MAC.
SKE in Practice.

Lecture 5

Active Adversary

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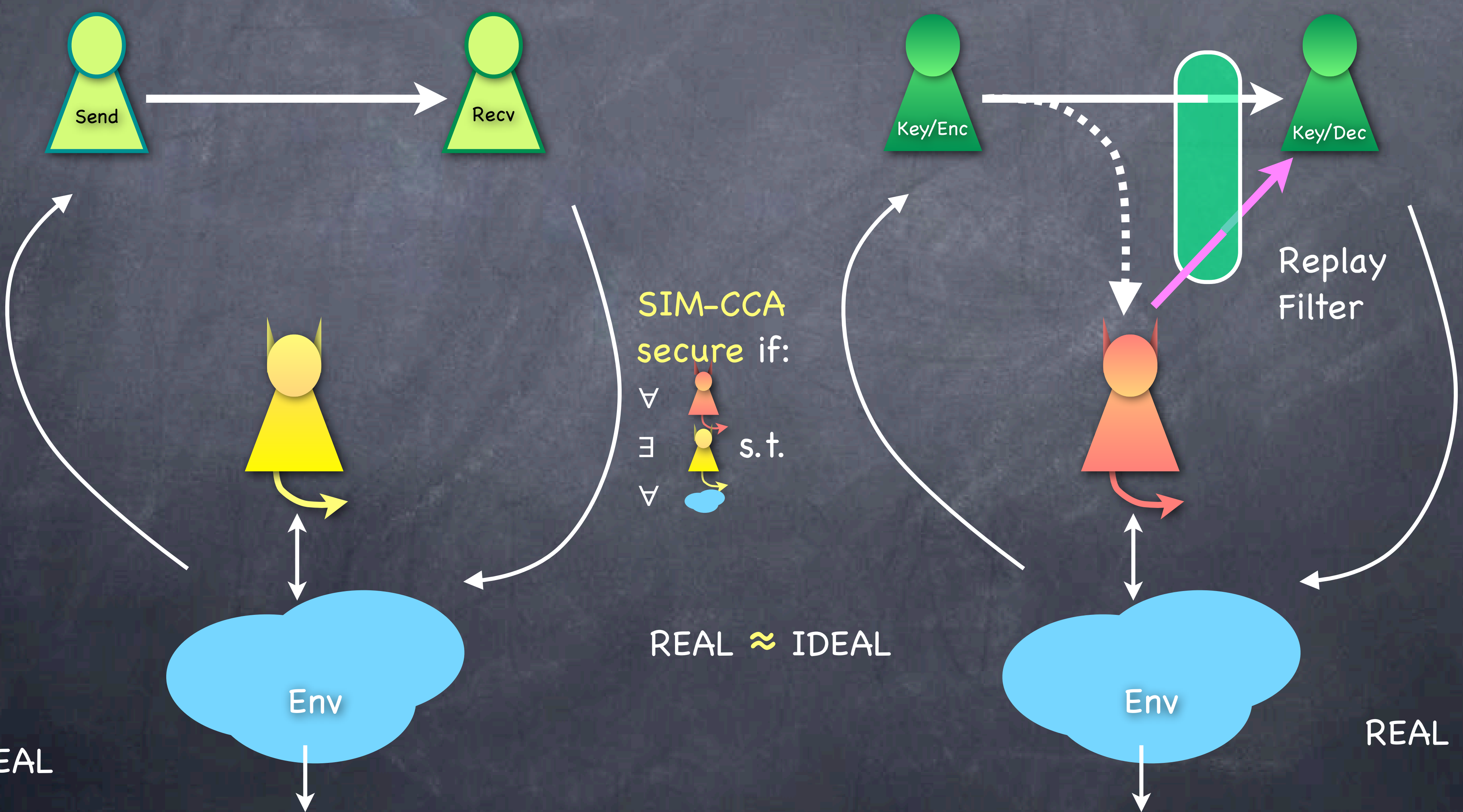
RECALL

Symmetric-Key Encryption

SIM-CCA Security



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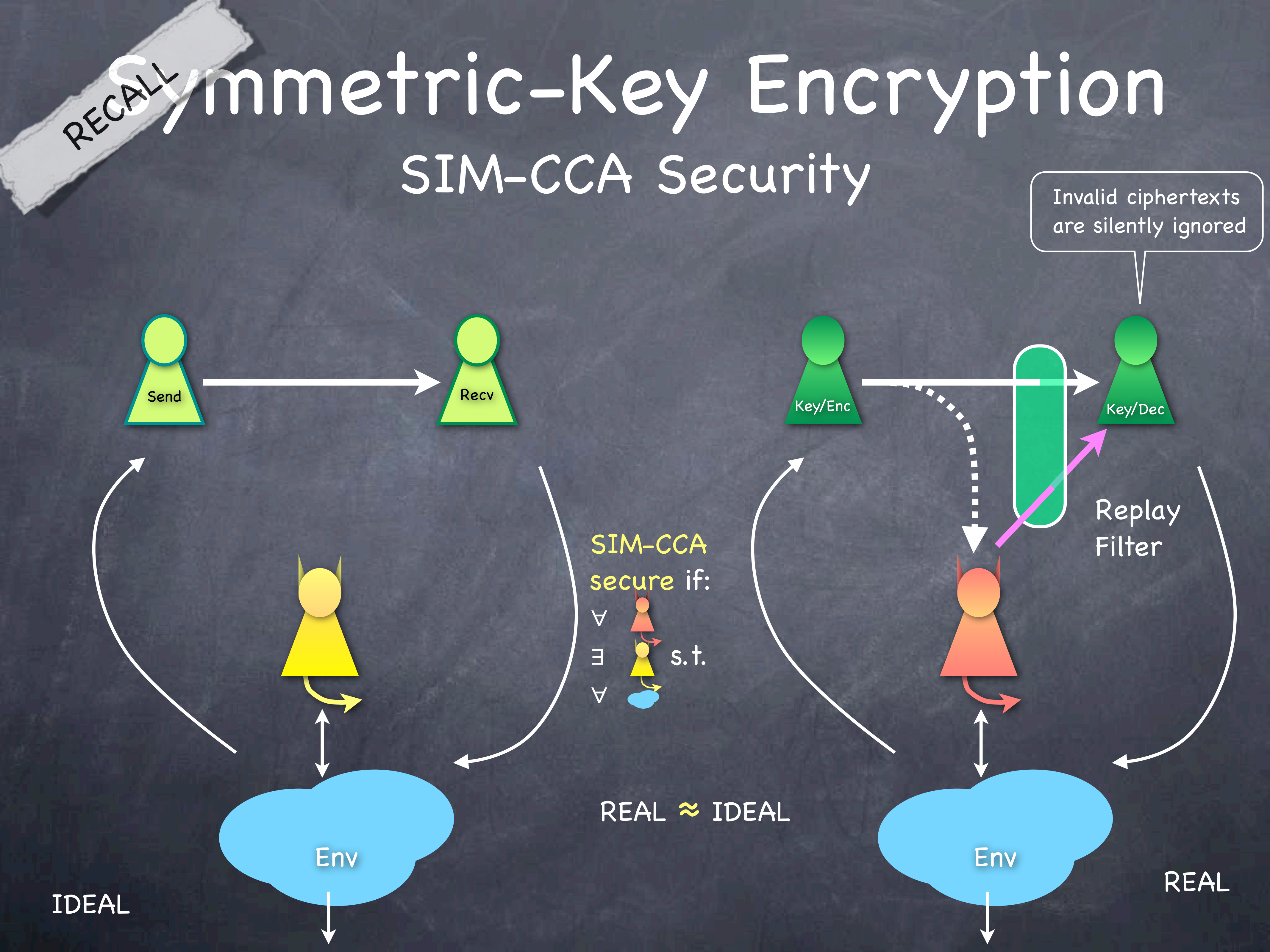

