UA Series / BRK Series
IIoT Cloud Solution

Vol. UA_4.23.03_EN

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CH1. IIoT Cloud Solution Products

Products introduction and features

The IIoT Cloud Solution of ICP DAS provides UA series of IIoT Communication Server to upgrade the front-end devices to the Cloud, connect IT with OT, link Cloud and Web APPs, and integrate the IIoT Cloud solution.

1 IIoT Communication Server : UA Series

The UA series integrates IT and OT systems and equipment to connect to the cloud, and converts data into OPC UA and MQTT communication data to connect to the cloud Internet, remote database, SCADA graphic control and management system. Support multiple cloud platforms (Amazon AWS, Microsoft Azure, IBM Bluemix, Baidu... etc.).

2 MQTT Communication Server : BRK Series

BRK Series is an Communication Server that specially provides Broker function of MQTT protocol for MQTT message distribution and concentrator in M2M and Industrial IoT. It supports QoS, retains, identity authentication, communication encryption, Last Will, Bridge, Cluster, Load Balancer, and High Availability functions.

3 OPC UA I/O Modules

OPC UA I/O modules are a series of Ethernet I/O modules with OPC UA Server, MQTT Client, and RESTful API services. Built-in logic function Rule Setting IF-THEN-ELSE, Scheduling, Event log... functions. And it can be connected with IoTstar Cloud management software.

Comprehensive Applications:

Plastic Injection Molding Machine Monitoring Applications

Due to labor costs increasing and manpower shortages in the manufacturing industry, how to digitize information is an important issue, companies have trouble integrating IT and OT staff because they have different perceptions, and eventually have to abandon the project. The difficulties, in this case, can be divided into the following items:

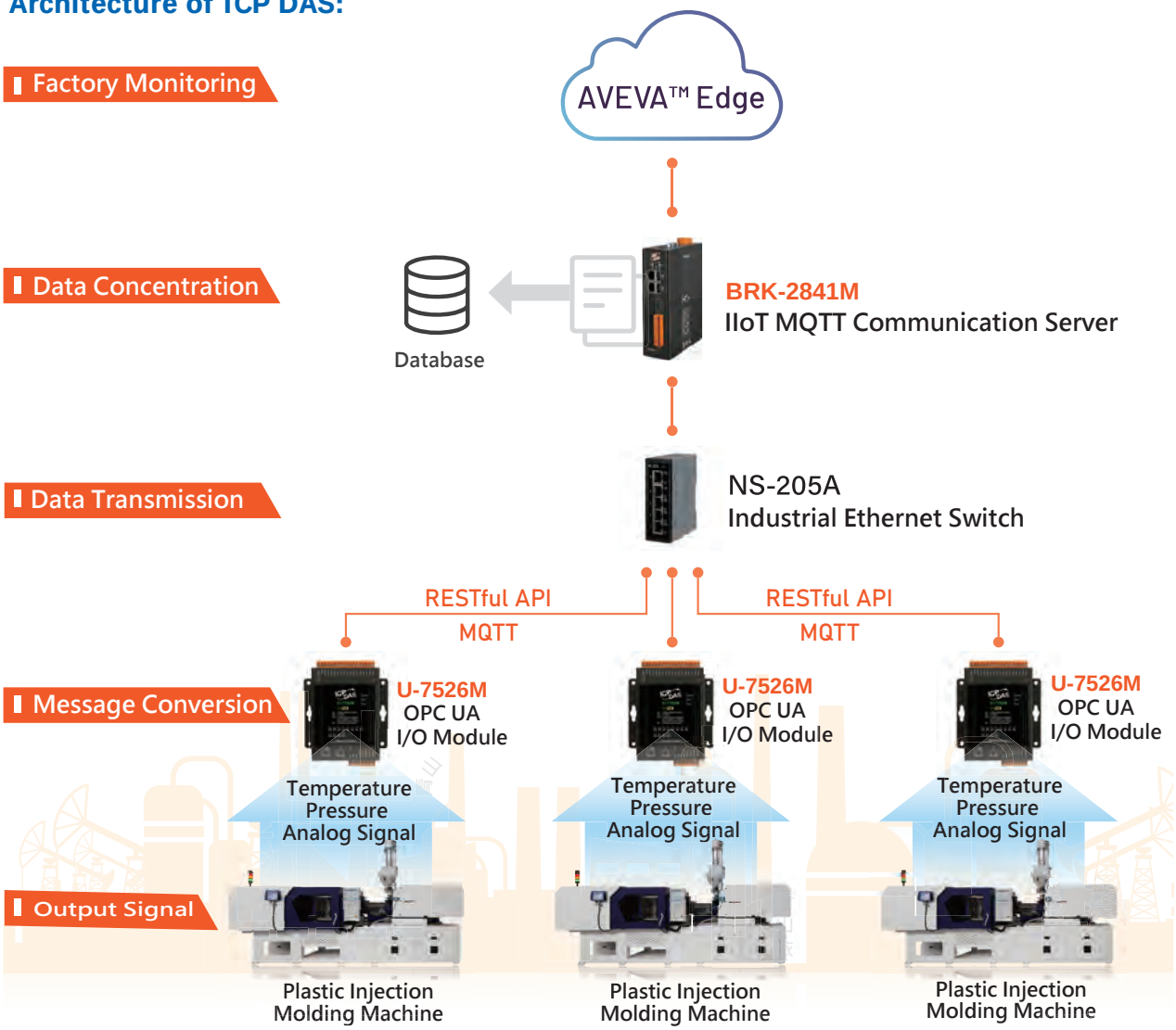
1. Hard to record Sensor value
2. Machine messages scattered
3. No Data Graphing

ICP DAS uses the U-7526M to convert analog signals into RESTful API / MQTT data to achieve the goal of "information digitization". Makes it more flexible for database and graphic software and makes it easier to control and record.

Projects	Before	After
Header vaule	Manual meter reading	Record in database
Machine Status	Manual inspection	Screen Monitoring
Quality	Manual adjustment	Data analysis
Management	Error-prone	Not error-prone
Communication	Difficult	Easy
KPI managing	According to experience	According to data

- **Advantages of ICP DAS:**
  1. Digitalization for recording
  2. Centralized message
  3. Data graphing

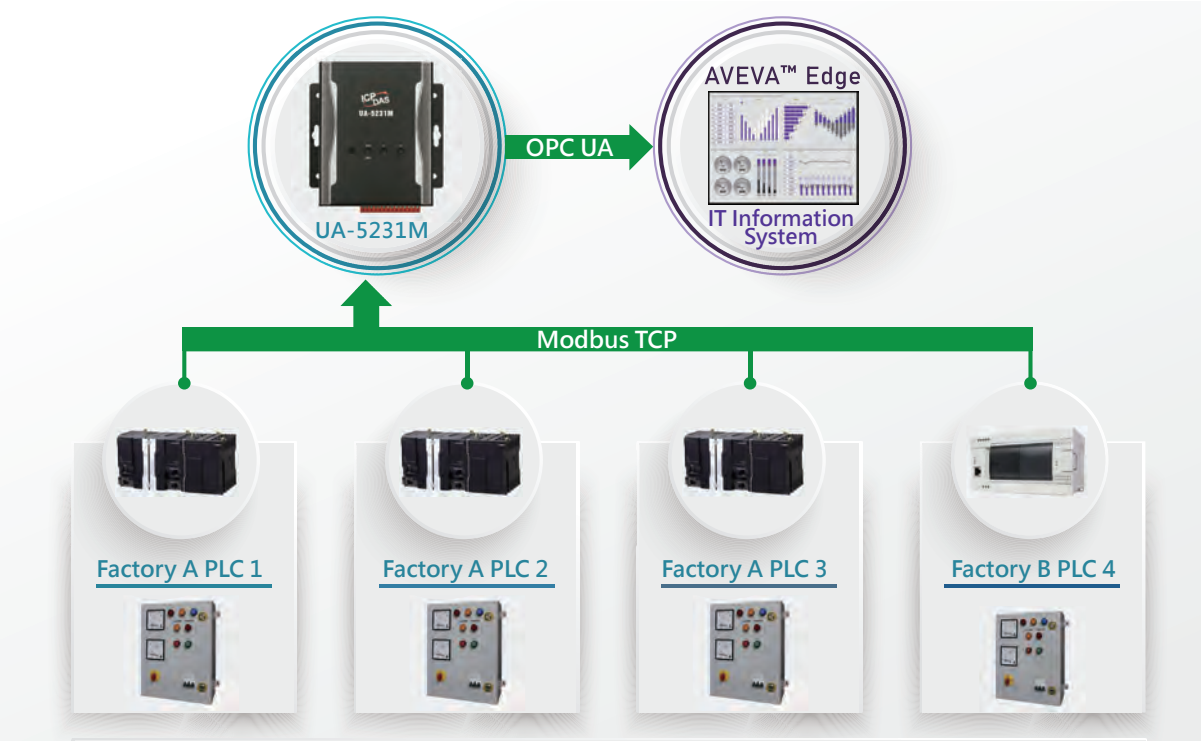
- **Architecture of ICP DAS:**



Chemical Factory Water Filters Applications

- **Reduce the difficulty of obtaining PLC data and save time for IT system setup**

  The IT system has to record the flow, pressure, and water quality data of the water filter. It's difficult to read the contents of the PLC in the filter tray. By deploying UA-5231M, the UA-5231M can convert PLC data into OPC UA service, which can reduce the difficulty of equipment and system integration.

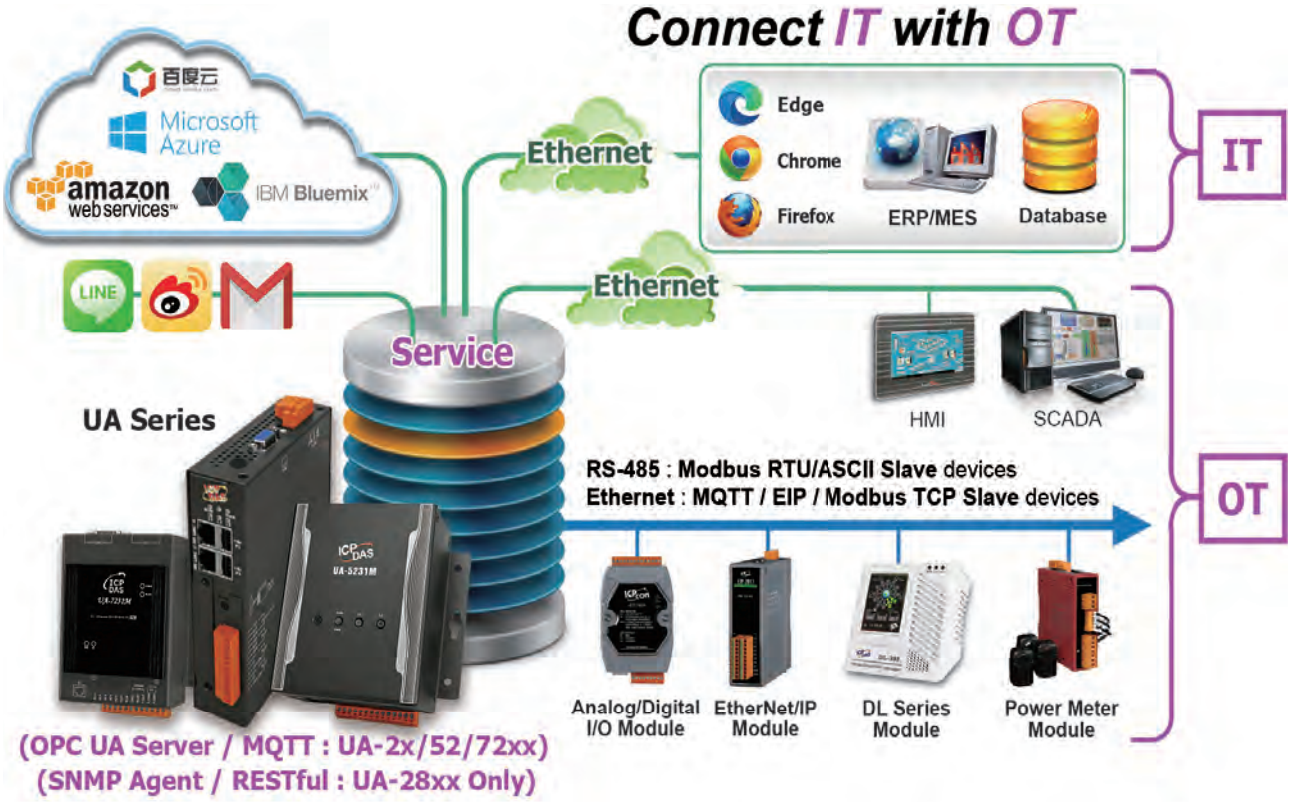


- **Integrate sensing and output modules to simplify difficulties in the field**

  The reverse osmosis equipment encountered the problem that no space to place the sensor module and the controller, the U-7526M provides analog sensor and OPC UA services to collect water quality, flow, and pressure data from equipment to the IT system, reducing field staffing integration burden.

CH2. IIoT Communication Server: UA Series
UA-2000/UA-5000/UA-7000

System Architecture:

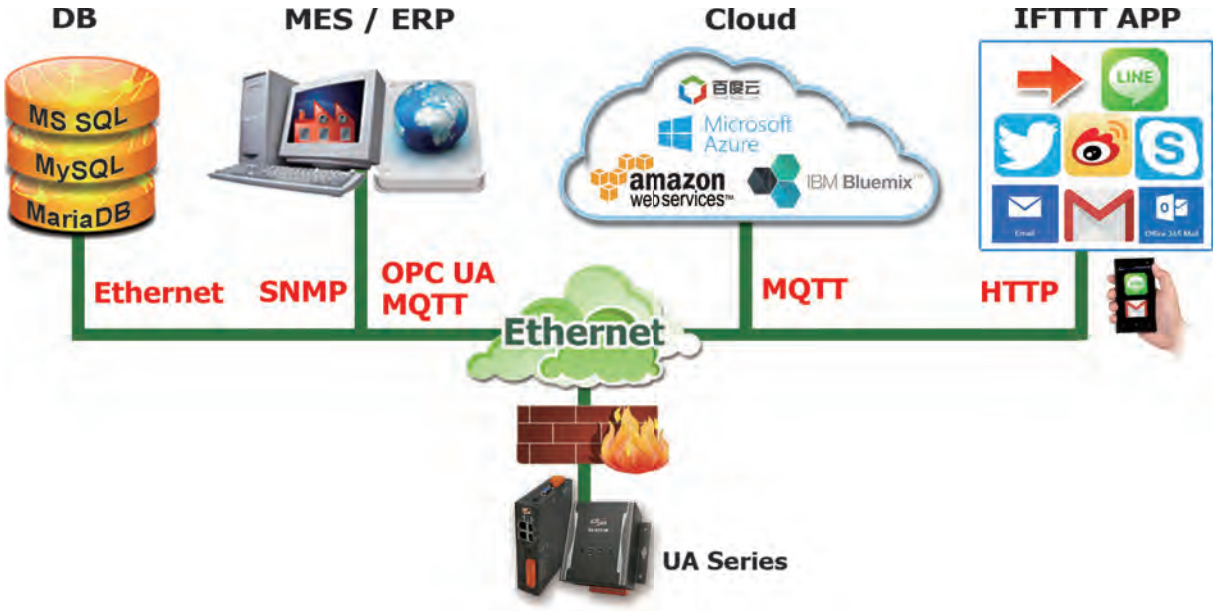


UA Series IIoT Communication Server: Connect IT with OT, Integrate Cloud and Web APPs

The IIoT Cloud Solution of ICP DAS provides UA series of IIoT Communication Server to upgrade the front-end devices to the Cloud, connect IT with OT, link Cloud and Web APPs, and integrate the IIoT Cloud solution.

