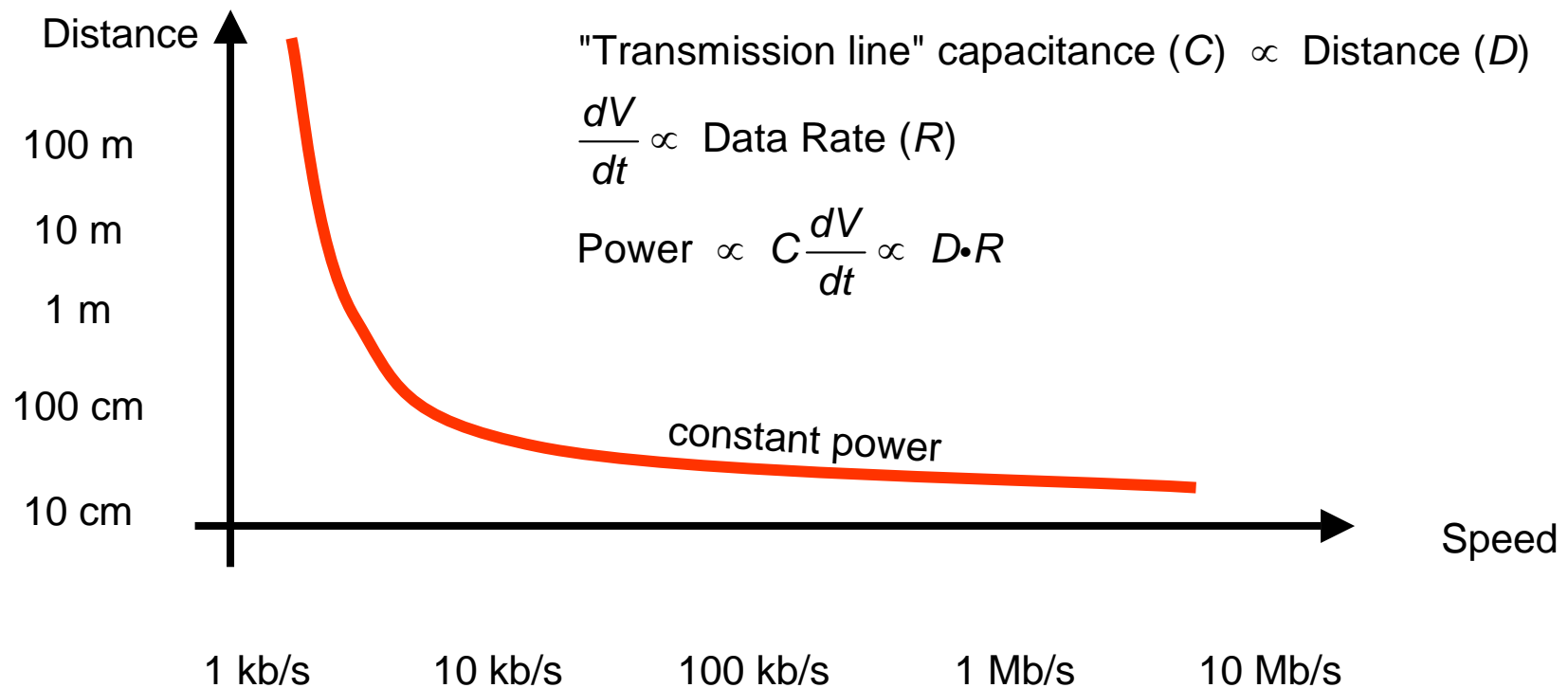


# Architecture, Design and Implementation of Embedded Systems for Real-Time Applications

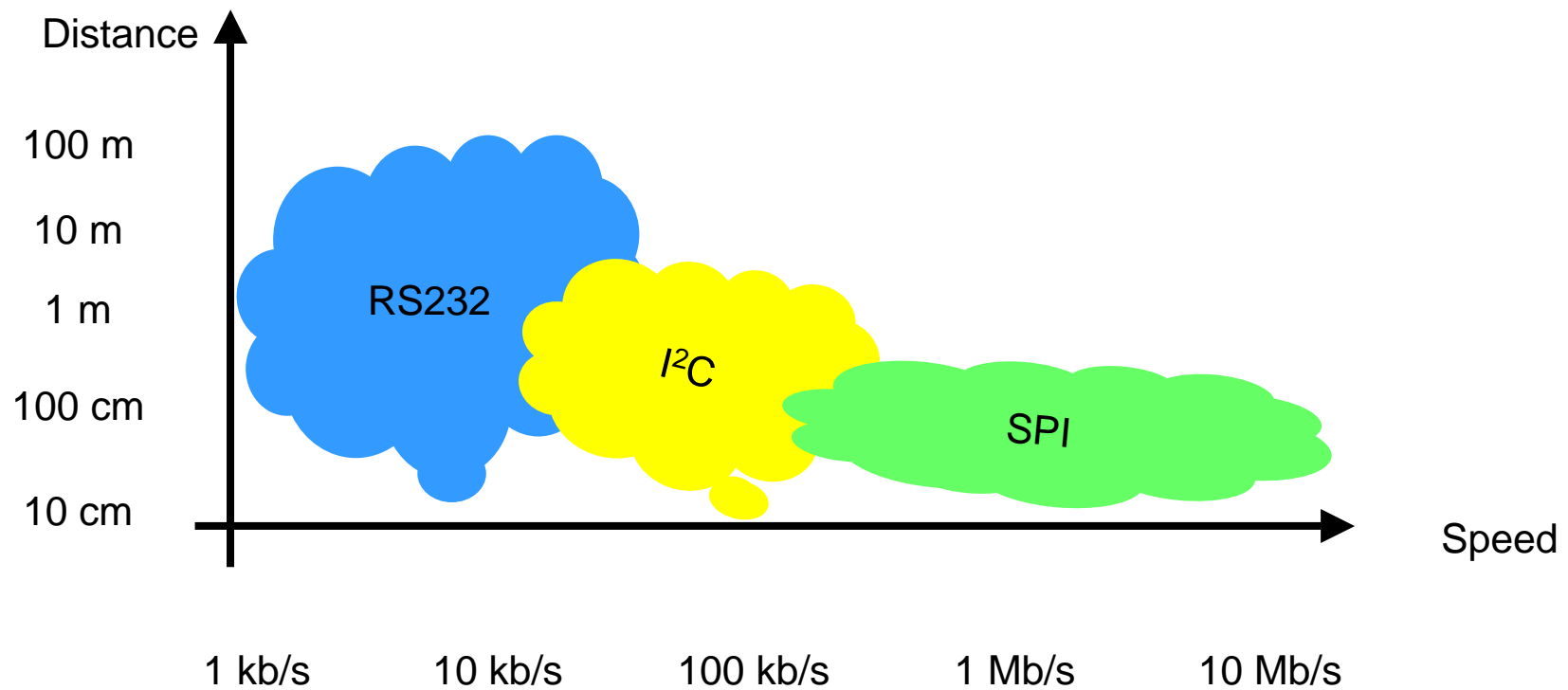
CpE-450 - Spring 05  
Class 13/14

Bruce McNair  
bmcnair@stevens.edu

# Interfacing to Embedded Systems

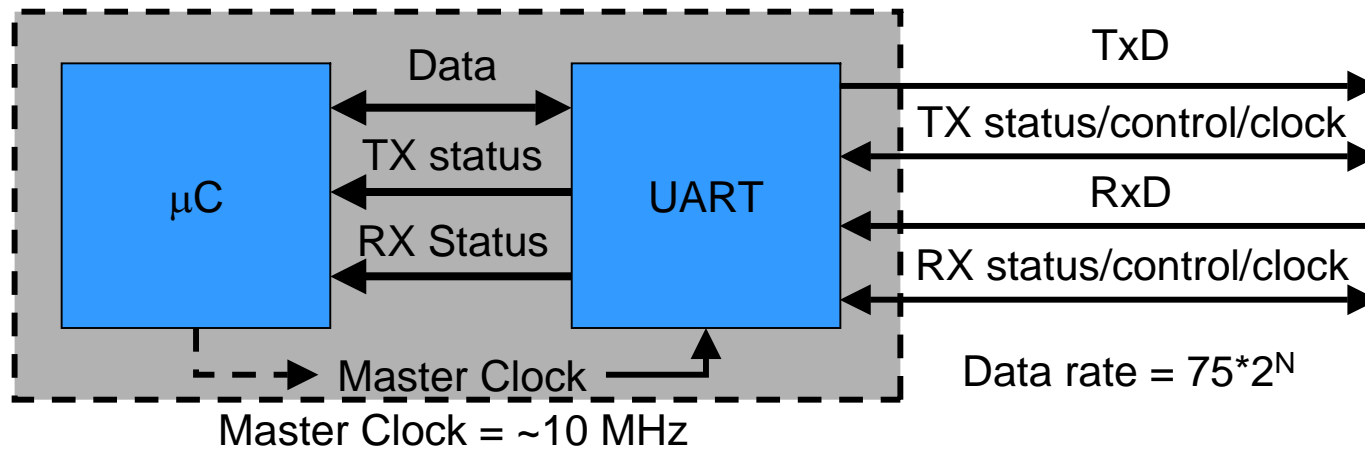


