# Communication Protocols 1

Team Emertxe

# Communication Protocols I

- Introduction
- UART
- SPI
- $I^2C$

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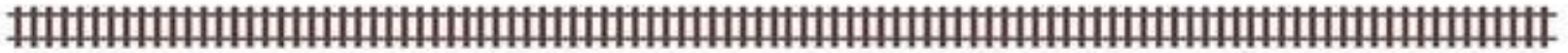
# Introduction

# Introduction

- What do mean by Communication?
- Mode of Communications
- Type of Communications
- Why Protocols?

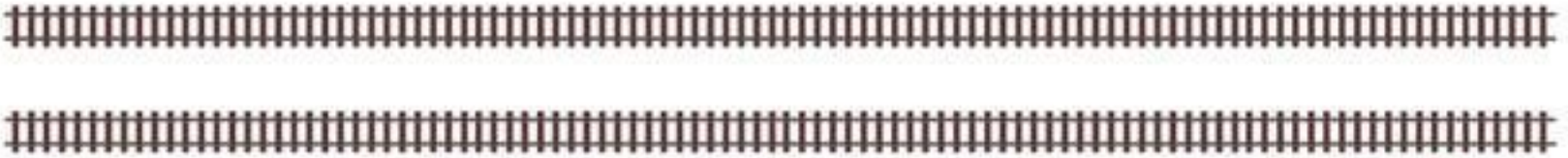
# Introduction
## Modes of Communication

- Simplex



- Half Duplex

- Duplex



# UART

# UART

# Serial Peripheral Interface

# Serial Peripheral Interface

- Introduction
- Interface
- Hardware Configurations
- Data Transmission
  - Data Validity

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# SPI
## Introduction

- Synchronous
- Full Duplex
- Master / Slave

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# SPI
## Interface

- SCLK
- MOSI
- MISO
- nSS

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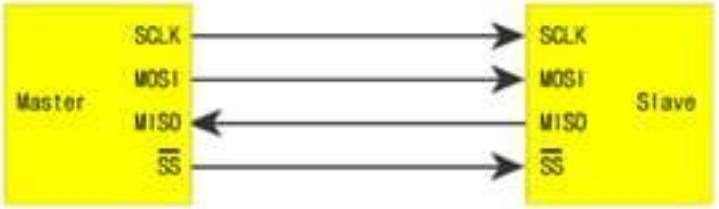
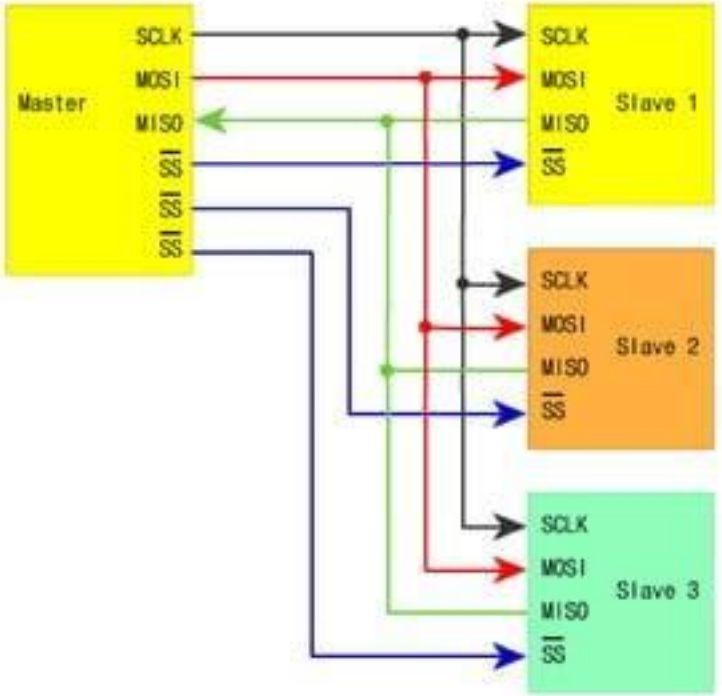
# SPI
## Hardware Configuration



