Cryptanalysis of OCB2
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OCB2

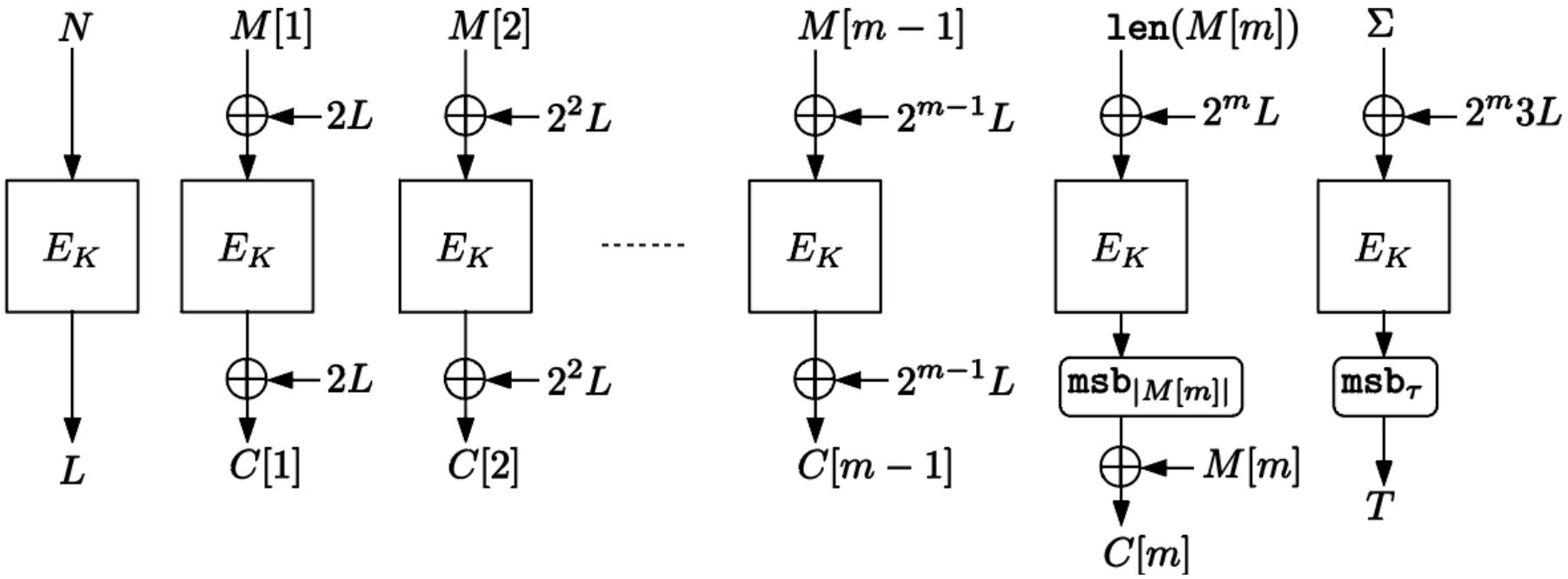
- Authenticated Encryption (AE) proposed by Rogaway at Asiacrypt 2004 [Rog04]
- Blockcipher mode with strong features
- Provable security
- Standardized in ISO/IEC 19772

- Three versions. OCB1/2/3
- (all versions of) OCB are widely believed to be secure

Our contributions

- OCB2 can be attacked
  - authenticity is broken
  - independent of the underlying blockcipher
- Simple and practical : one encryption query, then forgery
  - Existential forgery
  - Universal forgery after the first forgery