- **Built-in OPC UA, the industrial communication standard**
- **Built-in MQTT, the active IoT transmission technology**
- **Provide RESTful API service interface**
- **Support to execute OPC UA, MQTT and RESTful API communication at the same time**
- **Support Modbus RTU/TCP/ASCII, MQTT, EtherNet/IP device communication protocol**
- **Provide SNMP Agent function: SNMP protocol.**
- **Support Data Logger / Trmote Database (CSV log file) / (MS SQL, MySQL, MariaDB)**
- **Support IoT Cloud Platforms: Amazon AWS, MS Azure, Baidu...**
- **Support IFTTT for Cloud logic control: event notifications to LINE, Twitter, Mail, etc.**
- **Provide Wizard function wizard**
- **Provide Internal Module that can create virtual variables as an intermediary for reading, writing, or data exchange:**

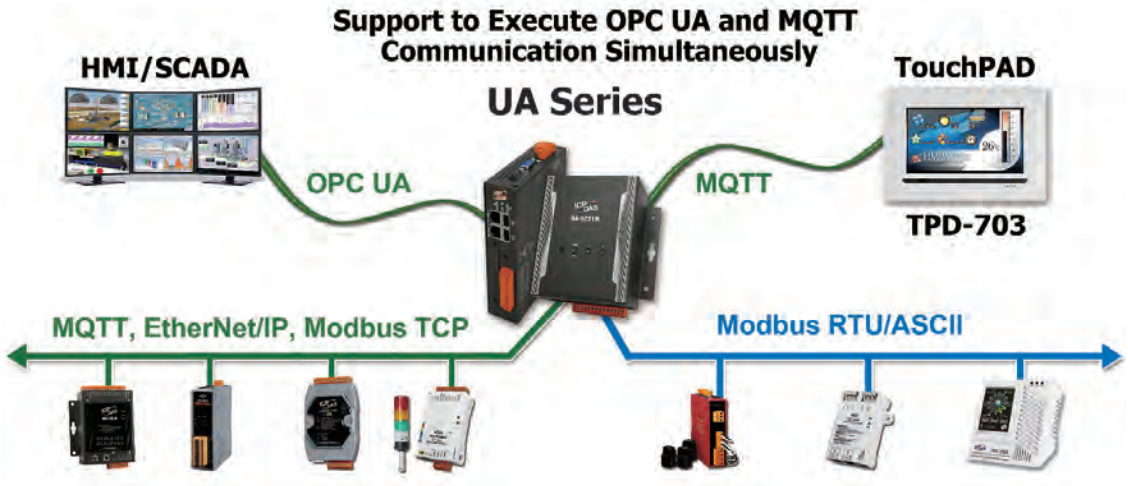
IT Integration Technology:



Technology:

- **OPC UA** : The **Industrial Communication Standard**
- **MQTT** : The **IoT Active Transmission** Technology
- **Data Logger** : I/O data save directly to **Local LOG file** or **Remote Database**
- **IFTTT** : The **Cloud Logic Control** (**IF** This **T**hen **T**hat)
- **Cloud** : The IIoT **Cloud Platform** Connection Technology
- **SNMP Agent** : SNMP **S**imple **N**etwork **M**anagement **P**rotocol Real-time monitoring device data

OT Integration Technology:



Technology:

- **OPC UA** : The **Industrial Communication Standard**
- **MQTT** : The **IoT Active Transmission** Technology
- **Modbus** : A **protocol** widely used within **Industrial Automation Systems**
- **EtherNet/IP** : **Industrial Ethernet protocol,** based on **TCP/IP** protocol and compatible with **factory and enterprise networks**

Selection Guide:

■ Hardware

Model	UA-2841M	UA-2241M UA-2241MX-4GE UA-2241MX-4GC	UA-5231/UA-5231M UA-5231M-3GWA UA-5231M-4GE/4GC	UA-7231M
System / Module				
OS	Linux Kernel 5.10.72	Linux Kernel 3.2.14		
CPU	ARM Quad Core, 1.6 GHz	ARM, 1.0 GHz		
SDRAM	DDR4 2 GB	DDR3 512 MB		
Flash	8 GB	512 MB	8 GB	
Expansion Memory	4 GB microSD Card, Max. 32 GB microSDHC or 2 TB microSDXC Card	4 GB microSD Card, Max. 32 GB microSDHC		
Communication Ports / Expansion				
Ethernet	2		1	1 PoE
USB	2 x 2.0 host		1 x 2.0 host	-
Serial Port	4 (2 x RS-232, and 2 x RS-485 isolated 2500 VDC)			1 (isolated RS-232/485)
XV-board Expansion	1 optional XV511i, expands 4 RS-485 ports (UA-5231 series: Rev.B version only) or 1 optional XV107/110/111/116/119/303/306/307/310, expands I/Os (soon)			-
Mechanical / Environmental / Power				
Temperature	Operating: -25 ~ +75° C / Storage: -40 ~ +80° C			
Humidity	10 ~ 90% RH			5 ~ 90% RH
	Non-condensing			
Input Range	+12 ~ +48 VDC			
Consumption	10 W	Ethernet: 4.8 W -4GE/4GC/3GWA: 6.5 W		3.5 W
Dimensions	42 x 164 x 130 (mm)		117 x 126 x 58	97x 114 x 38

[Advantages of each series]

- UA-2841M : High specifications, fast speed, and multiple support functions.
- UA-7231M : Compact size, high cost performance, and provides PoE power supply, it is more suitable for installation in a small environment or where it is difficult to configure a power supply.

■ Wireless Communication

Model		UA-2241MX-4GE UA-2241MX-4GC	UA-5231M-3GWA UA-5231M-4GE UA-5231M-4GC
Wireless Communication (Only For UA-2x41MX-4GE/4GC, UA-5231M-4GE/4GC/3GWA)			
4G System	-4GE	FDD LTE: B1/B3/B5/B7/B8/B20 bands (Asia Only, Except China)	
	-4GC	FDD LTE: B1/B3/B8 bands (For China only) TDD LTE: B38/B39/B40/B41 bands (For China only)	
3G System	-3GWA	WCDMA: 850/900/1900/2100 MHz	
	-4GE	WCDMA: 850/900/2100 MHz	
	-4GC	WCDMA: 900/2100 MHz, TD-SCDMA 1900/2100 MHz, CDMA2000 (BC0) 800 MHz	

■ Software

Series	UA-2841M Series	UA-2241M Series	UA-5231 Series	UA-7231 Series
Protocol (Note1, Note2)				
OPC UA Server	Max. Numbers of Client Sessions and Max. Tags			
	Max. 50 Sessions Max. 8000 Tags	Max. 20 Sessions Max. 8000 Tags		
MQTT Broker	Connections of non-SSL & SSL / WebSocket			
	Max. 2100	Max. 400		
MQTT Client	Connections of non-SSL & SSL			
	Max. 500	Max. 200		
Modbus RTU/ ASCII Master	32 * 3 Ports = 96 Devices			32 * 1 Ports = 32 Devices
Modbus TCP Master	Max. 250 Devices	Max. 100 Devices		
EtherNet/IP	Max. 125 Devices	Max. 50 Devices		
SNMP v3 Agent	Max. 10 Read / 10 Write	-		
RESTful	Max. 20 Read / 1 Write	-		
Firewall				
Dynamic Blocklist	Set conditions to monitor the connection status of the service port. When the external IP connections exceed the condition setting value, the dynamic blocklist will automatically block the subsequent connection of the IP to avoid a large number of abnormal connections from blocking network services and protect system stability.			
Data Storage (Note2)				
MS SQL / My SQL Data log	**3** Databases per Time, Max. 1000 Tags per link	Max. **1** Databases per Time, Max. 1000 Tags		
Local Data log	Stored in the local MicroSD card or SSD (CSV format)	Stored in the local MicroSD card (CSV format)		
Function (Note2)				
Internal	Can create virtual variables as an intermediary for reading, writing, or data exchange for OPC UA Client to Client.			
PID	Combine the remote I/O devices for the PID logic control system.			
IoT Cloud Platforms and Function (Note2)				
MQTT JSON Function	Microsoft Azure Amazon Web Services IBM Bluemix			
MQTT Custom Function	ThingSpeak			
IFTTT Condition Trigger Function	IFTTT Logic Trigger APP (Line, Twitter, Gmail ...)			

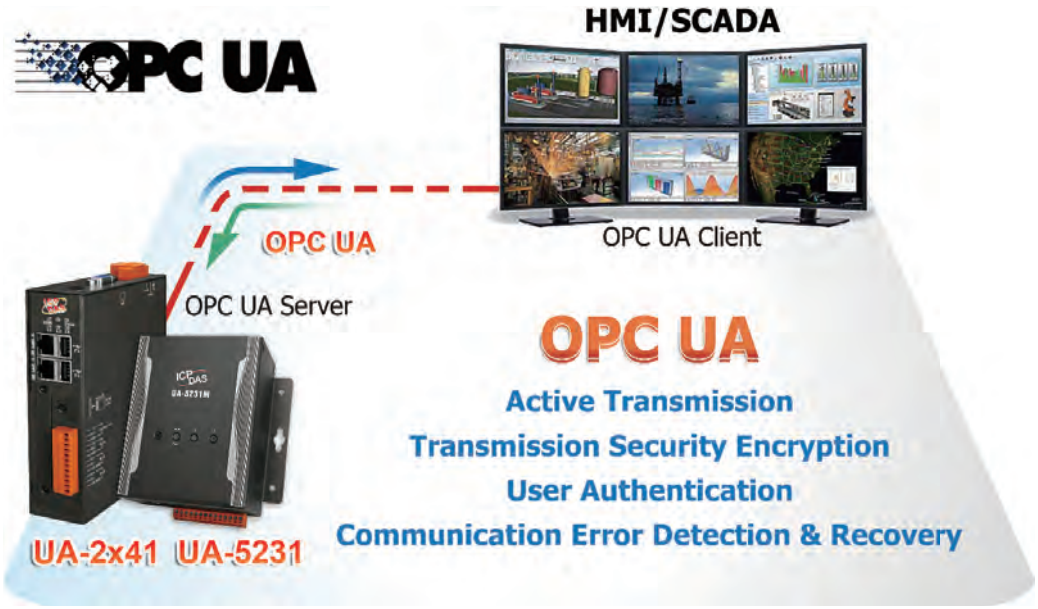
Note 1: The specifications are the maximum number of connections or usage when using a single Protocol.

Note 2: When using multiple protocols or functions, the user must adjust the actual usage to control the CPU Usage below 80%. Please refer to the CPU data on the UA web interface.

Features:

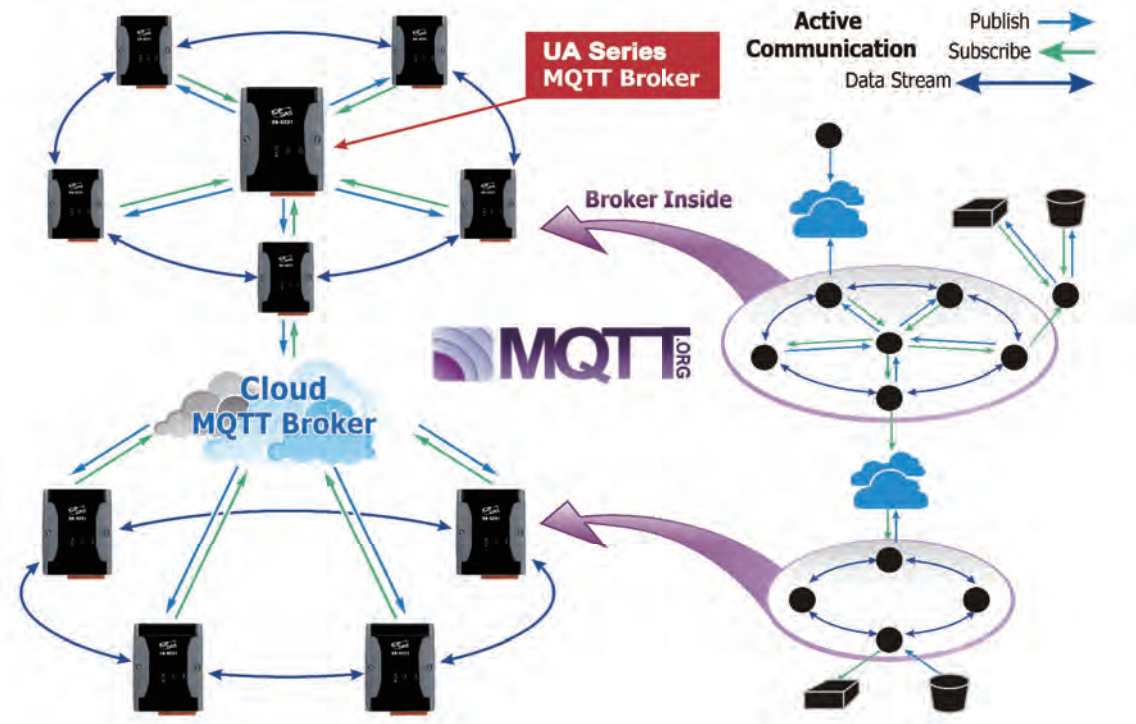
Built-in OPC UA Server Service

Compliance with IEC 62541 Standard. Provides functions of Active Transmission, Transmission Security Encryption(SSL/TLS), User Authentication (X.509 Certificates/Account password), Communication Error Detection and Recovery, etc. to connect SCADA or OPC UA Clients. Allowed up to 8000 OPC UA tags and up to 20 sessions for the OPC UA Client connection.



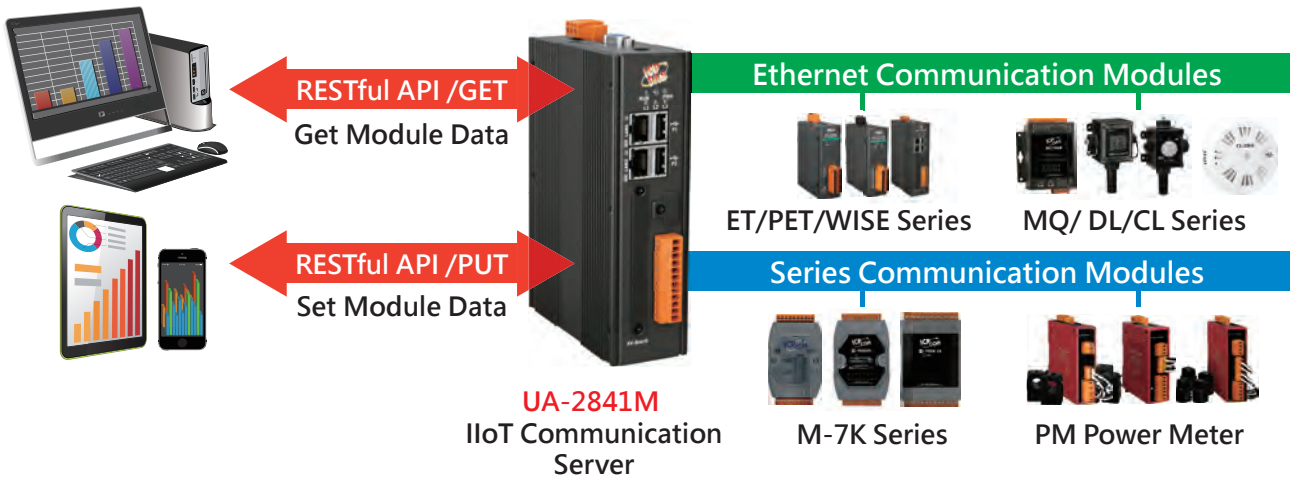
Built-in MQTT Broker Service

MQTT Broker inside and Compliance with MQTT V.3.1.1 protocol. Provides functions of IoT Active M2M Transmission, QoS Quality Service, Retain Mechanism, Identity Verification, Encryption, Last Will, MQTT Client Drivers, etc. The Broker can connect up to 400 MQTT Clients.



Provide RESTful API service interface (For UA-2800)

Provide the device data in JSON format, letting the user access it from the outside through the HTTP protocol. And UA support to execute OPC UA, MQTT and RESTful API communication at the same time.



Provide SNMP Agent function

UA-2841M series products allow IT practitioners to manage various workplaces through ICP DAS NMC-9181 or third-party SNMP software.

Sensor Data Upload with Information Security

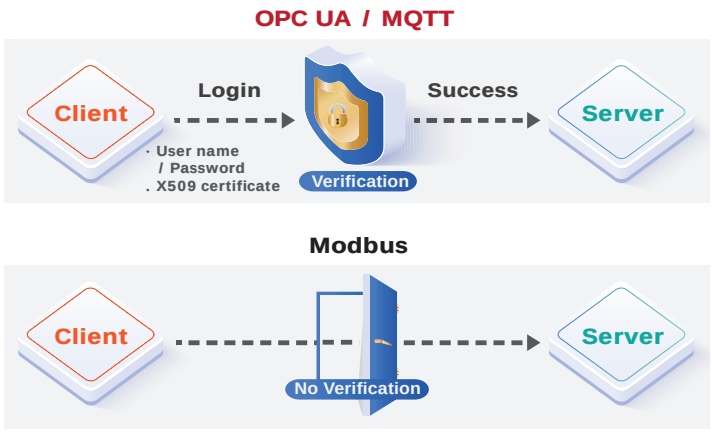
In the era of cloud IoT, data transfer between sensors and cloud or graphical control platforms is a prerequisite for the operation of the IoT system, And enabling "sensor data upload" to be protected by security mechanisms is the priority of IoT systems. The HTTPS of the UA series protects web data from leakage while the "MQTT with SSL/TLS" and OPC UA Server features that the sensor's real-time data upload is transmitted through encryption to prevent theft and use by anyone. In addition, the UA-2841M supports SNMP (V3) agent (Enhanced security for SNMP protocol) information security protocol.

Through the Firewall protection and Protocol data encryption mechanism provided by UA, it can meet the user's needs when building the IoT system.