# Interfacing to Embedded Systems



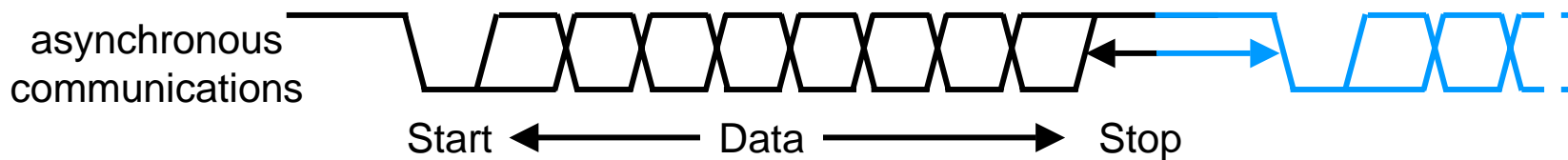
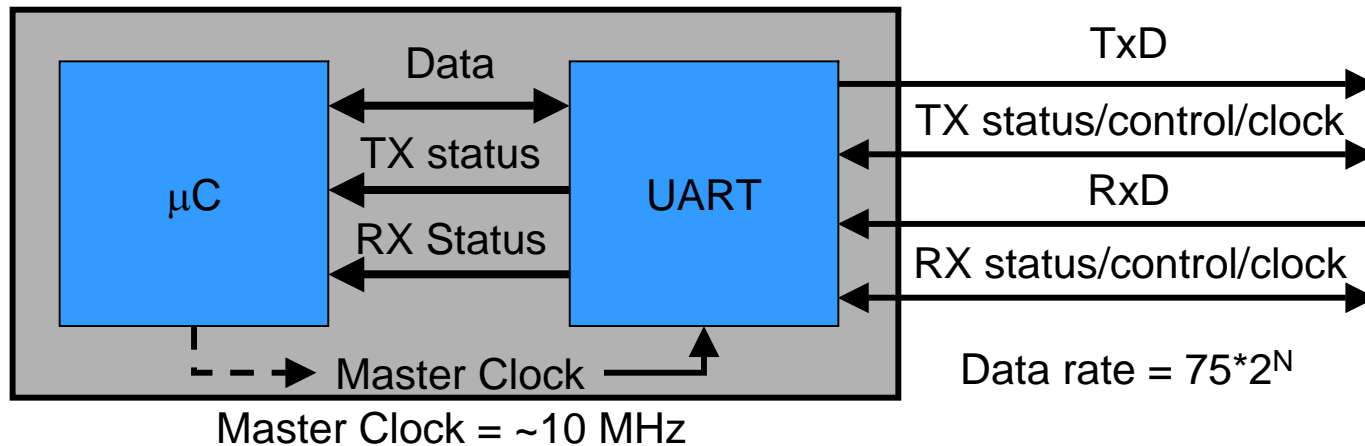
# Embedded System Interfacing

- RS-232 Serial Communications



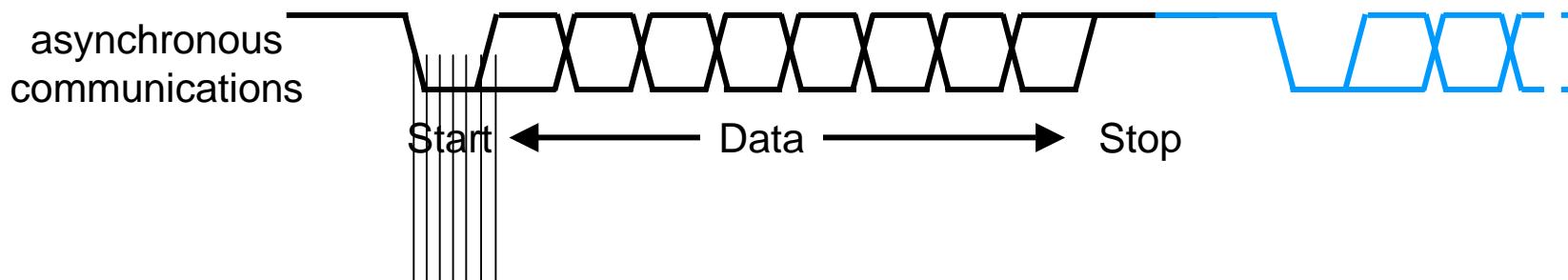
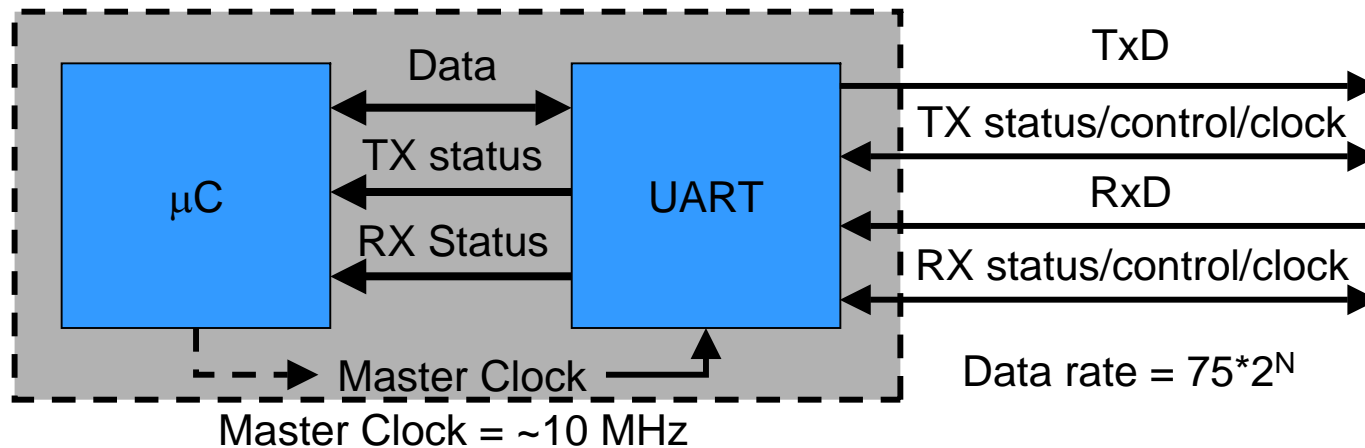
# Embedded System Interfacing

