

WHITE PAPER

INDUSTRIAL IOT DEVICES

Digital Transformation in Manufacturing, Oil and Gas, Utilities, Transportation, Mining, and Agriculture

Rugged, Customizable Industrial IoT Devices Assist in Complex Connectivity Situations in Harsh Environments



INTRODUCTION

This white paper provides a brief overview of Industrial IoT devices and solutions. It explores various Industrial IoT technologies and their impact on industrial markets. It is intended to help Original Equipment Manufacturers (OEMs) and end customers understand the infrastructure available for implementing Industrial IoT solutions and how they can help tackle different challenges across industries such as manufacturing, oil and gas, utilities, transportation, mining, and agriculture. Through this data, companies can focus on improving automation, flexible production techniques, and predictive maintenance, which will help bolster productivity and revenue. It will help industrial and manufacturing customers and partners evaluate Industrial IoT solutions according to purpose. This white paper highlights key features of Industrial IoT technology: cost reduction, optimum use of resources, secure infrastructure, improved efficiency, increased uptime, and more. It also explores the capabilities of Industrial IoT solutions, including device connectivity and management, edge computing, cloud and data infrastructure, and analytics.

This white paper will help OEMs understand how Industrial IoT solutions that can help their customers automate data capture from any number of connected machines or edge devices. Industrial IoT helps generate cooperative communications and interaction from the manufacturing field. Rapid maintenance, technology, operating conditions, environmental regulations, and innovation-triggered changes in the underlying infrastructure, make it hard for OEMs to keep adapting their products to the evolving infrastructure, leading to sub-optimal customer engagement. The goal is to deliver customer value by using Industry 4.0 technologies to help their operations become smarter. Smart manufacturing solutions are growing at a compound annual growth rate of more than 30 percent and are slated to reach hundreds of billions of U.S. dollars. The Industrial IoT market itself is predicted to reach \$110 billion by 2025. OEMs can implement Industrial IoT effectively by blending the use of off-the-shelf products with optimized devices to make the integration between new and existing infrastructure easier.

Industrial IoT is a network of interconnected computing devices embedded in physical objects for the purpose of gathering and exchanging data. The data gathered from these interconnected devices can be used in a variety of ways, such as to provide real-time visibility of shipments, predict impending breakdowns of industrial machinery, increase the productivity of the manufacturing workforce, reduce the cost of quality management systems, increase machine utilization, optimize supply chains, and more. Industrial IoT access points and radio modules provide communication between computing devices and cloud servers to gain insight into systems and processes to enhance and optimize work. The goals are to reduce human errors and manual labor, increase overall efficiency, and reduce production costs.

INDUSTRIAL IOT (IIOT) DEVICES

Industrial IoT devices can be categorized into access points, radio modules, antennas, and wireless communication sensors.

High-performance, rugged Industrial IoT devices help customers deliver next generation products by allowing them to run application-specific firmware, particularly at the evaluation phase.

Access Points: Industrial IoT access points are designed to provide reliable WiFi connectivity wherever it's required. With their highly scalable WiFi coverage, these access points deliver enterprise-grade connectivity to devices, even in the harshest environments. Industries such as manufacturing, utilities, transportation and agriculture that operate in high-temperature environments require strong, reliable, small, lightweight devices. Industrial IoT access points ensure high throughput over a wide temperature range. These industrial-grade solutions offer a wider operating temperature range and more rugged enclosure than commercial-grade access points.

Radio Modules: Radio modules are most often used for applications such as edge computing platforms, autonomous vehicles, and robotic cells. In such scenarios, rugged and high-power radio modules are purpose-built to support industrial applications. They have a small form factor, which makes them ideal for integration into various devices.

Antennas: Purpose-built antennas designed for industrial applications are the most cost-effective solution for use in challenging operating environments with high-temperature ranges across various deployments. Selecting and integrating a suitable antenna has a significant impact on RF-subsystem performance in terms of communication range, overall power consumption, and battery life.

Wireless Communication Sensors: Wireless communication sensors are a flexible and cost-effective solution to improve manufacturing efficiencies. Several sensor types and multiple radio connectivity technology options such as Bluetooth®, cellular, and LPWAN are available. Sensors must be able to measure various environmental and physical conditions depending on deployments.

> High-performance rugged IIoT platforms help customers deliver next generation products by allowing them to run application-specific firmware.

CUSTOMER PREFERENCES FOR INDUSTRIAL IOT DEVICES (BY USE CASE)

IIoT for Manufacturing: Condition Monitoring of Critical Assets

The manufacturing segment accounts for about 50 percent of the total Industrial IoT market in the U.S. The main adoption drivers for Industrial IoT solutions in manufacturing include cost reduction, shorter time to market, and mass customization. Several manufacturing plants are leveraging the potential of Industrial IoT solutions for condition-based monitoring, asset tracking, and dynamic routing and scheduling. For instance, aerospace manufacturers are deploying Industrial IoT devices to improve operational efficiencies and overcome manufacturing delays.

