IoT Wireless I/O Solutions

Providing IoT Wireless Smart Devices with Direct Cloud Accessibility

- Overview
- Application Scenarios
- Key Features
- IoT Developer Kit
- Selection Guide

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An Outgrowth of IoT Wireless Solutions

According to a report about IoT trends, there will be 25 billion devices connected by the end of 2015, and 50 billion by 2020. Devices can be connected with various interfaces, however the most popular is likely to be wireless because of it reduced number of cables and speed of installation. As mobile devices are widely used to access cloud services via Wi-Fi, 3G, LTE, etc., wireless solutions have become one of the most common ways to provide IoT services. Advantech's WISE (Wireless IoT Sensing Embedded) series are designed as sensing devices which use a wireless interface under the IoT framework.

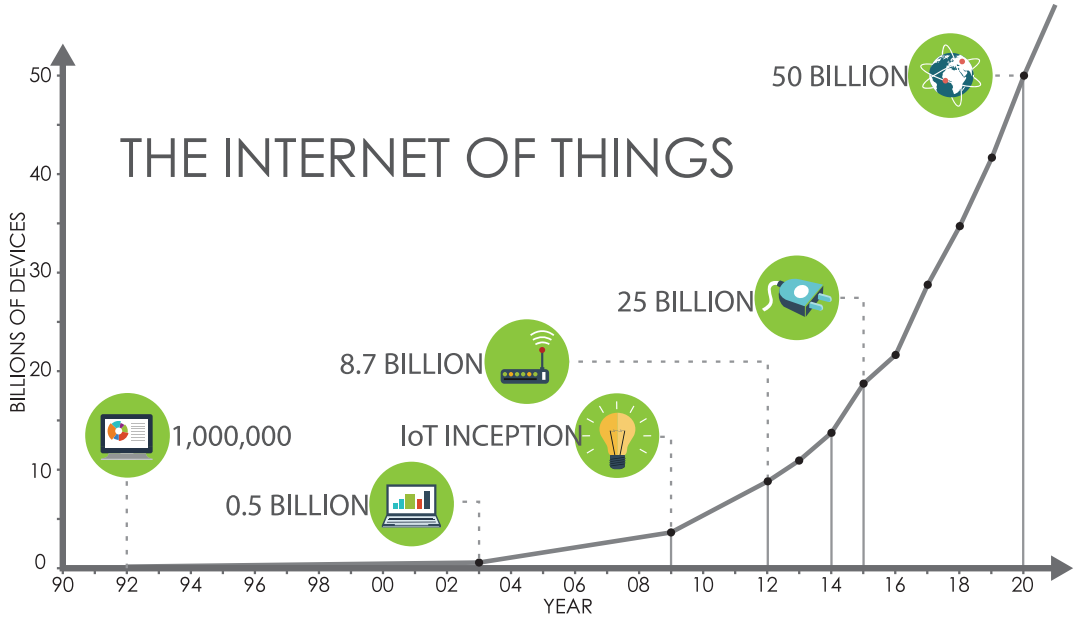
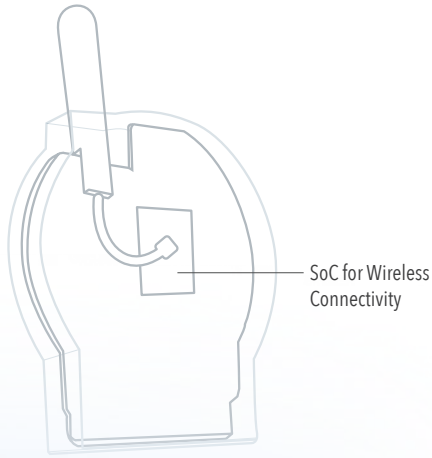


Image Source: The Connectivist

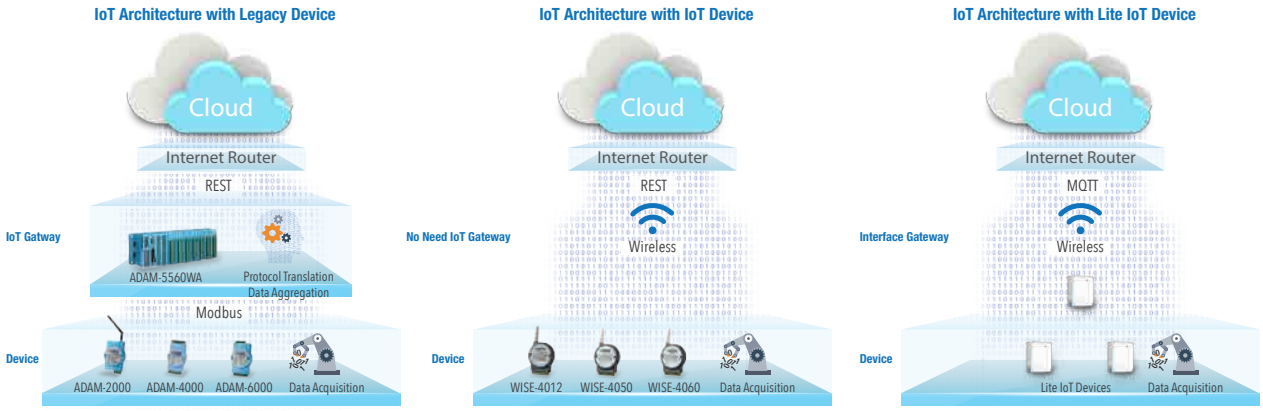
Realizing Wireless Connectivity with Advanced Technology

With the advances in silicon technology, more and more embedded chipsets are able to be implemented in our daily life. System on Chip (SoC) can serve not only as a Micro Control Unit (MCU), it can provide wireless connectivity even on a single SoC. This means the wireless interface can now be easily embedded in all the devices. As well as connectivity, sensors are also developed in silicon. In the past, people used thermometers to measure the temperature of field devices regardless of whether they are inside or outside. With the help of Microelectromechanical System (MEMS) technology, the size of a thermometer can now be reduced to a single silicon chip. Advantech's WISE series will offer more choices with various wireless connectivity solutions and with more kinds of MEMS sensor solutions, for more applications in different vertical domains.