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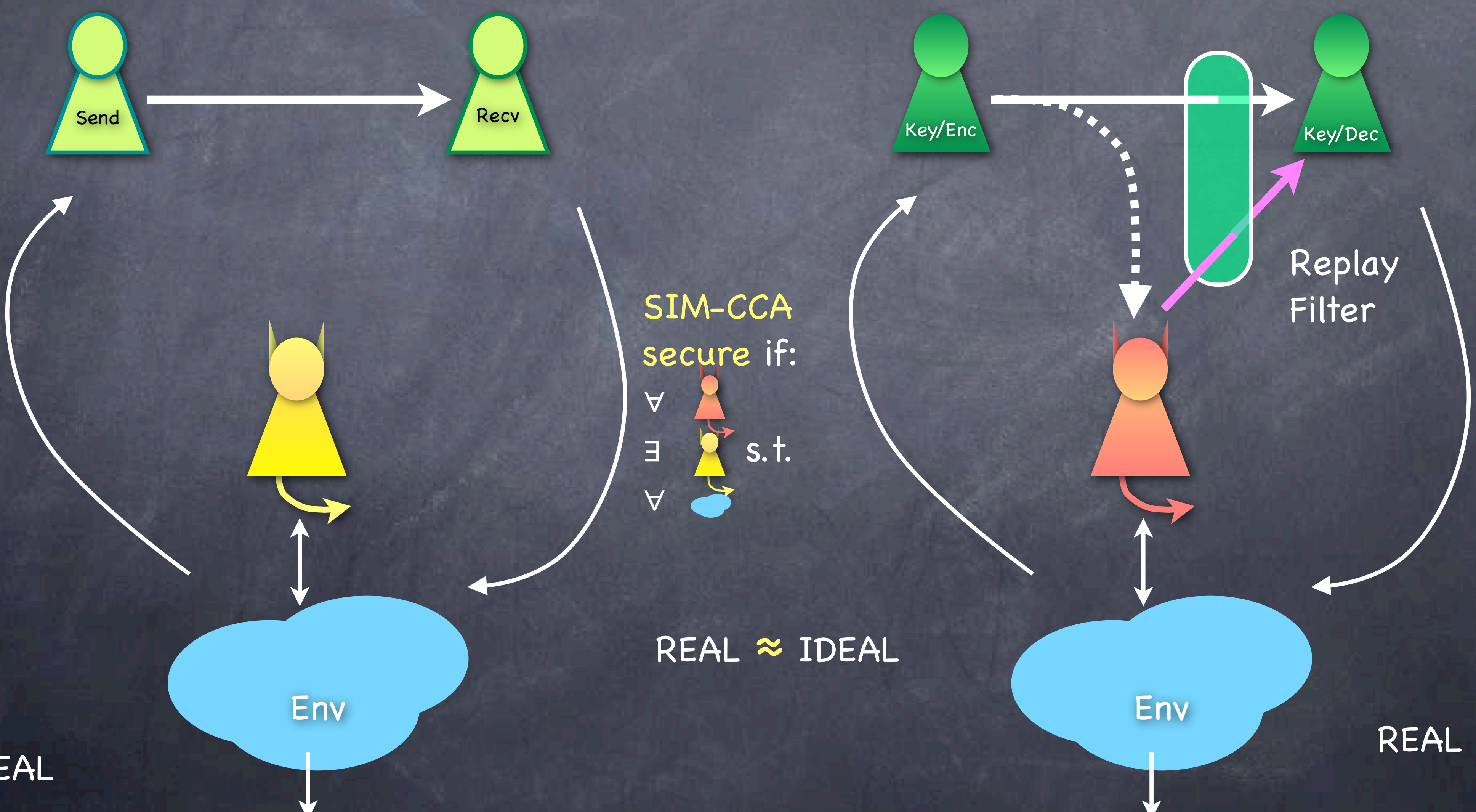

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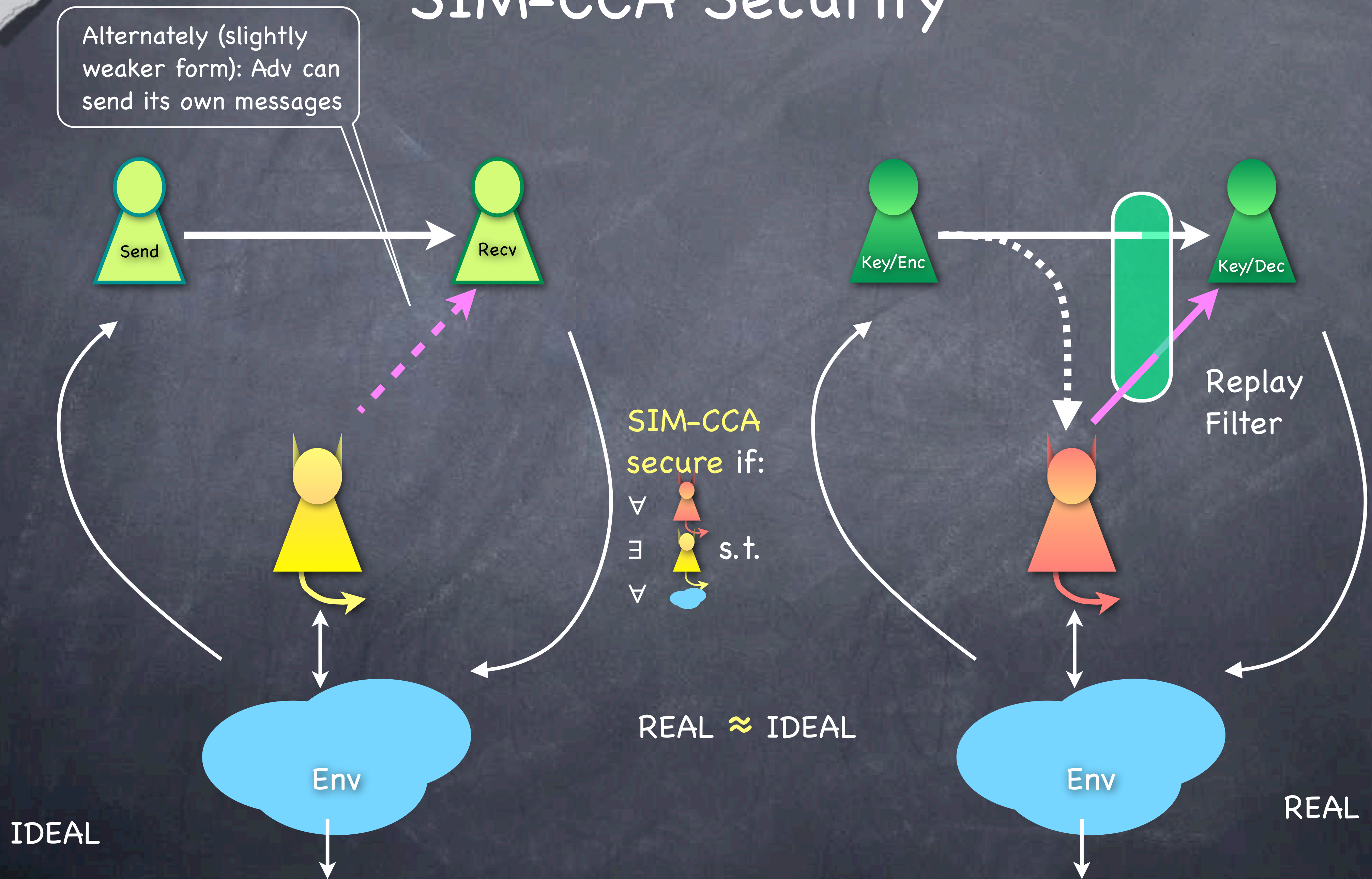

