All Controllers Are Not Created Equal

Knowledge of the differences is key to specification

By J. JAY SANTOS, PE
Principal
Facility Dynamics Engineering Corp.
Columbia, Md.

Many direct-digital-controls (DDC) manufacturers make controllers of two distinct "levels," while some make controllers of only one. These levels refer to where the controller resides within the system architecture on the control network. Knowing the difference between these levels is important because controllers are application-dependent. Unfortunately, many specifications do not distinguish between the various types of controllers. This article will explain the differences and discuss ways to specify the appropriate level of control hardware. Also, it will point readers to a Website where they can find unbiased information on a number of manufacturers' products (Figure 1).

LEVELS OF CONTROLLERS

Higher. Typically, higher-end controllers live on a higher-level network and communicate in a peer-to-peer fashion. I will call these "primary controllers" (Figure 2). "Peer-to-peer" means that the controllers can share information with other peer-to-peer devices without going through an intermediary, which I will call a "supervisory interface" (SI).

These primary controllers can range in cost from $1,500 to $4,000 and more. They have more memory, more-sophisticated CPUs, higher-resolution A/D converters, and more-accurate clocks and can store more-complex control strategies, as well as trends, schedules, and alarms.

Lower. Manufacturers also make lower-level controllers that typically reside on a lower-level polling network. These controllers have more-limited memory and processing capabilities and must utilize a supervisory-interface device to communicate with all other devices. They come in a number of flavors and can cost from $100 to $1,000. Some are designed for typical terminal applications such as VAV boxes and fan-coil units, while others are designed for air-handling systems with simple to moderately complex sequences of operation.

These terminal controllers typically are configured for the number of points required for the application. Some utilize a free form of programming (they require a complete set of custom programming), while others have application-specific programs for typical applications. These programs have selectable parameters that can be set up for each application. Since these controllers have more-limited memories, they typically do not store historical information (such as trends), relying on the supervisory interface for this function.

The secondary polling networks are configured so that one supervisory interface can monitor a limited number of controllers. This limitation varies by manufacturer. A large number of controllers on a secondary controller network can negatively impact the number of trends that can be utilized practically, the amount of data that can be processed, and the data's speed of transmission over the network. How many controllers is too many on a secondary network? The classic answer is, "It depends." It depends on the manufac-

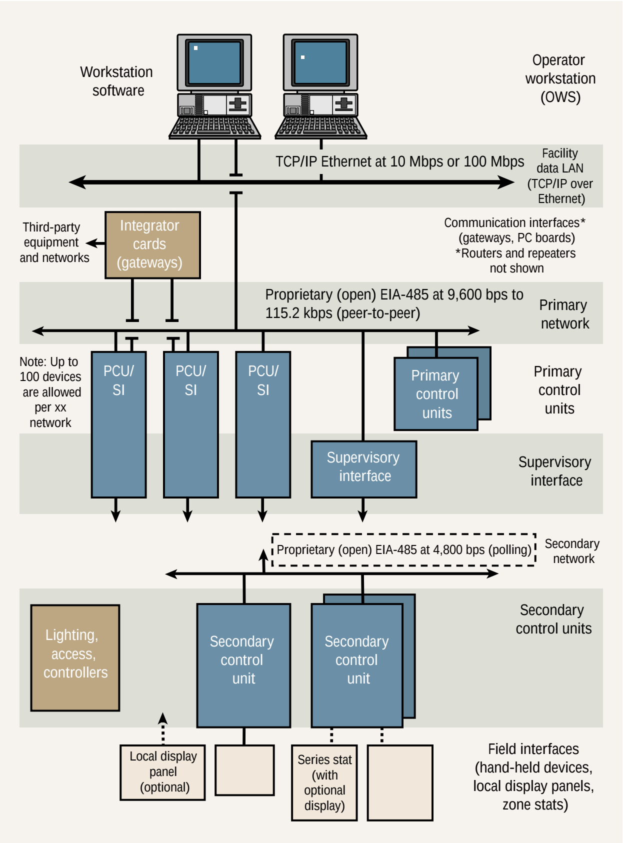

FIGURE 1. An example of a product-line ladder from the Direct Digital Controls Website (www.DDC-online.org).