Security	UA-2841	UA-2241	UA-5231	UA-7231
Firewall				
Dynamic Blacklist	Set conditions to put abnormal IPs into the dynamic blacklist			
Protocol				
HTTPS	Enable https and provide X.509 certificate and key upload for verification use			
OPC UA Server	Authentication: Username/Password, X.509 Certificate Security Policy: > Basic128Rsa15 (Sign / Sign & Encrypt) > Basic256 (Sign / Sign & Encrypt)			
MQTT Client	Provides SSL and TLS version 1.2 encryption verification can be checked through Microsoft Azure, Amazon Web Services,etc.			
MQTT Broker	Provides SSL and TLS (ver. 1.2) encryption and security authentication			
SNMP(V3) Agent	TLS authentication	None	None	None

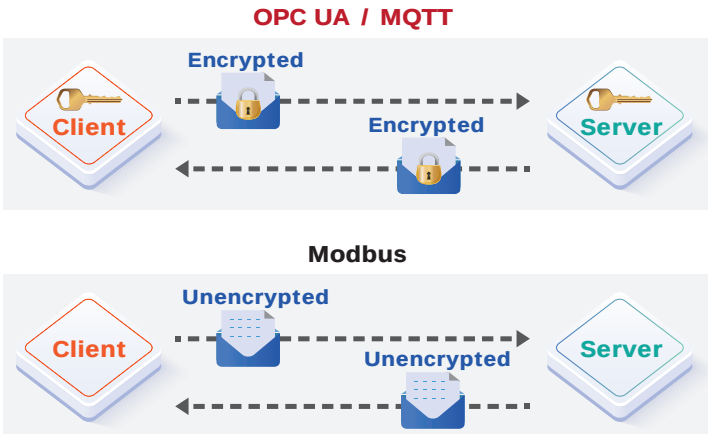
Support Identity Authentication

Identity Authentication			
ICP DAS UA Solution	OPC UA	ID/Password, Anonymous, Certificate	Yes ✓
	MQTT	ID/Password, Anonymous, Certificate	
Traditional	Modbus	None	



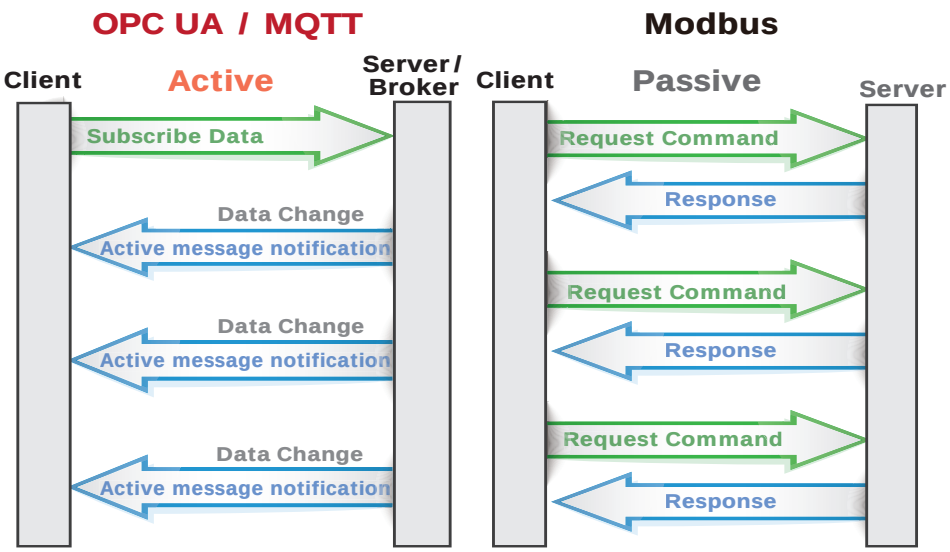
Support Data Encryption

Data Encryption			
ICP DAS UA Solution	OPC UA	SSL/TLS Encryption	Yes ✓
	MQTT	SSL/TLS Encryption	
Traditional	Modbus	None	

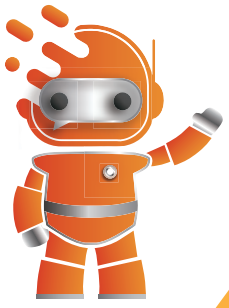


Active Data Transmission

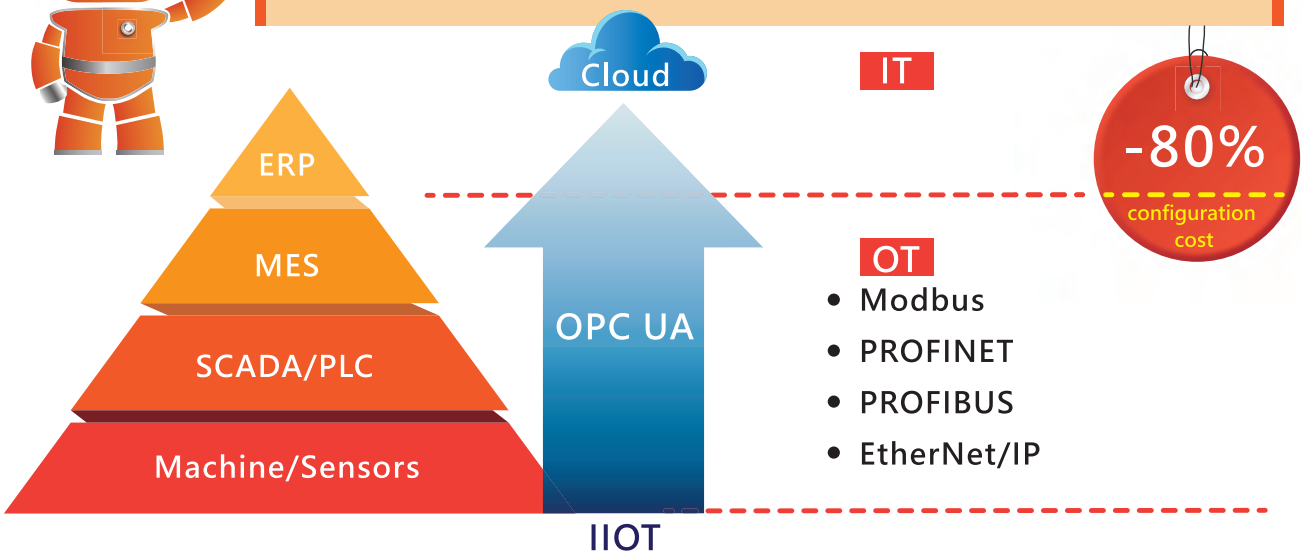
Data Transmission				
ICP DAS UA Solution	OPC UA	Active	Yes ✓	Server sends Data to the Client
	MQTT	Active		Client publishes Data to Broker, and the Broker sends Data to other Clients
Traditional	Modbus	Passive		Request/Response (Wait for Master to poll the Data)



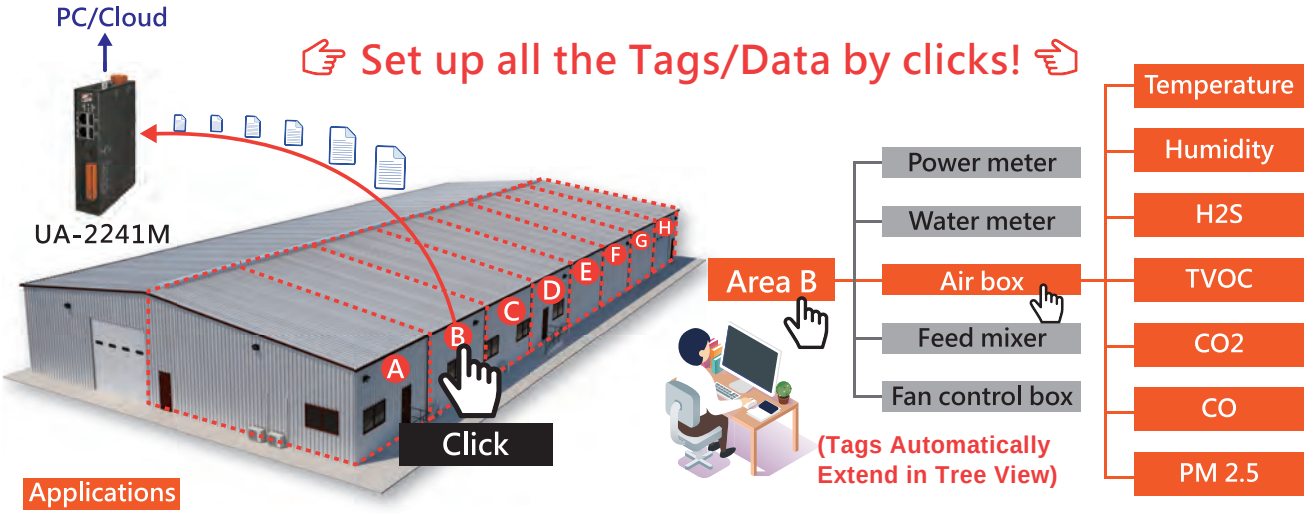
Easy Project Building



Using OPC UA protocol can help MES engineers & software development engineers save 80% configuration cost which is far in advance of competitors.



OPC UA (Easy)	Modbus (Hard)
STEP1 : Get the OPC UA Server URL Address	STEP1: Query the device IP table and get the linked device IP
	STEP2: Set Modbus Master SW and make an IP connection
STEP2 : Connect to the Server via the Client	STEP3: Search Tag Table and get the type and address range
	STEP4: Set Modbus Master SW and get device data
STEP3 : Browse/Subscribe Tags/Data in Server	STEP5: Set SW Tags table and assign recognizable names
	STEP6: Convert the device data to the actual value for the tag



Applications

Modern pig farms

- Temperature
- Humidity
- H2S/TVOC
- CO2/CO
- Water supply
- Food supply
- Fan control

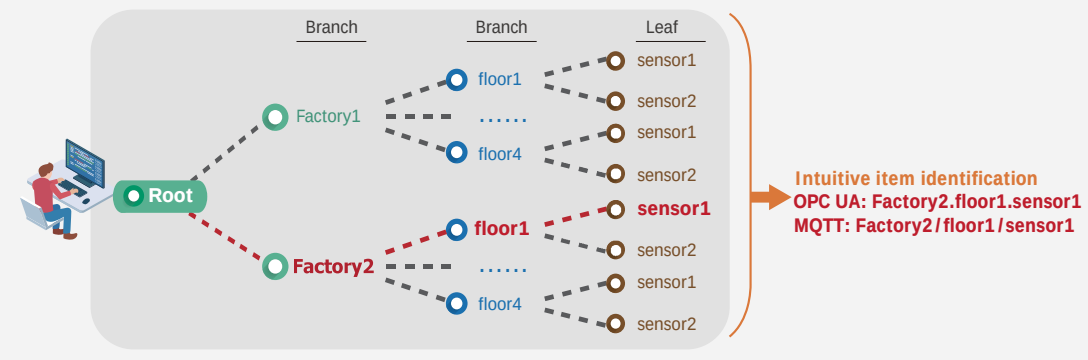
Chemical plant

- Temperature
- Humidity
- Air quality sensor
- Power management
- Access control
- Liquidity monitoring
- Related I/O

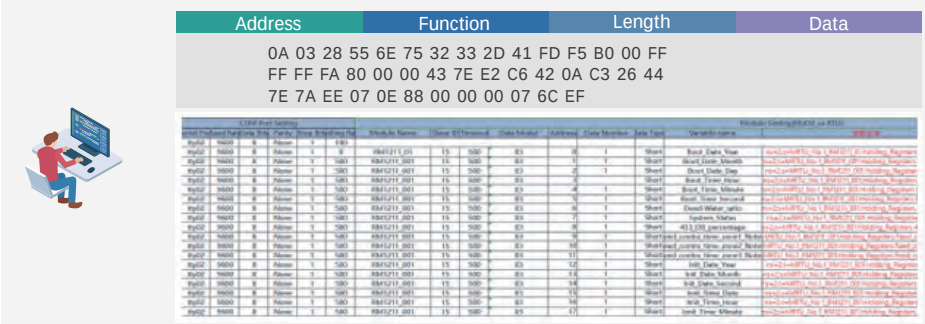
Easy Project Building: UA Project v.s. Traditional Project

Project Building				
ICP DAS UA Solution	OPC UA	Easy	Browse the Server Content	✓
	MQTT	Easy	Subscribe Topic from Broker	
Traditional	Modbus	Hard	Assign an ID and define a Data address, type... table, and then...	

OPC UA / MQTT

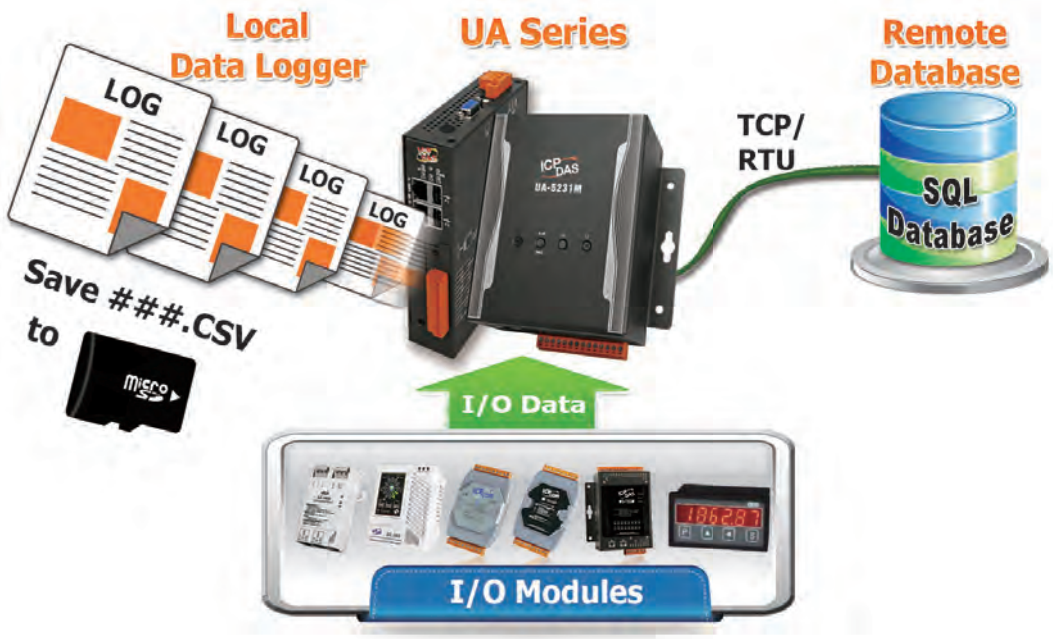


Modbus



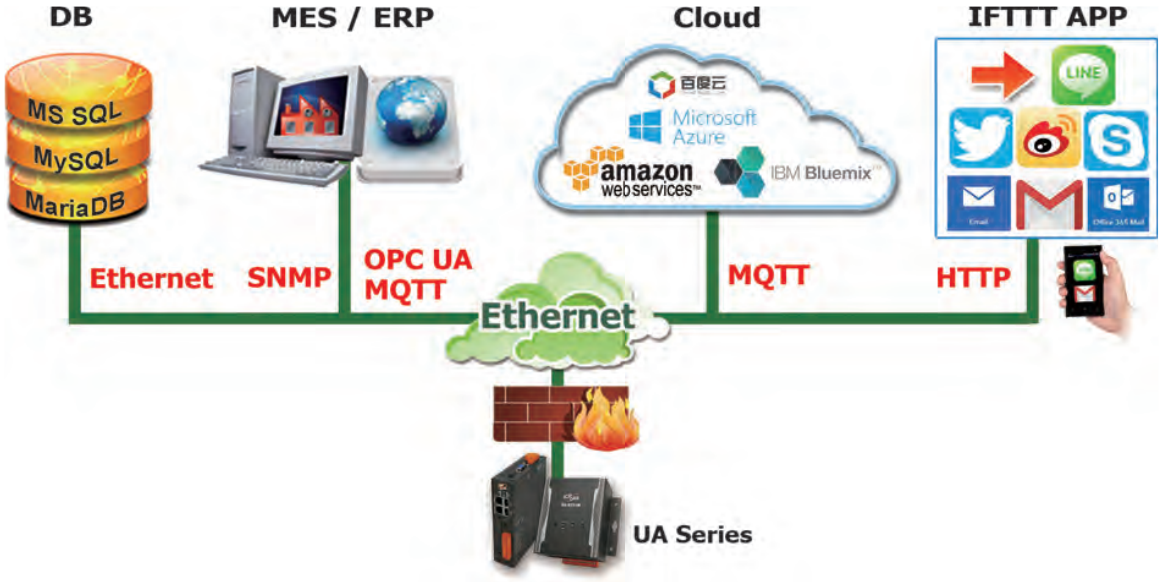
Save I/O Data Directly into Remote Database & Local Side LOG File

UA series can collect devices I/O status and then directly save into remote side SQL Database (MS SQL, MySQL and MariaDB). UA series can also save I/O data into a CSV log file on the local side. Furthermore, users can set the time interval of which CSV file to generate and divide on the local side.



Support Logic Control IFTTT To Send Event Messages To LINE... APPs

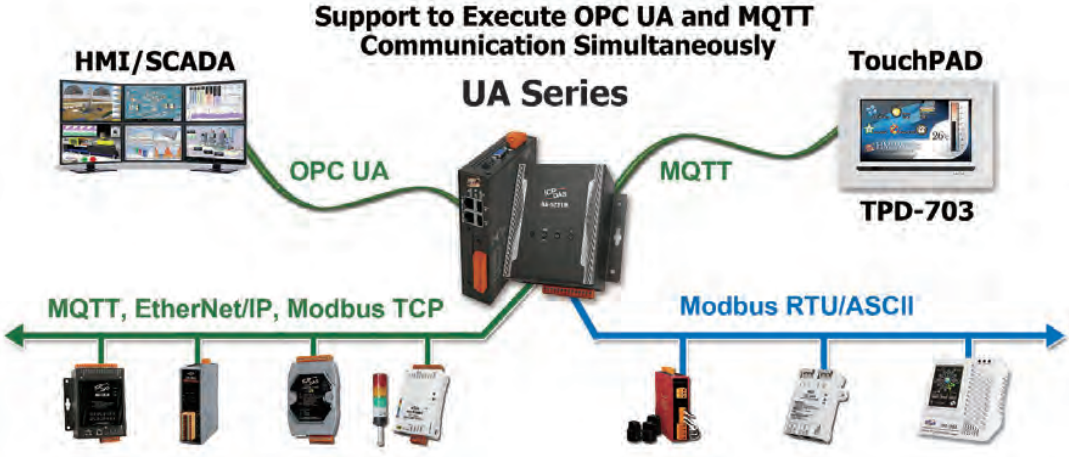
UA can combine the IFTTT cloud platform functions and send messages to more than 500 **Web APPs** (such as LINE, Twitter, Calendar, Mail, Sina Weibo... etc.) when the special events occur. The device I/O change can be set to trigger the event of the IFTTT cloud service, and then the preset "That" Web Service (**e.g. LINE**) will do the action follow the IFTTT (If This, Then That) logic control, for example, the LINE will send a message to the specific user or group to handle the event immediately.



