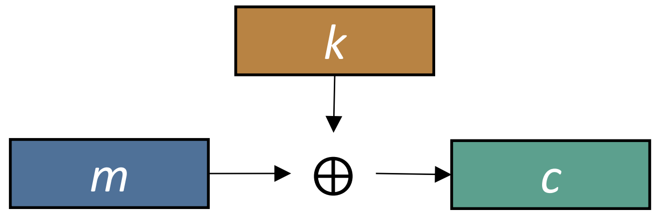
Perfect secrecy

Vernam Cipher (1917)

Encryption: $c = k \oplus m$
Decryption: $m = k \oplus c$



The key *k*:
- is as long as the plaintext *m* and the ciphertext *c*
- is uniformly random chosen in $\mathcal{K}$

$$\begin{array}{rl} k: & 0\,1\,1\,0\,1\,1\,0\,0 \oplus \\ m: & 1\,0\,1\,1\,1\,0\,0\,1 \\ \hline c: & 1\,1\,0\,1\,0\,1\,0\,1 \end{array}$$

$$\begin{array}{rl} k: & \mathtt{B\ V\ Q\ G\ F\ B} \oplus \\ m: & \mathtt{N\ O\ T\ I\ M\ E}\ (\mathrm{mod}\ 26) \\ \hline c: & \mathtt{P\ K\ K\ P\ S\ G} \end{array}$$

Multiple use of the same key k

$c_1 = k \oplus m_1$, $c_2 = k \oplus m_2$, $c_3 = k \oplus m_3$, …

1. Ciphertext-only attack: $\mathcal{A}$ just observes the ciphertexts

$\mathcal{A}$ finds relations between plaintexts: $c_1 \oplus c_2 = m_1 \oplus m_2$

2. Known-plaintext attack: $\mathcal{A}$ knows (at least) one pair (m_1, c_1) encrypted with *k*

$\mathcal{A}$ finds the key *k*, then decrypts any *c*: $k = m_1 \oplus c_1$, then $m_2 = k \oplus c_2$

3. Chosen-plaintext attack (CPA): $\mathcal{A}$ can obtain the encryption of a plaintext of his/her choice

4. Chosen-ciphertext attack (CCA): $\mathcal{A}$ can obtain the decryption of a cipertext of his/her choice

For 3 and 4, $\mathcal{A}$ can apply the same attack from 2.