Introduction To Hardware

I2C

I2C Protocol

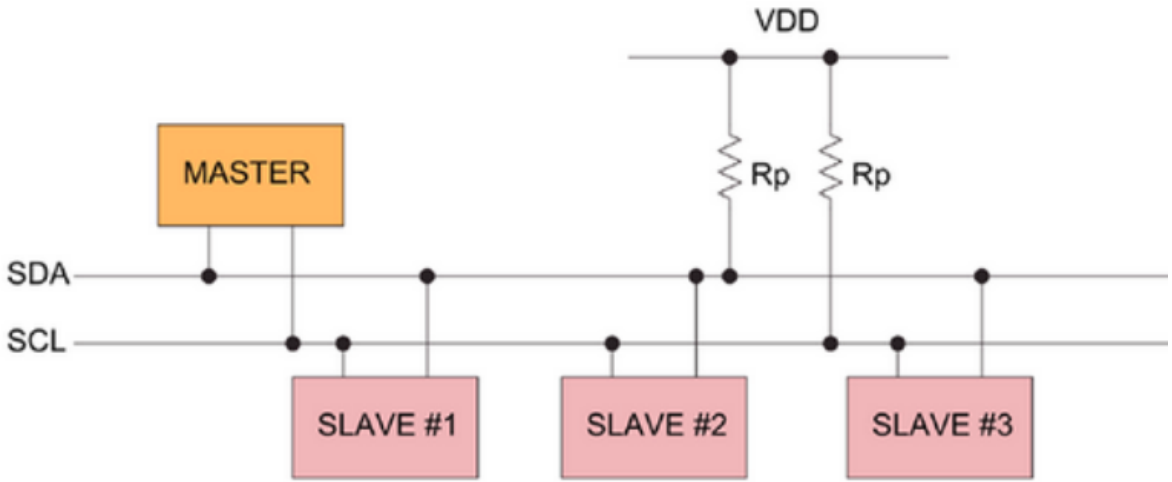
- It stands for inter integrated circuit and requires only two wires connecting all peripherals to microcontroller. i.e. SDA (serial data line) and SCL (serial clock line).
- Multiple master, multiple slaves
- It’s a master to slave type communication having unique addresses for each slaves.
- I2C is synchronous and bidirectional communication.
- Developed by Philips Semiconductor(now NXP Semiconductors)
- Half-duplex

I2C Protocol

- Bidirectional open-collector lines pulled up with resistors
- Crosstalk takes place between SDA and SCL and can be prevented by increasing the serial resistors Rs and termination Rp. Or by keeping short interconnections.
- Supported speed : 100 kbit/s standard mode, 400 kbit/s fast mode, 1 Mbit/s fast mode plus, 3.4 Mbit/s high-speed mode, and unidirectional 5 Mbit/s ultra-fast-mode

I2C Protocol

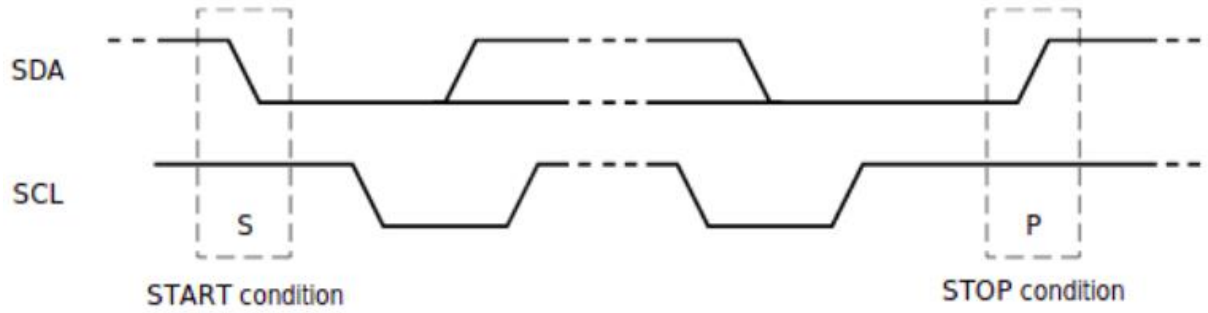
- Master nodes
- Slave nodes



Source - https://www.analog.com/en/technical-articles/i2c-primer-what-is-i2c-part-1.html#

