

Figure 11.18 *Send window for Selective Repeat ARQ*

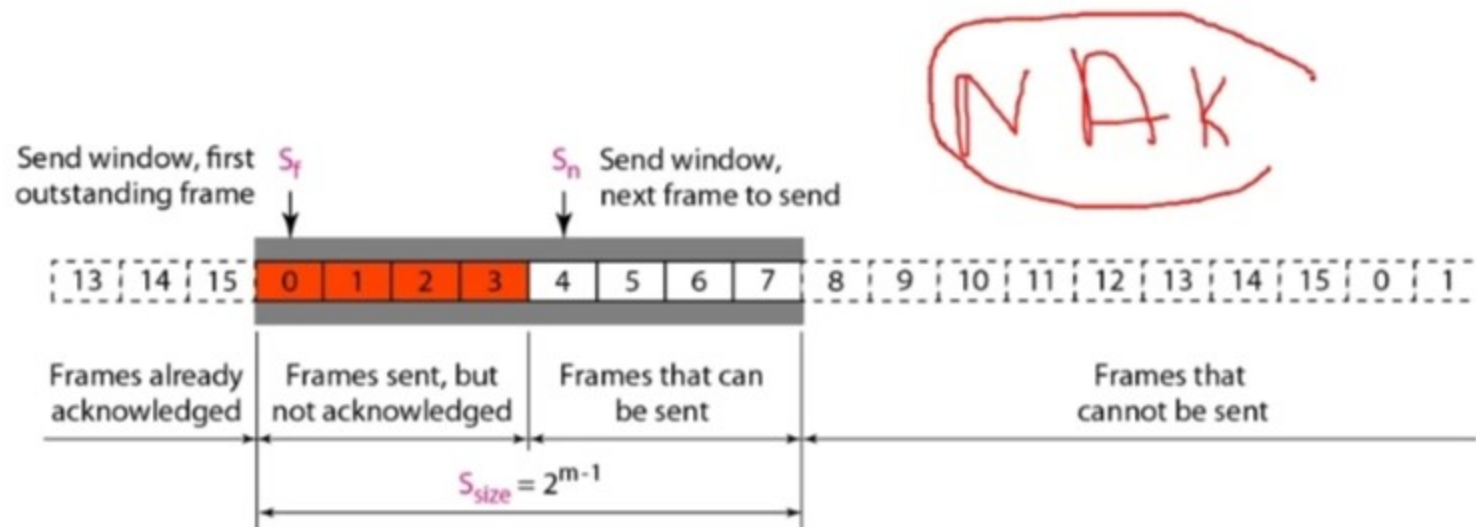
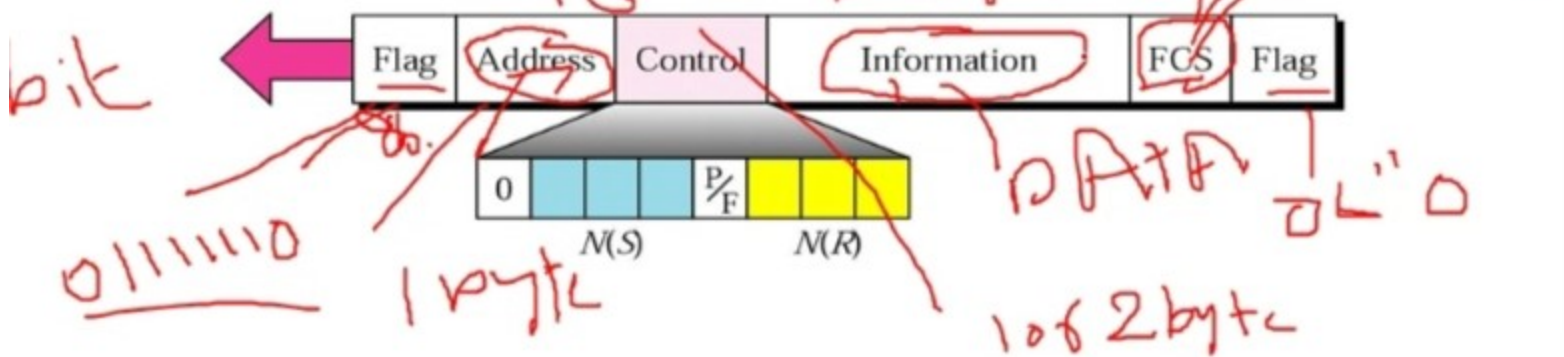


Figure 11.27 HDLC frames

Information frames (I-Frames) :



Supervisory frames (I-Frames) :

