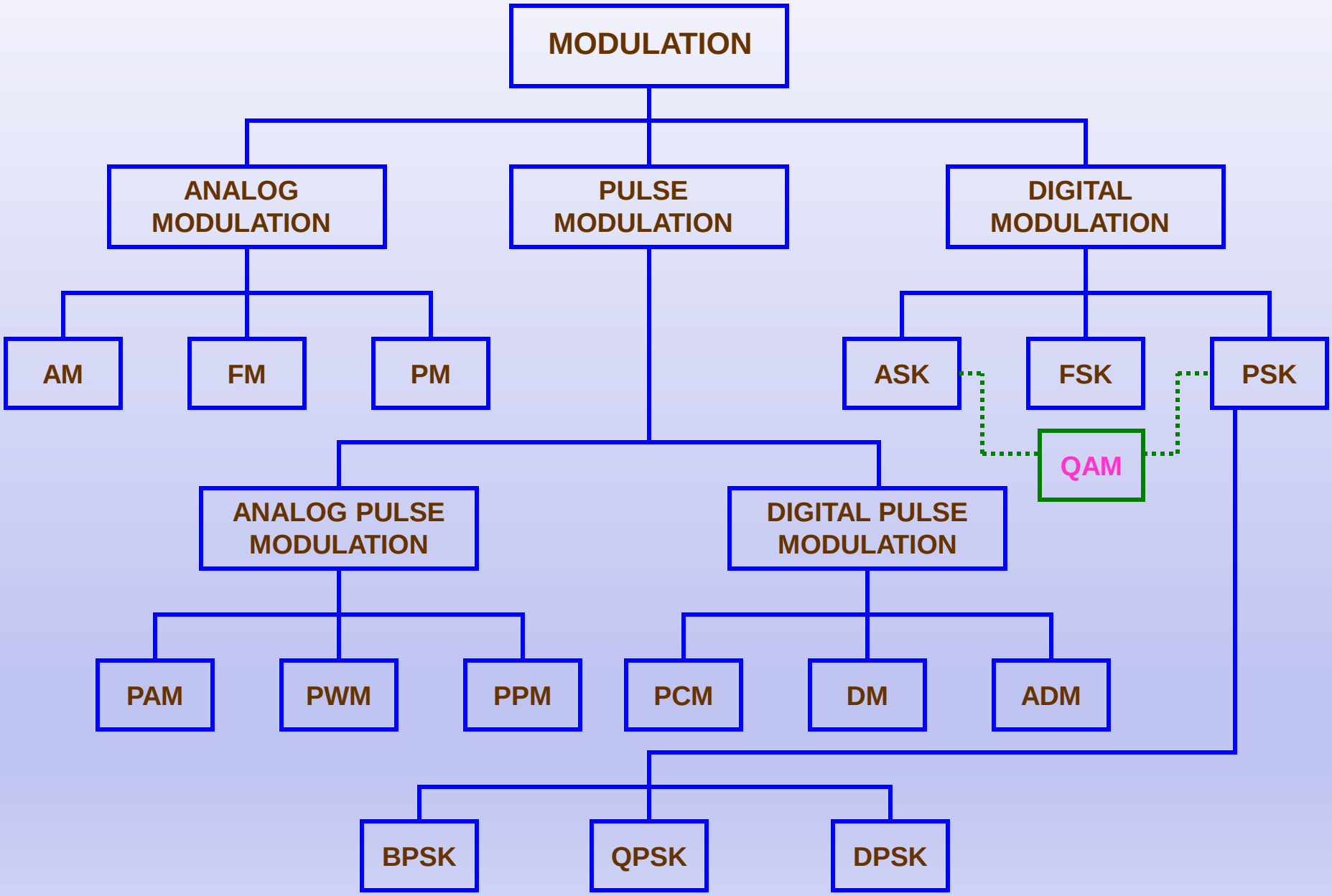
