PlantWeb University – Wireless 308

Wireless and Control

10 minutes

In this course:

Overview

Most of the wireless applications we've covered in other PlantWeb University courses have involved monitoring and diagnostics. That's because the greatest value wireless technology offers today is easy, cost-effective access to additional information that can help you make the most of your operation.

But what about control? Should you consider using wireless technology, there, too?

The answer is yes -- but you need to look at the specific application and consider the balance between the advantages and limitations of today's wireless technology.

You've already learned about the advantages of wireless in earlier courses, especially the low cost and ease of using wireless technology to collect additional information about your operation. Wireless field networks today also offer proven reliability greater than 99% and security that is as good as wired networks.

In this course we'll address additional factors that you need to consider when evaluating wireless for control, such as the update rate needed by the application and the impact of network latency. We'll also look at the suitability of wireless for different control applications.

At the end of the course you'll find a short quiz to help you confirm what you've learned – and earn valuable Reward Points.

Hint

As you go through the topics in this course, watch for answers to these questions:

- What is the impact of increasing a wireless device's update rate?
- What causes latency in wireless networks?
- Which types of applications are suitable for wireless control?
- What changes will expand the number of wireless control applications?

Next: **Update rates**

Update rates

The first step in deciding if wireless is the appropriate technology for your control application is to determine the update rate necessary for good process control.

Accurate control requires measurement data that adequately reflects what's happening in the process. Measurement transmitters typically sample the process variable many times, filter the readings, and then transmit the output across the network to the controller.

Some variables typically change slowly, and others very rapidly. If measurements aren't transmitted to the host system often enough to provide a good representation of the variable, the data used for control may not accurately represent what's happening in the process.

In the wireless world, however, fast updates are not always practical. Processing and transmitting the data for each update uses energy, and faster updates therefore use more energy. Unless you're willing to replace batteries every few months or hard-wire a power source directly to the field device – eliminating some key advantages of using wireless technology -- measurement update rates for wireless devices will typically be less than for wired systems.

Although devices in a truly wireless network will usually be configured for update rates of perhaps twice per minute, they are capable of supporting once-per-second update rates. This can be suitable for control in applications where the variable doesn't change rapidly, such as level and temperature loops or those that rely on online-analyzer feedback. Some slow and non-critical flow loops can also be good candidates for wireless-based control.

The key is to understand the requirements of your process, then determine the right balance between update rates and battery life. Some device suppliers provide a chart showing the relationship between battery life and update rate, which can help you find the right balance between the two -- and decide whether wireless control is suitable for a particular application.

Next: **Network latency**

Network latency

Control performance depends in part on how quickly the control loop responds to input changes. This response time includes how long it takes for a measurement signal to travel from the sensor to the controller, and then from the controller to the valve or other final control element.

Any delay in getting an information packet from its source to its destination is called **latency**.

Every communication has some amount of latency. In most hard-wired process control networks, latency is low enough to allow even very fast control loops. But message-handling techniques used in many wireless networks can increase network latency to the point that the technology today may not be suitable for fast loops where response time is typically measured in milliseconds.

Why is this?

In the world of wireless, signal strength drops off rapidly as the distance between transmitter and receiver (gateway or host system) increases. The lower the signal strength, the higher the chance of transmission errors, which in return reduces throughput-- increasing the time it takes a message to reach its destination.

Suppliers sometimes install a Yagi directional antenna to increase the signal gain for a stronger wireless link. Although this can reduce latency in some applications, it's also costly.

Another approach to avoiding signal-strength problems is to route the signal through other wireless nodes until it reaches the gateway or host. The shorter transmission distance between nodes increases communication reliability. So does the built-in redundancy of having multiple nodes available to route the message to its destination.

This reliability is important for process control. However, the additional "hops" from node to node can also increase total message-transmission time. This overall network latency may be as little as a few milliseconds, or as much as one or two seconds in extreme cases. At some point the total latency may be too high to reliably support a fast control loop.

That's why, before using wireless technology for control, you need to confirm that the network latency is within acceptable limits for your application.

Next: **Usage classes**

Usage classes

The factors we've discussed in this course make wireless technology more suitable for some types of applications than for others. Standards committees have therefore developed tools to help users think through applications and use cases for wireless in process control.

For example, the ISA SP100 committee – which is establishing standards for wireless networks in the process industry -- has defined six **usage classes** that can help you decide when wireless technology is appropriate. *(To learn more about the SP100 committee and its objectives, see the course on Wireless Standards.)*

Safety	**Class 0: Emergency action** Always critical
Control	**Class 1: Closed-loop regulatory control** Often critical
	Class 2: Closed-loop supervisory control Usually non-critical
	Class 3: Open-loop control Human in the loop
Monitoring	**Class 4: Alerting** Short-term operational consequence (e.g., event-based maintenance)
	Class 5: Logging & downloading/uploading No immediate operational consequence (e.g., history collection, SOE, preventive maintenance)

Increasing importance of message timeliness

ISA SP100 working groups are addressing use of wireless technology in several types of applications.

