Honeywell

White Paper

The Perils of a DIY Distributed Control System

Tim Sweet and Bill Stevens, Honeywell Process Solutions

Executive Summary

The DCS architecture has always been focused on distributing control on a network so that operators can monitor and interact with the entire scope of the plant. The classic DCS originated from an overall system approach - Coordination, synchronization and integrity of process data over a high-performance and deterministic network are at the core of the DCS architecture.

PLC architectures have always focused on very flexible and fast local control. Recent advancements in PLC technology have added process control features. When PLCs and HMI software packages are integrated, the result looks a lot like a DCS. But, all is not as it seems. This is very much a “do-it-yourself” (DIY) approach with plenty of technical risk as well as added costs that are not always immediately obvious.

Introduction

For certain industries, a distributed control system (DCS) provides substantially more value as the basis for automating the plant than a programmable logic controller (PLC)-based system.

Figure 1. For certain industries, a DCS provide substantially more value as the basis for automating the plant than a PLC-based system.

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Background

Until Honeywell’s Experion LS solution arrived on the scene a few years back and now Honeywell’s new Experion LX solution, DCSs have typically more expensive to purchase than a PLC-based system. And, many processing plants had lower demands in terms of production rates, yield, waste, safety and regulatory compliance than what they are experiencing today. A PLC-based system offered a lower capital investment and from a functional point of view was “good enough.” However, times have changed. All across the global marketplace, the demands on manufacturing companies have risen—and the purchase price of the DCS has come down. As a result, many control system engineers, maintenance managers and plant managers are taking a fresh look at the trade-offs between a DCS and a PLC-based control system architecture as they plan their automation capital expenditures (See Fig. 2).

Figure 2. As the price point of the DCS has come down, more manufacturers are looking at the advantages of a DCS architecture

Important Issues

Interestingly, this debate over the virtues of DCS vs. PLC has been ongoing since these two architectures came into existence 40 years ago. One might think that enough has been said, that the debate might well be over. But it is gaining strength! As functionality differences narrow and price points align, the debate is getting more intense and the arguments for and against each system are getting more and more murky. This white paper discusses the “Top Ten” issues to consider when evaluating a DCS vs. building your own “DIY” distributed control system using a PLC-based architecture.

Network Performance

Good network performance starts with proper network planning, which can only be done with an intimate knowledge of the communication behavior of each network node and the protocol used to carry network messages. Major process automation suppliers such as Honeywell Process Solutions have taken care of this requirement. They provide best practice information so the user starts with a sound network design for their control system. Contrast this to the DIY world where the application engineer is the first to ever put a particular network topology together (See Fig. 3).

Figure 3. Major automation suppliers provide best practice information so the user starts with a sound network design for their control system.

Once the network planning and installation are complete, it's time to see how the network performs. The same network topology can be subjected to a wide variation in communication traffic based upon the amount of data acquisition, alarm reporting, historization, peer-to-peer messages and backup tasks that are on-going. Again, suppliers like Honeywell take care of this through comprehensive maximum topology testing. Honeywell subjects the Experion network to the highest levels of message volume in its test labs to ensure reliable network performance in the most demanding environments.

Let's assume then the user has planned and installed their network, the plant has reached its maximum production capacity, and everything is working as expected. How does the user keep it that way year in and year out?

First, Honeywell provides its patented Fault-Tolerant Ethernet (FTE), a redundant industrial Ethernet networking technology utilizing inexpensive off-the-shelf components to provide a high-availability solution. FTE continuously cares for the process control network (PCN) by providing ample network diagnostics that are tracked and reported as a part of the base Experion system.

Second, seasoned network engineers know that every single device on the network needs to behave properly as a part of a functioning network community. One bad actor can spoil the performance of the entire network. That is why Honeywell takes the same care with the open components on the network as it does with Honeywell-developed technology. Honeywell qualifies the functionality and performance of service packs and hot fixes before they are loaded into the production system. When security patches are released, Honeywell qualifies them as well and notifies the customer when they are safe to load.

Great care goes into designing and maintaining a sold industrial control network. Is this something the DIY practitioner can deliver?

