NATIONAL INSTRUMENTS

Wireless Technology Considerations

A Shopper's Guide

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16 CONSIDERATIONS WHEN RESEARCHING WIRELESS TECHNOLOGY FOR PDM

WHERE TO START

Before you even look at hardware, write down your goals.

Remember, "culture eats strategy for breakfast," so know how your company works. Change management is hard.

Get IT involved early.

Ask, "Why does it matter?" as you look through datasheet features.

HARDWARE DESIGN FEATURES

Does it connect to standard wired sensors, or does it have a sensor built in?

Can you get a time stamp for your wireless data?

Are there battery options for power, and can you replace or recharge them?

How long will the battery last?

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THINK ABOUT YOUR PLANT

What environment will the sensor be in?

Do you need information on the spot—for example, from a tablet—or visual status from an LED?

Work with your vendor to get a site survey to see how the radios work in your plant. This also covers any range questions.

GETTING THE DATA

Does the sensor return simple calculated values or high-frequency waveforms?

Do you host it, or does the vendor host it, and is it on premises or in the cloud?

FOLLOW THE DATA

What measurements are needed to do the job?

Where do you want to use the data? Who is using the data and what tools are they using?

How much flexibility do you need for the future? Can IT work with your selected vendor to make it fit your needs?

Introduction

NI has more than 40 years of experience in test and measurement, and over those years has released multiple products that either use, or are designed to test, wireless standards and protocols.

This guide is vendor neutral—not specific to NI products—and hopefully helps you answer, or ask, some relevant questions as you research wireless devices for asset health maintenance in smart plants and factories.

Let's start this guide with three important recommendations:

1. Document your goals. It can be tempting to dive in and compare datasheets and research under-the-hood technology, but in the end, your goals should drive the business. Refer to them when the technology conversation gets confusing and the right answer isn't apparent.
2. Consider your corporate culture. Think about how you operate and how your business adapts to new approaches. Change management is tough, but, on the other hand, you can't (and shouldn't) avoid change at all cost.
3. Get IT involved early. The better the handshake between the engineering asset owners and the IT asset owners, the faster the roll out and time to value.

The list below identifies many of the features you will encounter—and some that you won't—as you research how wireless technologies can improve plant operations.

Hardware Design Considerations

There are two main architectures:

1. **Tethered Device or Wired Sensor Gateway**—This approach uses a wired sensor for device input and a wireless signal to the selected IT/plant network for output. A sample use case might involve higher-frequency measurements for earlier fault detection, because piezoelectric accelerometers can have a higher FMAX than the new microelectricalmechanical system (MEMS) accelerometers (although MEMS are rapidly increasing in FMAX capability). Another common use includes connecting to already-installed junction boxes or panels for routes.
2. **Integrated Node**—Here, a hardware device integrates a sensor, radio, and (usually) a battery in the same unit. Integrating the sensor eliminates another cable, and these devices are typically the easiest to install. MEMS—often triaxial—accelerometers are more common for this approach, though some integrated nodes use a piezoelectric sensor onboard. Do you need piezo or MEMS? Recommendation: Look back at your goals and ask why it matters.