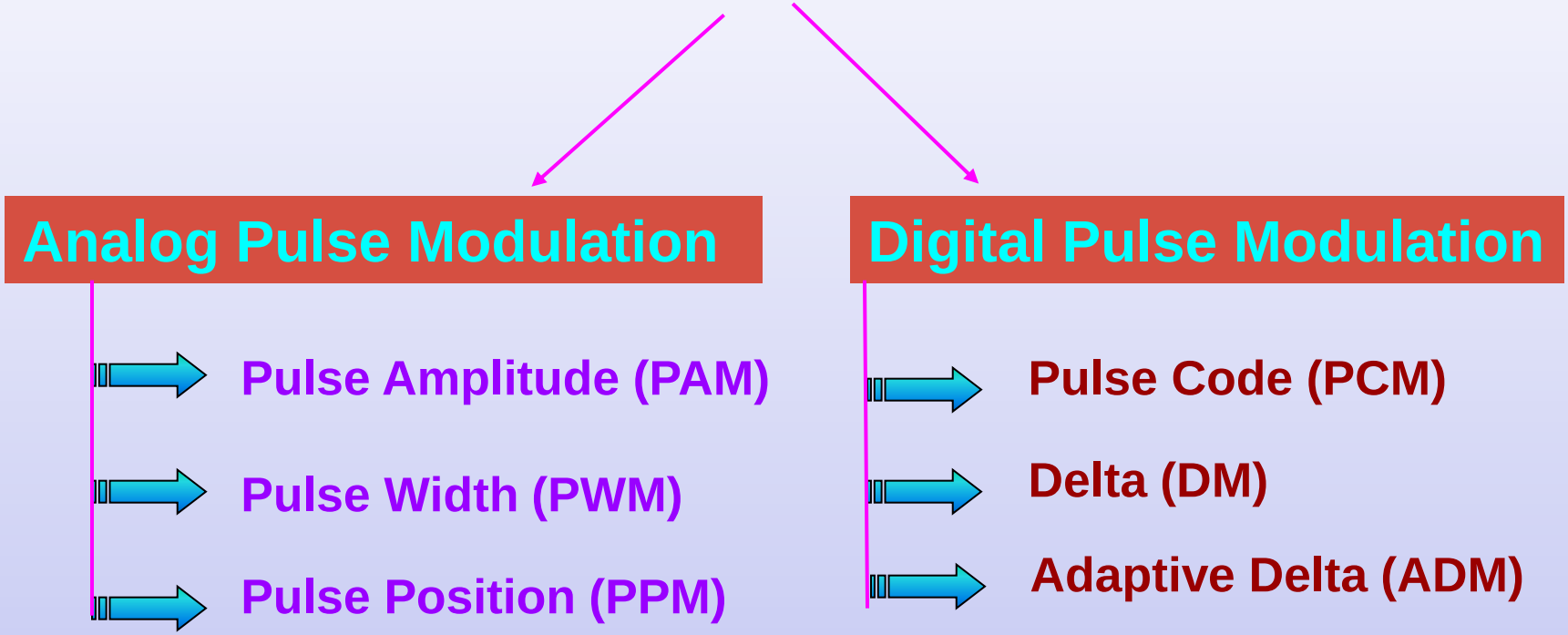
TYPES OF MODULATION



