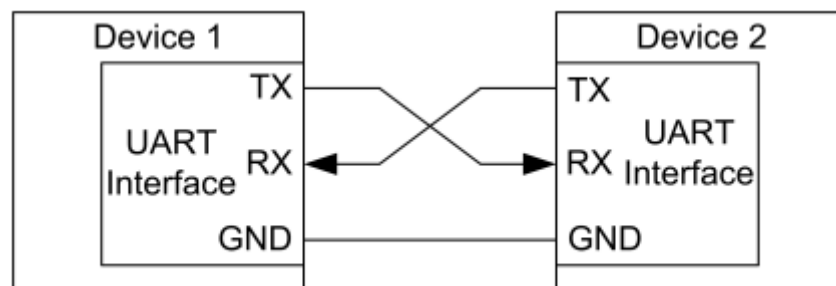


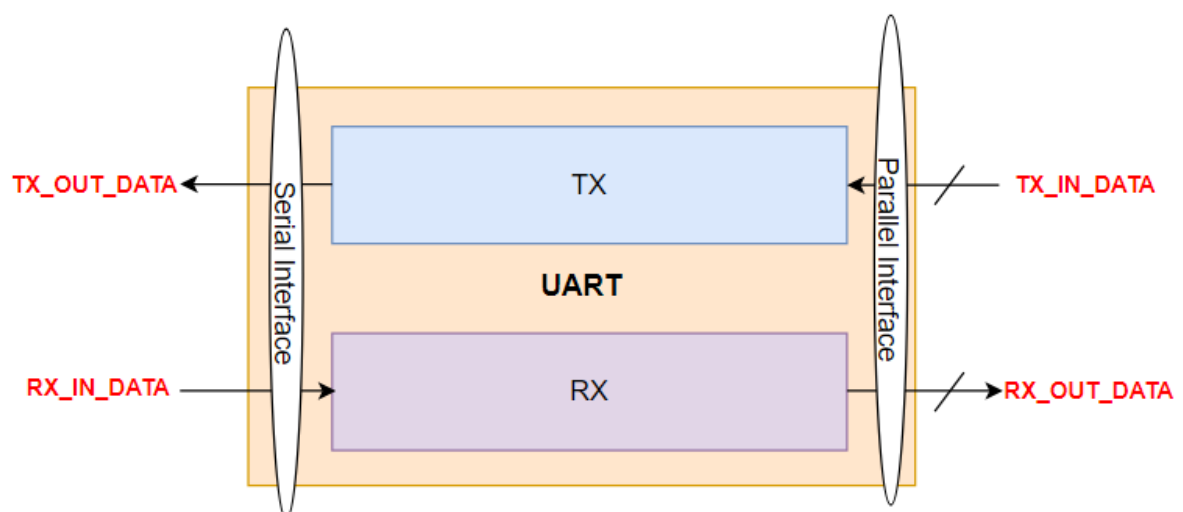
UART Receiver

Introduction: -

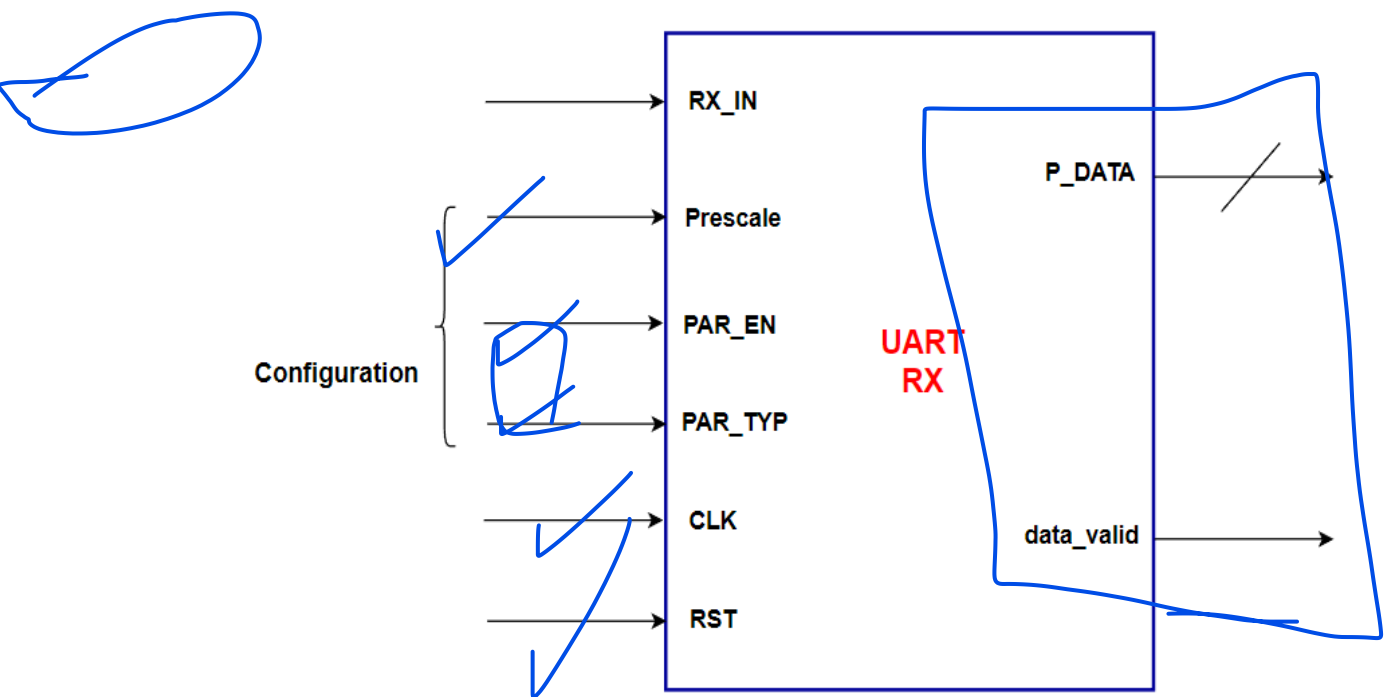
- There are many serial communication protocols as I2C, UART and SPI.
- A **U**niversal **A**synchronous **R**eceiver/**T**ransmitter (UART) is a block of circuitry responsible for implementing serial communication.
- UART is Full Duplex protocol (data transmission in both directions simultaneously)



- **Transmitting UART** converts parallel data from the master device (eg. CPU) into serial form and transmits in serial to the receiving UART.
- **Receiving UART** will then convert the serial data back into parallel data for the receiving device.



Block Interface: -



Port	Width	Description
CLK	1	UART RX Clock Signal
RST	1	Synchronized reset signal
PAR_TYP	1	Parity Type
PAR_EN	1	Parity_Enable
Prescale	5	Oversampling Prescale
RX_IN	1	Serial Data IN
P_DATA	8	Frame Data Byte
Data_valid	1	Data Byte Valid signal