Use Case: Predictive maintenance and condition monitoring play important roles manufacturing. For instance, in automotive, chemical, semiconductor, and aerospace applications, mineral deposits can cause heat exchanger conduits to clog. These complete blockages can cause serious problems that lead to manufacturing errors and hours of downtime. To overcome these challenges, Industrial IoT devices such as access points and radio modules play a major role. Threshold values can be defined by measuring and gathering the temperature differentials upstream and downstream of the heat exchanger in order to establish an alert system that notifies employees when the first signs of clogging occur.

> Industrial applications in manufacturing require compact, easy-to-deploy, Industrial IoT access points that can operate under harsh conditions and a wide temperature range.

Reliable infrastructure communication is key to making sure Industrial IoT devices stay connected. Access points and radio modules must be robust. Access points such as AP-Wi-Fi-1200 by PCTEL are best suited here. They have a rugged design suitable for deployments between -40°C and +65°C. For outdoor use, access points support -40°C to +55°C with full solar loading of 1200W/m² and withstand wind gusts up to 165 mph when properly mounted.

Similarly, radio modules such as RM-Wi-Fi-AC-2x2-HP 802.11ac Wave 2 by PCTEL are rugged and dependable. They have high transmitting output power and support all 802.11ac channel definitions—including 80 MHz, 80+80 MHz, and 160 MHz channels—making them suitable for tracking real-time employee and equipment data to increase work efficiency.



IIoT for Oil & Gas: Drilling Management and Pipeline Monitoring

The large amounts of data that are constantly collected from multiple sources in the oil and gas industry are difficult to standardize and analyze. Adopting Industrial IoT applications can improve the efficiency of capital and operating expenditures while reducing the negative effects of widely spread assets.

Use Case: Pipelines are an integral part of the oil and gas industry that are susceptible to multiple structural failures, such as corrosion, cracks, and leakages. Industrial IoT devices equipped with communication technology such as LPWAN and cellular are widely used to gather granular telemetry data in the field. Industrial IoT devices with LPWAN technology can connect a massive number of geographically dispersed metering points with minimal infrastructure. These smart sensor devices provide critical information pertaining to pipeline operating conditions and structural health.

Wireless communication sensors from PCTEL can detect air quality, temperature, relative humidity, acceleration, angular rate of change, magnetic field, range, and sound. In addition, they offer multiple radio connectivity technology options, including cellular, LoRa, Bluetooth® 5, and NFC, as well as 802.15.4 support. These sensor devices can operate in a range of -40°C to +85°C and are easy to install.

- Smart sensors with LPWAN technology can detect and convey telemetry data on the structural health of pipelines and their operating conditions to improve asset management.



IIoT for Utilities: Smart Metering

The adoption of Industrial IoT for smart metering and other grid applications, based on emerging technologies such as NB-IoT, LoRa, and LTE-M, is on the rise in the utility industry as a whole. In addition, the power industry's demand for smart meters, smart power grids, and smart water management has increased due to the global inclination toward renewable energy.

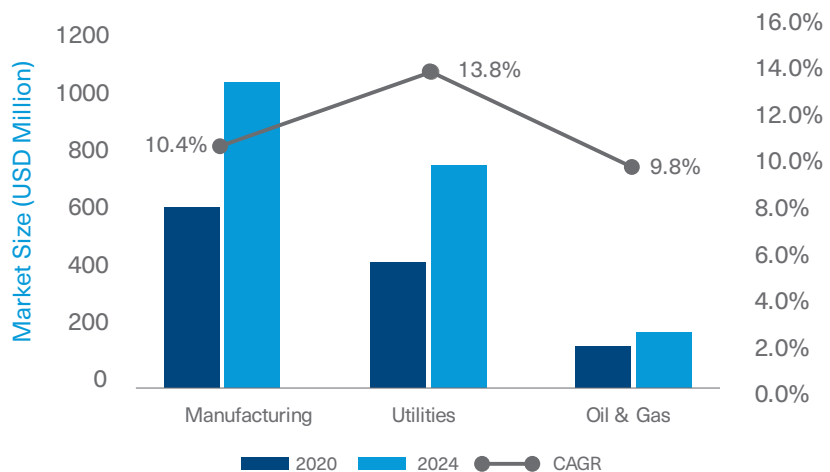
Use Case: Smart meters enable automatic meter reading for consumers and companies. They can monitor electricity consumption in real time and automatically transmit the data to alert electricity companies of power outages. Additionally, smart meters allow utilities and consumers to analyze consumption and gain critical insights.



➤ Purpose-built, rugged Industrial IoT antennas that can withstand high vibration and temperature are widely used in the utility industry to build communication networks between devices.