Support Ethernet and Serial Communication Modules

- **Ethernet** : UA supports **MQTT, Modbus TCP**, and **ICP DAS EtherNet/IP** modules
- **Serial** : UA supports **Modbus RTU/ASCII** modules (Max. 3 Serial ports)
- **UA Web UI**: users can quickly set up the modules and display the **real-time I/O status**.
- **Max. modules** supported by each connection:

Communication / UA Series	Ethernet			Serial
	MQTT	Modbus TCP	EtherNet/IP	Modbus RTU/ASCII
UA-2800	500	250	125	32 x 3(ports)
UA-2200/5200	200	100	50	32 x 3(ports)
UA-7200	200	100	50	32 x 1(port)

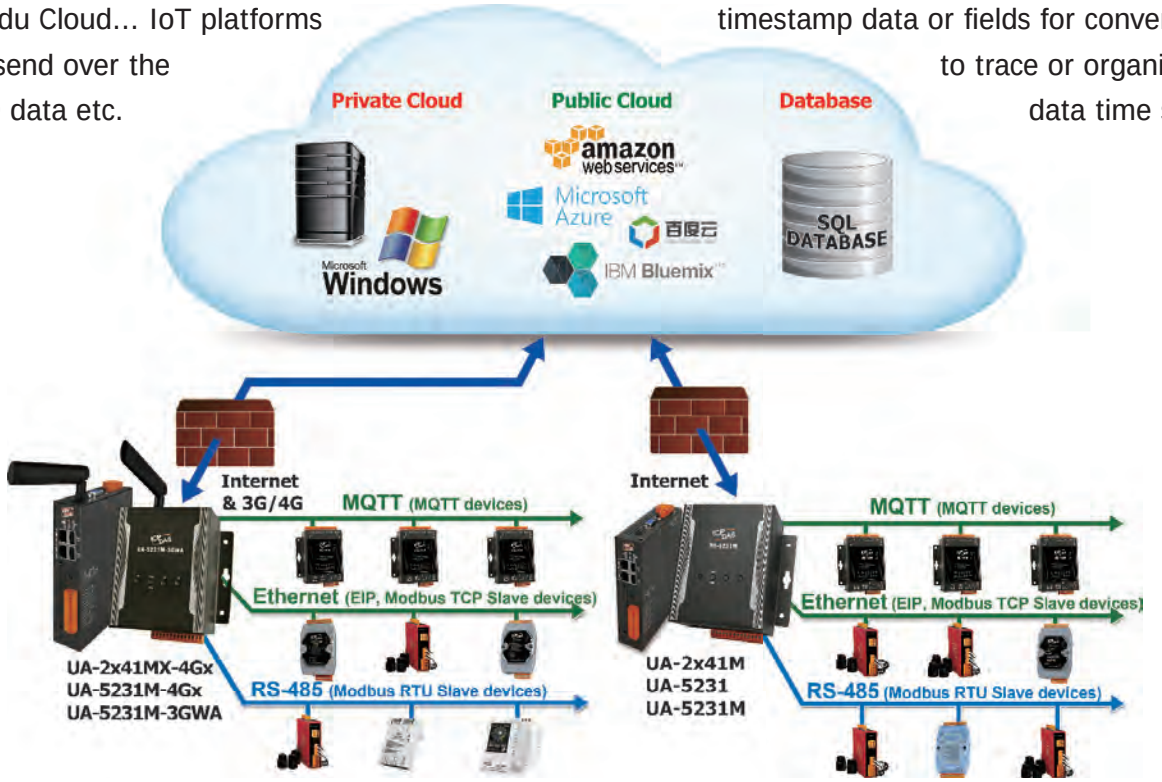


Support Cloud Platforms Connection

UA can actively connect to Amazon AWS, Microsoft Azure, IBM Bluemix, or Baidu Cloud... IoT platforms to send over the I/O data etc.

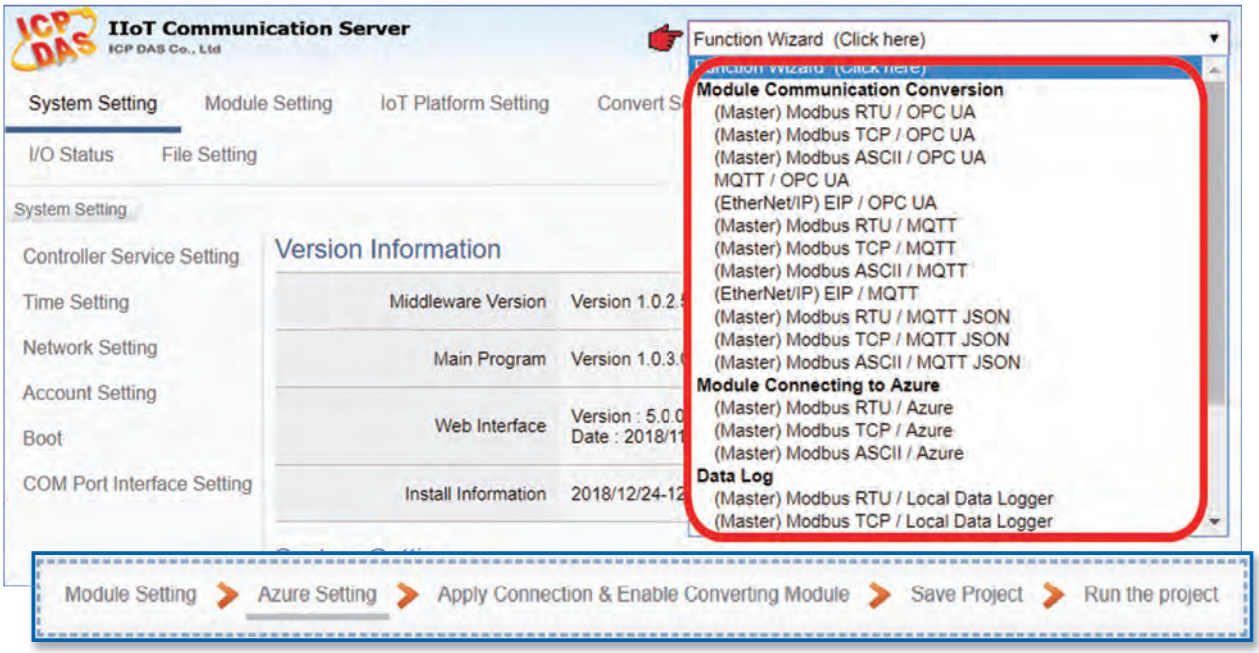
Provide Timestamp Function

All UA communications, such as MQTT Client, OPC UA, and database connection, include timestamp data or fields for convenience to trace or organize the data time series.



Provide Function Wizard Web UI for easily step-by-step setup

The Web UI of UA provides a wizard-like “Step Box” in the Function Wizard area to guide user step by step to complete the project or function. It provides many items for setting the Communication Conversion, Azure Connecting, Local Data Logger, Remote Database, Function Configuration, PID Operation, Condition Trigger the APP Message Notification (Line, Twitter) and will be more. It will help users to set projects easily and quickly.



Applications:

Alert Message Notify LINE Group Application

This security application provides active and non-active signal triggers for buildings, factories, etc. Through the IFTTT platform, it can send the message notification to the user-favorite APPs and instantly master the device information.

Application Features:

- DI or Switch Status Change Notification
- Message to LINE (Personal/Group)
- More APPs:
  Twitter,
  Skype,
  Weibo,
  etc.

CO2 Concentration Monitoring & Notification Application

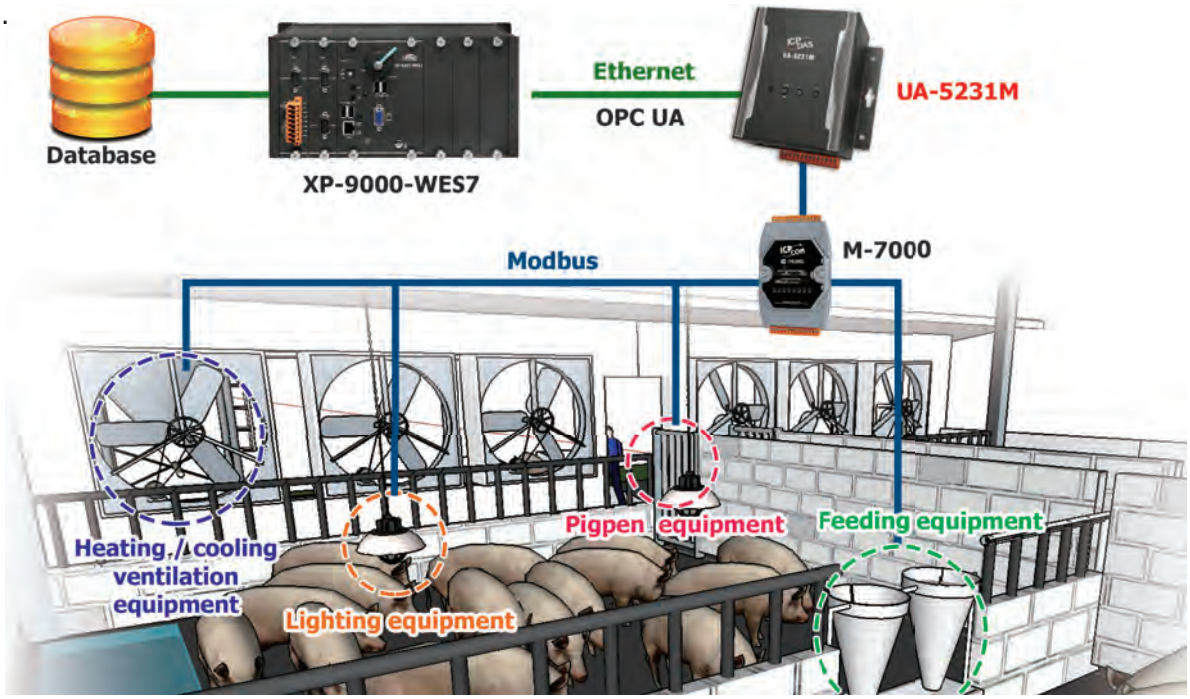
This application for indoor air quality management combines with LED displays, fresh air equipment, etc. When the CO2 concentration exceeds the limit, the system will display information on the LED display, force to ventilation, and sends notifications via IFTTT platform to pre-assigned web software, such as Gmail, e-mail, Office 365 Mail, etc.

Application Features:

- Dead Band Boundary Trigger
  - High:
    Danger Alert
  - Low:
    Safety Notification
- Mail Notification
  (PC/Mobile)
  - Gmail
  - Office 365 Mail
  - e-mail
  - Dropbox ...

Farm Automation Solution

The farm automation solution controls the on-site cooling/heating/ventilation environmental equipment, lighting equipment, feeding equipment, and pigpen equipment through UA-5231M and the connected M-7000 modules. The upper controller XP-9000 manages daily feeding and drinking equipment of every pigpen and integrates the data of the water supply, feed volume and diet to the database, and then analyzes the data and adjusts the application to plan the best breeding solution.

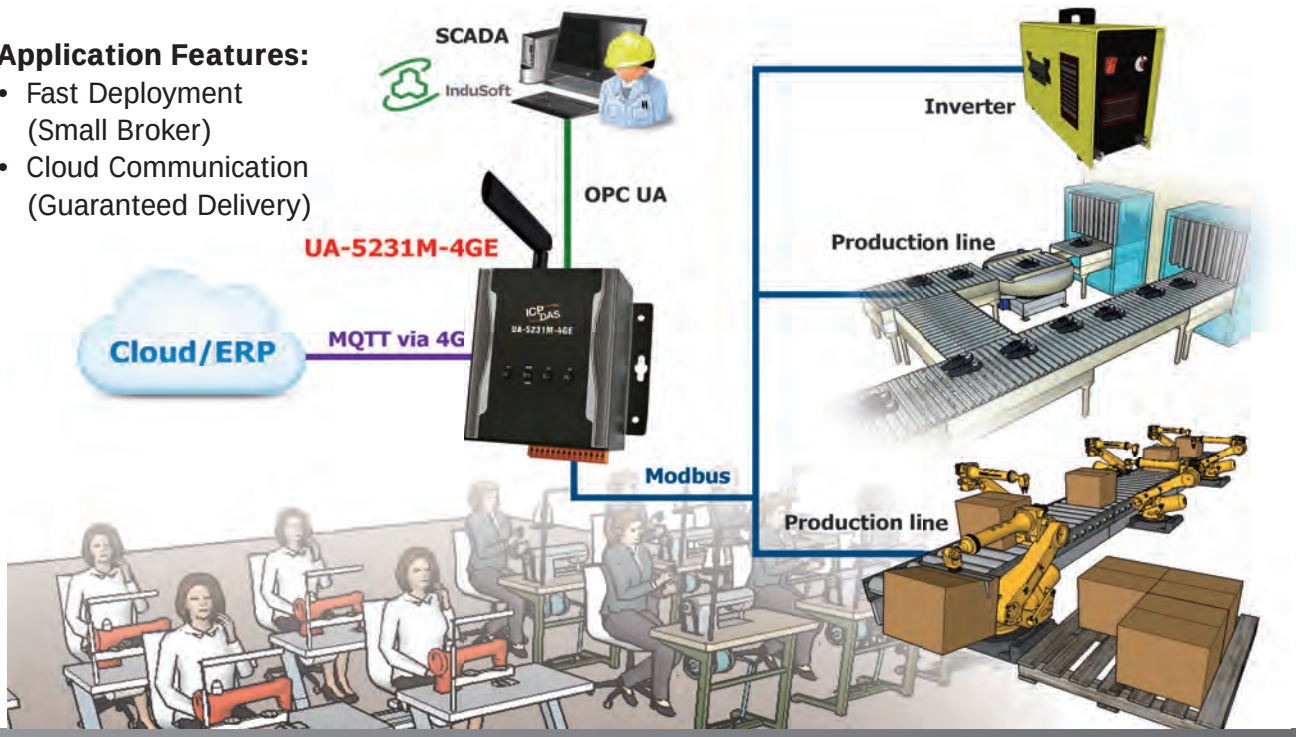


Factory Automatic Solution

The factory automatic solution uses the UA controller to obtain the information such as the safety status of the production line and the temperature, voltage and current status of the inverter, then transmits them to the SCADA control system for real-time factory management. Besides, the 4G wireless can help to integrate the machine status, temperature, product yield, production parameters, electricity consumption, etc. into the ERP system via the MQTT protocol for managing the production of the global factories.

Application Features:

- Fast Deployment (Small Broker)
- Cloud Communication (Guaranteed Delivery)

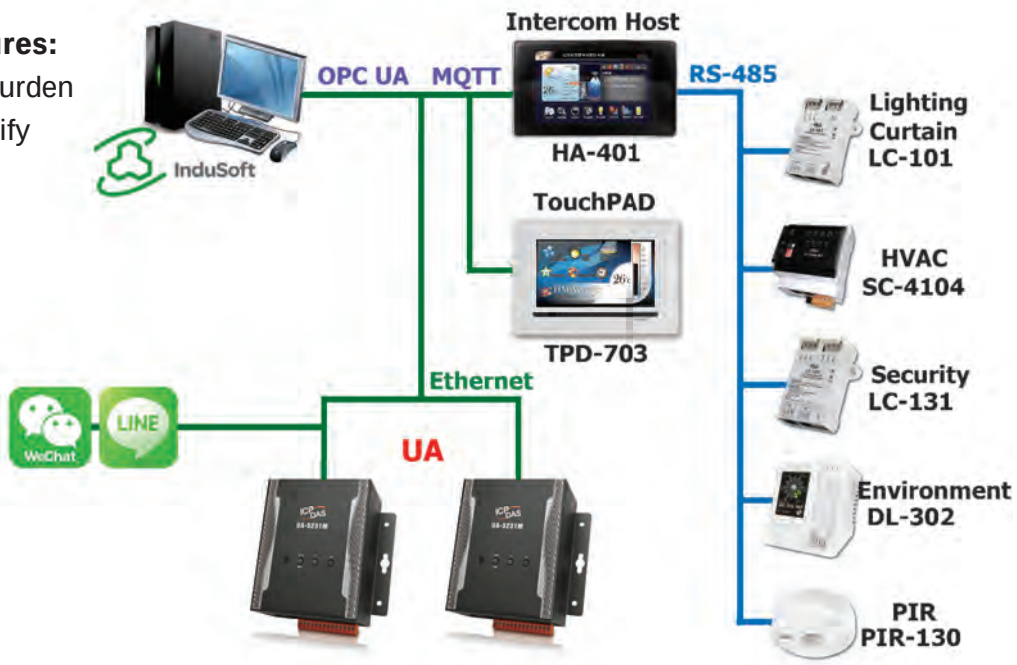


BA Smart Building IoT Application

This IoT application mainly combines the video intercom indoor host HA-401 with the lighting control, air conditioning, security, temperature, humidity, PM2.5, CH4, HCHO, and other harmful substance sense devices to create a safe and comfortable environment. When there is a special situation happens, UA can quickly trigger the event, send a notify to the Web App (ex: LINE, Weibo, Twitter, etc.). The dual UA architecture can reduce the system burden.

Application Features:

- Reduce System Burden
- APP Message Notify

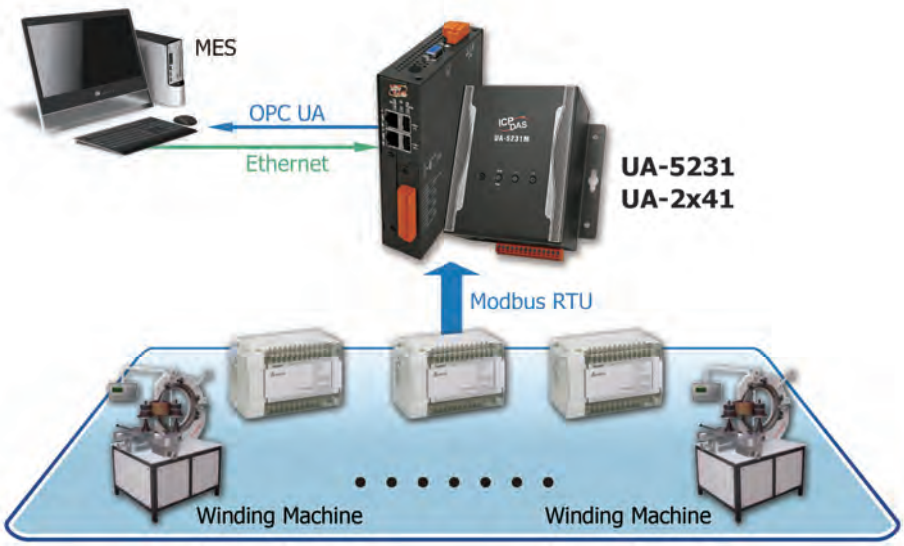


IIoT Factory Application of MES

The Manufacturing Execution System (MES) communicates the factory equipment via OPC UA Client, and the OPC UA Service of the UA-5200 series can seamlessly integrate the system and equipment. The MES is the main solution for today's factory system, and the UA-5200 series IIoT Communication Server is the best choice for the IIoT factory solution.

