Chaffinch: Confidentiality in the Face of Legal Threats

Richard Clayton and George Danezis
University of Cambridge
Information Hiding, 2002

Presenter: Weikun Yang
December 9, 2015

Confidential Message Passing

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Alice

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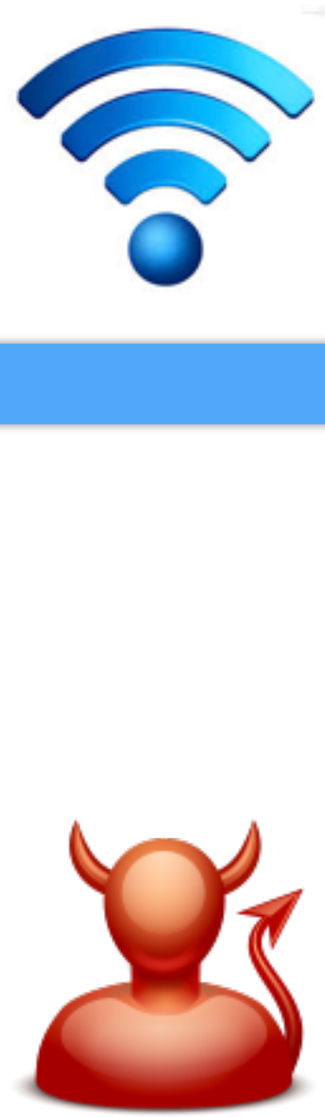

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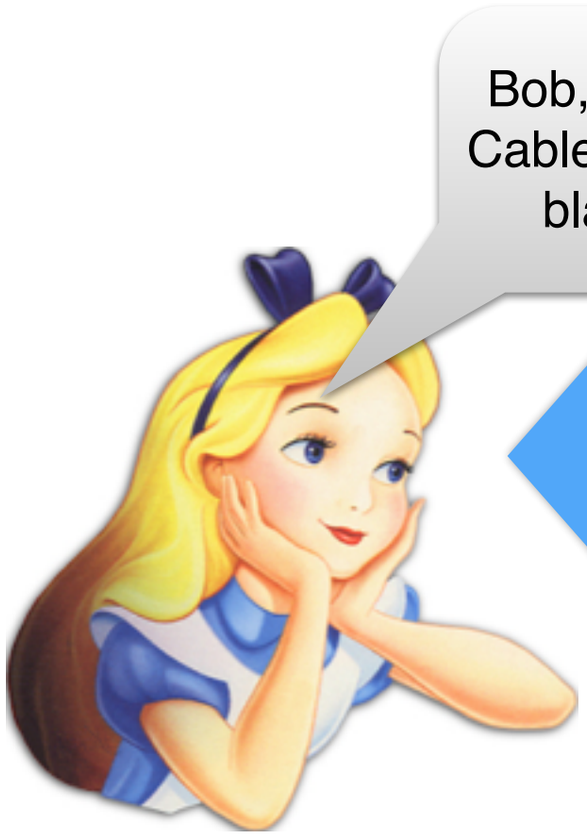
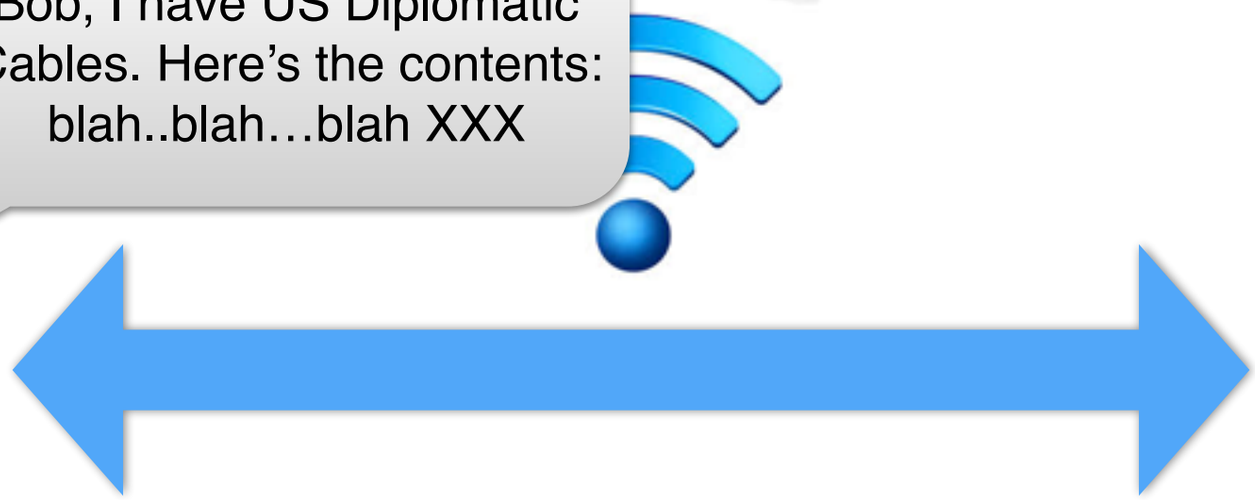