Data Acquisition in IoT

There are three different ways to send the data from device layer to the cloud. For legacy devices, an IoT gateway can be used to perform protocol translation and data aggregation. A gateway then publishes the aggregated data to the cloud. For IoT devices which support Ethernet, it can be directly connected to the cloud to provide further service if there are not many devices in the system, or the devices are widely deployed in different areas. Otherwise, an IoT gateway can be used to manage the data before publishing to the cloud to reduce the connections between cloud and devices, or reducing the network bandwidth.For a sensor network, which we call lite IoT devices, it could possibly support IP addresses, but does not support Ethernet interfaces, and coordinators or interface gateways would be needed to bridge the interface from the sensor to the internet.

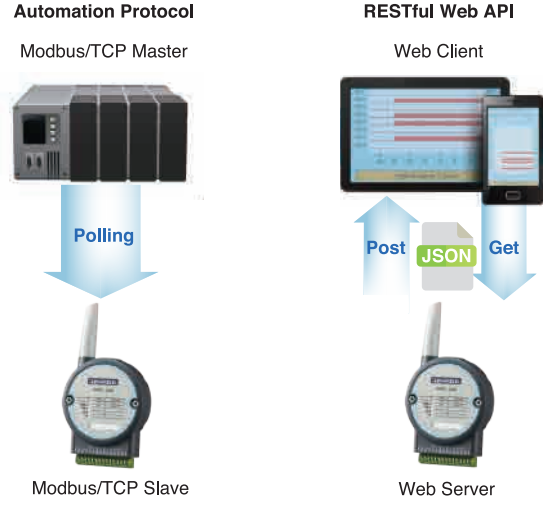


RESTful API

Representational State Transfer (REST) is a software architecture style and widely used for creating scalable web services. With the advantage of scalability, simplicity and performance, it's already adopted in IoT applications. It is based on Hypertext Transfer Protocol (HTTP) and uses verbs, like GET, POST, PUT, DELETE, etc., for web browsers to get web pages or retrieve data with remote servers. The data can be retrieved by internet media like HTML, XML, or JSON. REST is a uniform resource identifier (URI) to identify the data. Like using "http://10.0.0.1/analogin-put/ ch0" to identify the analog input value of channel 0.

Secure Socket

Compared to Modbus/TCP, which is also based on TCP, RESTful API provides higher scales to be used in a wide area network (WAN). Modbus/TCP does not support security, so it can only be used in local area networks (LAN). However, RESTful which uses HTTP for data retrieval, can support HTTPS (HTTP over SSL (Secure Socket Layer)) or TLS (Transport Layer Secure). For developing IoT applications, RESTful API will be a better option for publishing data to the cloud or retrieving data between devices.



Data Acquisition in the IoT Era

Data acquisition plays a key role in era of IoT. Despite being virtually hidden from view, it serves an important role as a key connection between the sensor and the cloud in various applications. Furthermore, when IoT becomes a reality, and when more people master how to excavate big data, a reliable source of data is important. Meanwhile, wireless applications are becoming the most common and preferred network solution since the cost and effort of wiring is eliminated. For the above reasons, data acquisition has been implemented in applications as diverse as traditional factory automation to the scope of smart cities. The use of data acquisition has been shifted from raising production efficiency and cost reduction to total environmental monitoring and control.

Various Applications in the Field

Vibration | Pressure | Flow/Level | Temperature | Humidity | Current | Voltage | Switch (on/off) | Door (open/close) | Illuminance

