Committing Authenticated Encryption

- What is it? How is it different than regular AE?
- Why is it important? What goes wrong without it?
- Why is an RFC needed? What should the RFC say?

<u>Committing authenticated encryption (cAE):</u>

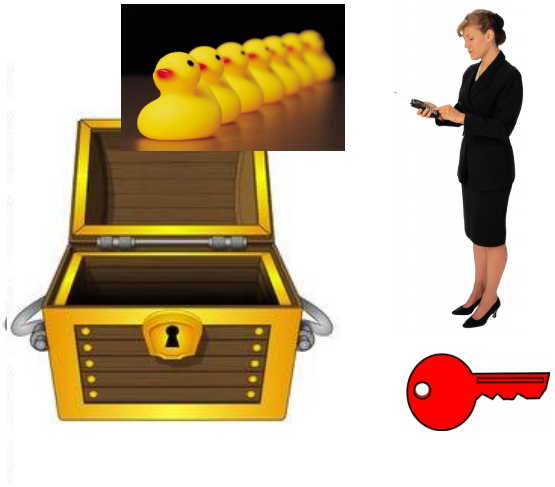
AE where it's hard to find a ciphertext
with multiple correct decryptions.
cAE => ciphertexts are ***binding commitments***

“Physical” Encryption

Many people think of authenticated encryption as a lock box.
Fine intuition, if keys are random and hidden:

- The box hides what’s inside it (confidentiality)
- Can’t change already-locked box (integrity)

This intuition fails badly if **keys can be adversarial**.



“Physical” Encryption

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AE has no security with attacker control of keys:

ciphertexts can have multiple correct decryptions.

cAE = AE + ***binds*** attacker to a single decryption

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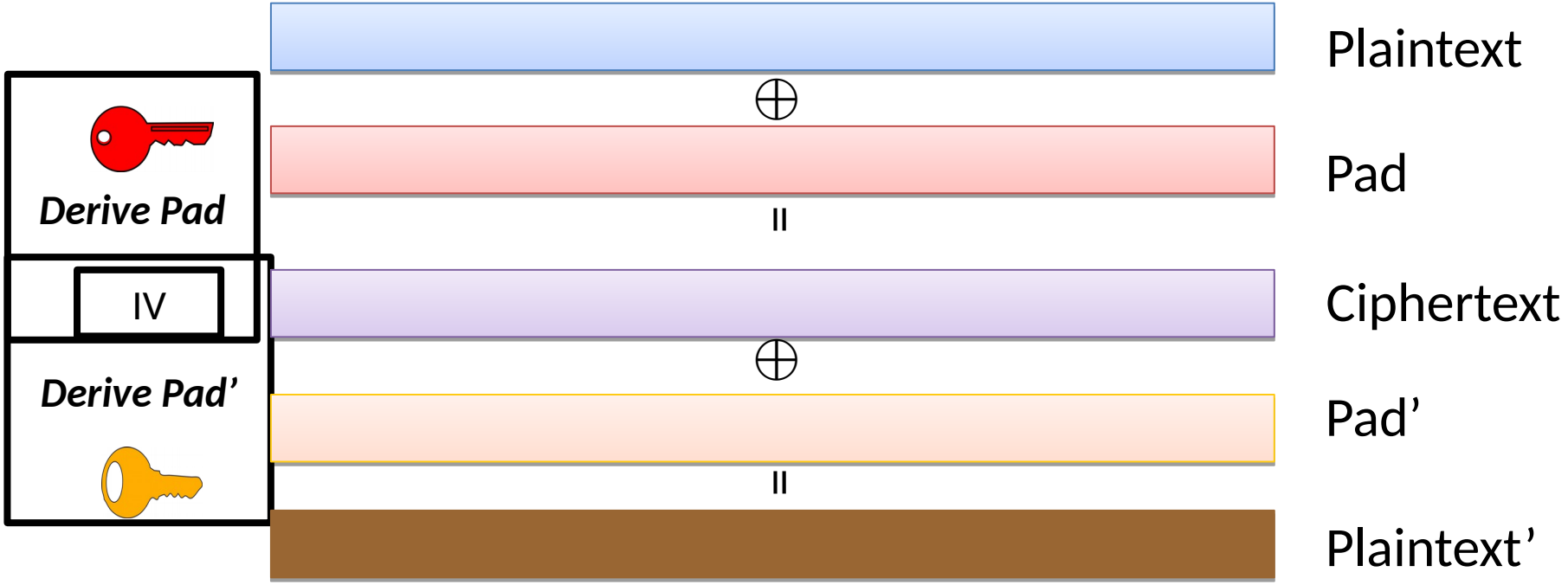
CTR mode is not committing

Any ciphertext can be decrypted under any key.

Adding a MAC does not help:

Galois/Counter Mode (GCM) is not committing.



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Scheme	cAE?
AES-GCM	No
ChaCha20/Poly1305	No
OCB	No
Encrypt-then-HMAC (distinct keys)	No
Encrypt-then-HMAC (derived keys)	Yes

Places where cAE is needed

- Message franking (abuse reporting for E2EE Messenger)
  - Lack of cAE led to [DGRW] “invisible salamander” bypass: GCM ciphertext with two image decryptions
  - Similar issues found elsewhere after [DGRW]
- OPAQUE (possible aPAKE standard) fragile without cAE
  - Active MitM of login could learn password from size-N dictionary via log(N) interactions with client (unpublished)
  - Needed in other protocols? (ongoing work)
- cAE ensures transcript consistency in group messaging (MLS may use)
- Widely used in research that may be deployed in the future

Abusive JPEG image

Innocuous BMP image

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RFC means fewer mistakes, better designs

- Anecdotally, misunderstanding is widespread
  - Practitioners and researchers alike make mistakes
- cAE can be tricky to build, many pitfalls
  - Checking multiple values in decryption
    => distinguishable failures possible!
- An RFC can dispel confusion and mandate good schemes

Some cAE constructions from research literature,
but many “knobs” to tweak w/r/t concrete choices

Need guidance on threat models, requirements, use cases!