Bob, I have US Diplomatic Cables. Here's the contents: blah..blah…blah XXX



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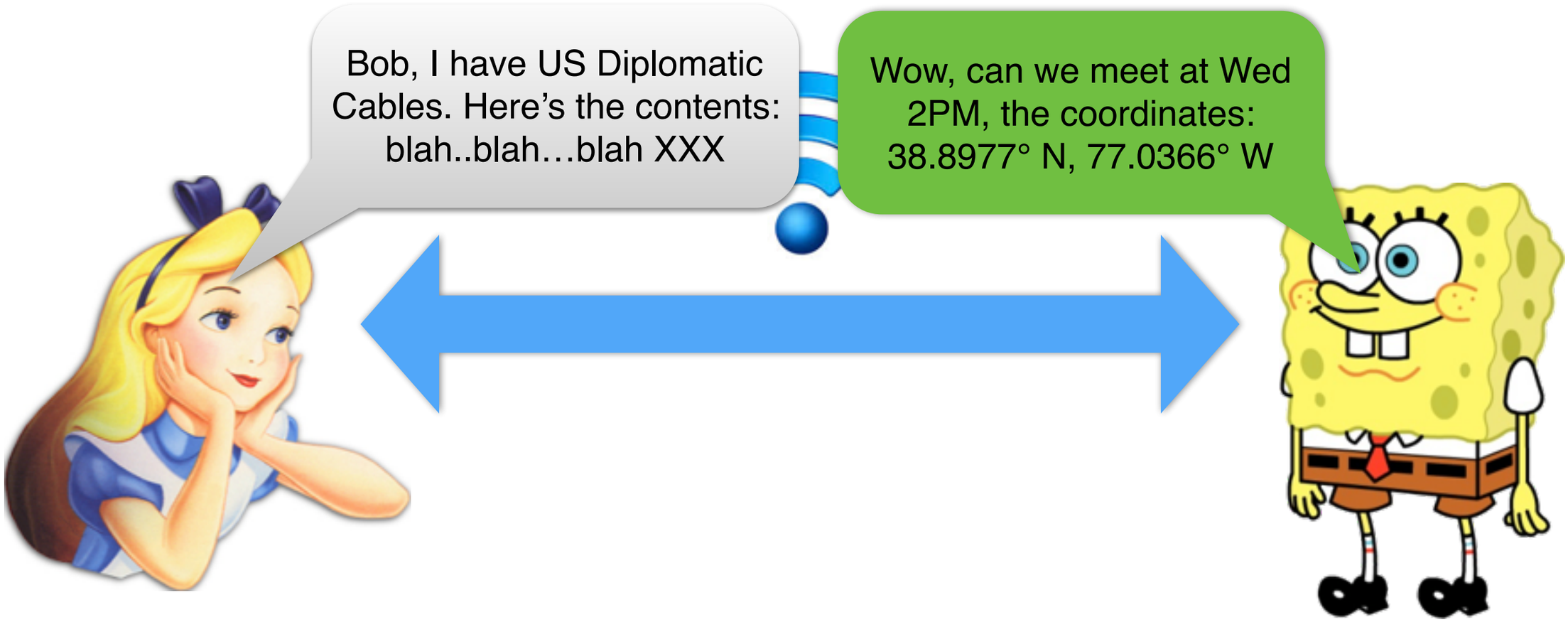

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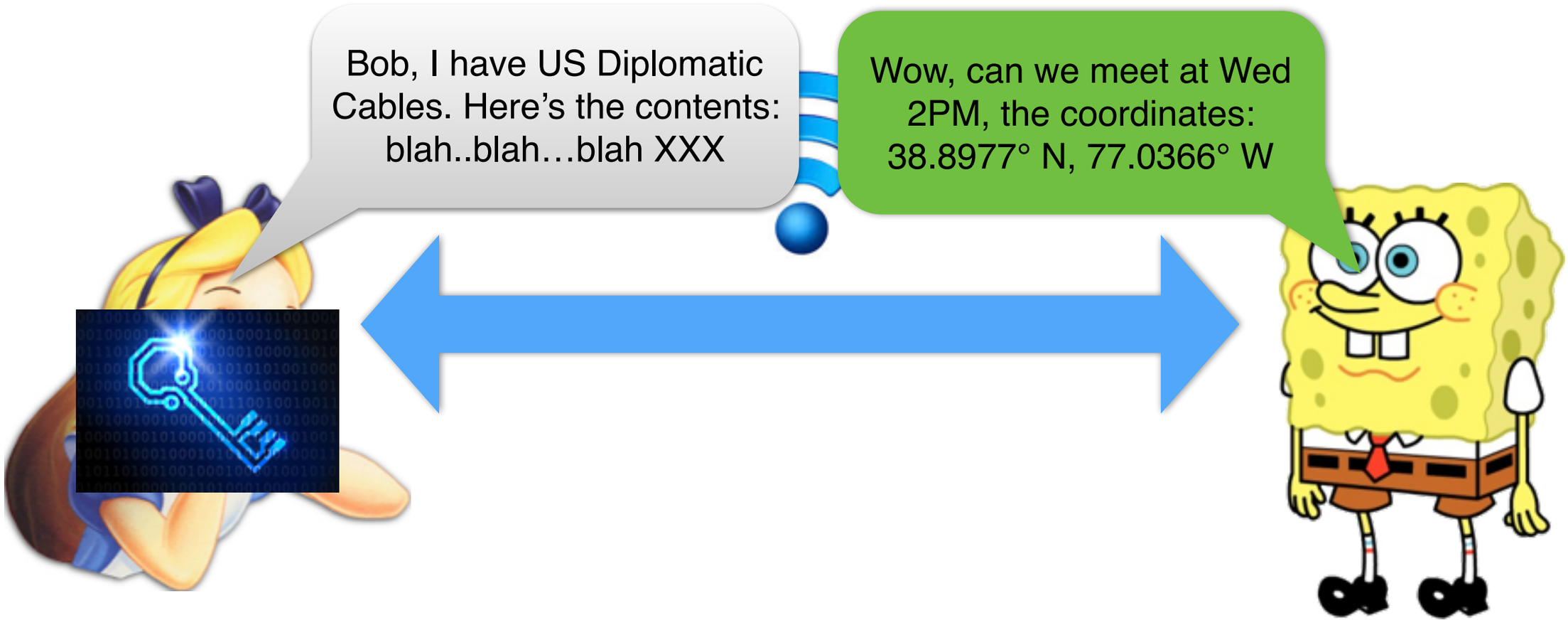

