BRIDGING THE GAP WITH IIoT

How Wireless Sensor Monitoring Can Improve Safety and Assurance in the Aerospace Industry

OMEGA

CHALLENGES CONTINUE TO RISE

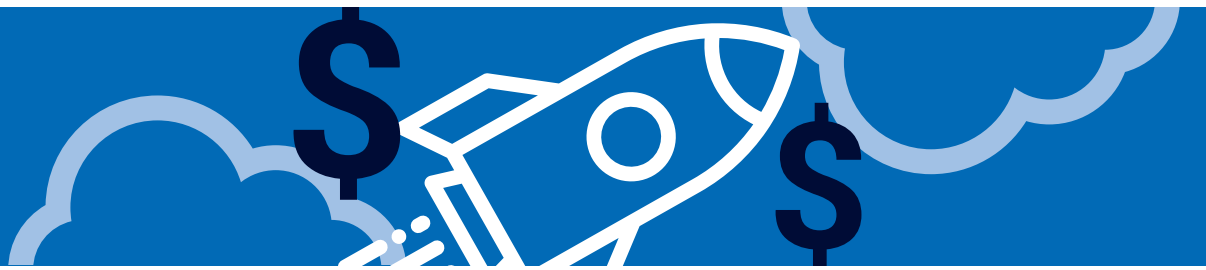
Over the past decade, the aerospace industry has undergone a tectonic shift. Changes in market power and pricing dynamics are already underway due to the expansion of the commercial aerospace industry. At the same time, advances in technology, digitalization, globalization, and heightened cyber security threats are creating a different set of pressures that are pushing legacy aerospace companies to innovate even further to keep up with nimble competitors. To maintain a strong position in the market, aerospace companies must deliver novel products at lower costs and more efficiently.

Yet, in a market where products need to meet the highest performance and safety standards, staying ahead of the competition through cost reductions and improved efficiency is no easy matter. According to a recent industry survey by the Aerospace Industry Association (AIA), "pricing pressures in commercial markets" was the top challenge for a third year in a row.[1]

Addressing these challenges will require a multi-pronged approach, including shifting from reactive to proactive tactics to address manufacturing, inventory, shipping, and other processes within the industry. Companies that harness the Industrial Internet of Things (IIoT) with intelligent wireless networks and wireless sensors can gain an immense amount of data intelligence. If used wisely, sensing data intelligence can not only proactively inform and improve manufacturing products and processes, but also lead the way for greater innovation and efficiency, while enhancing the safety and assurance of the manufacturing processes and the products produced.

For aerospace businesses ready to tap into the power of the IIoT and wireless sensors, this eBook provides an overview of the technology, current and future applications, and critical infrastructure, security, and implementation considerations.

Pricing pressures are the
#1 challenge for the Aerospace
Industry for the **3rd year in a row.**