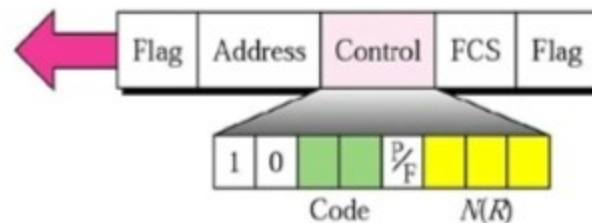


Figure 11.28 *Control field format for the different frame types*

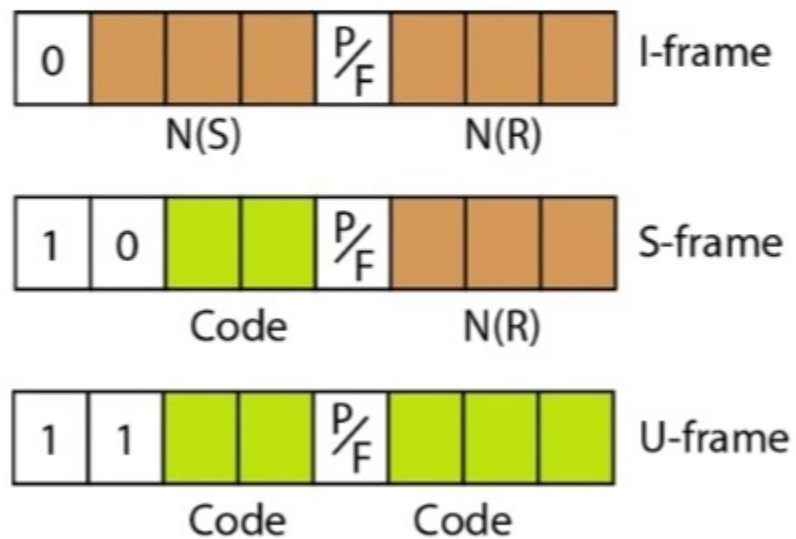


Figure 11.28 *Control field format for the different frame types*

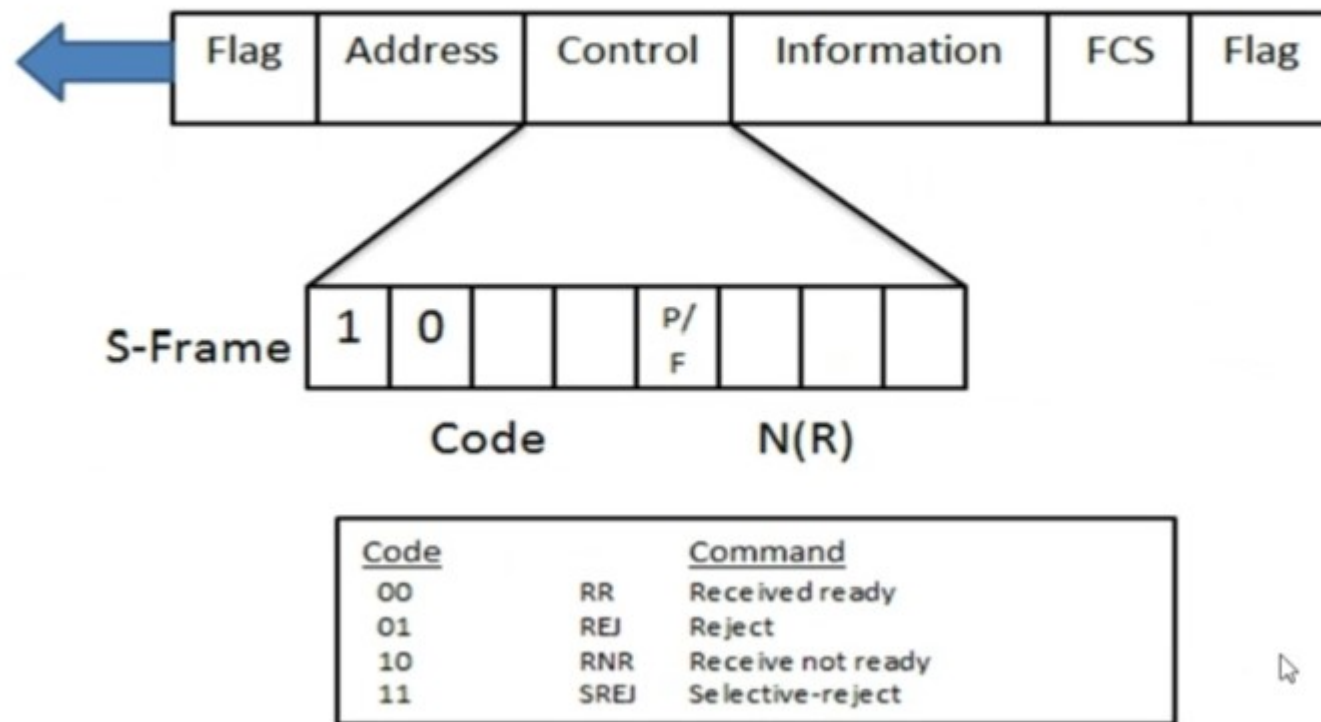
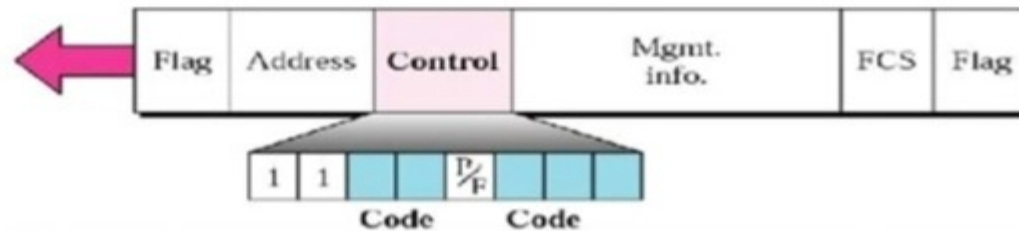