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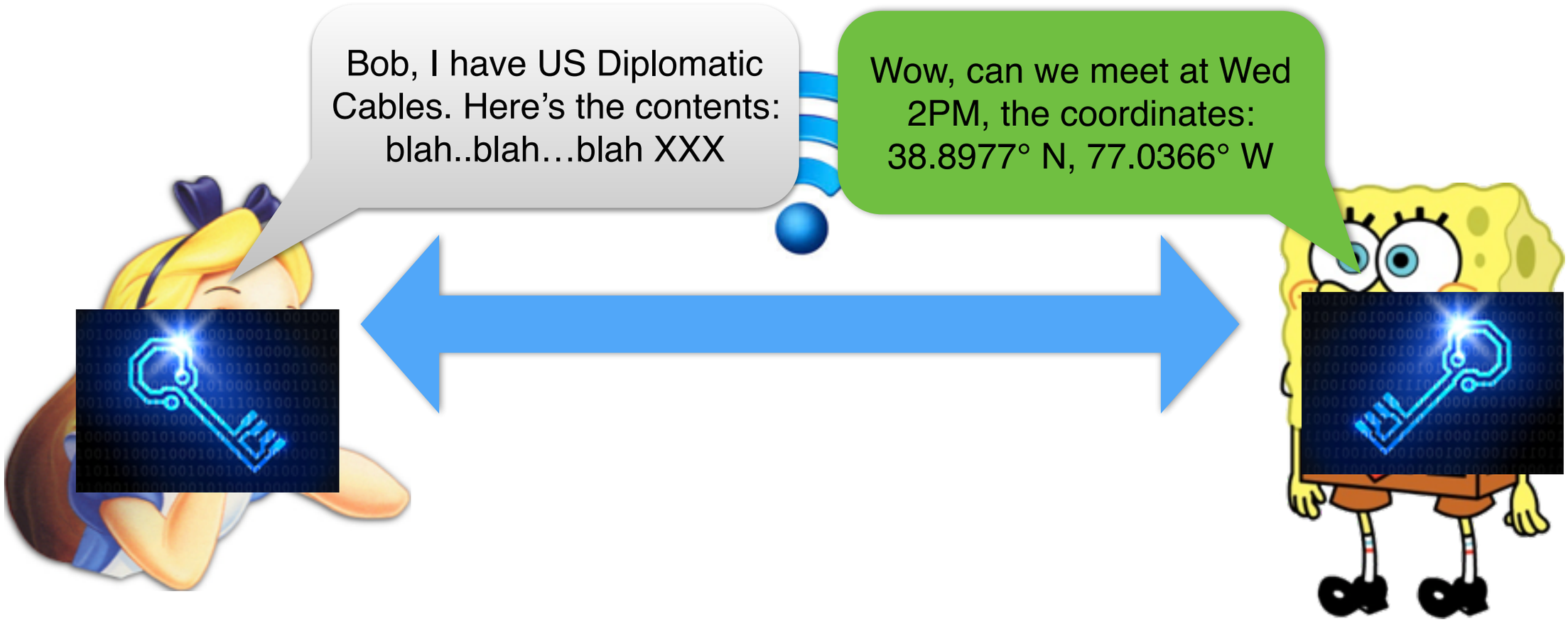

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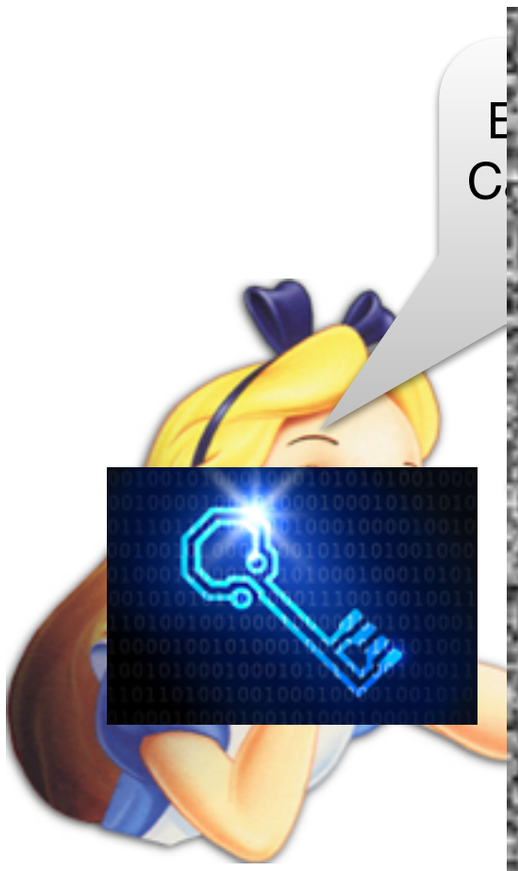

