SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF MECHATRONICS ENGINEERING

19MCB301 - INTEGRATED AUTOMATION

UNIT 3 – NETWORKING AND APPLICATIONS OF PLC

TOPIC 1 & 2 – Network Topologies & HART

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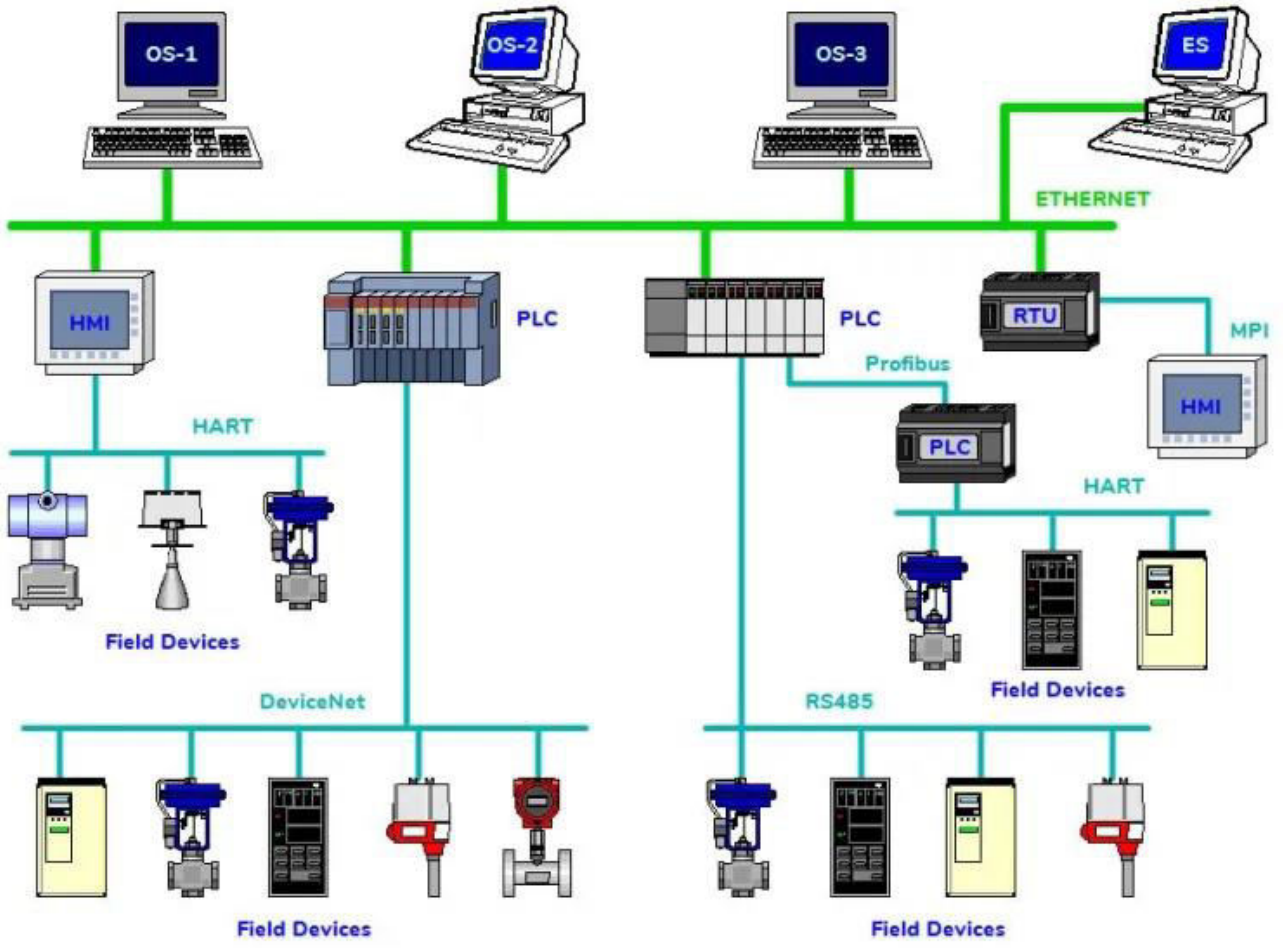
UNIT – 3 NETWORKING AND APPLICATIONS OF PLC

- Network Topologies
- Communication Modes HART Networks and OSI models
- Fieldbus, Modbus & Profibus
- Device net - System Operation and Troubleshooting
- Applications of PLC - Automatic control of warehouse door – Conveyor belt motor control - Automatic car washing machine - Bottle filling systems, PLC in process control

PLC Network Topologies

Topology is derived from two Greek words topo and logy, where topo means 'place' and logy means 'study'.