A member of HPAC Engineering's *Editorial Advisory Board, J. Jay Santos is a professional engineer focusing on controls and commissioning. Also, he teaches courses on building automation, direct digital control, and commissioning for the University of Wisconsin, North Carolina State University, and the Iowa Energy Center's Energy Resource Station.*

turer, the speed of the network, and the application.

SPECIFYING THE APPROPRIATE LEVEL

Most control specifications are performance-based, which both levels of controller types can meet. The engineer should indicate which controller is best-suited for the application at hand. A Pentium III-type processor is preferred for a computer running a CAD program, while an older 486 may still be adequate for a basic word processor. In HVAC controls, these lower-level controllers are adequate for many simple applications, while a primary controller is appropriate for more-critical ones. How does one specify these distinctly different controllers? First, the engineer must define requirements of various types of controllers and their corresponding interfaces (both network and operator). Once these are defined, the engineer can dictate which controller should be used.

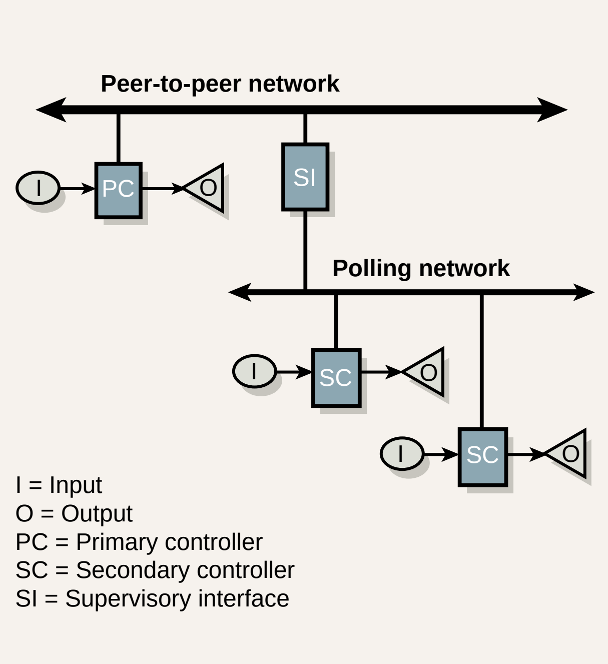

FIGURE 2. The higher and lower levels of controllers.

What if the vendor does not make primary controllers? There are two options:

- If, in the engineer's opinion, a primary controller is warranted because of the sophistication of the system, the specification could disallow all but these peer-to-peer devices.
- The engineer could allow a dedicated supervisory interface for the secondary controllers required for the control sequence of a given system.

Sometimes, depending on

the manufacturer's product line, it is necessary to use more than one controller to accomplish a given complex sequence of operation. This forces the application engineer programming the sequence to split up the various control loops of the system. This could result in the control loops for the starting and stopping of the fans and the variable-speed drive to be on one controller and the control loops for the mixed-air section and cooling and heating coils to be on the other. The potential problem comes from the polling nature of the secondary network. If one controller needs to send information to the other controller, it must first send it to the SI, which then forwards it to the other controller. Any loss of communication between these devices would interrupt the proper operation of the controls for the system. The engineer must determine whether this is acceptable for the application. As some product architectures move toward a flatter profile, with more distributed control logic, these controller classifications may not apply, but the engineer still will need to assess the robustness of the communication required for reliable and accurate control.

If the vendor is allowed to install a large quantity of units on this secondary network or implement a lot of network-heavy functions (such as trending), this could slow down critical control communication. For example, if the output to a variable-frequency drive is connected to one controller, and the controlled variable input is connected to another controller, the time delay in transmission could render the loop difficult or impossible to control.

The bottom line is that the design engineer needs to be more specific in dictating controller type. To accomplish this, he must possess detailed knowledge of the various control products. If the engineer has not kept up with the DDC industry, this will be no small undertaking.

INFORMATION RESOURCE

In an effort to make information about control products more readily available, the Direct Digital Controls Website (*www.DDC-online.org*) was created. This Website presents 20 different product lines in a generic "ladder" by the classification of the device. Figure 1 is an example of one of these ladders. Note that not all products fit on a single layer. For example, some devices contain both a primary controller and a supervisory-interface device.

From this system-architecture drawing, the user can double-click on a device and see a generic cut sheet appropriate for that product. This allows the user to more readily compare similar products.