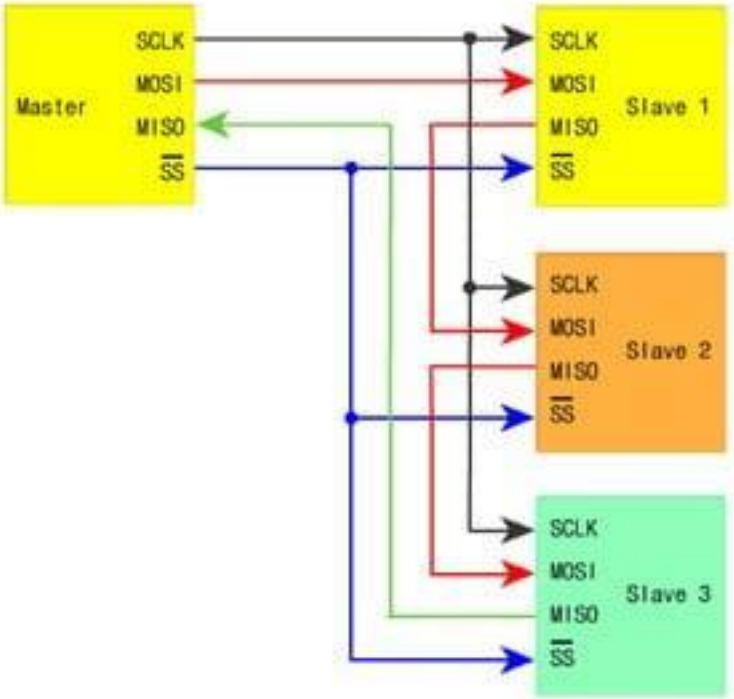

Single Master and Single Slave

# SPI
## Hardware Configuration



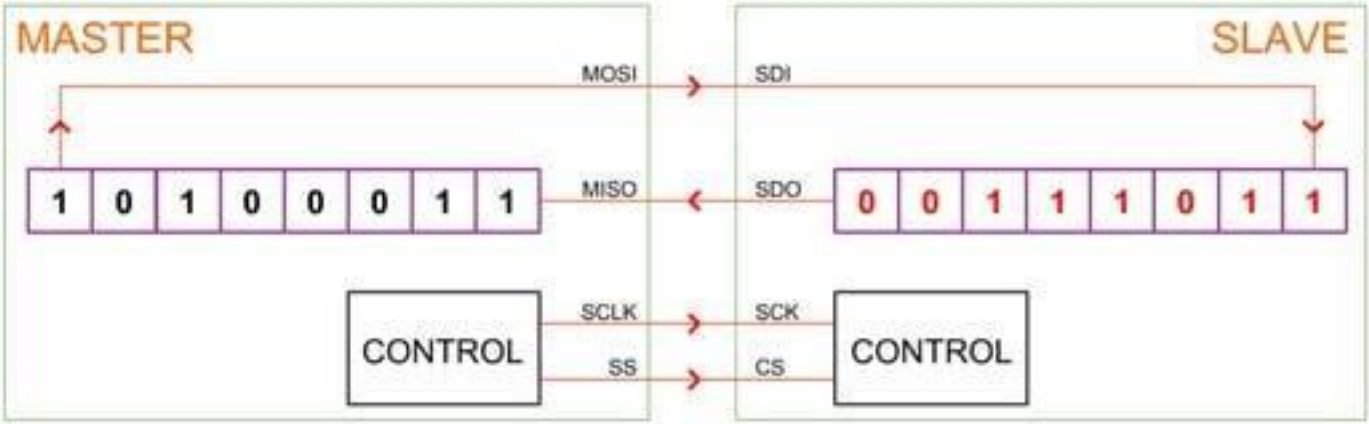

Single Master and three Slaves

# SPI
## Hardware Configuration

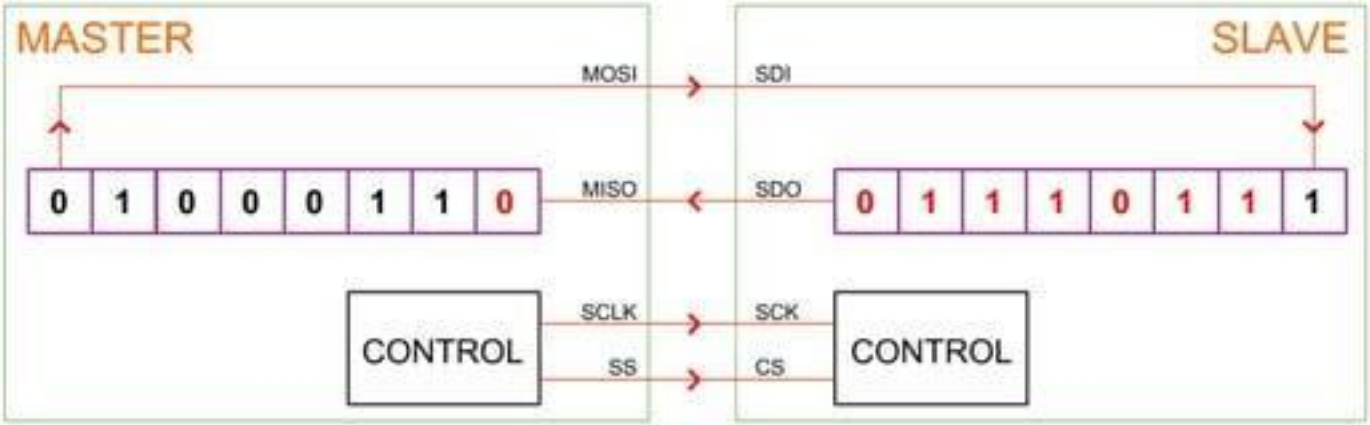



Single Master and three Daisy-Chained Slaves

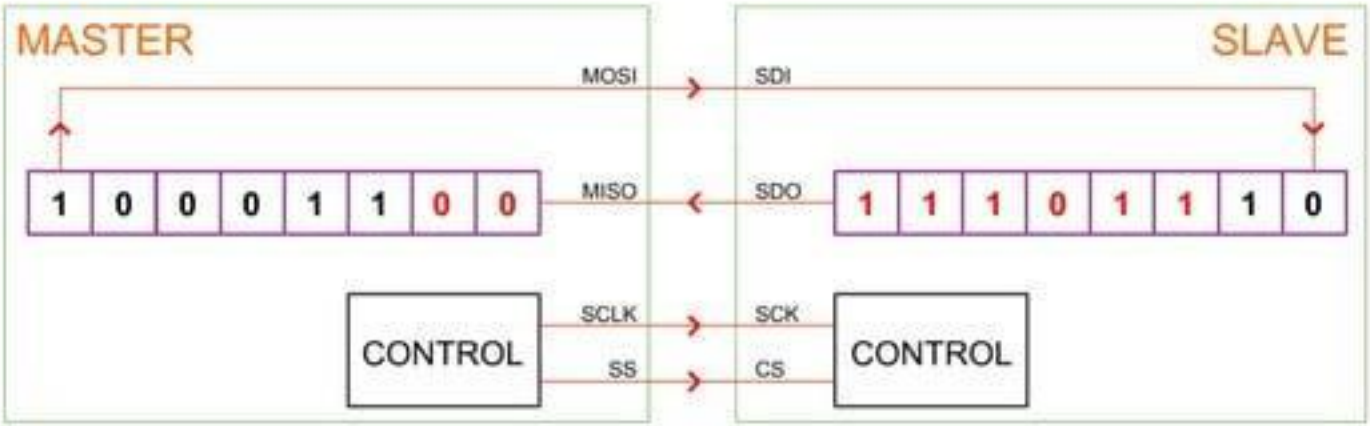
# SPI
## Data Transmission



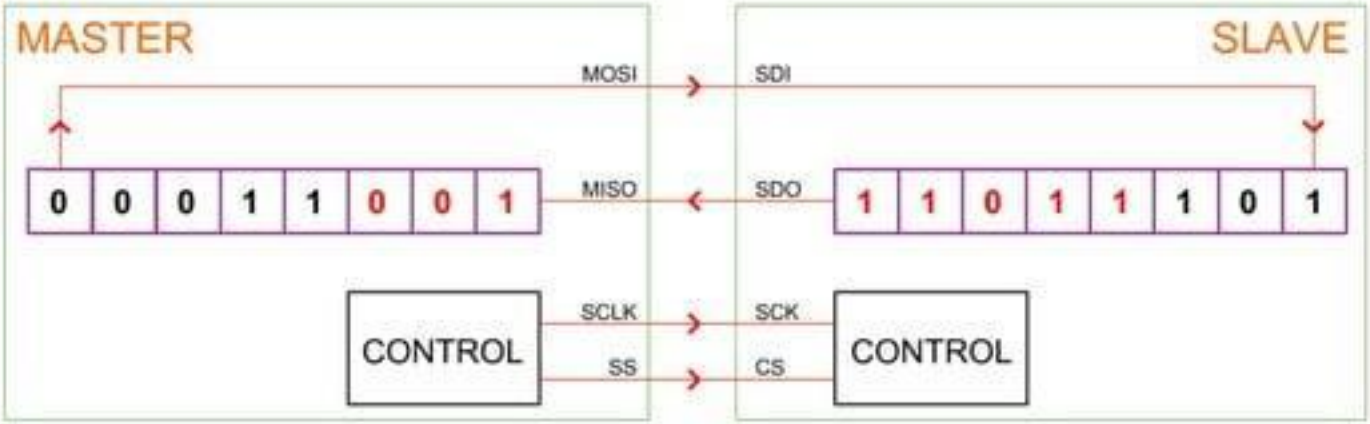
# SPI
## Data Transmission



# SPI
## Data Transmission



# SPI
## Data Transmission



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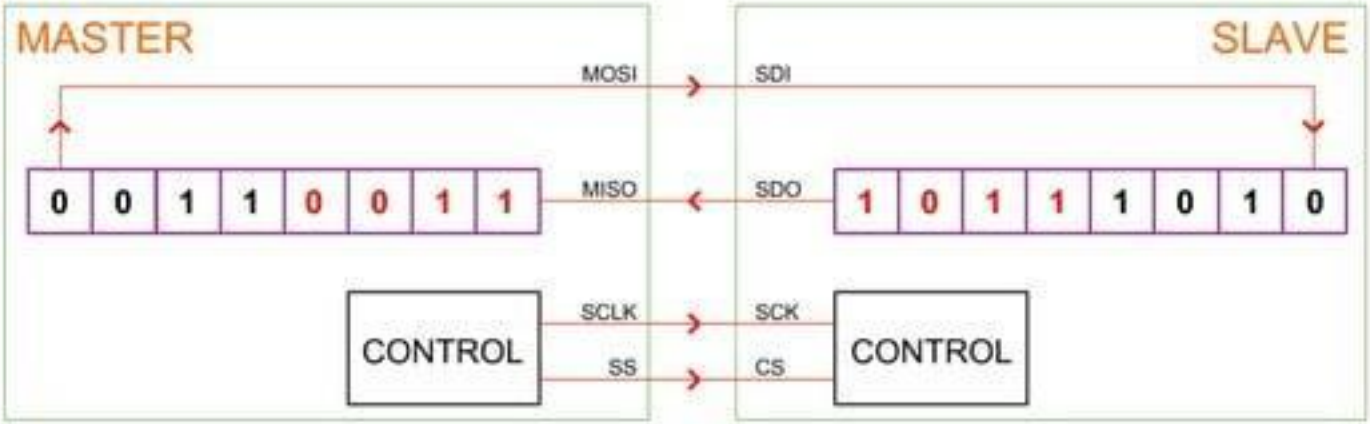
## Data Transmission