- RS-232 Serial Communications



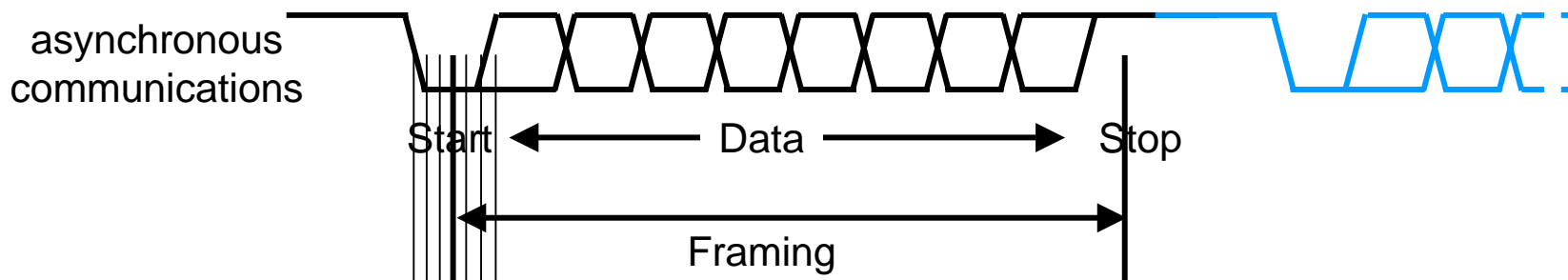
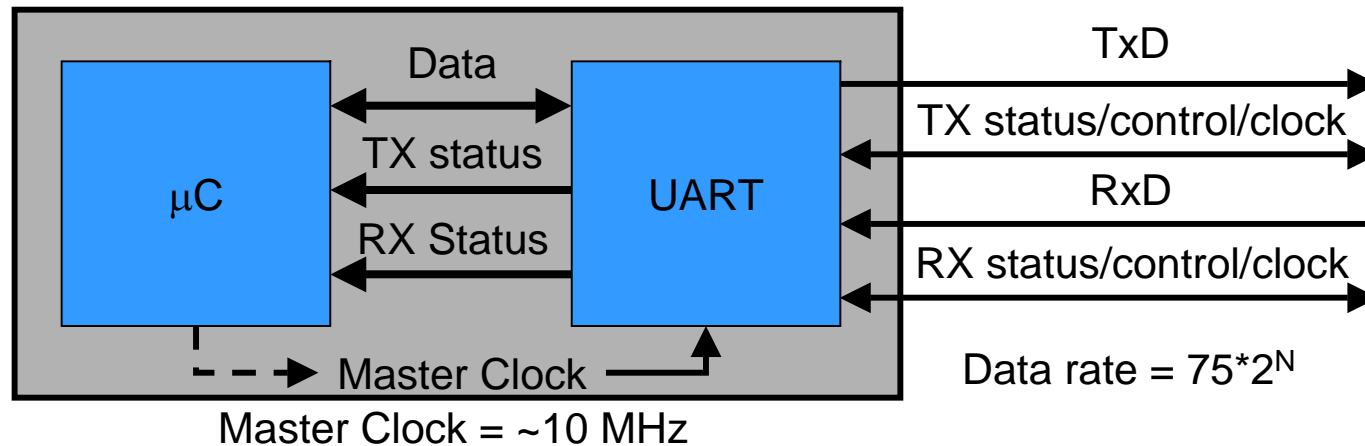
# Embedded System Interfacing

- RS-232 Serial Communications



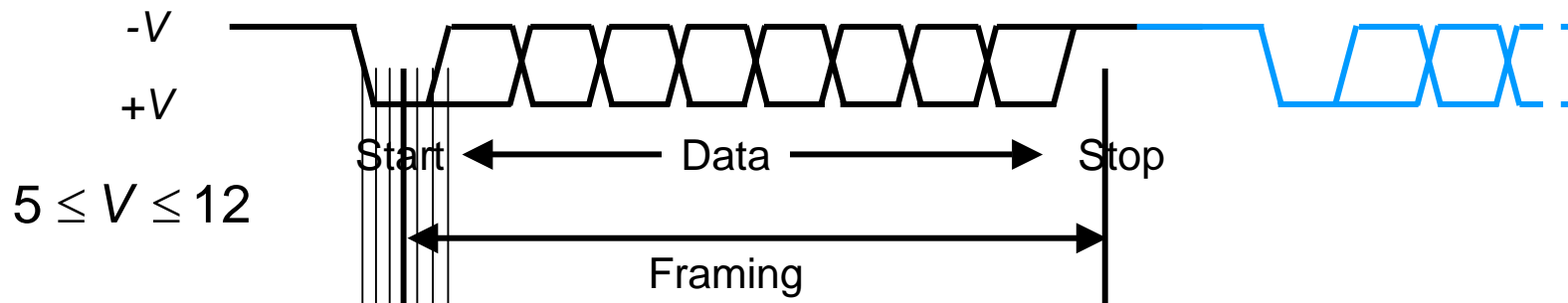
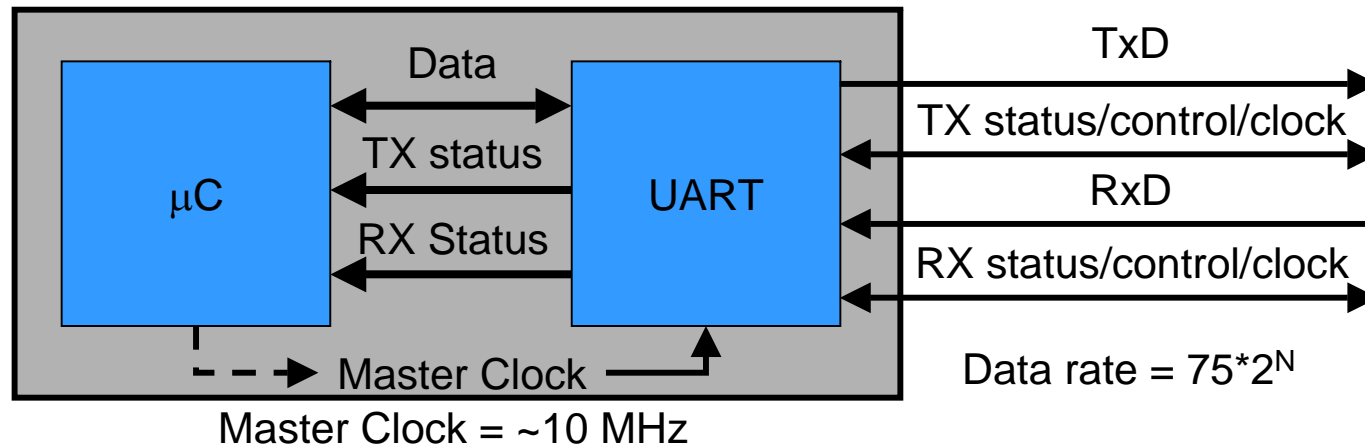
# Embedded System Interfacing

