SERIAL COMMUNICATION

What is Communication?

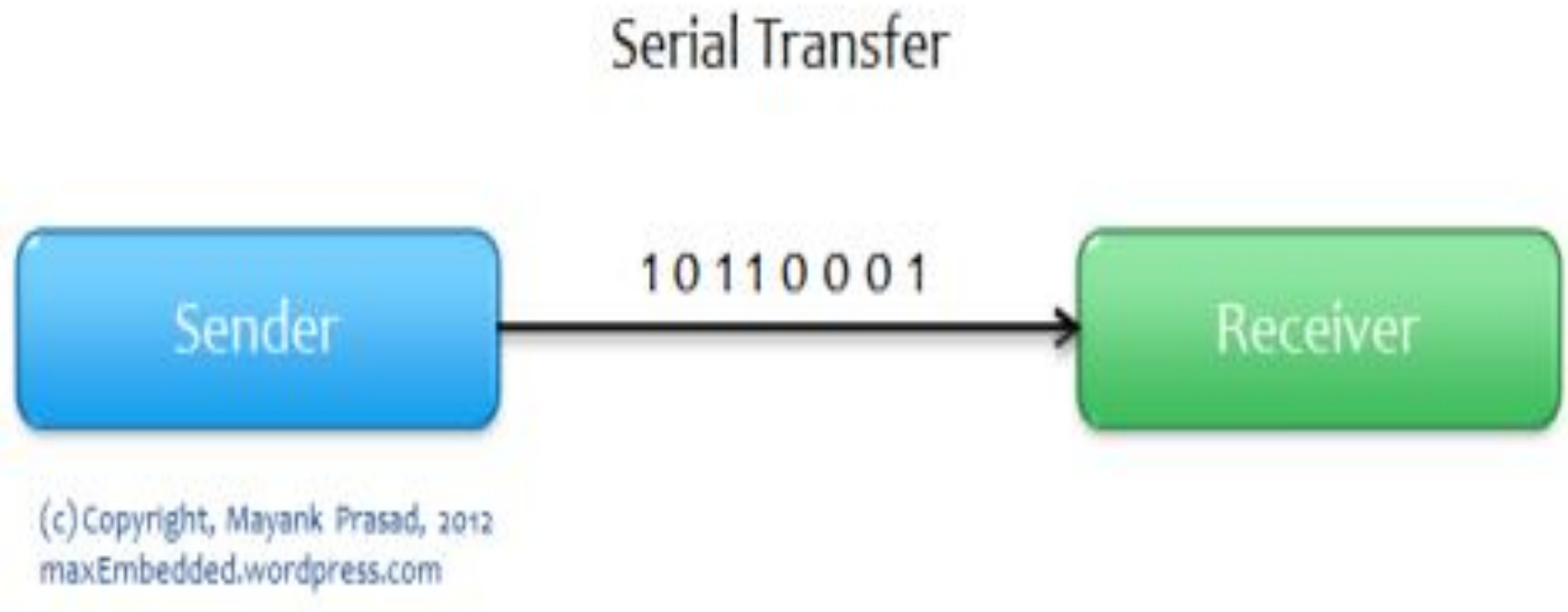
- communication between two controllers mean - An exchange of data (bits)!
- There are many protocols for communication,

several communication protocols have been developed based on

  - serial communication
  - parallel communication.

