Formalizing Known-Key "Distinguishers" - New Attacks on Feistel Ciphers

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CRYPTO 2010 Rump Session 17/Aug./2010 @ UCSB

1.

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2.

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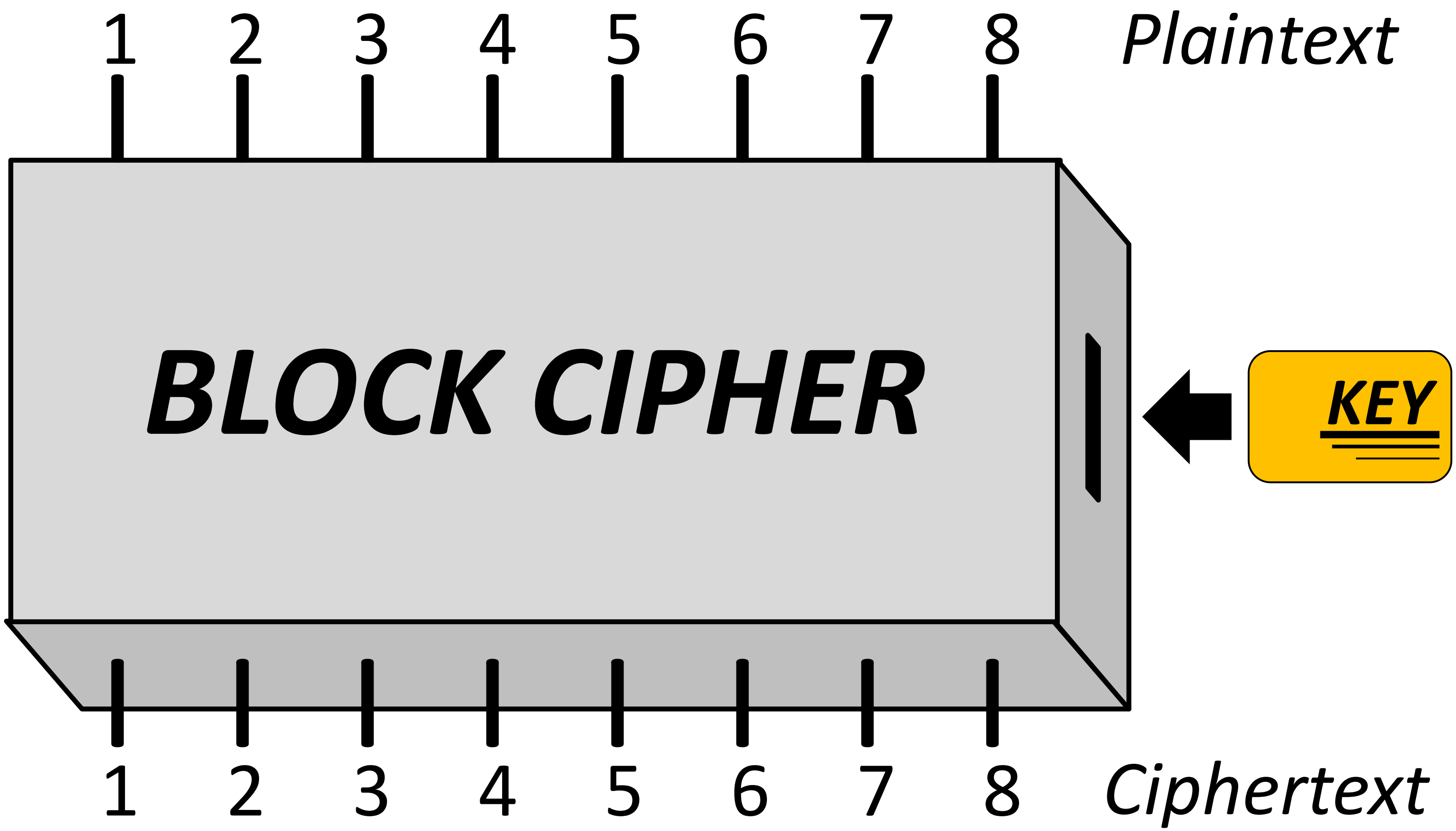
(3-bit) Block Cipher