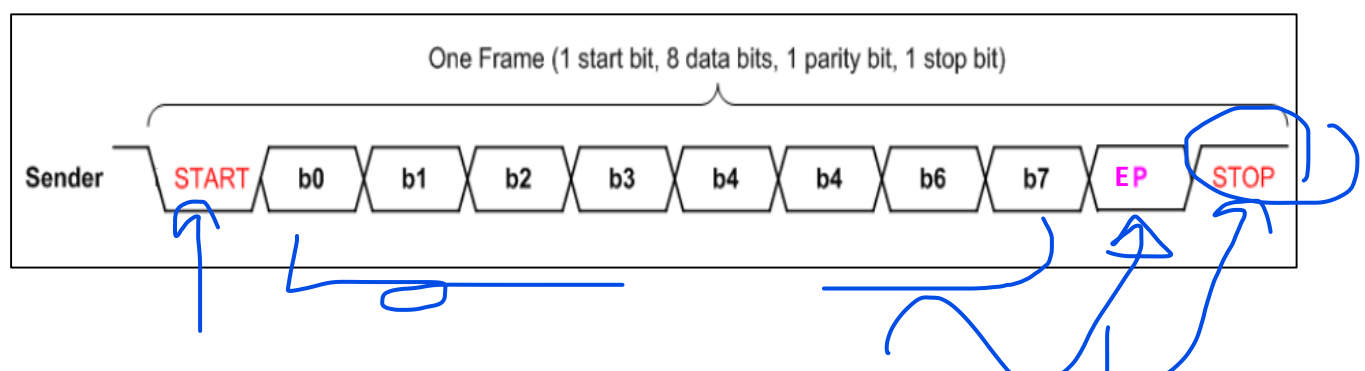
Specifications: -

- UART RX receive a UART frame on **RX_IN**.
- UART_RX support **oversampling** by 8, 16, 32
- **RX_IN** is high in the **IDLE** case (No transmission).
- **PAR_ERR** signal is **high** when the calculated parity bit not equal the received frame parity bit as this mean that the frame is corrupted.
- **STP_ERR** signal is **high** when the received stop bit not equal 1 as this mean that the frame is corrupted.
- DATA is extracted from the received frame and then sent through **P_DATA** bus associated with **DATA_VLD** signal **only** after checking that the frame is received correctly and not corrupted. (PAR_ERR = 0 && STP_ERR = 0)
- **UART_RX can accept consequent frames without any gap.**
- Registers are cleared using asynchronous active low reset
- **PAR_EN (Configuration)**
 - 0: To disable frame parity bit
 - 1: To enable frame parity bit
- **PAR_TYP (Configuration)**
 - 0: Even parity bit
 - 1: Odd parity bit

All Expected Received Frames: -

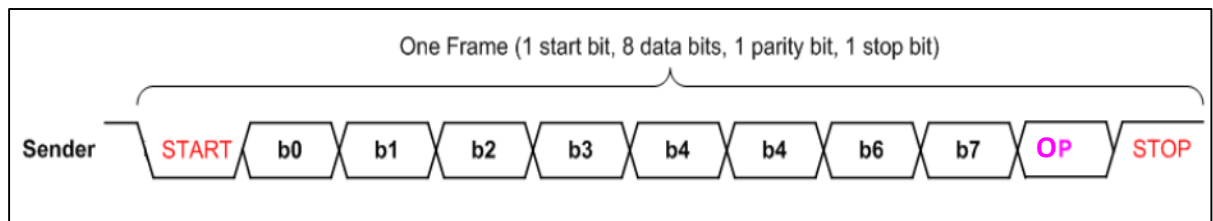
1. Data Frame (in case of Parity is enabled & Parity Type is even)

- One start bit (1'b0)
- Data (LSB first or MSB, 8 bits)
- Even Parity bit
- One stop bit



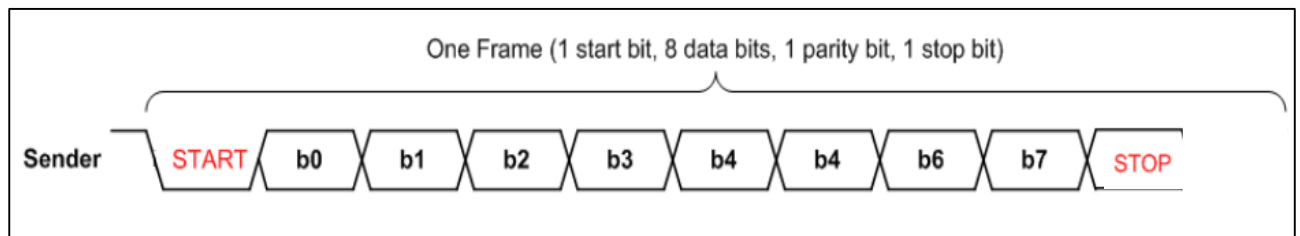
2. Data Frame (in case of Parity is enabled & Parity Type is odd)

- One start bit (1'b0)
- Data (LSB first or MSB, 8 bits)
- Odd Parity bit
- One stop bit



