Reducing total cost of ownership of instrumentation through the use of PROFIBUS' profile standard and Enhanced Electronic Device Description technology

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1.1 Introduction

Question: How is buying a process instrument like buying a cat?

While this may be a strange question to ask in a technical article, the process of buying a cat is actually similar to buying a process instrument – in both cases the buyer needs to be aware of all the costs!

Story: Last year, my five-year old daughter asked if she could get a kitten. I looked at the initial costs and I concluded the initial costs would total about $33.00 (cost of cat: $5.00, cost of litter box: $10:00, cost of litter for a month: $3.00, cost of food for a month: $15.00). Based on this information and the light in my daughter's eyes, the decision was easy – yes she could have her kitten. Then came the veterinarian bills for all the required shots and neutering which came to $550.00 for the first year. Total cost of ownership for the cat for the first year was thus $781.00 (first month:$33, cost of food and litter for 11 months: 11*18 = $198, veterinarian bill:$550), and the initial purchase price was a mere 0.6% of the total cost of ownership for the cat for the first year! So, in making my decision, I should have considered the total cost of ownership and not just the purchase price.

This maxim holds also true for purchasing process instruments. The initial cost of the instrument may be a small fraction of the total cost of its ownership, although quantifying this cost is difficult due to variations in instruments requirements and applications. A new instrument may cost $2,000; however, installing it might require shutting down the process one hour longer than the scheduled downtime, thereby adding $20,000 to the cost of that instrument. Then if the instrument fails five years later, it could shut down the process for another two hours and produce one ton of

bad product, adding an additional $80,000 to the cost of that instrument. All these costs need to be considered when contemplating a purchase.

Total cost of ownership = cost of device + cost of commissioning + cost of maintenance

Fortunately, unlike when buying a cat, design choices can be made with instrumentation that can reduce the total cost of ownership. Choosing PROFIBUS is a significant step forward to reducing costs. The profile standard and Enhanced Electronic Device Description (EDD) technology play key roles in speeding up commissioning and in simplifying the maintenance process.

1.2 Cost of commissioning

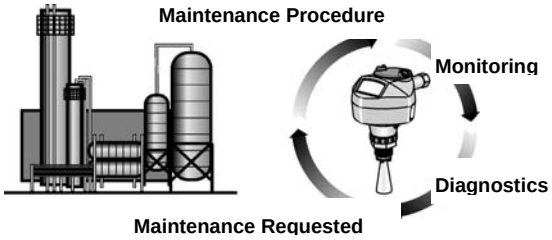
When commissioning a field device, an end user has to:

1. Learn/know about the field device.
2. Physically install the field device.
3. Connect to and identify the field device.
4. Configure the required parameters.
5. Test the configuration and the interface to other systems (verify control loops).
6. Repeat this process with every field device

Each step takes time and therefore costs money. Any reduction in steps or in the time it takes to complete them reduces overall cost of ownership.

1.3 Cost of maintenance

Once a field device is in operation, the maintenance cycle must be considered. The maintenance cycle is the process of going from general operation to a problem incident, followed by diagnosing the problem, repairing it, and then returning to operation. This cycle is the problem child of any operation as each step takes time and therefore costs money. Again, reductions in steps or in the time it takes to complete them saves money.



1.4 How can PROFIBUS reduce these costs?

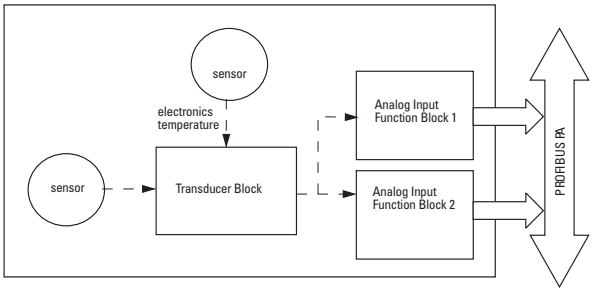
The entire protocol provides the perfect foundation for minimizing these costs. However, the profile standard and Enhanced EDD in particular play key roles in speeding up commissioning and reducing maintenance time and effort.

1.4.1 What is the profile standard?

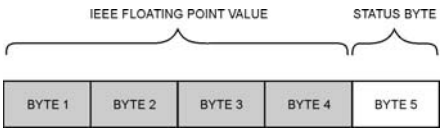
A profile is a standardization of a field device from the bus point of view. It defines the output and the core device parameters. A standardized profile creates a commonality between:

- devices of the same manufacturer and type (pressure, temperature, level, flow, valve positioners)
- devices of the same type and different manufacturers
- devices of different types

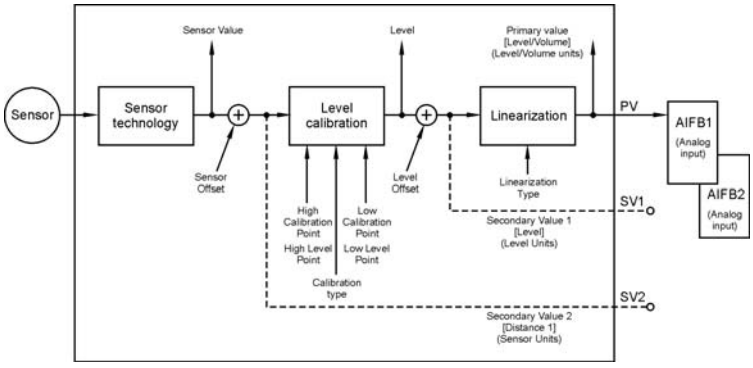
For example, pressure, level, flow, and temperature transmitters would all use the same overall structure and use the same analog input block.