Chemical / Pharmaceutical

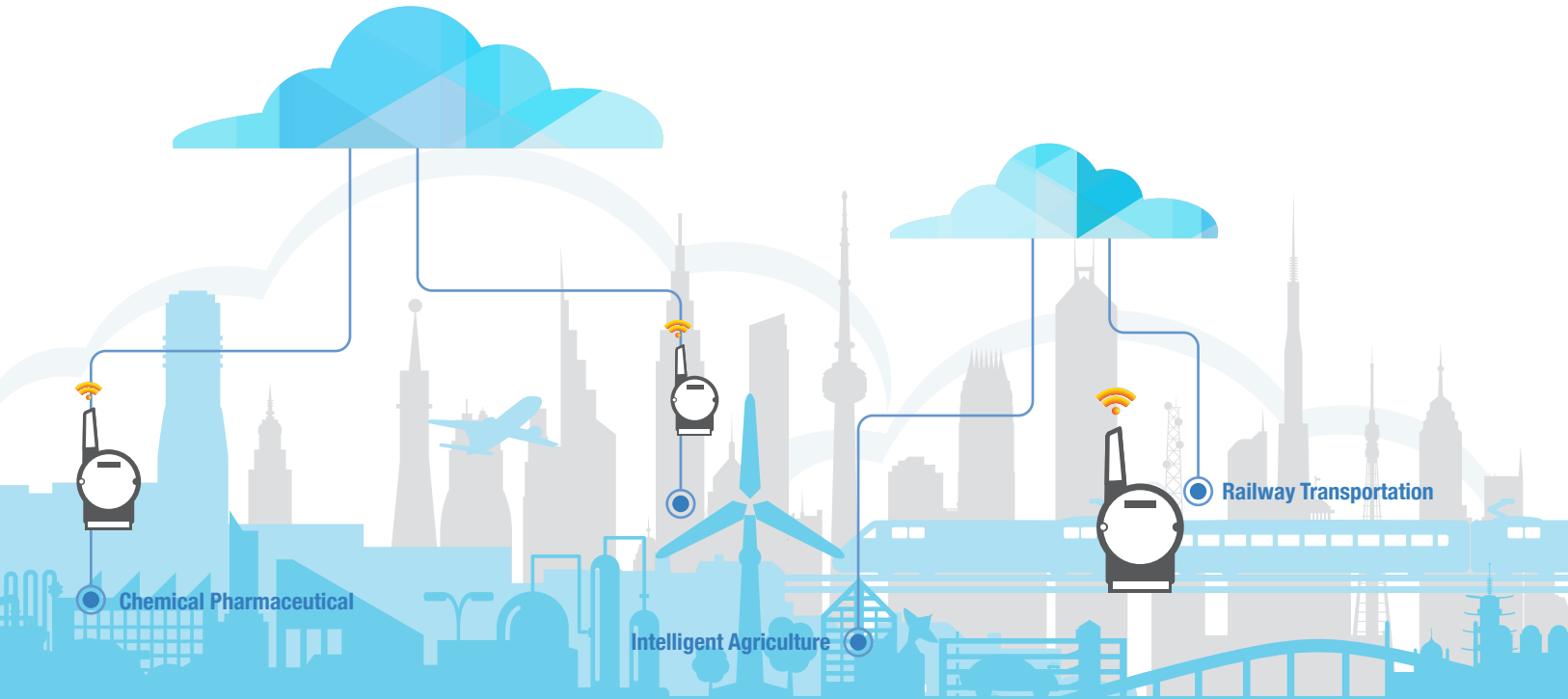
- Temperature
- Humidity
- Light

Intelligent Agriculture

- PH value
- Illuminance
- Electrical conductivity

Railway Transportation

- Door sratus
- Illuminance
- Rail track intrusion



Chemical / Pipeline Monitoring

- Liquid Level
- Valve Status
- Pressure

Warehouse Monitoring

- Door Status
- Light On/Off
- Temperature / Humidity

Machine Monitoring

- Door Status
- Vibration
- Voltage

Refrigerator and HVAC

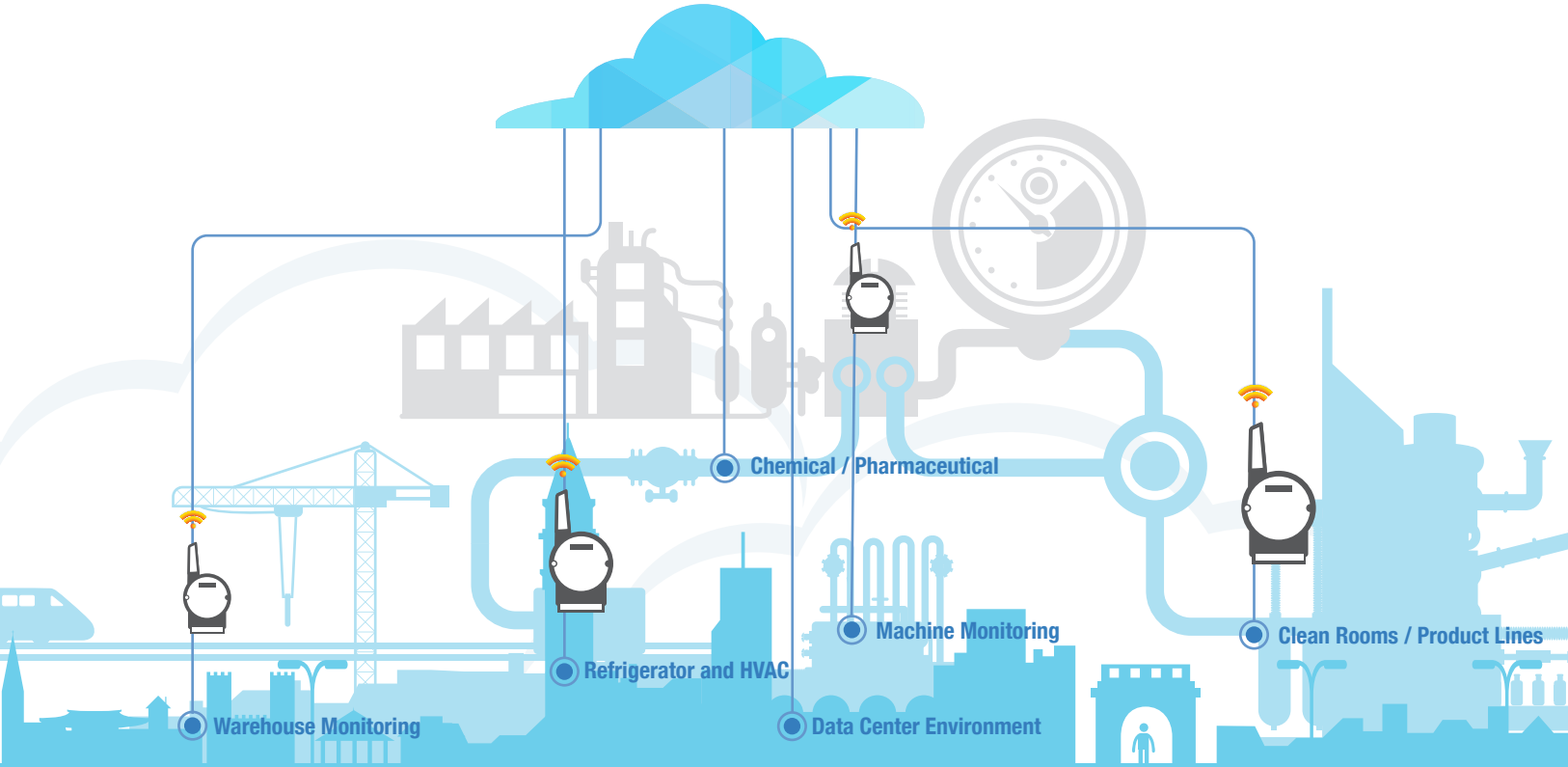
- Switch status
- Temperature
- Refrigertor compressor pressure