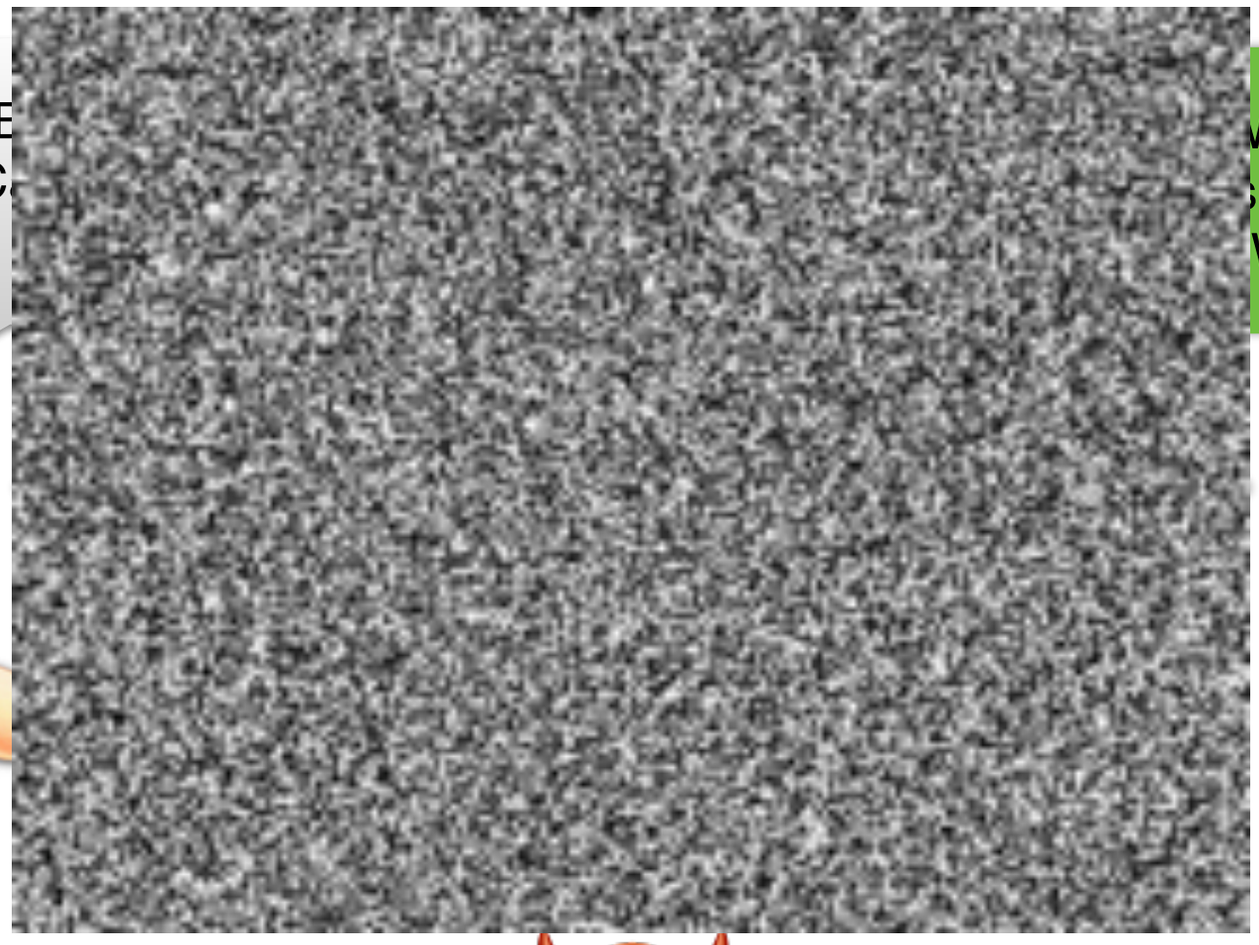

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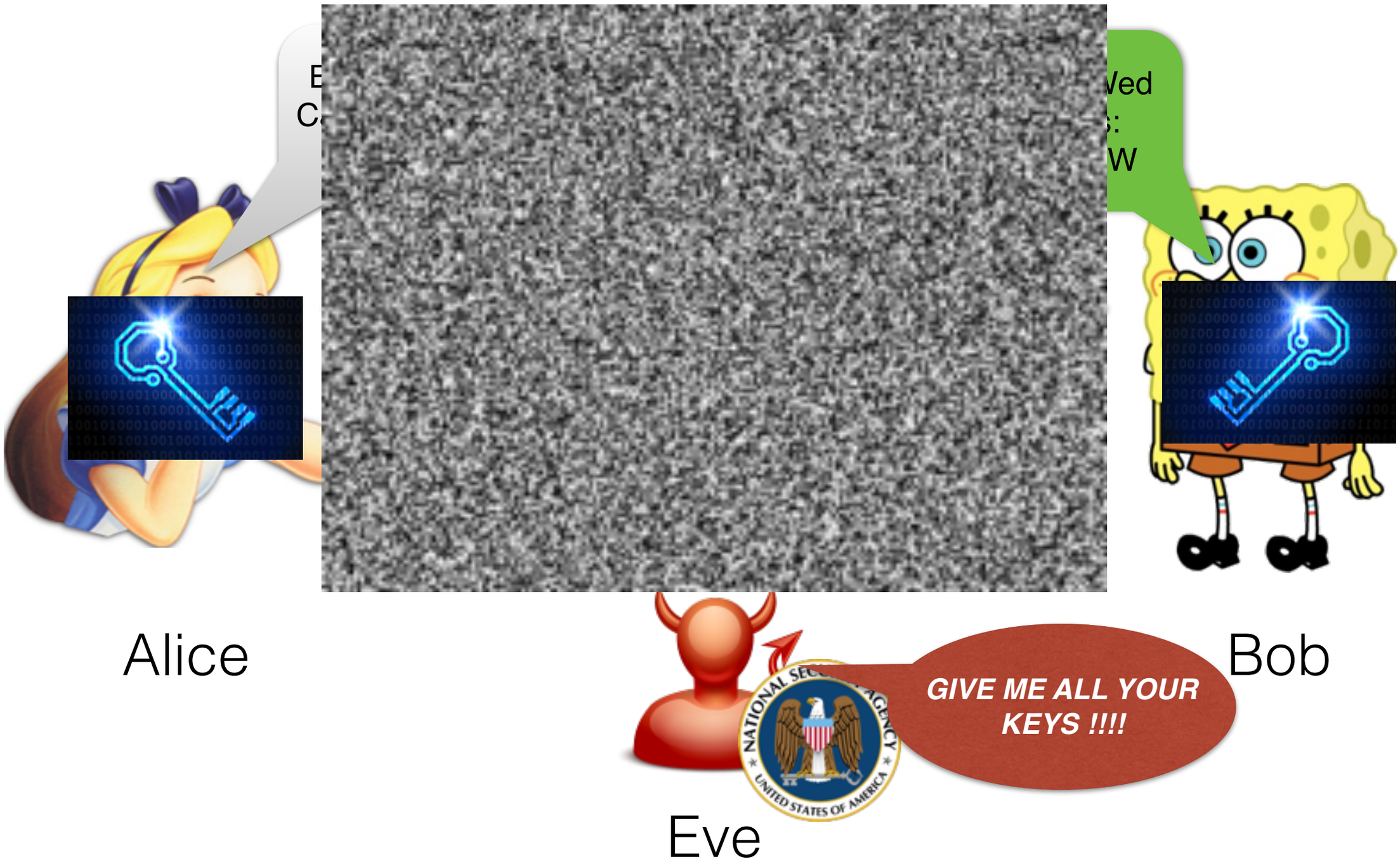

