Properties of Line Codes

DC Component:

Eliminating the dc energy from the single power spectrum enables the transmitter to be ac coupled. Magnetic recording system or system using

transformer coupling are less sensitive to low frequency signal components. Low frequency component may lost, if the presence of dc or near dc spectral component is significant in the code itself.

Self synchronization

Any digital communication system requires bit synchronization. Coherent detector requires carrier synchronization.

For example Manchester code has a transition at the middle of every bit interval irrespective of whether a 1 or 0 is being sent This guaranteed transmitter provide a clocking signal at the bit level.

Error detection

Some codes such as duo binary provide the means of detecting data error without introducing additional error detection bits into the data sequence.

Band width compression:

Some codes such as multilevel codes increase the efficiency of the bandwidth utilization by allowing a reduction in required bandwidth for a given data rate, thus more information transmitted per unit band width.

DIFFERENTIAL ENCODING

This technique is useful because it allow the polarity of differentially encoded waveform to be inverted without affecting the data detection. In communication system where waveform to be inverted having great advantage.

NOISE IMMUNITY

For same transmitted energy some codes produces lesser bit detection error than other in the presence of noise. For ex. The NRZ waveforms have better noise performance than the RZ type.

SPECTRAL COMPATABILITY WITH CHANNEL:

On aspect of spectrum matching is dc coupling. Also transmission bandwidth of the code musts is sufficient small compared to channel bandwidth so that ISI is not problem.

TRANSPARENCY

A line doe should be so designed that the receiver does not go out of synchronization for any line sequence of data symbol. A code is not transparent if for some sequence of symbol, the clock is lost.

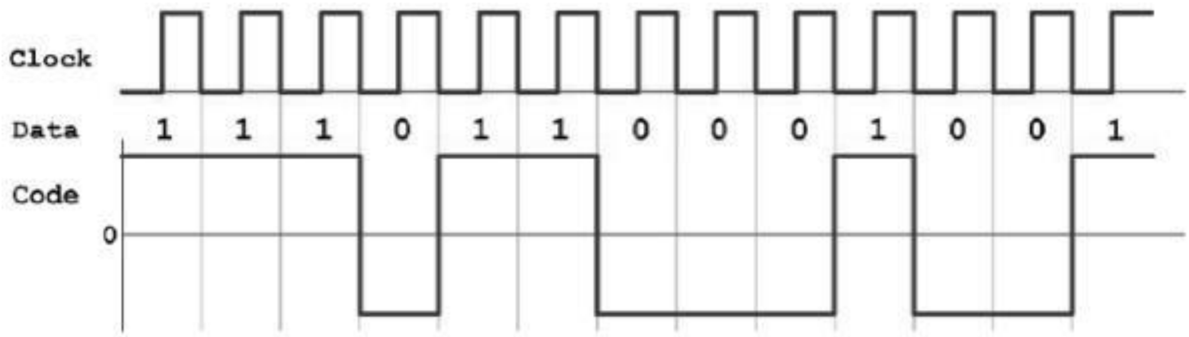
Power spectral density of unipolar NRZ line code

Line coding:

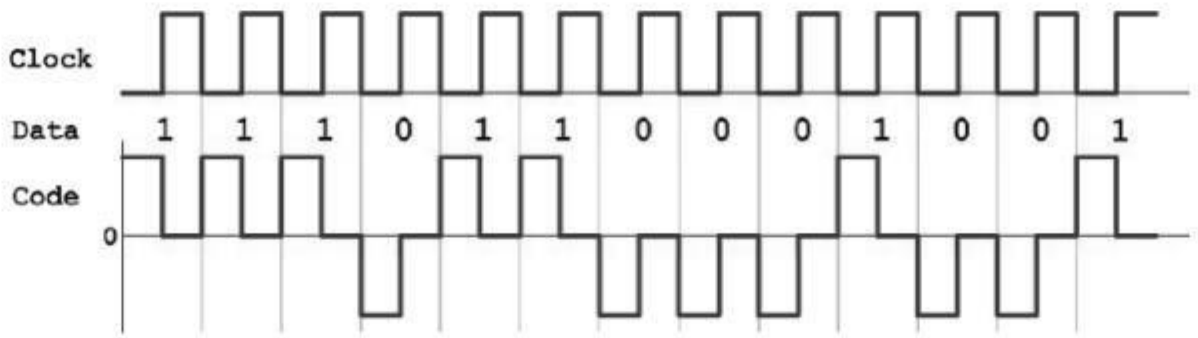
Line coding refers to the process of representing the bit stream (**1**s and **0**s) in the form of voltage or current variations optimally tuned for the specific properties of the physical channel being used. The selection of a proper line code can help in so many ways: One possibility is to aid in clock recovery at the receiver. A clock signal is recovered by observing transitions in the received bit sequence, and if enough transitions exist, a good recovery of the clock is guaranteed, and the signal is said to be **self-clocking**.