- RS-232 Serial Communications



# Embedded System Interfacing

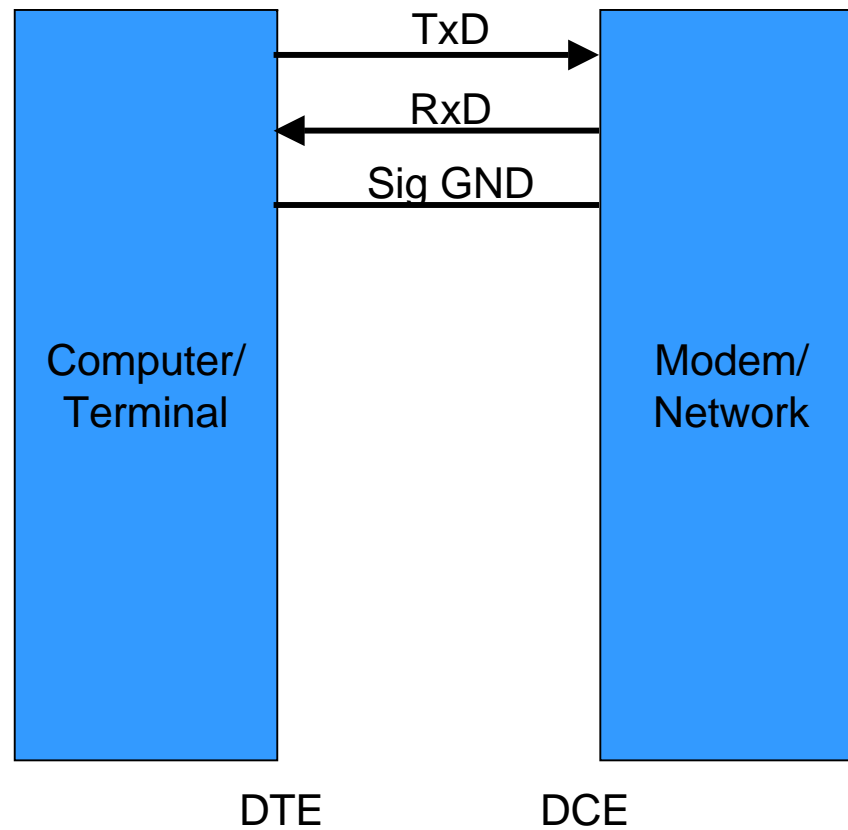
- RS-232 Serial Communications





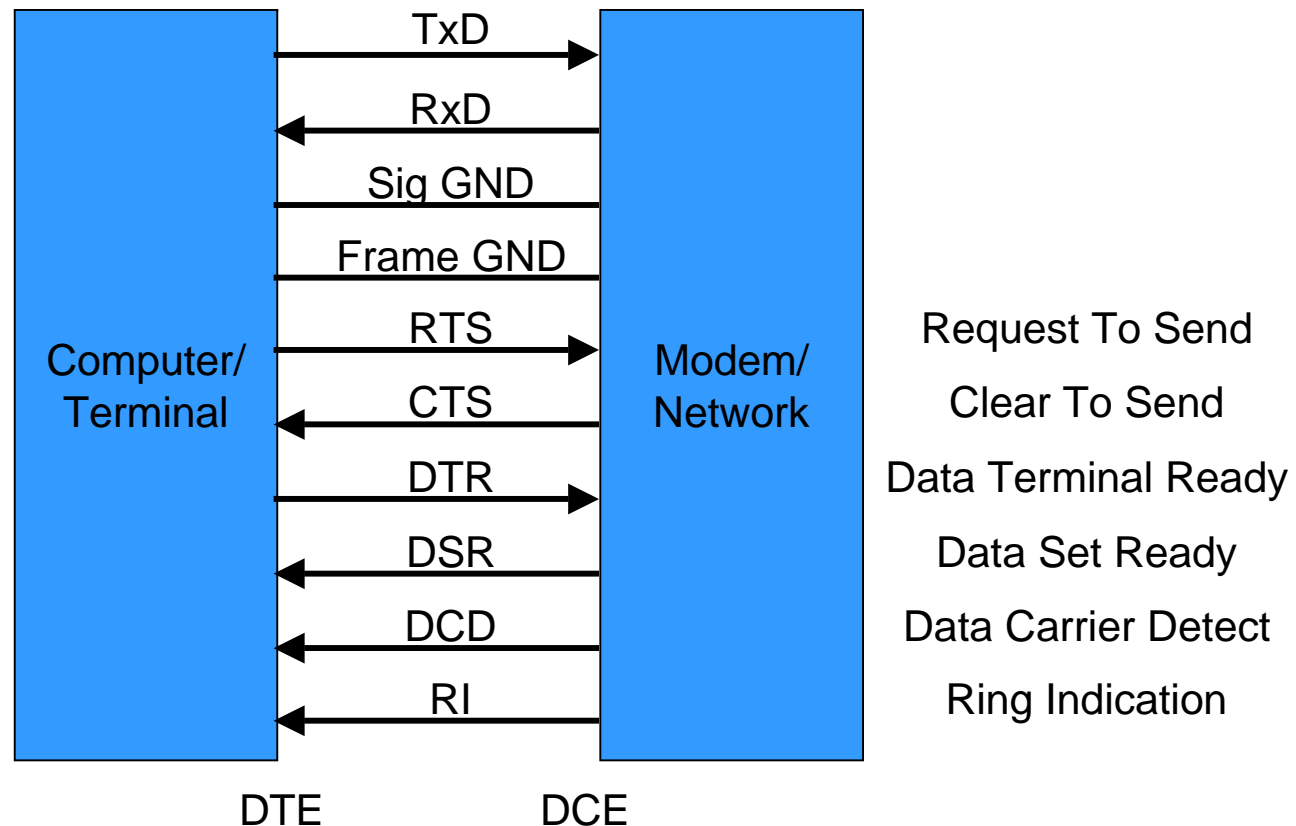
# Embedded System Interfacing

- RS-232 Serial Communications



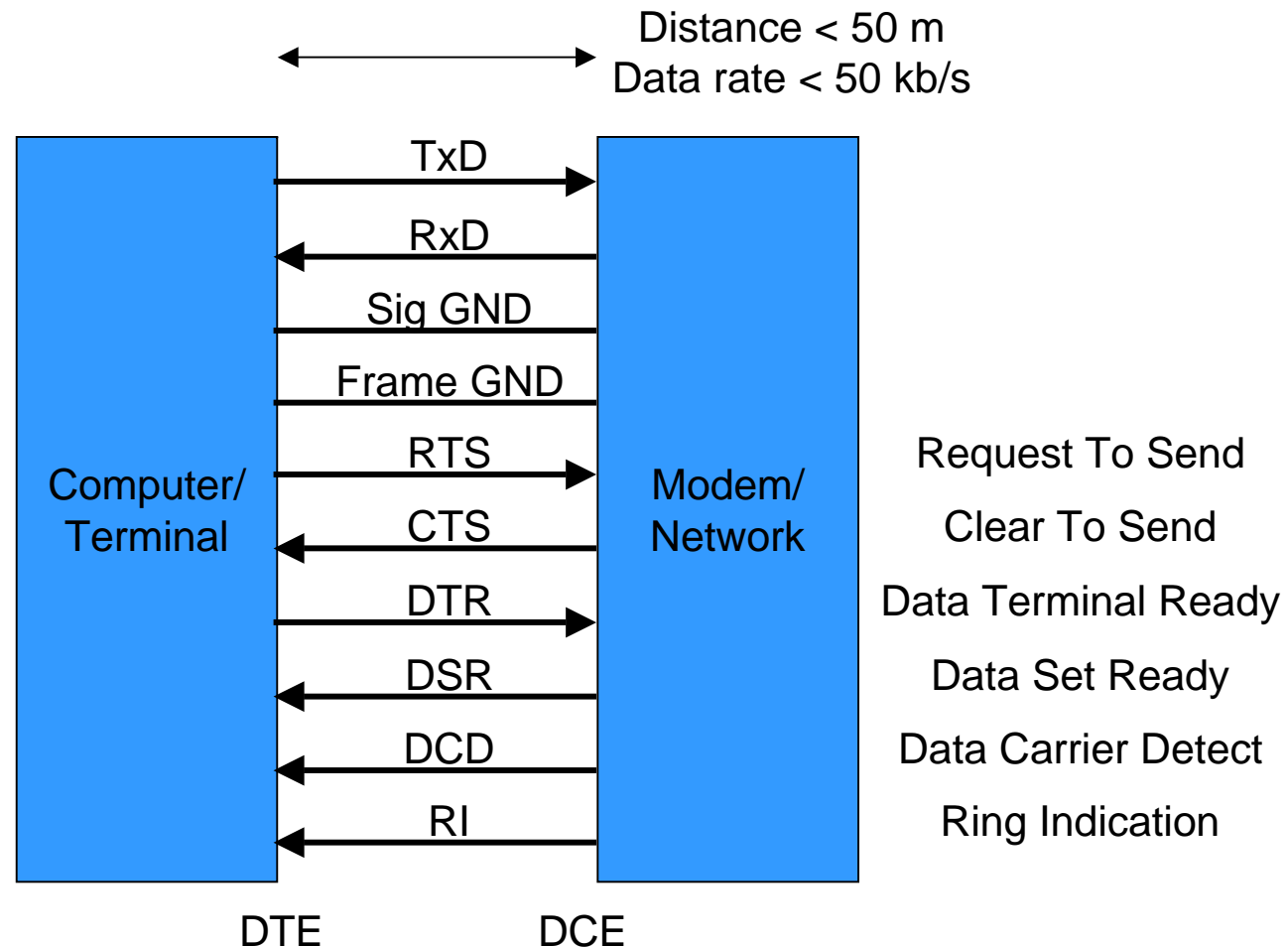
# Embedded System Interfacing

- RS-232 Serial Communications



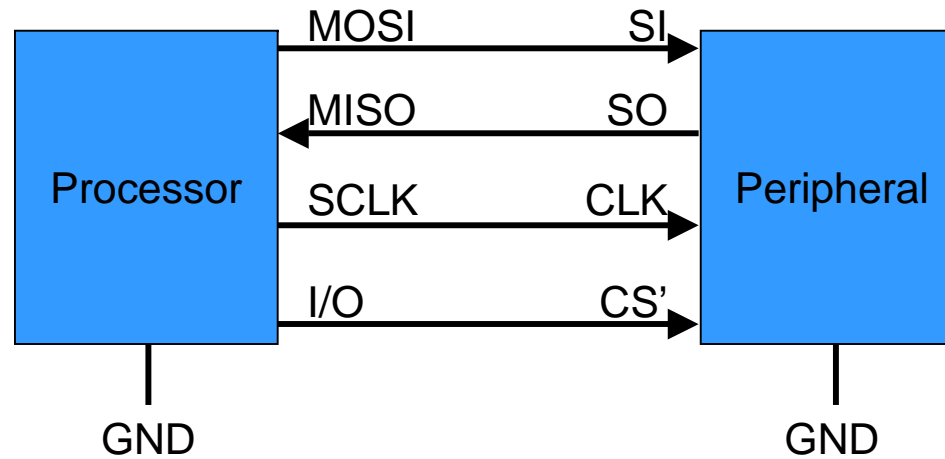
# Embedded System Interfacing

- RS-232 Serial Communications



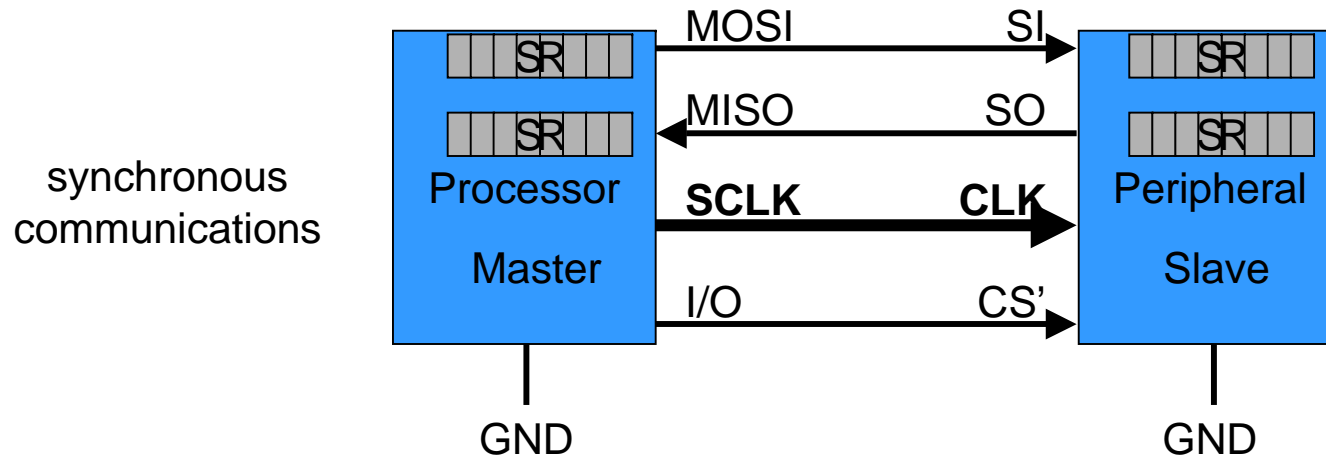