Industrial IoT antennas are widely used in the utility industry to build communication networks between devices. PCTEL optimizes various types of antennas to fit the environment and requirements of the application. Rugged and designed to withstand high vibration and extreme temperatures, they are also used in process automation, transit systems, asset tracking and monitoring, utility smart grids, and more. These antennas provide reliable wireless connectivity and general-purpose sensing that enables real-time data sharing in the utility sector.

Figure 1: Spend Increase on IIoT Devices in North America



LEGACY DEVICE INTEGRATION DRIVING PREFERENCE FOR CUSTOM-MADE INDUSTRIAL IOT DEVICES

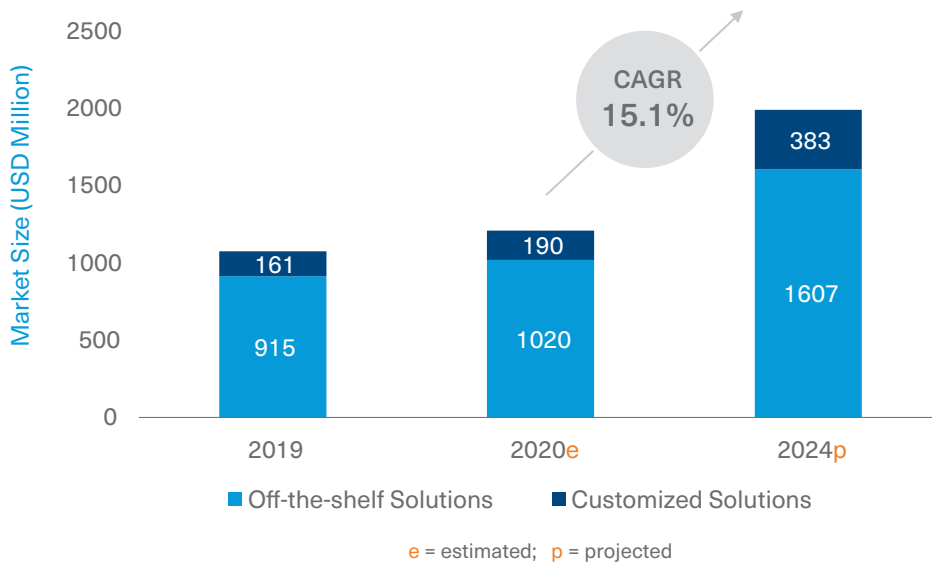
Automation, control system orchestration, and digitization have been in play for decades now, especially the manufacturing, mining, oil and gas, and utility industries. Coupled with merger and acquisition activities, the wave of automation initiatives has created layers of legacy devices that must connect with new devices and networks in order to broaden the reach of Industrial IoT.

The development of customizable interfaces is key to such integration. For example, strict mechanical requirements, multi-band capabilities, low-cost solutions, and maximum performance are some of the multiple factors driving antenna development. Moreover, customers have increased spending on customized Industrial IoT devices as compared to off-the-shelf.



- ▶ Customers have increased spending on optimized Industrial IoT devices as compared to off-the-shelf.

Figure 2: Projected Expansion of the IIoT Solutions Market



CASE STUDY: SUCCESSFUL DEPLOYMENT OF CUSTOM WIRELESS CONNECTIVITY SOLUTIONS

Challenge: A utility company needed an Industrial IoT device that could work at ground or below-grade level where it is difficult to receive RF signals. The antenna needed to be located outside of the equipment with co-located GPS, requiring multiple elements in one enclosure. The company needed a very rugged device capable of withstanding high impact and environmental extremes that could operate both over cellular carrier and mesh networks.

Customer Overview: The customer designs robust grid analytics systems that monitor the distribution grid to identify faults, events, and disruptions. It uses overhead and underground intelligent line sensors to send data to the utility control center over cellular carrier or mesh networks, improving response time to deliver power more dependably.





PCTEL's Solution: PCTEL provided an optimized solution to overcome the RF requirements, size constraints, and electronic restrictions that were placed on the customer's device. A high-performance, purpose-built antenna with a high impact-resistant radome was tailored to the specific application environment to enable reliable connectivity.

> A purpose-built antenna was optimized for below-ground connectivity and harsh environmental conditions, with a co-located GPS to operate over cellular carrier and mesh networks.



RUGGED, ADAPTABLE INDUSTRIAL IOT DEVICES BY PCTEL

PCTEL is a leading global provider of wireless technology, including purpose-built Industrial IoT devices and antenna systems. The company solves complex wireless challenges to help organizations stay connected, transform, and grow by providing Industrial IoT access points, radio modules, wireless communication sensors, and antennas that are built to perform in the most challenging environments. Rugged, adaptable, and reliable, these devices are ideal for multiple applications in industries such as manufacturing, oil and gas, utilities, transportation, mining, and agriculture.

