CPE201
Digital Design

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Class 27: Transmission and Buses

University of Nevada, Reno

Outline

- Bus Parameters
- Parallel Buses
- Serial Buses

Buses

- We are dealing with layer 1 and 2
  - 1 is bus type (Bluetooth, SPI, RS232, USB, etc.)

OSI model

Layer			Protocol data unit (PDU)	Function[22]
Host layers	7	Application	Data	High-level APIs, including resource sharing, remote file access
	6	Presentation		Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption
	5	Session		Managing communication sessions, i.e., continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
	4	Transport	Segment, Datagram	Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing
Media layers	3	Network	Packet	Structuring and managing a multi-node network, including addressing, routing and traffic control
	2	Data link	Frame	Reliable transmission of data frames between two nodes connected by a physical layer
	1	Physical	Bit, Symbol	Transmission and reception of raw bit streams over a physical medium

Bus Parameters

- Things You've Seen
  - Serial/Parallel
    - 1 bit at a time transmission (TX), or more
  - Synchronous/Asychronous
    - Is there a clock signal, or not

Bandwidth/Throughput

- Max data TX rate
- BW = Bus width (bits) x Frequency (Hz)/8 bits/byte
- BW = 16bits x 66MHz = 132MBps

Bandwidth

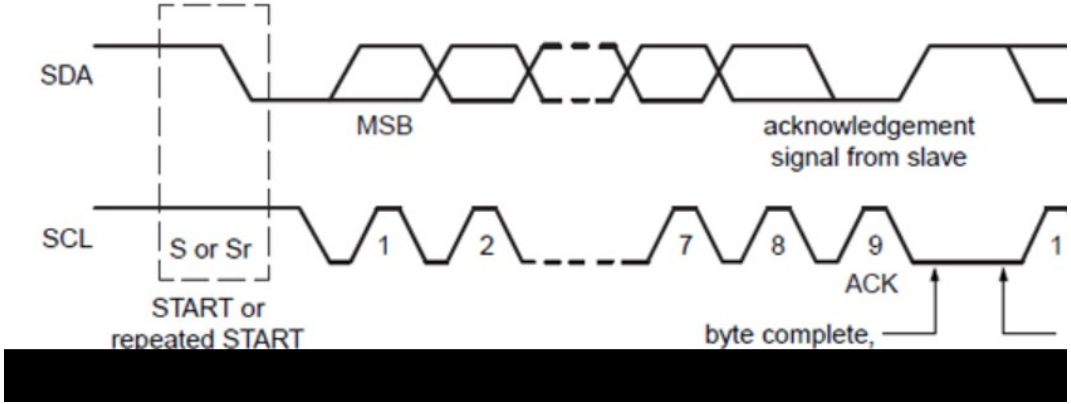
- Be aware
  - MBps = Megabytes per second
  - Mbps = Megabits per second
    - 1 MBps = 8Mbps

Bandwidth

- Measurements made on decimal values
  - 1 MB = 1,000,000 bytes instead of 1,048,576 bytes
  - Now 200 ‘MBps’ = 190 actual MBps
  - Same reason why your ‘1TB’ SSD has 931GB in it

