SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT312 – EMBEDDED SYSTEM DESIGN

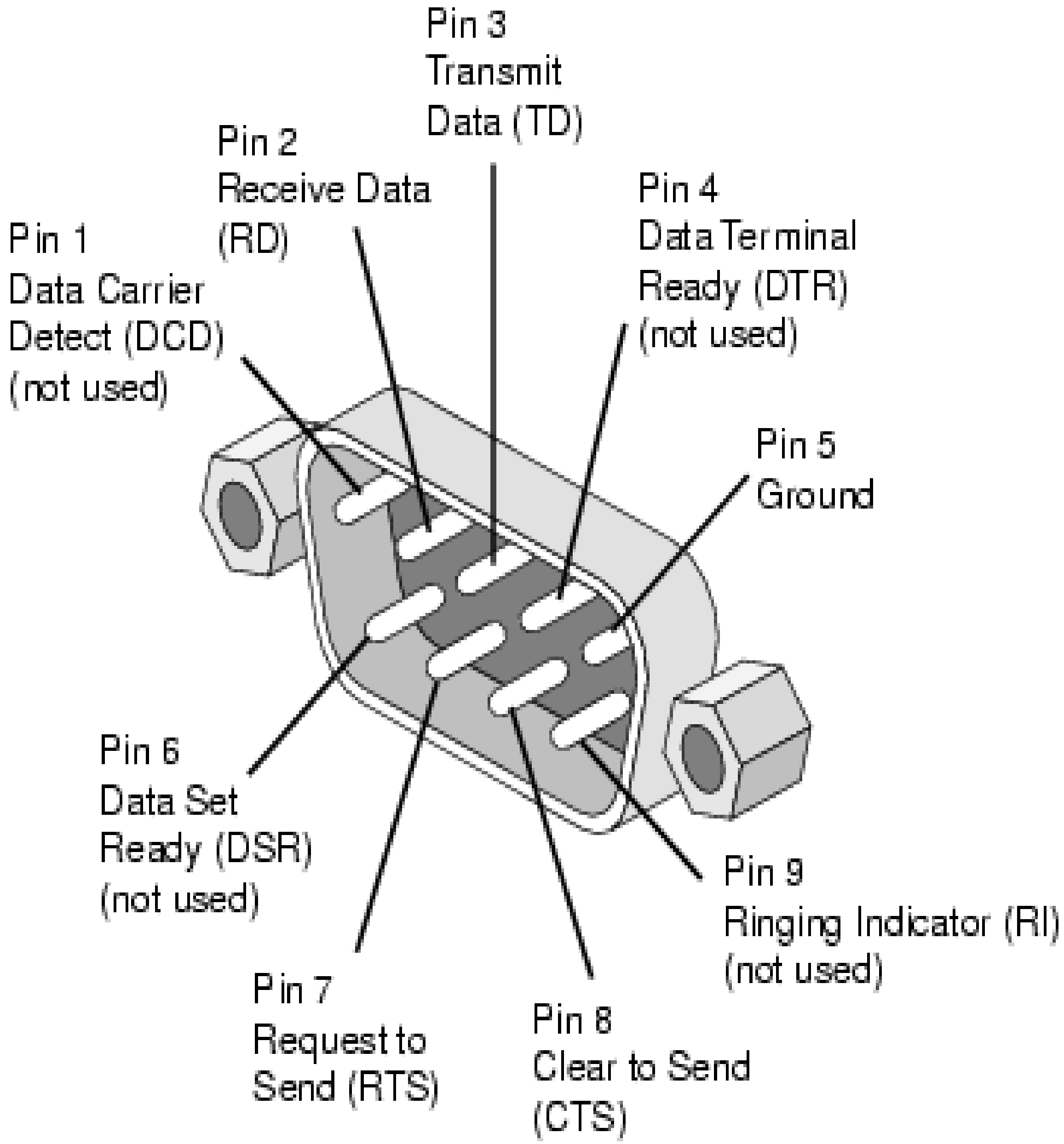
III YEAR/ VI SEMESTER

UNIT 2 :**DEVICES AND EMERGING BUS STANDARDS**

TOPIC 2.2 : Communication from serial devices-UART,SPI,I2C

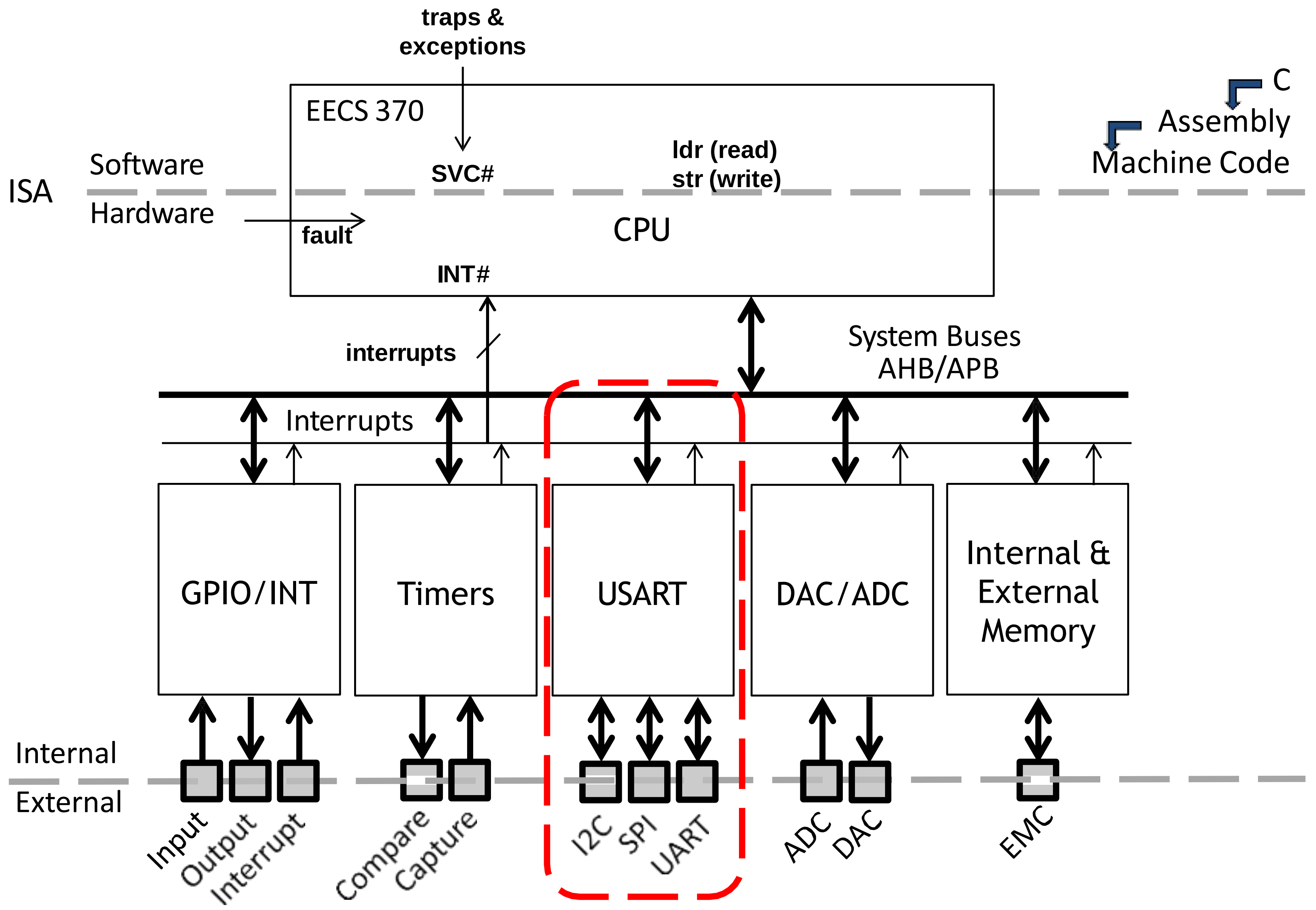
COMMUNICATION FROM SERIAL DEVICES

Serial buses



COMMUNICATION FROM SERIAL DEVICES

Serial interfaces



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Outline

- Introduction to Serial Buses
- UART
- SPI
- I2C

SERIAL BUS INTERFACE MOTIVATIONS

- Motivation
  - Connect different systems together
    - Two embedded systems
    - A desktop and an embedded system
  - Connect different chips together in the same embedded system
    - MCU to peripheral
    - MCU to MCU
  - Without using a lot of I/O lines
    - I/O lines require I/O pads which cost $$$ and size
    - I/O lines require PCB area which costs $$$ and size
  - Often at relatively low data rates
  - But sometimes at higher data rates
- So, what are our options?
  - Universal Synchronous/Asynchronous Receiver Transmitter
  - Also known as USART (pronounced: “you-zart”)

