and by automating the network validation and baseline documentation, tools like the ADM allow anyone to effectively commission fieldbus segments.

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In the real world, no two segments are alike. Based on the location, cable length and routing, loading, and the number of devices on a given segment, the physical layer values are different. Good physical layer diagnostic tools will individually analyze segments and automatically create configurable maintenance and out of spec alarms that can be monitored via a PAM station. The alarming identifies critical deviations in segment health such as a change in trunk current or voltage, signal level changes or changes in the fieldbus communication timing. The alarms automatically lead to "actionable" information. This means that the maintenance engineer will not only see that something on the physical layer has changed but will be guided toward solving the problem before a segment goes down.

Not all physical layer diagnostic solutions also include the necessary troubleshooting tools that are needed to further pinpoint a problem once it has been identified. However, it is very useful to have troubleshooting capabilities built-in as it eliminates the need for many less sophisticated handheld tools. Built-in troubleshooting tools should include an oscilloscope with fieldbus-specific trigger functions. This allows maintenance personnel to zoom in on a specific segment or an individual device to check the fieldbus signal. The scope should have the ability to save any wave form so that it can be emailed and shared with others. Even better would be an intelligent scope function that automatically analyzes the wave form and suggests counter measures. Although it sounds like science fiction, a scope function like this will soon be a reality.

Remote Access

Fieldbus technology in combination with advanced physical layer diagnostics allows plant managers to streamline their operations and to do more with less. A big contributing factor to eliminating operational cost is the ability to access all this information from a remote location (for example the control room or maintenance stations). This enables maintenance workers to diagnose and pinpoint a problem before sending somebody into the field, eliminating up to 60 percent of field trips. Now, maintenance personnel can be directed to areas of the plant where actual problems exist, rather than chasing ghosts.

Today, some physical layer diagnostic solutions offer remote access via Ethernet connections. Ethernet allows plant managers to easily share information within a plant using OPC based servers and clients. But the significant advantages of Ethernet based diagnostic architectures over, for example, the node approach are well known and already exist on the plant floor and in control cabinets. It also allows redundant connections, therefore increasing availability, and it can be converted to wireless or fiber optic to bridge longer distances or to eliminate costly cable runs. It has the bandwidth to transport a great deal of information and has the security options that are needed to assure plant safety.

Being able to allow an outside fieldbus expert to remotely log on to a network for troubleshooting support decreases the response time and eliminates costly trips.

Conclusion

Physical layer diagnostics are bridging the gap between intelligent fieldbus devices and the control system. They assure that the network itself was installed correctly and operates at peak performance thus drastically increasing plant availability. Modern physical layer diagnostic solu-

tions communicate on Ethernet and are embedded into fieldbus power supply solutions. This allows monitoring the health of the physical layer as well as the fieldbus power supply. Start up and commissioning can now be automated and done 80% faster than before. Expert knowledge is embedded in the diagnostic tools, allowing anyone to perform the task of an expert. Troubleshooting tools are also part of the package and automatically guide the user to a solution. Oscilloscope functions with fieldbus-specific triggers can capture wave forms that can be saved and emailed to others, minimizing downtime. In the future, oscilloscope functions will include a feature that automatically analyzes the waveform and gives recommendations as to what can be done to fix the problem.

All fieldbus physical layer diagnostic information

from an entire plant can be linked together via Ethernet, tied in to PAM systems and accessed remotely. This allows plant operators to quickly identify potential problems before they lead to a shut down and guides maintenance personnel to the root cause of the issue.

Physical layer diagnostics for fieldbus installations is a must-have tool for all fieldbus users that are interested in reducing cost and keeping networks up and running.

Pepperl+Fuchs designs, manufactures and offers application support for a broad range of automation solutions. The FieldConnex fieldbus installation system for Profibus and Foundation fieldbus provides maximum flexibility to modern process automation applications. For more information visit: www.pepperl-fuchs.com.

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