Figure 11.28 *Control field format for the different frame types*

HDLC(cont'd)

- U-Frame is used to exchange session management and control information between connected devices



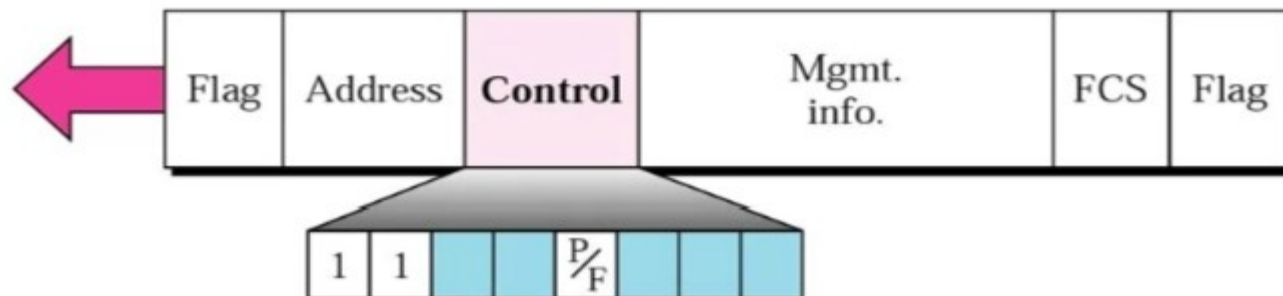
Code		Command	Response
00	001	SNRM	
11	011	SNRME	
11	100	SABM	DM
11	110	SABME	
00	000	UI	UI
00	110		UA
00	010	DISC	RD
10	000	SIM	RIM
00	100	UP	
11	001	RSET	
11	101	XID	XID
10	001		FRMR

Table 11.1 *U-frame control command and response*

<i>Code</i>	<i>Command</i>	<i>Response</i>	<i>Meaning</i>
00 001	SNRM		Set normal response mode
11 011	SNRME		Set normal response mode, extended
11 100	SABM	DM	Set asynchronous balanced mode or disconnect mode
11 110	SABME		Set asynchronous balanced mode, extended
00 000	UI	UI	Unnumbered information
00 110		UA	Unnumbered acknowledgment
00 010	DISC	RD	Disconnect or request disconnect
10 000	SIM	RIM	Set initialization mode or request information mode
00 100	UP		Unnumbered poll
11 001	RSET		Reset
11 101	XID	XID	Exchange ID
10 001	FRMR	FRMR	Frame reject

Figure 11.27 *HDLC frames*

Unnumbered frames (I-Frames) :



UART

UART

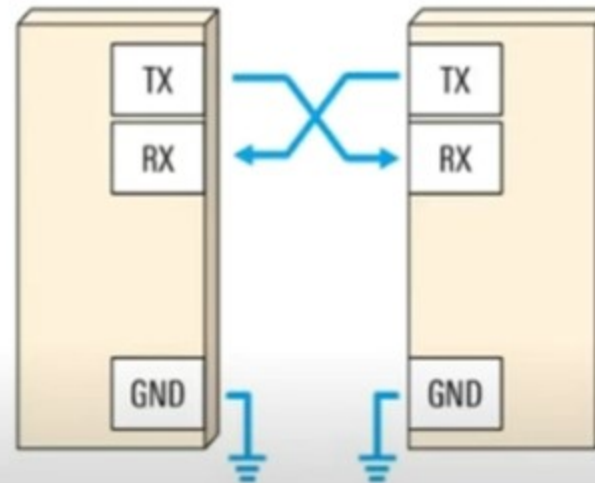
Introduction

- ✓ Universal Asynchronous Receiver-Transmitter
- ✓ Serial Communication Protocol
- ✓ Two Wire Communication Protocol
- ✓ Data Format & Transmission Speed are configurable

UART

What is UART?

