Introduction to Industrial Control Communication

Basics of Modbus RTU, Modbus TCP/IP, and BACnet/IP

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Agenda

- Overview of Industrial Communication
- Modbus RTU Basics
- Modbus TCP/IP Basics
- BACnet/IP Basics
- Standard Load Bank Points Lists
- Standard Fuel Supply Points Lists
- Q&A

What Are Industrial Communication Protocols?

Industrial communication protocols are standardized sets of rules (languages) enabling automated devices to securely share data in real-time within industrial control equipment.

These rules help ensure interoperability between different manufacturers, allowing interaction from one piece of equipment to another.

Examples: Modbus, BACnet, Profinet, EtherNet/IP, EtherCAT, OPC UA, etc.

How is Industrial Communication Implemented?

Serial Communications	• Communication over multiconductor twisted pair/multi-conductor wire
Industrial Ethernet	• Communication over CAT5, 5e, 6, 6A, or 8 Copper Ethernet cables
Fiber Optics	• Communication using optical fiber to transmit pulsed infrared light

What Protocols do Automation Direct PLC's support?

DL06 Series

- **Modbus RTU**: Supported as both **Master** and **Slave** on Port 2. Port 1 supports Slave mode only.
- **DirectNET**: AutomationDirect's native hex-based protocol. Port 2 can act as a Master or Slave, while Port 1 is Slave only.
- **K-Sequence**: Primarily used for programming with DirectSOFT or connecting to older HMIs. It is only supported in **Slave** mode.
- **ASCII**: Port 2 supports raw ASCII "In" or "Out" for devices like barcode scanners and printers using dedicated ladder instructions (AIN/PRINT).
- **Modbus TCP**: Not built-in, but fully supported by adding an H0-ECOM100 Ethernet module.
- **DeviceNet**: Supported via the D0-DEVNETS expansion module (Slave only).
- **Specialized Protocols**: Through the D0-DCM module, you can add extra RS-232/422/485 ports that support Modbus RTU and DirectNET.

BRX (Do-more) PLC Series

- **Modbus RTU & TCP**: Fully supported with a dedicated "Modbus Scanner" device that can handle up to 32 servers in the background.
- **EtherNet/IP**: Supports **Scanner** and **Adapter** modes with Implicit (I/O) and Explicit messaging.
- **IIoT & Web**: Advanced support for **MQTT/MQTTS** (including Sparkplug B), **REST API**, **HTTP/HTTPS** (GET, POST, etc.), and **OPC UA**.
- **IT Protocols**: Features **FTP Client**, **SMTP (Email)** with SSL/TLS, **SNTP**, and **DHCP**.
- **Legacy & Specialized**: Supports **K-Sequence** (for legacy AutomationDirect hardware), **Ethernet Remote I/O**, and customizable **TCP/IP** or **UDP** stacks for unique third-party devices.

