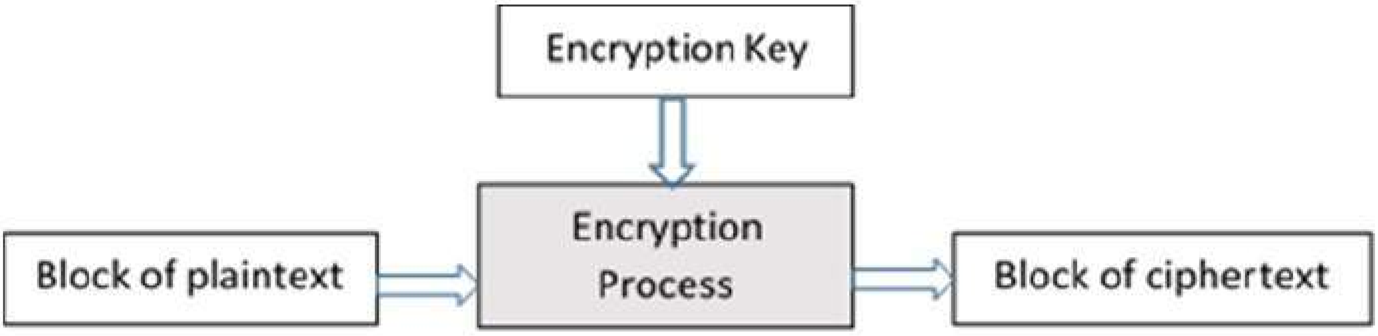


The basic scheme of a block cipher is depicted as follows −



A block cipher takes a block of plaintext bits and generates a block of ciphertext bits, generally of same size. The size of block is fixed in the given scheme. The choice of block size does not directly affect to the strength of encryption scheme. The strength of cipher depends up on the key length.

Block Size

Though any size of block is acceptable, following aspects are borne in mind while selecting a size of a block.

- **Avoid very small block size** − Say a block size is m bits. Then the possible plaintext bits combinations are then 2^m. If the attacker discovers the plain text blocks corresponding to some previously sent ciphertext blocks, then the attacker can launch a type of 'dictionary attack' by building up a dictionary of plaintext/ciphertext pairs sent using that encryption key. A larger block size makes attack harder as the dictionary needs to be larger.

- **Do not have very large block size** − With very large block size, the cipher becomes inefficient to operate. Such plaintexts will need to be padded before being encrypted.

- **Multiples of 8 bit** − A preferred block size is a multiple of 8 as it is easy for implementation as most computer processor handle data in multiple of 8 bits.

Padding in Block Cipher

Block ciphers process blocks of fixed sizes $say 64 bits$. The length of plaintexts is mostly not a multiple of the block size. For example, a 150-bit plaintext provides two blocks of 64 bits each with third block of balance 22 bits. The last block of bits needs to be padded up with redundant information so that the length of the final block equal to block size of the scheme. In our example, the remaining 22 bits need to have additional 42 redundant bits added to provide a complete block. The process of adding bits to the last block is referred to as **padding**.

Too much padding makes the system inefficient. Also, padding may render the system insecure at times, if the padding is done with same bits always.

Block Cipher Schemes

There is a vast number of block ciphers schemes that are in use. Many of them are publically known. Most popular and prominent block ciphers are listed below.

- **Digital Encryption Standard** DES − The popular block cipher of the 1990s. It is now considered as a 'broken' block cipher, due primarily to its small key size.

- **Triple DES** − It is a variant scheme based on repeated DES applications. It is still a respected block ciphers but inefficient compared to the new faster block ciphers available.

- **Advanced Encryption Standard** AES − It is a relatively new block cipher based on the encryption algorithm **Rijndael** that won the AES design competition.

- **IDEA** − It is a sufficiently strong block cipher with a block size of 64 and a key size of 128 bits. A number of applications use IDEA encryption, including early versions of Pretty Good Privacy PGP protocol. The use of IDEA scheme has a restricted adoption due to patent issues.

- **Twofish** − This scheme of block cipher uses block size of 128 bits and a key of variable length. It was one of the AES finalists. It is based on the earlier block cipher Blowfish with a block size of 64 bits.

- **Serpent** − A block cipher with a block size of 128 bits and key lengths of 128, 192, or 256 bits, which was also an AES competition finalist. It is a slower but has more secure design than other block cipher.

In the next sections, we will first discuss the model of block cipher followed by DES and AES, two of the most influential modern block ciphers.