- In computer networks, a topology is used to explain how a network is physically connected and the logical flow of information in the network.
- A topology mainly describes how devices are connected and interact with each other using communication links.



Important Parts of Communication Protocols

- There are some important parts on which you can decide which communication protocol is best for your application, like
  - **Baud Rate** - Baud Rate is the rate of transmission at which information is transferred in the communication channel. Baud rate is generally defined as the ***communication speed***. The unit of baud rate is ***bps(bits per second)***.
  - Network Length - Network length is the total length of the network.
  - Number of nodes - Nodes represent the total number of devices connected to the network.

List of Communication Protocols

- AS-i – Actuator-sensor interface
- BSAP – Bristol Standard Asynchronous Protocol
- CC-Link Industrial Networks
- CIP (Common Industrial Protocol)
- ControlNet
- DeviceNet
- DF-1
- DNP3
- DirectNet
- EtherCAT
- Ethernet Global Data (EGD)
- EtherNet/IP
- Ethernet Powerlink
- FINS
- FOUNDATION Fieldbus – H1 & HSE
- HART Protocol
- HostLink Protocol
- Interbus
- MECHATROLINK
- MelsecNet, and MelsecNet II, /B, and /H
- Modbus PEMEX
- Modbus Plus
- Modbus RTU or ASCII or TCP
- OSGP – The Open Smart Grid Protocol
- OpenADR – Open Automated Demand Response
- Optomux
- PieP – An Open Fieldbus Protocol
- Profibus
- PROFINET
- RAPIEnet
- Honeywell SDS
- SERCOS III
- SERCOS interface
- GE SRTP
- Sinec H1
- SynqNet
- TTEthernet
- MPI – Multi-Point Interface

30+ PLC Communication Protocols

HART Protocol

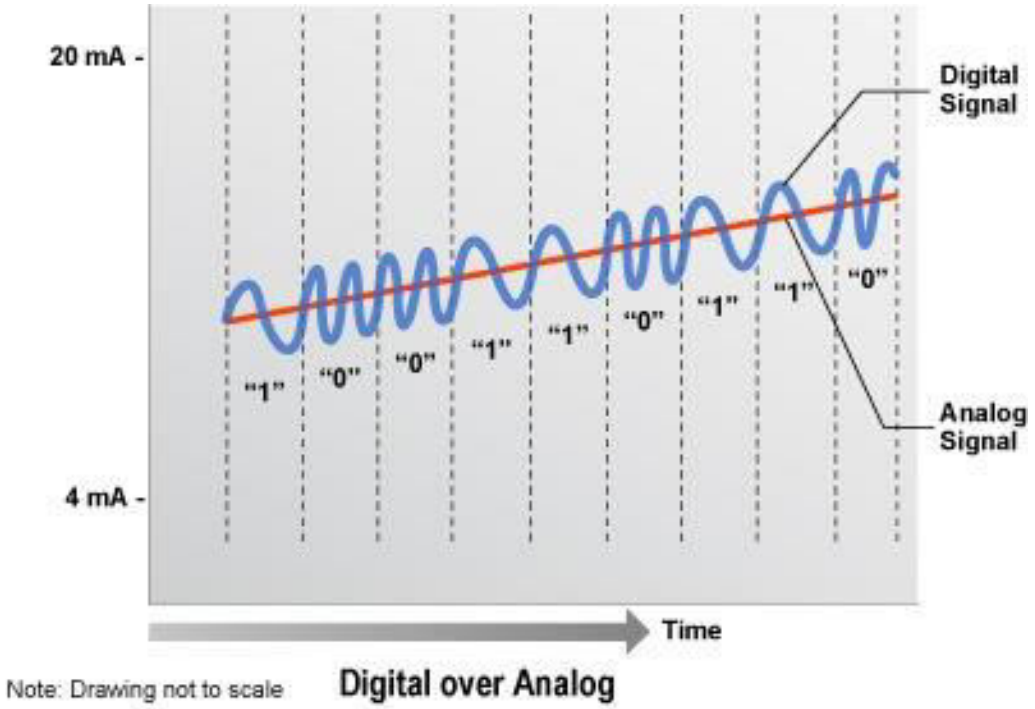
- HART (Highway Addressable Remote Transducer) Protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring system or Handheld communicators.
- More specifically, HART is a bi-directional communication protocol that provides data access between intelligent field instruments and host systems (DCS/PLC or Handheld Communicator).
- A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety or other system using any control platform.