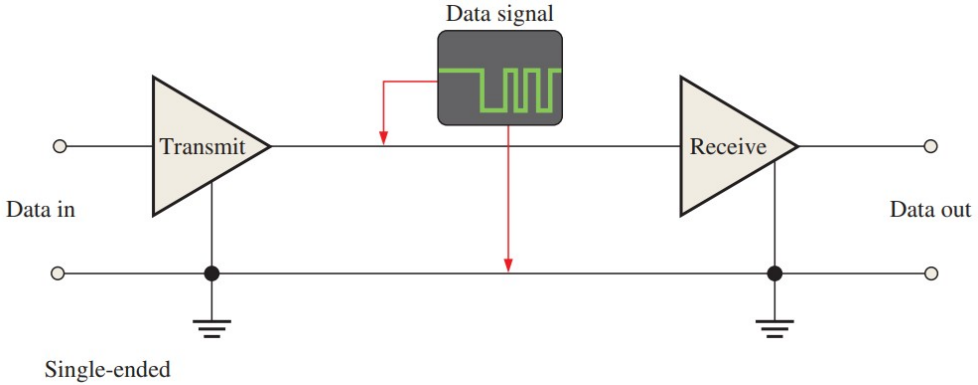
Handshaking

- Basic flow control – makes sure data is received or acknowledged

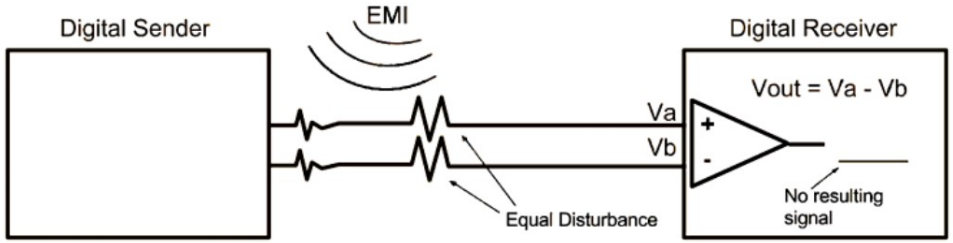


Single Ended vs Differential

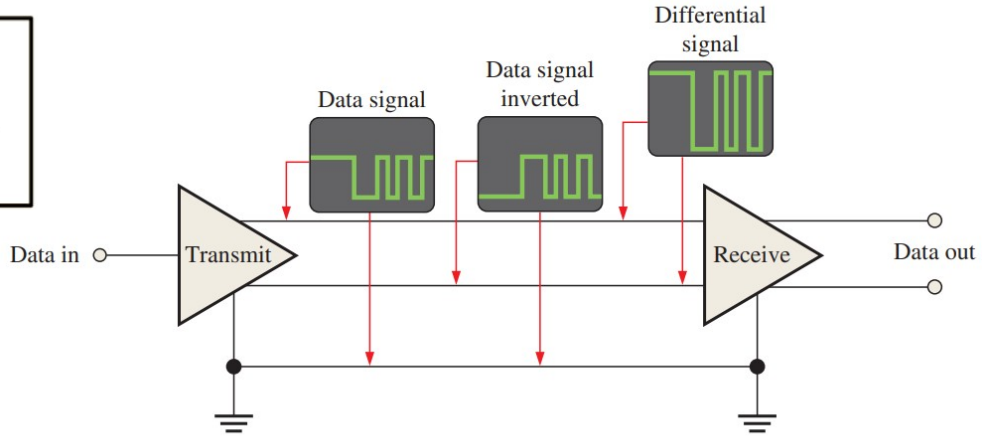
- Cheaper



Single-ended



