

8051, AVR, ARM MICROCONTROLLERS  
AND REAL WORLD INTERFACING AND  
IOs USING BUSES –  
Lesson-4: Serial Data  
Communication Input/Output in  
8051

# Serial Interface SI

programmable for

- half duplex synchronous serial or
- full duplex asynchronous UART mode

# Two 8-bit SFRs

- **SBUF** (8 serial received bits or transmission bits register depending upon instruction is using SBUF as source or destination)
- **SCON** (8-serial modes cum control bits register) and SFR **PCON.7** bit

# SBUF

- Single SFR address for transmit and received byte buffers when the serial output or input is sent.
- 0x99 the address of SI buffers.
- SFR holds the SI transmission 8-bits when it is written.
- MOV 0x99, A instruction writes A into transmission buffer from A register
- MOV R1, 0x99 instruction read R1s register from the receive buffer

# SCON

- SFR to control the SI interface.
- Three upper bits programs the modes as 0 or 1 or 2 or 3.
- Mode 0 is half duplex synchronous.
- Modes 1 or 2 or 3 are full duplex asynchronous modes.
- Bit SCON.4 enables or disables SI receiver functions.

# SCON

- Two bits SCON.3 and SCON.2 specify the 8th bit to be transmitted and 8th bit received when the mode is 2 or 3. A bit SCON.1 enables or disables SI transmitter interrupts (TI) on completion of transmission.
- Bit SCON.0 enables or disables SI receiver interrupts (RI) on completion of transmission.

# Mode 0 functions – Input or output

Depends upon instruction using SBUF as source or destination

- Synchronous serial mode data and clock inputs, or
- Synchronous serial mode data and clock outputs

Mode 0 when SCON bits 7 and 6 (mode-bits) are 00

# Mode 1 – Input or output

- 10 bit (start plus 8- serial data plus stop total 10 bits) UART mode serial input or output
- Input or output whether SBUF used for read or write in instruction
- Baud rate programmable using T1 or T0 timers (T2 in 8052)
- Mode 1 when SCON bits 7 and 6 are 01



# Mode 2 Input or Output

- Eleven bit (start plus 8- serial data plus RB8 or TB8 bit plus stop total 11 bits) UART mode serial input and output
- Input or output whether SBUF used for read or write in instruction
- Fixed baud rate of  $(f/32) \div 12$  or  $(f/64) \div 12$  Mbaud/s where  $f$  = crystal frequency depending upon PCON 7 bit SMOD = 1 or 0, respectively

