

Automation and Robotics (20EC53I)
V Semester
Electronics and Communication Engineering
(Week 5), SESSION 5

Industrial Automation Protocols:

Importance of using following Automation protocols.

- EtherNet/IP.
- Profibus.
- ProfiNet
- Modbus.
- DeviceNet

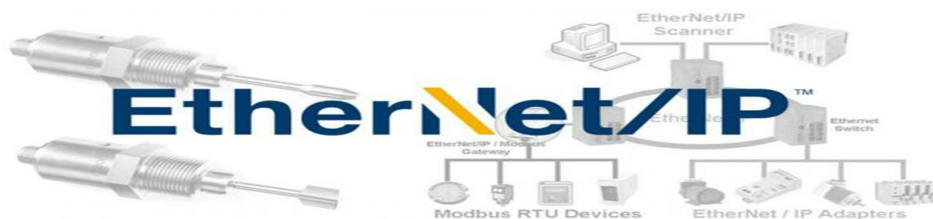
5.1 EtherNet/IP:

Ethernet/IP is used for communication between connected devices. It can be used for many devices, including devices not connected to controllers.

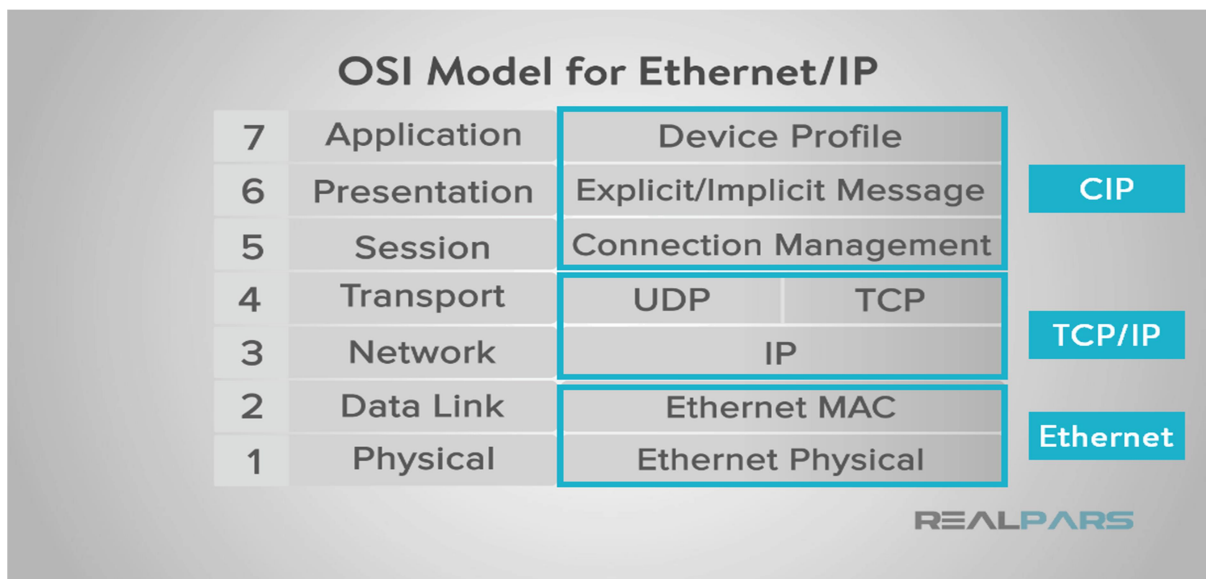
Ethernet/IP (Ethernet Industrial Protocol) is a network communication standard capable of handling large amounts of data at speeds of 10 Mbps or 100 Mbps, and at up to 1500 bytes per packet. The specification uses an open protocol at the application layer. It is especially popular for control applications. This type of network is easy to set up, operate, maintain, and expand. Ethernet/IP is used with personal computers, mainframes, robots, input/output (I/O) devices and adapters, programmable logic controllers (PLCs), and other devices.