Click Series

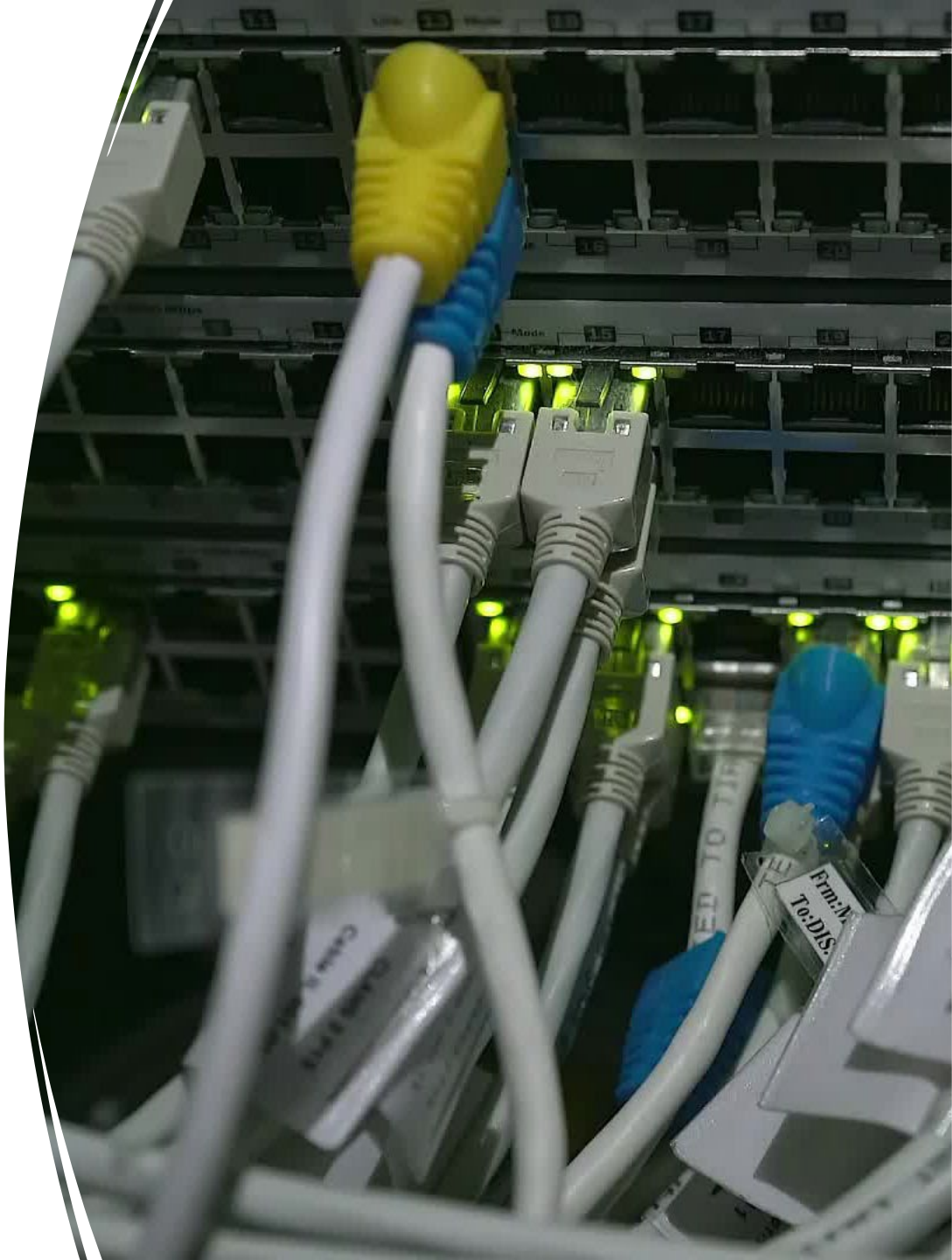
- **Modbus RTU**: Supported as both Master and Slave on all RS-232 and RS-485 serial ports.
- **Modbus TCP**: Supported as both Client and Server on Ethernet-equipped models.
- **EtherNet/IP**: Ethernet models support **Adapter/Server** functionality
- **ASCII**: Supported for sending and receiving data over serial ports (RS-232/RS-485) and Ethernet.
- **IIoT Protocols**: Newer **CLICK PLUS** models add support for **MQTT**, **OPC UA**, and **SNTP**.

Productivity Series (P1000, P2000, P3000)

- **Modbus RTU & TCP**: Standard support for both Master/Client and Slave/Server roles.
- **EtherNet/IP**: Supports both **Scanner** and **Adapter** roles with support for Implicit and Explicit messaging.
- **MQTT/MQTTS**: Built-in support for secure messaging to cloud platforms like IBM Watson or Mosquitto brokers.
- **ProNet**: A proprietary peer-to-peer protocol for high-speed data sharing between up to 32 Productivity PLCs over Ethernet.
- **Other Protocols**: Supports **ASCII**, **SNMP** (for network management), and **SMTP** (email).