HART Technology

- HART technology is easy to use and very reliable when used for commissioning and calibration of smart devices as well as for continuous online diagnostics.
- There are several reasons to have a host communicate with smart devices.
  - Device Configuration or re-configuration
  - Device Diagnostics
  - Device Troubleshooting
  - Reading the additional measurement values provided by the device
  - Device Health and Status

How HART Works

- “HART” is an acronym for Highway Addressable Remote Transducer. The HART Protocol makes use of the Bell 202 Frequency Shift Keying (FSK) standard to superimpose digital communication signals at a low level on top of the 4-20mA.

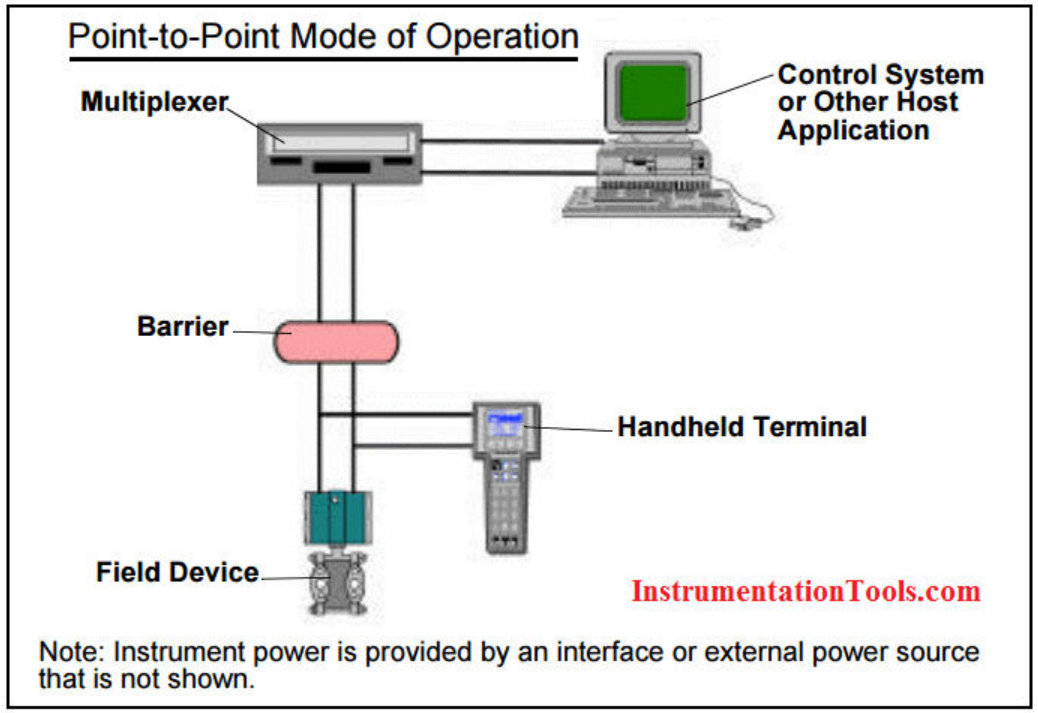


HART Networks

- HART devices can operate in one of two network configurations—point-topoint or multidrop.

