Hardware Session

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Topics Overview

1. Inside a FPGA

2. Standard memory on FPGA

3. Simulation, Implementation and Debugging skill on Vivado (Ex.1 using topic 2)

4. Serial and parallel communication

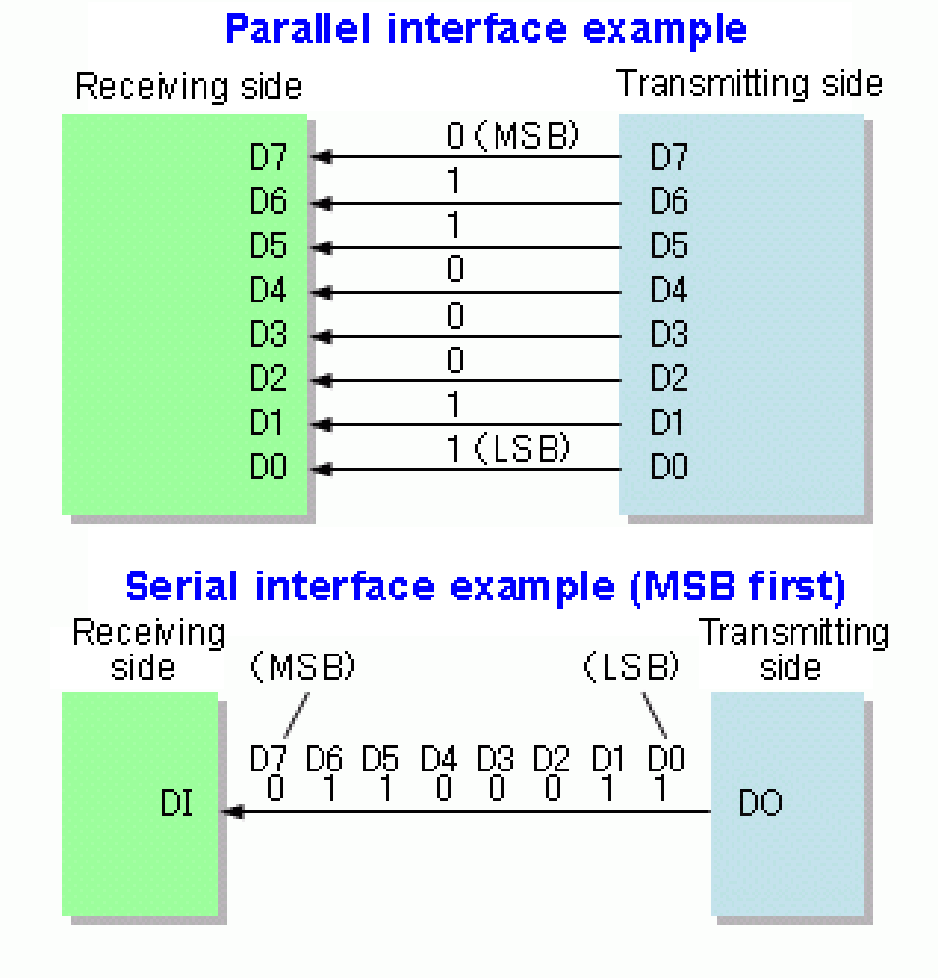
5. Image Capture and Pre-processing (EX.2)