EtherNet/IP is a standard communication protocol used in industrial automation and Internet of Things (IoT) communication. It's an accepted standard covered under Institute and Electrical Engineers Standards (IEEE) 802.3 with the TCP/IP protocol.

EtherNet/IP's adherence to IEEE 802.3 compliance standards allows it to robustly handle the physical and data-link layers for EtherNet and wireless communications.



The below image from maps out the components of EtherNet/IP in the OSI Model, a framework that describes the seven layers used by computer systems in order to communicate over a network:



EtherNet/IP uses the IEEE 802.3 standard, which defines the physical and data-link layers of the wired part of the EtherNet.

5.2 Profibus:

The term “Profibus” stands for “Process Field Bus” and it is the most widely used industrial control network worldwide for industrial process control, motion control, automation, and safety networks. This network is supported by above 1400 equipment vendors worldwide.

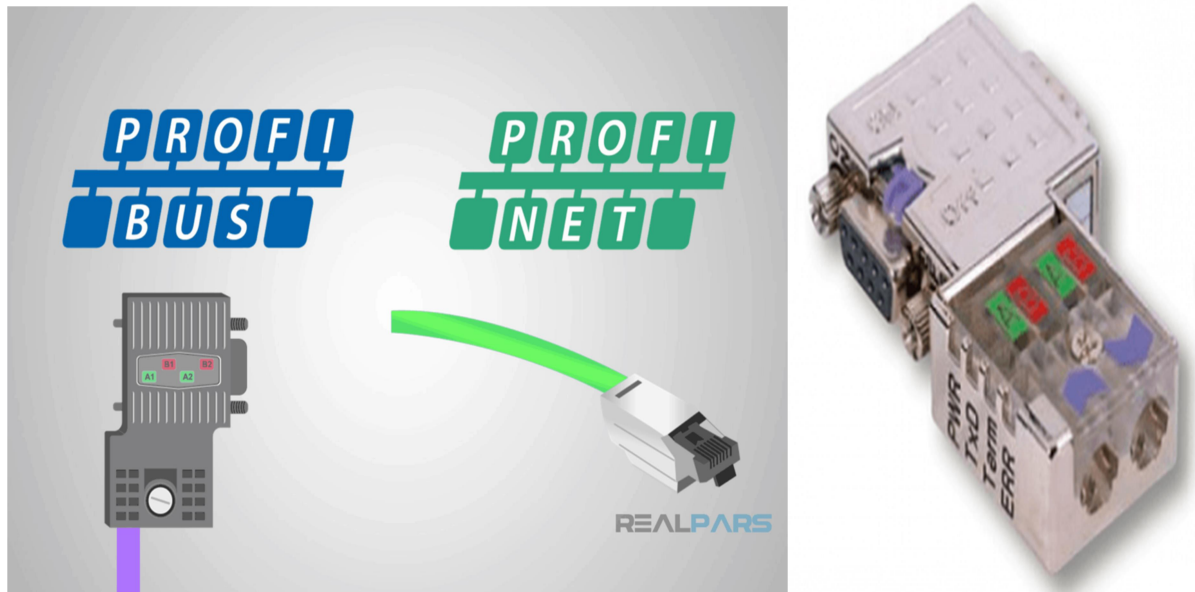
The main purpose of PROFIBUS is to provide the interaction between the controllers or the control system and the field sensors. This network uses the OSI model to ensure that devices from various vendors can interact together effectively & easily.

The two most frequently used Profibus versions are Profibus-DP & Profibus-PA.

The devices used by Profibus are masters & slaves. The main function of Master devices is to control the bus once they have the right to access the bus, so they may transmit messages without any remote request known as active stations. Slave devices are normally peripheral devices like sensors, transmitters & actuators which may allow received messages at the master’s request, send messages to that master which is known as passive stations.

PROFIBUS is an open field and vendor-independent standard bus used in different fields of applications like process automation & manufacturing.