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IND-CCA Security

IND-CCA + ~correctness equivalent to SIM-CCA

- Experiment picks b←{0,1} and K←KeyGen
  Adv gets (guarded) access to Dec_K oracle
  - For as long as Adversary wants
    - Adv sends two messages m_0, m_1 to the experiment
    - Expt returns $Enc(m_b,K)$ to the adversary
- Adversary returns a guess b′
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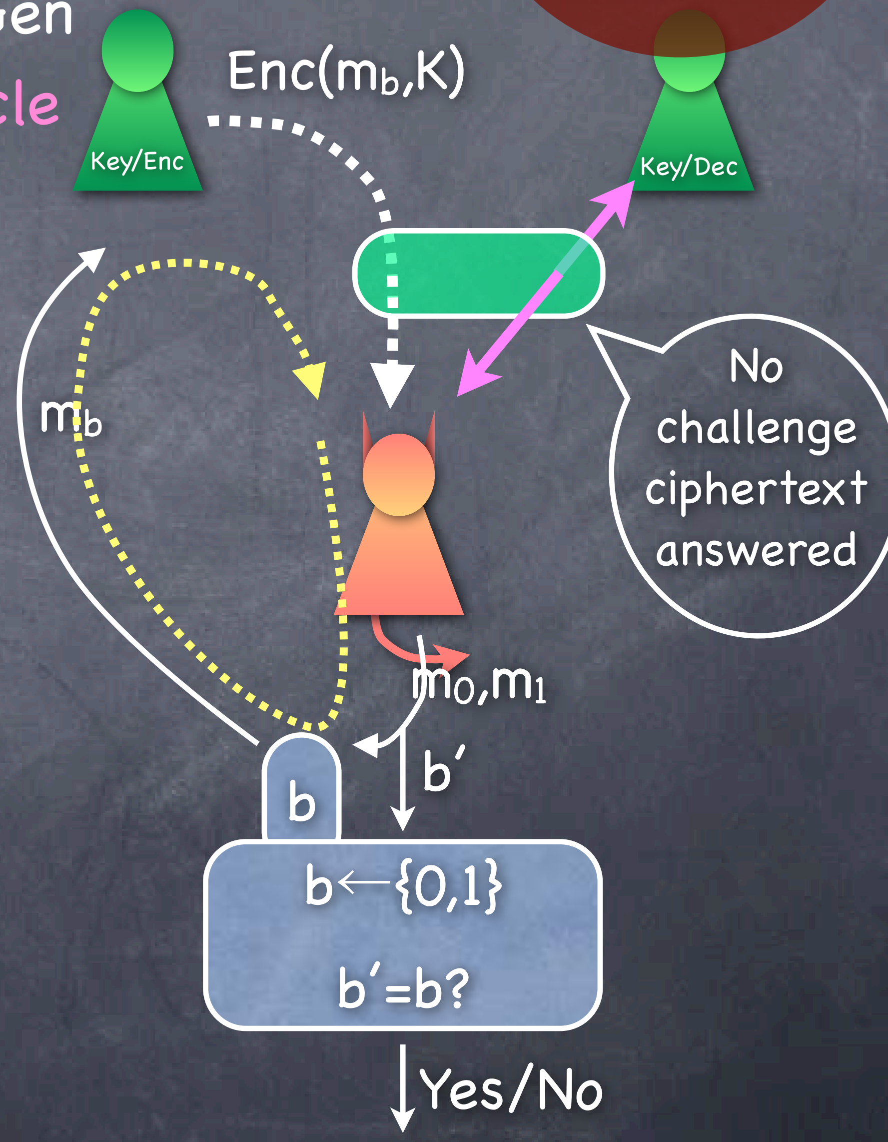
- IND-CCA secure if for all feasible adversaries Pr[b′=b] ≈ 1/2



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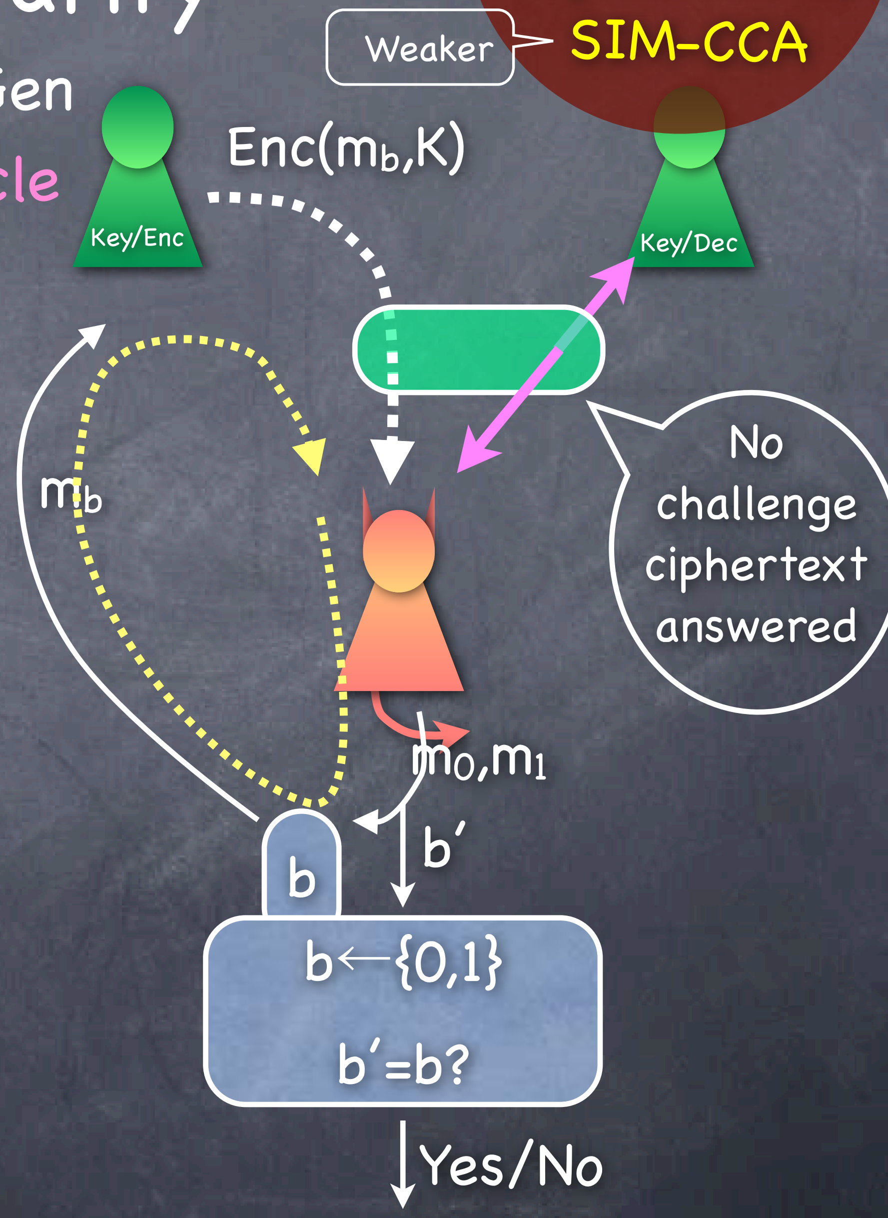

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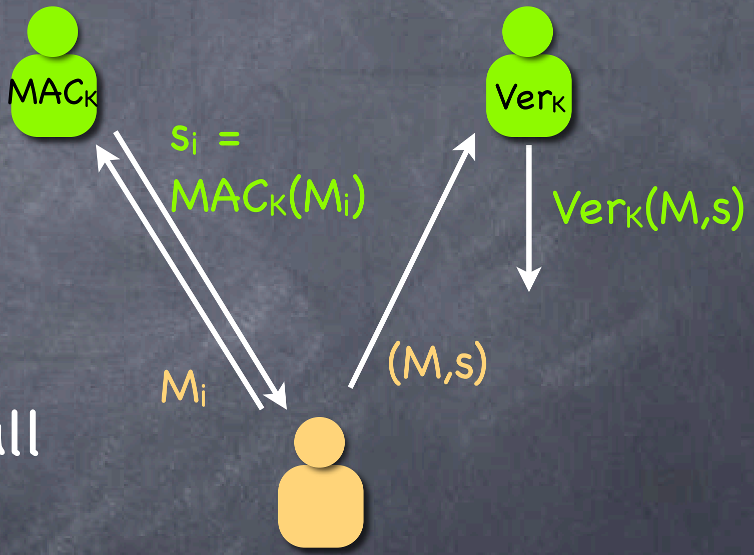
- Security: probability that an adversary can produce (M,s) s.t. $Verify_K(M,s)=1$ is negligible unless Alice produced an output $s=MAC_K(M)$