6. How to design FPGA on Zynq

7. Schematic design for FPGA (Optional)

4. Serial and parallel communication

Serial VS Parallel

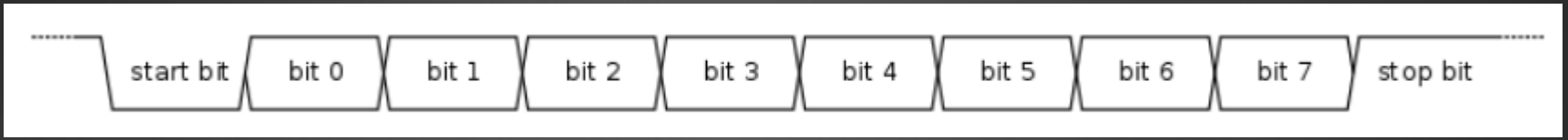


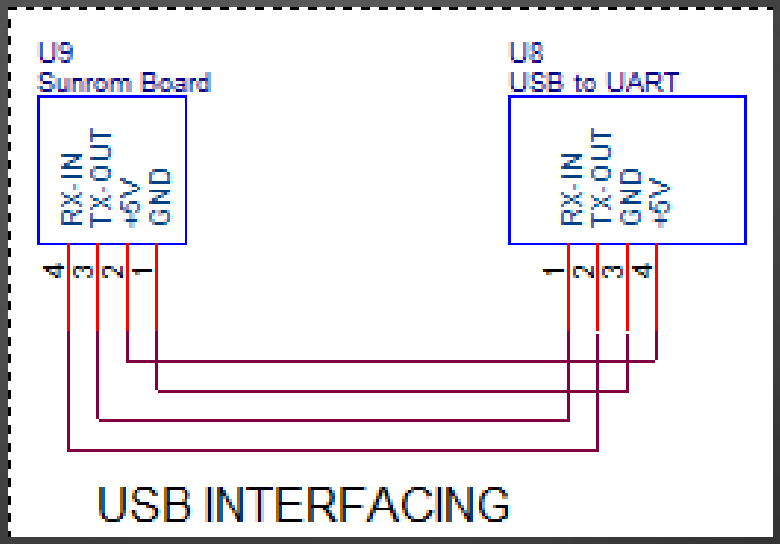
Serial communication example

Asynchronous clock	Synchronous clock
Universal Asynchronous Receiver-Transmitter (UART)	Serial Peripheral Interface (SPI)
	I²C (Inter-Integrated Circuit)

UART

A universal asynchronous receiver-transmitter (UART)is a computer hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable.





SPI

The Serial Peripheral Interface (SPI) is a synchronous serial communication interface specification used for short distance communication, primarily in embedded system.

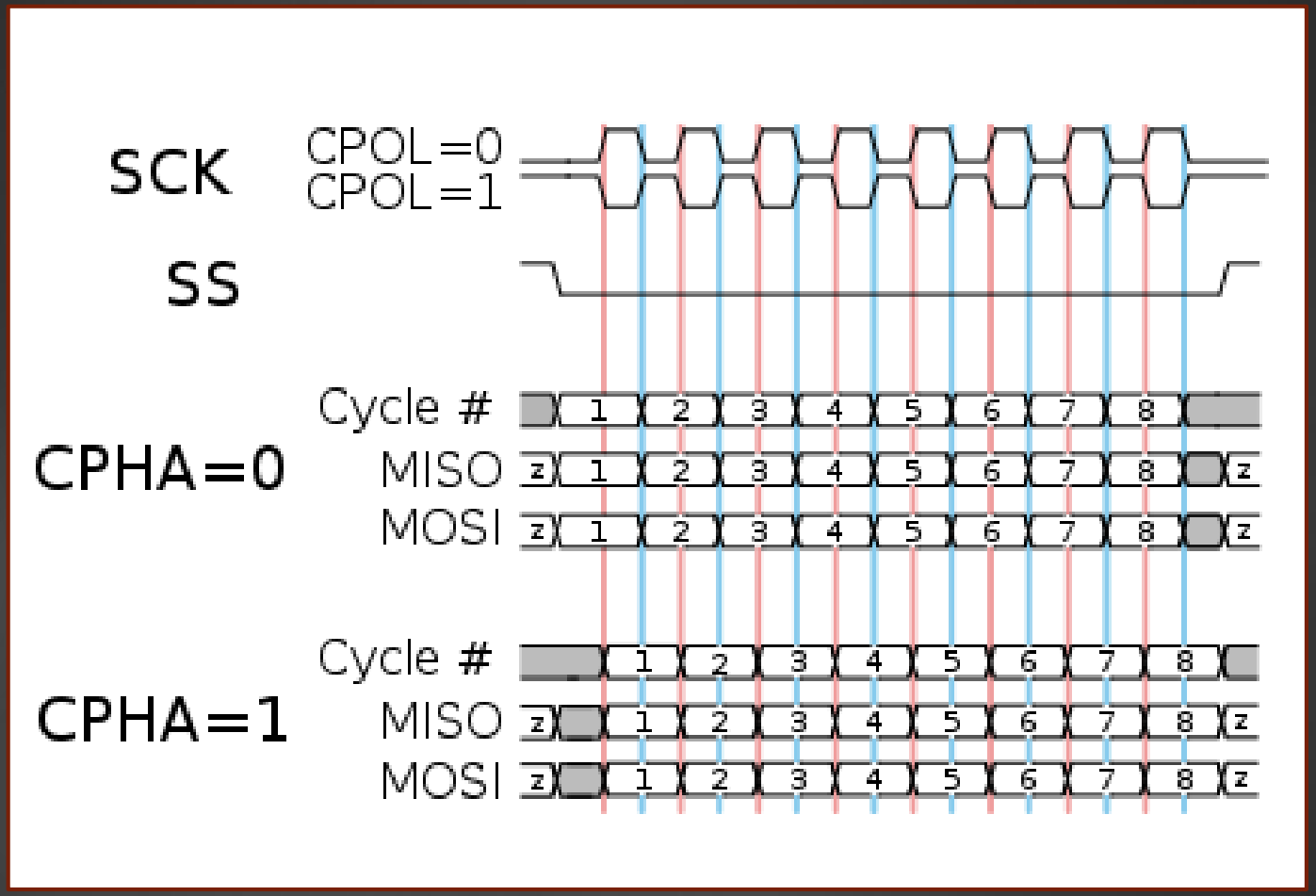
SPI devices communicate in full duplex mode using a master slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave devices are supported through selection with individual slave select (SS) lines.

