Serial Ports

Networks and Embedded Software

Module 4.2.5

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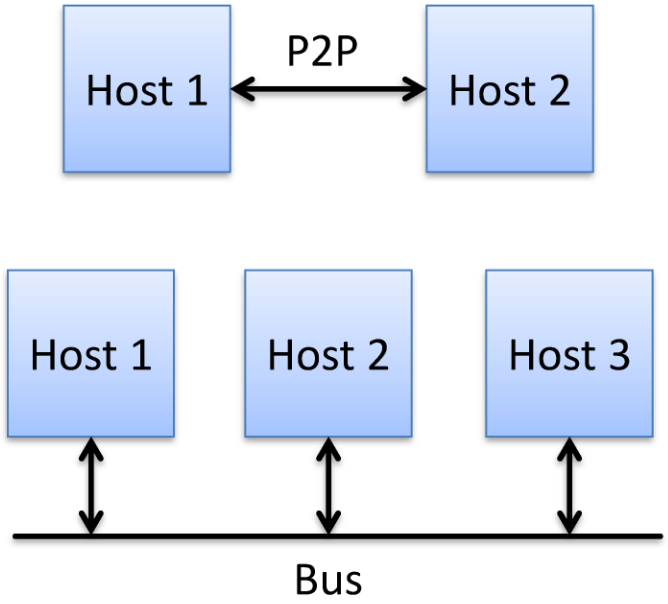
Serial Ports

- Serial communication
  - Point-to-point connection
    - RS-232 (UART)
  - Serial buses
    - SPI
    - I²C
    - CAN
    - USB

Module 5



UART (1)

- Universal Asynchronous Receiver Transmitter
  - Serial data exchange
  - Point to point connection
  - Used to interconnect
    - Teletypewriters
    - Mainframe computers
    - Terminals
    - Printers
    - Etc.

UART (2)

- Configuration
  - Baud rate (bps: bits per second)
  - Number of data bits (Baudot: 5 bit, ASCII: 7 bit)
  - Parity mode (even, odd, none)
  - Number of stop bits (one, two)
  - Example: 9600/8N1
    - 9600 bits per second (104 µs per bit)
    - 8 data bits, no parity bit, 1 stop bit

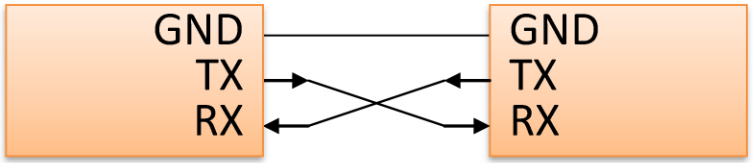
UART (3)

- Parity Bit
  - Simplest form of an error detecting code
  - Two variants of parity bit: even (E) or odd (O)
  - Number of 1s including parity bit must be E or O

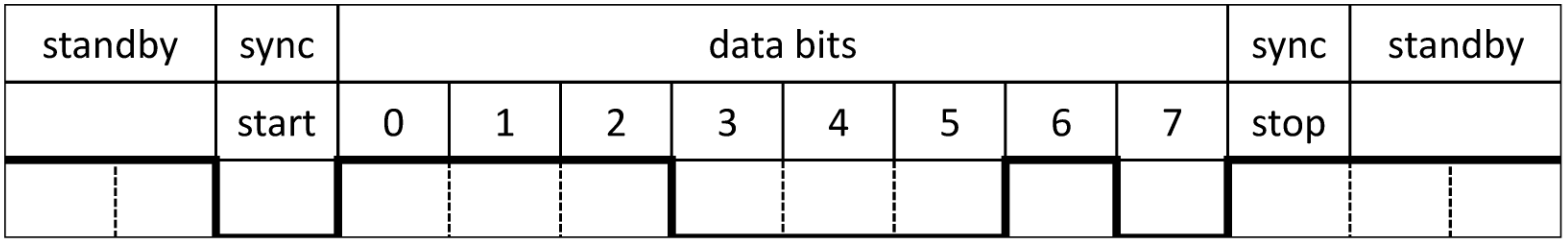
Data Bits	Even Parity	Odd Parity
0000000	+ 0 = E	+ 1 = O
1010001	+ 1 = E	+ 0 = O
1101001	+ 0 = E	+ 1 = O
1111111	+ 1 = E	+ 0 = O

UART (4)

- Asynchronous Transmission
  - Three line connection



  - Bit transmission
    - Example: 8N1, G = 47_{hex} = 01000111



UART (5)

