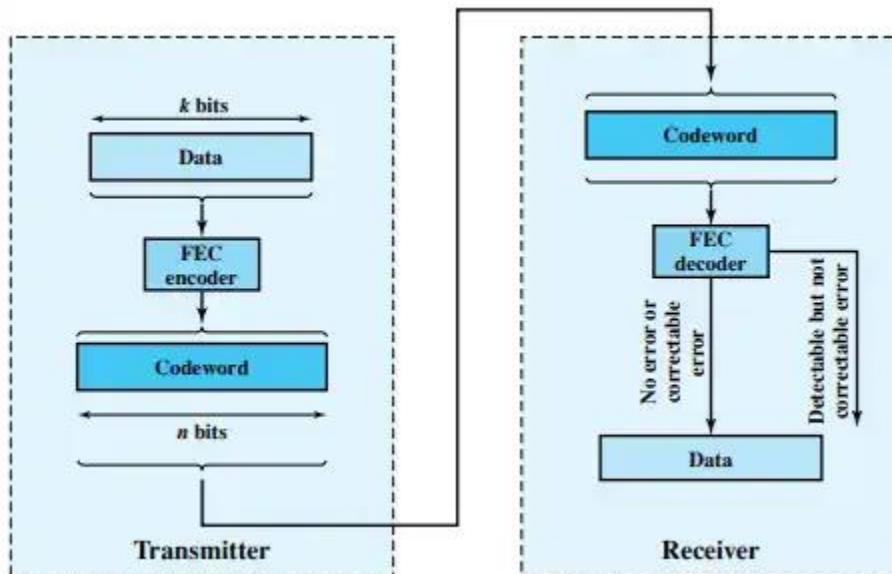


Error Correction

Error detection is a useful technique, found in data link control protocols, such as HDLC, and in transport protocols, such as TCP. However, correction of errors using an error-detecting code, requires that block of data be retransmitted. For wireless applications this approach is inadequate for two reasons.

1. The bit error rate on a wireless link can be quite high, which would result in a large number of retransmissions.
2. In some cases, especially satellite links, the propagation delay is very long compared to the transmission time of a single frame.

The result is a very inefficient system. the common approach to retransmission is to retransmit the frame in error plus all subsequent frames. With a long data link, an error in a single frame necessitates retransmitting many frames. Instead, it would be desirable to enable the receiver to correct errors in an incoming transmission on the basis of the bits in that transmission.



mapped into an n -bit block called a codeword, using an FEC (forward error correction) encoder. The codeword is then transmitted. During transmission, the signal is subject to impairments, which may produce bit errors in the signal. At the receiver, the incoming signal is demodulated to produce a bit string that is similar to the original codeword but may contain errors. This block is passed through an FEC decoder, with one of four possible outcomes:

1. If there are no bit errors, the input to the FEC decoder is identical to the original codeword, and the decoder produces the original data block as output.
2. For certain error patterns, it is possible for the decoder to detect and correct those errors. Thus, even though the incoming data block differs from the transmitted codeword, the FEC decoder is able to map this block into the original data block.

3. For certain error patterns, the decoder can detect but not correct the errors. In this case, the decoder simply reports an uncorrectable error. 4. For certain, typically rare, error patterns, the decoder does not detect that any errors have occurred and maps the incoming n -bit data block into a k -bit block that differs from the original k -bit block.

How is it possible for the decoder to correct bit errors? In essence, error correction works by adding redundancy to the transmitted message. The redundancy makes it possible for the receiver to deduce what the original message was, even in the face of a certain level of error rate. In this section we look at a widely used form of error-correcting code known as a block error-correcting code. Our discussion only deals with basic principles; a discussion of specific error-correcting codes is beyond our scope.

Before proceeding, we note that in many cases, the error-correcting code follows the same general layout as shown for error-detecting codes. That is, the FEC algorithm takes as input a k -bit block and adds check bits to that block to produce an n -bit block; all of the bits in the original k -bit block show up in the n -bit block. For some FEC algorithms, the FEC algorithm maps the k -bit input into an n -bit codeword in such a way that the original k bits do not appear in the codeword.