Data Center Environment

- Door status
- Switch status
- Temperature / Humidity

Clean Rooms / Product Lines

- Door status
- Illuminance
- Machine status
- Dust



Application Scenarios

Chain Store Environment Monitoring

The supermarkets and convenience stores rely on stable environments to preserve goods, and guarantee the quality of the foods. The status of the refrigerators is connected to good preservation and also electricity cost. The open shelves of refrigerators need extra care as their cool air for avoiding the risk of product spoilage. IoT Wireless I/O modules can help capture real time information and transmit the data via the shop's existing wireless environment allowing the refrigerators to be monitored, maintained, adjusted and reduce the cost of electricity.

- With Advantech's WISE-4000 series and sensors of temperature and refrigerator compressor pressure, the status of the refrigerators could be monitored. Meanwhile, the WISE-4000 series uses wireless signal, which helps the owner get rid of the trouble of wiring.

Data Center Environment Monitoring

Environmental operating parameters are very important for data centers. If the servers overheat, it may cause a system shutdown. Continuous monitoring can prevent accidental data server fault and using a wireless signal means the transmitted data won't share the bandwidth of the existing server network. This allows the system to operate without external interference or wiring.

- By using Advantech's WISE-4000 series and sensors of temperature and humidity, the environment of the rack could be ensured. The wireless interface of WISE-4000 series made it to be able to be planned in a standalone WLAN environment.

Intelligent Agriculture

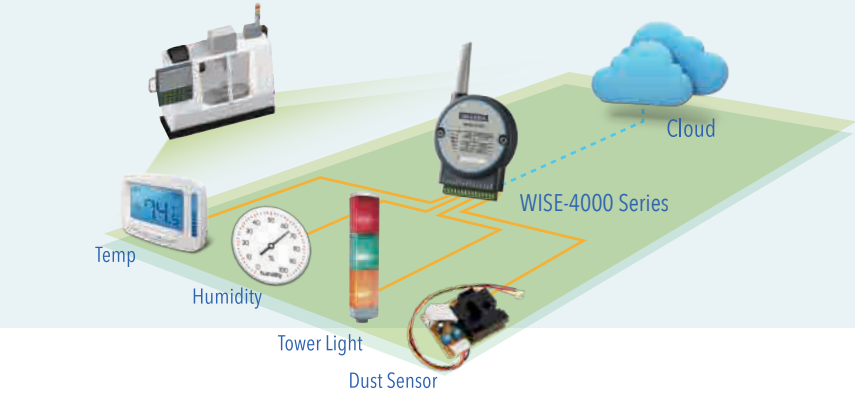
To look after the growth of seedlings, monitoring their progress is essential and can provide valuable records for the next production to follow or revise. Plant factories require extra care especially of illumination and temperature. Using wireless modules can reduce the volume of operators and can solve the problems associated with wired Ethernet. The effect of the nutrient concentration solution can also be monitored and logged with pH and electric conductivity (EC) sensors. With these statistics, food traceability statistics can be generated thus becoming more reliable for consumers.

- The WISE-4000 series can be installed in different layers of the shelves to close monitoring not only pH and EC value, but the illuminance which may be different from shelve to shelve.

Smart Factories

Clean rooms require a high quality environment since the product can be effected by the dust. Thus a low number of environmental pollutants such as dust, airborne microbes, aerosol particles, and chemical vapors need to be ensured. Besides the clean room environment, the overall equipment effectiveness (OEE) can be monitored to be at the optimum level or improve the overall OEE.

- For monitoring the environment, the temperature and humidity sensor can be implemented with WISE-4000 series to get real-time information. The tower light status can transferred as signals to reduce the effort of operators monitoring the lights.



IoT Wireless I/O Modules Key Features

DNA of IoT I/O and Sensing Devices

Advantech's new generation of remote I/O devices bring an IT oriented spirit to the market. With the advanced concepts of data A-P-P, data Acquisition, data Processing to data Publishing, fulfilling mobile monitoring and controlling needs under an IoT framework.