3. Data Frame (in case of Parity is not Enabled)

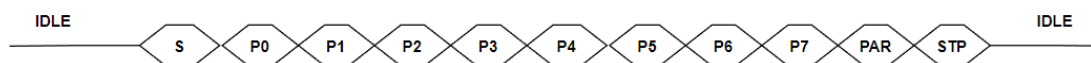
- One start bit (1'b0)
- Data (LSB first or MSB, 8 bits)
- One stop bit



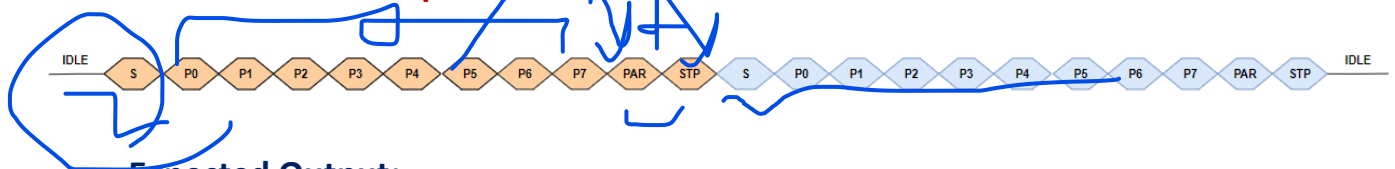
Waveforms: -

Expected Input (RX_IN): -

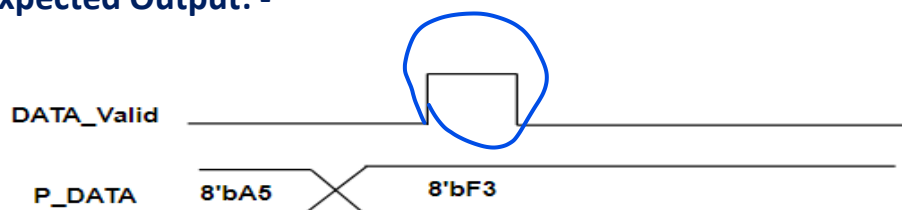
1. In case of one frame: -



