CSE 484 / CSE M 584: Finish Hash Functions + MACs

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Announcements

- Today:
  - Finish MACs + hash functions
  - Guest lecture!

Hash Functions Review

- Map large domain to small range (e.g., range of all 160- or 256-bit values)
- Properties of cryptographically secure hash functions:
  - **One-wayness:** Given a point in the range (that was computed as the hash of a random domain element), hard to find a preimage
  - **Collision Resistance:** Hard to find two distinct inputs that map to same output
  - **Weak Collision Resistance:** Given a point in the domain and its hash in the range, hard to find a new domain element that maps to the same range element

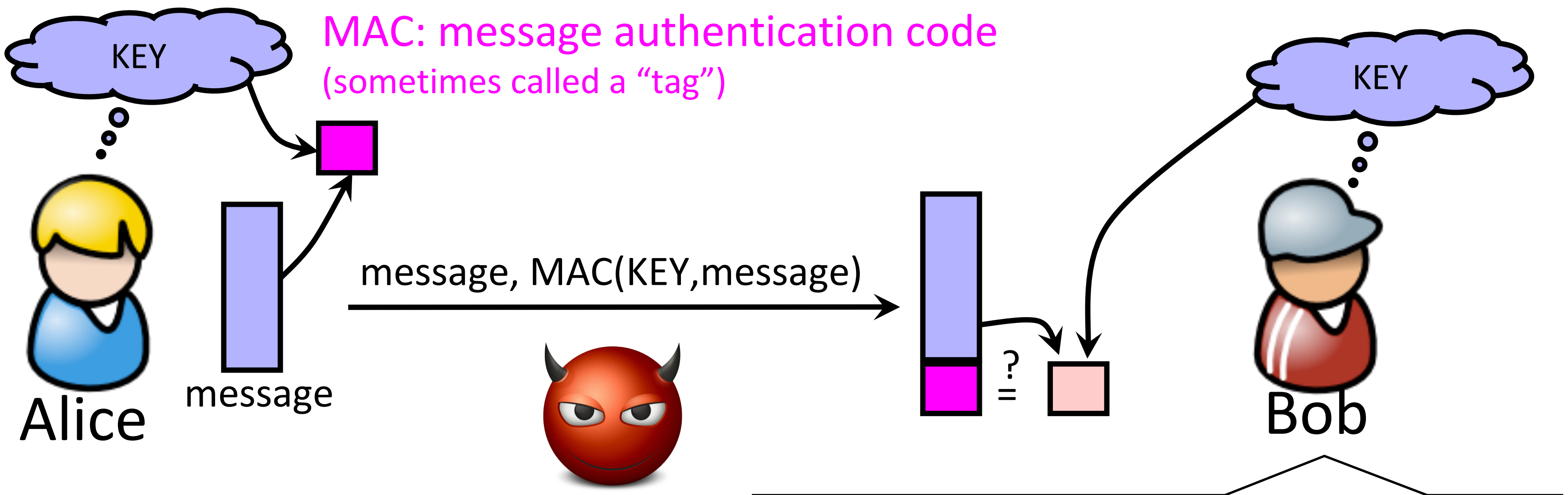
Which Property Do We Need?

One-wayness, Collision Resistance, Weak CR?

- UNIX passwords stored as hash(password)
  - **One-wayness:** hard to recover the/a valid password
- Integrity of software distribution
  - **Weak collision resistance**
  - But software images are not really random… may need **full collision resistance** if considering malicious developers

Recall: Achieving Integrity

Message authentication schemes: A tool for protecting integrity.


KEY
MAC: message authentication code
(sometimes called a "tag")
KEY
Alice
message
message, MAC(KEY,message)
?
=
Bob

Recomputes MAC and verifies whether it is equal to the MAC attached to the message

Integrity and authentication: only someone who knows KEY can compute correct MAC for a given message.