Advantage
$= \Pr[\ Ver_K(M,s)=1 \text{ and } (M,s) \notin \{(M_i,s_i)\}\ ]$

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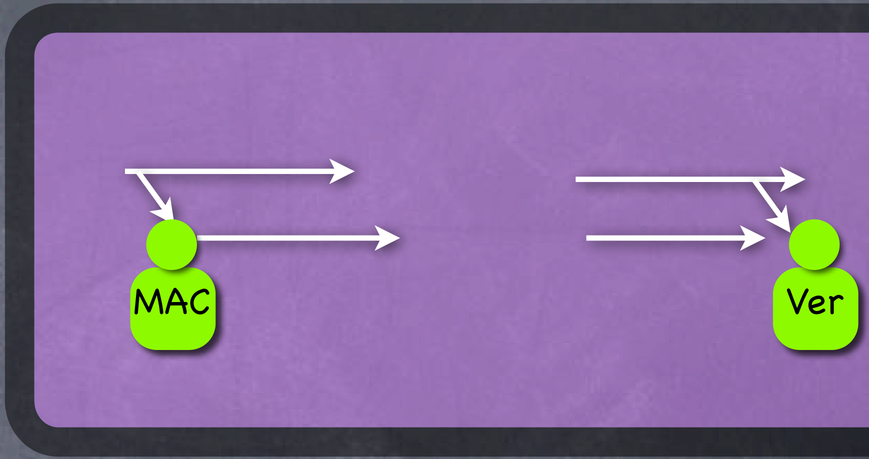
- In principle, constructions (less efficient) possible based on any One-Way Permutation or even any One-Way Function

Making a MAC

One-time MAC



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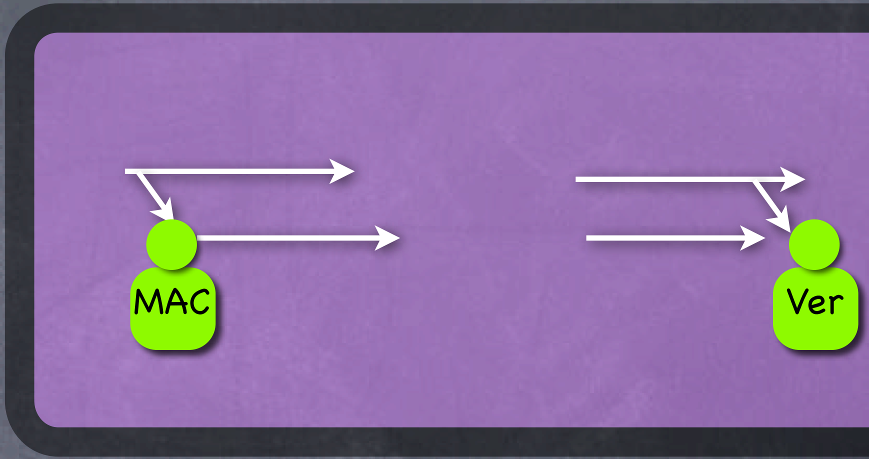

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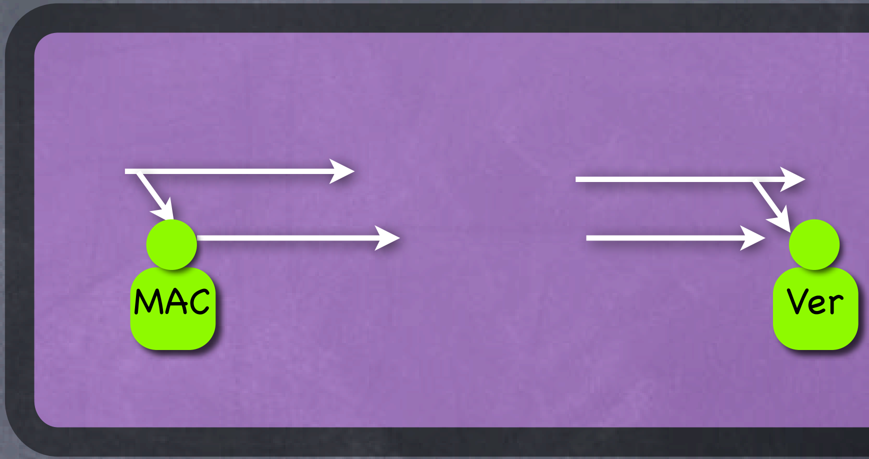

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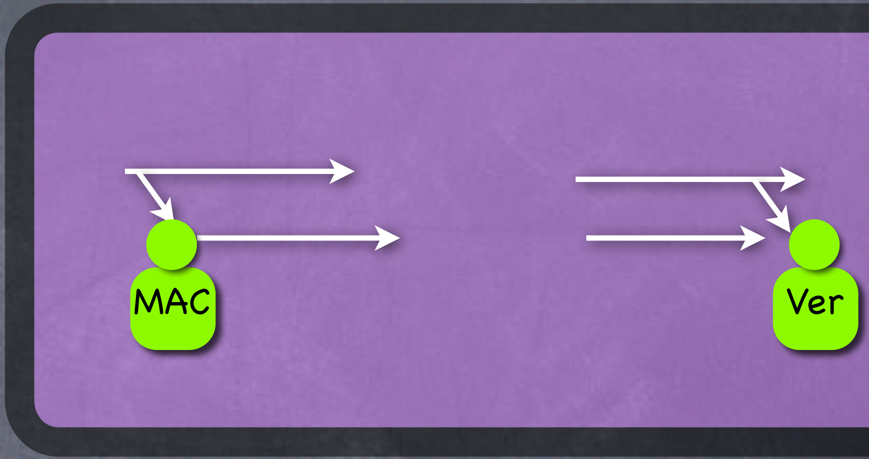

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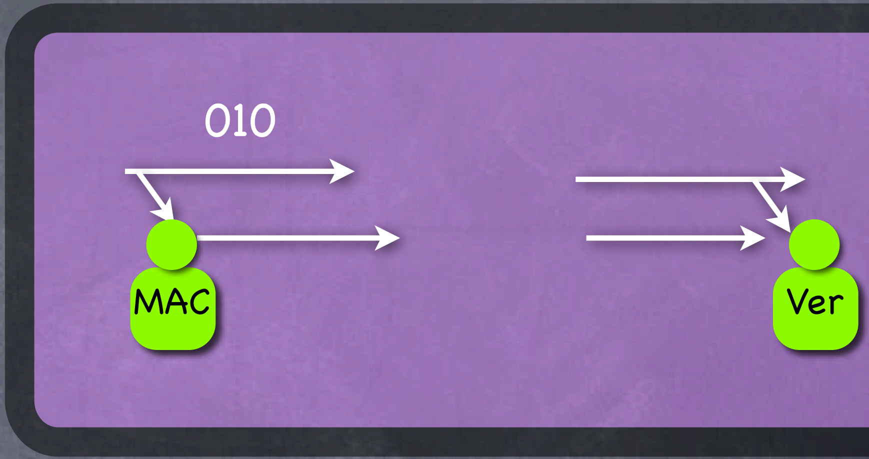

