Serial I/O standards

I/O schemes

- Polled
  - periodic checking by program; simple
- Interrupt
  - Externally triggered; async
- DMA
  - Direct transfer to/from memory from/to device

Serial I/O

- Bit-at-a-time
- Time domain multiplexing

Subclasses of serial

- Async
  - Clock recovered from data stream
- Sync
  - Clock carried with data stream
- Half-duplex
  - Data in one direction at a time; over.
- Full-duplex
  - Supports similtaneous transmission

SPI/Microwire

- Serial Peripheral Interface bus
  - Full duplex, synchronous serial
  - Master/slave
  - 4-wire
    - Serial clock
    - Master out/slave in
    - Slave out/master in
    - Slave select; no unique slave address
- Application: JTAG

Modes of Operation

- Point-point – 2 devices connected by a path
- Master/slave – one device is in charge
- Multimaster – one device at a time is in charge; hand-over arbitration protocol
- Peer-Peer – all devices are equal
- Multi-point – multiple transceivers on a bus-type architecture

I2C

- Inter-Integrated circuit
- 2-wire interface
- Multi-master
- Bidirectional
- 7-bit slave address

Def’n

- UDP (User datagram protocol)
  - Connectionless; post office model; broadcast (and spam) possible
  - No guarantee of delivery
  - No guarantee of order
- TCP (Transmission Control Protocol)
  - Connection-oriented; connection before transfer
  - Stream oriented; delivery and order guaranteed

IrDA

- Infrared Data Association
- Free space optical communication
- Line of sight
- to 1 gigabit/sec
- 2-24 inches

Bluetooth

- Short range RF networking
- 2400-2480 MHz carrier
- Wireless alternative to RS-232
- Frequency hopping spread spectrum
- 79 1-Mhz bands
- Master-slave
- Packet-based

Ethernet

- Local area network technology (1973)
- IEEE 802.3
- Packets contain destination and source addr.
- Routable
- Twisted pair, coax, optical fiber – shared.
- Repeaters, hubs, switches, bridges

USB

- Universal serial bus
- Communication and power
- USB 3 – to 5 Gbits/sec
- Hub based. Always a master hub

CAN

- Controller area Network (1983)
- Message-based protocol
- Developed for vehicle use & industrial automation
- Multi-master broadcast serial bus

RS-232

- Telecomm standard (1962)
- EIA standard: electrical, interface, timing
- DTE – data terminal equipment
- DCE – data communication equipment
- Who is which?
- Minimum 3-wire
- Current loop option

Firewire

- IEEE 1394
- Handles digital video
- Serial bus
- 63 peripherals in a tree or daisy chain
- Peer-peer, or multimaster

Spacewire

- IEEE1355
- ESA
- Full duplex, point-point, routable
- 400 Mbps

RS-422/423

- ANSI & International standard
- Balanced voltage (differential)
- Point-point or multidrop
- Electrical definition only
- RS-423 is unbalanced signaling, 4 Mbps
- Twisted pair

Video

- DVI
  - Digital Visual interface
  - Video, source to display; 165 MHz pixel clock
  - not analog compatible
- HDMI
  - Video and audio; EIA/CEA-861 standards
  - 340 MHz pixel clock
- GVIF
  - Gigabit video interface (Sony) 10-30 meters

1553

- Avionics bus, also used in spacecraft (1973)
- MIL-STD-1553
- Coax, Manchester bi-phase for code & data
- Bus Controller (BC) and remote terminals (RT)
- RT-RT allowed, under control of master BC

OBD-II

- On-Board diagnostics (for autos)
- Self-diagnostics and reporting (1969-VW)
- Diagnostic trouble codes
- California Air Resources Board – mandatory use (1991) for emissions control
- J1962 connector, socket is near steering wheel
- CAN protocol popular

ARINC

- Aeronautical Radio, Inc (Annapolis)
- ARINC-429 – avionics bus spec
- Self-clocking, self sync; 32-bit words
- Balanced differential over shielded twisted pair
- Bipolar return to zero waveform

DCC

- Digital Command Control (1980’s)
- Independent control for model locomotives on the same track.
- Modulates track voltage, bipolar dc.
- Each decoder (remote device) has a unique 8-bit code.

IP over Avian

- IP, Internet Pigeon
- RFC 1149, April 1, 1990
- Poor latency, high packet loss
- High throughput, using flash memory devices
- Capacity has increased 3x over bandwidth of the internet over last 20 years

CTAM

- Chevy Truck Access Method
  - Favored for moving large volumes of tape and disk backup material for data centers.

Homework

- Calculate the latency and bandwidth of a 747-freighter full of CD’s from New York to Los Angeles.