Data transmission - Digital data transmission

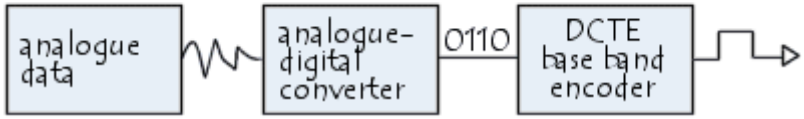
Introduction to digital transmission

Digital transmission is the sending of information over a physical communications media in the form of digital signals. Analogue signals must therefore be digitised first before being transmitted.

However, as digital information cannot be sent directly in the form of 0s and 1s, it must be encoded in the form of a signal with two states, for example:

- two voltage levels with respect to earth
- the difference in voltage between two wires
- the presence/absence of current in a wire
- the presence/absence of light
- ...

This transformation of binary information into a two-state signal is done by theDCE, also known as the *base band decoder*, which is the origin of the name*base band transmission* to designate digital transmission...



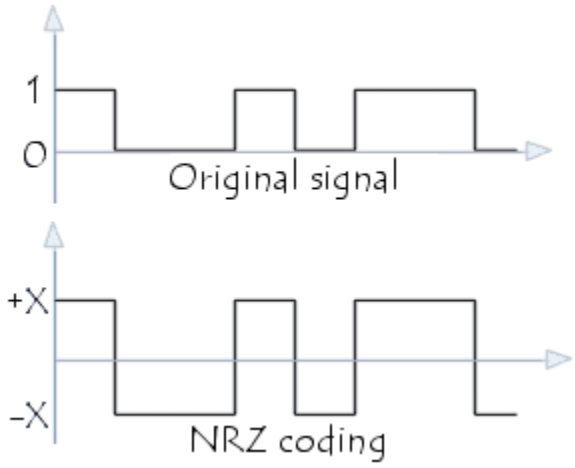
Signal encoding

To optimize transmission, the signal must be encoded to facilitate its transmission on the physical medium. There are various encoding systems for this purpose which can be divided into two categories:

- Two-level encoding: the signal can only take on a strictly negative or strictly positive value (-X or +X, where X represents a value of the physical quantity being used to transport the signal)
- Three-level encoding: the signal can take on a strictly negative, null or strictly positive value (-X, 0 or +X)

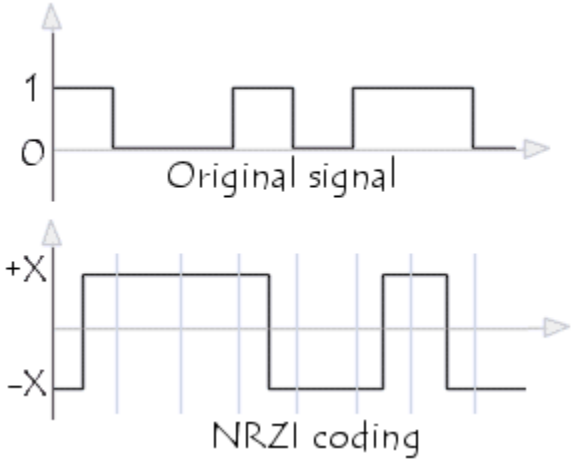
NRZ Encoding

NRZ encoding (meaning *No Return to Zero*), is the first encoding system, and also the simplest. It consists of simply transforming the 0s into -X and the 1s into +X, which results in a bipolar encoding in which the signal is never null. As a result, the receiver can determine whether a signal is present or not.



NRZI Encoding

NRZI encoding is significantly different from NRZ encoding. With this encoding, when the bit value is 1, the signal changes state after the clock tick. When the bit value is 0, the signal does not change state.



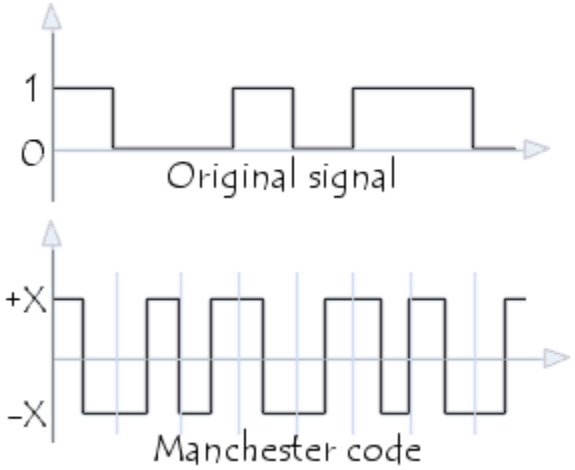
NRZI encoding has numerous advantages, including:

- Detection of whether a signal is present or not
- The need for a low signal transmission current

However, it does have one problem: the presence of continuous current during a sequence of zeros, which disturbs the synchronization between transmitter and receiver.

Manchester Encoding

Manchester encoding, also called *biphase encoding* or *PE* (for *Phase Encode*), introduces a transition in the middle of each interval. In fact, it amounts to performing an exclusive OR (XOR) of the signal with the clock signal, which translates into a raising edge when the bit value is zero and a falling edge in the opposite case.

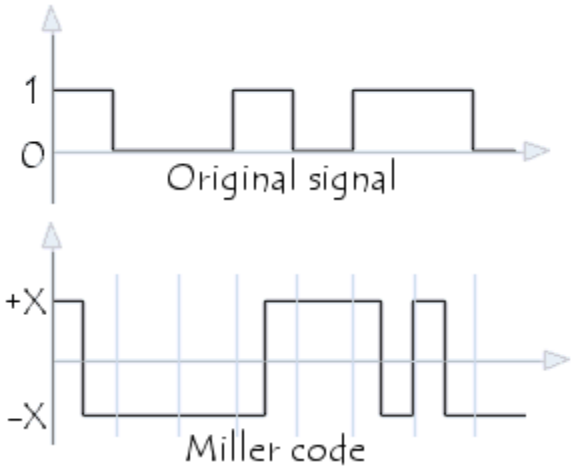


Manchester encoding has numerous advantages, including:

- as it does not take on a zero value, it is possible for the receiver to detect a signal
- a spectrum occupying a wide band

Delay Encoding (by Miller)

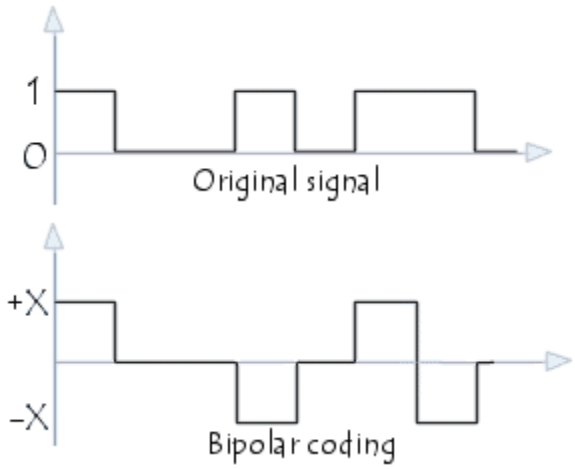
Delay encoding, also called *Miller encoding*, is similar to Manchester encoding, except that a transition occurs in the middle of an interval only when the bit is 1, which allows higher data rates...



Bipolar encoding

Bipolar encoding is a three-level encoding. It therefore uses three states of the quantity transported on the physical medium:

- The value *0* when the bit value is 0
- Alternatively X and -X when the bit value is 1



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