- ▶ Universal asynchronous receiver / transmitter
- ▶ Protocol for exchanging serial data between two devices
- ▶ Uses only two wires
 - TX to RX (each direction)
- ▶ Can be simplex, half-duplex, or full-duplex
- ▶ Data is transmitted as frames



UART

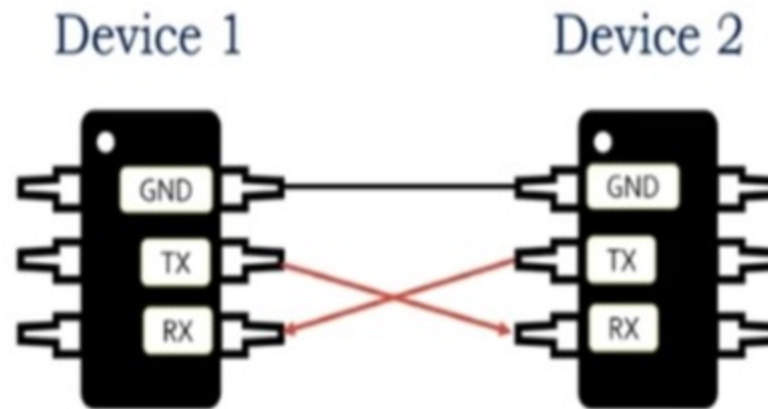
Where is UART used?

- ▶ UART was one of the earliest serial protocols
 - Serial (COM) ports, RS-232, modems, etc.



UART

UART *Connection*

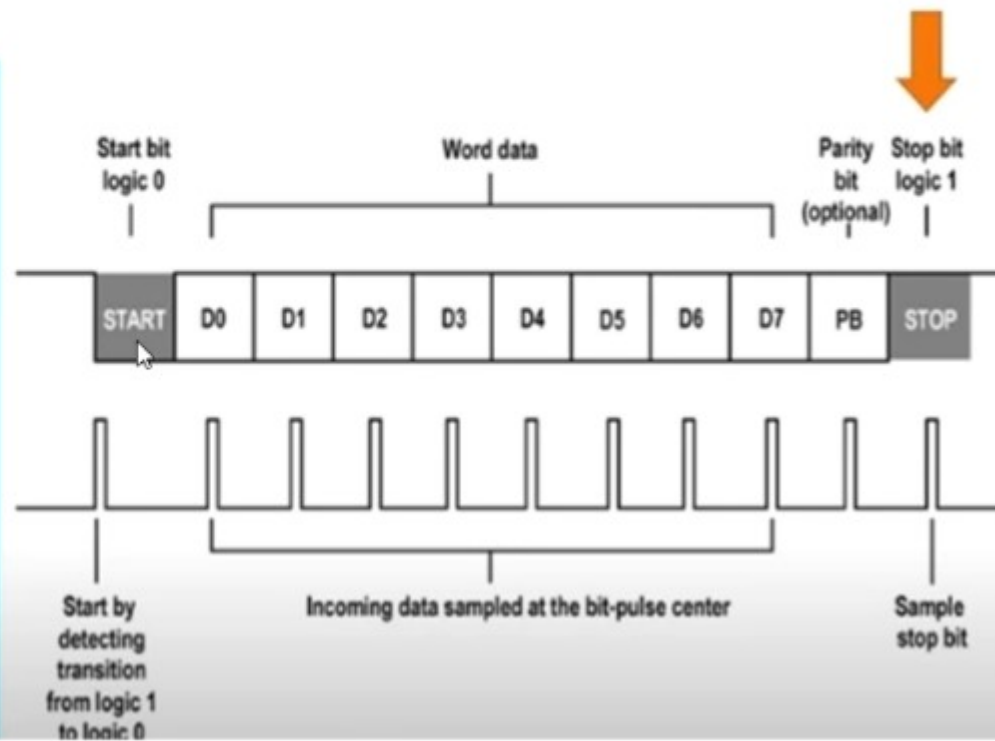


Data Synchronization in UART :

- ✓ Baud rate
- ✓ Start & Stop bit

UART

UART *Framing*



UART

Advantages :

- ✓ Only uses two wires.
- ✓ No clock signal is necessary.
- ✓ Provide error detection by Parity bit check.
- ✓ Cost & size will be much lesser compare to the parallel communication.