POINT-TO-POINT

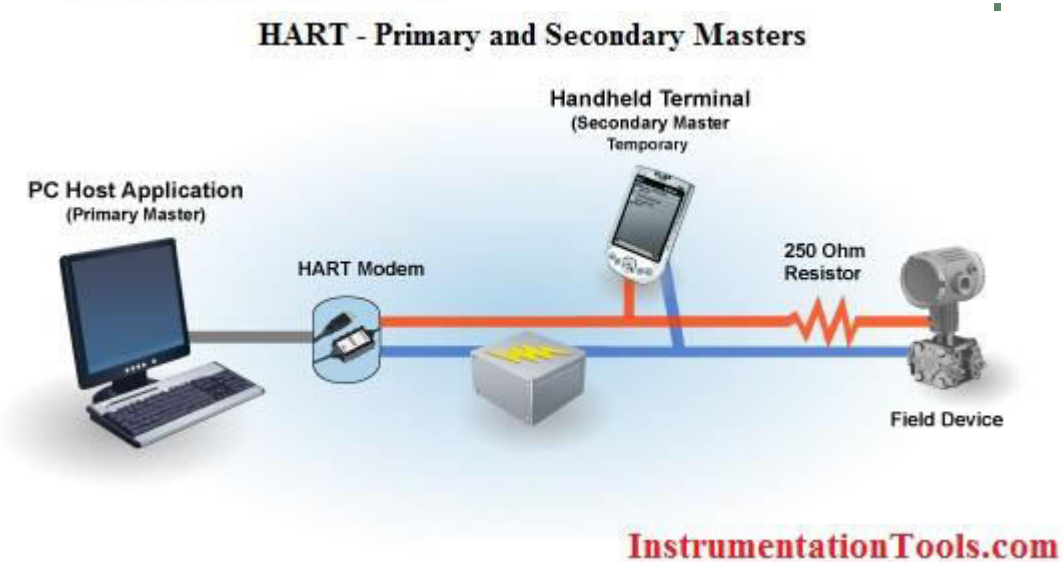
- In point-to-point mode, the traditional 4–20 mA signal is used to communicate one process variable, while additional process variables, configuration parameters, and other device data are transferred digitally using the HART protocol (Figure 2).
- The 4–20 mA analog signal is not affected by the HART signal and can be used for control in the normal way. The HART communication digital signal gives access to secondary variables and other data that can be used for operations, commissioning, maintenance, and diagnostic purposes.



Note: Instrument power is provided by an interface or external power source that is not shown.

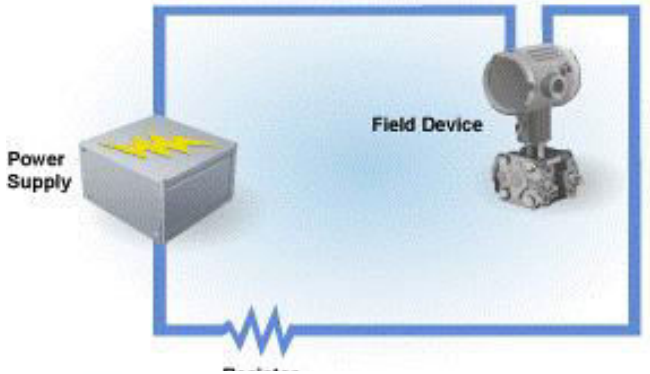
POINT-TO-POINT

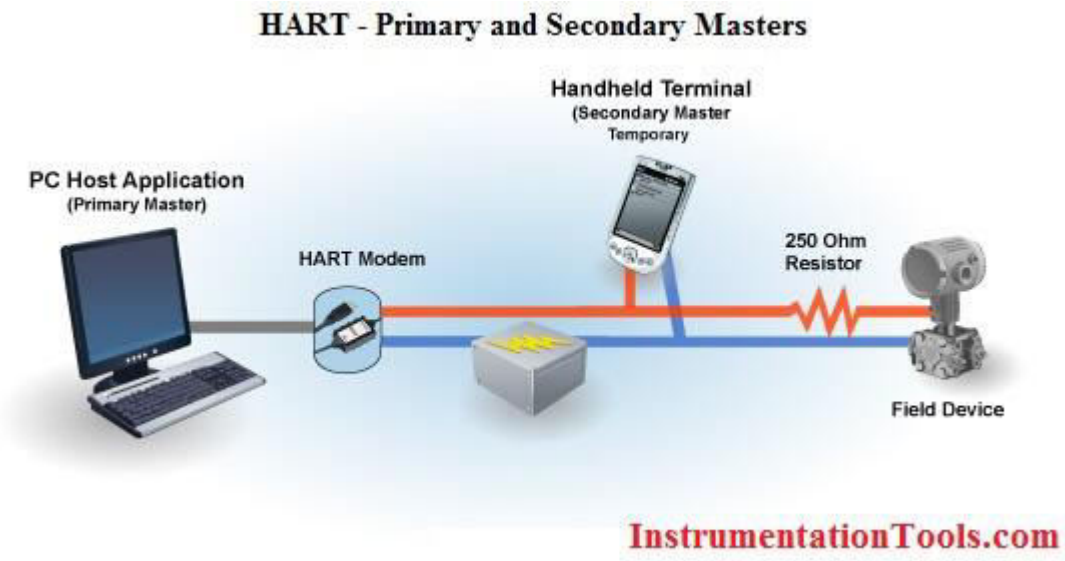
- The HART Protocol provides for up to two masters (primary and secondary). This allows secondary masters such as handheld communicators to be used without interfering with communications to/from the primary master, i.e. control/monitoring system.