When acquiring the data, Advantech's WISE-4000 series offer high compatibility with sensors in the market in different format with I/O channel types and amounts. Broad adoptability has made WISE a reliable source of big data which benefits users in identifying their next steps and which action to take. With intelligent processing and publishing features, the time it takes to generate insightful reports can be shortened. Thus users can quickly notice and identify possible issues and system downtime can be minimized or even avoided.

DNA 1 ▶ Data Acquisition

Highly Compatible

High compatibility with sensors in different formats and with different I/O channel types and amounts

Robust Protection

The wide operating temperature with isolation protection ensures it can be deployed in even more environments

Easy Installation

New industrial design for quick hardware installation and new interface for module configuration

DNA 2 ▶ Data Processing

Data Logging

Data can be logged on WISE-4000 modules with time stamp for up to 10,000 samples

Data Conditioning

Built-in local intelligence includes filtering, scaling and several other several logic rules

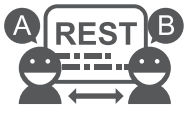
Web Configuration

With a HTML web server, all the modules can be accessed for configuration and troubleshooting from any device with a browser

DNA 3 ▶ Data Publishing

Cloud Access

WISE-4000 can transmit the data to the cloud without using a gateway



RESTful Web Service

With RESTful web service, the I/O module can seamlessly integrated with IT system

Direct Access

Mobile devices can connect to WISE models via Wi-Fi, without needing any other devices in between

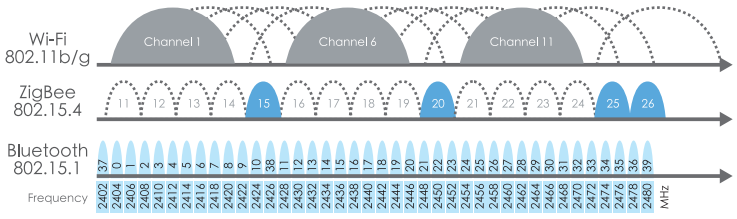
Ubiquitous Wireless Ethernet Interface

According to IDC, more than 85 percent of all installed network connections were Ethernet by the end of 1997. The convenience of implementation makes the Ethernet architecture accepted widely in different application scenarios. By simply adding an access point to the existing network, users can use the wireless connectivity to connect to Ethernet network. With wireless connectivity, users can be benefit from more flexible and quicker installation and wider network coverage.

Going Wireless by IEEE 802.11 b/g/n and Wi-Fi

The 802.11 specification is a wireless LAN (WLAN) standard that was ratified by the Institute of Electrical and Electronics Engineers (IEEE), focuses on the physical layer and link layer of the ISO model. Due to misuse of Wi-Fi, which originally means the certification of compatibility between hardware devices that use the 802.11 standard, the name of the standard is often confused with the name of the certification. A Wi-Fi network is known as a network that complies with the 802.11 standard.

Wi-Fi - The Widest Bandwidth among 2.4 GHz Interface



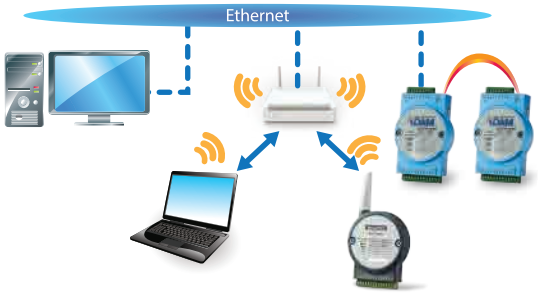
2.4 GHz radio band is one of the many industrial, scientific and medical (ISM) radio bands which covers Bluetooth, near field communication (NFC), wireless sensor networks (like Zigbee), and wireless LAN (Wi-Fi). WLAN provides widest bandwidth and is also the most widely used standard that each vendor's WLAN devices can communicate with others. The new standard of Bluetooth can perform frequency hopping to avoid radio band interference with WLAN. ZigBee, despite it provides low energy consumption with various network topologies, needs its own gateway to organize the network and cannot be used in environments with other 2.4GHz radio wireless devices.

Easy Implementation with an AP

The WLAN infrastructure is organized by WLAN Access Point (AP) and WLAN Stations. The wireless client, which is the end device like a smart phone, connecteds to a wireless access point to join the network is call WLAN station. The wireless server which provides the wireless network, and organizes the network for WLAN stations is called a WLAN access point (AP), or wireless adapter. WLAN APs sometime provides the function of a DHCP server with dynamically assigned IP address for WLAN stations. This kind of AP usually acts as a network router, so it can also be called a wireless router.

No Extra Cost - Application with Existing Ethernet Network

WLAN is the easiest interface to implement in an existing Ethernet network, users only need to add an access point in to an existing network to extend the wireless connectivity. Usually not all the network devices come from the same vendor. So it has been implemented widely in different application scenarios.



Dual Wireless Operation Mode for Easy Configuration and Diagnostic

Infrastructure Mode

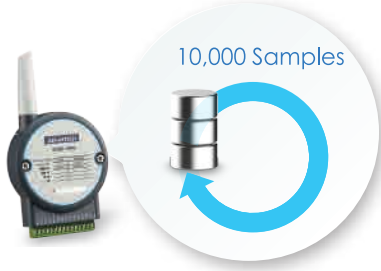
WISE modules can stay connected to access points (AP) to be online. The WISE modules can be connected with mobile devices using the same AP. In this case, that access point acts as a wireless switch for both Ethernet devices.