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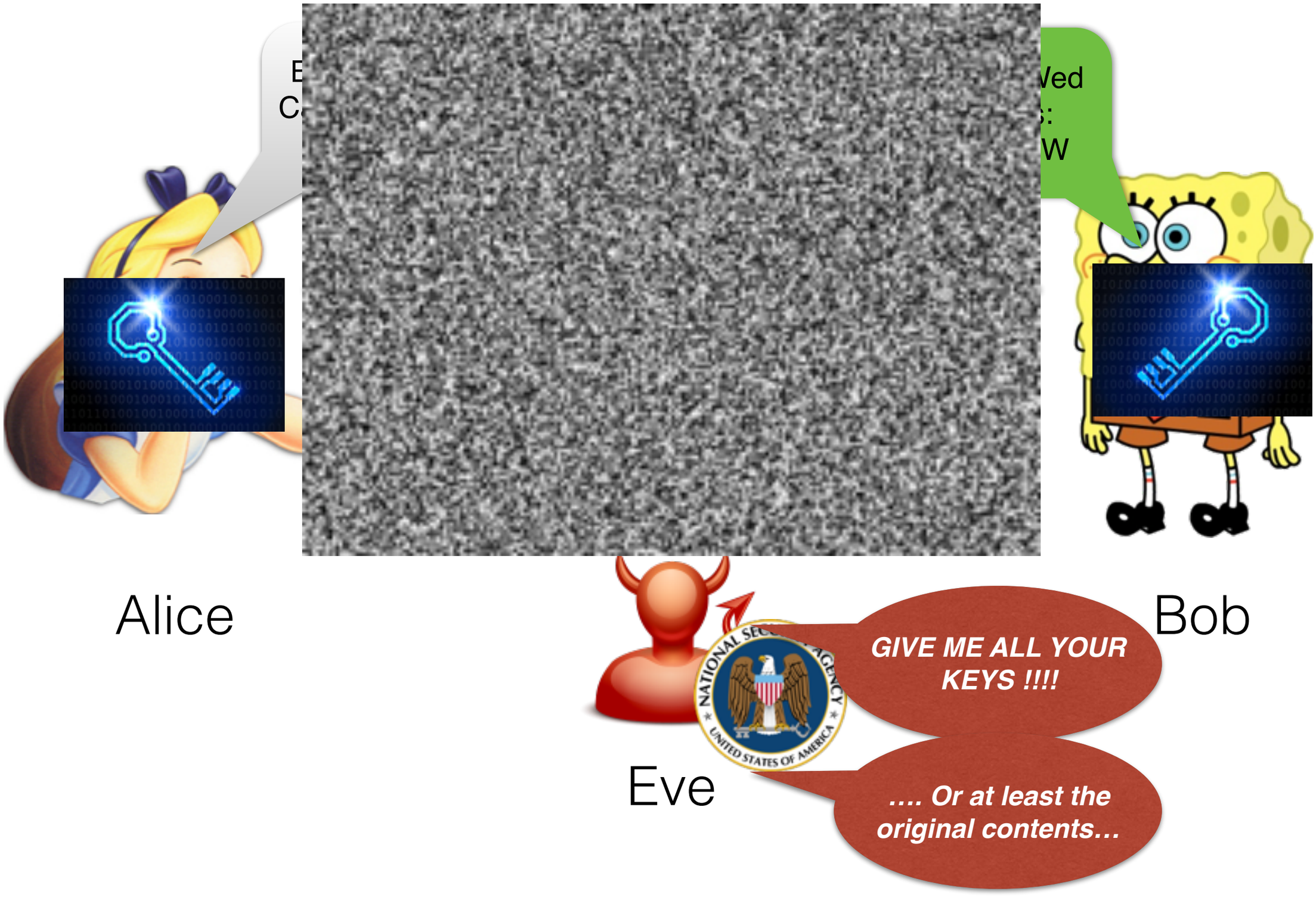

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- **Deny act of encryption** (using authentication only)

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- Deny the existence of communication (DenaLi)

Original *Chaffing and Winnowing*

- Hi Bob, Meet me at 7PM Love-Alice

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    - (1, Hi Bob, 465231)

    - (2, Meet me at, 782290)
    - (2, I'll call you at, 793122)

    - (3, 6PM, 891231)
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seq	*msg*	*auth*

Additions by Chaffinch

- **All-or-Nothing transformation** (more randomness, more effort for attacker)

- **Pass multiple messages.**

Chaffinch

Session	
Message 3 Section 1	Message 3 Authenticator
Message 1 Section 1	Message 1 Authenticator
Random	Random
Message 1 Section 2	Message 1 Authenticator
Message 2 Section 1	Message 2 Authenticator
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Fig. 1. Conceptual view of a Chaffinch block

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4byte

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128+ sections

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Block Construction

- Encode the messages
- Compute the authenticators

Message Generation (BEAR)

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- $L \,||\, R <= Nonce \,||\, M$