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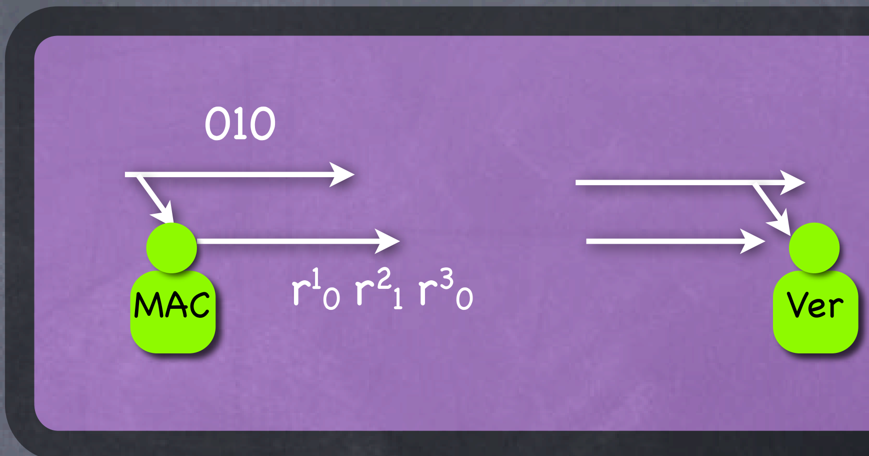

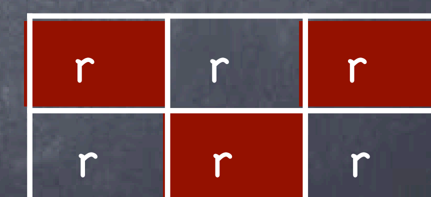

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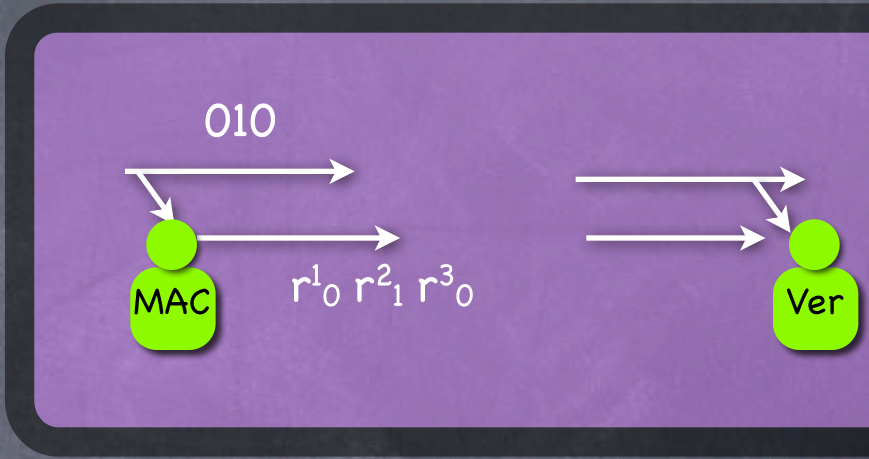

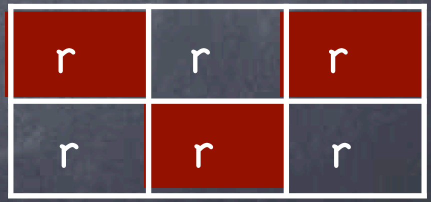

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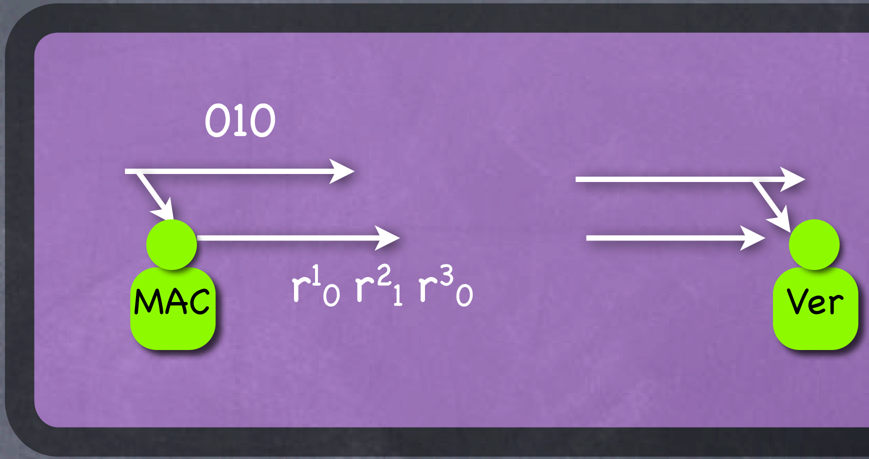

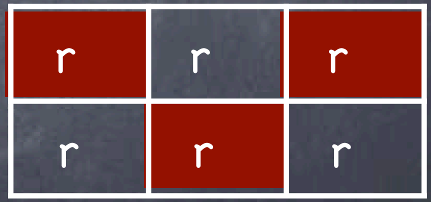

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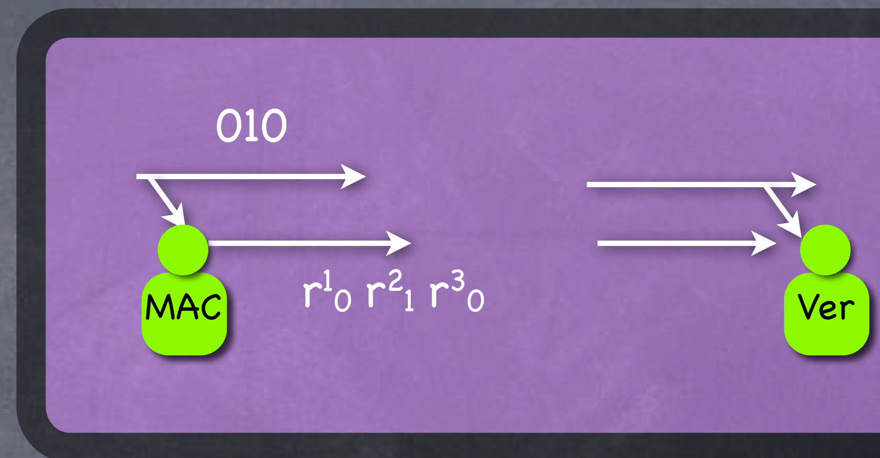

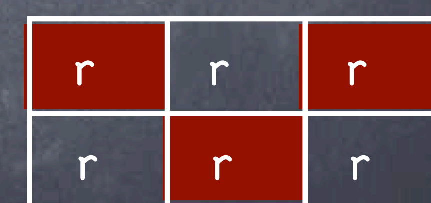

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- More efficient one-time MACs exist (later)

(Multi-msg) MAC from PRF

When Each Message is a Single Block

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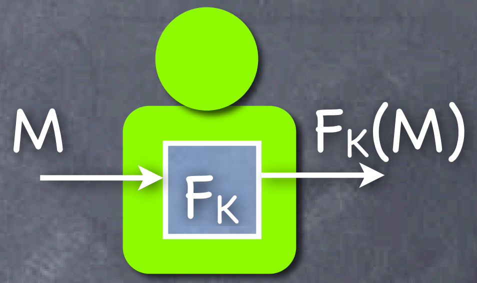

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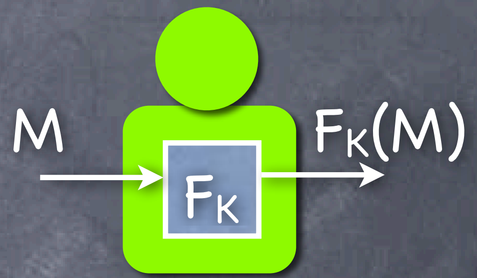