Application Features:

- Convenient for System Integration
- Unified Access Interface



Pumping Station IoT Application

This application is mainly about how to manage the pumping device data from stations. UA-5231 series uploads the data of all pumping stations to the control center and manages/configures with the IWS software. In this case, the UA-5231 shortens the configuring and adjusting time. Without the complicated PC configuration, the UA-5231 directly connect the Modbus and OPC UA Server by completing all configuration easily and efficiently on the web.

Application Features:

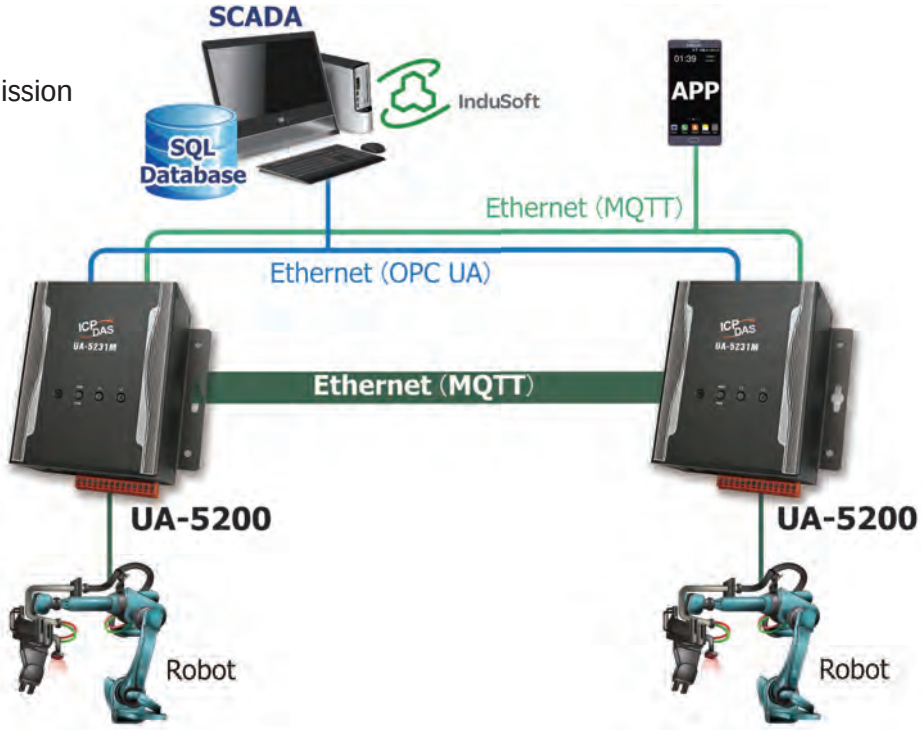
- Cross Web Domain
- Security

Robotic Arm Co-operation Application

This application allows two robotic arms interactive communication and coordinated operation through the MQTT, and do the data analysis and system monitor/control with the database of SQL, Big Data or SCADA through the OPC UA.

Application Features:

- Asynchronous Transmission
- Mobile Monitoring

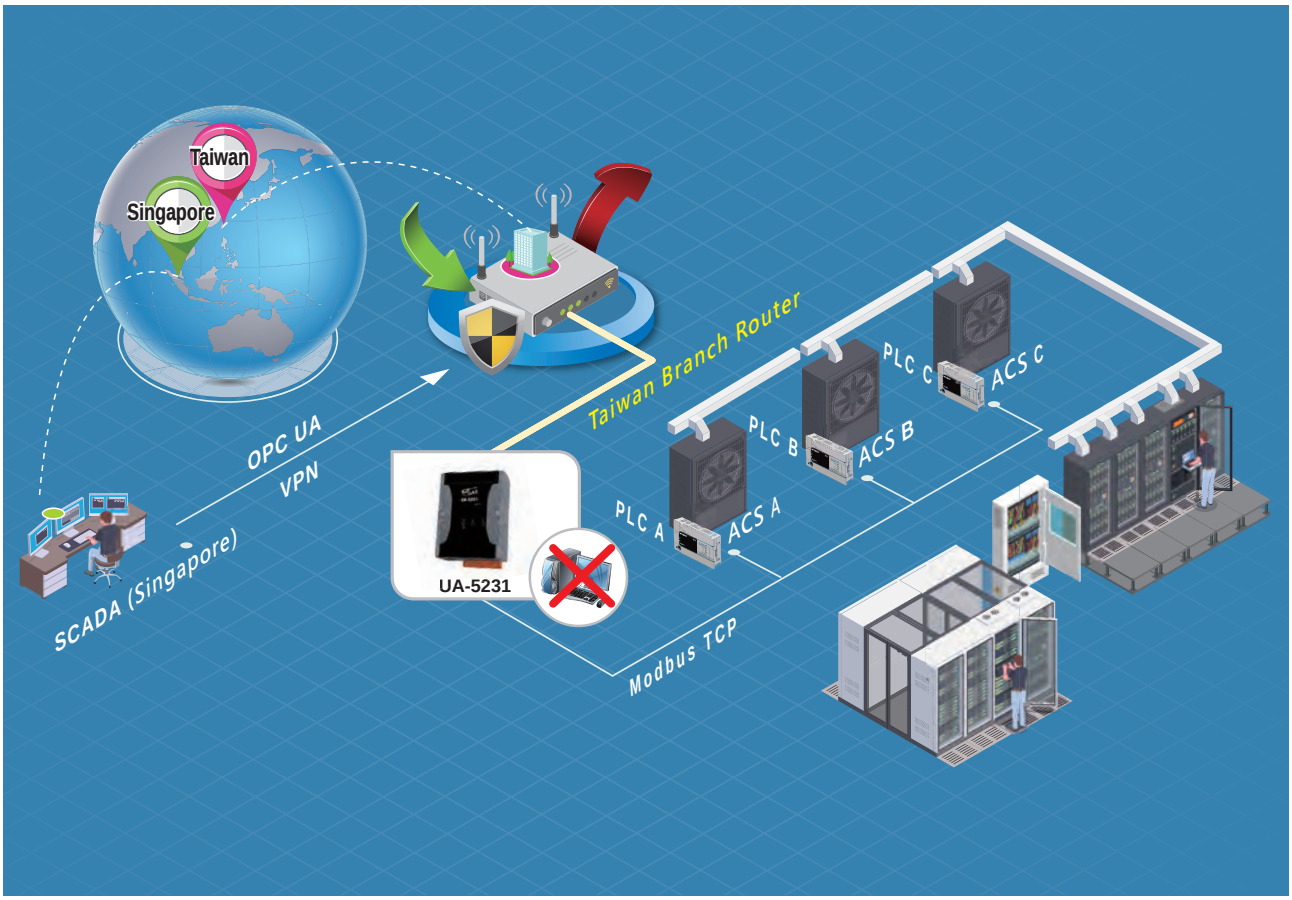


UA-5231 Cross-country Server Room Monitoring Applications

- **Replaces computers, uses OPC UA to connect to OPC Classic**

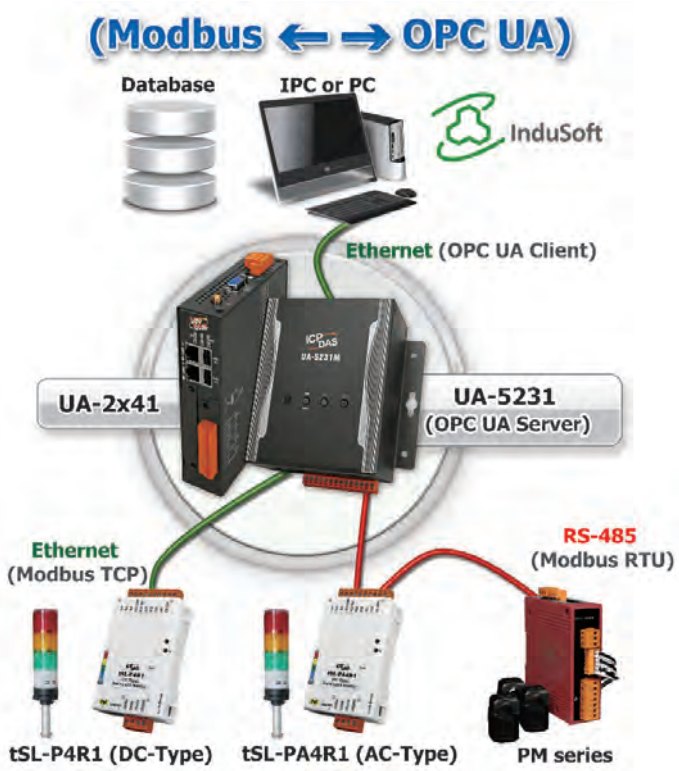
The UA-5231 is an embedded IIoT server with the advantages of smaller size, less heat dissipation, and long-term operation than a PC, and provides the latest version of OPC UA Server function of the industrial communication standard protocol OPC. Compared with OPC Classic, OPC UA provides firewall-friendly cross-domain communication and SSL/TLS encryption communication capabilities.

This case is a solution for a multinational technology company. There was a computer with an OPC Server in the server room of the Taipei branch. Uses the Modbus protocol to monitor the air conditioner of PLC to the head office in Singapore to use the graphic control system to connect remotely. In the new solution, the Taipei branch's server room was upgraded to use UA-5231 instead of a PC, therefore, gaining many advantages. The owner's graphical control system supports both OPC Classic and OPC UA. Change the graphical communication to OPC UA. It's an upgraded method with minimal changes.



Solutions:

1



2

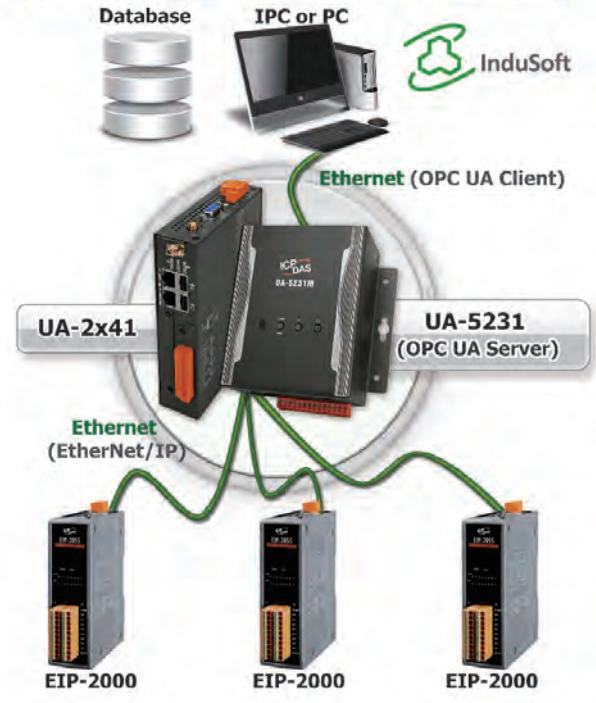
3

4

5 (I/O Event ➔ Comm. APP)

6 (I/O Event ➔ Mail)

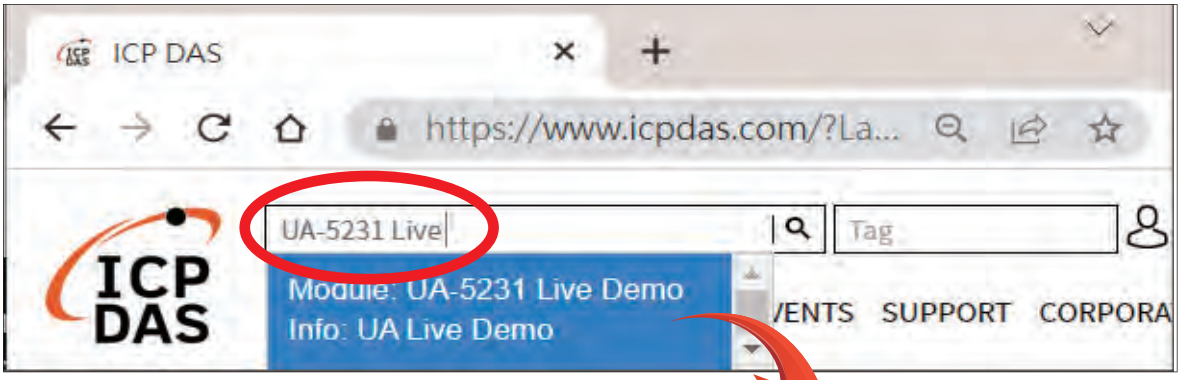
7 (EtherNet/IP ⇐⇒ OPC UA)

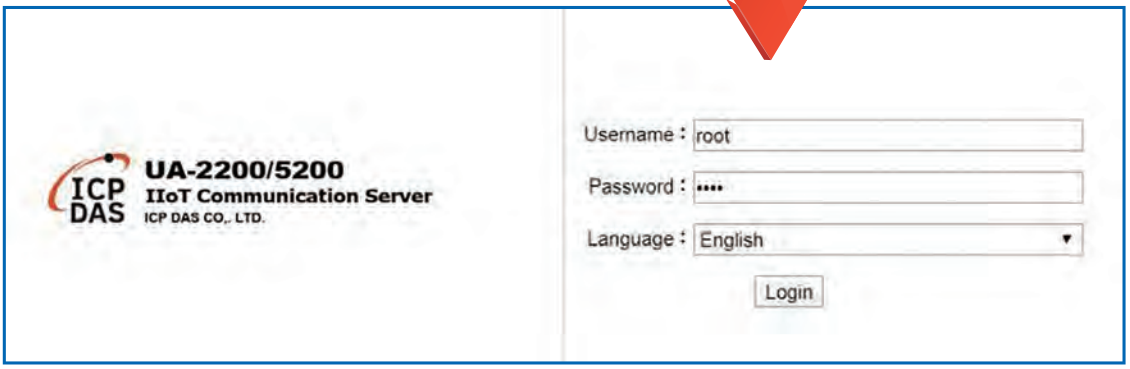


8 (EtherNet/IP ⇐⇒ MQTT)

9

UA-5231 Live Demo:





CH3.MQTT Communication Server: BRK Series

BRK-2000 Series

BRK Series IIoT MQTT Communication Server

Quad-core ARM CPU and 2 Ethernet Ports

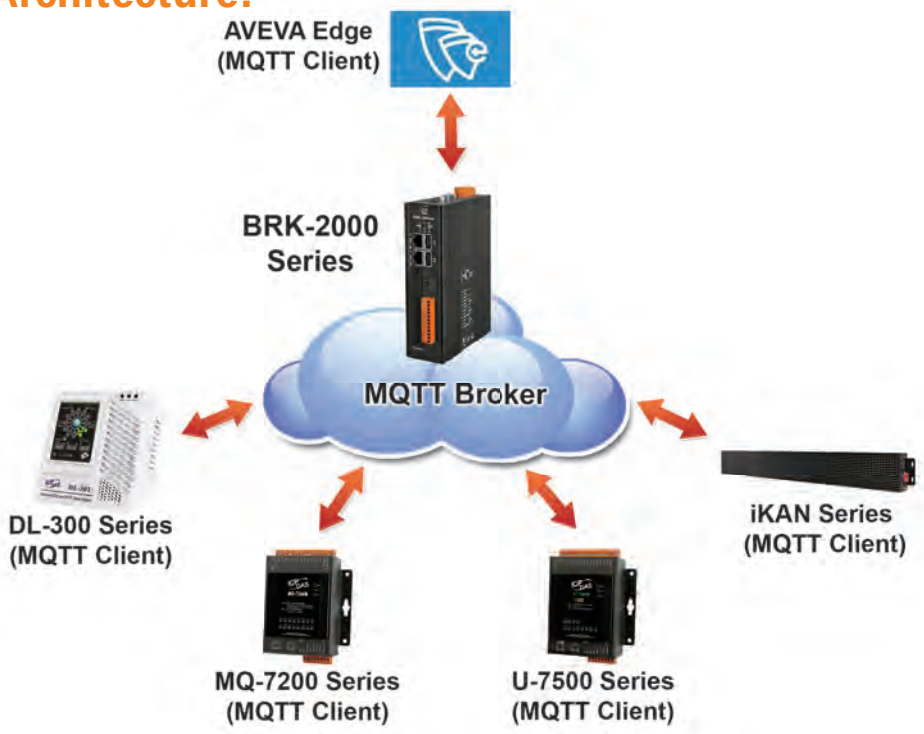
Features

- MQTT Broker Inside:
  - Bridge Function
  - Cluster Function
  - QoS Message Quality Mechanism
  - Retains Mechanism
  - Identity/Password Authentication
  - Communication Encryption
  - Last Message (Last Will)
- Support Load Balancing Function
- Support High Availability Architecture

Introduction :

BRK Series is an Communication Server that specially provides Broker function of MQTT protocol for MQTT message distribution and concentrator in M2M and Industrial Internet of Things environments. The BRK Series is compatible with the MQTT version V.3.1, V.3.1.1 and V.5.0 protocol. It supports many functions such as QoS message quality mechanism, retains mechanism, identity authentication, communication encryption, last message (Last Will), and bridge. The method of Web UI settings can quickly set up BRK functions. This reduce the burden of setting up the broker by user oneself and the maintenance cost. Besides, BRK Series provides Bridge, Cluster, Load Balancer, and High Availability functions. By forming multiple BRK Series a group to a better Redundancy system can prevent field systems from stopping services due to hardware or network failures.

System Architecture:



Advantages/Features:

Provide Bridge and Cluster functions, which allows excellent scalability

The Bridge and Cluster can expand the service limit and data sources for MQTT Broker application:

- **Bridge function**

  Allows BRK series to forward/subscribe the messages to other BRK series or third-party MQTT Brokers. By forwarding messages, it can direct the message to other BRK series service side. By subscribing to the remote brokers, it can increase the data sources.

- **Cluster function**

  Allows BRK series in the same group to share data to others with lower resources. When the number of connections and messages exceeds the limit of a BRK, using the cluster function can increase the number of connections to meet the needs.