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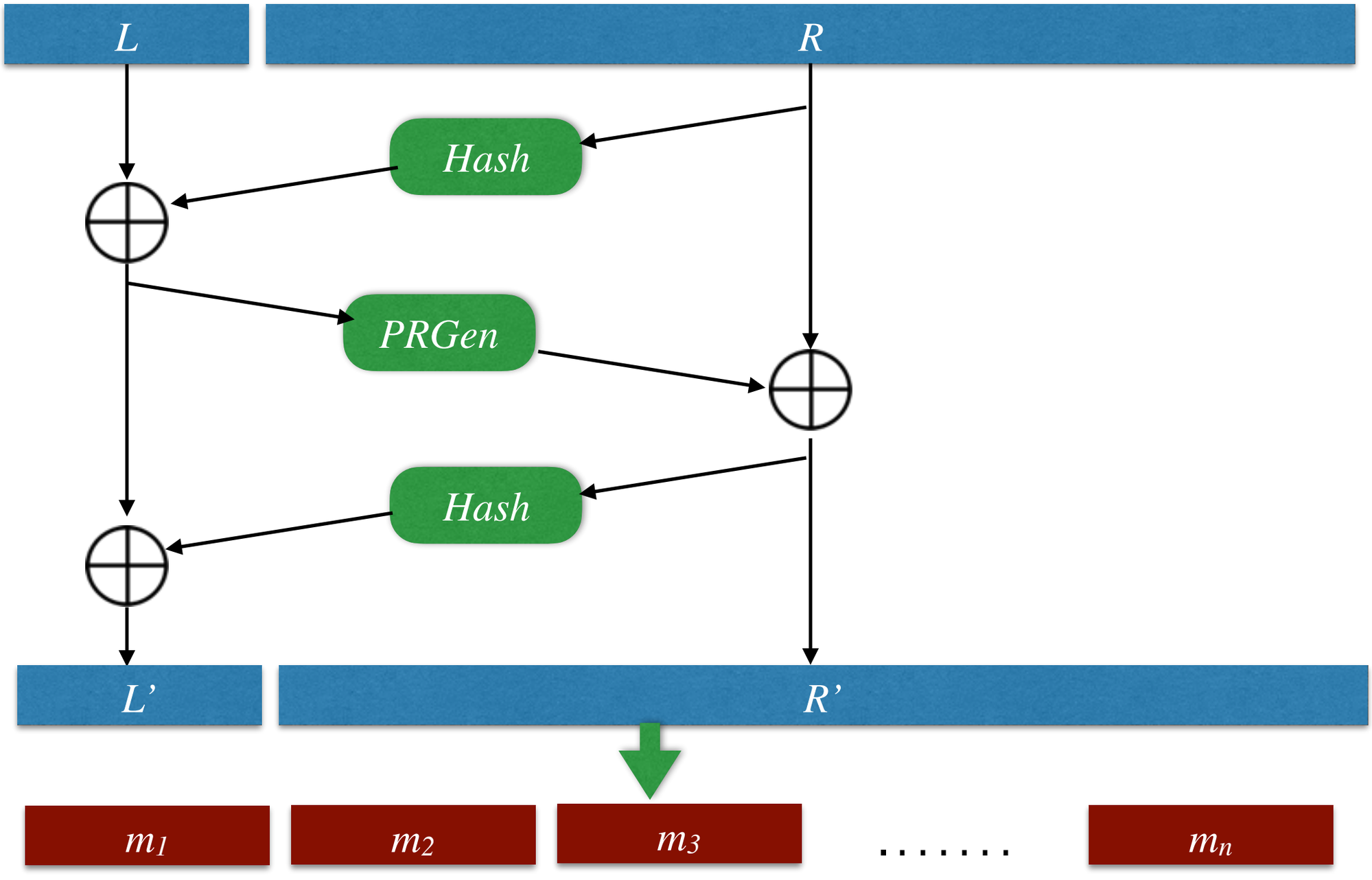

Block Construction

- Choose random arrangement of `(msg, auth)` pairs
- Sections of the same message stay in order
- Prepend with metadata `nonce, session, length, hash(nonce || full msg)`

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- BEAR transformation: messages are reclaimed "*all-or-nothing*", and maximum effort for brute-force.

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- Consistent behaviors of *BOTH* parties!

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- No implementation, not a complete system
- Probabilistic message recovery: timing attack
- Bandwidth and computation overhead

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(improved) “All-or-Nothing” Transformation

$$m'_i = m_i \oplus E(K', i) \quad \text{for } i = 1, \ldots, s$$

$$M = K' \oplus h_1 \oplus h_2 \oplus \ldots \oplus h_s$$

$$h_i = E(K_0, m'_i \oplus Z) \quad \text{for } i = 1, \ldots, s$$

$$Z = \text{HASH}(m'_1, m'_2, \ldots, m'_s)$$

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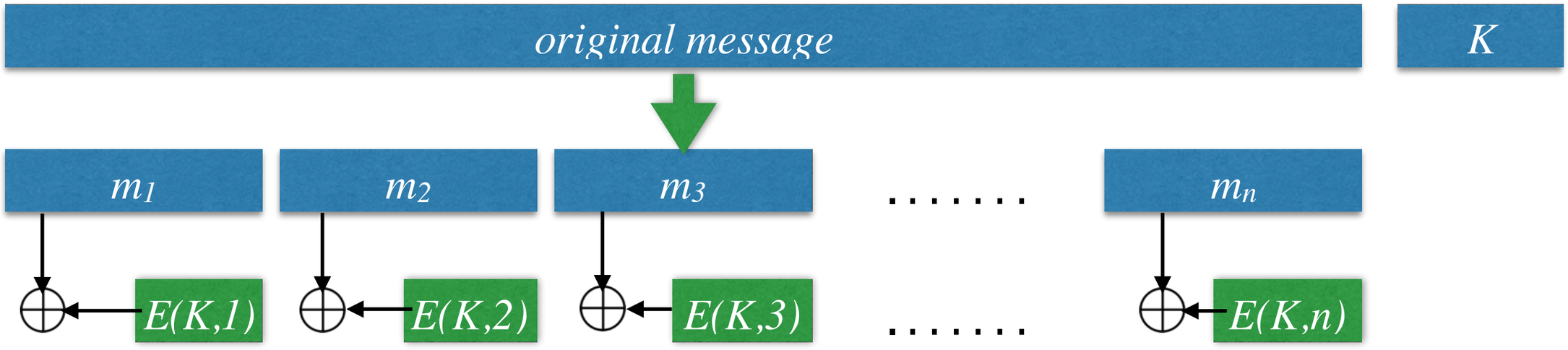