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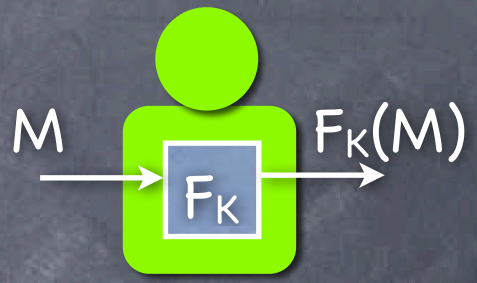

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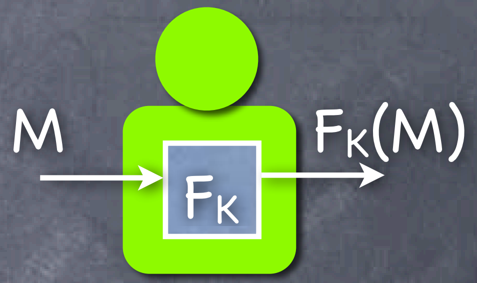

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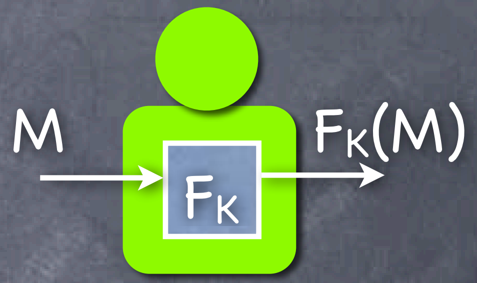

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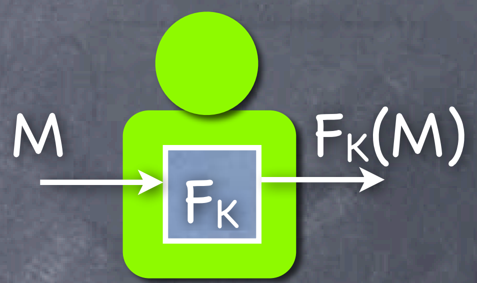

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  - If random function R used as MAC, then probability of forgery, $\varepsilon_{MAC^*} = 2^{-m(k)}$

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- Inefficient! Tag length increases with message length

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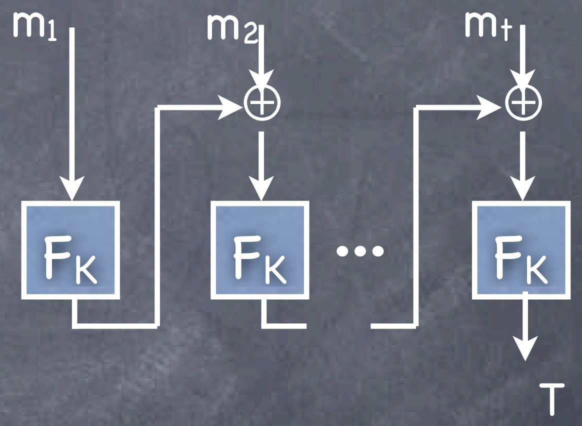

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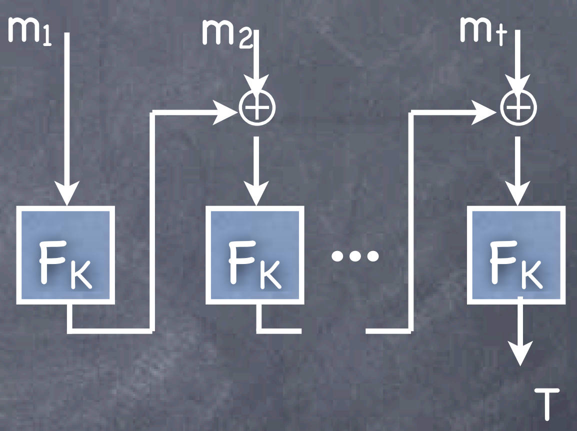

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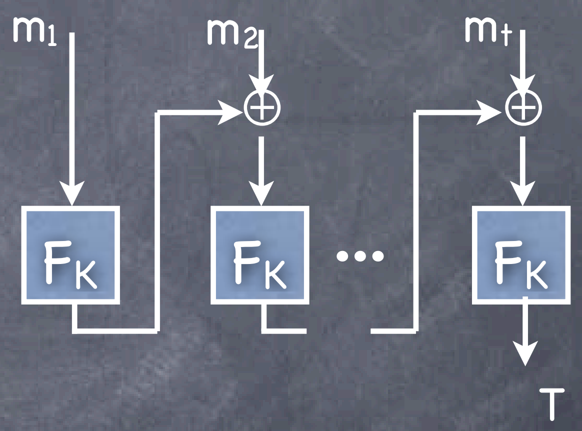

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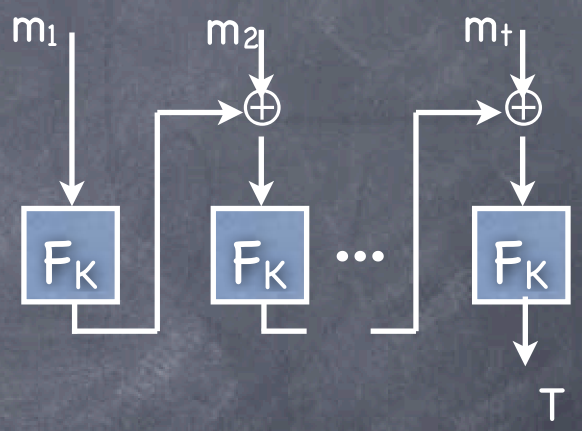

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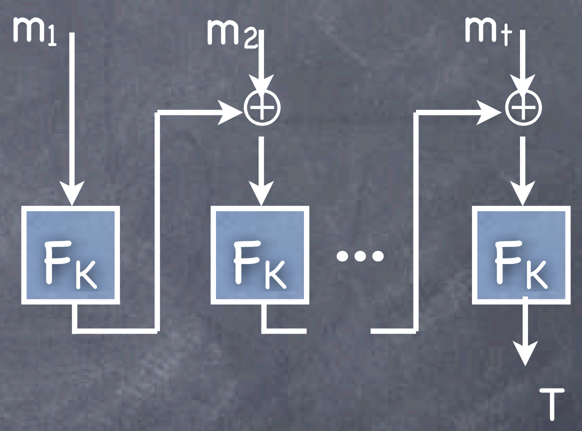

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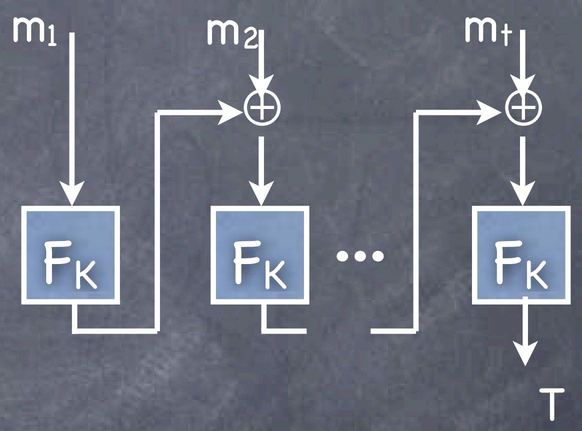

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- Later: Hash-based HMAC used in TLS and IPSec ← IETF Standard. 1997

SKE in Practice

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- NIST Standard: For multi-message encryption, use a block-cipher in CTR mode

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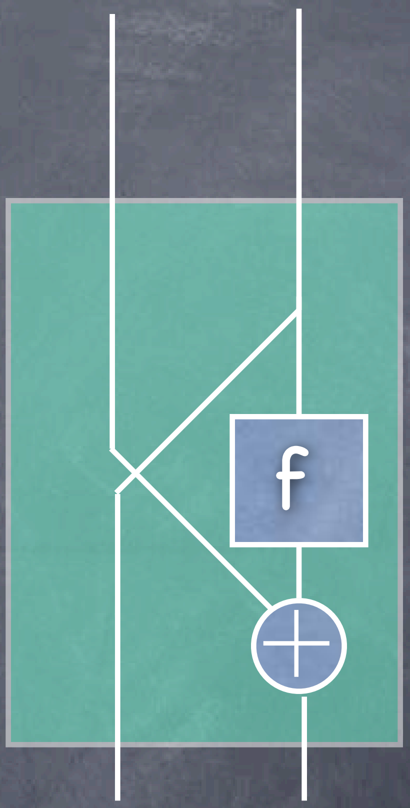