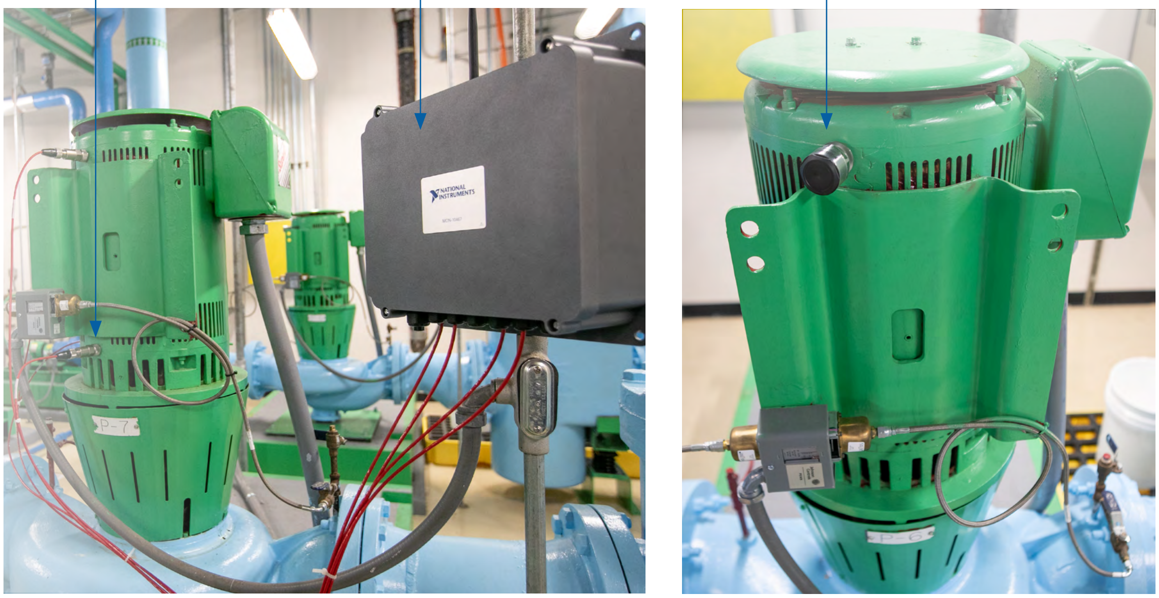

Figure 1. Wireless devices can connect to existing, wired sensors (left) or have integrated sensor technology (right).

Battery Life

Battery life varies dramatically, based on several factors:

- Ambient temperature
- RF environment (noisy environments may require extra power/chatter to get through)
- Data-transfer settings (big waveforms, little waveforms, or just calculations)
- Battery chemistry and size
- LED usage

Vendors can have difficulty accurately predicting multiple end-user environments and communicating expected battery life. Consumers can have trouble determining how the vendor establishes battery life specifications. Recommendation: Talk to your vendor about benchmarks or simulations and see how close they are to your real-world needs.

What about ease of replacement? Not all sensors have replaceable batteries. Recommendation: What is your plan for replacing batteries? Who will do it? Who orders the batteries, and how easy is that process?

Sensor Support

Accelerometers are one of the most popular sensors in the machine-analysis industry, but other measurements can be helpful—or necessary—for proper diagnosis. Common additional sensors include tachometers for a speed reference, potential transformers and current transformers for power measurements, RTD/DC for oil or surface temperature, event/pulse counters, and standard 4...20 mA or ±10/30 V measurements. Some tethered devices support multiple sensor types, whereas some are purpose-built, with different hardware nodes for each measurement.

Time Stamp

Having a time stamp at the point of data acquisition can help you correlate machine health with other plant activity (think SCADA/DCS/historian data). This is also a way to get a speed reference without needing a hard-wired tachometer.

On-Site Data Access

The main point of connecting asset data to enterprise/plant networks is to reduce the number of personnel walking around the plant monitoring data. That said, there are situations in which a plant employee NEEDS data on site. In that situation, some wireless sensors support ad hoc connections to cell phones or tablets, and others have green/yellow/red LEDs to provide visual status. You also can send data to the cloud and back down to the plant employee's cell phone. What is the need and what really matters?

Figure 2. An engineer installs a wireless device and accelerometers to monitor three cooling towers.

AC/DC Line-Powered Options

For applications that need more power (higher data rates, more waveforms per day), or have easy access to line power, an externally powered option eliminates the need to replace batteries.

Data Output

1. Calculated Features/Overalls—Sending an array of vibration data back (RMS, Pk-Pk) helps maintenance teams understand where the problems are, and typically uses less power. In theory, this would increase battery life. Workflows built around these devices typically use them to reduce routes down to the ones that are alarming. Once the sensor alarms on an overall measurement, a higher-quality portable instrument performs failure-mode diagnosis.

2. Waveforms—Waveforms are larger data payloads for wireless networks and larger drains on batteries, but the information contained in them helps machine analysts diagnose problems from their laptops anywhere with network access.