Parameters	Access Points	Radio Modules	Wireless Communication Sensors	Antennas
				
Connectivity Technologies/Bands	<p>TECHNOLOGY:</p> <ul style="list-style-type: none"> WiFi Bluetooth® 5.1 <p>BANDS:</p> <ul style="list-style-type: none"> 2.4 GHz: 20/40 MHz 5 GHz: 20/40/80 MHz 	<p>TECHNOLOGY:</p> <ul style="list-style-type: none"> WiFi <p>BANDS:</p> <ul style="list-style-type: none"> 5 GHz: 20/40/80/80+80/160 MHz Channels (up to 256-QAM) 	<p>TECHNOLOGY:</p> <ul style="list-style-type: none"> Cellular Cat M1/NB-IoT LoRa Bluetooth® 5 NFC 802.15.4 	<p>TECHNOLOGY:</p> <ul style="list-style-type: none"> Cellular 5G NR UHF WiFi <p>BANDS:</p> <ul style="list-style-type: none"> Multiband 5G NR with 802.11ac WiFi capability
Operating Temperature	<ul style="list-style-type: none"> -40°C to +65°C -40°C to +55°C with full sun load 	<ul style="list-style-type: none"> -40°C to +85°C 	<p>WIRELESS SENSOR ENDPOINT</p> <ul style="list-style-type: none"> -20°C to +60°C <p>WIRELESS SENSOR CORE</p> <ul style="list-style-type: none"> -40°C to +85°C (without Time-of-Flight sensor) -20°C to +70°C (with Time-of-Flight sensor) 	<ul style="list-style-type: none"> -40°C to +85°C
Features	<ul style="list-style-type: none"> Small size and light weight; easily mounted on walls or light poles Simple connection and powering Software-ready hardware 	<ul style="list-style-type: none"> Standard small form-factor mini-PCIe card 2 U.FL RF connectors for ease of integration Standard HW interface High transmitting power 	<ul style="list-style-type: none"> Faster time to market leveraging ARM Mbed OS Easy software development using the Wireless Sensor Development System Easy installation of preferred cellular provider SIM card 	<ul style="list-style-type: none"> Designed for multiple co-located radio configurations Detailed platform model for electro-magnetic (EM) simulation

CONCLUSION

Industrial IoT is a key building block of enterprise-wide Industry 4.0 Digital transformation initiatives, particularly for manufacturing, oil and gas, utilities, transportation, mining, and agriculture. While the strategic benefits of Industrial IoT are unquestionable, the implementation is replete with challenges that range from wide-area asset distribution to harsh operating conditions. Industrial IoT devices can help overcome complex operational challenges such as condition monitoring of critical manufacturing assets, oil and gas pipeline monitoring and drilling management, smart metering applications for utilities, and equipment and employee safety and security for transportation, agriculture and mining.

The devices provided by PCTEL are superior to commercial-grade products, which can often experience poor connectivity, especially in the presence of interference caused by metal, machinery, or competing wireless signals. PCTEL offers a wide selection of Industrial IoT devices that are optimized according to various customer segments and needs. These rugged, industrial-grade products meet customer expectations for dependable and efficient wireless solutions. PCTEL purpose-built antennas, radio modules, access points, and wireless communication sensors give system designers and OEMs the robust platforms needed to create Industrial IoT solutions. The company has the expertise, experience, and insight to assist in application-specific development covering all aspects of Industrial IoT, making PCTEL the ideal choice as your Industrial IoT solutions partner.

To connect with us, please visit our website at www.pctel.com

➤ PCTEL is an ideal IIoT partner for industrial automation OEMs, networks, and end-use industries.



MARKETSANDMARKETS™

The research used in this white paper has been commissioned by PCTEL, Inc. (NASDAQ: PCTI), a leading global provider of wireless technology, and underwritten by MarketsandMarkets™ Research Pvt Ltd, the world's largest revenue growth advisory firm. MarketsandMarkets™ provides quantified B2B research on 30,000 high-growth niche opportunities/threats that will impact the revenues of 70 to 80 percent of companies worldwide. Nearly 75,000 top officers across eight industries worldwide approach MarketsandMarkets™ for their pain points around revenue decisions. We have 850 full-time analysts and SMEs who track global high growth markets following the Growth Engagement Model (GEM). Our flagship competitive intelligence and market research platform, Knowledge Store, connects over 200,000 markets and entire value chains for a deeper understanding of unmet insights along with market sizing and niche market forecasts.

Solving Complex Wireless Challenges

PCTEL is a leading global provider of wireless technology, including purpose-built Industrial IoT devices, antenna systems, and test and measurement solutions. Trusted by our customers for over 25 years, we solve complex wireless challenges to help organizations stay connected, transform, and grow.

For more information, please visit our website at
pctel.com/Industrial-iot-devices



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