Support High Availability architecture

When there are more than two BRK devices in the same site, they can be set as backup between each other. When the BRK device that is providing services fails or goes offline, other BRK device can detect and take over in a short time to ensure that the service will not be interrupted for a long time.

Support Load Balancer function, which can effectively configure tasks and optimize MQTT communication

The BRK load balancing function can be used in conjunction with the MQTT bridging or clustering function. A BRK device in this group provides a single fixed IP and communication port to connect other BRK clients in the group, which can be effectively allocated to the BRK devices in the group for MQTT communication services. This function simplifies user configuration and maximizes the overall system service capacity: when a single or a small number of devices in the group fail, the connection can be redistributed to other BRK devices to continue to provide communication services.

Support Redundancy System

Based on the High Availability architecture and Load Balancing function. This redundancy is hardware backup. In the entire MQTT Broker group, if one of the BRKs fails or disconnects, the other BRKs with normal functions will take over to provide MQTT services, and users do not need to perform other related settings.

Selection Guide:

Model		BRK-2841M
Main Unit		
CPU		Quad-core ARM CPU, 1.6 GHz/Core
System Memory		DDR3 SDRAM 1 GB
Storage		Flash 8 GB
Non-Volatile Memory		FRAM 64 KB, MRAM 128 KB
Ethernet		
Ports		RJ-45 x 2, 10/100/1000 Base-TX (Auto-negotiating, Auto MDI/MDI-X)
Power		
Input Range		+12 ~ +48 VDC
Consumption		4.8 W
Environmental		
Operating Temperature		-25 ~ +75 ° C
Storage Temperature		-40 ~ +80 ° C
Humidity		10 ~ 90% RH,Non-condensing
Software		
MQTT Client Connection Numbers		Max. 100000
MQTT Broker	**Basic Features**	
	Bridge Function	Support
	Cluster Function	Support
	QoS (Quality of Service)	Support QoS0, QoS1, QoS2
	MQTT Protocol	Support V3.1 / V3.1.1 / V5.0
	Retained Message	Support
	Last Will Message	Support
	System Topic($SYS/#)	Support
	Delay Publish	Available Soon
	Topic Alias	Available Soon
	Supported Protocol	
	TCP/SSL	Support
	Websocket (SSL)	Available Soon
	STOMP	Available Soon
	MQTT-SN	Available Soon
	CoAP	Available Soon
	LwM2M	Available Soon
	Identity Authentication	
	Client ID	Support
	User Account & Password	Support
	IP Address	Support
Load Balancing Function		Support
High Availability Architechture		Support

Applications:

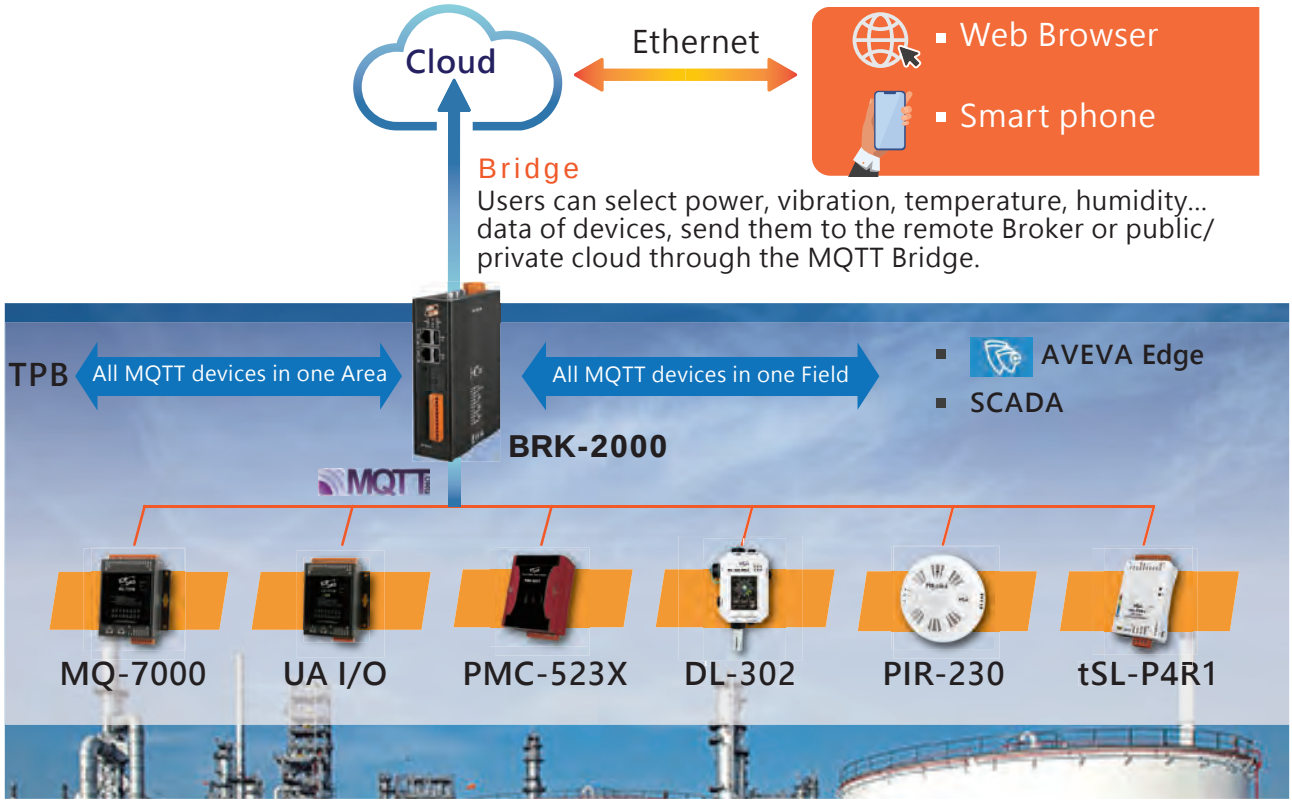
BRK Bridge Architecture Application

Many corporations have large factories, ex: manufacturing, and some areas (ex: confidential data areas or clean rooms) require access control, which causes inconvenience in entering and exiting that takes longer when need troubleshoot. The corporations often take remote control systems to solve the problem. However, the remote control will expose the devices to the external network environment. As long as any device in the system has a data security vulnerability, the entire system may be attacked or even paralyzed.

ICP DAS provides BRK-2000 Series MQTT Bridge Architecture. Through the MQTT Bridge mechanism, only the Topics and permissions that are authorized to be transmitted will send to the Remote Broker in the Bridge Architecture. And the built-in MQTT connection authentication methods such as Account/Password, Client ID, Certificates, etc., to increase the security of the communication to protect data. When doing the remote control, the operations are only to the Remote Broker. The equipment network in the factory can separate from the external network. If the external network communication is abnormal, the internal factory system can still operate without external influence.

Why Choose MQTT Bridge?

- **Safety:**
  Separate Monitor/Control
  ➡ Improve Data Security
- **Management:**
  Separate Areas
  ➡ Classify Infomation Security Management



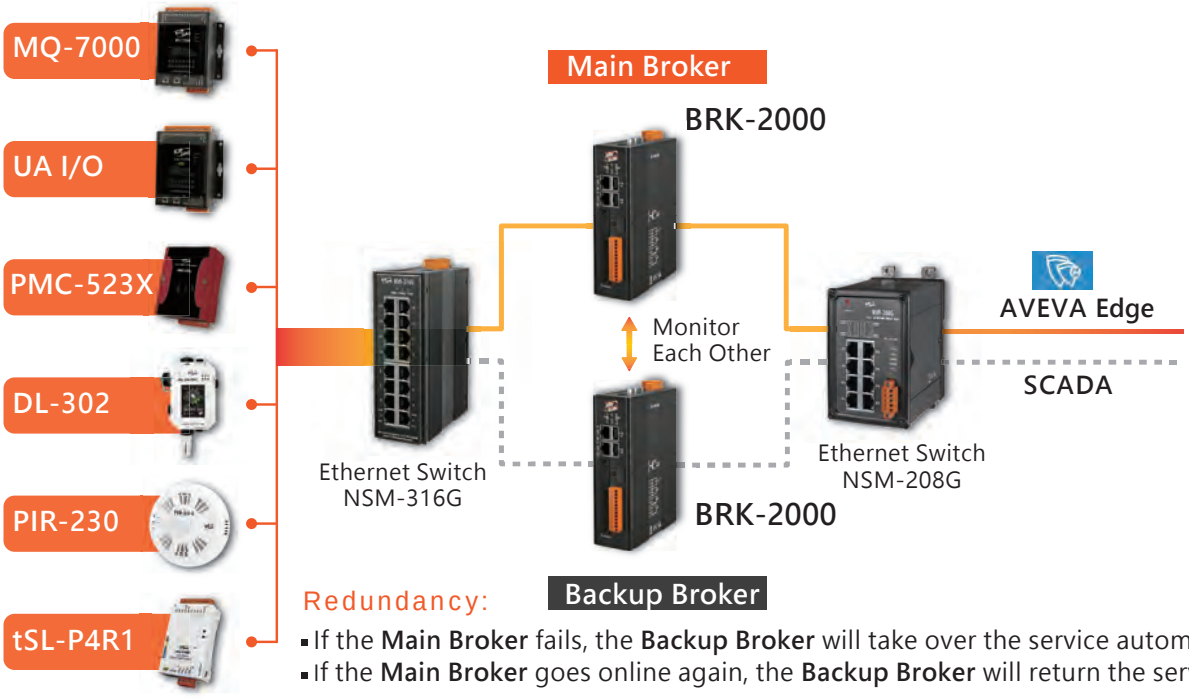
BRK Redundancy Architecture Application

With the development of the Internet of Things, more companies widely use Machine-to-Machine communication to track on-site producing processes, machine operating conditions, report errors, and issue service alerts in real-time. Under the needs, how to protect data from natural disasters and man disasters that damage the system or data has always been the main topic.

ICP DAS provides the BRK Redundancy Architecture for a solution that uses two BRK-2000 Series, one BRK-2000 (Main Broker) provides the MQTT services, and the other is used as a standby backup (Backup Broker) monitor the Main Broker at any time. Once the Main Broker is abnormal (such as shutdown without warning), the standby Backup Broker will take over in time. The MQTT service will not be interrupted, the system manager will have more time to deal with the problem, and the entire system will continue work.

Why Choose MQTT Redundancy?

- **Non-Stop Service:**
  About 5 sec. to switch, no time stamp.
- **Load Balancer Function:**
  Effectively allocate CONN. and COMM.



Redundancy:

- If the **Main Broker** fails, the **Backup Broker** will take over the service automatically.
- If the **Main Broker** goes online again, the **Backup Broker** will return the service.

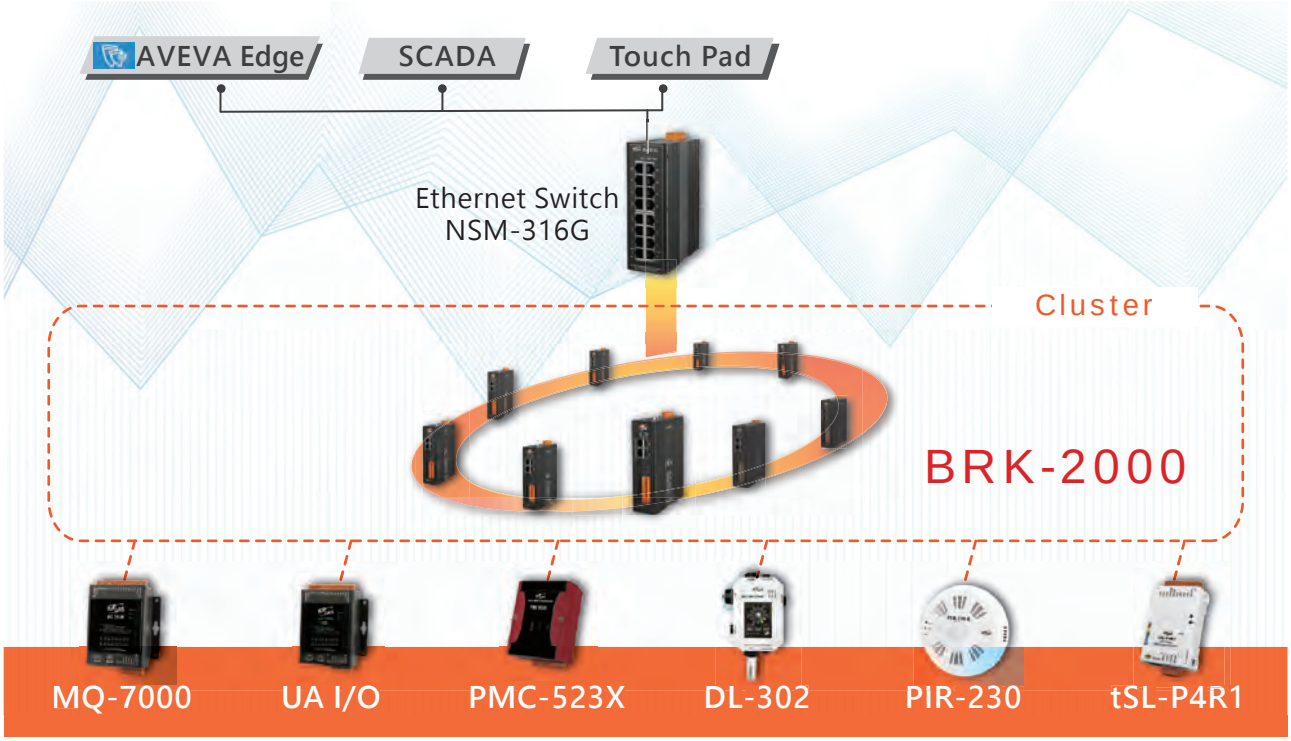
BRK Cluster Architecture Application

The manufacturing industry often deploys sensors to collect the machine status of the production process, parameters, etc. to improve production efficiency, control quality, and reduce the production line shut down due to equipment failure. The sensors send these data to the control center to perform calculations and visualization so that the on-site person can instantly get the status of the production process. However, during the data collection process, the control center may not get the field devices data due to the failure of the network traffic.

To solve this problem, ICP DAS provides the BRK-2000 Series Cluster Architecture that uses two and more BRK-2000 to form a High Availability Cluster. The BRK devices in the Cluster share to do the MQTT services. Since the BRK devices in the Cluster can complete the same tasks, if one BRK fails, other BRK devices can continue to work, thus ensuring the nonstop of MQTT services. BRK-2000 has a built-in Load Balancer function, which allows connection services to be equally distributed in the Cluster, making full use of the processing capabilities of each Broker in the Cluster and improving the processing efficiency of tasks.

Why Choose MQTT Cluster?

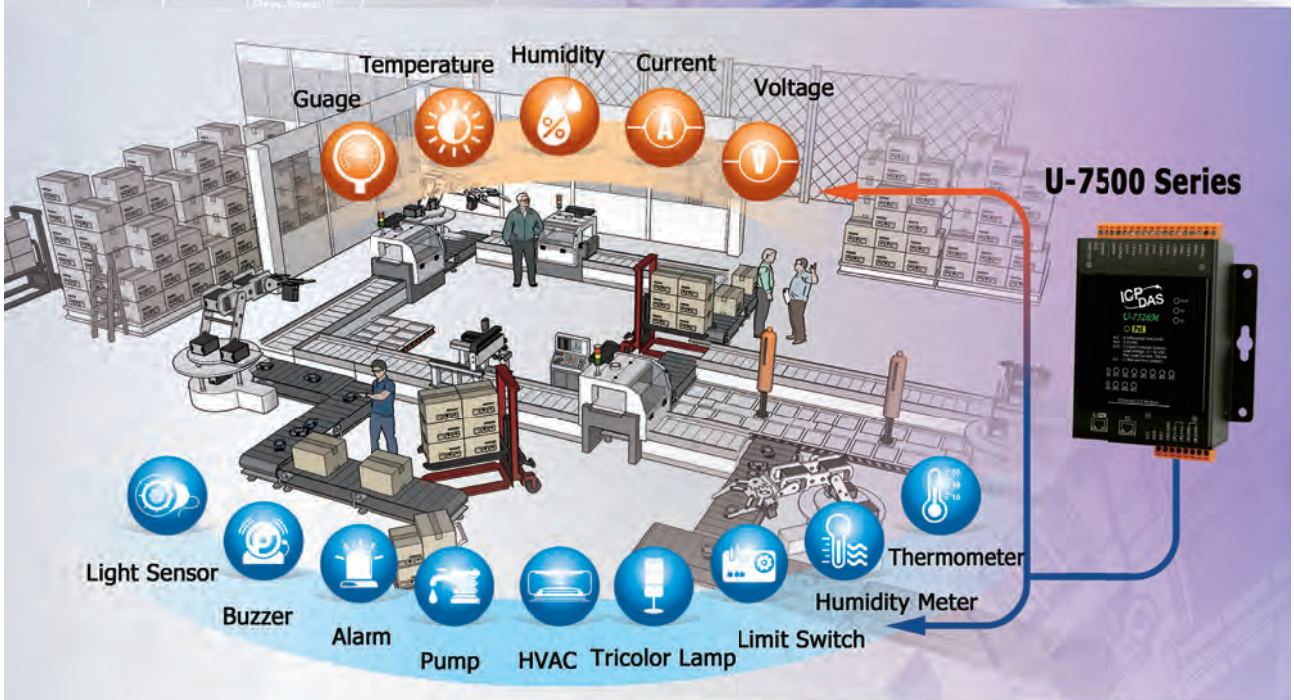
- **Hot-Add:**
  Non-Stop Expansion.
- **High Availability:**
  Non-Interrupted System.