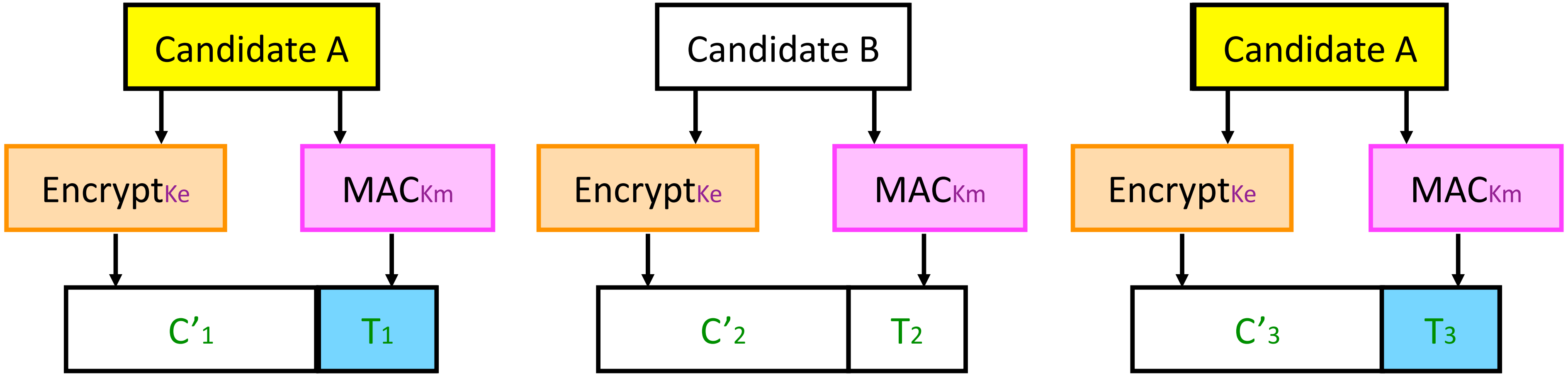
MAC with SHA3

- SHA3(Key || Message)
- Nice and simple ☺
- Previous hash functions couldn’t quite be used in this way (see: length extension attack)
  - HMAC construction (FYI)

- Why not encryption? (Historical reasons)
  - Hashing is faster than block ciphers in software
  - Can easily replace one hash function with another
  - There used to be US export restrictions on encryption

Authenticated Encryption

- What if we want both privacy and integrity?
- Natural approach: combine encryption scheme and a MAC.
- But be careful!
  - Obvious approach: Encrypt-and-MAC
  - Problem: MAC is deterministic! same plaintext → same MAC

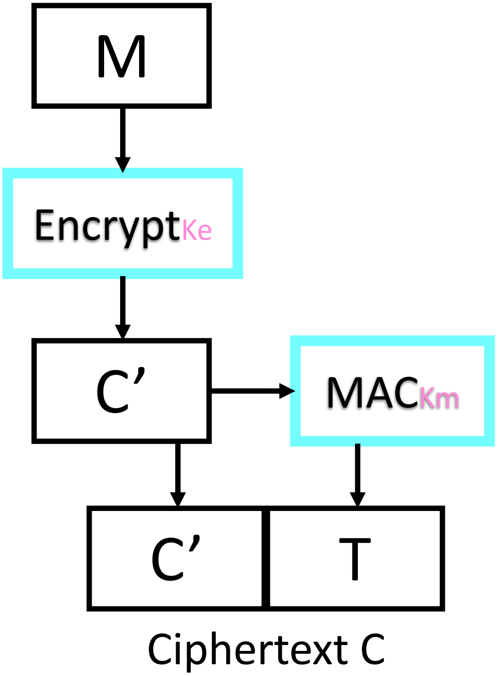


Authenticated Encryption

- Instead:

  Encrypt *then* MAC.

- (Not as good: MAC-then-Encrypt)



Encrypt-then-MAC