PROFIBUS simply allows communication between different manufacturers' devices without any adjustment of a special interface. It can be simply used for both time-critical, high-speed & difficult communication-based tasks. PROFIBUS gives communication protocols like FMS & DP based on the request, the transmission technologies like RS-485, IEC 1158-2 otherwise fiber optics are accessible.



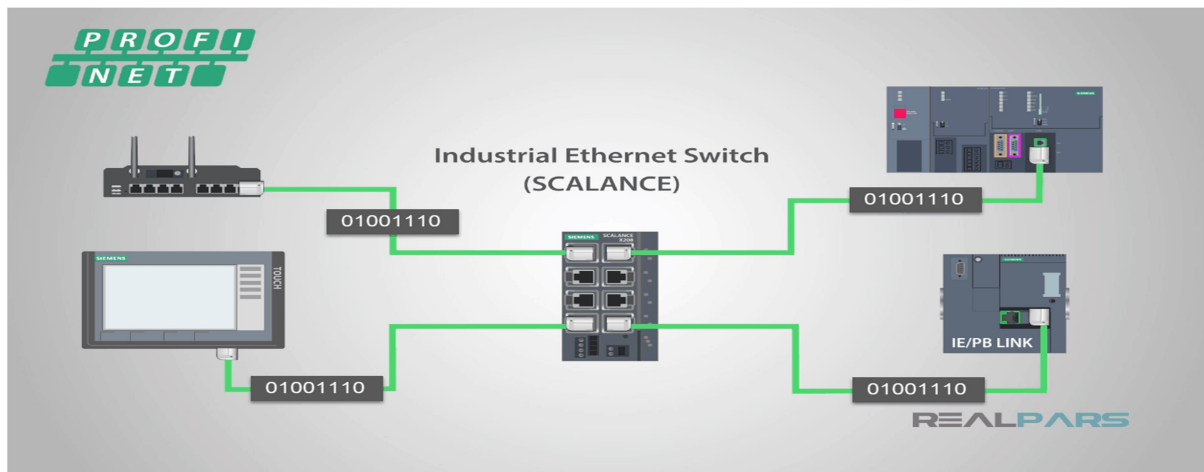
5.3 ProfiNet:

PROFINET or Process field Net is an open Industrial Ethernet solution based on international standards. It is a communication protocol designed to exchange data between controllers and devices in an automation setting. It was introduced in the early 2000s and is the most well-adopted Industrial Ethernet solution.

PROFINET offers a host of functions on one cable: Machine data and standard IT data run together. This creates integration and saves costs by reducing the overhead for cabling and training.



Siemens uses the Ethernet standard for automation with PROFINET. PROFINET enables quick and secure data exchange on all platforms and creates the possibility of realizing innovative concepts for the production and processing industries. Due to its openness and flexibility, PROFINET offers users a high amount of freedom when designing machine and system structure.



High performance for boosting your productivity

PROFINET's performance power offers you more than enough reserves to meet today's requirements and those of the future, and thus makes it possible for you to continually increase your productivity.

More efficiency for your economic advantage

Continually rising raw material prices and constantly new environmental regulations make it necessary for companies around the world to use their resources more cost-effectively and more efficiently. This applies above all to production.

