SPi Global CRM Inc. (Formerly: ePLDT Ventus, Inc.) Embedded Programm

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Embedded Systems +2

What are the difference between the different protocols use in embedded systems such as UART, SPI, I2C, Bluetooth, USB etc.?

Kindly explain each if possible, I always confused among them. Though I have worked with UART and I2C on AVR microcontrollers. If there any other protocols kindly mention them too. I am a Third year electronics engineering undergraduate and have done some projects.

4 Answers

Aram Yegiazaryan, Experience with Micro-controllers
3.1k Views

UART: Stands for Universal Asynchronous Receive/Transmit. In simple terms UART relies on a baud rate agreement between receiving and transmitting controllers. The receiving MCU will expect to receive bits into its RX port at specific baud rate, for example 9600, and the transmitting MCU will transmit bits at the same baud rate, 9600. There is no master clock between the two parties, only the agreement in baud rate. Therefore the receiving MCU will know the rate that bits will flow into its RX port, and know when it has a full symbol. More stuff on UART and EUSART can be found here : Page on mosaic-industries.com
Although when it comes to a specific project using specific chip set, read the data sheets for your chips.

SPI: Stands for Serial Peripheral Interface involves a master and a slave, or multiple slaves. SPI interfacing involves 3 or more wires, consisting of a clock, serial data out, serial data in, and chip select if necessary. The master MCU basically sets the clock rate for the slaves, asks a specific one to listen up using the chip select port, and sends them commands via its serial data out port, and expects to receive the output from the slave through the serial data in port. More on SPI can be found here: Introduction to Serial Peripheral Interface
and here: Introduction to I²C and SPI protocols
Again, when it comes to a specific project using a specific chip set, read the data sheets for your chips.

IIC: Or I^2 C stands for inter-integrated circuit, where every chip in the circuit has a defined address which they can be called up from. Two wires are involved, SDA and CLK. SDA is a bi-directional data flow meaning data can be accepted and sent out based on conditions set. The master sets the clock for communication, a start condition is sent by the master via SDA which tells all the slaves to listen for their address. The master then sends the address of the chip from which interfacing is desired (typically with MSB being a read or write command) and waits for an acknowledgement. After acknowledgement is received the read or write command is sent, followed by some end of transmission.
More on IIC : I2C Info – I2C Bus, Interface and Protocol

Bluetooth: Is just a means of communication (instead of communication via wires you communicate wireless through Bluetooth transmitter or receiver). Blue tooth usually involves UART or EUSART.
Project example I found using blue tooth to transmit data to a PC terminal: Bluetooth Module Interfacing with Microcontroller

Related Questions

Can an I2C-UART bridge, configured as a slave, be used as a COM port in WinCE?

How should I decide between I2C and SPI?

What is I2C in simple terms? Where do we use this protocol? Why would most SOCs have I2C protocol?

What are different communication protocols used in embedded systems?

What is SPI protocol in Embedded Systems?

How should I decide which interface to use, SPI or I2C, while developing an AHRS?

Embedded Systems: What are the different ways to control Ac current /voltage a microcontroller?

What is the difference between C and Embedded C?

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Bluetooth: What is the difference between BluetoothSocket and TCP IP Socket?

USB: USB is a little more complicated that the others. USB involves a host who must 'ok' any transaction of data between components. Data transmission is as follows, first the header which holds the purpose of the data or command; read, write, or configure to the target. Next the data flows for either writing to the target, reading by the host or configuring the target. The last part of the transmission can be an acknowledgement from the target in a write procedure, stating whether or not they received the data, or an acknowledgement from the host stating that they have read the data that was sent from the target. USB gets much more complex than this of course so here are some good reads on the protocol: USB in a NutShell
USB.org - Welcome

If you want to get anything done, read the data sheets.

I hope this helps.

Written May 23, 2015 • View Upvotes

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Mohit Rohilla, Embedded Engineer
1.3k Views

UART -

UART requires only data signal.

In UART, the data does not have to be transmitted at a fixed rate.

In UART, data is normally transmitted one byte at a time.

In UART, data transfer speed is set around specific values like 4800, 9600, 38400 bps ,etc.

UART speed is limited around 115200 bps.

Full duplex.

USART -

In USART, Synchronous mode requires both data and a clock.

In USART's synchronous mode, the data is transmitted at a fixed rate.

In USART, Synchronous data is normally transmitted in the form of blocks

Synchronous mode allows for a higher DTR (data transfer rate) than asynchronous mode does, if all other factors are held constant..

USART is faster than 115kb.

Half duplex.

I2C -

I2C requires only two line(two wire), but those two wires can support up to 1008 slave devices.

Unlike SPI, I2C can support a multi-master system, allowing more than one master to communicate with all devices on the bus (although the master devices can't talk to each other over the bus and must take turns using the bus lines).

Data rates of I2C devices can communicate at the rate of 100kHz to 400kHz.

Best answer in the following link -

I2C Protocol

SPT -

The Serial Peripheral Interface-SPI Protocol was developed by Motorola which is used to communicate between microcontrollers and peripheral devices such as SD cards, Serial LCDs, ADC/DAC ICs, shift registers, etc. Basic connection diagram of SPI is seen in below figure which shows master-slave communication with 4 lines named as MISO(Master-In Slave-Out), MOSI(Master-Out Slave-In), SCLK(Serial clock) and CS(Chip select) .

Best answer in the following link -

Serial Peripheral Interface-SPI Protocol

For more details please refer to the following link :-

Difference between UART and USART

Written Dec 8

Kapil Thakar, Firmware Engineer.
1k Views

for I2C, SPI:
I2C vs SPI Synchronous Serial Protocol
What is difference between I2C and SPI?

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Jayendhar Gautham
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All these protocols differ in the number of devices they can connect and also in their coverage distance...so each of these is generally used for a specific application.

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robotics as a whole?

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I think so. Frankly, I'd prefer a friggin amendment to the Constitution on this matter. Not sure about the wording, but it would contain:

- Creation of a constitutionally specified body to oversee and regulate elections (to supervise the presence of donors and to limit the way candidates reach voters

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Why do democrats waste time on Bernie Sanders if a poll taken this year show half of the electorate will not even consider a socialist for president?

Matthew Smedberg, Atheist, mathematician, homebrewer
1.4k Views

Two reasons: 1. The old guard of the Democratic Party doesn't want to spend time on Sanders. They'd love to freeze him out. The only reason he's in the race is that a substantial chunk of party members are basically staging a revolt. 2. The Republican

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