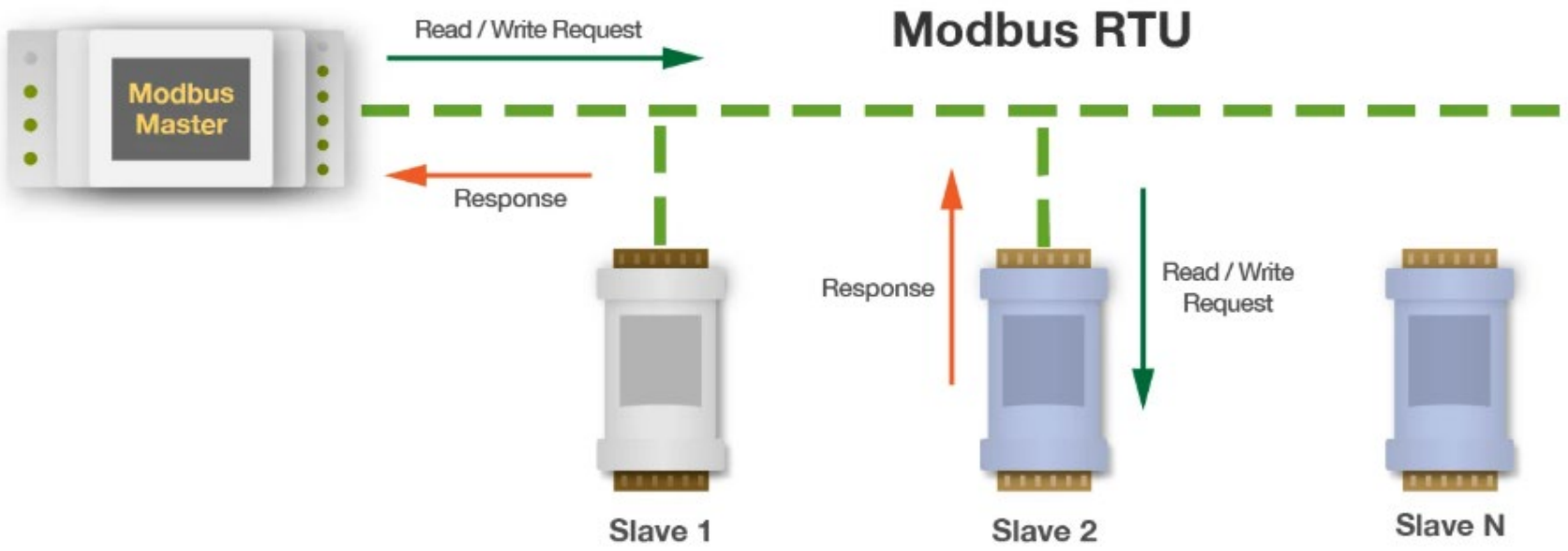
Introduction to Modbus

- Developed in **1979** by **Modicon** for PLC communication.
- Most widely used in industrial automation communication Protocol.
- Simple, robust, and open protocol.
- Two main variants:
  - **Modbus RTU:** Serial communication
  - **Modbus TCP/IP:** Ethernet communication
- How Modbus Works
  - Master sends requests
  - Slave respond
  - One device communicates at a time



Modbus RTU(Remote Terminal Unit)

- **Communication Type:** Serial (RS-232, RS-422, RS-485)
- **Topology:** Master-Slave (one master communicates to multiple slaves)
- **Data Format:** Binary (compact and efficient)
- **Speed:** Up to 115.2 kbps (typical industrial use: 9600–19200 bps)



Advantages & Limitations of Modbus RTU

- **Advantages:**
  - Simple and easy to implement
  - Reliable over long distances (up to 1200 m with RS-485)
  - Low cost
- **Limitations:**
  - Slower than Ethernet protocols
  - Limited to one master
  - No inherent security

Modbus TCP/IP

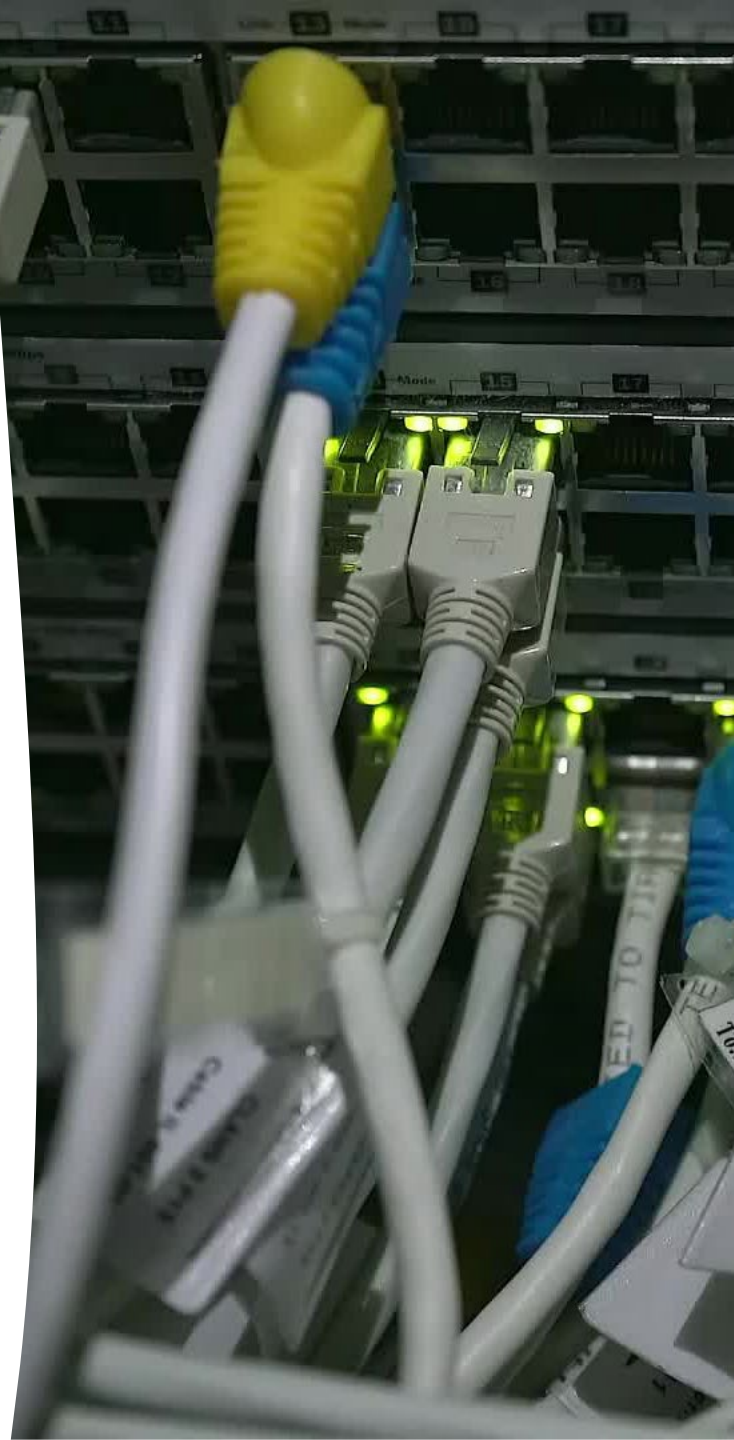
- **Communication Type:** Ethernet-based (TCP/IP network)
- **Topology:** Client-Server (similar to Master-Slave)
- **Data Format:** Encapsulates Modbus RTU messages inside TCP frames
- **Speed:** Depends on Ethernet network (100 Mbps to 1 Gbps typical)