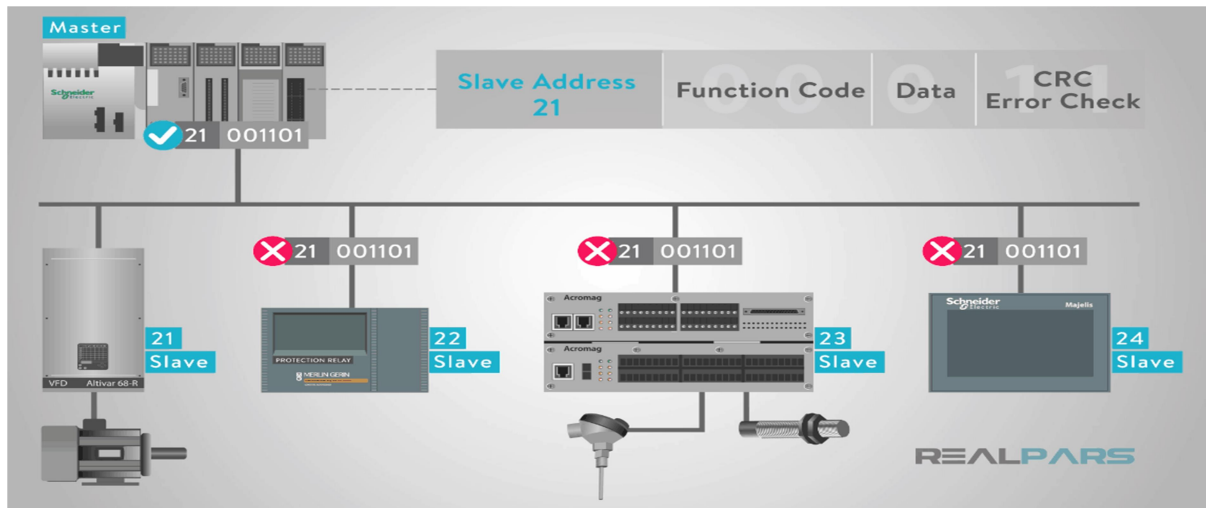
5.4 Modbus:

Modbus is an important protocol and has grown in its popularity **because of its simplicity**. It has a very basic structure, and is extremely easy to implement as it is based on a master-slave relationship where a master device sends commands and the addressed slave responds back with the required information.

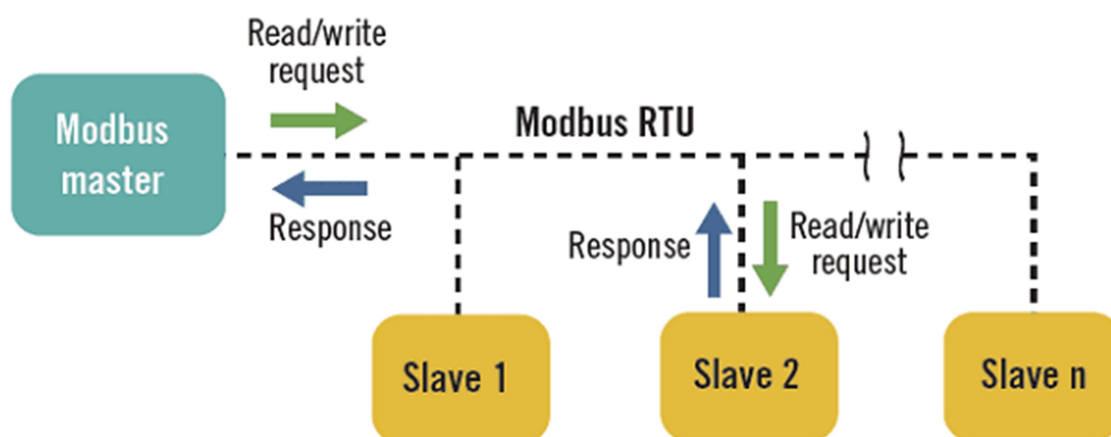
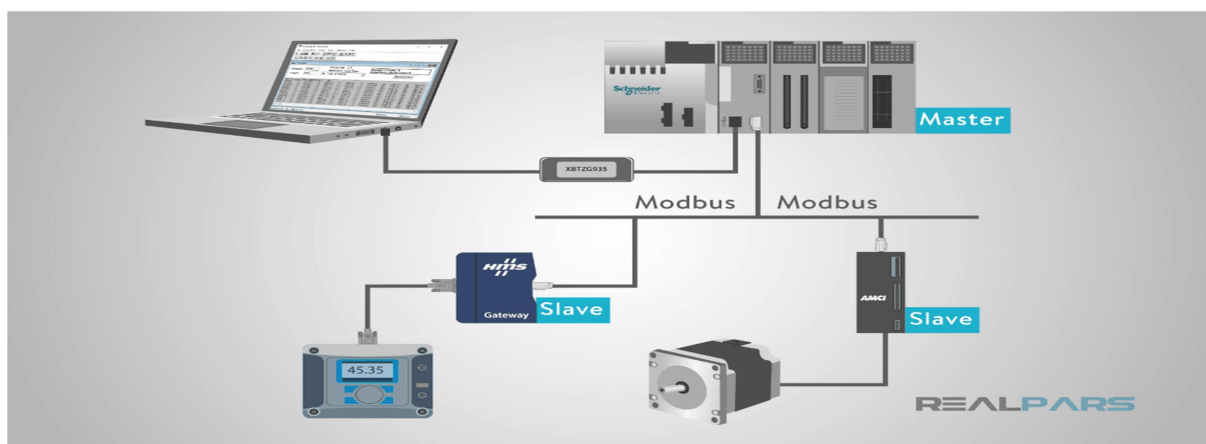
How does Modbus communication protocol work?