Control Performance

Good process control is built upon reliable and repeatable execution of the control strategy. The process controllers that are a part of the classic DCS architecture have fundamentally different operating philosophies than found in a PLC. While the PLC runs "as fast as it can," the process controller favors repeatability. That means, the control strategy runs on fixed clock cycles—running faster or running slower are not tolerated. Repeatable control every cycle means repeatable quality, repeatable yield and repeatable results for the plant.

Clock cycles are not the only secret. Other system services are also designed to give priority to solving the controller configuration. For instance, controller-generated alarms can be throttled if they are interfering with control and recovered later when process disturbances slow down. This can only be effectively managed by tightly coordinating the control generating the alarms, as well as the alarm and event subsystems that collect, store and report those alarms. Again, a system approach from the onset is what the DCS is all about.

HMI Graphics

Suppliers of HMI software packages typically boast about how easy it is to design graphics for the operator. But designing graphics, no matter how impressive, is not how a process plant makes money. Imagine a process control environment where one doesn't need to build graphics…because they are built for you?

With a system where the control and operator environments are designed and built together, often 90% of what is needed to run a process plant can be made standard. For example, Honeywell's years of experience enables it to provide hundreds of standard faceplates, group displays and status displays that are vital to safe and efficient plant operation. These graphics are provided out-of-the-box and are ready to be instantiated from the Experion Server to any connected operator station.

Over the past 10 years, Honeywell has supported the Abnormal Situation Management (ASM®) Consortium to define safe display principals and practices, and to build that know-how into Experion HMIWeb technology and standard displays. Every HMIWeb graphic follows the same visual and operational conventions as defined by ASM. As a result, the user gets fewer operator errors—with little or no effort—thanks to better, safer HMI graphics (See Fig. 4).

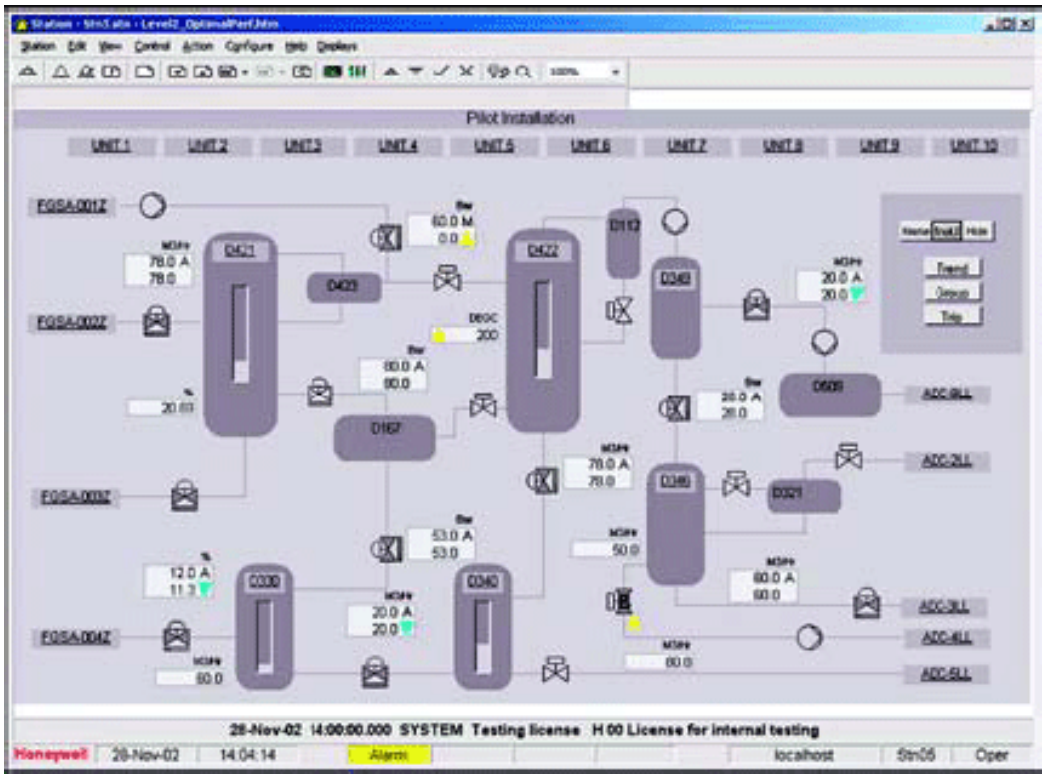

Figure 4. With Experion, plant personnel have access to standard displays that improve efficiency, save money and increase safety.

Control Algorithms

The Experion library of object-oriented function blocks reflects Honeywell's extensive domain expertise and vast knowledge of controlling industrial processes. By creating function blocks with a complete set of parameter-based functions, the user can develop and fine-tune control strategies without designing control functions. All necessary functions are available and documented as configurable selections. The application engineer simply assembles the blocks into the desired control configuration with a minimum of effort. A self-documenting, programming-free controller configuration is what makes the DCS architecture efficient to engineer and troubleshoot.

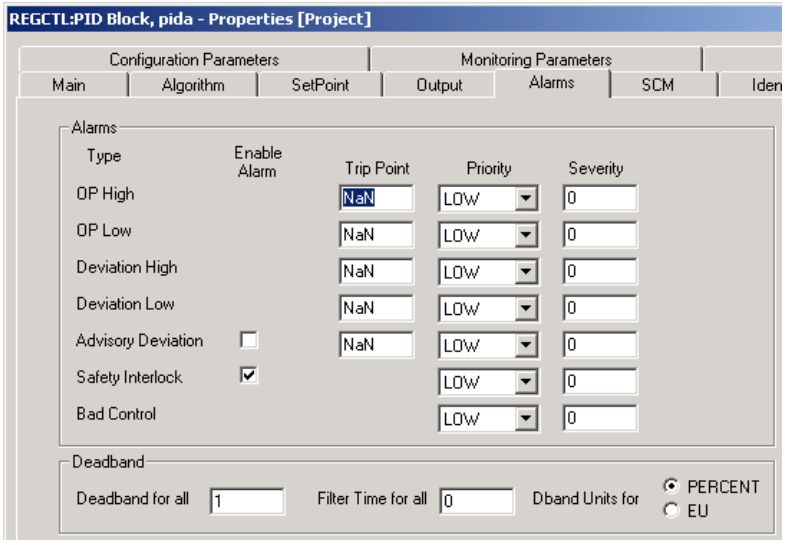

Figure 5. Experion LX configuration screen.

As an example, let's look at a commonly used process control function, the PID block. In Experion LX, using a DCS-style global data model, all aspects of the PID function are contained in a single tabbed configuration screen. Various algorithms that have proven the test of time are available for easy selection. As explicitly shown in the following view of the configuration screen, parameters used for alarming, trending, and history in the HMI are configured here. No more configuration of these parameters is needed to populate HMI configuration (See Fig. 5).

Application Software

In the world of DIY, one can find all of the applications needed to run a process plant. Just look in the catalogs from PLC and HMI vendors. Customers can make a list, place their purchase order and soon licenses, DVDs and downloads will begin to arrive. But isn't it easier to order one model number and receive everything needed at once via the same download or DVD? One license can supply all of the controlware, a data historian, trend objects, business integration software, and graphics needed to runa process plant. Thanks to the capabilities of a DCS architecture, all of your control applications load correctly, are guaranteed to be the correct version, and are tested to work together. In fact, they work so well together it seems as if they were all conceived, architected, engineered and optimized to behave as one complete system!

Think about the 20-30 year life span of an automation system. How often will the typical user need to expand or modify their system? How many times will they want to add a new control technology to the system? By partnering with a major DCS supplier like Honeywell, users are assured they will always receive a complete, tested suite of applications as they expand and upgrade—in other words, a system they can start with, live with and grow with.

Data Management

There is an old adage that goes something like: "Show me a person with a wristwatch, and I will show you a person who knows what time it is. Show me a person with two wristwatches, and I will show you someone who is not sure." Multiple data models spawn multiple data elements representing the same piece of information. This happens when the DIY distributed control system is pieced together. When piece parts are brought together to form a system, the various data models must be synchronized and maintained. A burden exists on application engineers and system administrators to accomplish this task.

