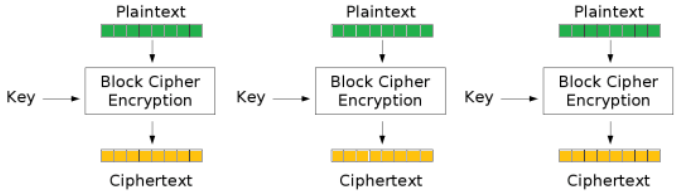
Encryption Modes of Operation

COMP620

Electronic codebook (ECB) Mode

- Data are divided into blocks which are encrypted separately.

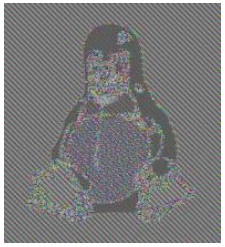


Electronic Codebook (ECB) mode encryption

Difficulties with Block Encryption

- Two identical blocks of plaintext will be encrypted to two identical blocks of cipher text

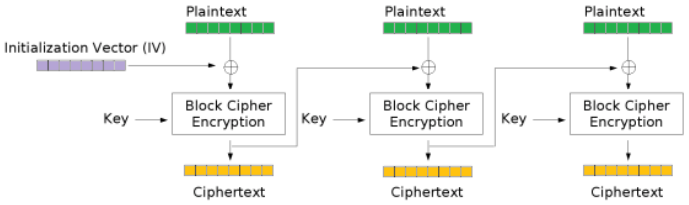
original image



encrypted with ECB

Cipher-block Chaining (CBC) Mode

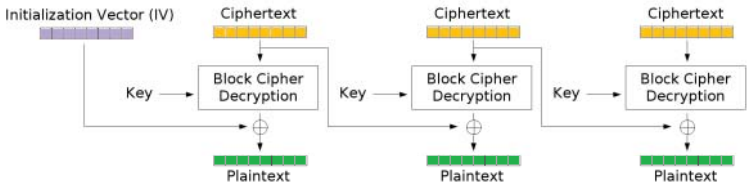
- Each block of ciphertext is XOR with the next block of plaintext before encryption.
- Note that a one-bit change in a plaintext block affects all following ciphertext blocks



Cipher Block Chaining (CBC) mode encryption

Cipher-block Chaining Decryption

Decryption requires only the previous block of ciphertext, so it can be parallelized



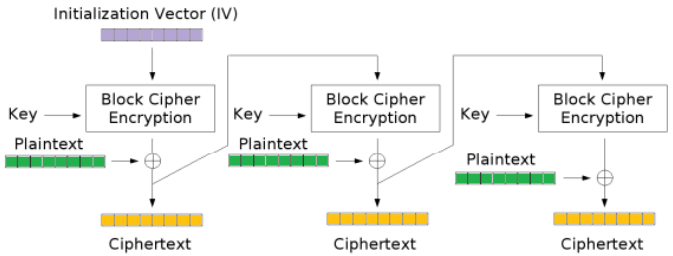
Cipher Block Chaining (CBC) mode decryption

Initialization Vector

- The initialization vector (IV) is like dummy ciphertext to start the process
- The IV does not have to be secret
- The IV should be a random value
- By using a different IV every time you encrypt a message, identical messages will encrypt to different ciphertext
- The IV should be protected with a MAC to maintain message integrity

Cipher Feedback (CFB) Mode

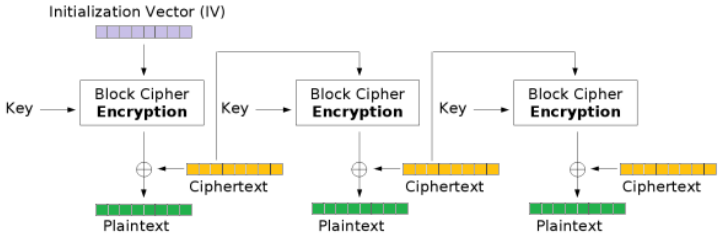
- The IV is encrypted to create a "random" stream of bits that are XOR with the plaintext



Cipher Feedback (CFB) mode encryption

Cipher Feedback Decryption

- CFB decryption uses the encryption algorithm, not the decryption algorithm



Cipher Feedback (CFB) mode decryption

And More

- There are several other encryption modes that are used.
- The initialization vector needs to be kept with the ciphertext.
- Adding the IV makes the ciphertext a little larger than the plaintext. This could be a problem in some situations.