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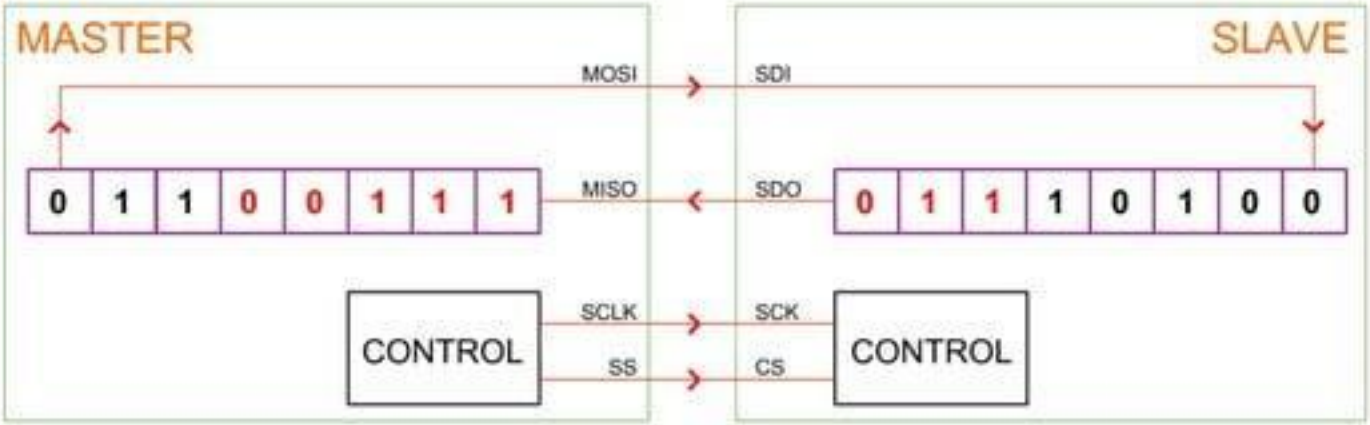
## Data Transmission



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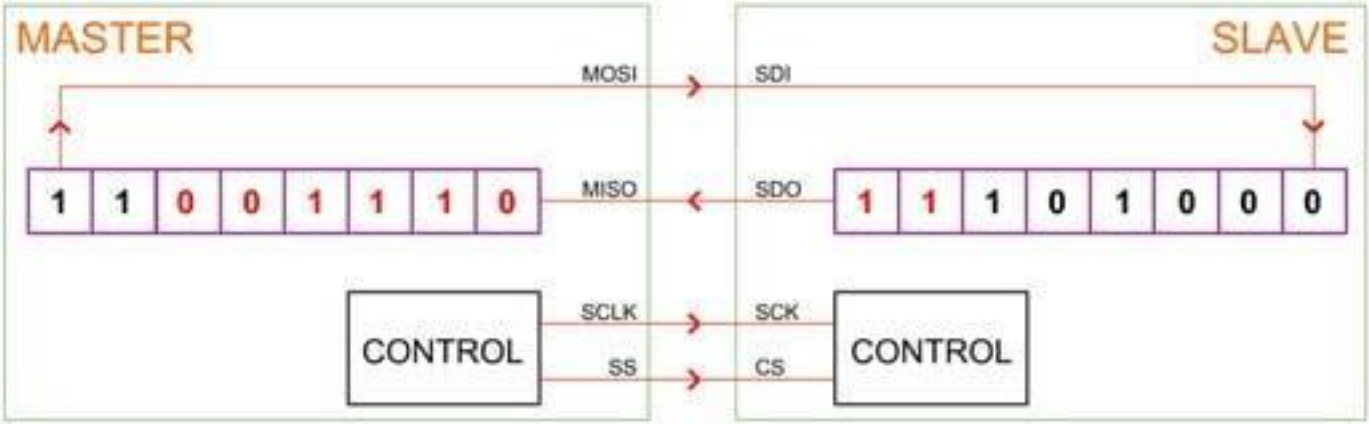
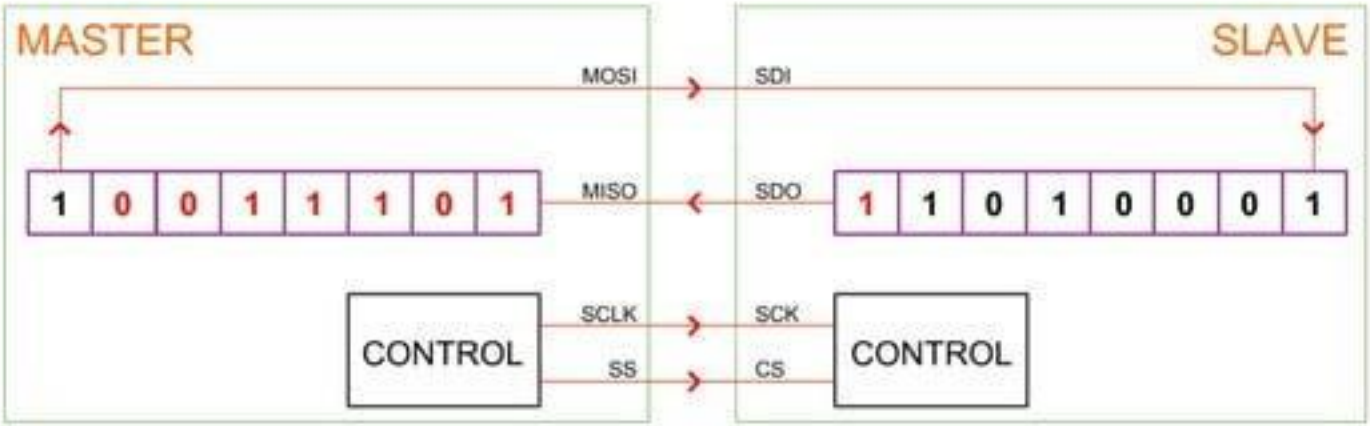
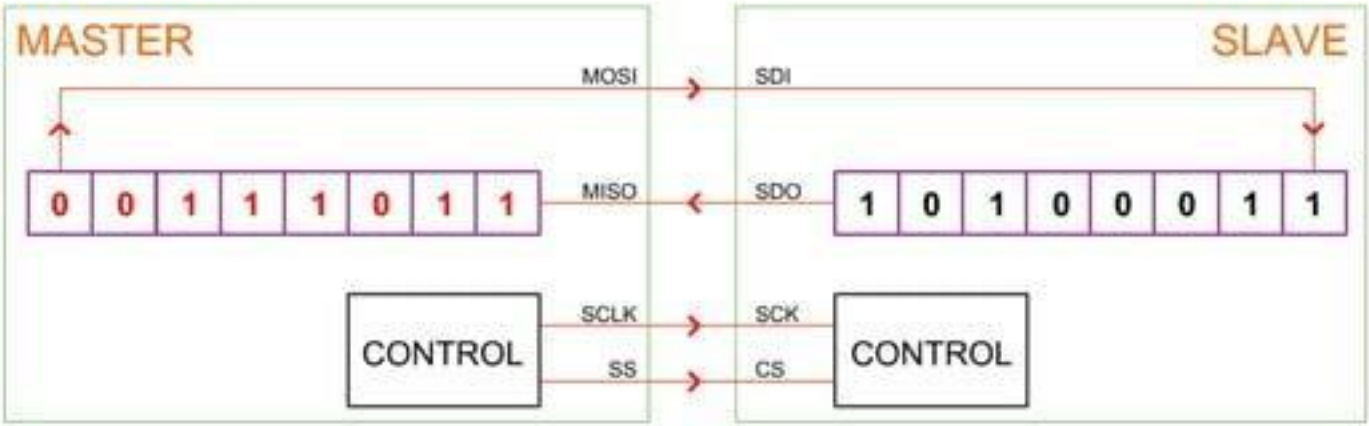


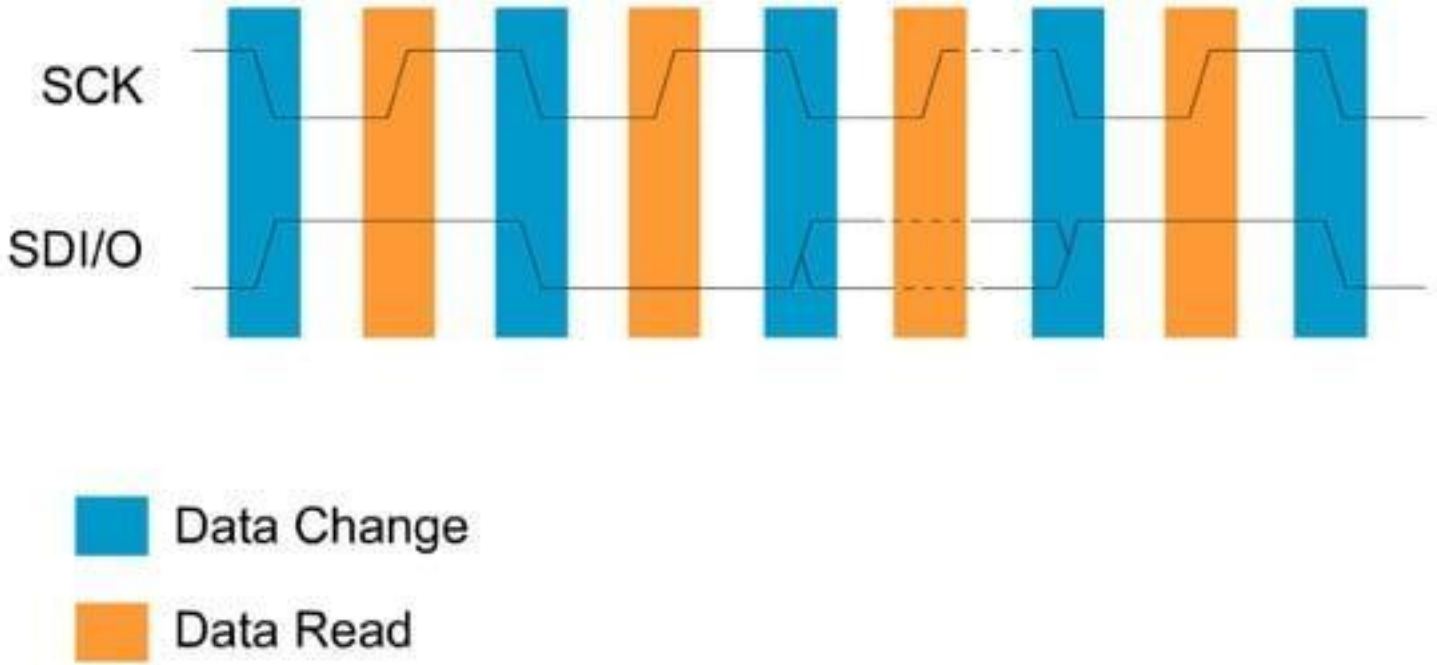
# SPI
## Data Transmission



# SPI
## Data Transmission



# SPI
## Data Validity



Inter Integrated Circuits

# Inter Integrated Circuits

- Introduction
- Bus Features
- The Protocol
- Bus Speeds

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# $I^2C$
## Introduction

- Synchronous
- Half Duplex
- Multi Master / Slave

# $I^2C$
## Bus Features

- Two Line Interface
- Software Addressable
- Multi Master with CD
- Serial, 8 bit Oriented, Bidirectional with 4 Modes
- On Chip Filtering

# $I^2C$
## Protocol

- Example
- Signals
- A Complete Data Transfer

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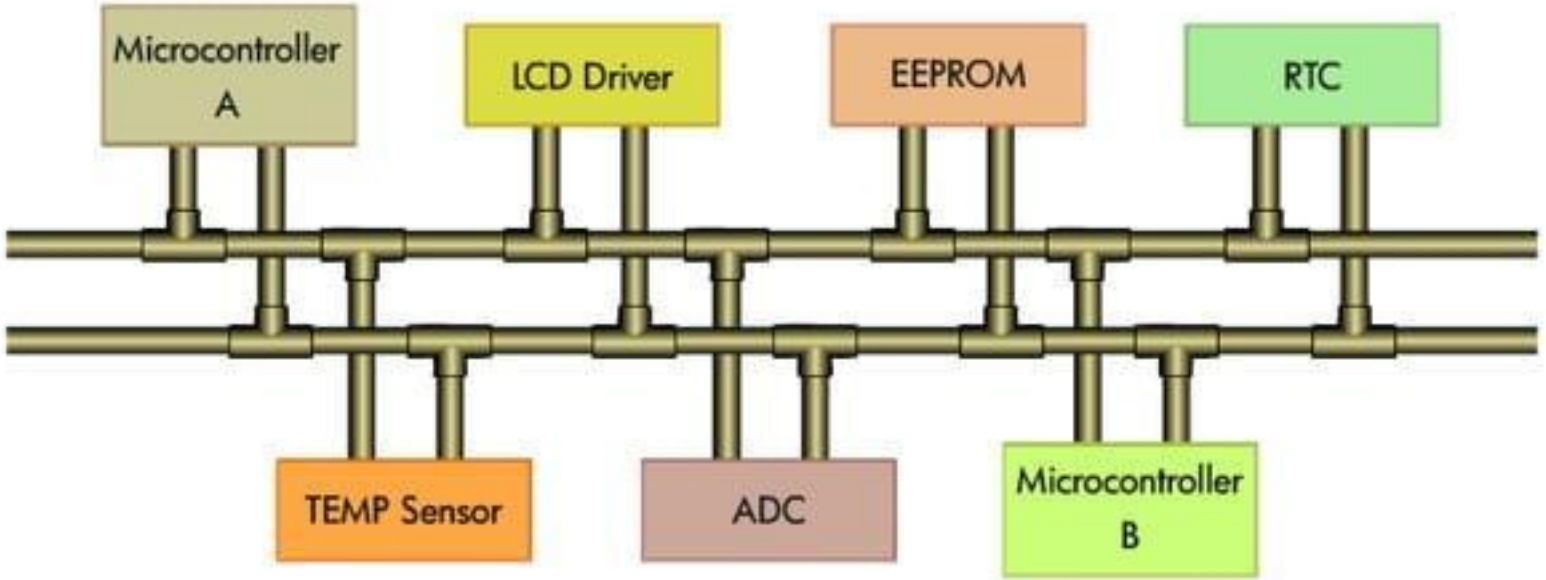
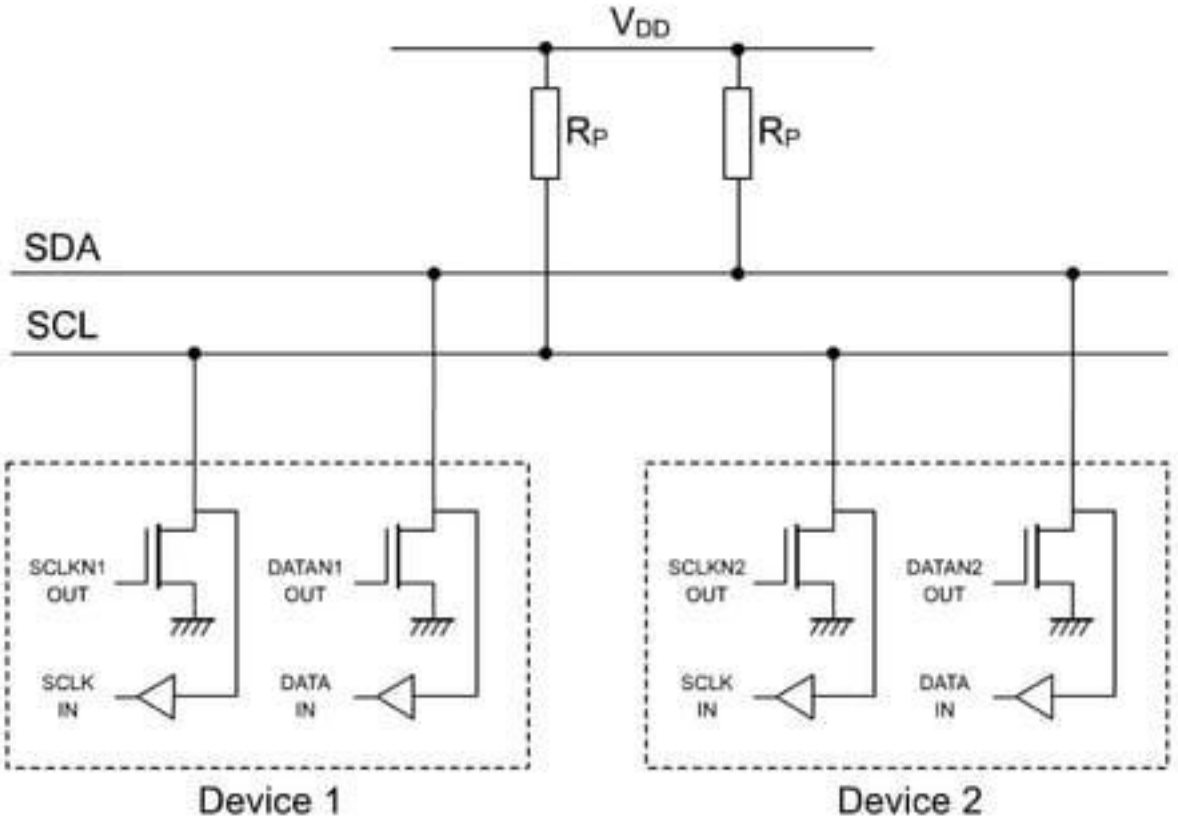
# I²C
## Example


Microcontroller A
LCD Driver
EEPROM
RTC
TEMP Sensor
ADC
Microcontroller B

# $I^2C$
## Signals

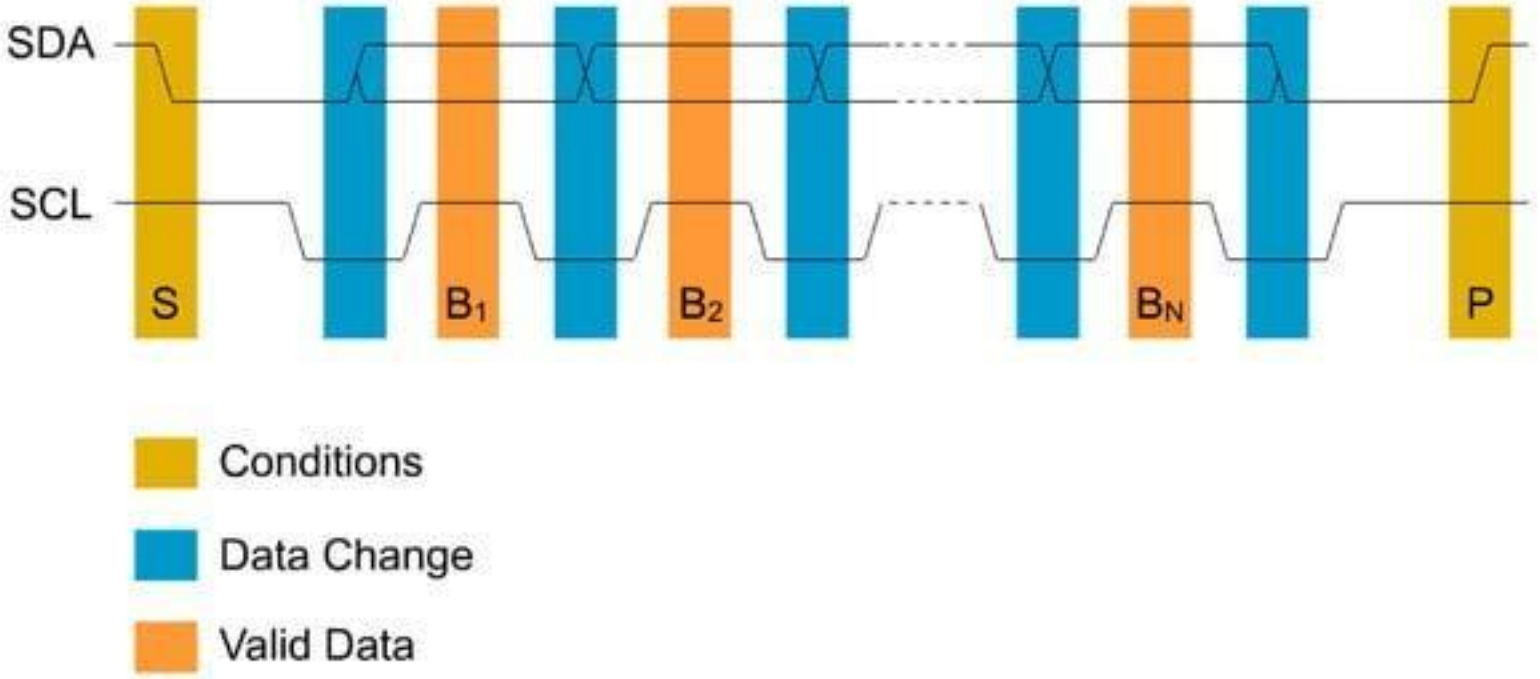
- Two-wired Interface
  - SDA
  - SCL
- Wired-AND
- Conditions and Data Validity
- Transmission