Limited AP Mode

The Limited AP Mode allows users to access WISE module from a mobile device without an AP, for quick configuration or diagnostics.

When the WISE-4000 works in Limited AP mode, users can find the SSID for the WISE module, and connect to it as a wireless switch. It makes the configuration and diagnostics of WISE modules much easier.

Data Backup from Local to the Cloud



Up to 10,000 samples of local data storage

The internal flash of the WISE module can log up to 10,000 samples of data with a time stamp. The I/O data can be logged periodically, and also when the I/O status changes. Once the memory is full, users can choose to overwrite the old data to ring log or just stop the log function. When the module is powered-off, data can be kept in the module. When restarting, users can decide whether to clear all data or continue logging.

Data storage with time stamps

The definition of data in the IoT is not only the status of everything, but also includes time or location information. With a built-in Real Time Clock (RTC), WISE modules log data with a time stamp and the MAC address of the WISE module. The internal RTC can be calibrated by SNTP with time server. Once the module has been switched off, the internal time can also be saved using the time backup battery. When users poll the data from the data logger, the time stamp will always be attached to the data.

Reduce the communication time and bandwidth

In the IoT communication architecture, periodic polling takes lots of time and bandwidth. Once the data can be logged in the module, users can poll a batch of data at the same time, instead of polling each piece of data individually. In this case, users can simplify the polling mechanism and also reduce the communication interface fee.

Cloud Logger function with public cloud or private cloud

Locally stored data can not only be polled by the user, it can also be automatically pushed to Dropbox or appointed private cloud. Once the Logger meets the upload criteria, Data Logger will push the data to a public cloud service. This data will be saved on the cloud using a *.csv file extension and users can synchronize the data on the cloud using the application provided by the cloud provider and access it from it from wherever they are. Cloud Logger provides a very flexible solution for cloud data storage making WISE modules a one stop solution from data acquisition to the cloud.

Reducing the concerns of a wireless interface

WISE-4000 Wireless IoT I/O modules focus on wireless connectivity. Eventhough new a new generation of Wi-Fi interface could be stable, users are concerned that the wireless signal maybe reduced or nonexistent. In this situation, WISE modules provide local data storage. The I/O data and system events are logged in the internal flash memory of the WISE module. So now users can fetch this logged data when communication is restored.

Quick Installation and Easy Maintenance

Changeable Antenna

For flexibility the wireless antenna of the WISE module is not fixed. Users can replace the antenna by unscrewing it counter-clockwise. Note that Advantech only ensure the performance of the default antenna. And performance is decided by the application's environment.

LED Indicator for Diagnostics

WISE modules have an LED indicator on the front of the module, the name plate of the module. Besides the Status and Communication indicator, users can instantly see the network mode with an LED indicator. The LED will be ON when working in AP mode. During infrastructure mode, the LED will be OFF and the signal strength LED will be on to indicate the signal quality between the WISE module and wireless access point.

External Switches and Detailed Product Label

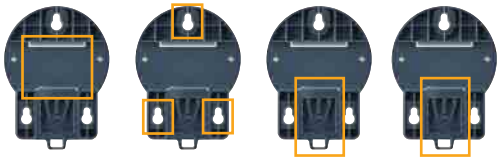
The I/O input setting switches are on the back of the WISE module. Users don't need to open the device to configure the I/O type. For example, users can configure the digital input contact to be dry or wet by the switch. The details of the switch will be shown on the product label for the user's reference. The MAC address of the module is also on the label.

Initial Switch

There is a DIP switch on the back of the device for restoring the WISE module to the default factory communication settings. If the user forgets the IP address of the WISE module, or wireless communication password they can configure this switch to the OFF position for the default factory communication settings.

New Mounting Kit

WISE modules come with a new type of mounting kit. Users can use this kit for DIN-rail and wall mounting (panel mount). The new mounting kit provides fast mounting for to DIN-rails, users just need to switch the hook for the mounting kit to lock or release the module on the DIN-rail. WISE modules also support stack mounting as used on Advantech's other I/O modules.



DIN-rail mounting | Wall (panel) mounting | ↑ Push up to lock | ↓ Pull down to release

Power Supply

Power Input (Not Applicable to WISE-4012E)

The WISE-4000 is designed for a standard industrial unregulated 24 VDC power supply. For further applications, it can also accept 10~30 VDC of power input, 200mV peak to peak of power ripple.

USB Power Input (WISE-4012E Only)

For the IoT Developer Kit, easy power is a very important feature to quickly experience the module. So a micro-B USB power connector is provided for powering the WISE module via the computer's USB port, mobile device's USB power adapter, or USB power bank. (WISE modules are not battery chargeable, the USB port is only for powering up the module, not for USB communication)

IoT Developer Kit

WISE-4012E

6-ch Input/Output IoT Wireless I/O Module for IoT Developers

Introduction

The Advantech WISE-4012E IoT Developer Kit is a complete hardware & software solution to help users develop IoT applications and simulate their projects in the simplest way. The WISE IoT Developer Kit provides everything you need to get going: a WISE-4012E 6-ch universal input or output wireless Ethernet I/O module, and developer kit including: WebAccess 8.0 with open interfaces for intelligent application developer, extension board for simulating sensor status, a micro USB cable for power input, and a screwdriver for wiring. The WISE-4012E has an integrated Wi-Fi interface with AP mode and web configuration which can be accessed by mobile device directly. Data can be logged in the I/O module and then automatically pushed to the file-based cloud.

IoT Developer Kit

WebAccess Cloud Mobile WiFi

- WISE-4012E (x1)
- Extension Board (x1)
- USB Cable (x1)
- Screwdriver (x1)
- WebAccess (x1)

Features

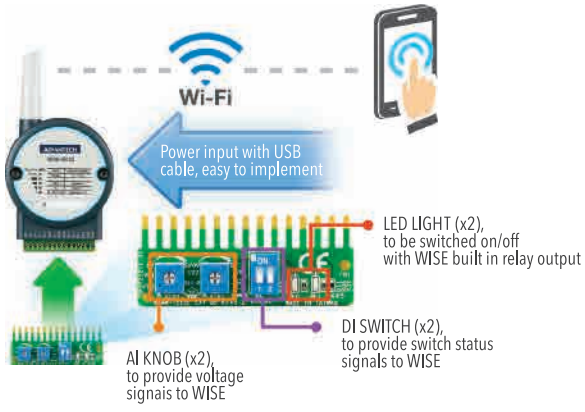
- 2.4 GHz IEEE 802.11b/g/n WLAN
- 2-ch 0~10V Input, 2-ch DI, and 2-ch Relay Output
- Includes WebAccess with demo project for developer
- Includes extension board for simulating sensor status
- Includes micro USB cable for power input
- Supports Modbus/TCP with RESTful web service
- Supports wireless client and server mode that can be accessed directly without AP or router
- Supports web configuration with HTML5 without the platform limitation
- Supports file-based cloud storage and local logging with time stamp

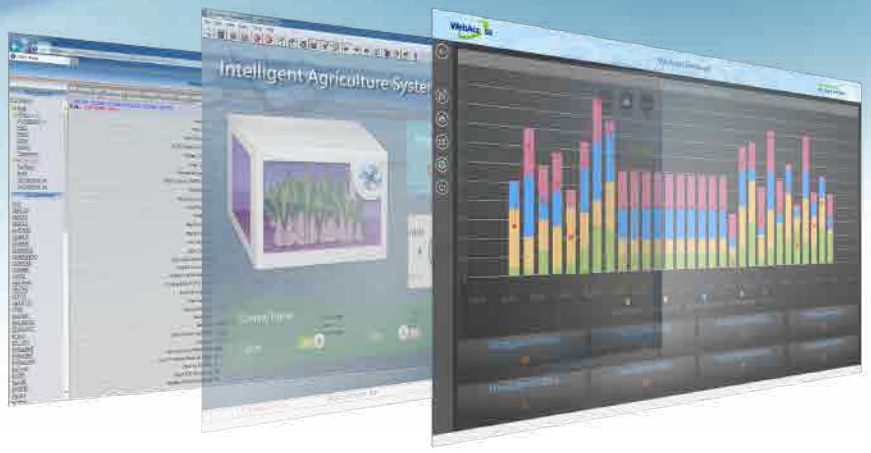
Application Scenar

Connect to end devices

Application Scenario

Connect to an extension board





The IoT Software Framework

Advantech WebAccess provides powerful SCADA management functions including Advanced alarm management, Scheduler, Historical and real-time trends, Demand control and Database maintenance. WebAccess can also meet users' needs in focused vertical markets. WebAccess is a 100% web-based HMI and SCADA software with private cloud software architecture. To catch up the IoT wave, we keep evolving the WebAccess architecture to a public cloud design, target on providing centralized big data for large equipment vendors, SIs, and Enterprises, to configure, change/update, or monitor their equipment, projects, and systems all over the world through IoT. The user behavior on SCADA software will be evolved from data acquisition/manipulation to business intelligence and big data analysis.

WebAccess provides Business intelligence analytic services by a HTML5-based Dashboard. Users can create the customized information page by using analysis charts and diagrams which are called widgets. Users can view the data in different browsers, like Explorer, Safari, Chrome, and Firefox for a seamless viewing experience across PCs, Macs, tablets and smartphones.

Dashboard Editor

Configuration tool for users to create the dashboard, including Layout, Dashboard Display, data source mapping, Widget Type, pluggable widget interface, and Widget interaction.

Dashboard Viewer

View tool to the customized dashboard with real-time data information. Provide Pad and Mobile Dashboard Viewer mode with Full Screen/Normal mode Layout.

Built-in Widget Library

Built-in standard widgets in the Widgets library for users to design and build their own Dashboard to show the analysis information via WebAccess Database, includes widgets such as Line Chart, Bar Chart, Meter,etc.

Support Cross Browser

WebAccess Dashboard supports HTML5 compliant browsers, including Internet Explorer, Safari, Chrome and Firefox.