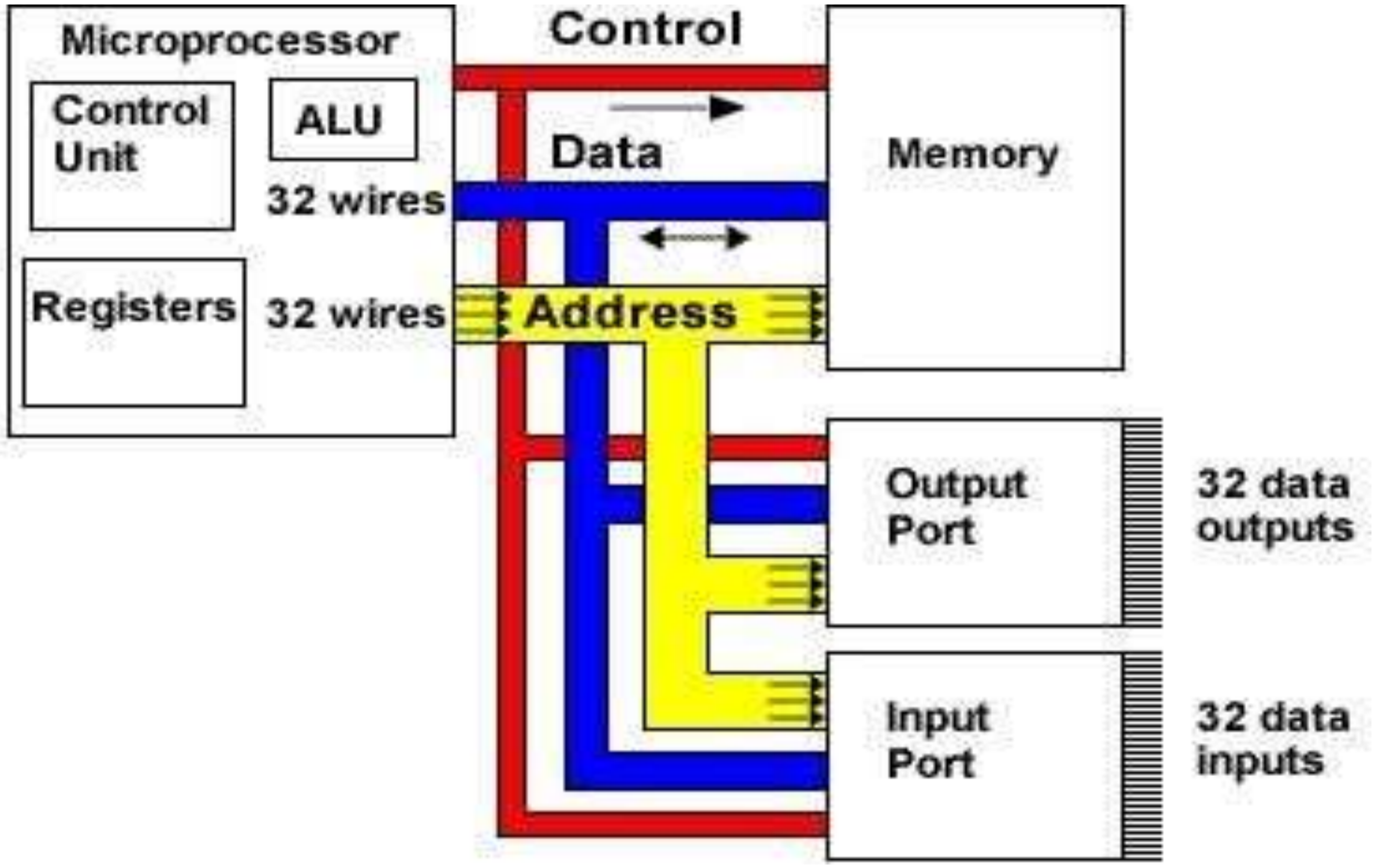
2/20/2023

Serial bus design space

- Number of wires required?
- Asynchronous or synchronous?
- How fast can it transfer data?
- Can it support more than two endpoints?
- Can it support more than one master (i.e. txn initiator)?
- How do we support flow control?
- How does it handle errors/noise?