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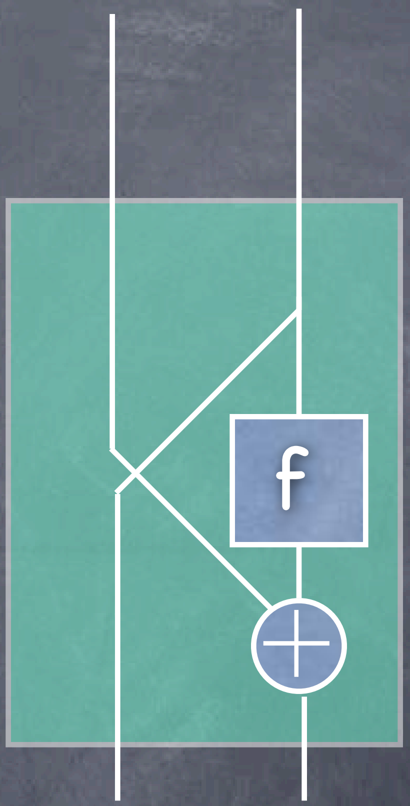

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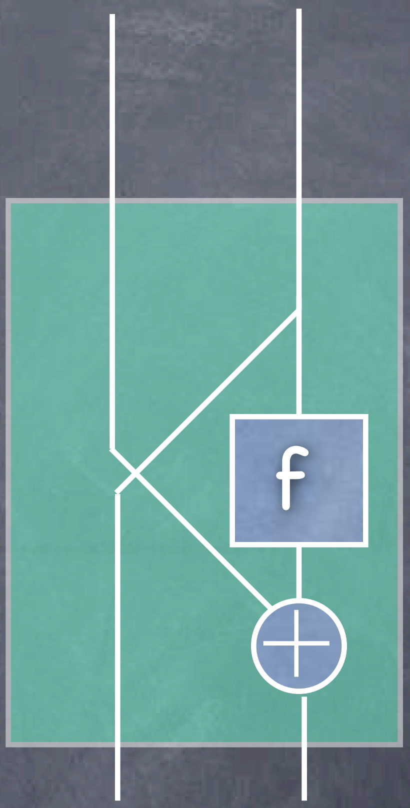

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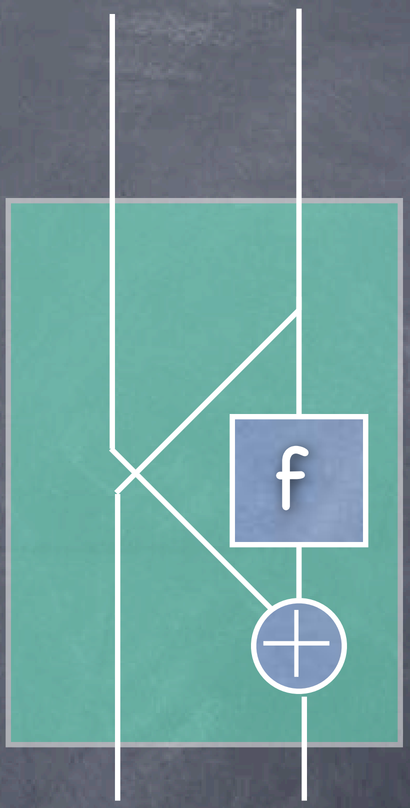

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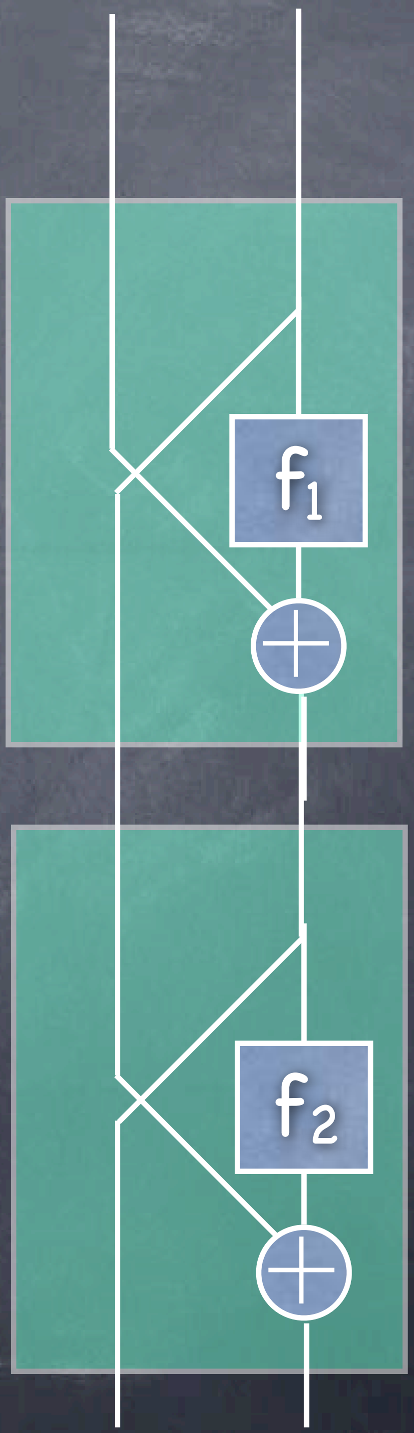

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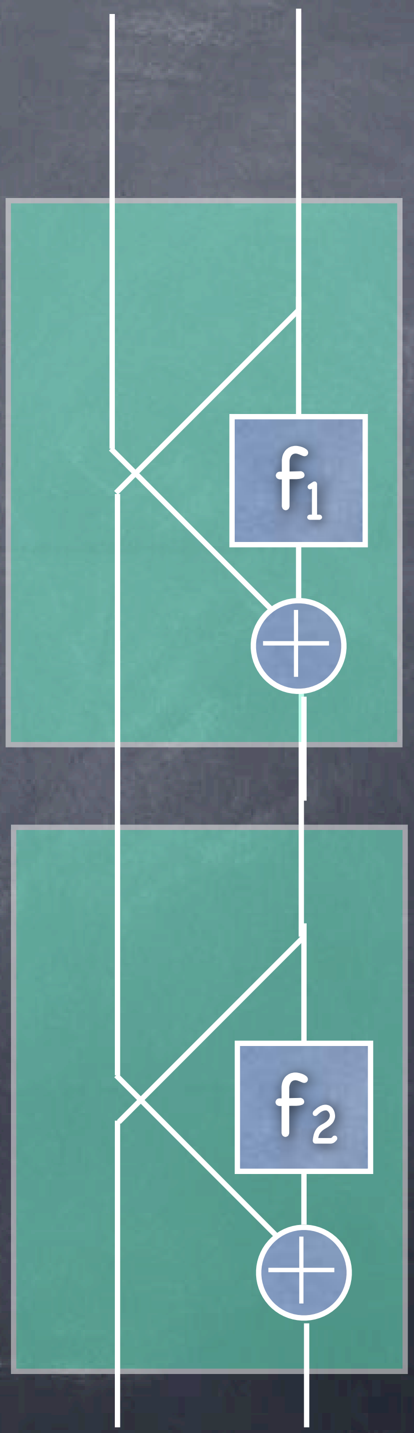