Selection Guide

IoT Wireless I/O

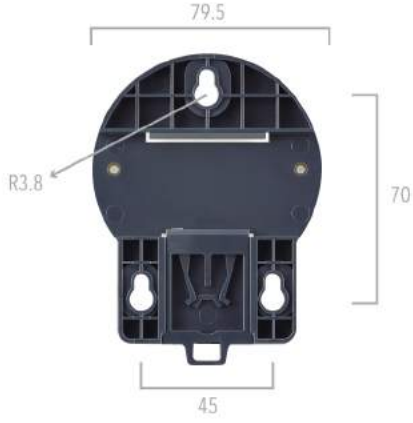
Model		WISE-4012E	WISE-4012	WISE-4050	WISE-4060
Description		6-ch Input/Output IoT Wireless I/O Module for IoT Developer	4-ch Universal Input and 2-ch Digital Output IoT Wireless I/O Module	4-ch Digital Input and 4-ch Digital Output IoT Wireless I/O Module	4-ch Digital Input and 4-ch Relay Output IoT Wireless I/O Module
Wireless Network	IEEE Standard	IEEE 802.11b/g/n			
	Frequency Band	2.4GHz			
	Network Mode	Limited AP, Infrastructure			
	Wireless Security	WPA2 Personal, WPA2 Enterprise			
	Antenna Connector	Reverse SMA			
	Outdoor Range	100m			
Analog I/O	Channels	2	4	-	-
	Resolution	12-bit	16-bit	-	-
	Accuracy	1% of FSR	0.1% of FSR	-	-
	Sampling Rate	10Hz/Channel	10Hz/Total	-	-
	Voltage Input	0~10V	0~5V, 0~10V, ±5V, ±10V	-	-
	Current Input	-	0~20mA, 4~20mA	-	-
	Digital Input	-	Dry Contact	-	-
Digital I/O	Input Channel	2 (Dry Contact)	-	4	4
	Output Channel	2 (Form A Relay)	2	4	4 (Form A Power Relay)
	Counter Input	-	-	3k Hz	3k Hz
	Frequency Input	-	-	3k Hz	3k Hz
	Pulse Output	-	1k Hz	1k Hz	1 Hz
Isolation Protection		No	3,000 V_{rms}	3,000 V_{rms}	3,000 V_{rms}
LED Indicator		Status, Comm, Mode, Wireless Signal			
Power Requirement		$5V_{DC}$ Micro-B USB	$10\sim30V_{DC}$ ($24V_{DC}$ Standard)	$10\sim30V_{DC}$ ($24V_{DC}$ Standard)	$10\sim30V_{DC}$ ($24V_{DC}$ Standard)
Power Consumption		2.5W @ $5V_{DC}$	2.5W @ $24V_{DC}$	2.2W @ $24V_{DC}$	2.5W @ $24V_{DC}$
Operating Temperature		-25 ~ 70°C (-13~158°F)			
Storage Temperature		-40 ~ 85°C (-40~185°F)			
Operating Humidity		20 ~ 95% RH (Non-condensing)			
Storage Humidity		0 ~ 95% RH (Non-condensing)			

Dimensions for WISE-4000 Series

Unit: mm

Front View

Side View



Mounting Kit

IoT Gateway Sensor Hub

IoT Gateway

Wi-Fi Sensor Hub

ZigBee Sensor Hub

Cellular Sensor Hub

Model	WISE-5000	WISE-4220	WISE-4230	WISE-4273
CPU / MCU	Intel Quark 400Mhz	ARM Cortex M4	ARM Cortex M4	ARM Cortex M4
Connectivity	2x LAN, 2x COM, 2x USB, 3G / Wi-Fi / Zigbee by mPCIs	IEEE 802.11b/g/n 2.4GHz	IEEE 802.15.4 2.4GHz	• 900/2100 MHz for WCDMA network • 900/1800 MHz for EDGE/GPRS/GSM network
Operation Temperature	-20~60°C	-25~70°C	-25~70°C	-25~70°C
Dimension (W x H x D)	70 x 90 x 100 mm	80 x 139 x 25 mm	80 x 139 x 25 mm	80 x 139 x 25 mm

Sensor Board

	Indoor Environment	Data Center Enclosure	Water Leak Detection	Control Room Status	Power Unit Monitoring
Model	WISE-S110	WISE-S210	WISE-S220	WISE-S230	WISE-S240
Sensor Type	Temperature / Humidity / Pressure	Temperature / Humidity / RTD / On-Off	Temperature / Humidity / Water Leak	Temperature/ Humidity / RS-485 / On-Off	Temperature / Humidity / Analog Input

IoT Ethernet I/O

Model		WISE-4010/LAN	WISE-4050/LAN	WISE-4060/LAN
Description		4-ch Current Input and 4-ch Digital Output IoT Ethernet I/O Module	4-ch Digital Input and 4-ch Digital Output IoT Ethernet I/O Module	4-ch Digital Input and 4-ch Relay Output IoT Ethernet I/O Module
Analog I/O	Channels	4	-	-
	Resolution	12-bit	-	-
	Accuracy	±0.2% of FSR	-	-
	Sampling Rate	10/100Hz/Channel	-	-
	Current Input	0~20 mA, 4~20 mA	-	-
Digital I/O	Input Channel	-	4	4
	Output Channel	4	4	4 (Form A Power Relay)
	Counter Input	-	3k Hz	3k Hz
	Frequency Input	-	3k Hz	3k Hz
	Pulse Output	1k Hz	1k Hz	1 Hz
Isolation Protection		No	3,000V_{rms}	3,000V_{rms}
LED Indicator		Status, Comm		
Power Requirement		10 ~ 30V_{DC} (24V_{DC} Standard)		
Power Consumption		1.2W @ 24V_{DC}	2.2W @ 24V_{DC}	2.5W @ 24V_{DC}
Operating Temperature		-40 ~ 70°C (-40~158°F)		
Storage Temperature		-40 ~ 85°C (-40~185°F)		
Operating Humidity		20 ~ 95% RH (Non-condensing)		
Storage Humidity		0 ~ 95% RH (Non-condensing)		

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