I2C Protocol

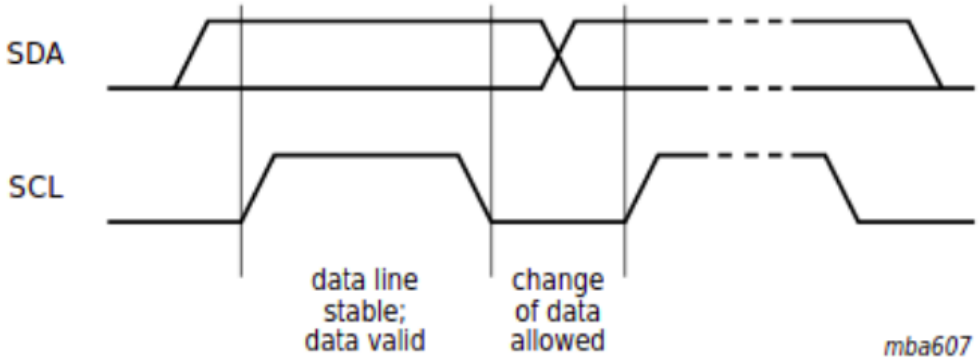
- Each slave has unique address
- No. of nodes depends on address space (7-bit or 10-bit) and bus capacitance (400 pF)
- START and STOP bits apart from data bits



Source : https://www.nxp.com/docs/en/user-guide/UM10204.pdf

I2C Protocol

- The size of transmitted data frame - 8 bits
- During transferring, the data is put on the SDA line after SCL is pulled low



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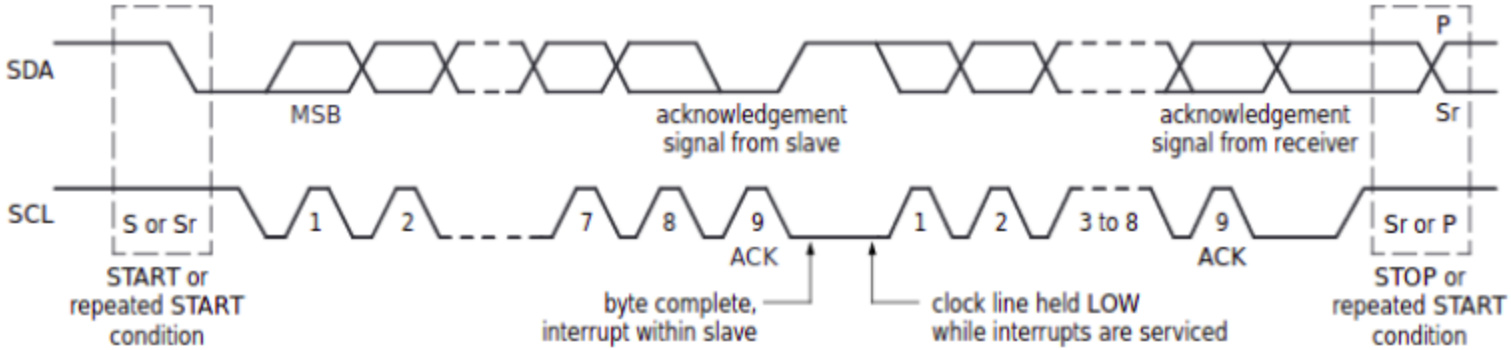
I2C Protocol



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I2C Protocol

- Clock synchronization and arbitration
- Clock stretching

Source : https://www.nxp.com/docs/en/user-guide/UM10204.pdf

I2C - Possible Attacks

- Signal sniffing
- Signal manipulation
- Data extraction
- Data manipulation
- Clock glitching (Research:

  https://www.researchgate.net/publication/314629854_Hardware_Attacks_on_Mobile_Robots_I2C_Clock_Attacking)

I2C - Tools/Framework

- EXPLIoT Nano - https://expliot.io/products/expliot-nano
- Bus Pirate - http://dangerousprototypes.com/docs/Bus_Pirate
- Shikra - https://int3.cc/products/the-shikra
- CH341A - https://www.onetransistor.eu/2017/08/ch341a-mini-programmer-schematic.html
- EXPLIoT Framework - https://gitlab.com/expliot_framework/expliot
- Pyi2cflash - https://github.com/eblot/pyi2cflash
- Logic Analyzer
- RaspberryPi or Beaglebone can also be used.

The End