Another advantage is to get rid of DC shifts. The DC component in a line code is called the *bias* or the *DC coefficient*. Unfortunately, most long-distance communication channels cannot transport a DC component. This is why most line codes try to eliminate the DC component before being transmitted on the channel. Such codes are called *DC balanced*, *zero-DC*, *zero-bias*, or *DC equalized*. Some common types of line encoding in common-use nowadays are unipolar, polar, bipolar, Manchester, MLT-3 and Duo binary encoding. These codes are explained here: **1. Unipolar**(Unipolar **NRZ** and Unipolar **RZ**):

Unipolar is the simplest line coding scheme possible. It has the advantage of being compatible with TTL logic. Unipolar coding uses a positive rectangular pulse *p*(*t*) to represent binary **1**, and the absence of a pulse (i.e., zero voltage) to represent a binary **0**. Two possibilities for the pulse*p*(*t*) exist3: Non-Return-to-Zero (NRZ) rectangular pulse and Return-to-Zero (RZ) rectangular pulse. The difference between Unipolar NRZ and Unipolar RZ codes is that the rectangular pulse in NRZ stays at a positive value (e.g., +5V) for the full duration of the logic **1** bit, while the pule in RZ drops from +5V to 0V in the middle of the bit time. A drawback of unipolar (RZ and NRZ) is that its average value is not zero, which means it creates a significant DC-component at the receiver (see the impulse at zero frequency in the corresponding power spectral density (PSD) of this line code.



Polar NRZ Code

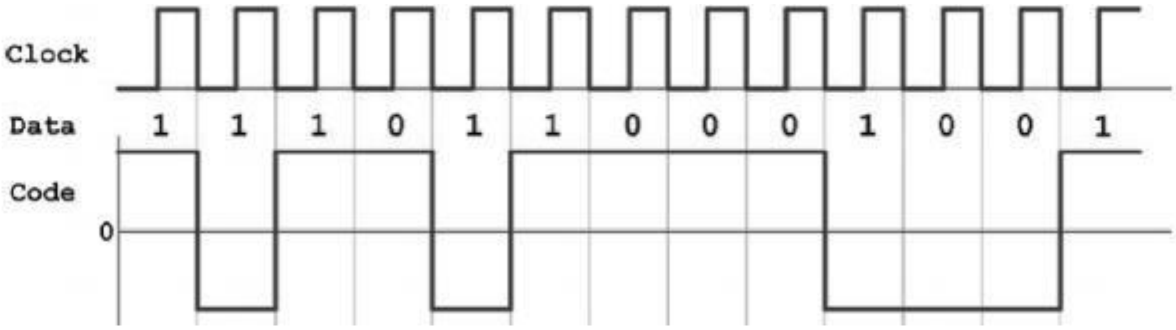


Polar RZ Code

(Source:Studytronics)

that polar signals have more power than unipolar signals, and hence have better SNR at the receiver. Actually, polar NRZ signals have more power compared to polar RZ signals. The drawback of polar NRZ, however, is that it lacks clock information especially when a long sequence of **0**‟s or **1**‟s is transmitted.

Non-Return-to-Zero, Inverted (NRZI): NRZI is a variant of Polar NRZ. In NRZI there are two possible pulses, $p(t)$ and $-p(t)$. A transition from one pulse to the other happens if the bit being transmitted is logic **1**, and no transition happens if the bit being transmitted is a logic **0**.

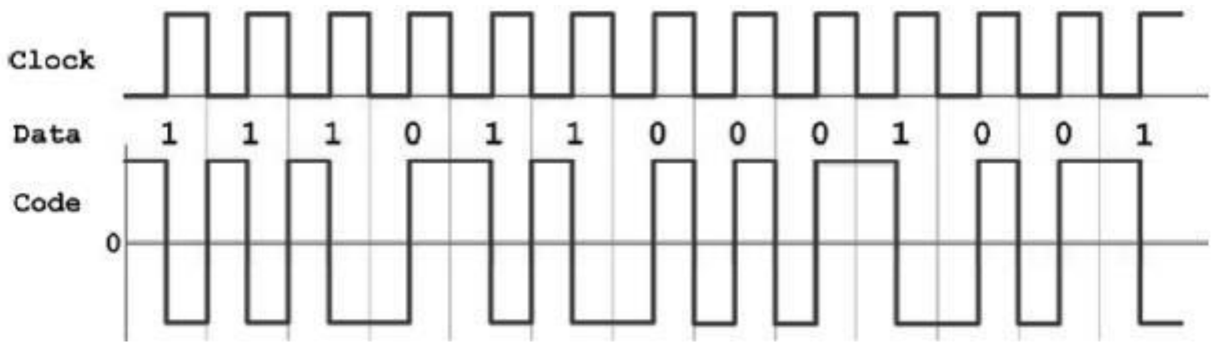


(Source:Studytronics)

This is the code used on compact discs (CD), USB ports, and on fiber-based Fast Ethernet at 100-Mbit/s.

Manchester encoding

In Manchester code each bit of data is signified by at least one transition. Manchester encoding is therefore considered to be self-clocking, which means that accurate clock recovery from a data stream is possible. In addition, the DC component of the encoded signal is zero. Although transitions allow the signal to be self-clocking, it carries significant overhead as there is a need for essentially twice the bandwidth of a simple NRZ or NRZI encoding.



(Source:Studytronics)

The power spectral density of polar signaling