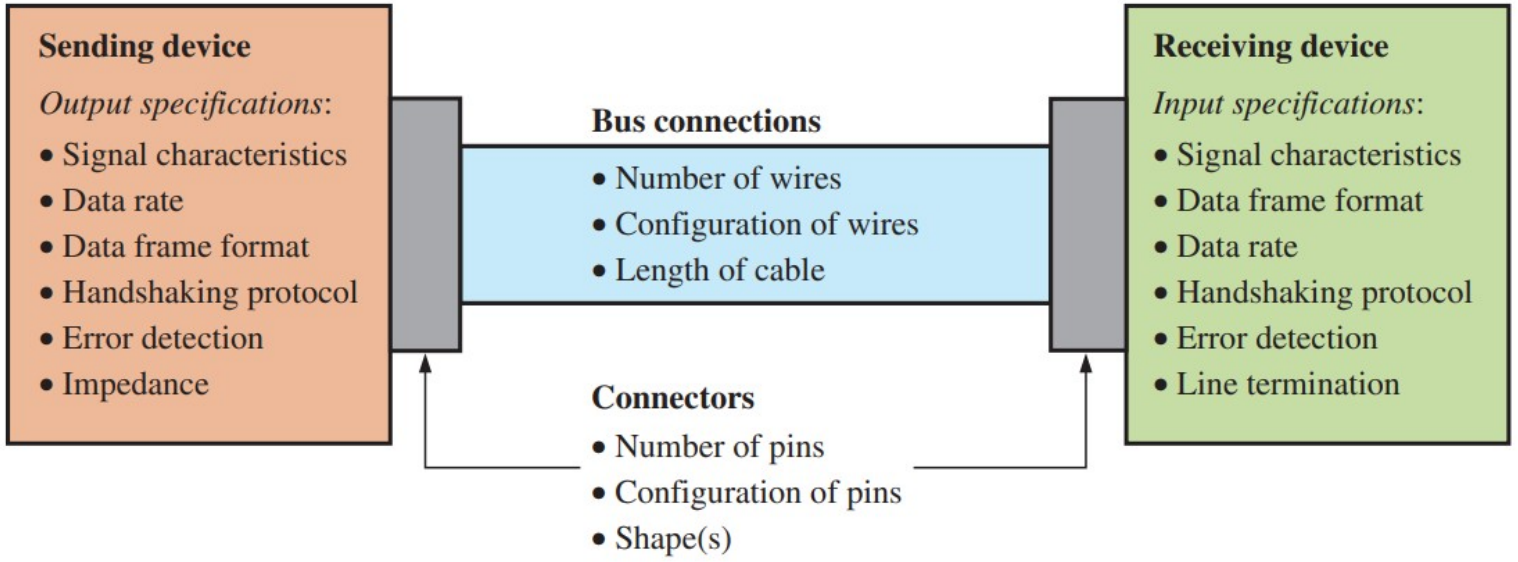
- More noise immun



Differential

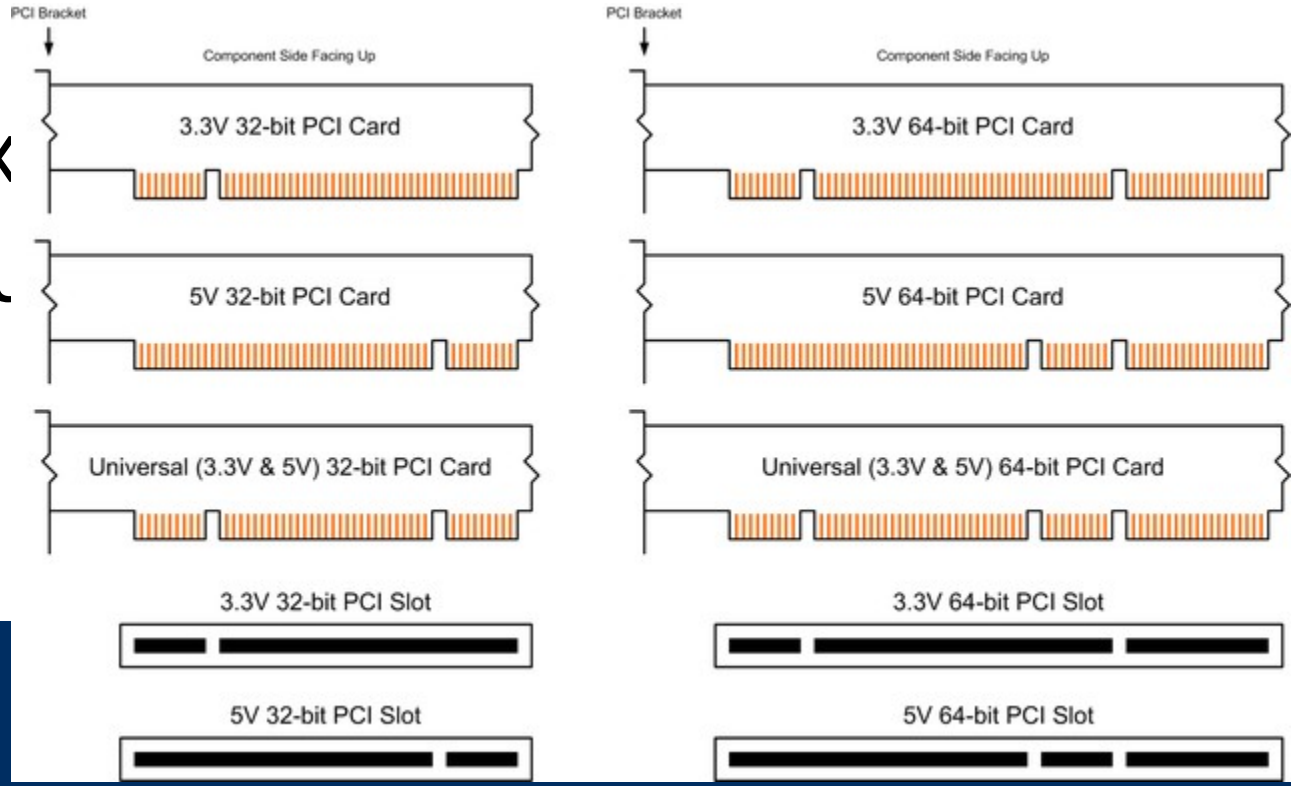
Buses

- Picking a bus type will define many of these parameters



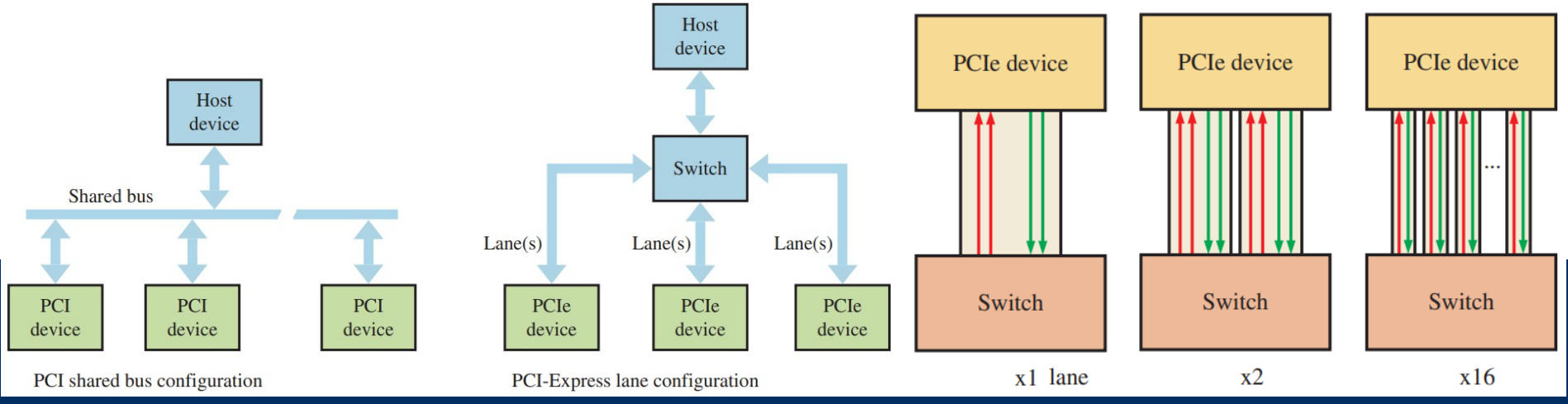
Parallel Buses - PCI

- 1992-2003
- Half-duplex
- Synchronou



Parallel Buses - PCIe

- Multiple smaller parallel buses
- Full-duplex, synchronous

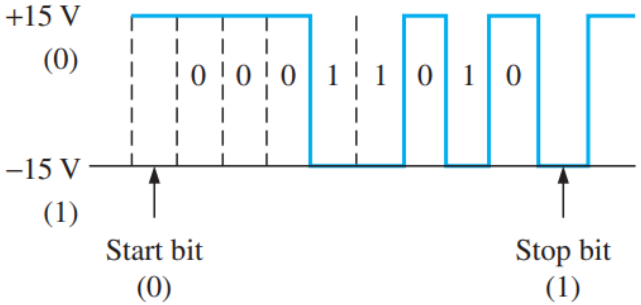


Parallel Buses - SCSI

- Since 1981
- Full-duplex, synchronous
- Still popular for HD connectior
  - Now serial and parallel options