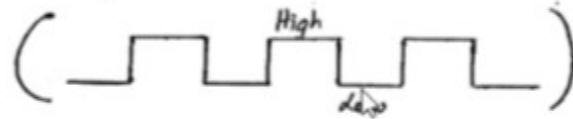
Disadvantages :

- ✓ The size of the data frame is limited to a maximum of 9 bits.
- ✓ Doesn't support multiple slave or multiple master systems.
- ✓ Limited speed is the bottleneck for the application which required higher data transmission rate.

PWM

Pulse width Modulator (PWM):-

- * A pulse width modulator (PWM) generates an op signal that repeatedly switches between high and low values



- * We control the duration of the high value and of the low value by indicating the desired period (T) & the desired duty cycle (D).
- * Duty cycle is defined as the ratio of on time to the total period (ON + off) & is expressed in percentage.

$$\left\{ \begin{array}{c} \text{Square Wave} \end{array} \Rightarrow \% D = \frac{T_{ON}}{T_{ON} + T_{OFF}} \times 100 \right\}$$

PWM

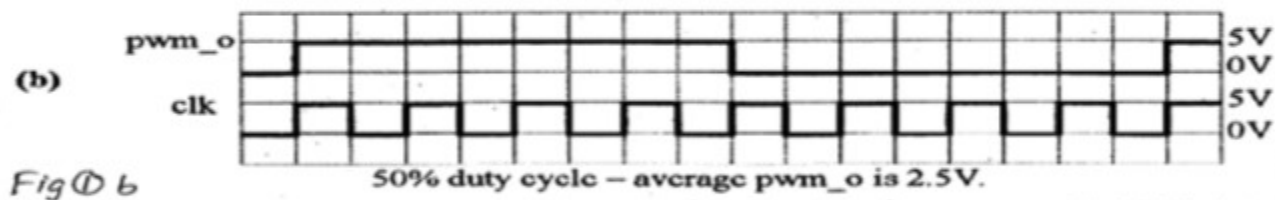
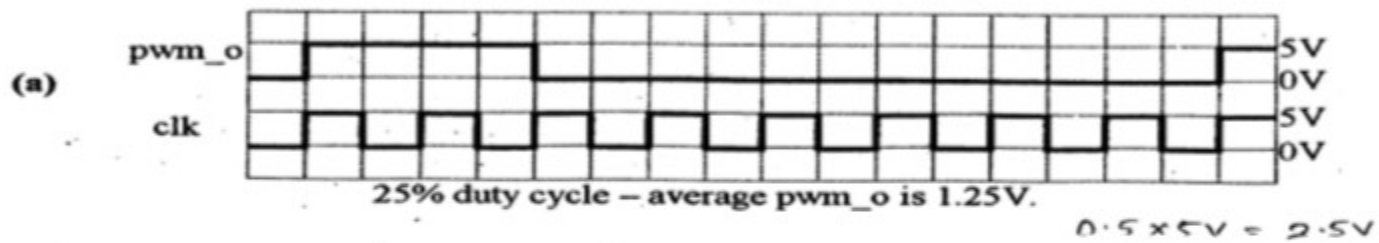


Fig ① b

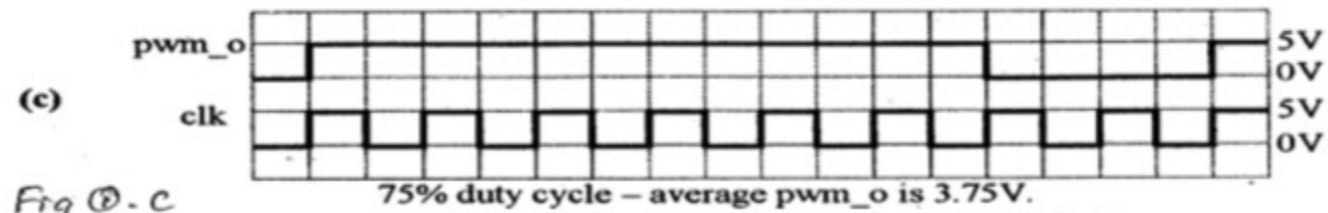


Fig ① c

PWM

Controlling a DC Motor Using a PWM

* The speed of the DC Motor is proportional to the voltage applied to the motor. We must set the duty cycle of a PWM such that the average of voltage equals the desired voltage.