Advantages & Limitations of Modbus TCP/IP

- **Advantages:**
  - Faster and scalable
  - Supports multiple clients
  - Easier integration with IT systems
- **Limitations:**
  - Requires Ethernet infrastructure
  - Still lacks strong built-in security

Introduction to BACnet

- Developed in **1987** by ASHRAE for building automation systems (HVAC, lighting, security).
- Open standard (ANSI/ASHRAE 135)
- Designed for interoperability across multiple vendors
- Five main variants:
  - **BACnet/IP:** The most common variant for modern systems, enabling communication across IP networks and subnets.
  - **BACnet MS/TP (Master-Slave/Token-Passing):** A widely used, cost-effective serial variant for field devices using RS-485.
  - **BACnet over Ethernet:** An older, high-speed variant, less common today as BACnet/IP has taken over.
  - **BACnet/SC (Secure Connect):** A modern variant that provides secure, encrypted communication over IP networks.
  - **BACnet over ARCNET:** A, less common, field-level network type.



BACnet/IP

- **Communication Type:** Ethernet over IP
- **Topology:** Peer-to-Peer or Client-Server
- **Data Model:** Objects (e.g., analog input, binary output)
- **Service Types:**
  - **Who-Is / I-Am:** Device discovery
  - **Read/Write Property:** Data exchange
  - **Change-of-Value (COV):** Event-driven updates

Advantages & Limitations of BACnet/IP

- **Advantages:**
  - Open standard, multi-vendor compatibility
  - Scalable and network-friendly
  - Supports events, schedules, and alarms
- **Limitations:**
  - More complex than Modbus
  - Requires configuration and device addressing
  - Security features need careful implementation

Comparing Modbus and BACnet

Feature	Modbus RTU	Modbus TCP/IP	BACnet/IP
Communication	Serial	Ethernet	Ethernet/IP
Topology	Master-Slave	Client-Server	Peer-to-Peer / Client-Server
Speed	Slow	Fast	Fast
Complexity	Low	Low-Medium	Medium-High
Use Cases	Simple I/O	Industrial networks	Building automation

Typical Applications

Modbus RTU: PLC-to-sensor communication in factories
Modbus TCP/IP: Industrial Ethernet, SCADA systems
BACnet/IP: HVAC control, lighting, security in smart buildings

Standard Load Bank Communication Points Lists

- LBD/Vector
- Electra/Dynamite/Trident
- Stationary BRX Standard
- Custom

Fuel Supply Communication Points Lists

- Day Tank BRX
- Day Tank DL06
- Filling System BRX
- Filling System DL06
- Pump Set DL06
- SFG BRX
- SFG DL06

Key Takeaways

Industrial communication protocols are standardized sets of rules (languages) enabling automated devices to pass data back and forth

Automation Direct PLC's support Modbus and many other Protocols but do not natively support BACnet. BACnet Protocol require a converter to go from Modbus to BACnet

Modbus – Most used industrial communication Protocol – Two main variants – Modbus RTU(RS485, RS422, RS232) and Modbus TCP/IP(Ethernet)

BACnet – Often used in HVAC, lighting, security, etc. in "Smart Buildings"

Communication points lists should always be considered preliminary until all testing of units are finished. All preliminary points list should be considered subject to change.


Questions: