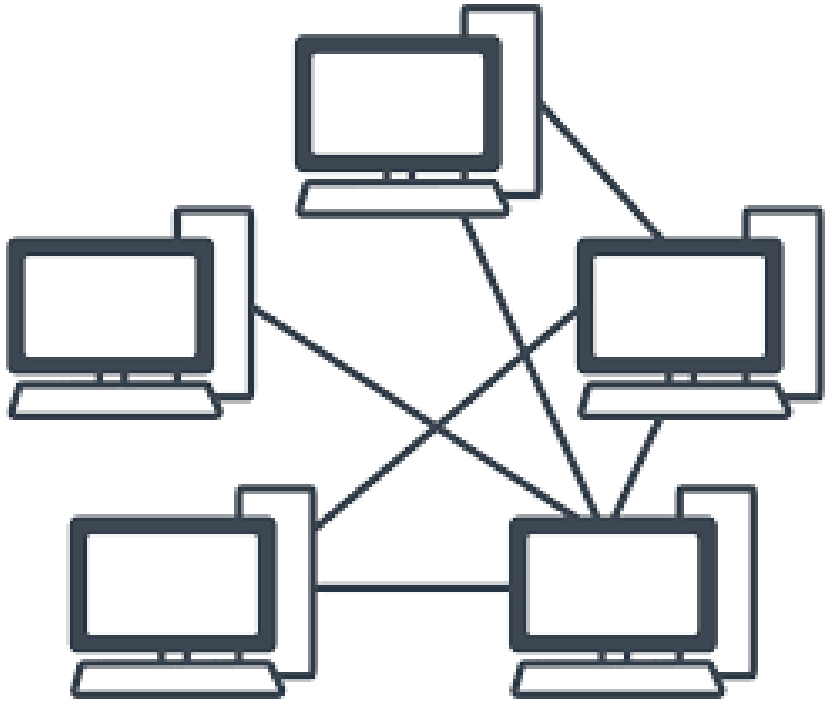
Networks

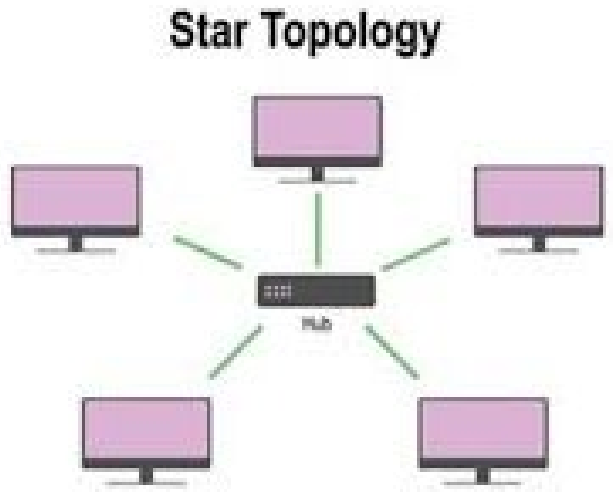
What is a network

- A network is a system that allows multiple devices to communicate and exchange data.
- In PLC systems, networks connect PLCs, HMIs (Human-Machine Interfaces), sensors, and actuators.
- Networking enables centralised monitoring and control of automated processes.
- It allows remote programming, diagnostics, and data logging from a control station.
- Helps improve system efficiency, flexibility, and fault detection in industrial automation.



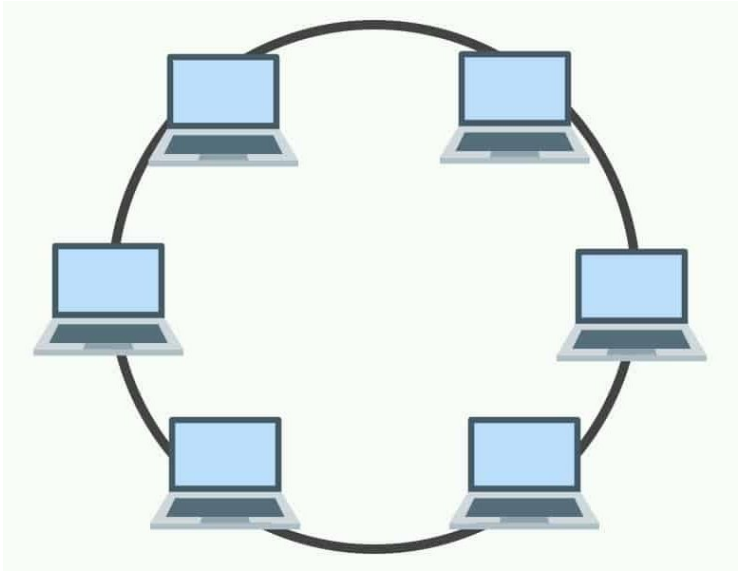
Star Network Topology

- All devices are connected to a central hub or switch.
- The central device manages and routes all communication between nodes.
- Common in PLC systems using Ethernet switches to connect multiple PLCs and HMIs.
- Easy to add or remove devices without affecting the whole network.
- If one device fails, the rest of the network remains operational.
- If the central hub fails, the entire network stops functioning.
- Offers high performance and easy fault isolation.