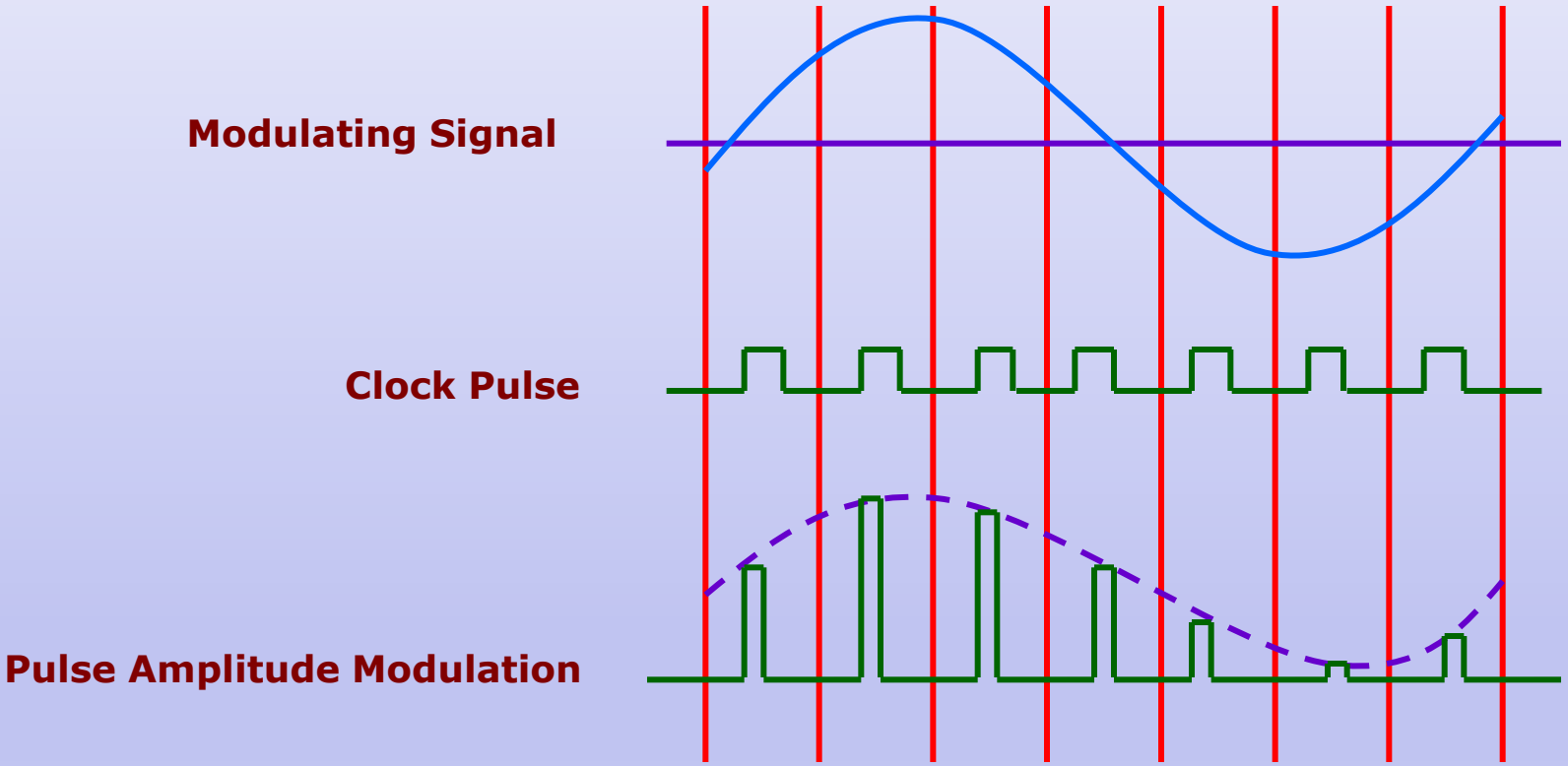
Pulse Modulation



PULSE AMPLITUDE MODULATION

- In pulse amplitude modulation the amplitude of each pulse is made proportional to the instantaneous amplitude of the modulating signal.
- The time duration of each pulse may be quite short and the time interval between pulses may be relatively long.
- If a radio frequency is pulse amplitude modulated instead of simply being amplitude modulated, much less power is required for the transmission of information because the transmitter is actually switched off between pulses.
- This is one advantage of pulse amplitude modulation.