CH4. UA I/O Module: U-7000 Series

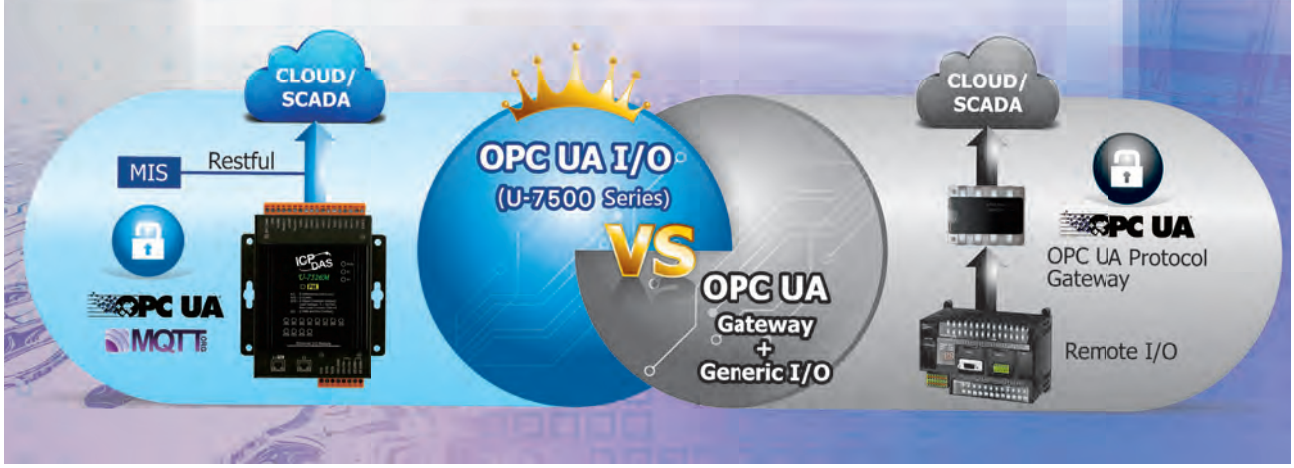
OPC UA I/O Module

Device Connectivity Solutions



Advantages

Information Security	HTTPS, Port Binding, Allowlist
Data Security	Certificate (X.509), Communication Encryption (SSL/TLS)
Logic Control	IF(AND/OR), THEN, ELSE Menu Setting, Output Groups, Linkage Control
Scheduling	Daily Scheduling Weekly Scheduling Weekly Scheduling Exceptions
Event Log	Record when I/O status or value changes



UA I/O Module: U-7000 Series

U-7500 Series

Features:

- Support OPC UA Server and MQTT Client Protocol
- Support RESTful API via HTTP and HTTPS
- Support to Execute OPC UA, MQTT and RESTful API Simultaneously
- Support Scaling For Analog Signal Converting
- Support Logic Function Rule Setting: IF, THEN, ELSE
- Support Schedule: to Execute the Set Rules at a Specific Time.
- Support Event Log: Record the I/O Change for Device Tracking
- Built-in Web Server to Provide the Web User Interface
- Built-in I/O Channels (DI, DO, AI, AO)
- Dual-port Ethernet Switch for Daisy-Chain Topology
- IEEE 802.3af-compliant Power over Ethernet (PoE)

Intrudoction

UA I/O Module, also called **UA I/O** or **U-7500 Series,** is a series of Ethernet I/O modules with built-in **OPC UA Server** and **MQTT Client**. It has a built-in dual-port Ethernet switch to implement daisy-chain topology. The cabling is much easy and can reduce the total cable and switch cost. It follows IEEE 802.3af (Class 2) compliant Power over Ethernet (PoE) specifi cation. It allows receiving power from PoE enabled network by Ethernet pairs. This feature provides greater flexibility and efficiency to simplify system design, save space, and reduce wirings and power sockets.

In industrial communication, UA I/O provides OPC UA Server, MQTT Client and RESTful API protocols (can execute all communications at the same time.). Users can choose the networking mode according to their cases. And to transmit the values of the built-in I/O channels to the Cloud IT system or field control system for reading and writing. Support Scaling. Let the analog signal be converted into a more readable value. Support logic function Rule Setting IF, THEN, ELSE, can set up logical condition/action for I/O and virtual point; Provide schedule function to execute the set rules at a specifi c time; support RESTful API function, can read/write I/O and virtual point through HTTP or HTTPS.

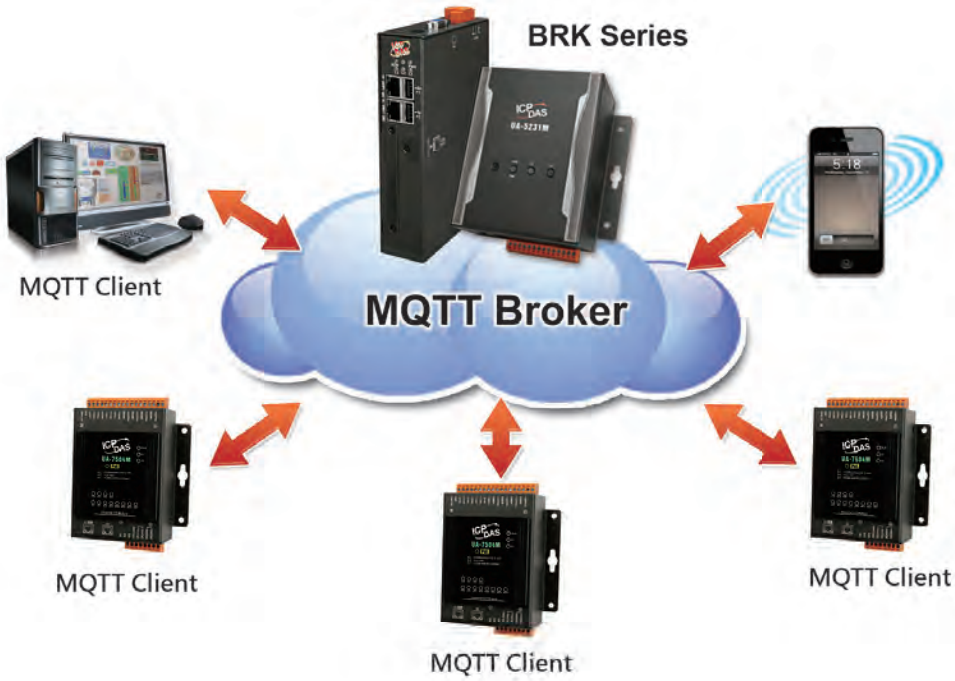
We provide the following functions to enhance the I/O networking security respectively:

Connectivity for various platforms	OPC UA, MQTT, RESTful API can be used simultaneously
Connect to Cloud	OPC UA, MQTT
Connect to SCADA	OPC UA, MQTT
Connect to MES	OPC UA
Connect to IT	MQTT, RESTful API (HTTP, HTTPS)

Security	I/O Networking Security Functions
Information Security	HTTPS, Port Binding, Allowlist, ICMP drop
Data Security	Certificate (X.509), Communication Encryption (SSL/TLS)

OPC UA Architecture:

MQTT Architecture:



Comparison: ICP DAS UA I/O Module v.s. Traditional I/O Module

Item	ICP DAS UA I/O Module		Traditional I/O Module
Protocol	**OPC UA Server**	**MQTT Client**	**Modbus TCP Slave**
Identity Authentication	Account ID/Password, Anonymous, Certificate Verification	Account ID/Password, Anonymous, Certificate Verification	None
Encryption	SSL/TLS, Anonymous	SSL/TLS, Anonymous	None
Data Transmission	Active (Actively sends Data to the Client)	Active (Actively publishes Data to Broker, and the Broker sends Data to other Clients)	Passive (Wait for Master to poll the Data: Query/Response)
Project Building	Via browse the Server Content	Via subscribe Topic from Broker	Manually assign an ID and define the Data address and type.

Features:

Protocol	
OPC UA Server	● OPC Unified Architecture: 1.02 ● Core Server Facet ● Data Access Server Facet ● Method Server Facet ● UA-TCP UA-SC UA Binary ● User Authentication: - Anonymous - Username/Password - X.509 Certificate ● Security Policy: - None - Basic128Rsa15 (Sign, Sign & Encrypt) - Basic256 (Sign, Sign & Encrypt) ● Max. Session Connections: 3 ● Can Execute with MQTT and RESTful API Communication Simultaneously
MQTT Client	● Connect to the MQTT Broker to read orcontrol the I/O channel value by thepublish/ subscribe messaging mechanism. (MQTT Ver. 3.1.1; TLS Ver. 1.2)
RESTful API	● User can read/write the I/O & Virtual points through HTTP and HTTPS.

Function	
Web Interface for Configuration	● The system operation can be performed through the browser without installing software tools. ● Use AES 256 encryption algorithm to encrypt web page setting data for general communication. ● HTTPS upgrades the security of web communication.
Scaling	● Convert the analog signal to a more readable value. ● Function is only available for modules with AI/O.
Security	● Infromation Security: Provide HTTPS, Port Binding ,Allowlist, ICMP drop functions. ● Data security: Provide Certificate (X.509),Communication Encryption (SSL/TLS) functions.
Rule Setting	● Provide simple logic condition rule setting, let UAI/O do automatic condition judgment and actioncontrol, to achieve simple intelligentization.
Schedule	● Provide schedule function to execute the set rules at a specific time.
Event Log	● When the I/O value changes, record the current I/O value for easy device tracking in the future.
IoTstar Setting	● Support IoTstar cloud management software developed by ICP DAS.

Selection Guide:

Module Name	AI		AO		DI		DO	
	Ch.	Type	Ch.	Type	Ch.	Type	Ch.	Type
U-7502M	3	±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V, +0 mA ~ +20 mA, ±20 mA, 4 ~ 20 mA	-	-	6	Wet (Sink/Source)	3	Power Relay Form A (SPST N.O.)
U-7504M	4	±500mV, ±1V, ±5V, ±10V, 0~20mA, ±20mA, 4~20mA	4	0~5V, ±5V, 0~10V, ±10V, 0~20mA, 4~20mA	4	Dry (Source), Wet (Sink)	-	-
U-7515M	7	Pt100, Pt1000, Ni120, Cu100, Cu1000	-	-	-	-	-	-
U-7517M	8	±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V, ±20 mA, 0 ~ 20 mA, 4 ~ 20 mA	-	-	-	-	4	Open Collector (Sink)
U-7517M-10	10 / 20	±150mV, ±500mV, ±1V, ±5V, ±10V, ±20mA, 0~20mA, 4~20mA	-	-	-	-	-	-
U-7518ZM/S	10	±15 mV, ±50 mV, ±100 mV, ±500 mV, ±1 V, ±2.5 V, ±20 mA, 0 ~ 20 mA, 4 ~ 20 mA Thermocouple: J, K, T, E, R, S, B, N, C, L, M, LDIN43710	-	-	-	-	3	Open Collector (Sink)
U-7518ZM/S2								
U-7519ZM/S	10	±150mV, ±500mV, ±1V, ±5V, ±10V, ±20mA, 0~20mA, 4~20mA Thermocouple: J, K, T, E, R, S, B, N, C, L, M, LDIN43710	-	-	-	-	3	Open Collector (Sink)
U-7519ZM/S2								
U-7524M	-	-	4	0~5V, ±5V, 0~10V, ±10V, 0~20mA, 4~20mA	5	Dry (Source), Wet (Sink Source)	5	Open Collector (Sink)
U-7526M	6	±500 mV, ±1V, ±5V, ±10V, 0~20mA, ±20mA, 4~20mA	2	0~5V, ±5V, 0~10V, ±10V, 0~20mA, 4~20mA	2	Dry (Source), Wet (Sink,Source)	2	Open Collector
U-7528M	-	-	8	0~5V, ±5V, 0~10V, ±10V, 0~20mA, 4~20mA	-	-	-	-
U-7542M	-	-	-	-	-	-	16	Open Collector (Sink)
U-7544M	-	-	-	-	8	Wet (Sink,Source)	8	Open Collector (Sink)
U-7545M	-	-	-	-	-	-	16	Open Collector (Source)
U-7550AM	-	-	-	-	12	Dry (Source) Wet (Sink)	6	Open Collector (Sink)
U-7551M	-	-	-	-	16	Wet (Sink,Source)	-	-
U-7552M	-	-	-	-	8	Wet (Sink,Source)	8	Open Collector (Source)
U-7553M	-	-	-	-	16	Wet (Sink,Source)	-	-
U-7555M	-	-	-	-	8	Dry (Source), Wet (Sink,Source)	8	Open Collector (Sink)
U-7558M	-	-	-	-	8	Wet (Sink/Source)	-	-
U-7559M	-	-	-	-	6	Wet (Sink/Source)	-	-
U-7560M	-	-	-	-	6	Wet (Sink/Source)	6	Power Relay Form A (SPST N.O.)
U-7561M	-	-	-	-	-	-	11	Power Relay Form A (SPST N.O.)
U-7567M	-	-	-	-	-	-	8	Power Relay Form A (SPST N.O.)

Applications:

UA I/O Module Motor Monitoring Applications

[Customer Needs]

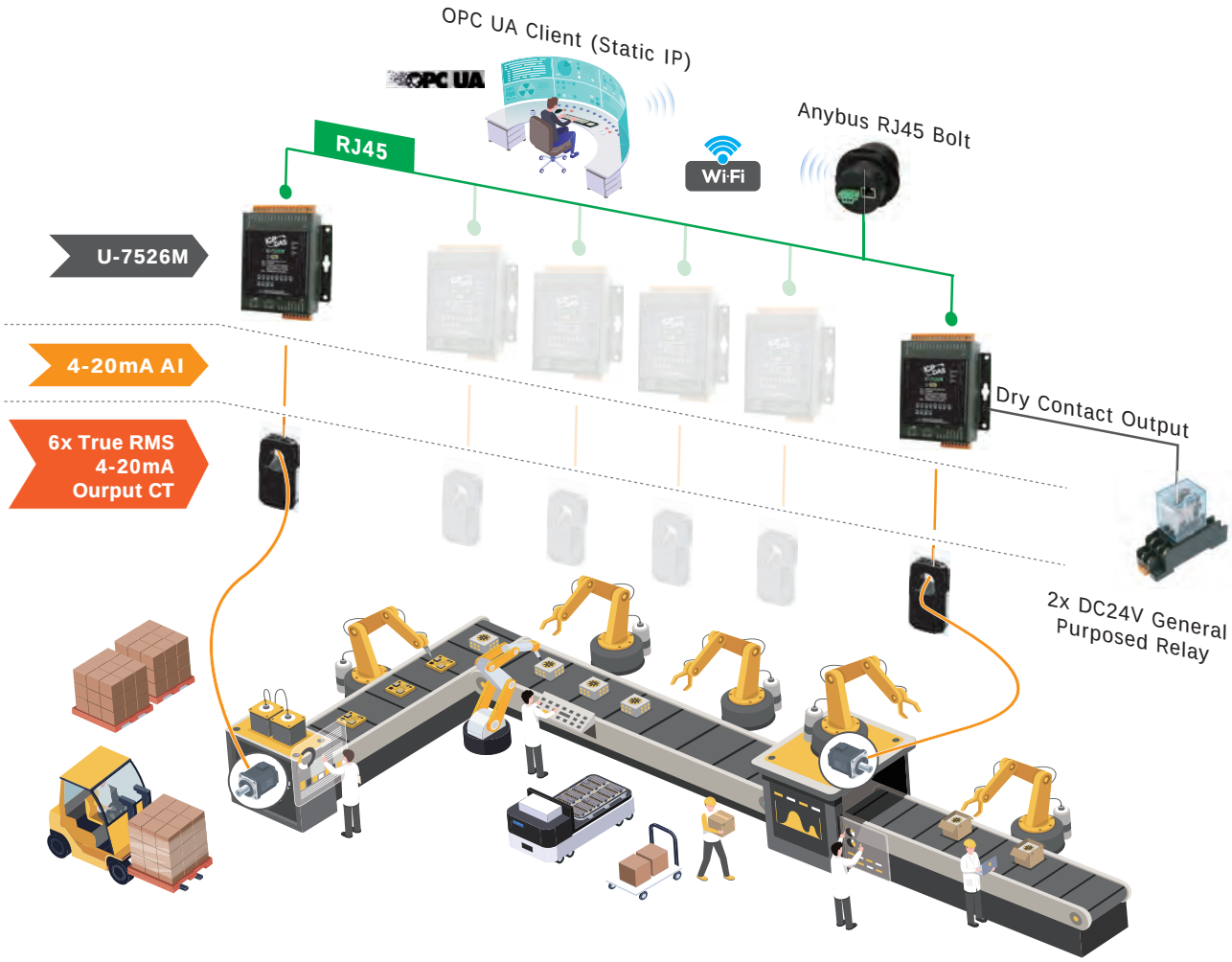
1. Monitoring the motor special-output current in the factory
2. High security data transmission
3. Monitor the factory through wireless according to the client's needs

- **1. Designed to monitor the special-output current motor in the factory**
  The input of the electric meter is 50 / 60 Hz, and the output of the motor in the field is 50 / 6000 Hz, the precision is not enough to use an electric meter for motor monitoring, therefore, a high-frequency CT is used to monitor the motor output current.

- **2. Enhanced data transmission with high security**
  The U-7500 series modules transfer the motor= streaming data through OPC UA and MQTT protocols with high security, so the information security of the factory can be improved.

- **3. Monitoring the client's factory via wireless**
  Through the RJ45 to Wi-Fi adapter, the wired signal in the factory is converted to wireless signal transmission, allowing customers to monitor the factory.