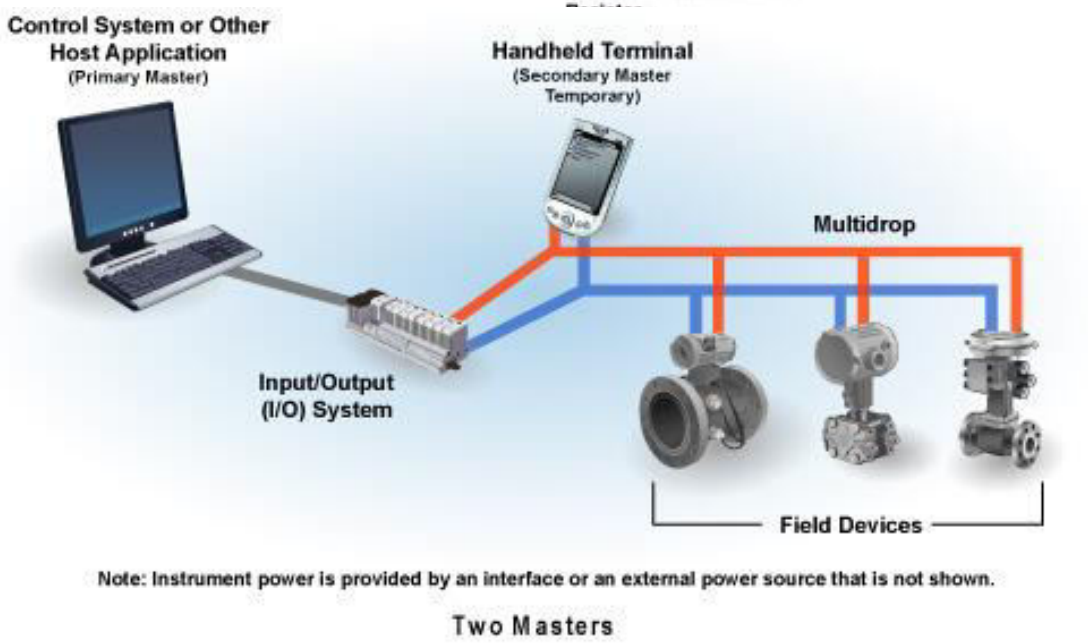


POINT-TO-POINT

- The HART Protocol permits all digital communication with field devices in either point-to-point or multidrop network configurations:

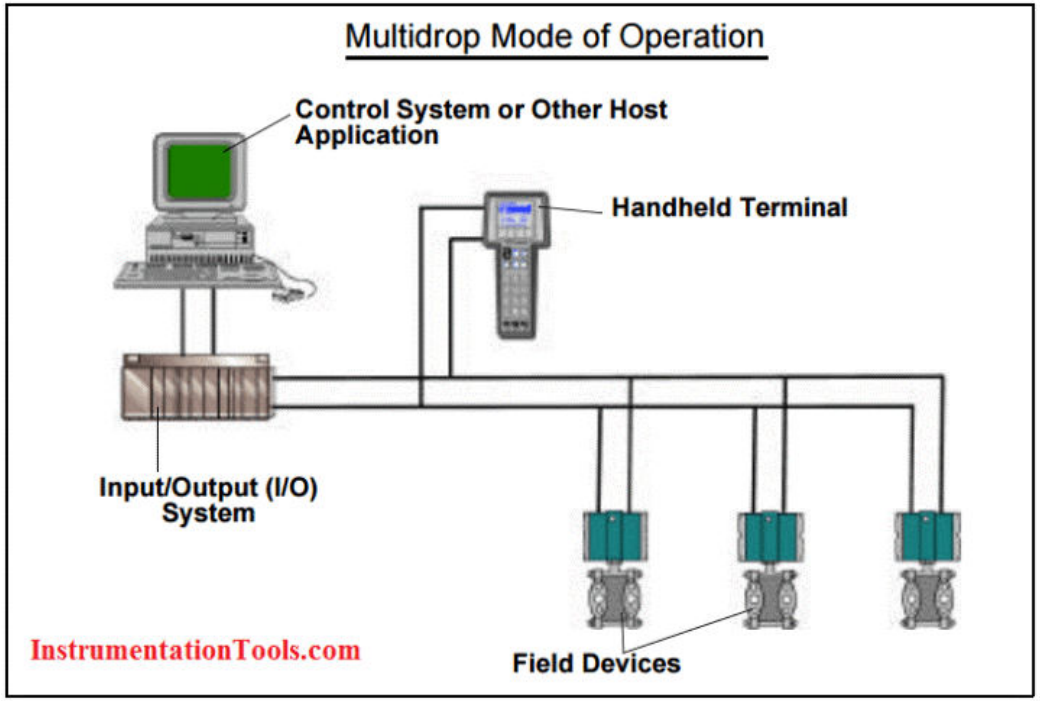






Multidrop Configuration

- There is also an optional “burst” communication mode where a single slave device can continuously broadcast a standard HART reply message. Higher update rates are possible with this optional burst communication mode and use is normally restricted to point-to-point configuration.
- The multidrop mode of operation requires only a single pair of wires and, if applicable, safety barriers and an auxiliary power supply for up to 15 field devices. All process values are transmitted digitally. In multidrop mode, all field device polling addresses are >0, and the current through each device is fixed to a minimum value (typically 4 mA).

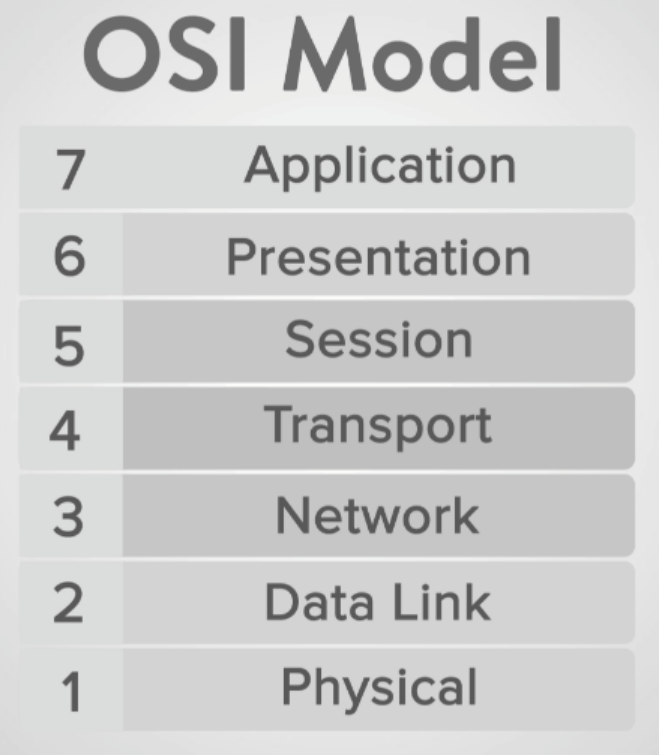


Communication Modes

- 1. Master Slave Mode - HART is a master-slave communication protocol, which means that during normal operation, each slave (field device) communication is initiated by a master communication device. Two masters can connect to each HART loop. The primary master is generally a distributed control system (DCS), programmable logic controller (PLC), or a personal computer (PC). The secondary master can be a handheld terminal or another PC. Slave devices include transmitters, actuators, and controllers that respond to commands from the primary or secondary master
- 2. Burst Mode - Some HART devices support the optional burst communication mode. Burst mode enables faster communication (3–4 data updates per second). In burst mode, the master instructs the slave device to continuously broadcast a standard HART reply message (e.g., the value of the process variable). The master receives the message at the higher rate until it instructs the slave to stop bursting.

OSI - Open Systems Interconnection

- It is a conceptual framework for how applications communicate over a network.
- There are seven layers within the model and the layers depiction is used to help users identify what is happening within a networking system.



