Manchester Encoding

The Manchester Line Code is a line code that transports both data and timing information on a single serial binary data stream.

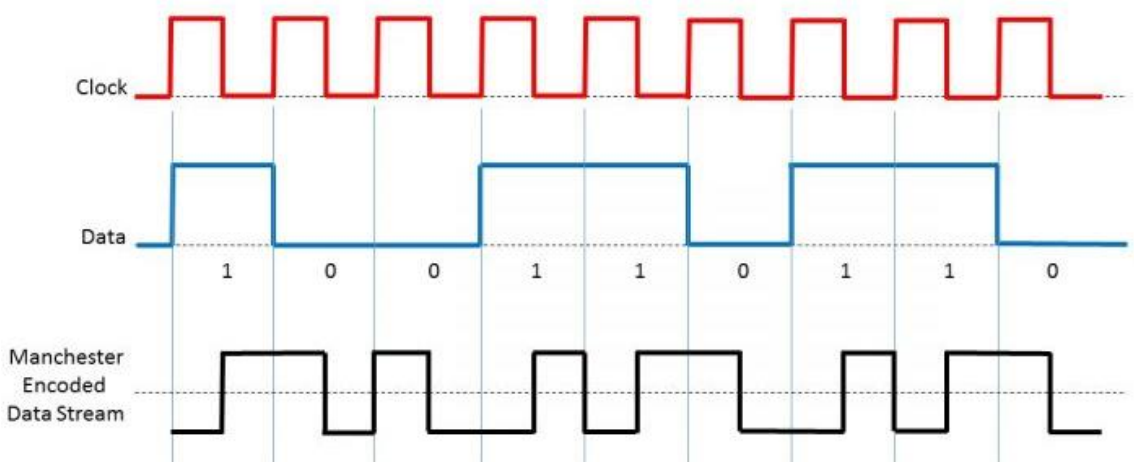
The Manchester Line Code is used in the Physical Layer.

A Manchester Line Encoder works by encoding each data bit to be either low-then-high or high-then-low – for equal amounts of time. Since this encoded data is “high” and “low” for equal times, there is no DC bias within this signal.

More specifically, IEEE 802.3 specifies that a Manchester encoder should encode a “1” bit by setting the output to a logic “low” for the first half of a bit period and then by setting the output to a logic “high” for the second half of this bit period. This encoding scheme requires a rising clock edge at the middle of this bit period.

Conversely, IEEE 802.3 also specifies that a Manchester encoder should encode a “0” bit by setting the output to a logic “high” during the first half of a bit period and then set the output to a logic “low” for the second half of the bit period. This situation requires that a falling clock edge occurs in the middle of this bit period.

Figure 1 presents an illustration of a data stream that is being encoded into the Manchester format. The very top trace is that of a clock signal. The middle signal trace contains the data (that we wish to encode). Finally, the bottom signal trace presents the resulting encoded data.



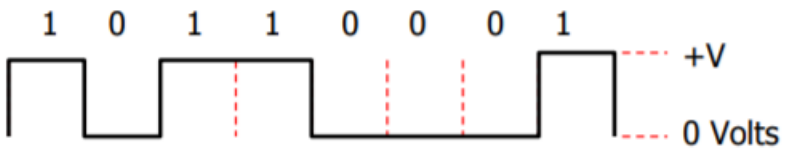
Manchester coding works by exclusive-OR (XOR) the Original Data and the Clock signal as Table 1 presents below.

Original Data		Clock Signal		Manchester Encoded Data
0	+	0	XOR	0
		1		1
1		0		1
		1		0

Where it is used - 10BASE-T (10Mbps Ethernet over Twisted Pair) applications use the Manchester Line Code.

Return-to-Zero (RZ)

- Signal amplitude varies between a positive voltage, i.e. unipolar
- Binary 1: a constant positive voltage
- Binary 0: Absence of voltage (i.e. 0 Volts or Ground)



Non-Return to Zero (NRZ)

Non-return to zero is one of the encoding formats used in digital signals. it is commonly used in slow speed communications interfaces.

Some problem arises while using NRZ to encode a synchronous link which may have long runs of consecutive bits with the same value. In Ethernet for example, there is no control over the number of 1's or 0's which may sent consecutively. There could potentially be thousands of 1's or 0's in sequence. If the encoded data contains long 'runs' of logic 1's or 0's, this does not result in any bit transitions. This is the reason why Manchester coding is used in Ethernet LANs.

There are two variations of NRZ:

Non-return to Zero Level (NRZ-L)

- Two different voltages for 0 and 1 bits
- Negative voltage for one value and positive for the other, eg
    - Binary 0: Positive
    - Binary 1: Negative
- Voltage constant during bit interval
    - no transition i.e. no return to zero voltage

Non-return to Zero Inverted (NRZ-I)

If a 1 occurs at the incoming signal, then there occurs a transition at the beginning of the bit interval. For a 0 at the incoming signal, there is no transition at the beginning of the bit interval.

Non-return to zero inverted on ones
• Constant voltage pulse for duration of bit time
• Data encoded as presence or absence of signal transition at beginning of bit time
    - Transition (low-to-high or high-to-low) denotes a binary 1
    - No transition denotes binary 0
• NRZI is an example of differential encoding