# Embedded Systems Interfacing

- SPI – Serial Peripheral Interface



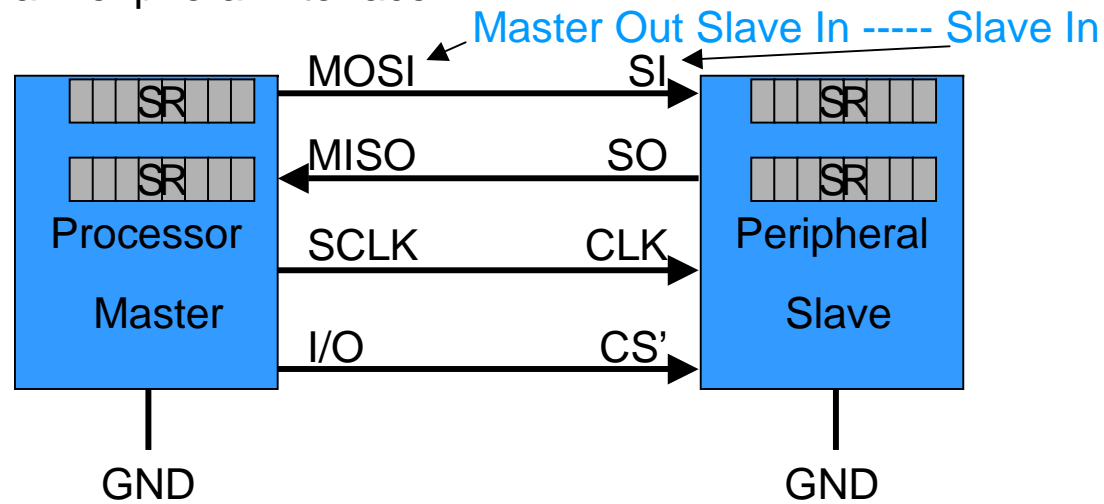
# Embedded Systems Interfacing

- SPI – Serial Peripheral Interface



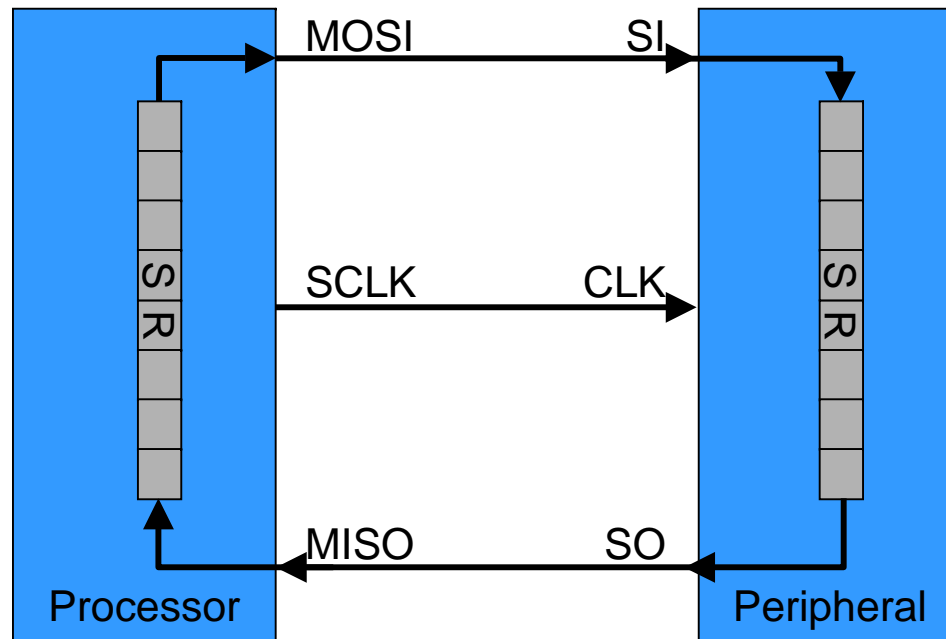
# Embedded Systems Interfacing

- SPI – Serial Peripheral Interface



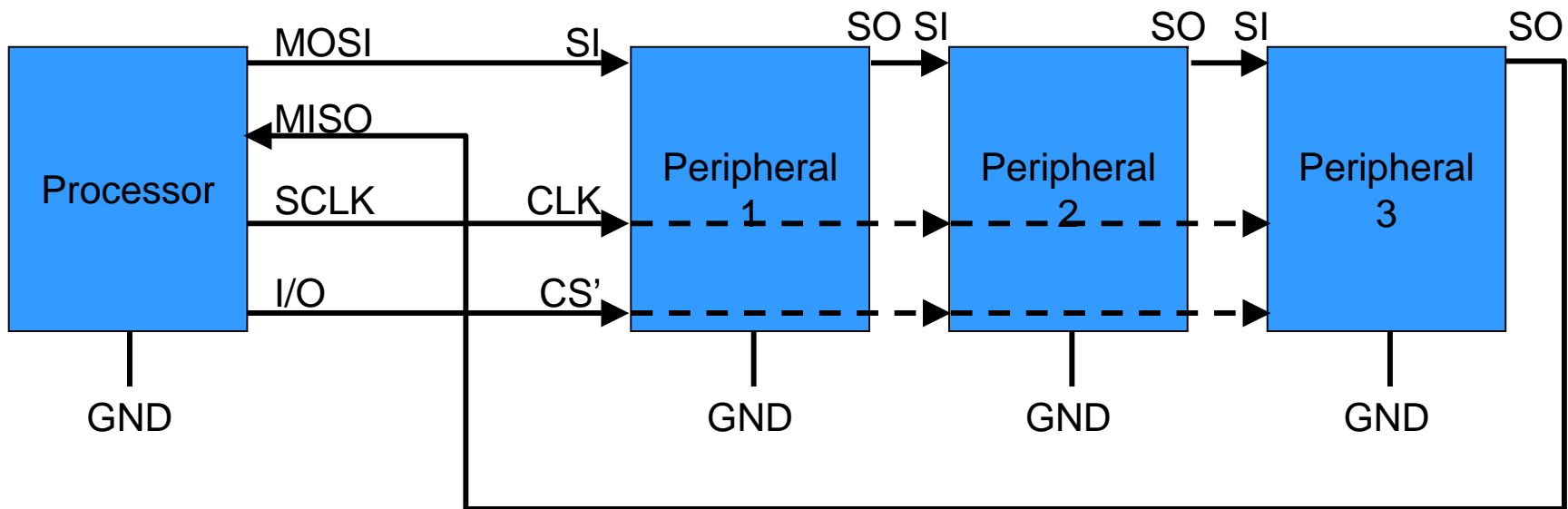
# Embedded Systems Interfacing

- SPI – Serial Peripheral Interface



# Embedded Systems Interfacing

- SPI – Serial Peripheral Interface



Extension to multiple peripherals:

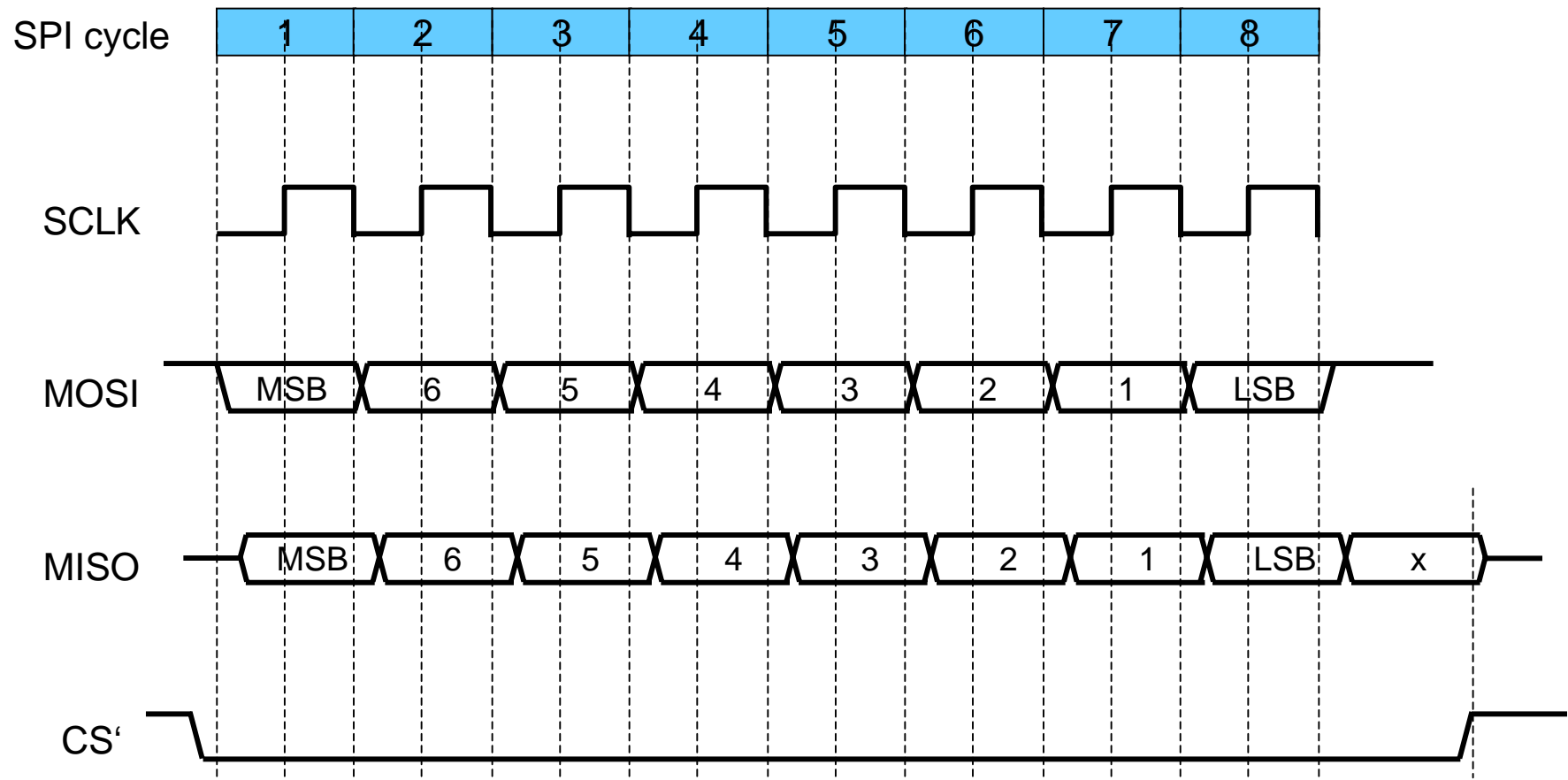
- Real Time Clocks (time of day)
- Sensors (e.g. potentiometers)
- FLASH memory

- Interface speed limited by device technology  
Mb/s, compared to kb/s for RS-232



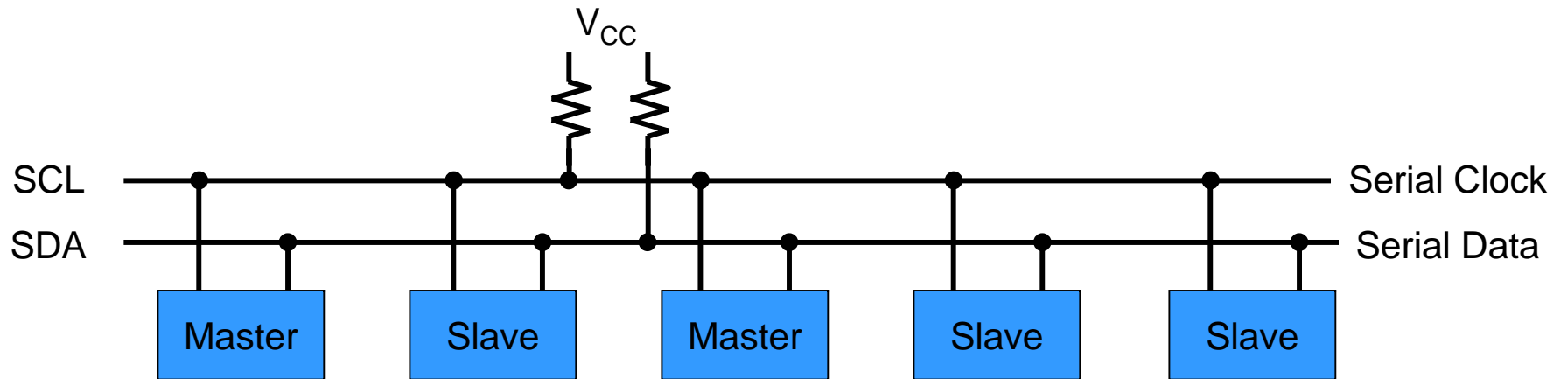
# Embedded Systems Interfacing

- SPI timing (Clock low, Clock phase 0)



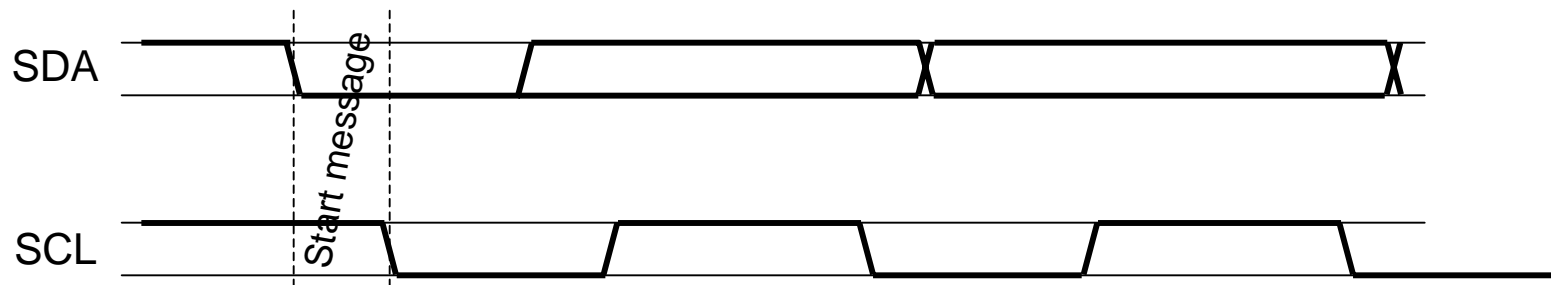
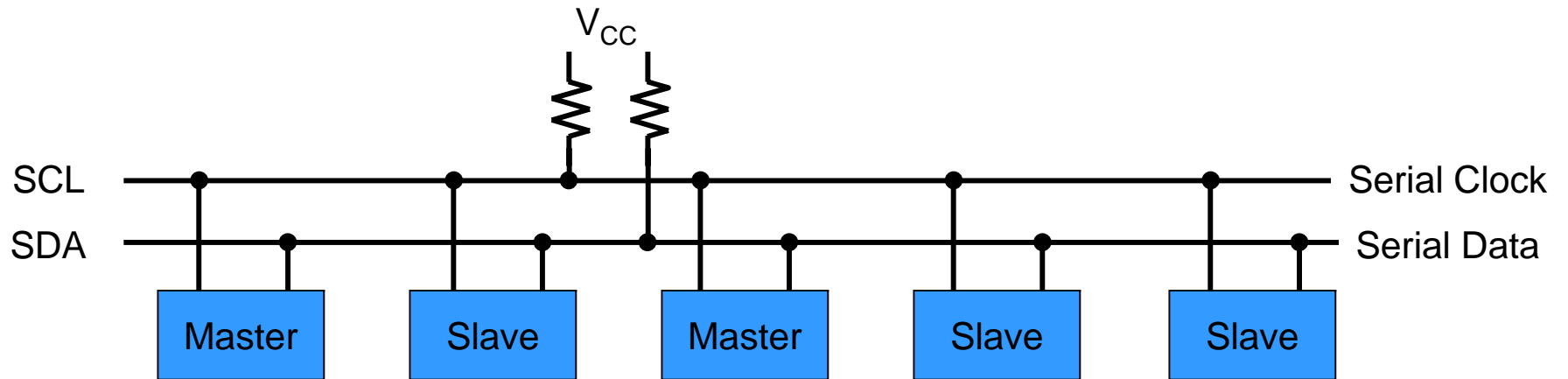
# Embedded Systems Interfacing