Serial Buses – RS232

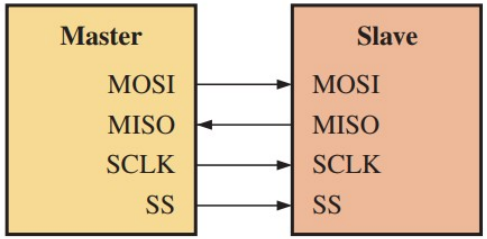
- Or RS422/423/485
- Asynchronous
- Half or full-duplex



Specifications	RS-232	RS-423	RS-422	RS-485
Operation	Single-ended	Single-ended	Differential	Differential
Drivers/Receivers	1/1	1/10	1/10	32/32
Cable length	50 ft	4000 ft	4000 ft	4000 ft
Max data rate	20 kbps	100 kbps	10 Mbps	10 Mbps
Driver output signal level (+/– min/max)	5 V/15 V	3.6 V/6 V	2 V/6 V	1.5 V/6 V

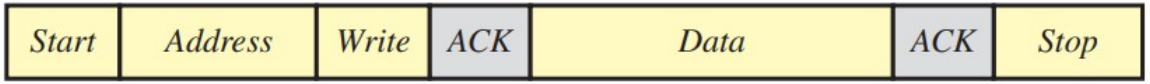
Serial Buses - SPI

- Since 1979
- Full duplex, synchronous
- Select line for each device
- Wonderfully simple