SPI: PIN interface

The SPI bus specifies four logic signals:

- SCLK: Serial Clock (output from master)
- MOSI: Master Output Slave Input, or Master Out Slave In (data output from master)
- MISO: Master Input Slave Output, or Master In Slave Out (data output from slave)
- SS: Slave Select (often active low, output from master)

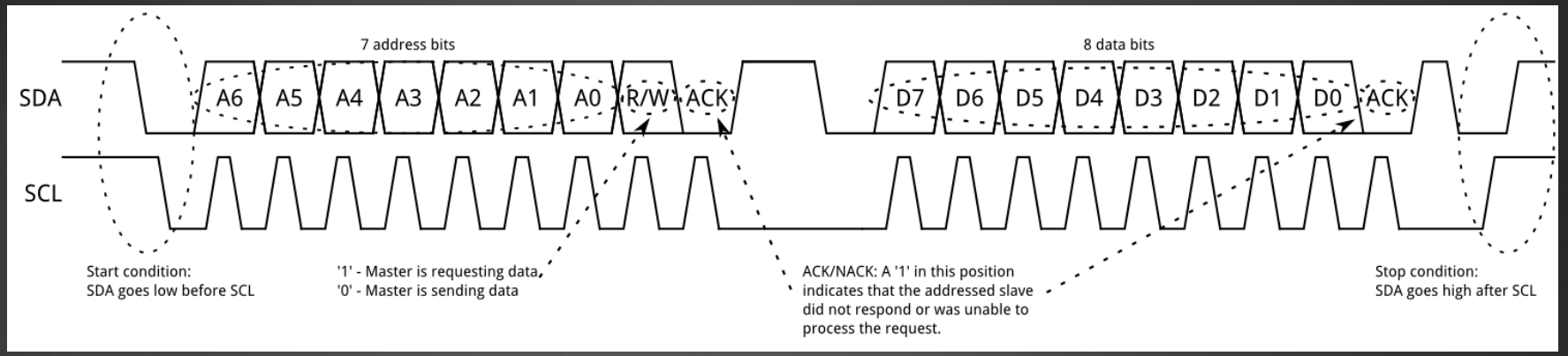
SPI: Data transmission



CPOL = Clock Polarity
CPHA = Clock Phase

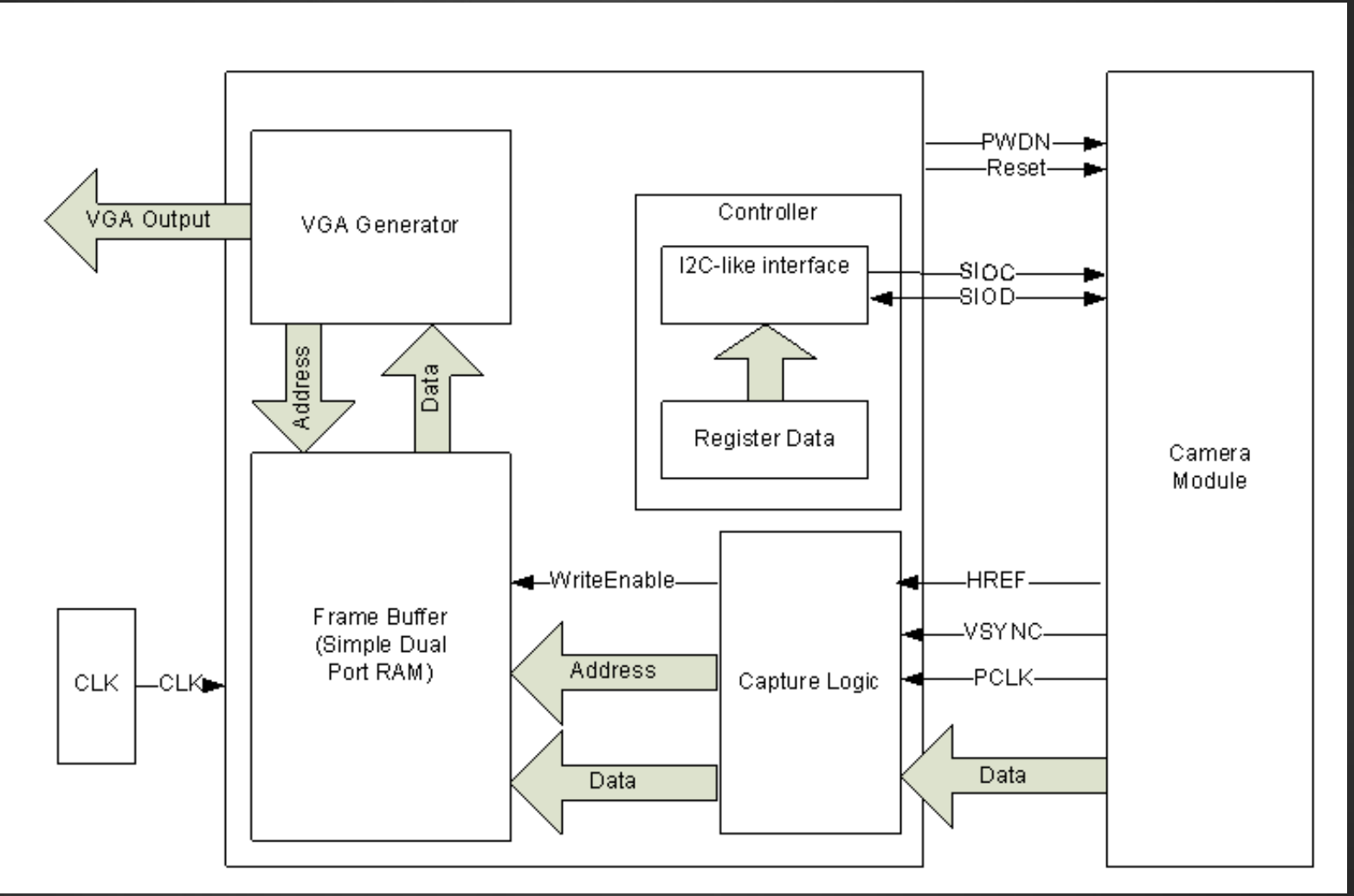
I2C

I²C (Inter-Integrated Circuit), pronounced *I-squared-C*, is a synchronous, multi-master, multi-slave, packet switched, single ended, serial computer bus invented in 1982 by Philips Semiconductor (now NXP Semiconductors). It is widely used for attaching lower-speed peripheral ICs to processors and microcontrollers in short distance, intra-board communication



5. Image Capture and Pre-Processing

Architecture of Image Capture



EX.2 Design Gray and Binary image