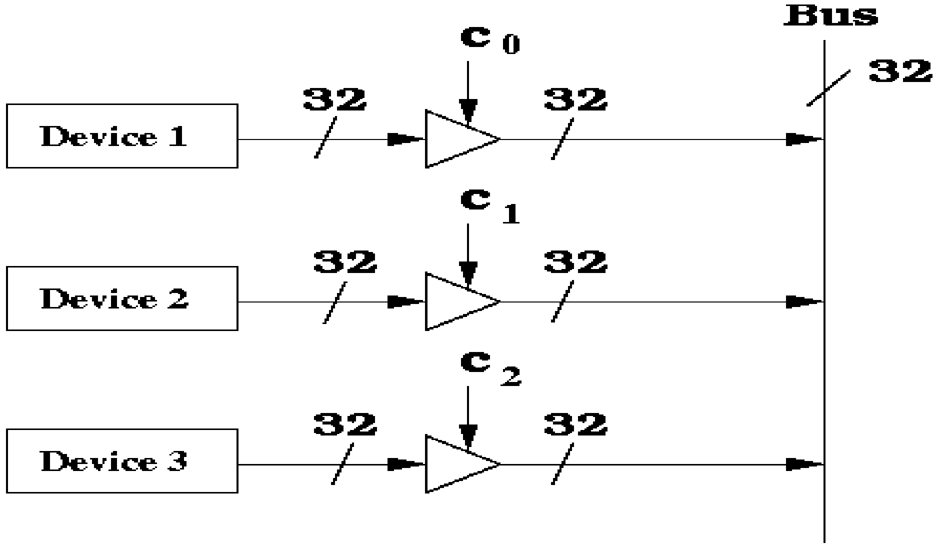
Fun with buses

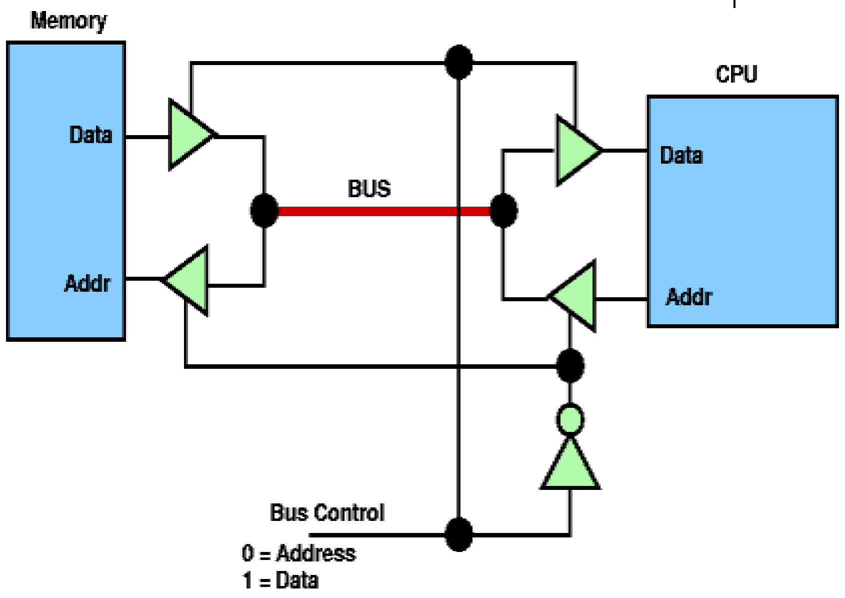
- A multidrop bus (MDB) is a computer bus in which all components are connected to the same set of electrical wires. (from Wikipedia)
  - In the general case, a bus may have more than one device capable of driving it.
    - That is, it may be a "multi-master" bus as discussed earlier.



How can we handle multiple (potential) busdrivers? (1/3)

- Tri-state devices, just have one device drive at a time. Everyone can read though
  - Pros:
    - Very common, fairly fast, pin-efficient.
  - Cons:
    - Tri-state devices can be slow.
      - Especially drive-to-tristate?
    - Need to be sure two folks not driving at the same time
      - Let out the magic smoke.
  - Most common solution (at least historically)
    - Ethernet, PCI, etc.