Mode 2 when SCON bits 7 and 6 are 10

# Mode 3 Input or Output

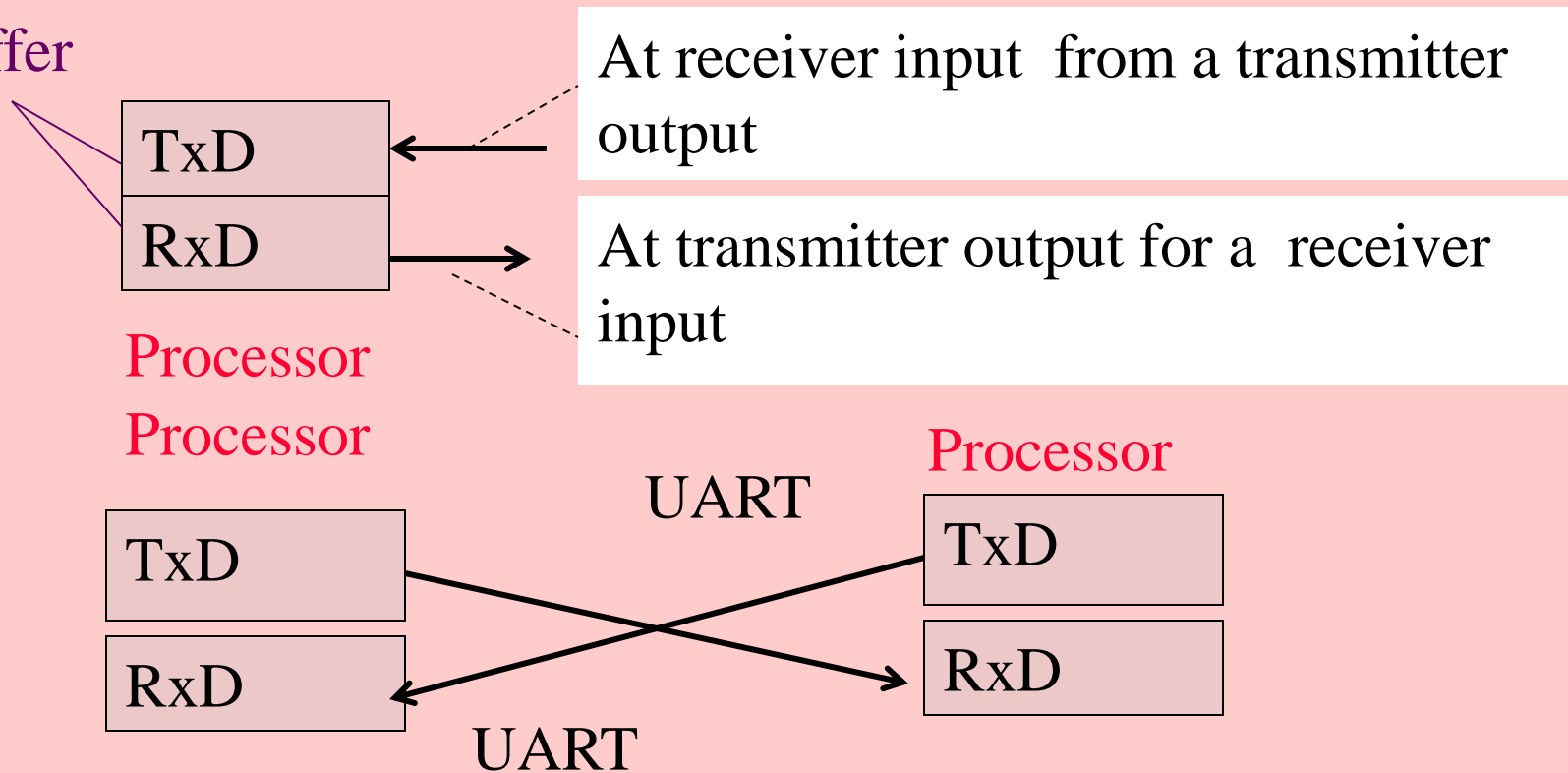
- 11 bit (start plus 8- serial data plus RB8 or TB8 bit plus stop total 11 bits) UART mode serial input and output
- Input or output whether SBUF used for read or write in instruction
- Baud rate with programmable using T1 or T0 timers (T2 in 8052)

Mode 3 when SCON bits 7 and 6 are 1,1

# SI Full duplex signals Mode 1, 2 or 3

SBUF Serial  
transmit/receive data  
buffer

**TxD/CLK, RxD/Data pins**

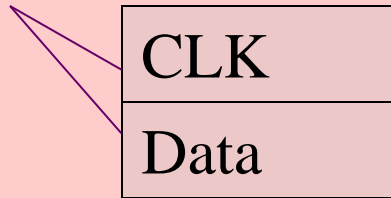


# SI Half duplex signals Mode 0

SBUF Serial

TxD/CLK, RxD/Data Pins

transmit/receive data  
buffer



From a transmitter Processor output  
at receiver input

At transmitter output for a receiver  
Processor input

Processor

Processor

Processor

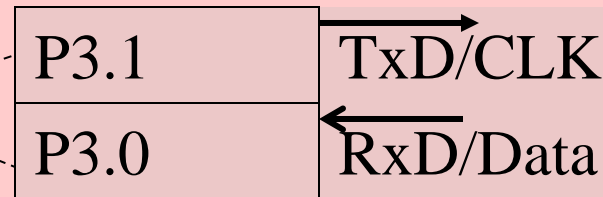


# 8051 SI signals at Port P3.1 and P3.0

## TxD/CLK, RxD/Data Pins

SBUF Serial  
transmit/receive data  
buffer

Programmed as per mode  
selected and SBUF read  
or write instruction  
executed



P3

## 8051 SI Features

1. Mode 0– Half\_ duplex synchronous mode of operation
2. T8 and R8 for the inter-processor communication in 11\_ bit format
3. Mode 1 or 2 or 3 – Full\_ duplex asynchronous serial communication
4. Signals not programmable for RxD or TxD no DDR in

# Summary

# We learnt

- Serial Interface functions
- Half duplex synchronous serial mode 0 or
- Full duplex asynchronous UART mode 1, 2 or 3
- SBUF
- SCON

End of Lesson 4 of Chapter 3 on  
: Serial Data Communication  
Input/Output in 8051