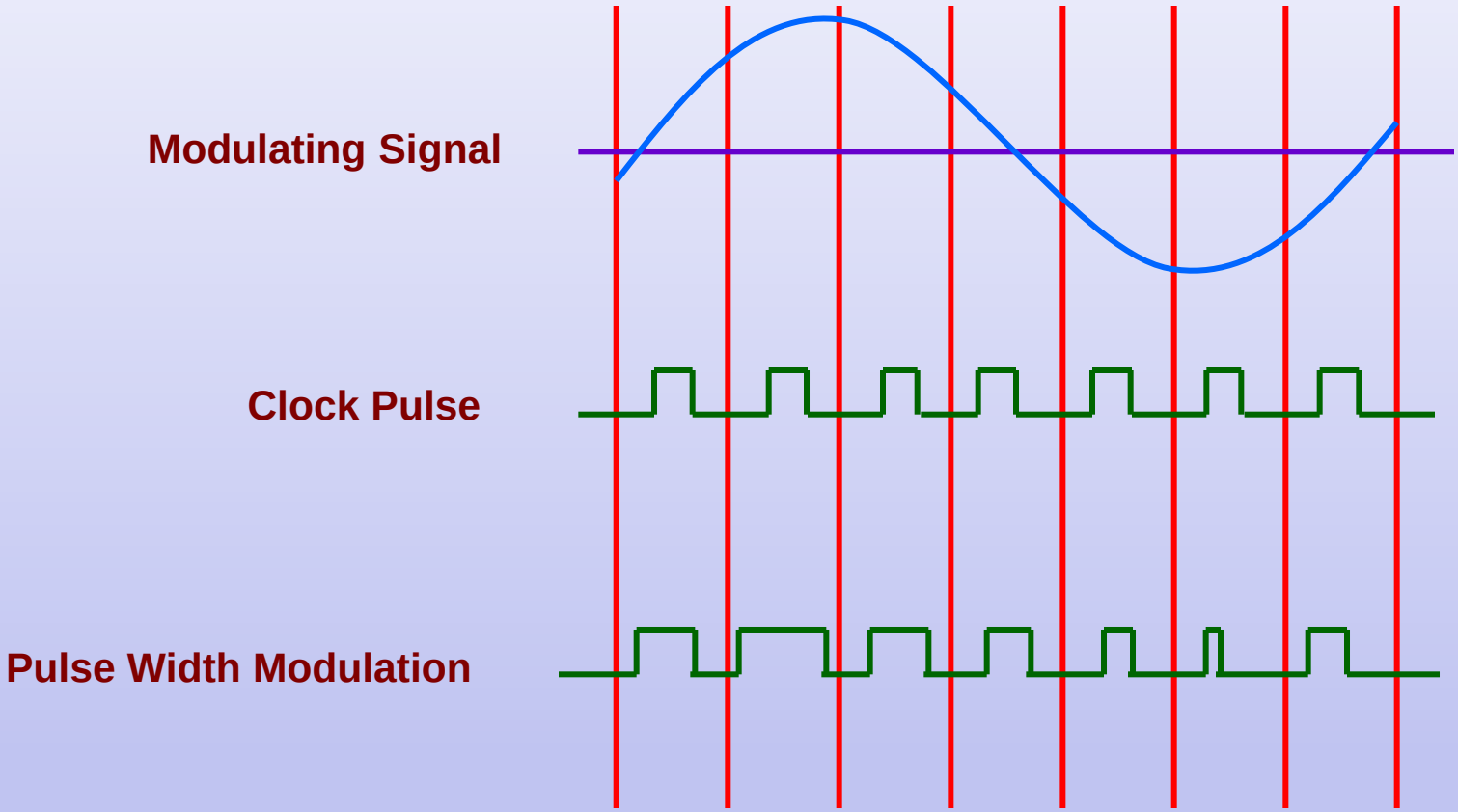
PULSE AMPLITUDE MODULATION WAVEFORM



PULSE WIDTH MODULATION

- **Pulse duration modulation also termed pulse width modulation, the pulses have a constant amplitude and a variable time duration.**
- **The time elevation of each pulse is proportional to the instantaneous amplitude of the modulating signal. In this case the narrowest pulse represents the largest –ve sample of the original signal, and the widest pulse represents the largest +ve sample.**
- **When PDM applied to radio transmission, the carrier frequency has a constant amplitude and the transmitter On-times is carefully controlled.**