- **[UA I/O Module Motor Monitoring Framework] :**



Environmental Monitoring and Maintenance Applications

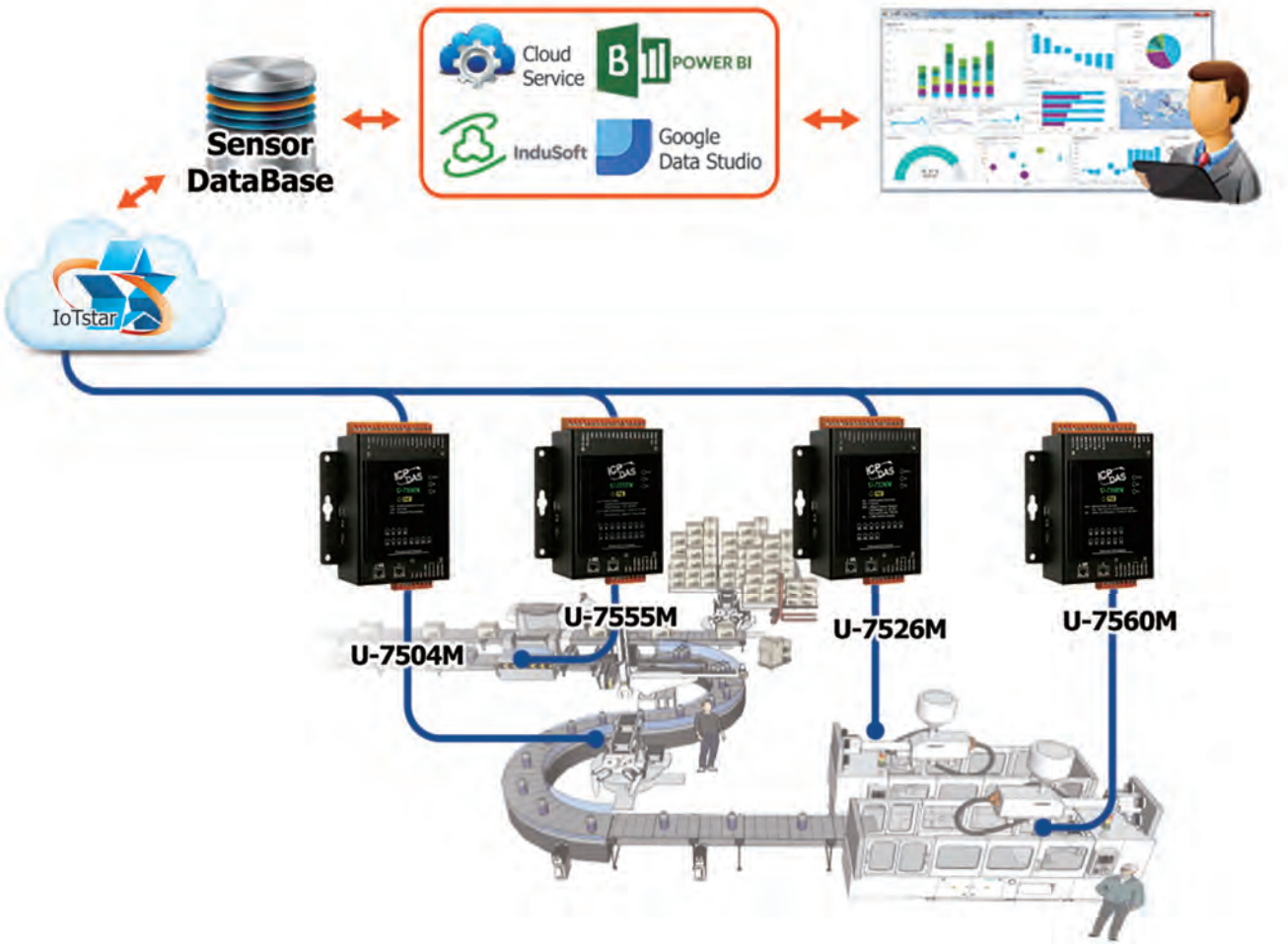
Using ICP DAS IoTstar with UA I/O solution can bring many benefits. In this case, the customer uses IoTstar cloud management software combined with UA I/O module series to set up a cloud IoT monitoring system, and the manager can get the following benefits.
** Support IoTstar cloud management software

- 1. **No programming is required**
  Collect environmental parameters and store them in the cloud database, the system can be set up through the web interface without writing programs.

- 2. **Collection and monitoring of production line information**
  Check environment parameters of the site in real-time via IoTstar Dashboard Service, information on the production line can be collected and monitored completely.

- 3. **Reduce the cost of equipment maintenance**
  Through IoTstar Remote Access Service, cloud monitoring, setting adjustment, and firmware updates can be performed, reducing the time and cost of personnel movement due to equipment maintenance.

- **[IoTstar with UA I/O Module Environmental Monitoring Framework] :**



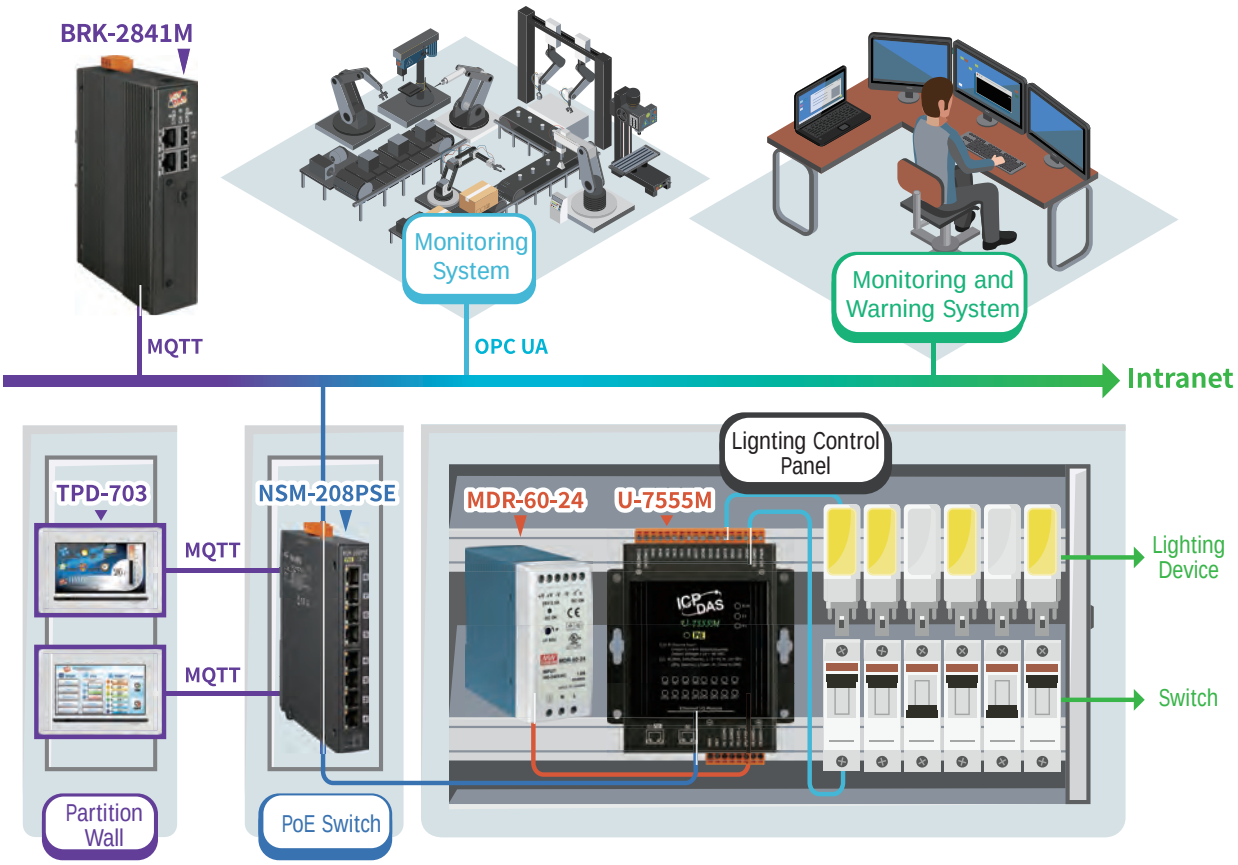
Smart Lighting Control System for Biomedical Factory

Various smart devices have been added to daily life. Smart lighting control can achieve energy savings, data analysis, and remind maintenance of lighting equipment. However, it also faces the threat of security attacks. ICP DAS has installed an intelligent lighting control system to provide stable lighting and arrange maintenance to reduce management costs.

The new function reduces the distance between the new technology and people by retaining the traditional light control panel switch. It provides the service when the lighting control module needs to be repaired. The security of data transmission using the network interface for lighting control also needs to be considered.

- **System Architecture**

  ICP DAS on the lighting control system for medical factorys, in addition to the traditional lighting and physical switches, six additional units have been added, a lighting control panel, network switch, touch screen, communication server, factory monitoring system, and monitoring and early warning system.



The lighting control can also be integrated with various sensors to realize context-based dimming functions to achieve energy-saving effects, and data analysis can be added to remind equipment maintenance to reduce management costs.

• 1. Lighting Control Panel

The control core is the U-7555M module. The digital outputs and inputs on the module are wired to the relays of the lighting circuits and the lighting panel switch, respectively. This module also provides logic and scheduling control. It's a stand-alone lighting control module. Provides three highly secure data exchange protocols, OPC UA, MQTT, and Restful API (https) to reduce information security risks.

• 2. Network Switch

The network switch is daisy-chained to the U-7555M in the lighting control panel, the user expects to install the touch screen on the cubicle wall and integrated it into the main network. The communication protocols are not polling mechanisms, the bandwidth requirements for the factory are extremely low.

• 3. Touch Screen

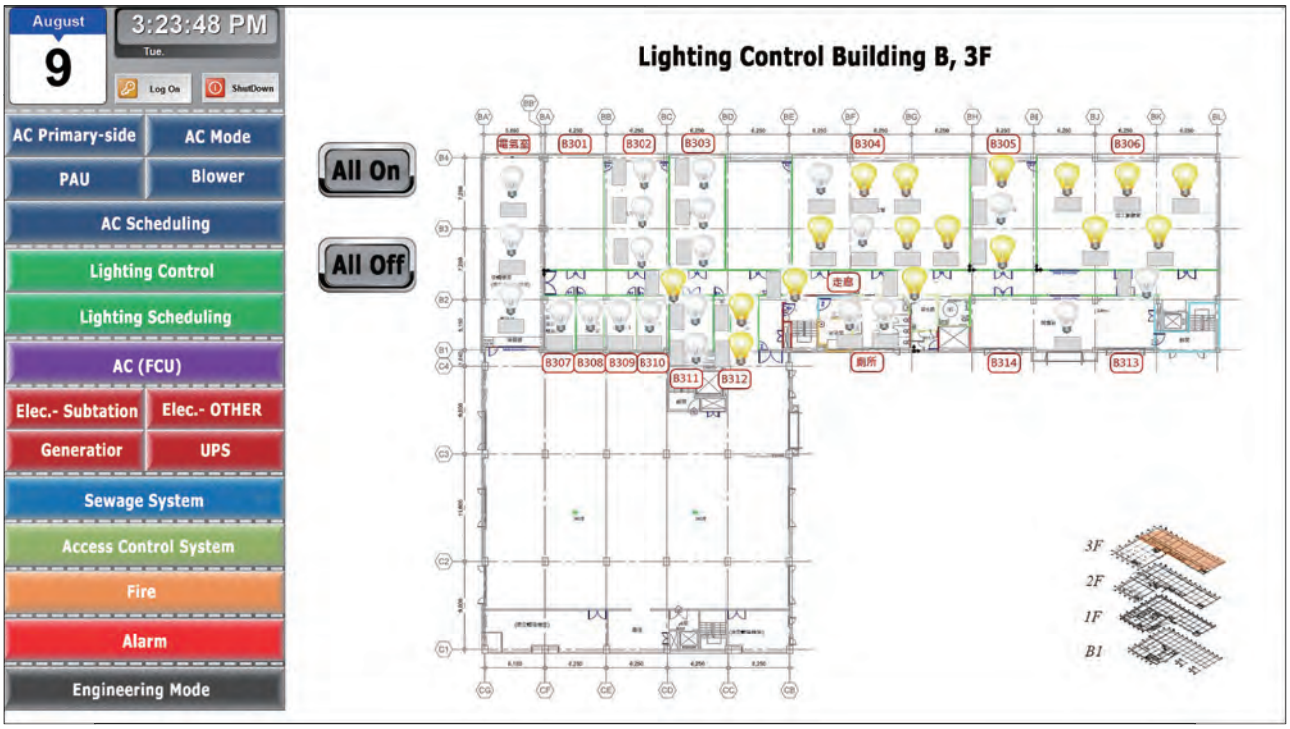
The touch screen is available in 2.8", 4.3", or 7". Small size fits only light switches, large size with other settings that can be integrated, such as air conditioning, access control, power information, environmental sensor information, etc. It can also use a control interface for lighting and air conditioning.

• 4. Communication Server

BRK-2841M provides the Broker function of MQTT protocol for MQTT message dispatching and proxy. It is compliant with MQTT V.3.1, 3.1.1, and 5.0 protocols, and supports the QoS message quality mechanism, retention mechanism, identity verification, communication encryption, Last Will, and bridging function. Supports Web UI setting to quickly set up the BRK function, which can reduce the burden of setting up the Broker by individuals and reduce management costs. It provides clustering, bridging, load balancing, and high availability functions to prevent service downtime due to system failure in the field.

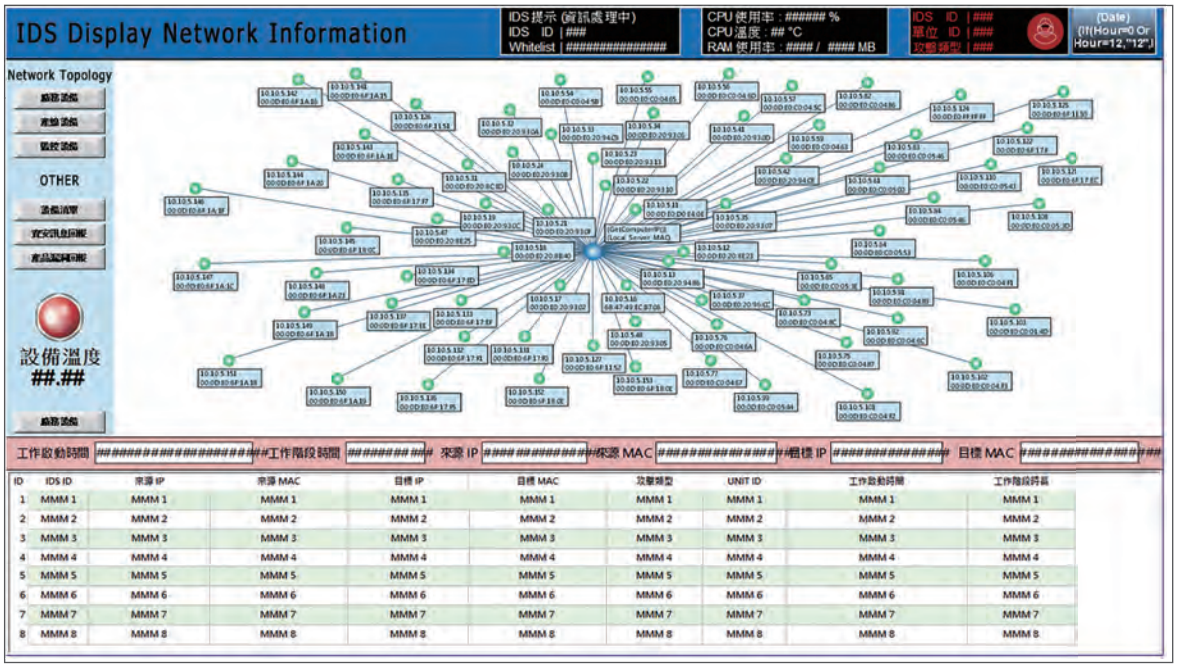
• 5. Factory Monitoring System

Using AVEVA Edge to integrate water, electricity, gas, lighting, access control, etc. within the factory. Provides the information in real-time on factory computers, handheld devices, and databases where information is not immediately available but needs to be stored. The former provides a stable production environment, while the latter is used for data analysis and supplied maintenance notification, etc.



• 6. Monitoring and Early Warning System

The network planning is based on the Purdue model of IoT, but most of the equipment purchased in the factory cannot provide high-security communication protocols. Therefore, a monitoring and early warning system is built to monitor IP and devices without encrypted communication protocol (Modbus TCP) in the factory in real-time, and notify MIS, factory management and record notification in case of abnormalities.



Energy Management Solution

- InduSoft SCADA Software
- Smart Power Meter Concentrator
- Smart Power Meter
- True RMS Input Module
- TouchPAD Devices - VPD Series

IIoT Product

- IoTstar : cloud management software
- UA-5200 : communication server
- WISE series : IIoT host
- iCAM series : IP camera
- MQ-7200M series : MQTT I/O module
- Sensors : temperature, humidity, CO2, PM2.5,...

Industrial Fieldbus

- RS-485
- Industrial Ethernet
- Profinet
- CAN bus
- CANopen
- Devicenet
- J1939
- PROFIBUS
- HART
- Ethernet/IP
- BACnet

Wireless Solution

- Built-in OPC UA Server Service
- Built-in MQTT Broker Service
- Support Logic Control IFTTT
- Support IoT Cloud Platforms Connection and IoTstar Cloud Management
- IIoT Factory Application of MES
- Pumping Station IoT Application
- BA Smart Building IoT Application
- Robotic Arm Co-operation Application

Machine Automation

- Motionnet Solutions
- EtherCAT Motion Control Solutions
- Ethernet Motion Control Solutions
- Serial Communication Motion Control Solutions
- CANopen Motion Control Solutions
- PC-based Motion Control Cards
- PAC Solutions - Motion Modules

Smart Building, Smart Home Automation

- Video Intercom & Access Control
- Touch HMI - TouchPAD Series
- Smart Lighting Control
- Energy Saving - PM/PMC Series
- Environmental - DL/CL Series
- Motion Detector - PIR Series
- Wi-Fi Wireless - WF Series
- Infrared Wireless - IR Series
- ZigBee Wireless - ZT Series
- IIoT Server & Concentrator
- LED Display - iKAN Series

TouchPAD HMI Solutions

- Introduction
- TPD/VPD Products Series
- Video Intercom & Access Control Series
- TPD/VPD Application

PC-based I/O Boards

- PCI Express Bus Data Acquisition Boards
- PCI Bus Data Acquisition Boards
- ISA Bus Data Acquisition Boards

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