

## **Introduction:**

All communication systems involve three main subsystems: the transmitter, the channel and the receiver. The channel medium in general attenuates the signal and as a result the noise level of the channel and the noise of the receiver will cause errors at the receiver. Here comes the task of the engineers to design communication systems with the least possible errors while satisfying design constraints, such as allowable transmitted energy, allowable signal bandwidth and cost. To optimize the performance of the communication systems, channel coding is used. The term channel coding is the techniques performed on the information bearing digital signal, which requires the use of redundancy to detect and possibly correct errors. The main techniques of channel coding are: automatic repeat request (ARQ) and forward error correction (FEC).

The effectiveness of a communication system is measured using different criteria such as, cost, channel bandwidth used, required transmitter power, signal to noise ratio, and time delay. In digital systems, the optimum system might be defined as the system that minimizes the probability of bit error at the system output subject to constraints on transmitted energy and channel bandwidth.

One of the most efficient FEC techniques is the convolutional encoding and Viterbi decoding. Convolutional codes operate on serial data, one or few bits at a time, they are usually described by the code rate and the constraints length. The code rate,  $k/n$ , is expressed as a ratio of the number of bits into the convolutional encoder ( $k$ ) to the number of channel symbols output by the convolutional encoder ( $n$ ). Which gives a bandwidth expansion of  $n/k$ . The constraint length parameter is the length of the convolutional encoder.

Viterbi decoding is an algorithm used with convolutional coding when fixed decoding time is needed. But its computational requirements grow exponentially as a function of the constraint length, so it is usually limited in practice to constraint length of  $K=9$  or less. The advantage of using the Viterbi decoding with the convolutional codes is the significant saving in the energy.