Today most industrial wireless networks are suitable for applications in **Classes 4 and 5**, which include monitoring. Typical latency and update rates for today's wireless networks are well within the requirements of these applications.

Wireless networks could also be used in **Classes 2 and 3** if the update rate and latency meet control-response requirements for that loop.

For example, wireless control can work well in Class 3 open-loop control applications where an operator has to leave the control room (perhaps after first getting a work permit) to perform the appropriate control action, such as turning on a pump or opening a manual block valve. In such cases, one-minute updates (what you expect with wireless devices today if you want batteries to last several years) are more than fast enough.

Somewhat faster control loops can also be controlled wirelessly if local line power for the devices is available, or if you are willing to replace batteries more frequently.

Although wireless control is currently not recommended for **Classes 0 and 1,** as the industry gains experience and confidence in the technology more and more of these applications will be candidates for wireless control.

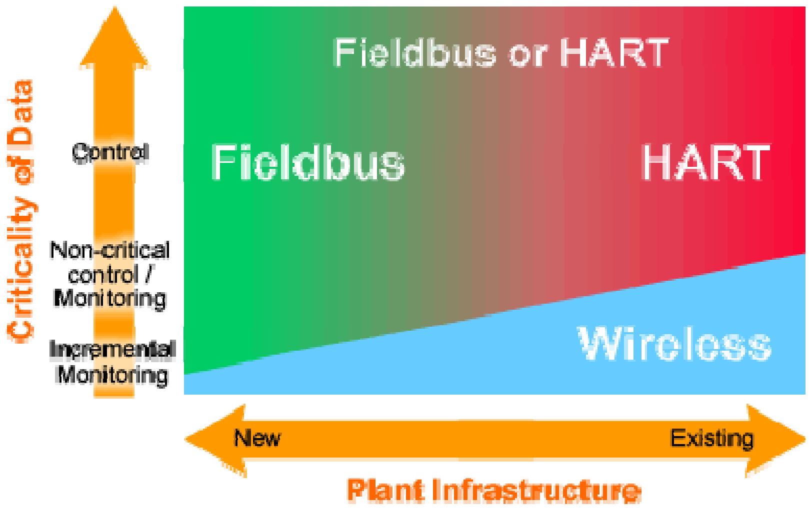
Next: **Where should I use wireless?**

Where should I use wireless?

You'll get great value from wireless technology by using it to monitor measurements that were previously out of economic and physical reach — for example, where the cost of installing physical cabling outweighed the benefits.

These applications typically require update rates from once per minute to several times per day. The data they provide is typically more important to business optimization than to critical safety applications or basic production, and is just as often integrated with data historians or asset management software as with control systems.

As the following graphic shows, wireless technology is particularly cost-effective for incremental monitoring in existing facilities, where adding new wiring runs can be a complex, expensive task. However, it may also provide a way to cost-effectively automate non-critical control loops in these facilities, especially those that don't require fast update rates.



Wireless technology works well for incremental monitoring applications and for non-critical control applications.

If your wireless technology supplier allows control for all applications, confirm that the devices don't need line power and that battery life is measured in years rather than months. Otherwise, costs for providing power or frequently replacing batteries can erode the initial wiring and installation savings that wireless technology offers.

As suppliers continue to improve power efficiency and management in wireless devices, the ability to increase measurement and transmission rates will make more non-safety and critical applications feasible with self-organizing networks.

Until then, your operation probably offers hundreds or even thousands of opportunities to add measurement points for improved process and business performance.

Practical pointer

Because monitoring applications offer the greatest economic benefit from wireless technology, it makes sense to choose a wireless architecture that minimizes the cost and maximizes the benefits of such applications. Look for technology that

- Supports a truly wireless architecture, with no unnecessary cabling or other infrastructure for power *or* communications.
- Does not require costly site surveys to ensure reliable communications.
- Uses standard industrial sensors for easier installation and process connections, robust data collection, and lower training requirements.

Emerson's in-depth research and testing – as well as extensive user experience – have shown that self-organizing wireless networks can provide an ideal balance of capabilities: robust enough for control, and cost-effective enough for monitoring.

Next: **Summary**

Summary

There are unique considerations for doing wireless control. Before you apply it to your most difficult process control problem, it's a good idea to first gain experience on monitoring and non-critical control applications such as open-loop control and latency-tolerant non-critical control.

However, control capabilities are only one consideration in choosing a wireless architecture. Because wireless offers great value in monitoring applications, it pays to choose a wireless architecture that can be optimized for deployment in either a control or monitoring scenario. Most in-plant wireless solutions utilizing self-organizing networks are robust enough for control while maintaining a cost-effective architecture that's optimized for monitoring. A good flexible network design will allow you to meet all your application needs cost-effectively.