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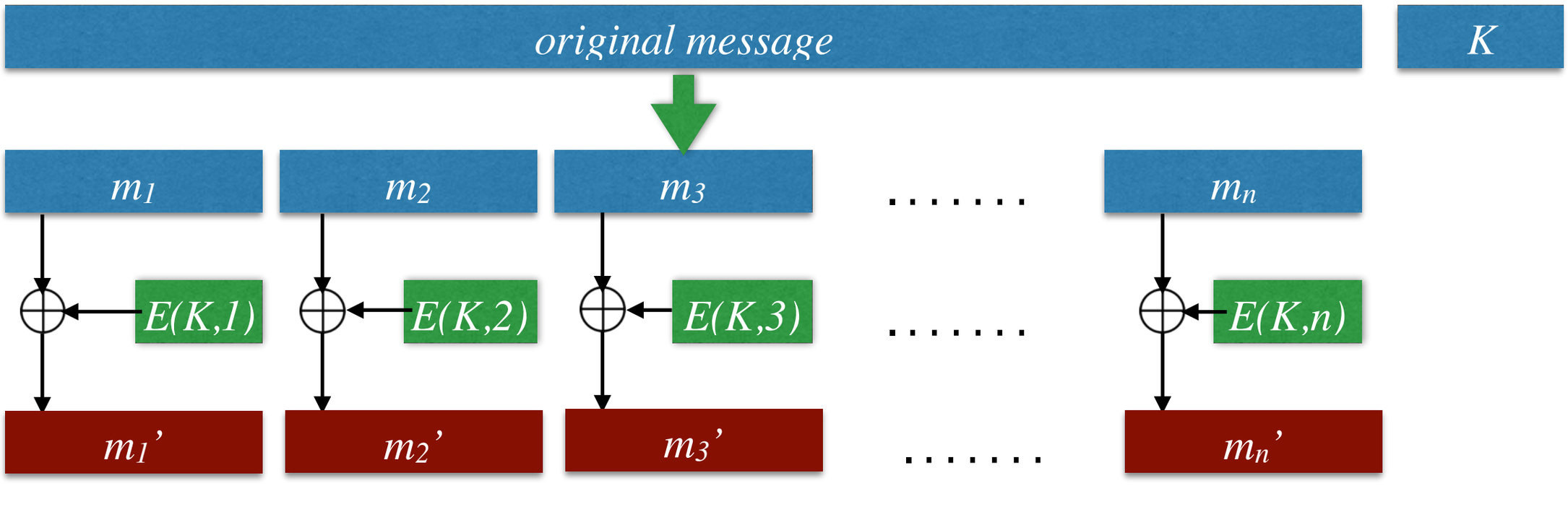

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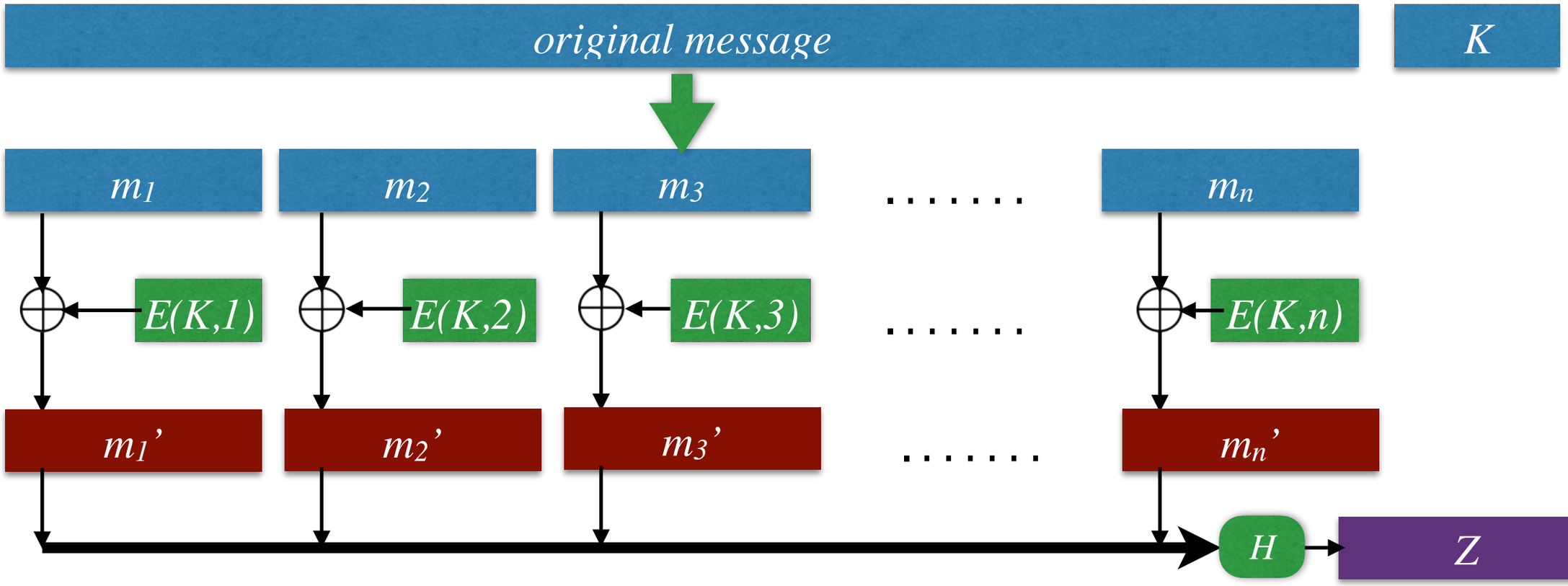