A Modbus master sends a message, and depending on the contents of the message, the slave interprets the message and responds to it. Physical slave addressing in the message

header is used to define which slave device should respond to a message. All other nodes on the Modbus network ignore the message if the address field doesn't match their own address.



In a detailed way, this is the communication protocol that is employed for information transmission between the electronic equipment through serial lines or through Ethernet connections. In an open standard condition, anyone can implement it. This is probably utilized for the connection of a system controlling using an RTU in SCADA in the power domain.



The major applications are:

- Used in the healthcare domain for analyzing automated temperature levels
- Analysis of traffic behavior
- Implemented in home automation for streamlined data transfer
- Employed in industries such as Gas, Oil, Geothermal, Hydel, Wind, and Solar

In addition to these, the other major concepts also to be known in the concept are data visualization, register types, exception codes, communication with these gateway devices, data encoding in this type of RTU, data representation, troubleshooting, speed, and serial communication, and messaging.

5.5 DeviceNet:

DeviceNet is an application-level protocol used in the automation environment. It is a communication tool that allows you to logically talk between a PLC (Programmable Logic Controller) and many control devices, such as motors, conveyors, flowmeters, level sensors, etc.

Instead of the PLC talking directly to discrete I/O modules, DeviceNet talks via a piece of hardware called DeviceNet Scanner.

DeviceNet protocol was originally developed by Allen-Bradley which is a Rockwell Automation brand, and they decided to share this new technology with others and make it an open network.

DeviceNet is now managed by Open DeviceNet Vendors Association (ODVA), an organization that develops standards and allows third-party vendors to utilize the network protocol. This protocol simply uses the normal industrial protocol over a CAN (Controller Area Network) media layer & describes an application layer to cover various device profiles. The main applications of the Devicenet protocol mainly include safety devices, exchange of data & large I/O control networks.



The advantages of DeviceNet are low cost, widespread acceptance, high reliability, efficient use of network bandwidth and power available on the network. The disadvantages of DeviceNet are limited bandwidth, limited message size, and maximum cable length.

- ❖ DeviceNet protocol simply supports up to 64 nodes including the 2048 highest number of devices.
- ❖ DeviceNet is a communications link used to connect industrial devices like inductive sensors, limit switches, photoelectric, push buttons, indicator lights, barcode readers, motor controllers, and operator interfaces to a network by avoiding complex & costly wiring. So, direct connectivity gives better communication between devices. In the case of wired I/O interfaces, an analysis of the device level is not possible.
- ❖ It carries both the signal & power on a similar cable.
- ❖ It supports different modes like master-slave, peer-to-peer & multi-master to transmit data within the network.