THE NEW FRONTIER OF IIoT TECHNOLOGY

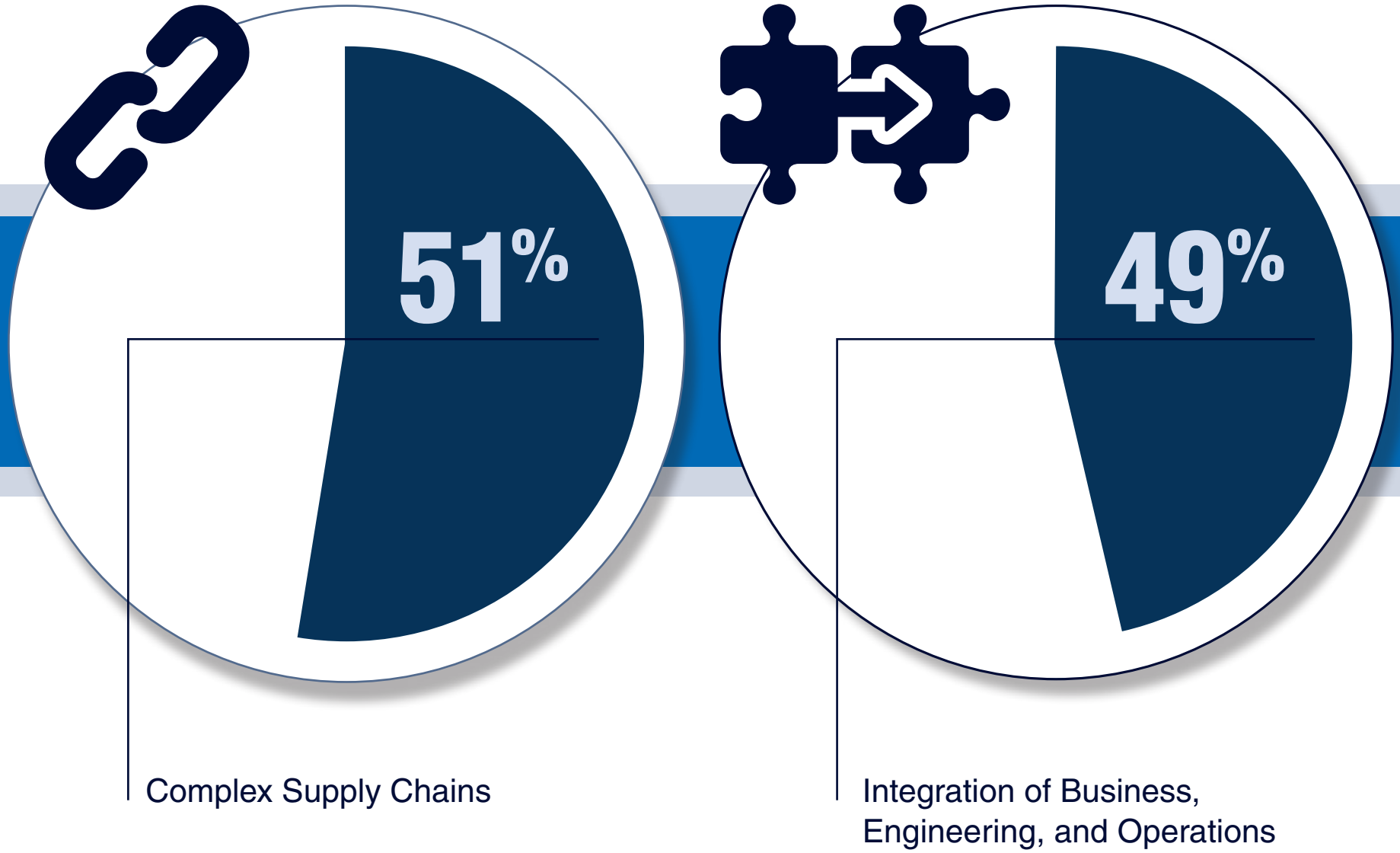
The Internet of Things (IoT) is transforming almost every industry by allowing businesses to collect and exchange data through a network of physical object or "things" embedded with electronics. For industrial manufacturers, including the aerospace industry, the IIoT allows manufacturers to use sensors to generate data about activities, events, and processes. In turn, enhancing visibility into the performance of these "things" to support proactive decision-making throughout the manufacturing and product lifecycle.

While IoT is still in the early stages of adoption, Gartner predicts that more than half of major new business processes and systems will incorporate some element of IoT by 2020.[2] This will likely hold true not only across all businesses, but particularly for industrial manufacturers like the aerospace industry. In fact, the investment in the IIoT is expected to be northward of $60 trillion during the next 15 years, according to General Electric.[3] For the aerospace industry in particular, the key trends propelling IIoT initiatives include the need to collaborate with increasingly complex supply chains (51 percent) and the integration of business, engineering, and operations (49 percent).[4]

By improving data capture and demand planning through IIoT initiatives, aerospace manufacturers can drive operational process improvements and cost savings across a number of areas including equipment maintenance, inventory forecasting, asset tracking, and more. However, concerns over scalability, infrastructure requirements, security, and costs are holding some aerospace companies back from capitalizing on IIoT's advantages. Wireless sensor networks address many of these concerns, providing more opportunity for aerospace companies to tap into the IIoT.

> "The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so."
>
> – Kevin Ashton

TOP TRENDS DRIVING IIoT ADOPTION IN THE AEROSPACE INDUSTRY

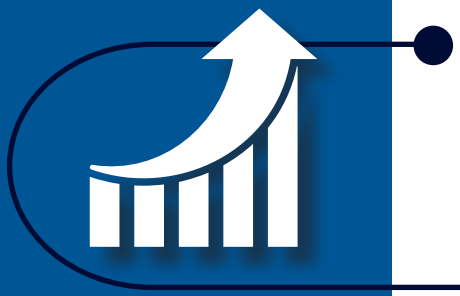


WIRED OR WIRELESS IIoT?

Any IIoT initiative requires connectivity to a network in order to communicate data. While traditionally organizations have tended to use wired networks to distribute information because it offers more control and security, wired networks also tend to be harder to maintain and more costly than wireless networks. Additionally, with the introduction of low-power processors and sensors, intelligent wireless networks offer many advantages and limited drawbacks compared with a wired network.

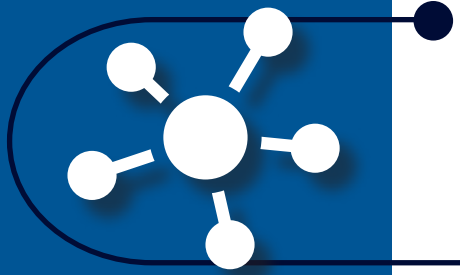
Wired networks have their place, but for businesses who want to be able to quickly and cost-effectively scale IIoT initiatives, a wireless sensor network (WSN) is the inevitable choice given its numerous benefits over wired. In fact, a 2014 ON World survey done in collaboration with ISA not only found that WSN adoption is accelerating in industrial environments, but that most end users are highly satisfied with their WSN systems.[5] The survey also noted that industrial wireless sensor networking is growing not just in size, but in diversity of applications with the ability to measure temperature, pressure, level, flow, and humidity—the five most common applications as of 2014.[6]

The benefits of using a wireless network and sensors, include:



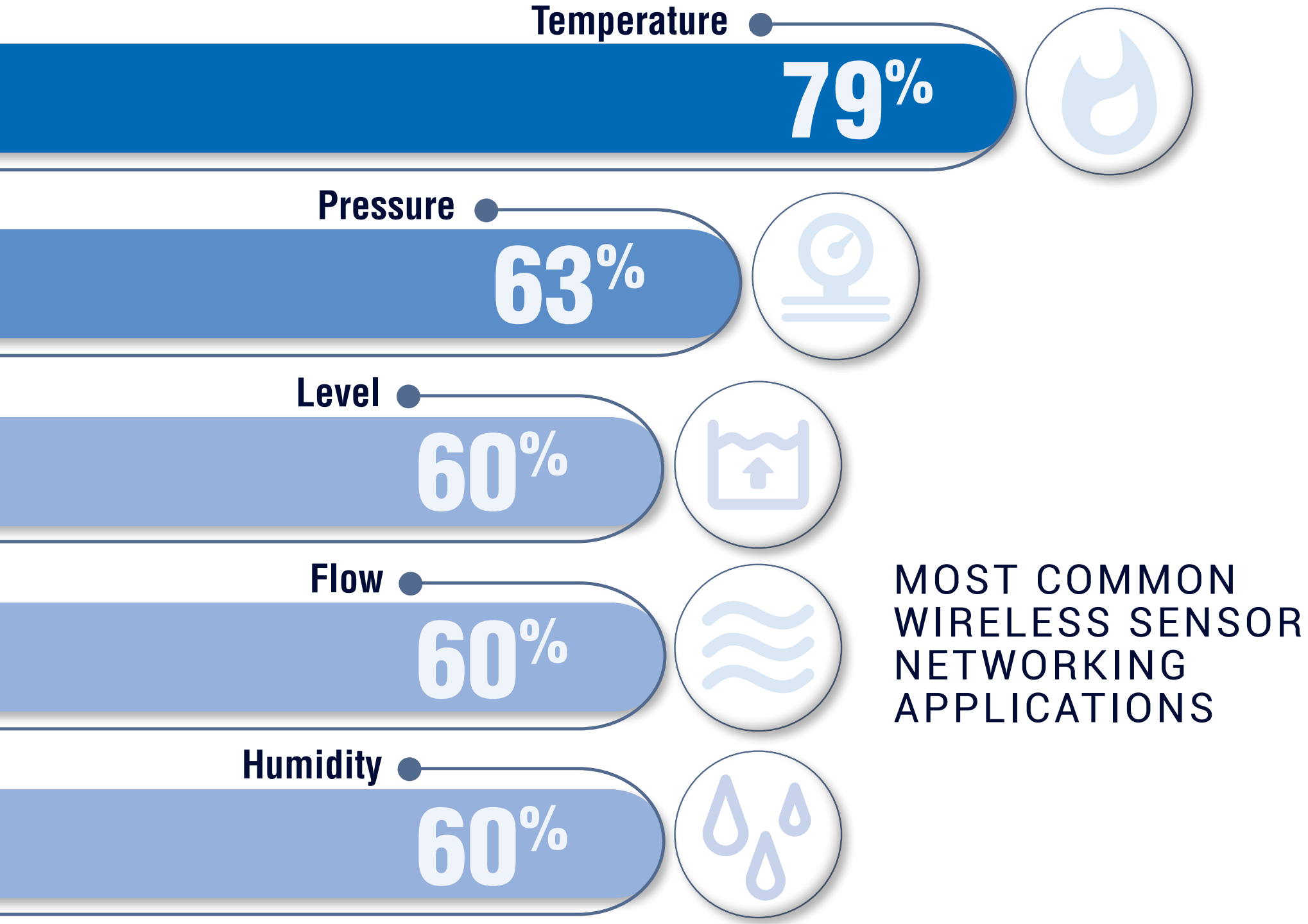
Improved Performance – Wireless sensors with industrial processes and systems provide greater performance by allowing easily deployed redundancy and capabilities for anticipatory system maintenance and failure recovery.

Improved Safety – Wireless sensors can be located or easily repositioned in areas that may be problematic for wired systems. Additionally, once a wireless network is in place, deploying additional safety monitoring at remote locations on an as-needed basis is simple.



Improved Connectivity – A wireless network with wireless sensors is easier to establish and connect, especially in existing factories that want to retrofit to take advantage of modern technologies. Wired networks, on the other hand, can be difficult to scale given the need to connect to direct power sources and the complexity of laying cable in a manufacturing environment already laden with equipment.

Improved Maintenance – A wired network has the potential to break and power sources may be difficult to locate to conduct routine or emergency maintenance. A wireless environment eliminates the use of costly and difficult to maintain cables and allows self-powered sensors to communicate data without a local power source.



MOST COMMON WIRELESS SENSOR NETWORKING APPLICATIONS

Source: ISA

WIRELESS SENSORS DRIVE GREATER SAFETY AND INNOVATION

The ability to measure and collect data is at the heart of any discovery, including improving industrial processes and productivity. Sensors provide the means to measure any number of things and are the lifeblood of the IIoT.

In an industrial setting, sensors are key to ensuring safety, quality, and efficiency and are heavily relied upon to determine the appropriate temperature, pressure, moisture, and flow of aerospace products or manufacturing processes. Even as traditional sensors continue to evolve, becoming more sophisticated, smaller, and more embedded, they remain limited in functionality, requiring manual collection of data when no network connection is present.

In an IIoT environment, sensors must be able to collect data, connect to the network, and often be self-powered if no local power source is available. Wireless sensors can communicate data in places that traditional sensors cannot, particularly those that lack access to power or to a wired network. Given how easy it is to deploy wireless sensors, they can and should replace sensors where manual data collection efforts are currently required. Doing so will allow more frequent collection of data and improve the safety of the data collection process by eliminating the need for human intervention.

> "Nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient, long-continued labour in the minute sifting of numerical results."
>
> – Lord Kelvin

5 WAYS WIRELESS IIoT SENSORS ADD VALUE

1

Improved Manufacturing Processes

Intelligent sensors can use analytics and networks to adapt to changing environmental circumstances. For instance, IIoT sensors deployed in the manufacturing process can relay data to help determine how hot or cold a product needs to be when coming off the manufacturing line in order to avoid developing too much moisture, which could lead to mold during packing of the product. This way, instead of always heating all products to a specific temperature, such as 70 degrees, smart sensors (which can take input from its physical environment and perform predefined functions based on those inputs) can determine humidity levels for each product. This allows the manufacturer to heat the product only to the point that humidity levels would not create added moisture, rather than to a defined temperature. Thus, modifying the manufacturing process to improve both yield and energy use.

2

Enhanced Safety

Embedded sensors connected to an intelligent network can detect variations in operating patterns and communicate this information via the network to maintenance, rather than waiting for maintenance to manually check a specific sensor to see the how the equipment is performing. For example, when a sensor detects that a component is vibrating at an unusually high level, the system can instantly alert maintenance to the component's malfunction. In this scenario, the IIoT sensors proactively identify an issue that if left unattended could cause catastrophic results, if the higher generation of vibrations damaged other components and caused the potential failure of the entire system.

Reliable Inventory Forecasting

From providing advance warning on shipping errors, to monitoring inventory levels, to analyzing data patterns, IIoT data from wireless sensors can provide critical information. Through this data intelligence, companies can gain insights into when demand will increase or decrease, enabling better decision-making on materials and production levels, such as uncovering data patterns around seasonal demands for certain types of components.

Reduced Risks

Many high-value stored assets require continual monitoring to ensure there is accurate traceability of environmental conditions during storage. Prior to using WSNs, monitoring these assets was often risky because of the manual effort involved. There was considerable potential to damage the asset in the process of monitoring because of the intrusive nature of having to touch the equipment to get readings. In addition, the process was labor intensive and frequently fraught with human error when capturing the data. With an IIoT wireless sensor, continuous monitoring of high-value assets is possible without human intervention. Data can be sent across the WSN as frequently as requested and uploaded to the cloud without any manual involvement. The automation of this task through a WSN significantly reduces the risk of harming the asset through physical tracking, saves resources, and provides more accurate traceability of the asset's current condition.

Lower Costs

Smart sensors can communicate on the WSN with cloud-based analytic systems to assess the working condition and service requirements of equipment in advance, saving costs in the long run. Routine scheduled maintenance cycles for replacement of parts, for instance, can be delayed as long as the equipment continues to function at optimal levels, resulting in higher uptime of equipment and significant savings in maintenance costs.

OVERCOMING BARRIERS TO WIRELESS IIoT

Despite the benefits wireless networks and sensors offer, there remain some concerns in the aerospace industry around the use of a wireless network to communicate sensitive data. In ON World's global survey of industrial wireless sensor network users, reliability and security were the two most important concerns cited when considering a wireless network.[7]

Here's a look at these concerns and how they can best be addressed in a wireless sensor network.

Security

Security is a chief concern in any environment, wired or wireless, but given that wireless networks don't require the same physical presence for access as a wired network, there is heightened concern about the security of data on a wireless network. Fortunately, wireless technology continues to advance, including wireless security technology.

To protect a wireless network from cyber criminals or hacking, organizations must incorporate end-to-end security into the wireless network. This includes ensuring strong encryption with robust keys and key management (cryptographic-quality random number generators to deter replay attacks), message integrity checks (MICs) in each message, and access to specific devices. These security protocols are standard on many WSN devices, but not all protocols can be found on all devices, so it's important to determine what security is available on the devices you choose to purchase.[8]

Reliability

Interference and range issues can reduce the reliability of a wireless network. However, by building redundancy into the WSN, reliability can be greatly improved and even surpass that of a wired network. A properly formed mesh network can provide high levels of reliability by allowing every node to communicate with two or more adjacent nodes. Additionally, redundancy can be achieved by using multiple channels available in the RF spectrum to avert temporary issues with any given channel.

PUTTING IT ALL TOGETHER

As aerospace companies continue to look for ways to be more flexible, agile, and competitive, tapping into the power of the IIoT will continue to increase in importance and is likely to be a defining factor of those in the industry that continue to succeed and those that decline against more nimble competitors.