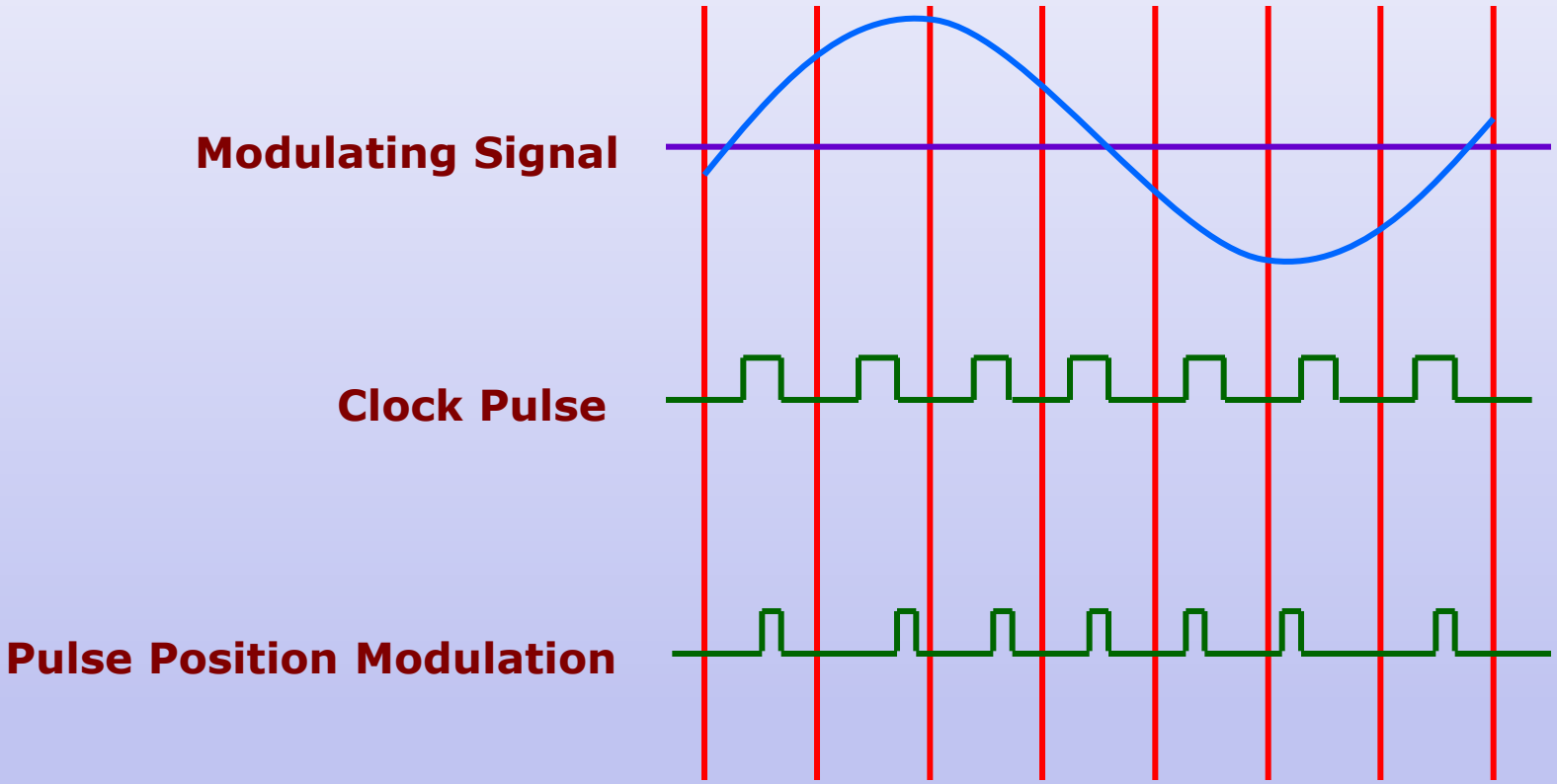
PULSE WIDTH MODULATION WAVEFORM



PULSE POSITION MODULATION

- In PPM, all pulses have the same constant amplitude and narrow pulse width.
- The position in time of the pulses is made to vary in proportion to the amplitude of the modulating signal.
- The pulse near the right side of the sampling time period represent the largest positive signal sample, and those toward the left side correspond to the most –ve sample of the original signal.
- PPM uses less power than PDM and essentially, have all advantages of PDM.
- One disadvantage of PPM is that the demodulation process to recover the original signal is more difficult than PPM.

PULSE POSITION MODULATION WAVEFORM



PULSE CODE MODULATION

- Pulse code modulation is the most complicated type of pulse modulation. However it can be the most accurate and the most efficient of the other methods.
- In certain circumstances, it may be the only type of pulse modulation that can be employed. In PCM each amplitude sample of the signal is converted from an analog to a digital signal.
- The sample amplitude is then represented by a group of pulses, the presence of pulse indicating 1, and the absence of a pulse indicating 0. The accuracy can be improved by increasing the number of bits, employed.

Pulse Code Modulation (PCM):

* Analog signal is converted into digital signal by using a digital code.

* Analog to digital converter employs two techniques:

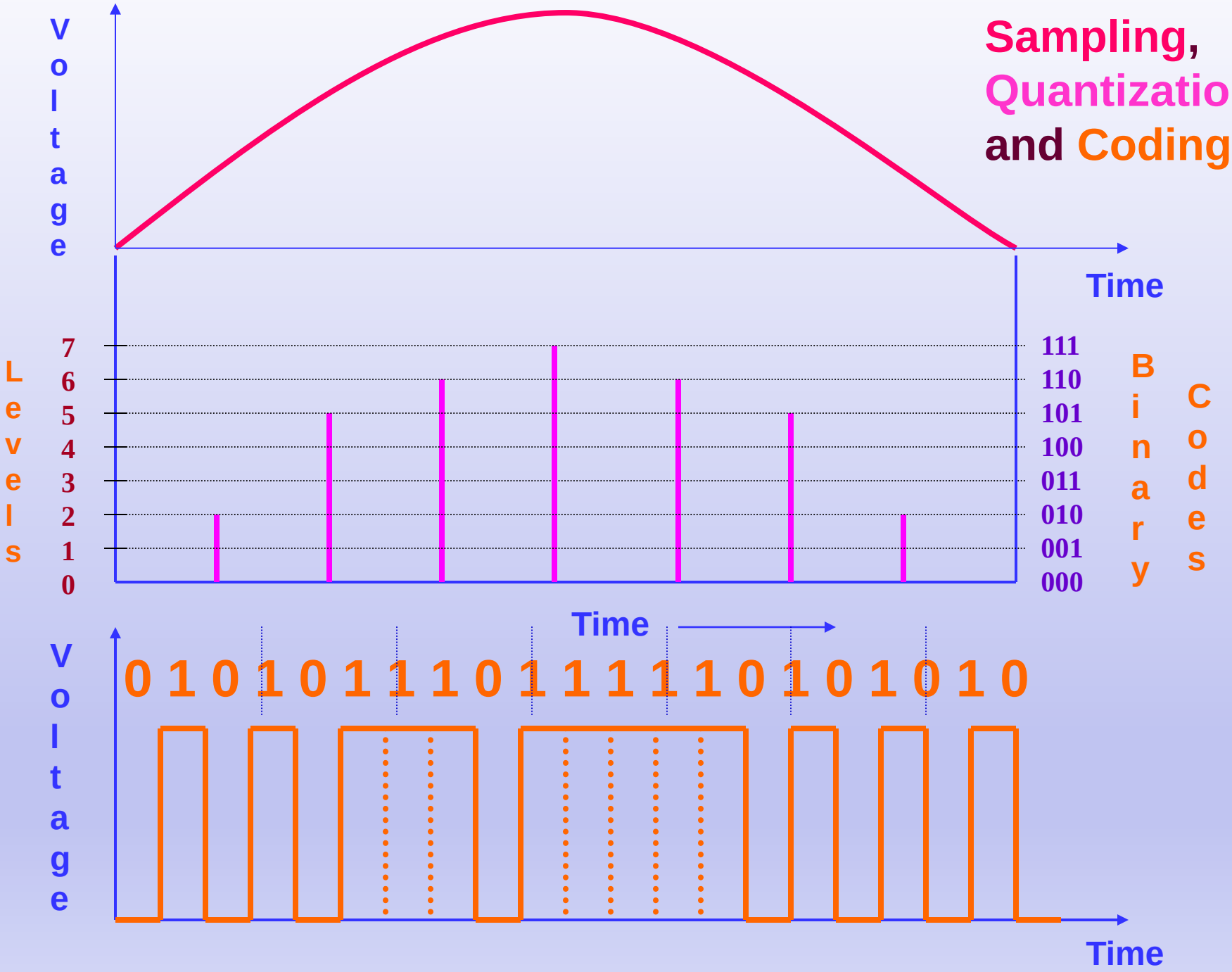
1. Sampling: The process of generating pulses of zero width and of amplitude equal to the instantaneous amplitude of the analog signal. The no. of pulses per second is called "sampling rate".

2. Quantization: The process of dividing the maximum value of the analog signal into a fixed no. of levels in order to convert the PAM into a Binary Code.

The levels obtained are called "quanization levels".



Sampling, Quantization and Coding



DELTA MODULATION

- **DM is the simplest method for converting analog to digital form.**
- The transmitter and receiver implementation are very simple for data modulation.
- It is a cost-effective technique and can be used if financial problems there.
- Delta modulation transmits only one bit for one sample, therefore the signaling rate and transmission channel bandwidth is quite small for the delta modulation as compared to the pulse code modulation.
- It requires less number of quantization.

Advantages of delta modulation:

- The transmitter and receiver implementation are very simple for data modulation.
- It is a cost-effective technique and can be used if financial problems there.
- Delta modulation transmits only one bit for one sample, therefore the signaling rate and transmission channel bandwidth is quite small for the delta modulation as compared to the pulse code modulation.
- It requires less number of quantization.

ADAPTIVE DELTA MODULATION

- **It is the modification of DM in which the step size is not kept constant.**
- **In Delta Modulation step size is fixed for the whole signal. Whereas in Adaptive delta modulation, the step size varies depending upon the input signal**

Thank you