The output from the analog input bock would all be in the same format; four bytes representing the process variable in IEEE floating point format and a status byte representing the health of the process variable.



Similar devices types have the same transducer block. Below is the standard diagram for a level transducer block. All the blocks shown in this diagram are defined in the profile standard, with the exception of the sensor technology block which is defined by the vendor.



For field instruments, the first released version of the profile standard, Profile 3.0, was published in 1999, and it defines the standardized output and standardized device parameters. Since the release of the profile standard in 1999, there have been two minor updates:

- Version 3.01 released in 2004
- Version 3.02 released in early 2009

Version 3.01: aimed at error/diagnostic messages and the flow of those messages. It added an alternative status byte called *Condensed Status*, with these results:

- reduced the number of error messages
- created a progression of alert steps for maintenance messages (maintenance required, maintenance demanded, maintenance alarm)
- designed easy filtering between process and maintenance alarms. The condensed status codes are bitmapped so that a simple bit filter can separate process and maintenance alarms
- permitted full user control over error messages (i.e. end users can go into an instrument and choose if an error should be an error, a warning, or not to be an alert)

Version 3.02: brings in many innovations[1] simplifying life cycle management:

- improves the speed of uploading/downloading by a factor of between five to ten times
- improves device integration through better version handling

Associated with the profile standard is another standard called *Identification and Maintenance Functions*. A separate part of the PROFIBUS standard until it was added to the profile standard V3.02, the identification and maintenance functions defined these standard parameters used to identify field devices:

- part number
- software version
- hardware version
- serial number
- date of commissioning

[1] These innovations have been welcomed by the NAMUR working group 2.6 ‘Fieldbus’ as meeting customer requirements. This was stated in a joint PROFIBUS and NAMUR press release dated November 26, 2008.

1.4.2 How can profiles speed up commissioning?

Profiles speed up commissioning by:

- reducing the total amount of training/knowledge employees require
- making it easier and faster to identify the field device
- speeding up configuration due by reducing knowledge required
- speeding up verification by using simulation functions in the field device

In most process plants, the instruments are supplied by multiple vendors, creating the problem of how to 'manage' all this information from different and differing sources. The commonality provided by the profile specification has a significant impact on the amount of information. For example, if a user first sets up a Siemens' level radar and an Endress+Hauser's level radar, the general structure of the two devices is the same. The transducer block and the core parameters are the same between the instruments, and in both cases the high calibration point and the low calibration point are set in the transducer block. The analog input block is the same for both devices and is thus easily configured. In plants where the setup requires moving from device to device, the time saved with PROFIBUS is substantial.

When identifying the field device, the profile standard provides the information in the field device for the configuration software to read, saving the user a trip to the device to get the nameplate information. It is easily read over the network and then stored in the configuration software.

When configuring field devices, the commonality means that configuring ten different instruments is more like configuring one instrument ten times – as the user moves from instrument to instrument, configuration speed increases with familiarity as the parameters and setup process are very similar from instrument to instrument.

Since the profile standard defines the instruments in terms of blocks, most field devices provide easy methods for simulation of the process variable. This simulation speeds up verification because the user will not have to go to the instrument to test the output. Everything is done over the network.

The latest revision of the profile standard (3.02) increase the time saved even more by boosting upload/download times by a minimum factor of six. While this increase may save only one or two minutes per device, the benefits become significant when dealing with large processes of, for example, a hundred instruments.

1.4.3 How can profiles speed up maintenance?

Profiles speed up maintenance by:

- providing instant alerts to potential and existing problems
- enabling predictive maintenance
- common approach to diagnostic messages

The status byte defined in the profile standard instantly alerts the user to either just before something goes wrong or just as something goes wrong. This information allows for a quicker maintenance response and for predictive maintenance.

Predictive maintenance is when the instrument manufacturer adds intelligence to the instrument so that problems are detected with the instrument before they occur.

Additional diagnostics built into the devices provide clear information on what to do, and the profile standard provides the common information platform, speeding up the maintenance process.

Profile standard V3.02 also significantly helps maintenance with the device replacement process because if a device has to be replaced, the new device adapts to the older one providing full backward compatibility.

1.4.4 Enhanced Electronic Device Descriptions (Enhanced EDD)

Field instruments can be configured over the bus by using Electronic Device Descriptions (EDD).

EDDs are text based files that describe:

- all parameters in a field device
- how to read and write those parameters
- all parameter interactions
- how to display those parameters
- simple procedures for setup and troubleshooting

EDDs are written using Electronic Device Description Language (EDDL) which is an international standard (IEC 61804-2). The standard was released in 2006.

