

Communication Protocol

Serial protocols: I²C

- I²C (Inter-IC)
 - Two-wire serial bus protocol developed by Philips Semiconductors nearly 20 years ago
 - Enables peripheral ICs to communicate using simple communication hardware
 - Data transfer rates up to 100 kbits/s and 7-bit addressing possible in normal mode
 - 3.4 Mbits/s and 10-bit addressing in fast-mode
 - Common devices capable of interfacing to I²C bus:
 - EPROMS, Flash, and some RAM memory, real-time clocks, watchdog timers, and microcontrollers

Serial protocols: CAN

- CAN (Controller area network)
 - Protocol for real-time applications
 - Developed by Robert Bosch GmbH
 - Originally for communication among components of cars
 - Applications now using CAN include:
 - elevator controllers, copiers, telescopes, production-line control systems, and medical instruments
 - Data transfer rates up to 1 Mbit/s and 11-bit addressing
 - Common devices interfacing with CAN:
 - 8051-compatible 8592 processor and standalone CAN controllers
 - Actual physical design of CAN bus not specified in protocol
 - Requires devices to transmit/detect dominant and recessive signals to/from bus
 - e.g., '1' = dominant, '0' = recessive if single data wire used
 - Bus guarantees dominant signal prevails over recessive signal if asserted simultaneously

Serial protocols: FireWire

- FireWire (a.k.a. I-Link, Lynx, IEEE 1394)
 - High-performance serial bus developed by Apple Computer Inc.
 - Designed for interfacing independent electronic components
 - e.g., Desktop, scanner
 - Data transfer rates from 12.5 to 400 Mbits/s, 64-bit addressing
 - Plug-and-play capabilities
 - Packet-based layered design structure
 - Applications using FireWire include:
 - disk drives, printers, scanners, cameras
 - Capable of supporting a LAN similar to Ethernet
 - 64-bit address:
 - 10 bits for network ids, 1023 subnetworks
 - 6 bits for node ids, each subnetwork can have 63 nodes
 - 48 bits for memory address, each node can have 281 terabytes of distinct locations

Serial protocols: USB

- USB (Universal Serial Bus)
 - Easier connection between PC and monitors, printers, digital speakers, modems, scanners, digital cameras, joysticks, multimedia game equipment
 - 2 data rates:
 - 12 Mbps for increased bandwidth devices
 - 1.5 Mbps for lower-speed devices (joysticks, game pads)
 - Tiered star topology can be used
 - One USB device (hub) connected to PC
 - hub can be embedded in devices like monitor, printer, or keyboard or can be standalone
 - Multiple USB devices can be connected to hub
 - Up to 127 devices can be connected like this
 - USB host controller
 - Manages and controls bandwidth and driver software required by each peripheral
 - Dynamically allocates power downstream according to devices connected/disconnected

Parallel protocols: PCI Bus

- PCI Bus (Peripheral Component Interconnect)
 - High performance bus originated at Intel in the early 1990's
 - Standard adopted by industry and administered by PCISIG (PCI Special Interest Group)
 - Interconnects chips, expansion boards, processor memory subsystems
 - Data transfer rates of 127.2 to 508.6 Mbits/s and 32-bit addressing
 - Later extended to 64-bit while maintaining compatibility with 32-bit schemes
 - Synchronous bus architecture
 - Multiplexed data/address lines

Parallel protocols: ARM Bus

- ARM Bus
 - Designed and used internally by ARM Corporation
 - Interfaces with ARM line of processors
 - Many IC design companies have own bus protocol
 - Data transfer rate is a function of clock speed
 - If clock speed of bus is X, transfer rate = $16 \times X$ bits/s
 - 32-bit addressing

Wireless protocols: IrDA

- IrDA
 - Protocol suite that supports short-range point-to-point infrared data transmission
 - Created and promoted by the Infrared Data Association (IrDA)
 - Data transfer rate of 9.6 kbps and 4 Mbps
 - IrDA hardware deployed in notebook computers, printers, PDAs, digital cameras, public phones, cell phones
 - Lack of suitable drivers has slowed use by applications
 - Windows 2000/98 now include support
 - Becoming available on popular embedded OS's

Wireless protocols: Bluetooth

- Bluetooth
 - New, global standard for wireless connectivity
 - Based on low-cost, short-range radio link
 - Connection established when within 10 meters of each other
 - No line-of-sight required
 - e.g., Connect to printer in another room

Wireless Protocols: IEEE 802.11

- IEEE 802.11
 - Proposed standard for wireless LANs
 - Specifies parameters for PHY and MAC layers of network
 - PHY layer
 - physical layer
 - handles transmission of data between nodes
 - provisions for data transfer rates of 1 or 2 Mbps
 - operates in 2.4 to 2.4835 GHz frequency band (RF)
 - or 300 to 428,000 GHz (IR)
 - MAC layer
 - medium access control layer
 - protocol responsible for maintaining order in shared medium
 - collision avoidance/detection