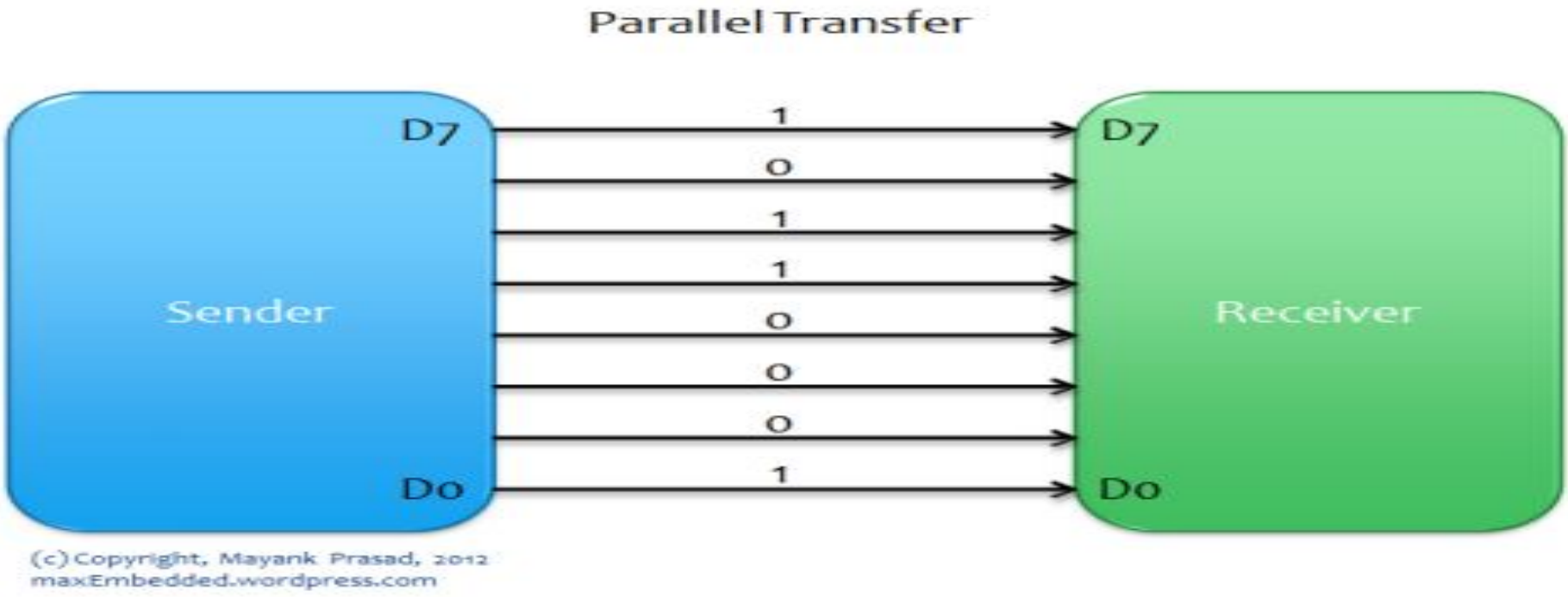
Serial Communication

- In Computer Science, serial communication is the process of sending/receiving data in one bit at a time. It is like you are firing bullets from a *machine gun* to a target… that's one bullet at a time!



Parallel Communication

- Parallel communication is the process of sending/receiving multiple data bits at a time through parallel channels. It is like you are firing using a *shotgun* to a target – where multiple bullets are fired from the same gun at a time!



Serial Vs Parallel Communication

Serial Communication	Parallel Communication
1. One data bit is transceived at a time	1. Multiple data bits are transceived at a time
2. Slower	2. Faster
3. Less number of cables required to transmit data	3. Higher number of cables required

Advantages of Serial over Parallel

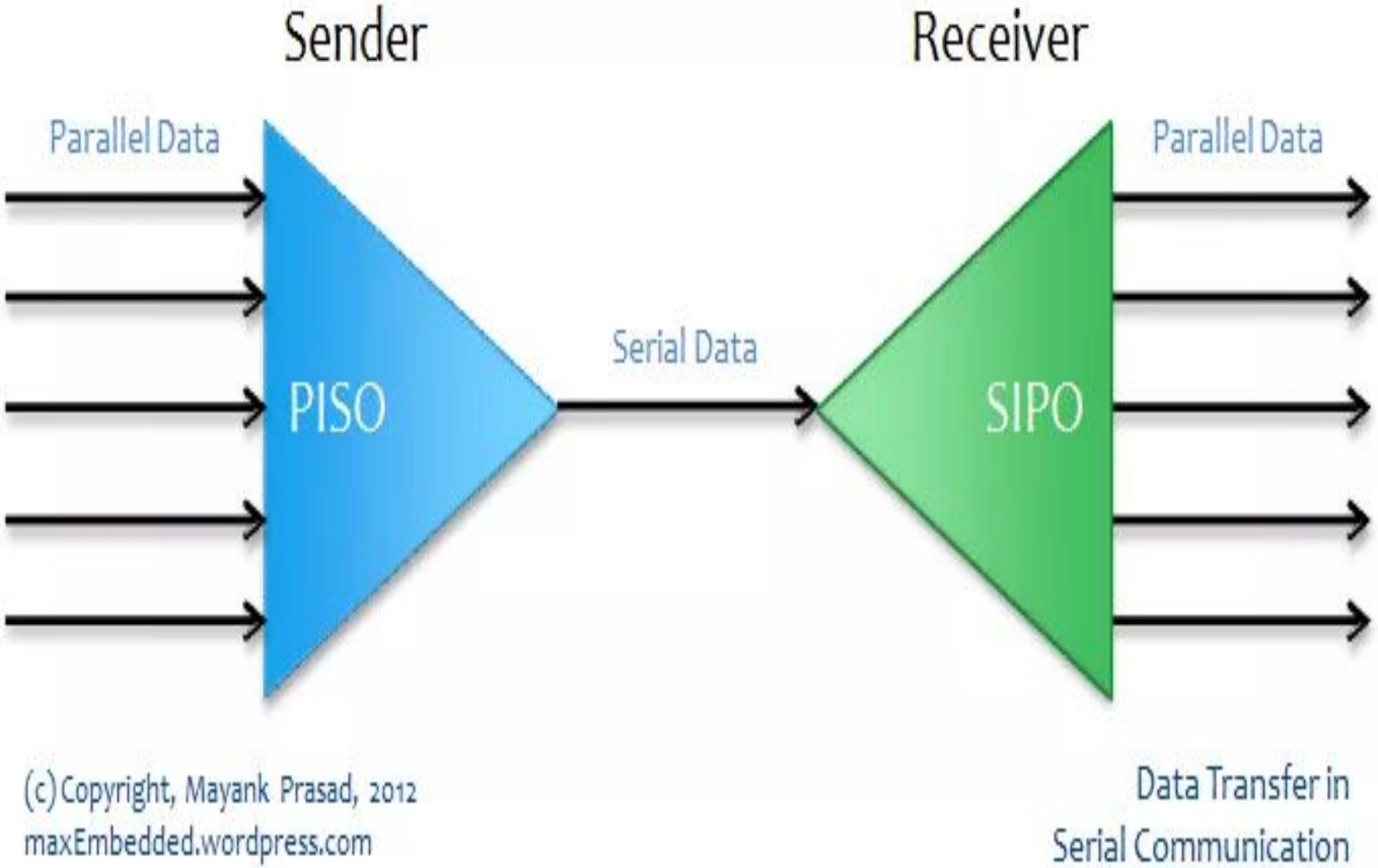
A number of factors allow serial to be clocked at a higher rate:

- Clock skew between different channels is not an issue (for un-clocked asynchronous serial communication links).
- A serial connection requires fewer interconnecting cables (e.g.wires/fibers) and hence occupies less space. The extra space allows for better isolation of the channel from its surroundings.
- Crosstalk is not a much significant issue, because there are fewer conductors in proximity.

How is Data sent Serially?

- A particular data set in the controller is in parallel form, and any bit can be accessed irrespective of its bit number.
- When this data set is transferred into the output buffer to be transmitted, it is still in parallel form.
- The output buffer converts the data into Serial data (**PISO**) (**Parallel In Serial Out**), MSB (Most Significant Bit) first or LSB (Least Significant Bit) first as according to the protocol.
- Then the data is *transmitted in Serial mode.*
- If the data is received by another controller in its receiver buffer, the receiver buffer converts it back into parallel data (**SIPO**) (**Serial In Parallel Out**) for further processing.

How is Data sent Serially?



Serial Transmission Modes

Serial data can be transferred in two modes – asynchronous and synchronous.

Asynchronous Data Transfer

- Data Transfer is called Asynchronous when data bits are not “synchronized” with a clock line, i.e. there is no clock line at all!

Synchronous Data Transfer

- Synchronous data transfer is when the data bits are “synchronized” with a clock pulse.

Serial Communication Protocols

- **SPI – Serial Peripheral Interface**

- It is a three-wire based communication system.
- One wire each for Master to slave and Vice-versa, and one for clock pulses.
- There is an additional SS (Slave Select) line, which is mostly used when we want to send/receive data between multiple ICs.

Serial Communication Protocols

I^2C Inter-Integrated Circuit

- Pronounced eye-two-see or eye-square-see,
- An advanced form of USART.
- The transmission speeds can be as high as a whopping 400KHz.
- The I2C bus has two wires – one for clock, and the other is the data line,
- which is bi-directional – this being the reason it is also sometimes (not always – there are a few conditions) called **Two Wire Interface (TWI)**.
- It is a pretty new and revolutionary technology invented by Philips.

Serial Communication Protocols

- **FireWire**
  - ✔ High-speed buses
  - ✔ Capable of audio/video transmission.
  - ✔ Contains a number of wires depending upon the port,
  - ✔ Can be either a 4-pin, or a 6-pin, or an 8-pin one.
- **Ethernet**
  - ✔ Used mostly in LAN connections,
  - ✔ the bus consists of 8 lines, or 4 Tx/Rx pairs.
- **Universal serial bus (USB)**
  - ✔ This is the most popular of all.
  - ✔ Is used for virtually all type of connections.
  - ✔ The bus has 4 lines: V_{CC}, Ground, Data+, and Data-.

Serial Communication Protocols

RS-232 – Recommended Standard 232

- ✔ typically connected using a DB9 connector,
- ✔ has 9 pins - 5 are input, 3 are output, and one is Ground.
- ✔ You can still find this so-called “Serial” port in some old PCs.
- ✔ In our upcoming posts, we will discuss mainly about RS232 and USART of controllers.