OCB2

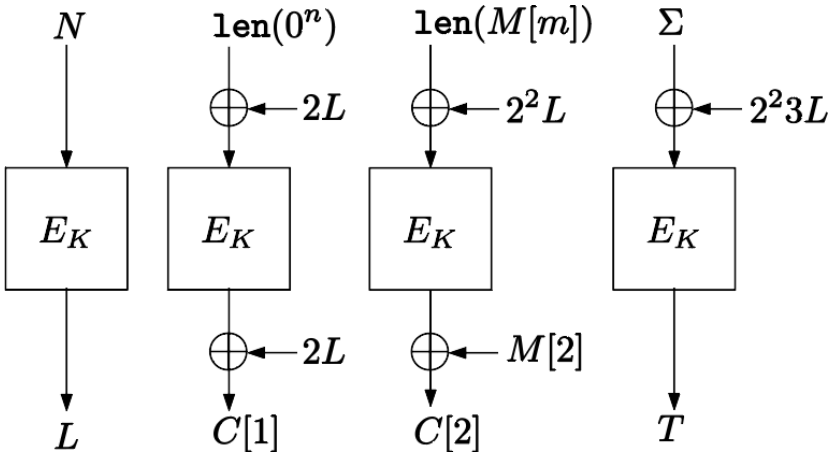


- 2L and 3L : GF(2^n) multiplication by **x** and **x+1**
- Checksum Σ = M[1] + … +M[m-1] + M[m]

Minimal Attack

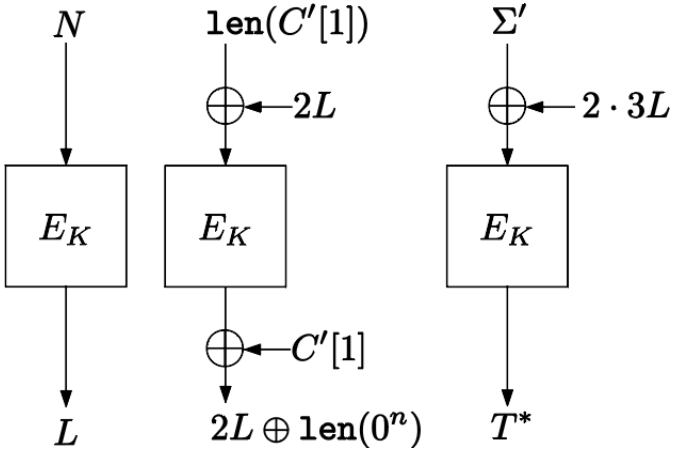
1. First, encrypt (N, M) :

- M = len(0^n) || M[2]
  for any n-bit M[2]
- Get (C =C[1]C[2] ,T)



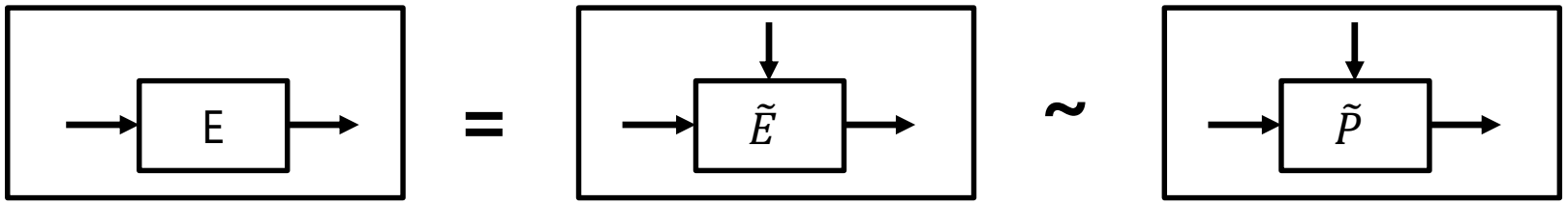
2. Decrypt (N, C′ , T′) s.t.

- C′= C[1] + len(0^n),
  T′= M[2] + C[2]
- will be accepted as valid



A flaw in the hybrid argument [Rog04]

- OCB2 relies on the security of XEX* (internal TBC made of blockcipher)
- XEX* is provably secure, but
- This hybrid forces an *prohibited* use of XEX*
- The security of XEX* does not imply security of OCB2



OCB2[E] ΘCB2[$\tilde{E}$] ΘCB2[$\tilde{P}$]

Extensions and Summary

Follow-ups:

- Poettering (2018/1087) [Pot18]
- Iwata (2018/1090) [Iwa18]
  - Various extensions, such as privacy attack and plaintext recovery

Summary:

- OCB2 is totally broken, practical forgery is possible, and even more
- Not applicable to the general structure of OCB, not applicable to OCB1 and OCB3

 Thank you !