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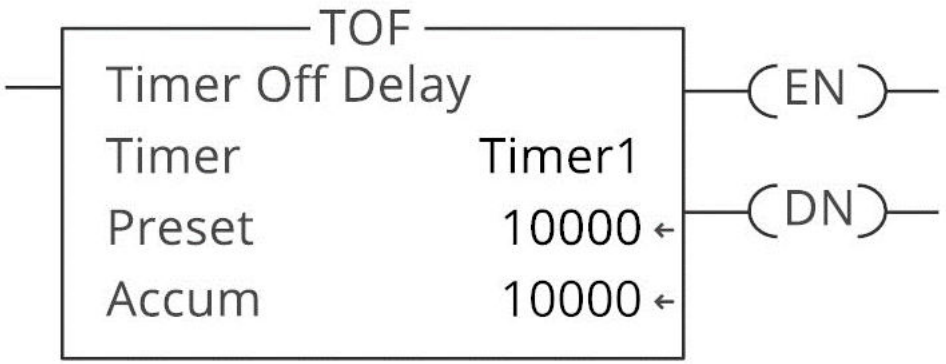
The below table represents the speed, length, and a maximum number of devices you can connect with this protocol.

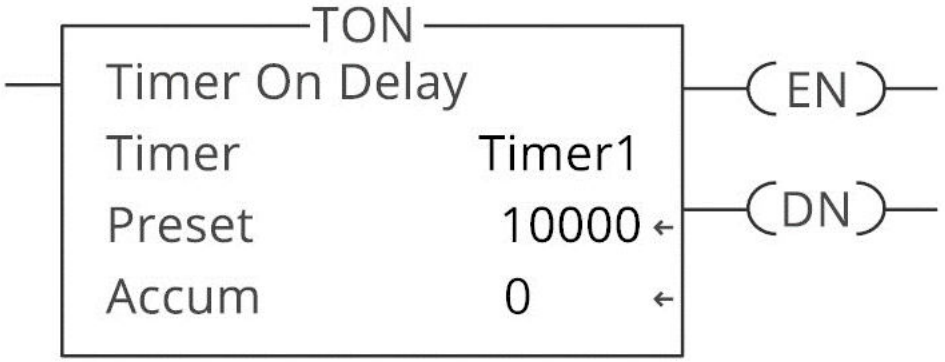
Protocol	Baud Rate	Network Length	Number of nodes
Ethernet	100 Mb/s	100 m	255
Profibus	9.6 Kb/s – 12 Mb/s	1.2 km – 100 m	127
RS-232	19.2 Kb/s	10 m	1
RS-485	10 Mb/s	1.2 Km	32
MPI	19.2 – 38.4 Kb/s	50 m	32
PPI	187.5 Kb/s	500 m	1
DH	230.4 Kb/s	3.048 m	64
ControlNet	5 Mb/s	1000 m	99
DeviceNet	500 Kb/s	100 m	64

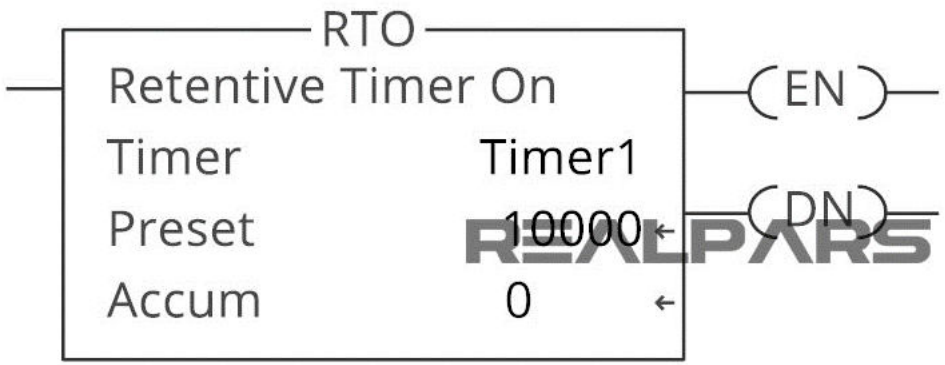
Types of PLC timers

There are three main types of PLC timers:

- The on-delay timer,
- The off-delay timer,
- The retentive on-delay timer.







SOME PLC MAKERS.....