In the world of the DCS architecture, the entire data model has been conceived to cover all parts of the system. (Note the HMI alarming and history parameters set in the PID example above). Hence, one data owner can provide that piece of information to any application or service anywhere in the system. The issue here isn't the number of databases. The key is having a single data model so, no matter where a data element resides, it can be used by any element of the architecture and that particular data element is never duplicated. A comprehensive data model doesn't necessarily mean one database, but it does mean only one location for any given element of data.

Batch Automation

The comprehensive nature of the DCS architecture has long been a favorite for batch automation projects. More than anywhere else, batch requires careful coordination between phases, units, recipes, formulas, etc. Even the classic DCS architecture has also been challenged to provide a complete "packaged" solution because of all the various and diverse elements in a batch environment. For this reason, many batch automation projects have resorted to a myriad of packages brought together to form the solution (See Fig. 6).

With Honeywell's Experion Batch Manager, the batch data model has been tamed! Now, the various aspects of the batch automation solution are captured in a single DCS data model. All elements needed for batch management and execution are run in the process controller (or a redundant pair of controllers when robustness is desired). There is no longer a need for a personal computer operating as a batch server. Because all batch elements are handled in the controller, we experience faster batch execution, reduced cycle time and increased throughput. The operators learn one, consistent environment for alarms, security and displays so that fewer errors are made. From an engineering and maintenance perspective the advantage is in learning and supporting one tool with no duplication in engineering.

Figure 6. The packaged DCS architecture has long been a favorite for batch automation projects.

Open Connectivity

Rarely are today's process plants run by a single brand of controller. That's why the classic DCS architecture also serves to bring third-party devices into the same data model employed by the DCS. This incorporation of existing controllers means that operators can view information from various brand controllers in a consistent fashion.

It is also important to choose the control solution that will allow you to seamlessly add enterprise solutions onto your control layer. Right now, you may not be thinking of things like manufacturing execution systems (MES), asset management, reporting packages, statistical process control (SPC) downtime tracking or a variety of other enterprise layer solutions, but information-rich applications will most likely be expected right around the corner. Your vendor should be able to provide a seamless flow of process information from the control layer to information layer.

Simulation Technology

Control strategies need a thorough ringing out before they are deployed to control the actual process. Because process control is so focused on repeatability, it is necessary for a simulation environment to run the control strategy without alteration. "Timing is everything" in process control, thus, a simulator must replicate the process execution timing in a faithful manner.

Honeywell and other major DCS suppliers offer advanced simulator technology to support improved performance throughout the lifecycle of a plant—from off-line use in steady-state design simulation, control check-out and operator training, to online use in control and optimization, performance monitoring, and business planning.

Process History

Good process improvement relies on good process data. History collection must be coordinated with the functioning of the plant automation system so it does not interfere with more urgent control requirements. Yet, if it becomes necessary to suspend the collection of history, the history must be recovered (incomplete history is not acceptable). Plants need a reliable solution for archiving history data, and also retrieving it for use in trending, quality analysis, etc. (See Fig. 7).

Figure 7. Plants need a reliable solution for archiving history data, and also retrieving it for use in trending, quality analysis, etc.

Honeywell has responded to this requirement by building robust process history functionality directly in into Experion LX, enabling engineers and plant management to analyze performance of the entire operation from a single location. Robust data collection also ensures speedy fail-over to a secondary collector upon loss of a primary.

Conclusion

Many industrial operations require the proven performance and reliability of a DCS and seek to avoid the pitfalls of a DIY distributed control system. Honeywell has addresse**d** this need with its Experion LX system, which offers the power and reliability of a DCS in a small and versatile solution ideal for continuous processors as well as batch and sequence-oriented manufacturers. Experion LX requires less engineering effort to configure and is easier to maintain than a PLC-based system. With out-of-the-box functionality and flexibility, it requires less implementation cost and less ongoing maintenance.

For More Information
To learn more about Honeywell's Control Systems, visit our website www.honeywellprocess.com or contact your Honeywell account manager.

Honeywell Process Solutions
Honeywell
1250 West Sam Houston Parkway South
Houston, TX 77042

Honeywell Control Systems Ltd
Honeywell House Skimped Hill Lane Bracknell
RG12 1EB

Shanghai City Centre, 100 Junyi Road
Shanghai, China 20051

www.honeywellprocess.com

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