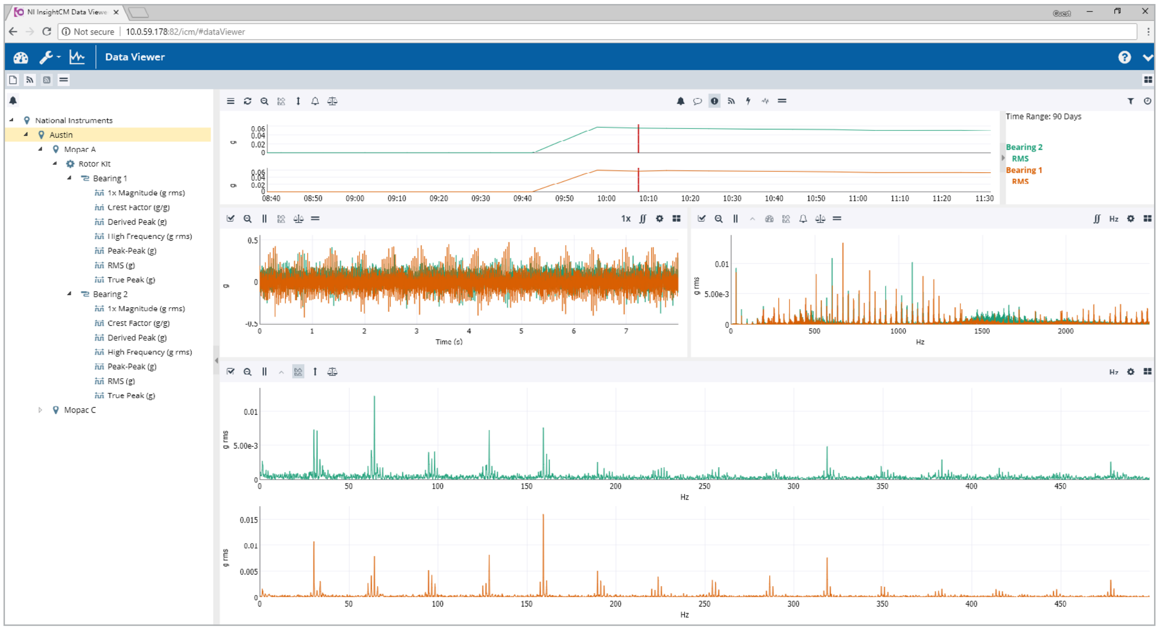

Figure 3. Maintenance teams can use waveform data to analyze machine failure (middle and bottom rows above), whereas trending data (top row) helps detects problems that need further investigation.

Protocols and Standards

Protocols and standards are an important and sometimes contentious part of the wireless technology process.

The options and their benefits are as unique as the organizations deploying them: ISA100, WiFi, Bluetooth, ZigBee—does this matter? You may want to evaluate the options below individually rather than trying to evaluate standards.

- Range: How many gateways do you need, and how expensive is installation?
- System capacity and bandwidth: How many nodes need to communicate in your plant at any given time?
- How secure is the data at different points in the network?
- Battery life: How much does the radio drain the battery?

Recommendation: It doesn't matter until it does, and IT/compliance will know when it does. Work with your vendor on a site survey and discuss system capacity/plant coverage. Additionally, many standards and protocols can be converted using Internet of Things gateways. Your IT department can probably help here.

Environmental

Understanding the operational environment is important when selecting not just wireless, but any equipment. Considerations include:

- Material design regarding whetted surface area for chemical, corrosion, or food-safe applications
- IP rating for water and dust protection, identified by "IP" followed by two numbers representing solid-particle protection on a 0-6 scale and liquid ingress protection on a 0-9 scale

IP6X: Dust ingress test (under vacuum)–8hr with no incursion

Who Owns, Controls, and Has Access to the Data

Software is every bit as important as (sometimes more important than) the hardware, so it's good to have answers to the following questions:

- Should the software live on premises or in the cloud?
- Who manages the application layer (in-house versus vendor)?
- What is the software support and service model?
- Who has access to and ownership of the data (doesn't have to be the same)?

These considerations rely heavily on your initial goals, how you operate, and IT involvement.

Compatibility

Understanding where tools need to connect is critical. Ask questions such as:

- What other (nonwireless) hardware needs to be part of this total solution?
- Is a multivendor solution ok?
- Does it require compatibility and access between plants?
- What software do you already use (part of how your company operates) that needs to work with the new solution?

Recommendation: Understand what you want to do with the data. Who is consuming it and what other data do they need to get the job done? These questions drive system compatibility. IT can help bridge multiple systems (good thing you got them involved early).

Conclusion

There are a lot of considerations when it comes to wireless technology for asset health monitoring data in plants and factories. Partnering with an experienced vendor to serve as a trusted advisor can help you decide what's important, and what's less relevant. Keep in mind the three key recommendations and you're off to a good start:

- Document your goals up-front
- Consider your corporate culture
- Get IT involved early