# I²C
## Signals - Wired-AND



# I²C

## Signals - Conditions and Data Validity



# I²C
## Signals - Transmission

- Data on SDA
- Clocking on SCL
- Clock Synchronization
- Data Arbitration

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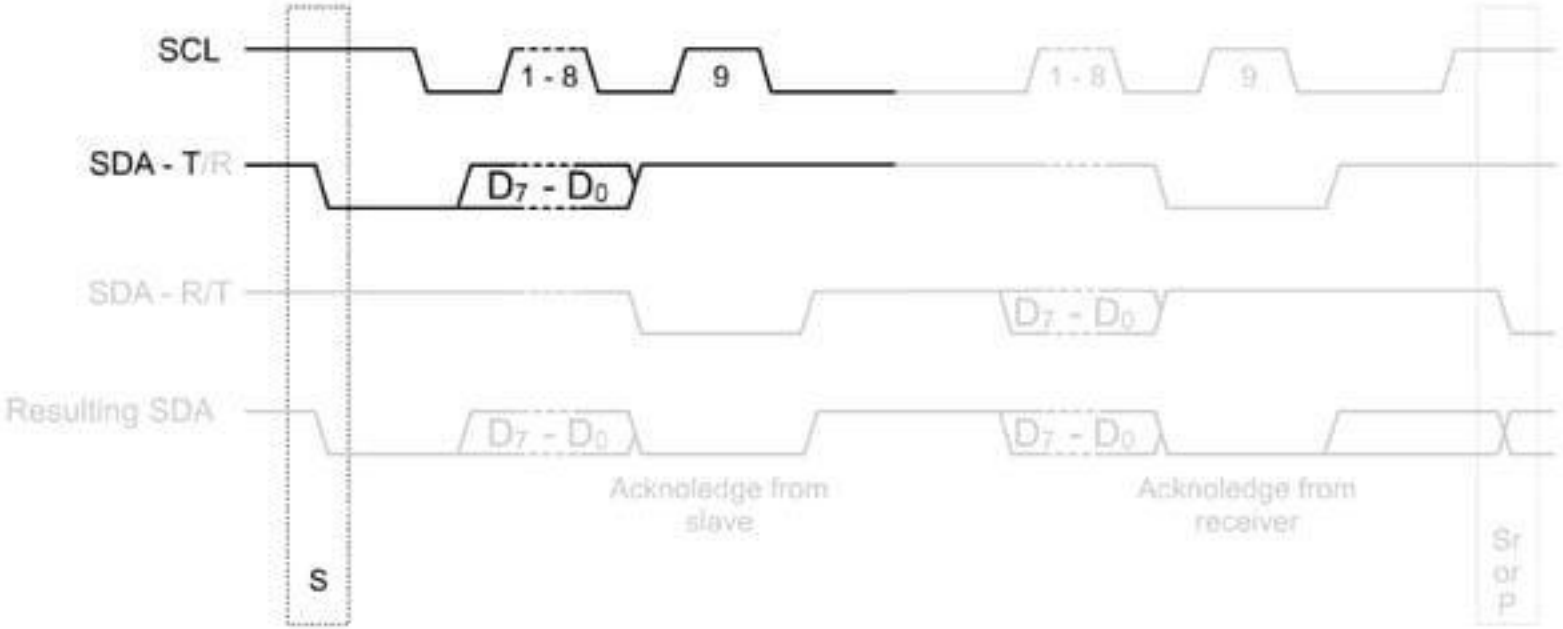
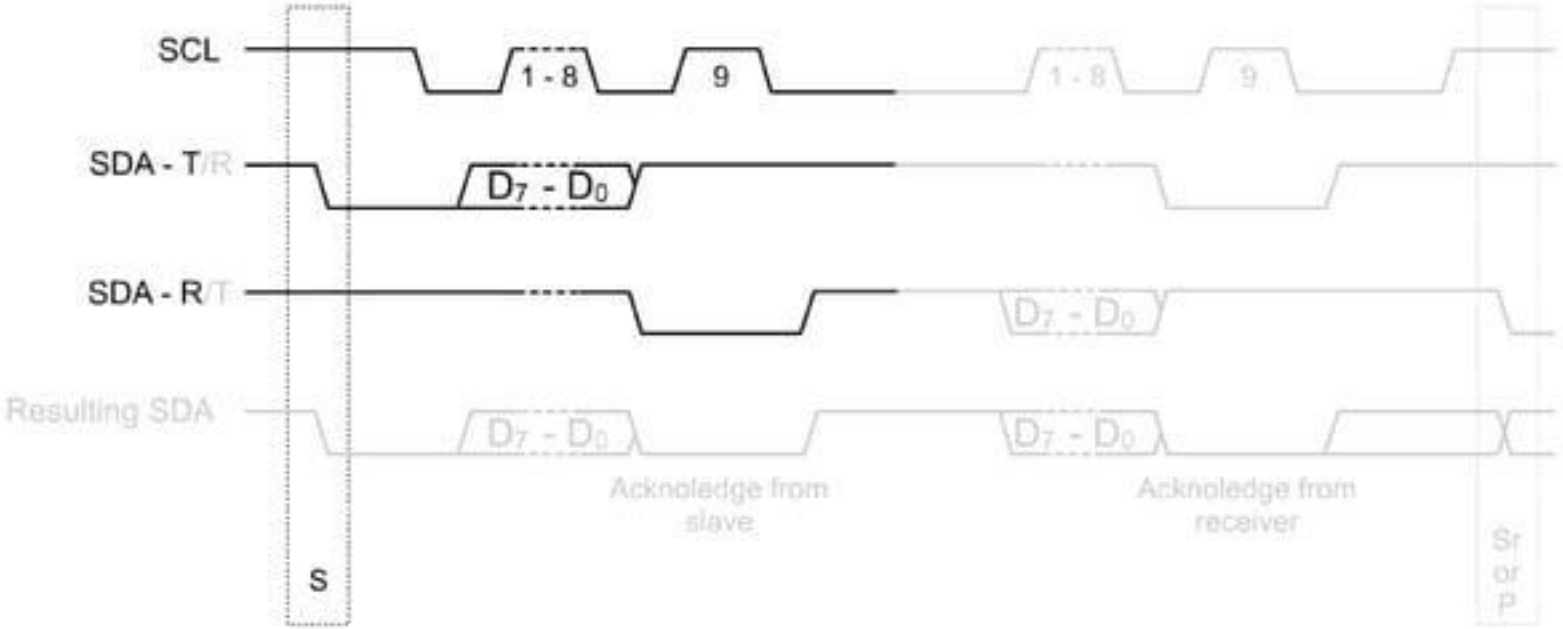
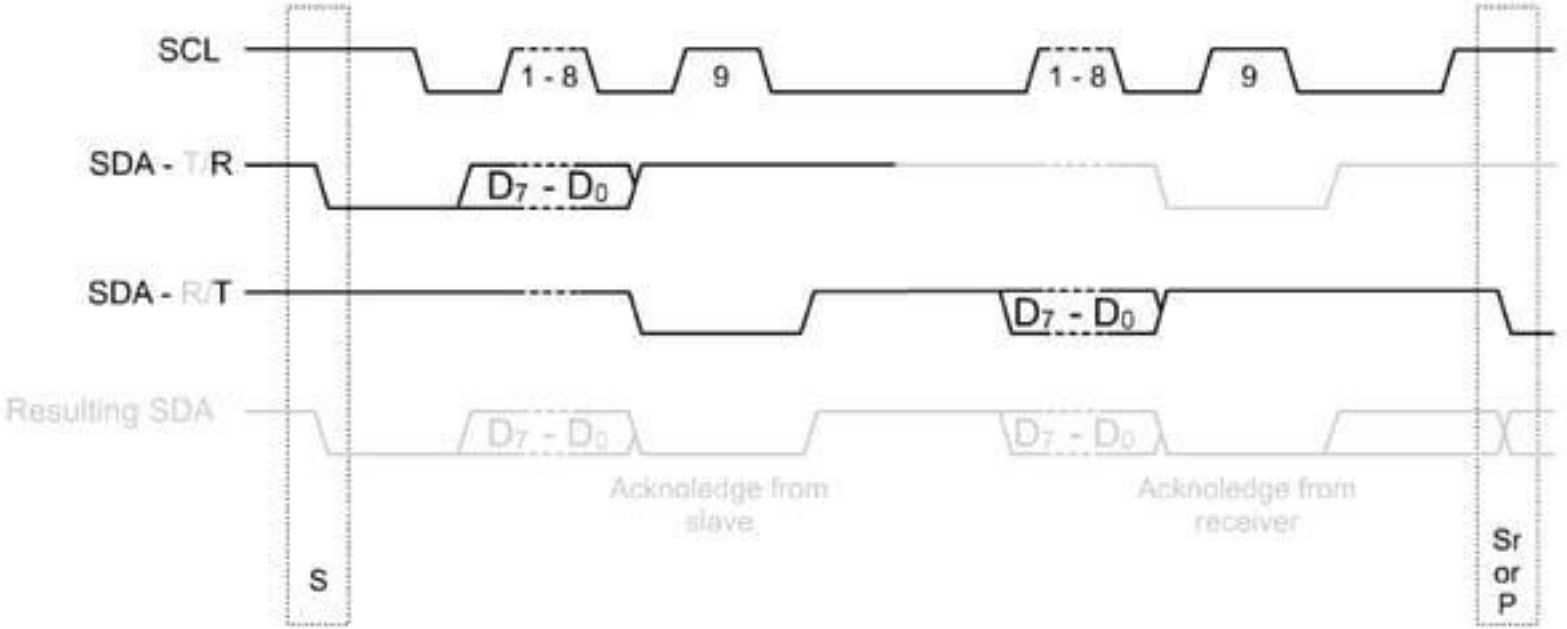
# I²C
## Signals - Data on SDA



