



The Native vs. the Layered (Mapped) Approach to FOUNDATION Fieldbus

With the advent of FOUNDATION™ fieldbus, vendors had a choice: develop a new system from the ground up based on Ff; layer (interface) the new Ff technology onto preexisting control system architecture; or do nothing.

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Introduction

With the advent of FOUNDATION fieldbus (Ff) in the 1990s, process control systems vendors were faced with the most important decision they had ever had to make: at what level should this new standard be embraced? (e.g., how should this new technology be brought to market, if at all?) Quite simply, vendors had a choice: develop a new system from the ground up based on Ff; layer (interface) the new Ff technology onto their preexisting control systems architecture; or do nothing.

The DeltaV (Native) Approach to FOUNDATION Fieldbus

Emerson Process Management saw the potential of Ff from very early on. That is why our response to this emerging technology was to fully embrace it. We did this by building a brand new control system architecture based on Ff. This allowed us to take full advantage of all the new functionality embedded in this new standard. Additionally, by building a brand new architecture, we were able to leverage the benefits offered by Windows, OPC, and other industry standards.

In our view, one of the critical elements of the new FOUNDATION fieldbus standard was that it was meant to be an open standard, open meaning that plug-and-play interoperability among all the different host systems and the various makes of field devices was facilitated. Emerson Process Management immediately realized that the only possible way for this open standard to be fully used was to design and develop an equally open host system. The reason was that, if we just took our existing proprietary closed DCS technology and interfaced to the open Ff layer, the resulting system would not be truly open and able to take full advantage of the functionality offered by fieldbus.

The DeltaV system, originally released in late 1996, was built to fully embrace the Ff standard. Ff was a driving force in the DeltaV architecture, not just an afterthought. This is what makes the DeltaV system a native Ff system. "Native" refers to the fact that the DeltaV system was designed to consistently use the FOUNDATION fieldbus-specified data model and function blocks throughout the entire system. In other words, the same data model and function blocks are used regardless of whether the function blocks execute in a controller or in a Ff device.

Non-native systems, on the other hand, do not use the specified data models and function blocks consistently throughout the system. While they do use them down at the fieldbus device level, up in the host system they use a proprietary (closed) data model and set of function blocks.

This means that all control functions in the DeltaV system are managed in a single database. Thus, the system does not require a second database (for managing the Ff data), which then must be mapped back to the main database. Non-native systems, on the other hand, must have a second database for managing the Ff data and, therefore, they require that this mapping operation be done.



The Layered (Mapped) Approach to FOUNDATION Fieldbus

Instead of building a new system to fully embrace the open Ff standard, other vendors opted to layer Ff onto their preexisting proprietary control system architecture. The benefits of this approach for those vendors who chose it are less cost and less risk; less cost in that they did not have to develop a complete new architecture and less risk in that they did not tie their future to that of Ff and busses in general. This approach enabled those vendors to be able to provide some sort of Ff offering while sitting back and waiting to see if there was true market acceptance of this emerging standard. Then, once it was clear that there was market acceptance of Ff, they could make the considerable investment in bringing a native Ff system to market.

At the heart of other vendors' layered Ff offerings was a closed DCS platform. This platform contained the data model for the system and was responsible for defining the traditional I/O and control strategies. On top of the base platform, specific software has been layered to add some limited Ff capabilities. Distinctive of these types of systems are the following attributes:

- ❖ Each system's closed and proprietary control engineering architecture was designed well before the Ff specifications were developed.
- ❖ The legacy software does not understand how to handle information conveyed in Ff formats/specifications; therefore, it has to be mapped
- ❖ Third-party (separate) engineering tools are layered on top of the existing control system functionality.
 - These engineering tools handle all aspects of the fieldbus segment, device definition and commissioning of devices.
 - These "layered" Ff application packages establish and maintain entirely separate databases:
 - one for the fieldbus information
 - another for traditional, hard-wired I/O
- ❖ Getting Ff information into the control system requires a converter box (i.e. linking device):
 - Ff data is stored in registers.
 - These registers are mapped to traditional hard-wired I/O locations within the control system.



Comparison of the DeltaV Approach versus Competitive Systems

	The DeltaV System	Competitive Systems offering Ff
System Type	Native Ff	Non-native Ff
Approach to Ff	Built new system from ground up to support Ff standard	Ff functionality layered on top of existing proprietary closed DCS
Host system data model and function blocks	Conform to the Ff specification	Does not conform to the Ff specification
Device level data model and function blocks	Conform to the Ff specification	Conform to the Ff specification
Number of databases in the system	One	Two
Common data model and function blocks used throughout the system	Yes	No
Is data mapping required	No	Yes



Advantages of the DeltaV (Native) Approach

The use of a single database in the DeltaV system eliminates the hazardous possibility of data mismatches where the two databases become misaligned. In the DeltaV system, there can be no misalignment of data, since there is only one database.

Additionally, using the same Ff-defined function blocks in both the controller and the field devices enables:

- ❖ **Ease of configuration**
 - Engineers have to learn only one software package and one type of function block. Non-native systems require learning multiple block types: one for Ff blocks, the other for traditional.
 - Control strategies templates can be developed and used in classical I/O, Ff I/O, or any mixture. This saves engineering time by reducing the number of control strategy templates that need to be developed.
 - All Ff data parameters are indigenous to the system; therefore, no mapping is required (either manually or automatic).
- ❖ **Ease of use**
 - Access to device diagnostics is embedded in the control system. The health, status, and internal diagnostics of Ff devices are directly accessible through the host system with no extra configuration or mapping required. This is very important as new devices are brought online over time.
 - Actual device status can be directly and easily reconciled with stored configuration information. Compare the current status of fieldbus with the stored status in the fieldbus database.
 - Embedded Fieldbus Technician functionality allows the user to configure all transducer, resource, and input/output function blocks contained in the fieldbus devices.
- ❖ **Ease of Product Enhancements**
 - Product enhancements are delivered faster than with a layered system because the overhead needed to "integrate" Ff functionality into the legacy structure is eliminated.

Disadvantages of the Layered (Mapped) Approach

Layered systems will prove to be more costly and less beneficial to own and operate than native systems for many reasons including:

- ❖ Converter box limits throughput. It provides for limited data handling capabilities, sometimes permitting as few as 48 Ff parameters per segment (16 AI, 16 AO, 16 DI/O) in total. This means many critical device parameters can never make it out of the device and up to the control system (device parameters, e.g. detection of plugged impulse lines in transmitters, that enable you to catch problems before they lead to process downtime).
- ❖ The chance of data mismatch between the two mapped databases. What if the data that you are seeing on your screen is not the correct value because it has been corrupted in the database mapping process?
- ❖ Multiple data entry points requiring twice the effort and more debugging are typical.
- ❖ Extra time and effort to bring new Ff devices on-line as each one has to be correctly mapped into the system. Additionally, there is the time it takes to configure any device parameters you may want to see, assuming that it is even accessible and that parameter limitations have not been exceeded.