2. In case of consequent frames: -

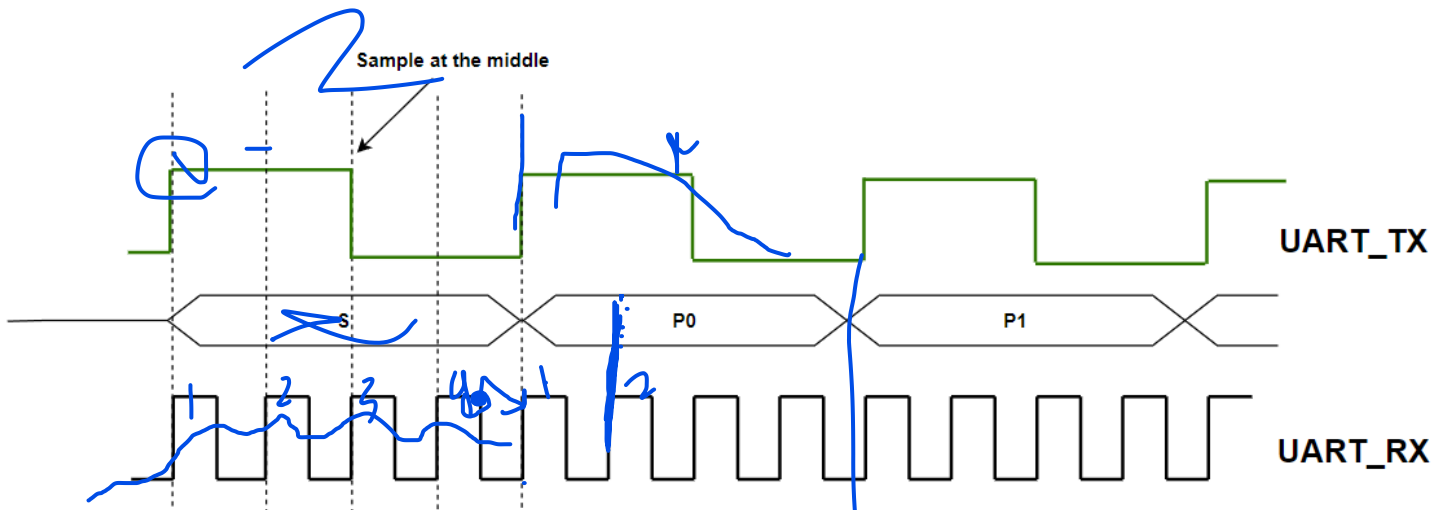


Expected Output: -

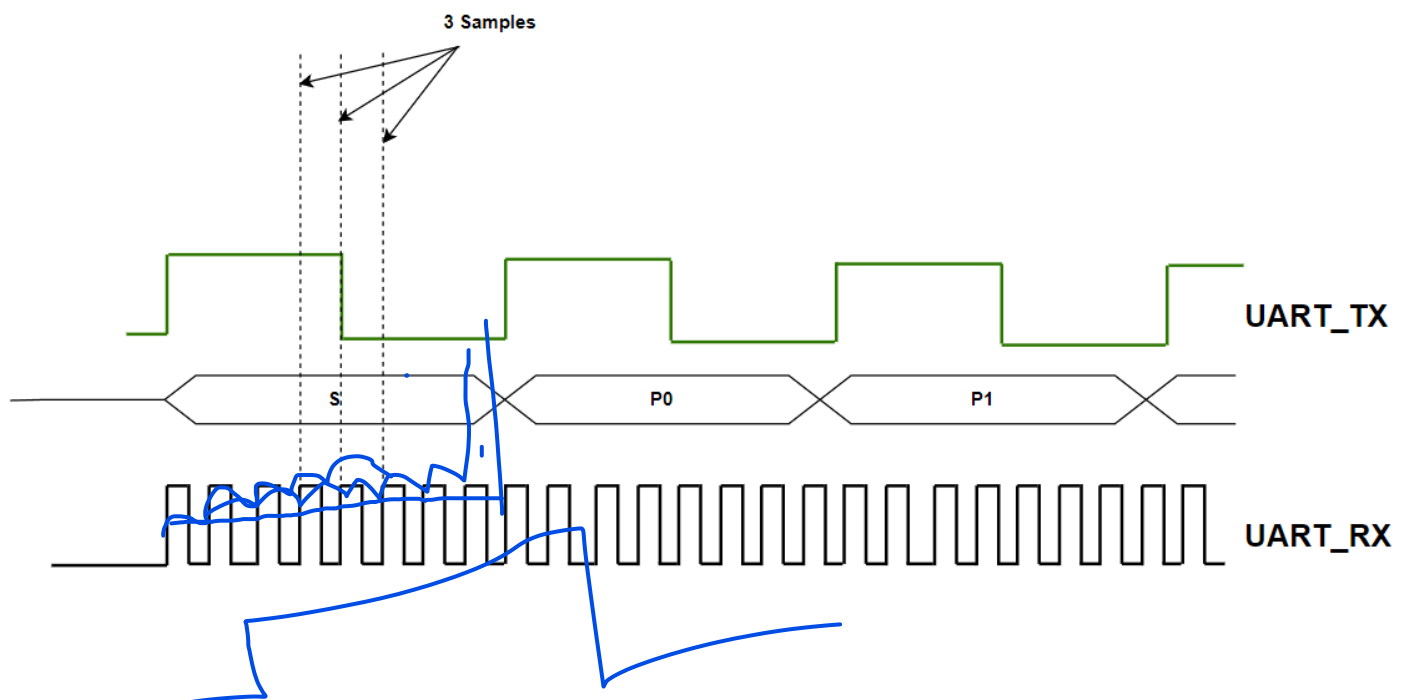


Oversampling: -

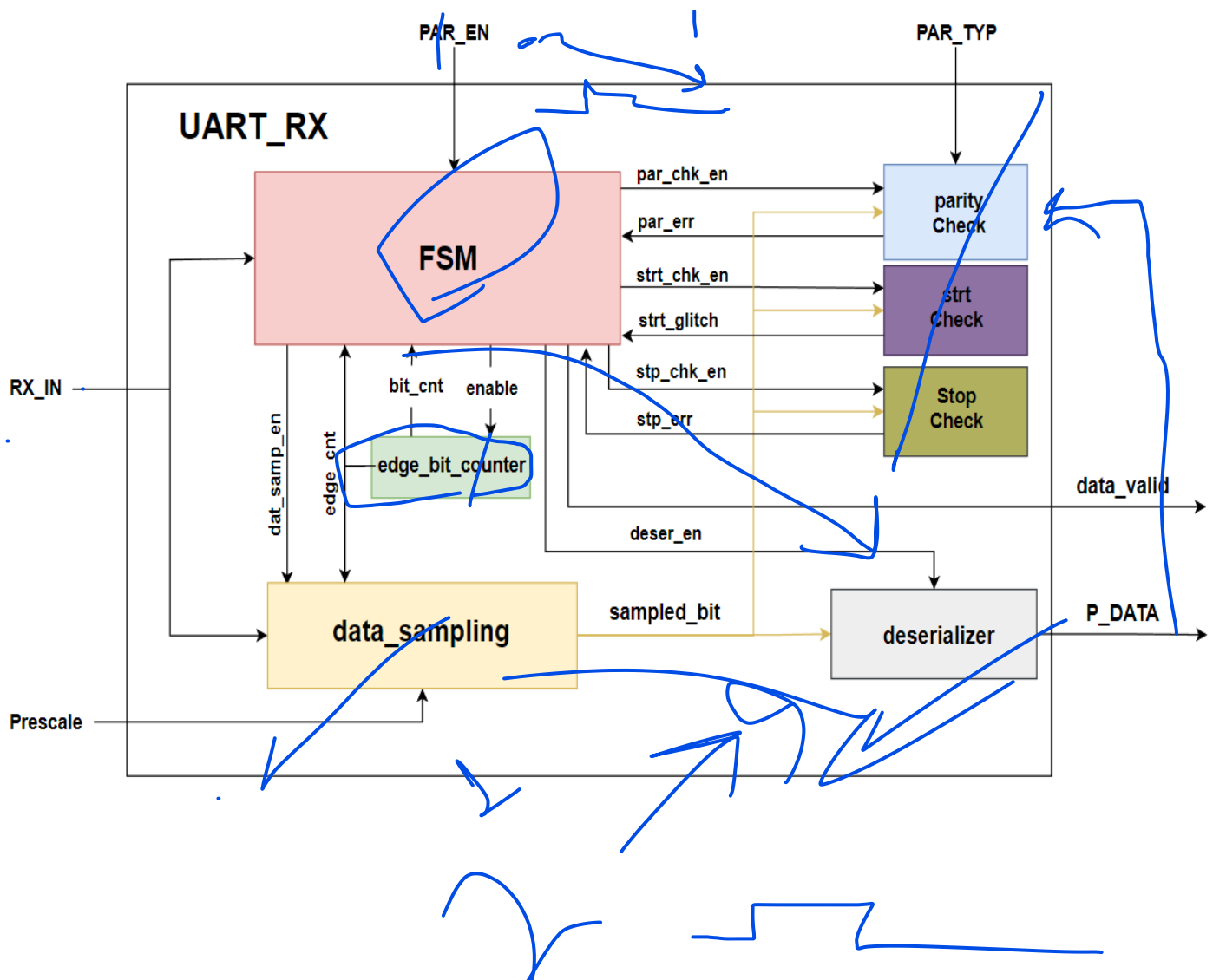
1. Oversampling by 4: This means that the clock speed of UART_RX is 4 times the speed of UART_TX.



2. Oversampling by 8: This means that the clock speed of UART_RX is 8 times the speed of UART_TX.



Recommended Block Diagram: -



Requirements: -

- 1- Implement the above Specifications for UART RX using Verilog language.
- 2- Write a testbench to validate your design using 200 MHz clock frequency.