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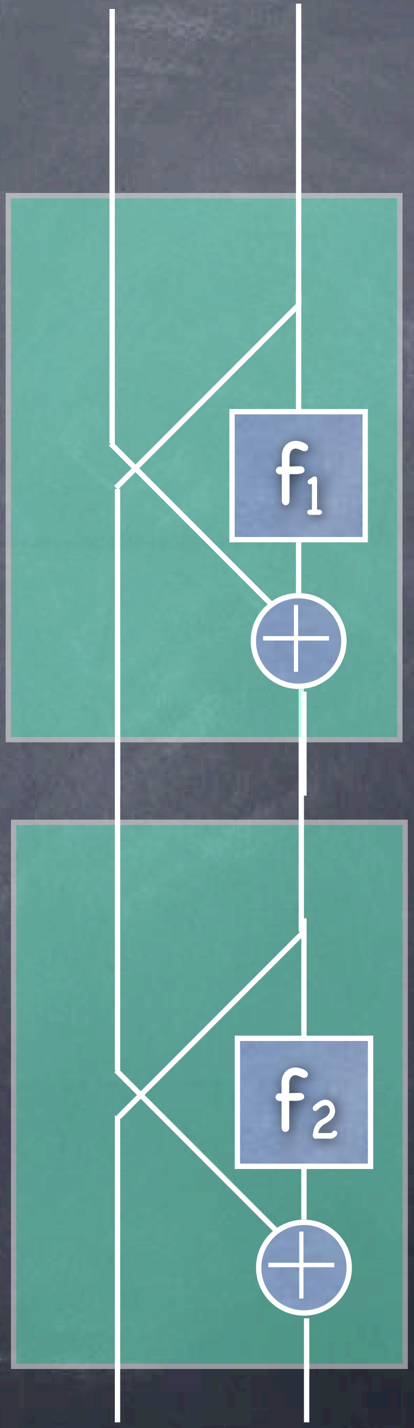

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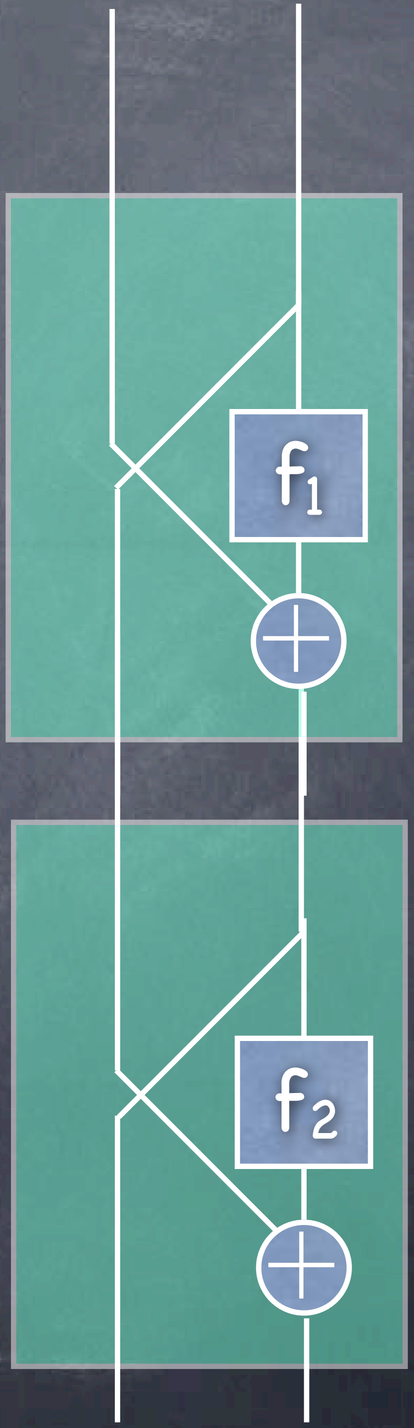

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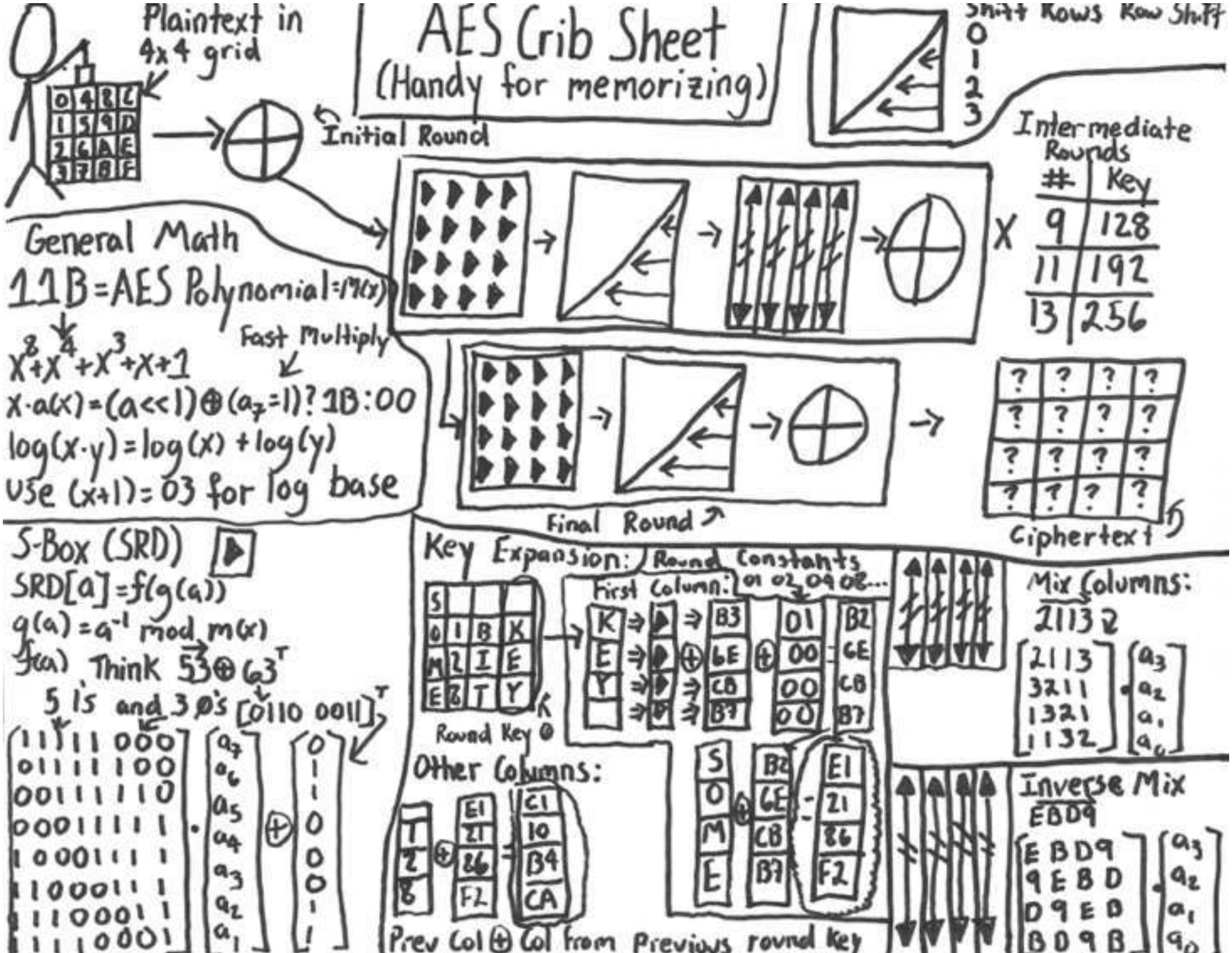

By Jeff Moser (http://www.moserware.com/2009/09/stick-figure-guide-to-advanced.html)

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  - Meet-in-the-middle, linear cryptanalysis, differential cryptanalysis, impossible differential cryptanalysis, boomerang attack, integral cryptanalysis, cube attack, ...

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  - AE with Associated Data: Allows unencrypted (but authenticated) parts of the plaintext, for headers etc.

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