- I<sup>2</sup>C – Inter Integrated Circuit



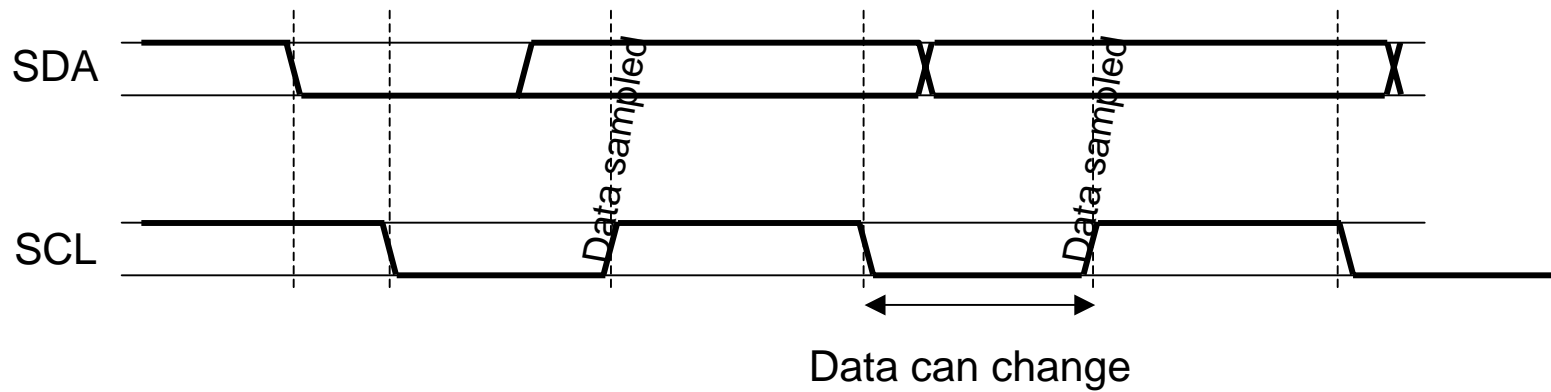
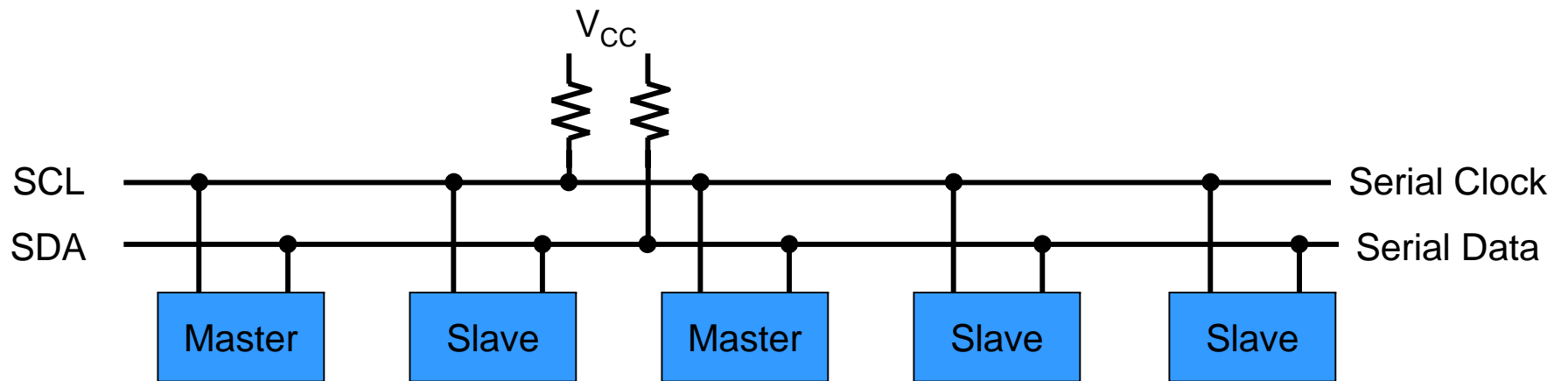
# Embedded Systems Interfacing