Serial Buses –I2C

- Since 1982
- Half-duplex, synchronous
- Addresses

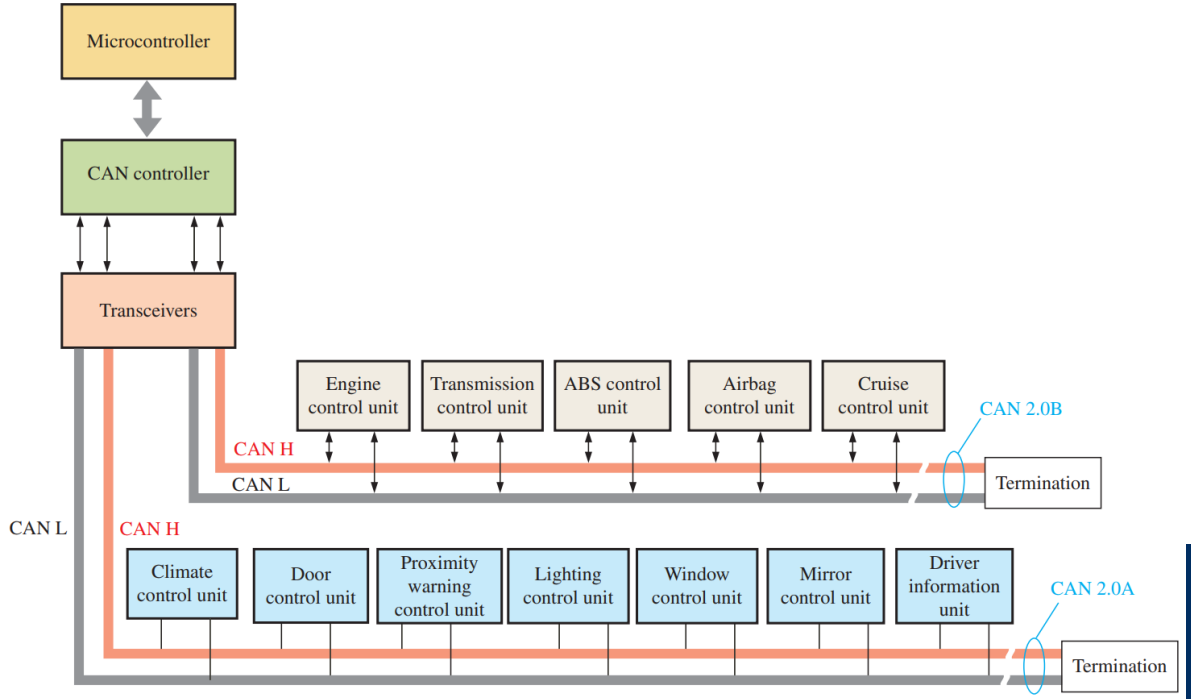


Data transfer from master to slave

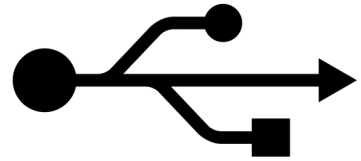
Data transfer from slave to master

Serial Buses - CAN

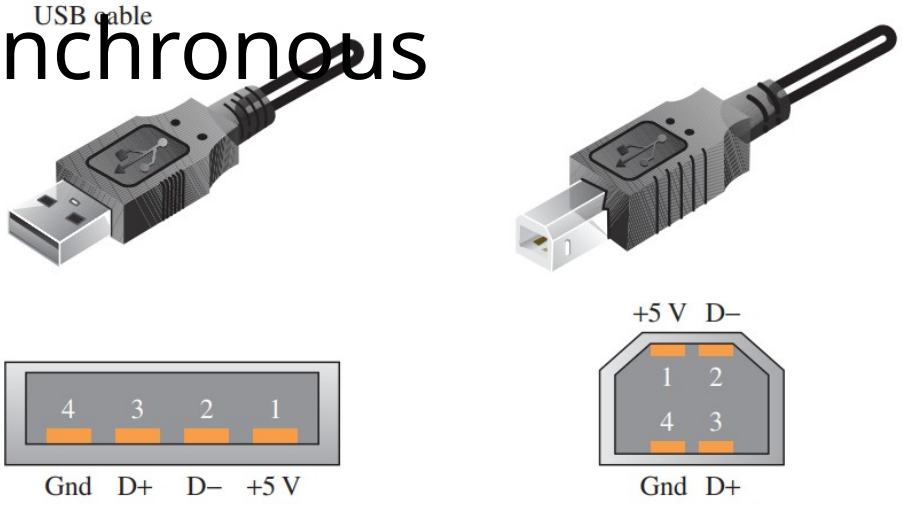
- Very robust – auto applications
- Differential
- Asynchronou
- Half-duplex

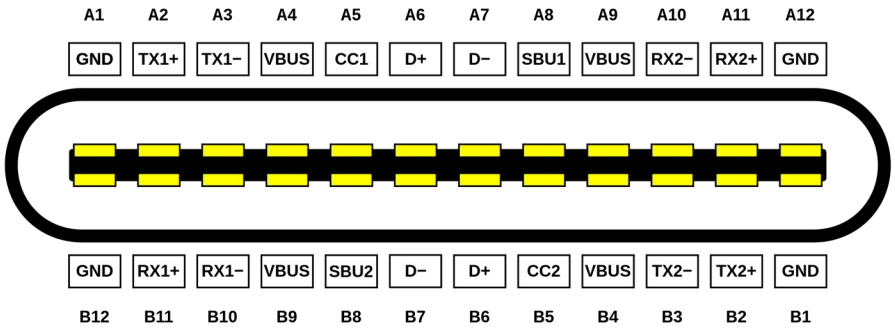


Serial Buses - USB



- Since 1982
- Full-duplex (3.0), asynchronous
- Addresses, packets, and types





Reading

- This lecture
  - Sections 13.6-13.9
- Final Exam
  - Friday May 6th, 9:50-11:50am