Launching an IIoT initiative on a wireless sensor network requires four specific capabilities :

1 Appropriate Wireless Sensor

Determine what it is that needs monitoring. Will you be measuring the temperature, moisture, pressure, or flow? Make sure the sensor you select has the capability measure within the range needed. Size of the sensor, connection mechanism, and how it's powered are also important considerations. If there isn't a standard product to meet your specifications, consider customization or in-house modifications. For locations without local power ensure that the sensor is self-powered or low-powered with long-lasting batteries. All sensors should be able to broadcast their signal in order to connect to a wireless network.

2 Wireless Network

If there is already a wireless network on the premise, determine if it has the appropriate infrastructure and security protocols in place or if additional end-points and security measures are necessary. Determine how data will be moved across the network. For instance, will it go directly to the cloud and then to local connections or will it go to local end points first and then into the cloud? Whatever method of data transfer you deploy, make sure that the data can move securely from each gateway with end-to-end security, a key component of the design.

3 Connectivity

The ability of the sensor to connect to the network and communication sources is the essence of IIoT. With technology advances, seamless plug-and-play connectivity should be the norm. The critical component is to ensure that the sensors have the capability to connect wirelessly.

4 Data Analytic Capabilities

The value of the IIoT is not only the collection of data from a network, but the intelligence the data provides for proactive decision-making. In addition to having the infrastructure to collect data, organizations must have the capabilities to analyze the data in real-time and in ways that make it usable to end users. User-friendly dashboards and real-time reporting capabilities will make this easier.

Finding a partner who understands sensor technology, wireless networks, and how to connect the systems together can streamline the implementation process and ensure a system with high functionality. In the instance of needing to connect legacy products to the sensors or the network, a knowledgeable consultant can help map out overall system architectures and help simplify integration.

CONCLUSION

Not too long ago, purchasing one satellite was a big investment for a company. Today, businesses are ordering the manufacturing of not one, but thousands of satellites as well as other aerospace products. Given the scale of production required to meet commercial demands for aerospace products and services, IIoT is a key requirement for continued innovation within the aerospace industry. IIoT not only allows the aerospace industry to become more dynamic and agile at investing at all levels to promote change, but enables manufacturers to meet heightened market demands for better and safer products.

[Endnotes]

1 “2015 A&D Market Survey,” Aerospace Industries Association, 2015, https://assets1.csc.com/aerospace_defense/downloads/2015_A_D_Survey_Report_CSC_and_AIA.pdf

2 “Gartner Says by 2020, More Than Half of Major New Business Processes and Systems Will Incorporate Some Element of the Internet of Things,” Gartner, Jan. 14, 2016, http://www.gartner.com/newsroom/id/3185623

3 “GE Announces Predix Cloud – The World’s First Cloud Service Built for Industrial Data and Analytics,” General Electric, August 5, 2015, https://www.ge.com/digital/press-releases/ge-announces-predix-cloud-worlds-first-cloud-service-built-industrial-data-analytics

4 “Manufacturing Metrics in an IoT World,” MESA International and LNS Research, 2016, http://cdn2.hubspot.net/hubfs/136847/LNS_ManufacturingMetrics2016.pdf

5 Hatler, Mareca, “Industrial Wireless Sensor Networks: Trends and Developments,” ISA, March-April 2015, https://www.isa.org/intech/201504web/

6 Ibid.

7 Ibid.

8 Weiss, Joy and Yu, Ross, “Wireless Sensor Networking for the Industrial IoT,” Electronic Design, Sept. 16, 2015, http://electronicdesign.com/iot/wireless-sensor-networking-industrial-iot

For over fifty years OMEGA Engineering has been a pioneer in the design, manufacture, and distribution of sensors and instrumentation for process measurement and control. Today we offer 100,000 products for temperature, humidity, pressure, strain, force, flow, level, pH, conductivity, data acquisition, and electric heating. Customers choose OMEGA for our product quality, exceptional customer service, and easy on-line ordering via 24 country-specific websites. Our technical support engineers have the knowledge to ensure customers find the right solution for their needs—whether off-the-shelf, configured, or custom designed.

For more information, please visit
omega.com/aerospace

US and Canada
1-888-826-6342

International
1-203-359-1660

omega.com

OMEGA®