- ASCII code table

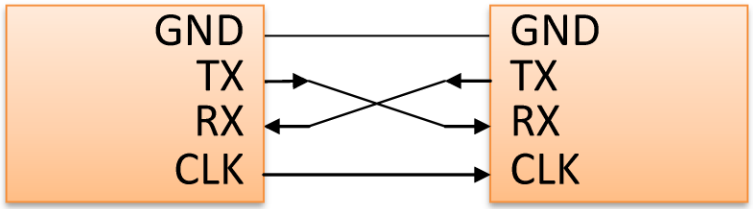
ASCII		Lower Hex Digit															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Higher Hex Digit	0	NUL	SOH	STX	ETX	EOF	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
	1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
	2		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
	6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

UART (6)

- Clock Drift
  - When clocks drift bits can be lost

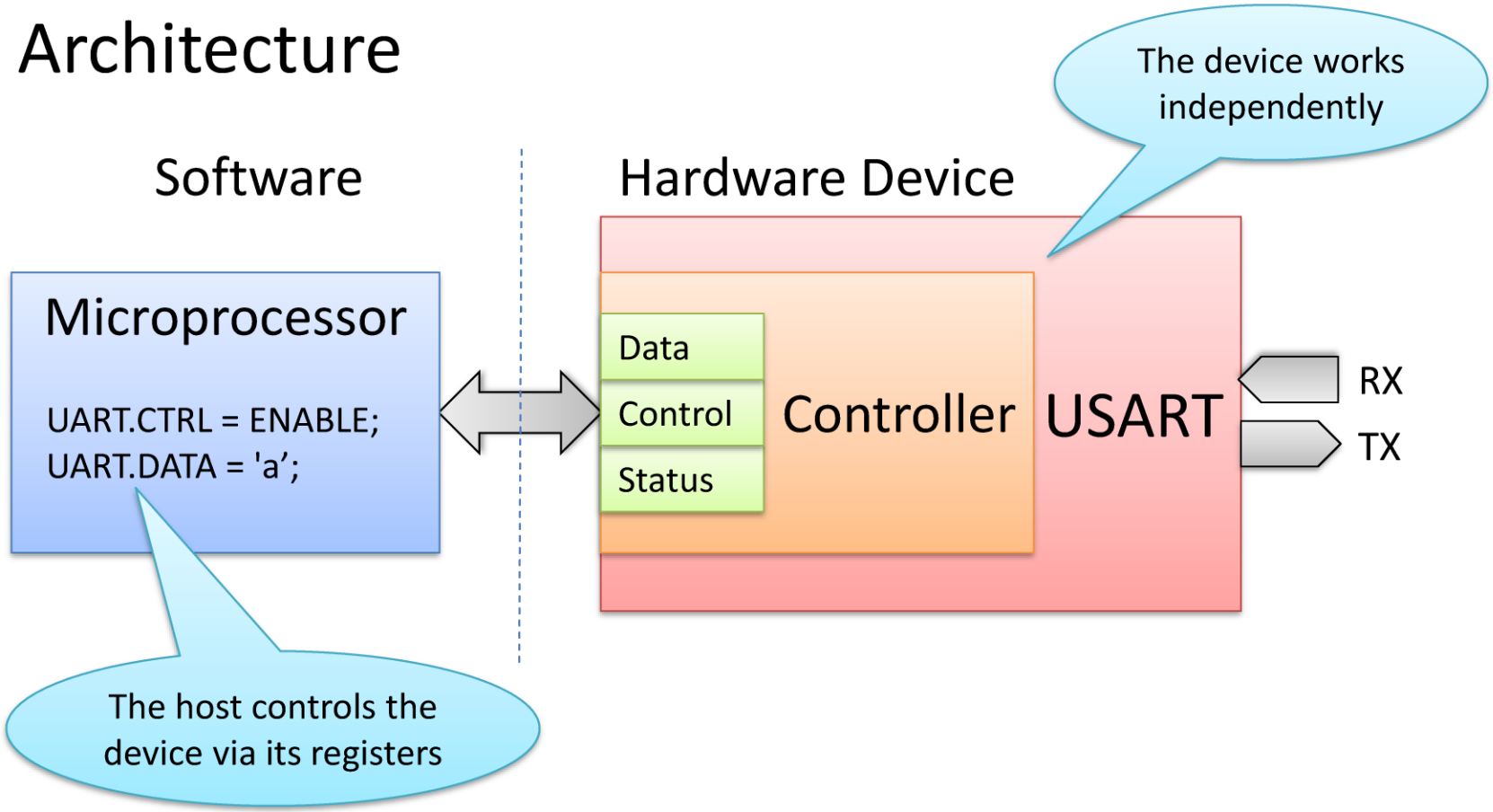
Clock A	0	1	2	3	4	5	6	7
Clock B	0	1	2	3	4	5	6	

  - Correctives
    - Synchronization bits (start bit, stop bit)
    - Synchronization line (synchronous transmission, USART)



UART (7)

- Architecture



UART (8)

- Architecture (continued)