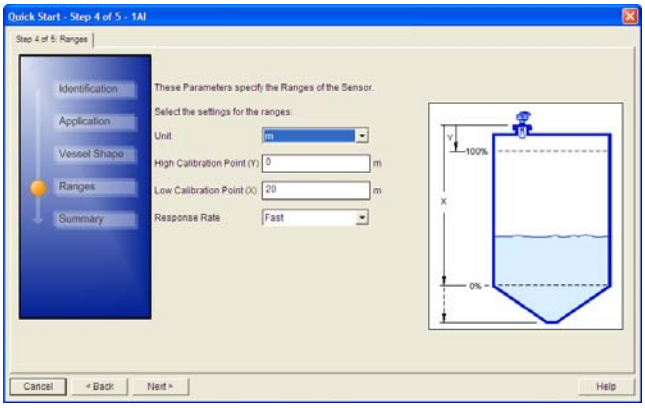
To make EDDL an international standard, the EDDL Cooperation Team standardized the existing language across the three protocols and the three major interpreters (SIMATIC PDM, Emersion AMS, Emerson HART hand-held 375) in IEC 61804-2. After examining the language, they realized that enhancements were necessary to fulfill user requirements. These enhancements were developed and incorporated into IEC 61804-3 and are now implemented in most EDDL based configuration software. The EDD's that make use of these enhancements are referred to as Enhanced EDDs.

As an added benefit, these enhancements permit manufacturers to provide added functionality not possible before, such as graphical quick start wizards.

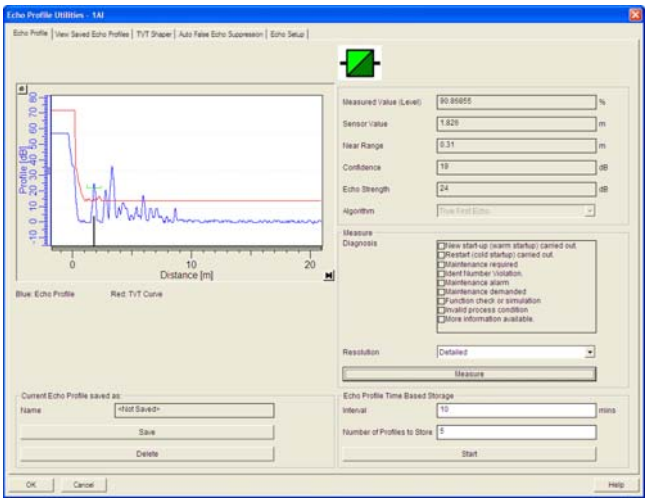
1.4.5 How can Enhanced EDDs speed commissioning?

Enhanced EDDs can speed up commissioning by:

- providing methods for vendors to implement quick start wizards
- providing methods for vendors to implement commissioning aids



The smarter the configuration software is, the faster commissioning proceeds. Quick start wizards have been implemented by a number of vendors and speed up the commissioning process, reduce errors, and lessening the installer's knowledge requirements. For example, when configuring a Siemens' level radar the end user does not have to know what High Calibration point means, it is defined on the drawing. The end user does not require as much training and error potential decreases.



When commissioning a field device, instrument vendors can create utilities making the process easier for end users. Such is the case with the radar unit. Some tank applications have obstructions – Siemens Milltronics, like other manufacturers, have created methods to shape the measurement around these obstructions. Enhanced EDD allows Siemens Milltronics to implement a utility that puts all echo processing tools in one dialog box. The user can thus flip from one tab to another when setting up this advanced feature known as "Auto false echo suppression."

1.4.6 How can Enhanced EDD speed up maintenance?

Enhanced EDDs speed up maintenance by:

- providing methods for vendors to implement troubleshooting aids

- providing detailed diagnostic screens

Instrument vendors can create utilities (like the Echo Profile Utilities – see above) to speed up the troubleshooting process. For example, the radar echo profile utility lets the user do the following:

- view the profile
- save the profile (and send it to technical support)
- record the echo profile in timed increments

Enhanced EDD also allows vendors to create user friendly dialog screens showing detailed error messages along with icons that quickly identify the device state.

When troubleshooting a field device, the user often needs to get information about a certain error message or parameter. Using Enhanced EDDs, the vendors provide this information.

1.5 Conclusion

The PROFIBUS profile standard creates a commonality between devices that will significantly speed up commissioning and reduce the probability of errors. In addition, profiles also create a common approach for diagnostics and enables predictive maintenance – both of which will reduce the maintenance cycle.

Enhanced EDD technology enables vendors to create quick start wizards and commissioning aids that both speed up commissioning and reduce the probability of errors. In addition, the technology also enables vendors to create troubleshooting aids and diagnostic screens that will reduce the maintenance cycle.

Together, profiles and enhanced EDDs speed up commissioning and reduce the maintenance cycle which will significantly reduce the total cost of ownership for field instruments.

2 References

Powell, James and Henry Vandelinde, *Catching the Process Fieldbus.* SMPI Press, 2009.