# Wired (UART, USART, SPI, I2C and Ethernet) at Physical-Data Link layer communication technologies

# Serial and Parallel Communication

- Serial means one bit after another in successive time intervals over a wire

- Parallel all bits in a word at the same times communicate at different wires

# Use of a Bus for communication

- Bus: a common set of signals connected to number of devices

- Each device is assigned distinct address and Source device specifies a destination address

- But at a given instance, only one pair of devices communicate over the bus

# Two modes: Asynchronous and Synchronous communication

- Asynchronous means all bytes in a data frame may transmit with variable time-interval spacing or phase difference

- Synchronous means all bytes in a frame transmit with equal time interval spacing or phase difference

# Wired Communication Technologies

(i) Serial asynchronous communication, for example, UART interface

(ii) Synchronous serial-communication devices, for example, SPI interface, and

(iii) Parallel input, output and input-output ports in devices.

# Wired communication Examples

- UART or USART

- I2C

- SPI

- Ethernet Protocol

- USB port, microUSB or USB 3.0 adapter

# UART (Universal Asynchronous Receiver and Transmitter)

- Serial asynchronous communication (transmission) of 8 bits serially

-  A start bit at start of transmission of a byte on serial TxD (Transmitter Data) output line

- An additional bit appends between stop bit and last bit of the byte

# USART (Universal Synchronous/ Asynchronous Receiver and Transmitter)

- Two modes: Synchronous/Asynchronous
- Mode 1: Synchronous means all bytes in a frame transmit with equal time interval spacing and a set of sync code bits between successive bytes;
- Mode 2: Asynchronous mode as UART

# SPI (Serial Peripheral Interface) Bus

- ICs mutually network through four set of signals

- SCLK, MISO, MOSI, and SS (slave select) on four wires

# SPI (Serial Peripheral Interface) Bus

- Master input slave output (MISO) and master output slave input (MOSI) for synchronous serial bits I/Os at the master and slave

- IOs are as per synchronizing clock of the master SCLK

# SPI (Serial Peripheral Interface) Bus

- Master input slave output (MISO) and master output slave input (MOSI) are synchronous serial bits I/Os at the master and slave

- IOs as per synchronizing clock signal of the master at SCLK

# I2C (Inter-Integrated Circuit) Bus

- ICs mutually network through a common synchronous serial bus

- Four potential modes of operation (master transmit, Master receive, slave transmit and slave receive)

# I²C (Inter-Integrated Circuit) Bus

- Three I2C bus standards: Industrial 100 kbps I2C, 100 kbps SM I²C, and 400 kbps I2C

- I²C Bus has two lines that carry the signals— one for the clock and one bi-directional data.

# Ethernet Bus

- Uses wired bus topology
- Transmission speeds: 10 Mbps, 100 Mbps (Unshielded and Shielded wires)
- 1 Gbps (high-quality coaxial cable)
- 4 Gbps (in twisted pair wiring mode)
- 0 Gbps (fiber-optic cable)

# Ethernet Bus

- Uses 48-bit MAC addresses assigned distinctly to each device or computer on the LAN.

- Address Resolution Protocol (ARP) resolves 32 bit IP addresses at Internet Application into the 48 bit destination host media address when receiving data from Internet protocol.

# Communication technologies– A Comparison

- Refer Table 2.1 in the Text

Chapter-2 L03: "Internet of Things " , Raj Kamal,
Publs.: McGraw-Hill Education

# Summary

We learnt commonly used bus communication

- UART asynchronous serial

- USART asynchronous and synchronous serial

- SPI synchronous serial master-slave mode

# Summary

- I2C synchronous serial master-slave mode two wires SDA and SCK

- Ethernet Polled high speed bus

# End of Lesson 6 on Wired (UART, USART, SPI, I2C and Ethernet) at Physical-Data Link layer communication technologies