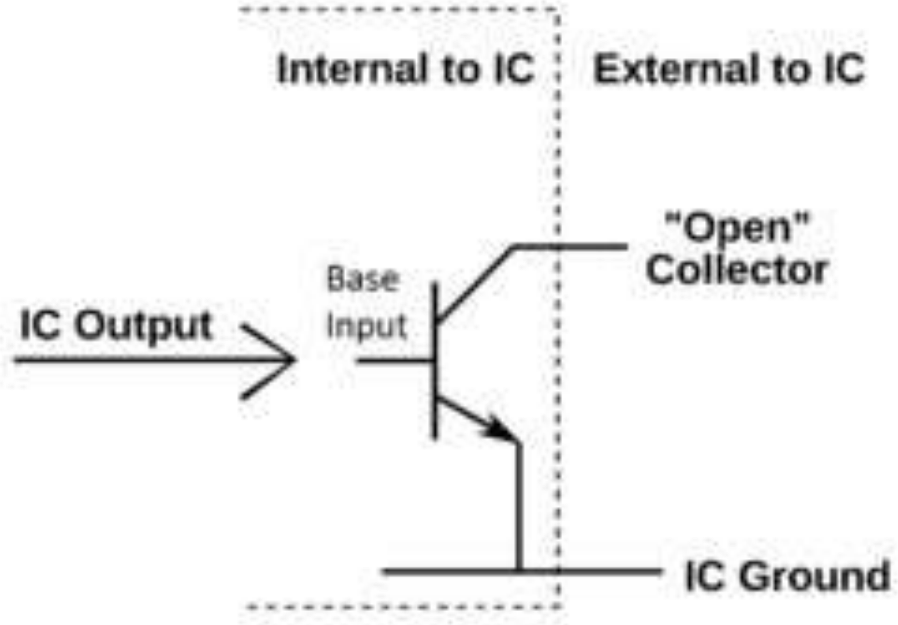


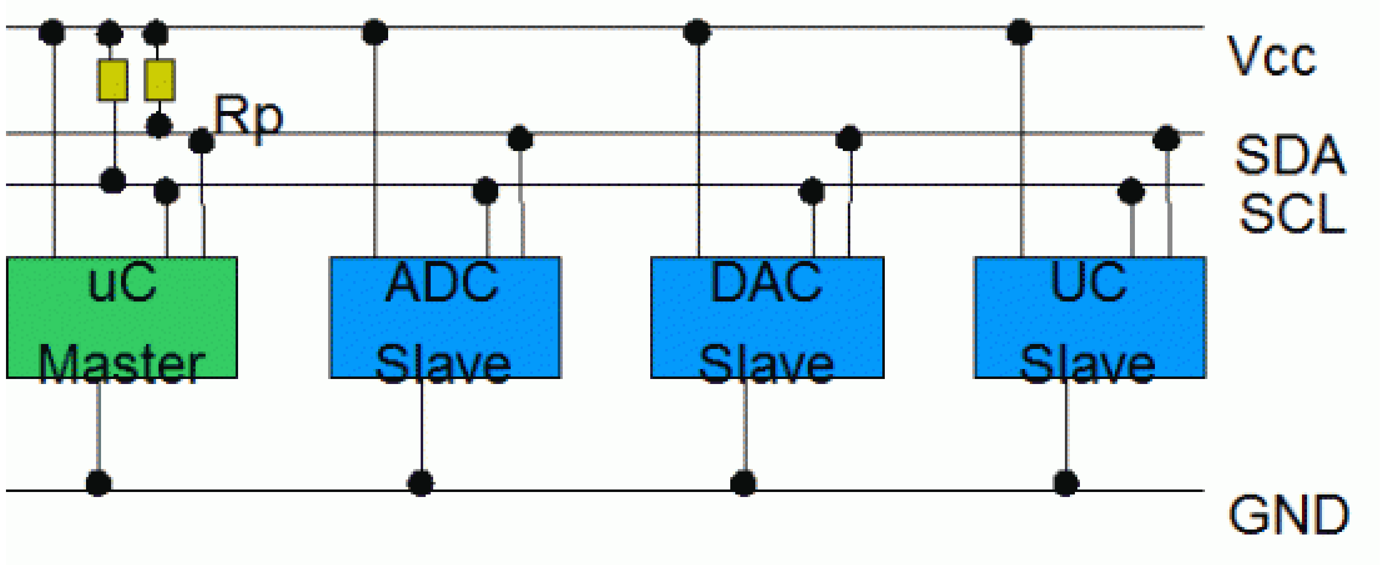
How can we handle multiple (potential) bus drivers? (2/3)

- MUX
  - – Just have each device generate its data, and have a MUX select.
    - That’s a LOT of pins.
      - – Consider a 32-bit bus with 6 potential drivers.
        - » Draw the figure.
        - » How many pins needed for the MUX?
  - – Not generally realistic for an “on-PCB” design as we’ll need an extra device (or a lot of pins on one device)
    - But reasonable on-chip
      - – In fact AHB, APB do this.

How can we handle multiple (potential) bus drivers? (3/3)

- “pull-up” aka “open collector” aka “wired OR”
  - Wire is pulled high by a resistor
  - If any device pulls the wire low, it goes low.
- Pros:
  - If two devices both drive the bus, it still works!
- Cons:
  - Rise-time is very slow.
  - Constant power drain.
- Used in I2C, CAN





SUMMARY & THANK YOU