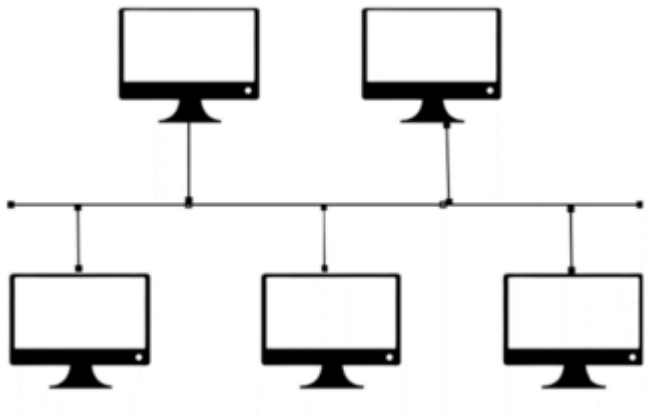
Ring Network Topology

- Each device is connected to two others, forming a closed loop.
- Data travels in one direction (or both, in dual-ring systems).
- Common in token-passing networks like Token Ring or some industrial protocols.
- Can offer predictable performance and is good for real-time communication.
- Failure in one device or connection can disrupt the whole network (unless redundancy is built in).
- Some PLC systems use fiber-optic ring networks for high-speed, fault-tolerant communication.
- More complex to configure and troubleshoot than a star network.



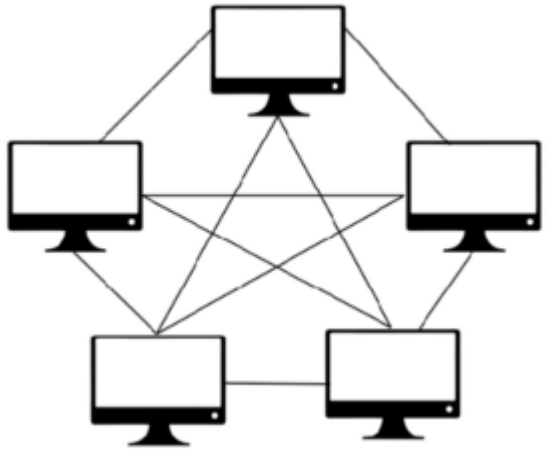
Bus Topology

- All devices share a single communication line (backbone).
- Devices communicate by broadcasting messages on the bus.
- Simple and cheap to set up, with minimal cabling.
- Failure of the main cable brings down the whole network.
- Common in older industrial systems using RS-485 or Modbus RTU.
- Difficult to troubleshoot and limited scalability.



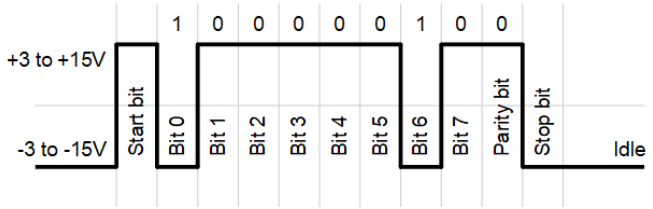
Mesh Topology

- Every device is connected to every other device.
- Offers multiple paths for data transmission.
- Very reliable and fault-tolerant—ideal for critical systems.
- Requires extensive cabling and configuration.
- Used in large-scale industrial control systems or where redundancy is key (e.g., SCADA networks).



RS-232 Signalling Standard

- Uses single-ended signalling—each signal is referenced to a common ground.
- Voltage levels:
  - Logic 1 (Idle): –3 V to 15 V
  - Logic 0 (Active): +3 V to +15 V
  - Voltages between –3 V and +3 V are undefined
- Designed for point-to-point communication (only two devices: one transmitter, one receiver).
- Maximum cable length is typically 15 metres (50 ft) at full speed.
- More susceptible to noise and signal degradation over long distances.
- Commonly used for older PLC programming interfaces, serial terminals, and legacy equipment.



RS-485 Signalling Standard

- Uses differential signalling to transmit data over two wires (A and B lines).
- Voltage levels:
  - Logic 1 (Idle): A < B (typically –0.2 V to –6 V)
  - Logic 0 (Active): A > B (typically +0.2 V to +6 V)
- Supports long-distance communication up to 1200 metres (4000 ft).
- Allows for multi-drop connections—up to 32 devices on a single bus.
- Highly resistant to electrical noise, making it ideal for industrial environments.
- Commonly used in Modbus RTU networks and between PLCs and remote I/O devices.