- I<sup>2</sup>C – Inter Integrated Circuit



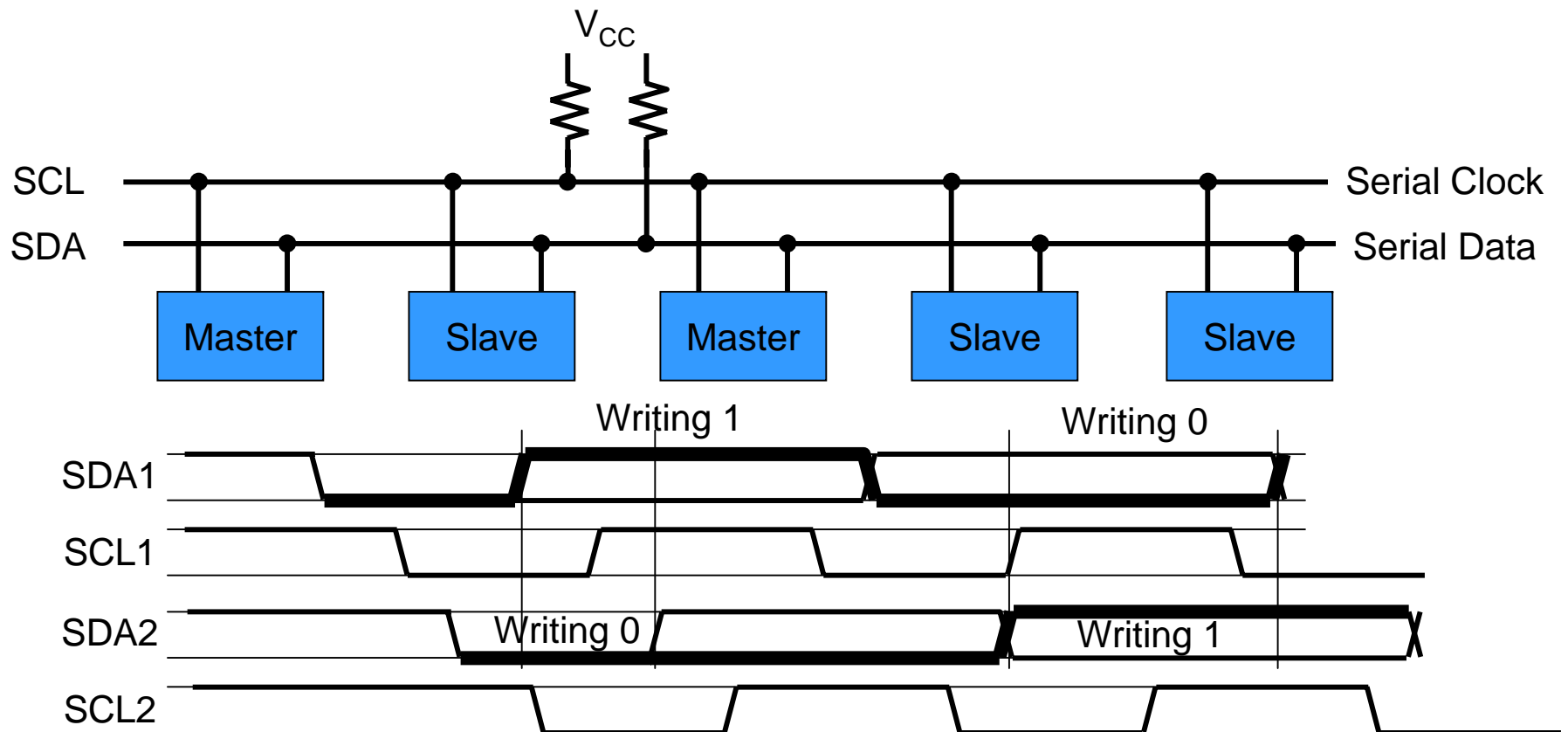
# Embedded Systems Interfacing

- I<sup>2</sup>C – Inter Integrated Circuit



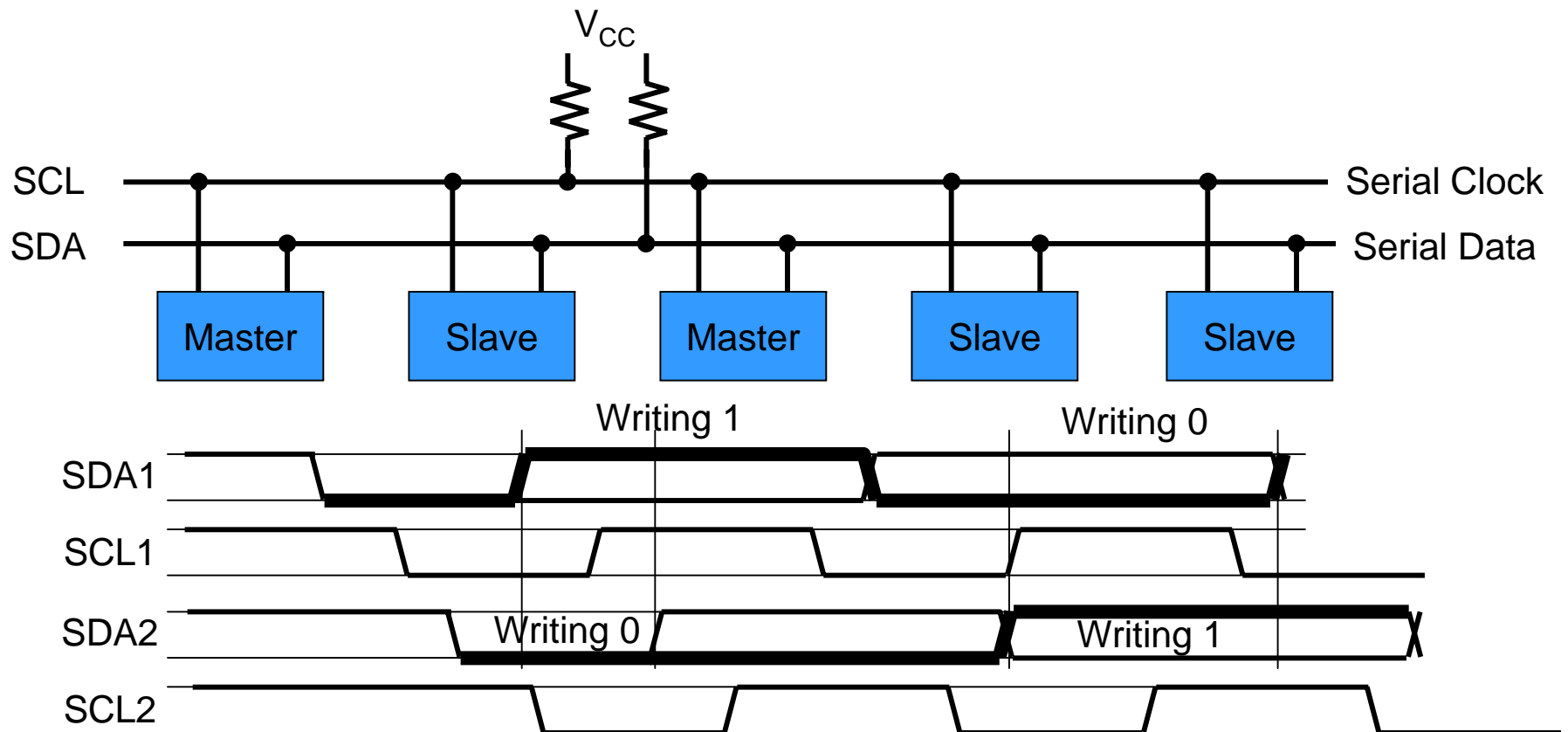
# Embedded Systems Interfacing

- I<sup>2</sup>C – Inter Integrated Circuit – Multi-master bus



# Embedded Systems Interfacing

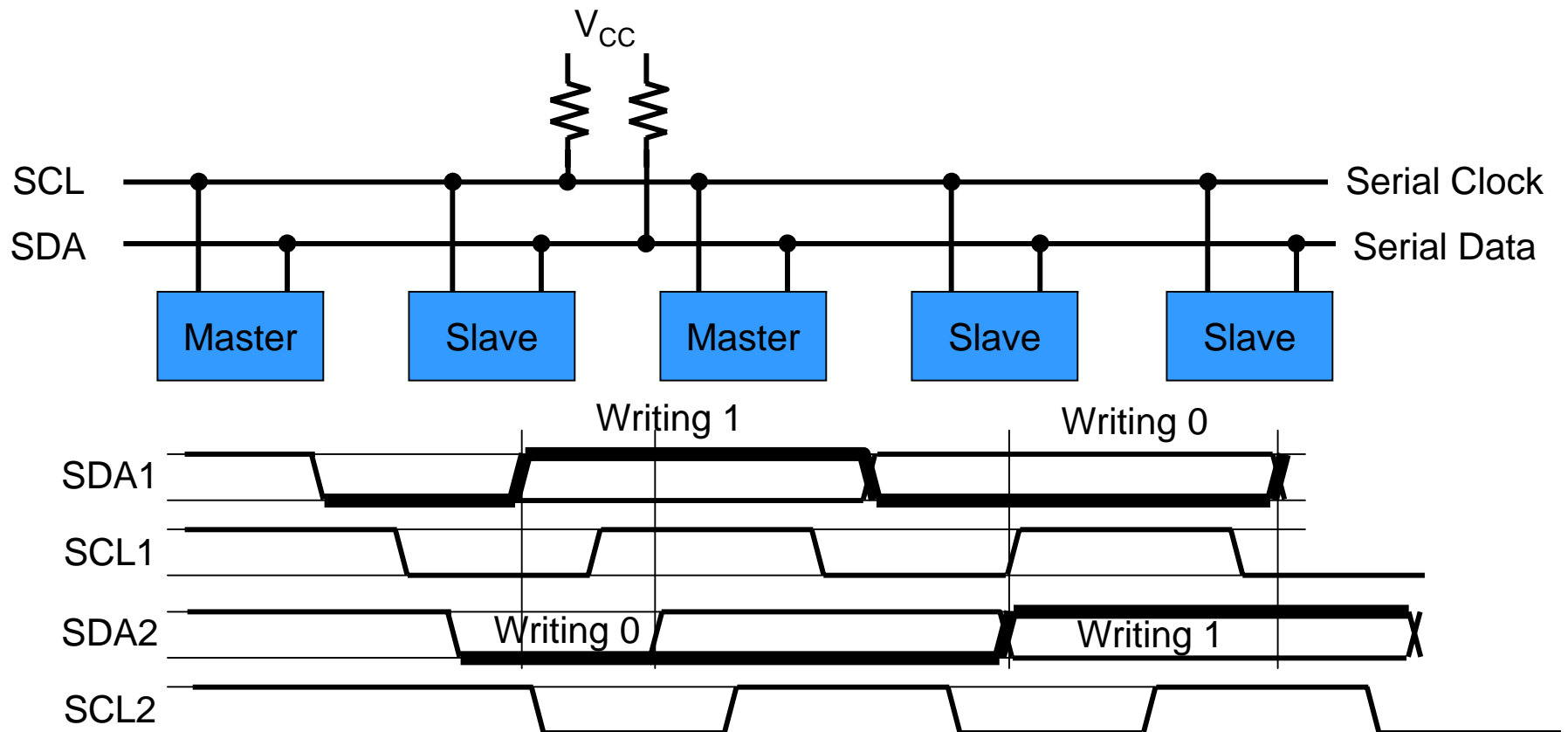
- I<sup>2</sup>C – Inter Integrated Circuit – Multi-master bus



- Device writing “1” passively allows pullup resistors to pull bus to “1”
- Device writing “0” actively sets bus to “0”

# Embedded Systems Interfacing

- I<sup>2</sup>C – Inter Integrated Circuit – Multi-master bus



- Device writing “1” passively allows pullup resistors to pull bus to “1”
- Device writing “0” actively sets bus to “0”
- Device that writes “1” but hears “0” aborts transmission and tries later