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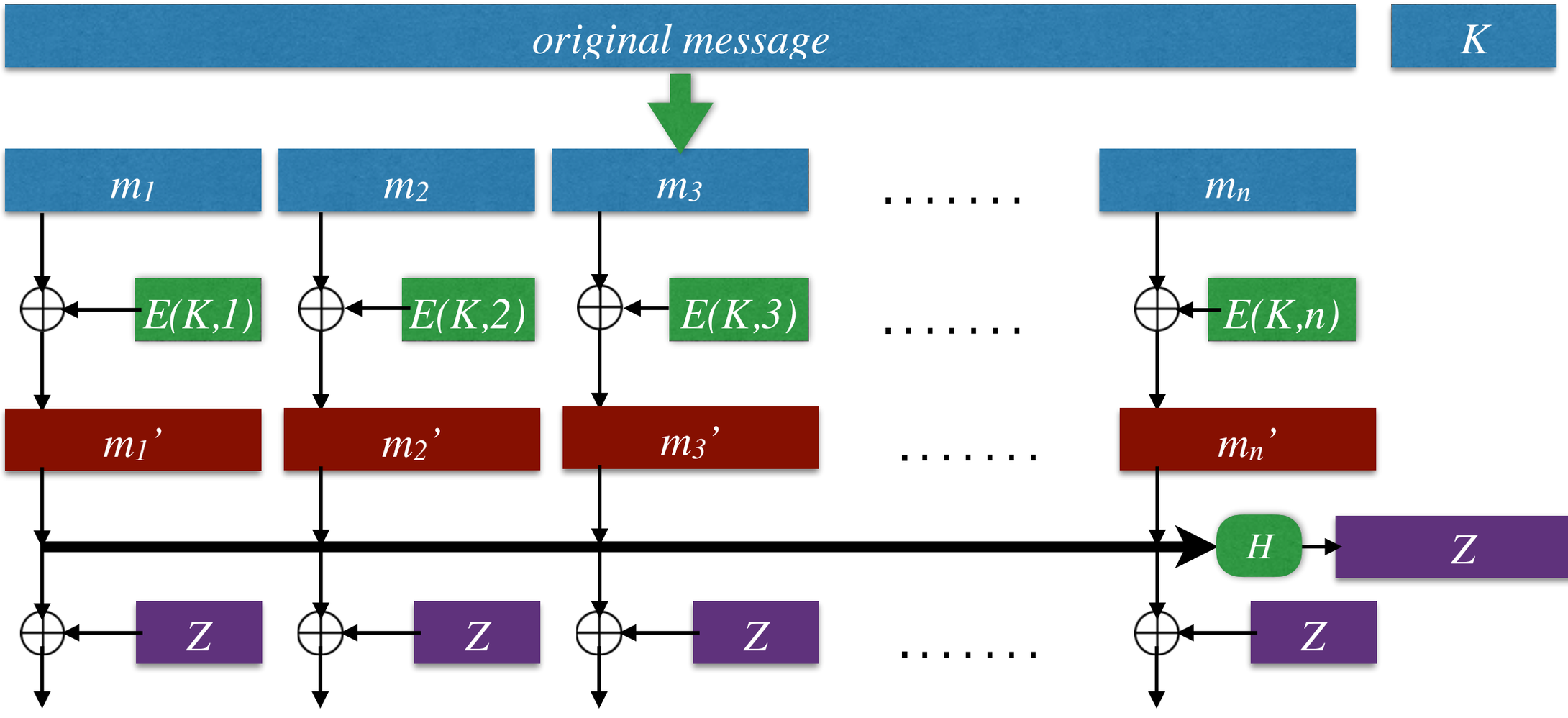

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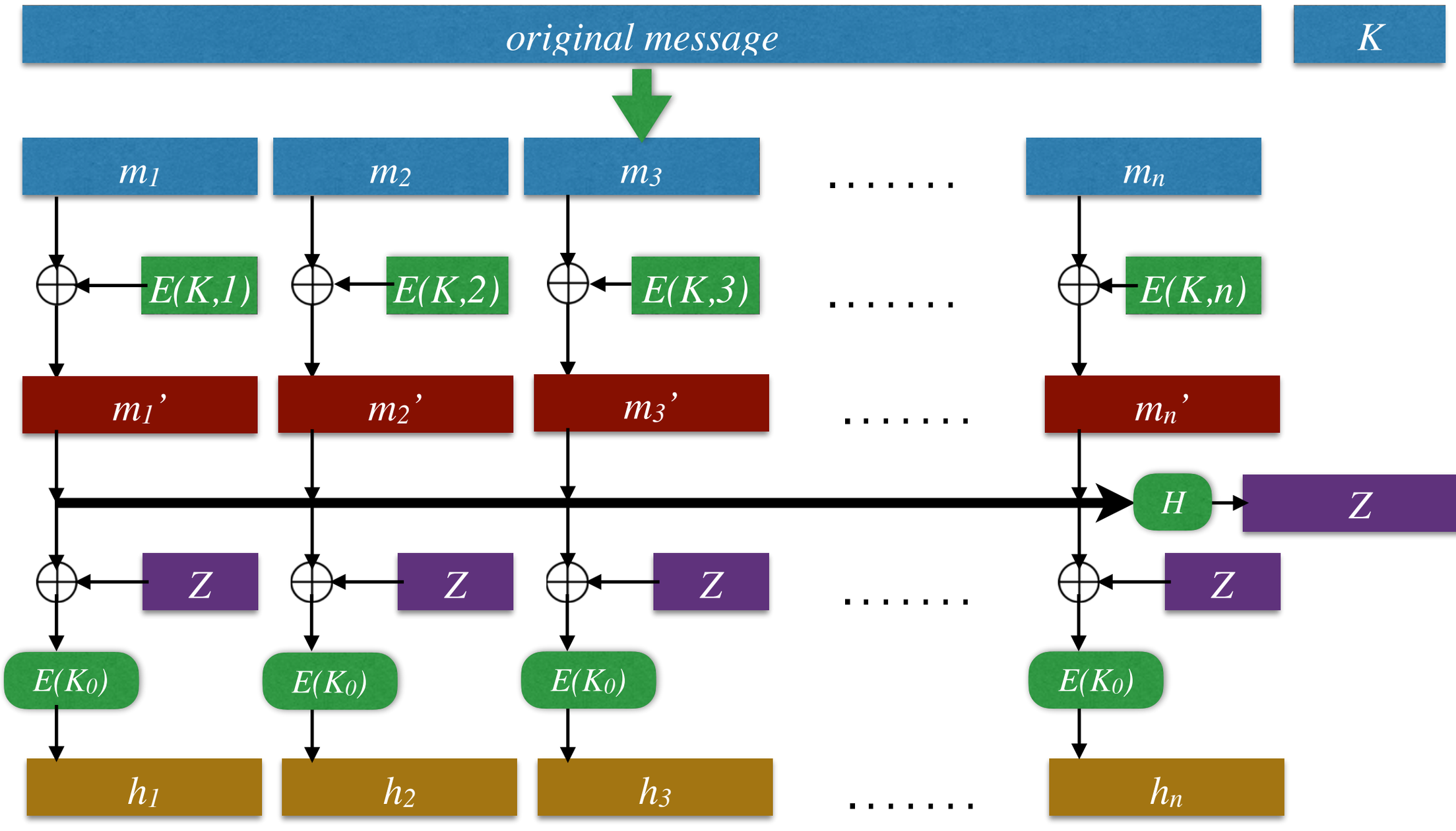

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