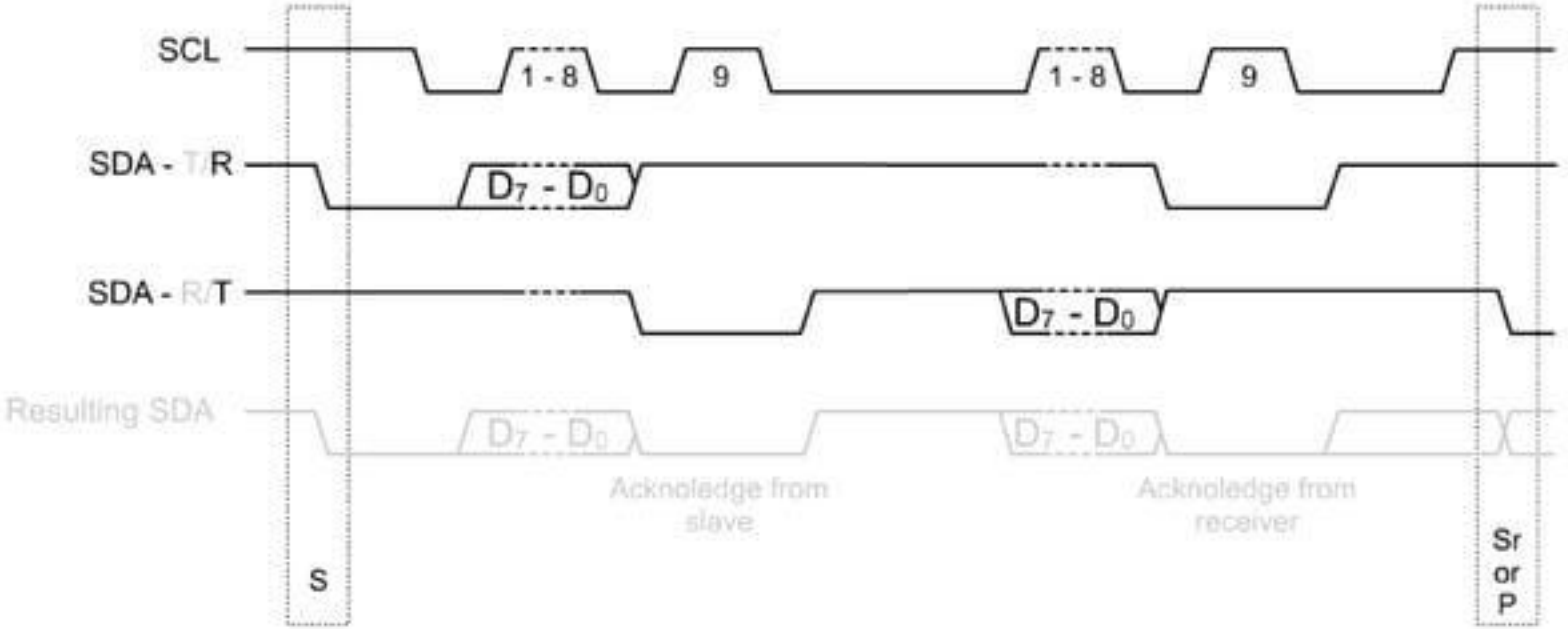
# $I^2C$
## Signals - Data on SDA



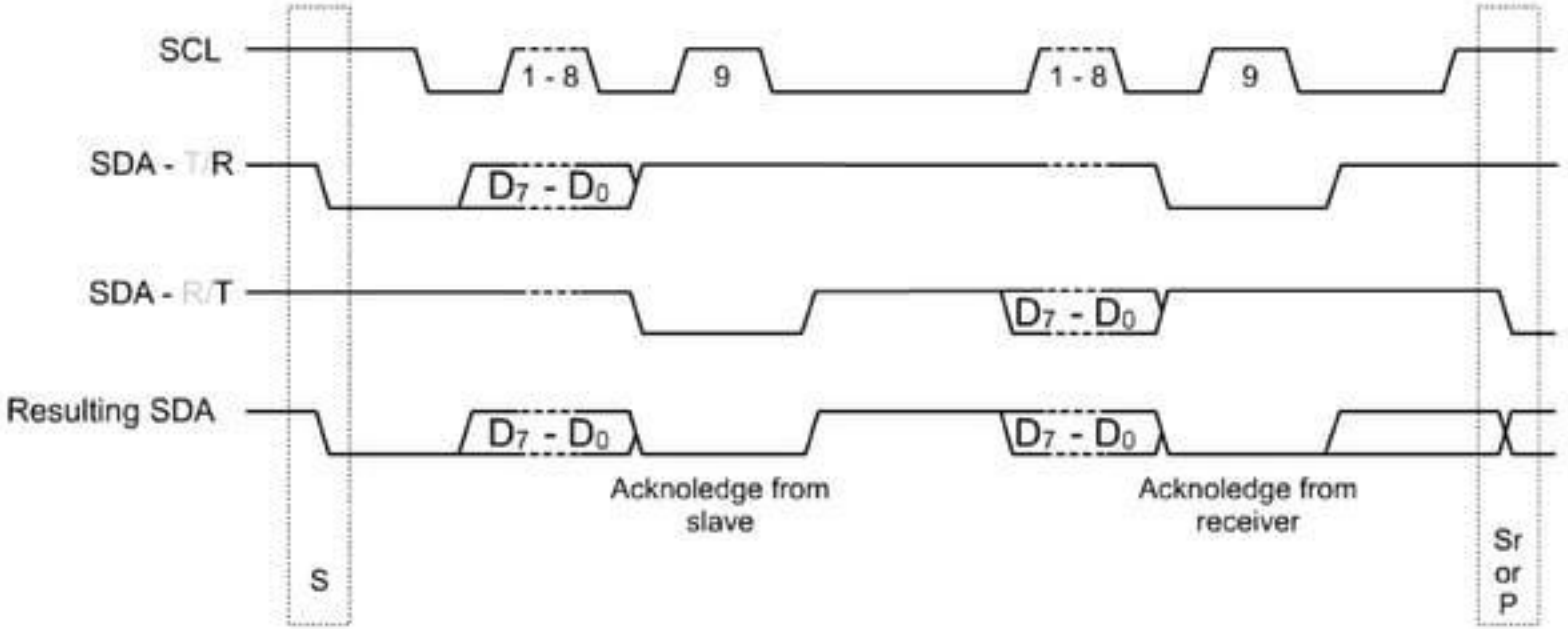
# I²C
## Signals - Data on SDA



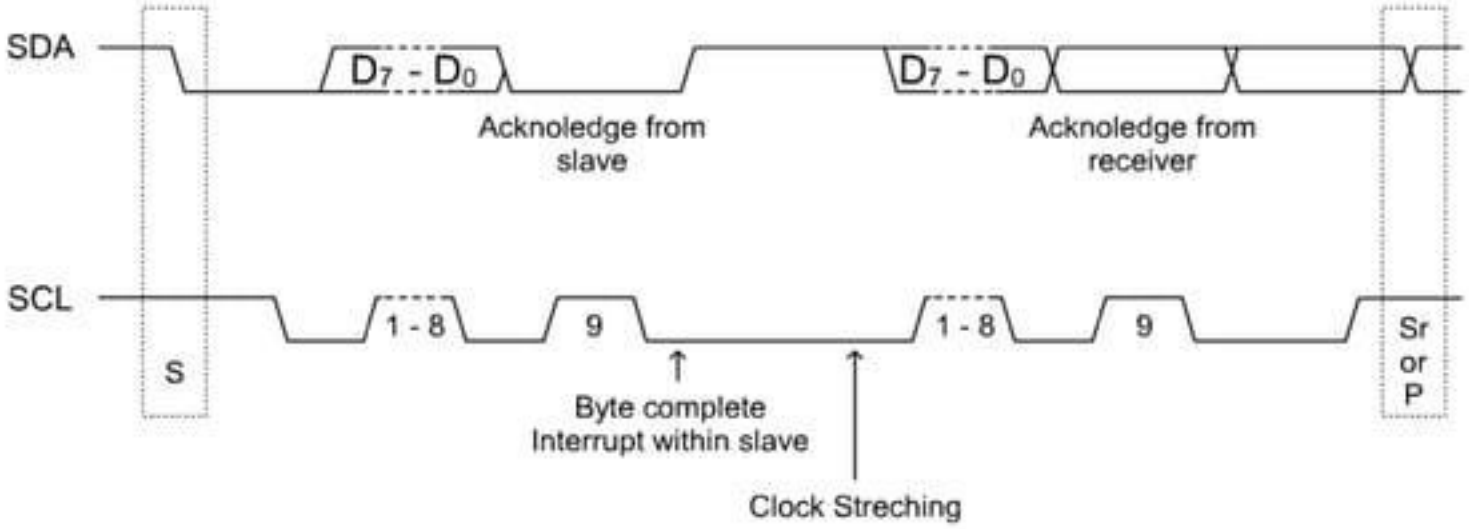
# I²C
## Signals - Data on SDA



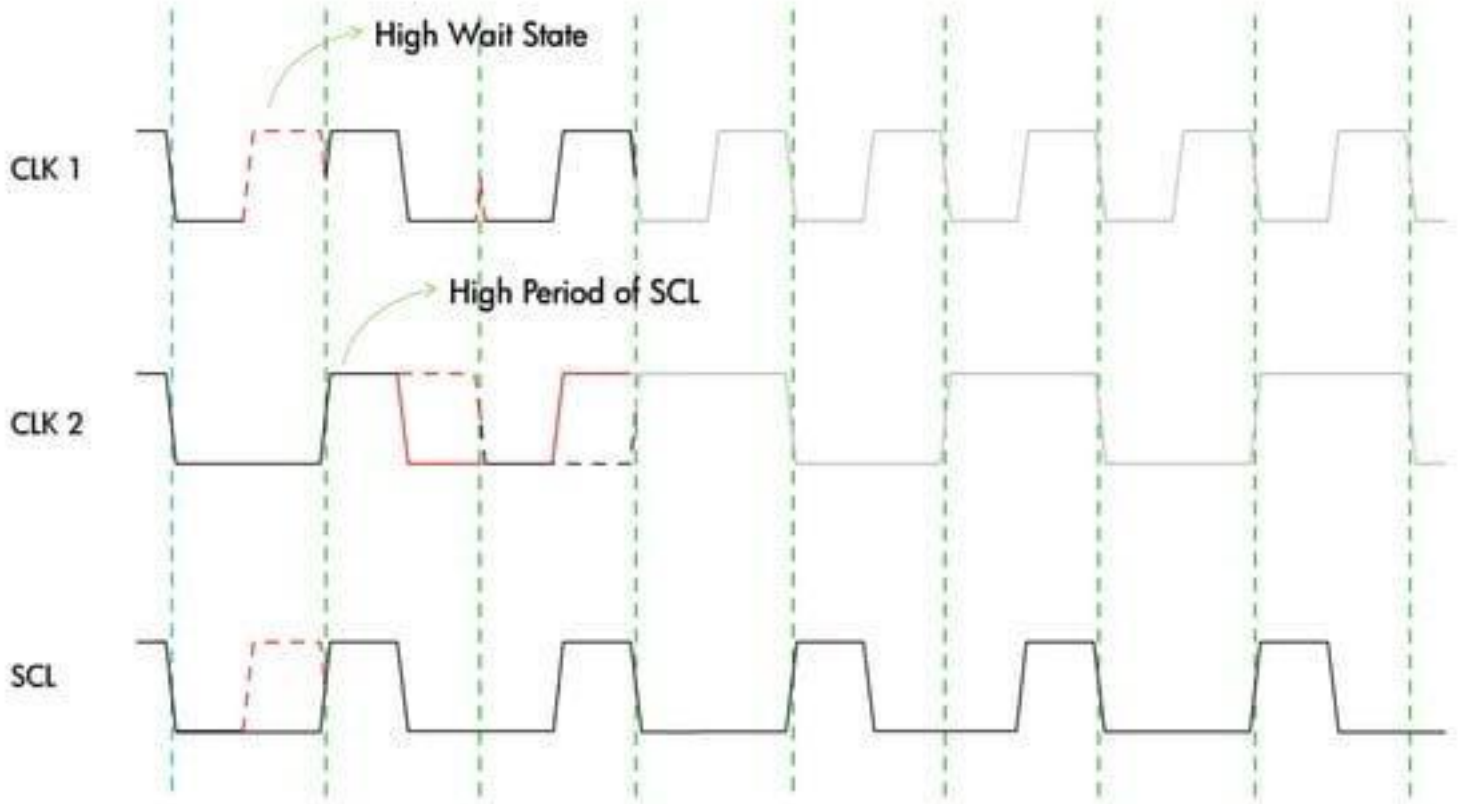
# I²C
## Signals - Data on SDA



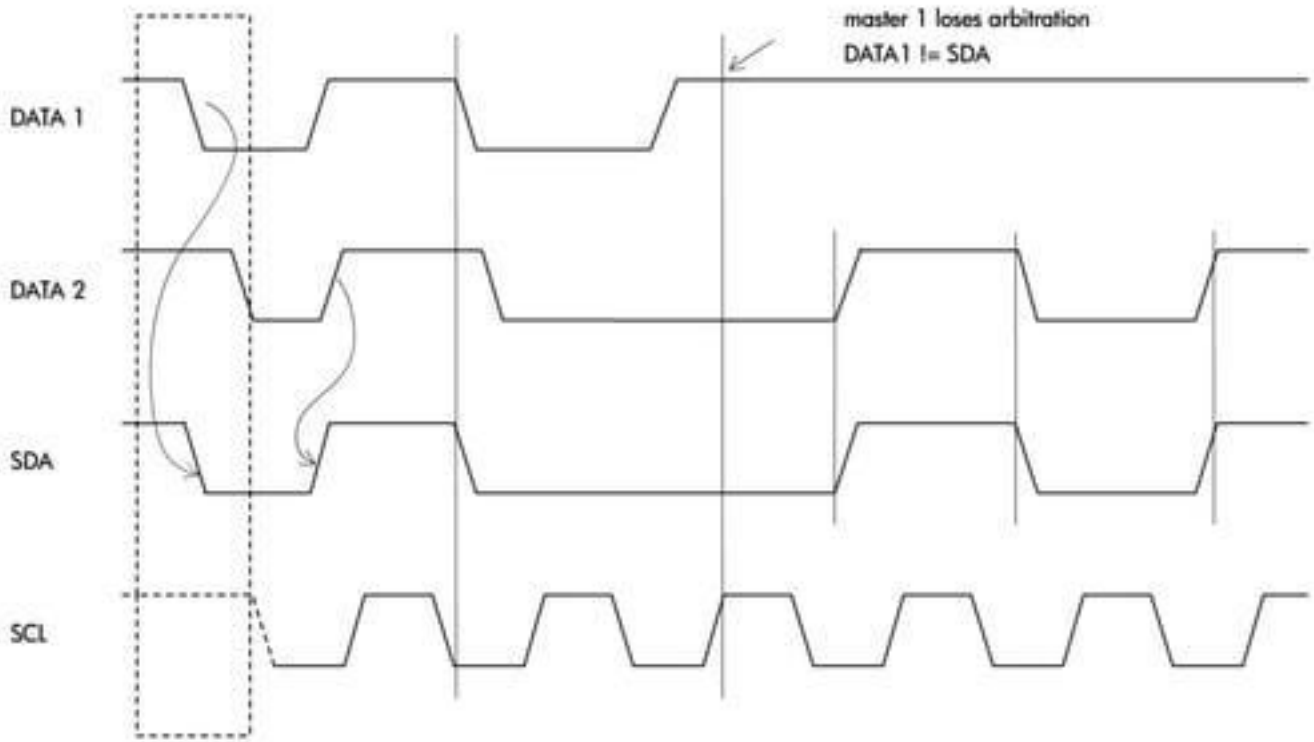
# I²C
## Signals - Clocking on SCL



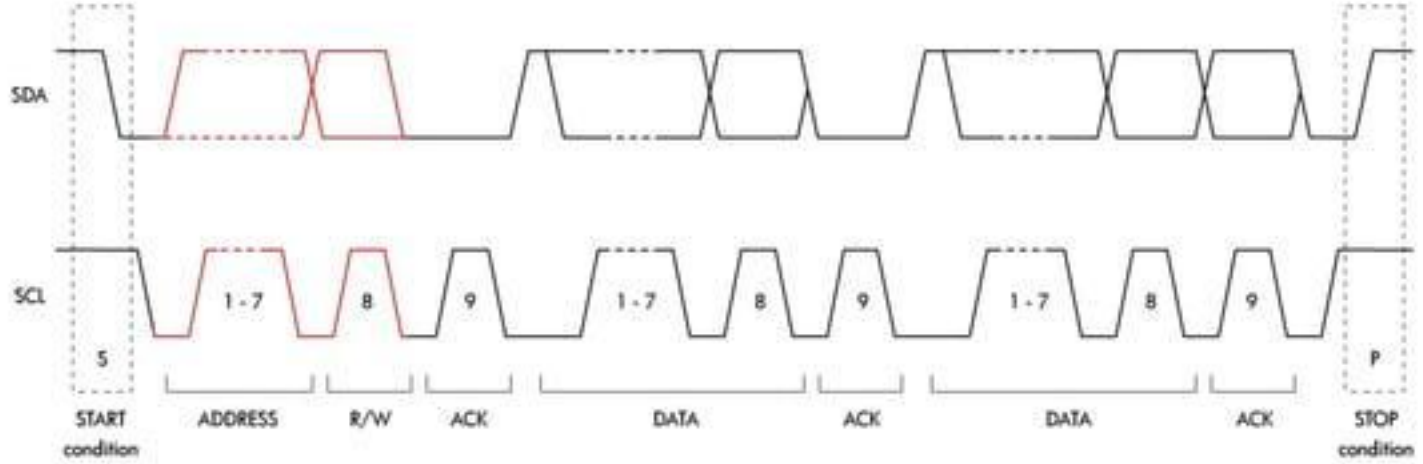
# I²C
## Signals - Clock Synchronization



# I²C
## Signals - Data Arbitration



# $I^2C$
## A Complete Data Transfer



# $I^2C$
## Bus Speeds

- Bidirectional Bus
  - Standard Mode - 100 Kbit/s
  - Fast Mode - 400 Kbits/s
  - Fast Mode Plus - 1 Mbits/s
  - High Speed Mode - 3.4 Mbits/s
- Unidirectional Bus
  - Ultra Fast Mode – 5 Mbits/s
    - Uses Push-Pull Drivers (No Pullups)

Thank You