Key Dependent Permutation



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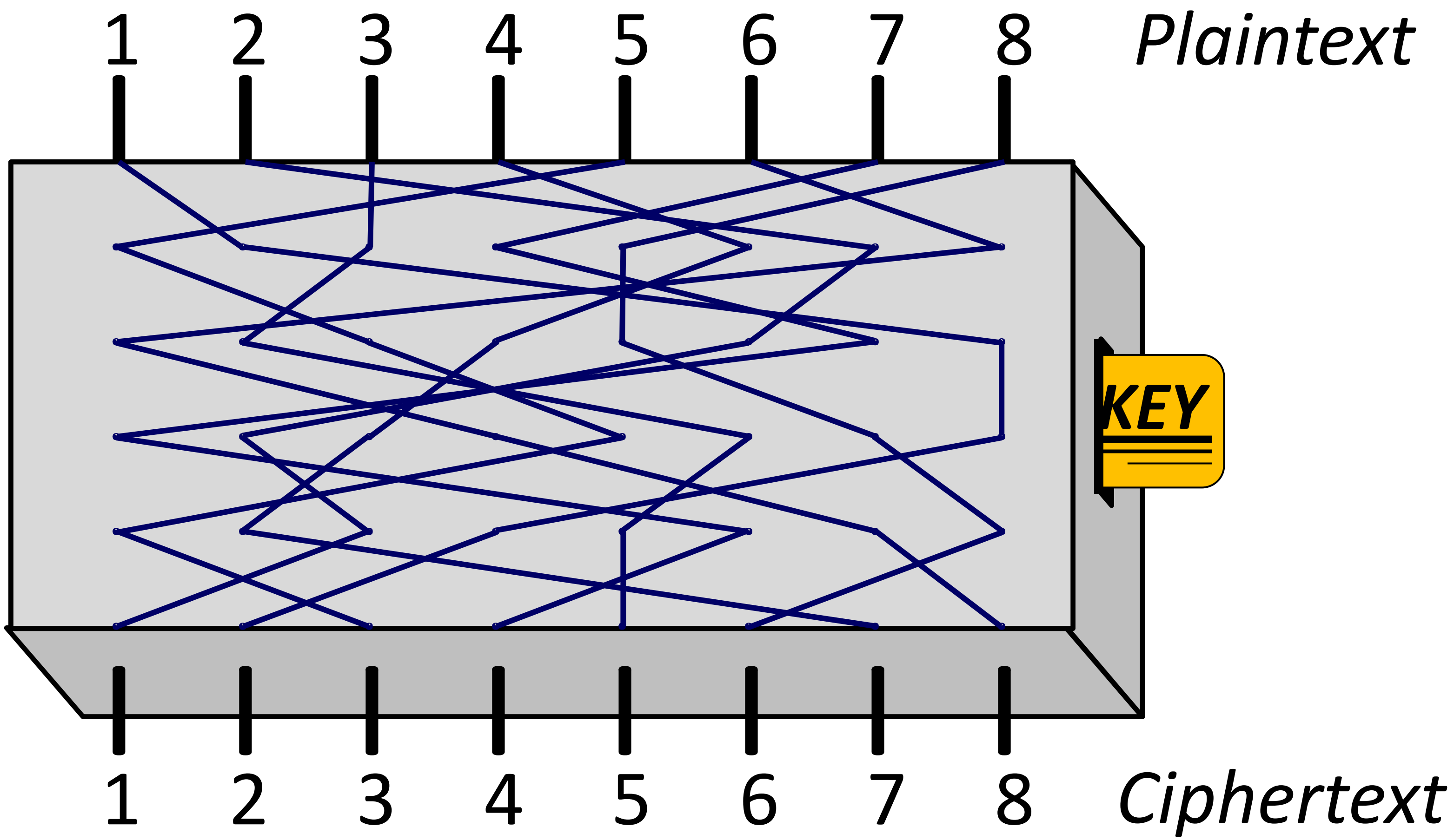
(3-bit) Block Cipher

Choose a key. ➡ Permutation is fixed.



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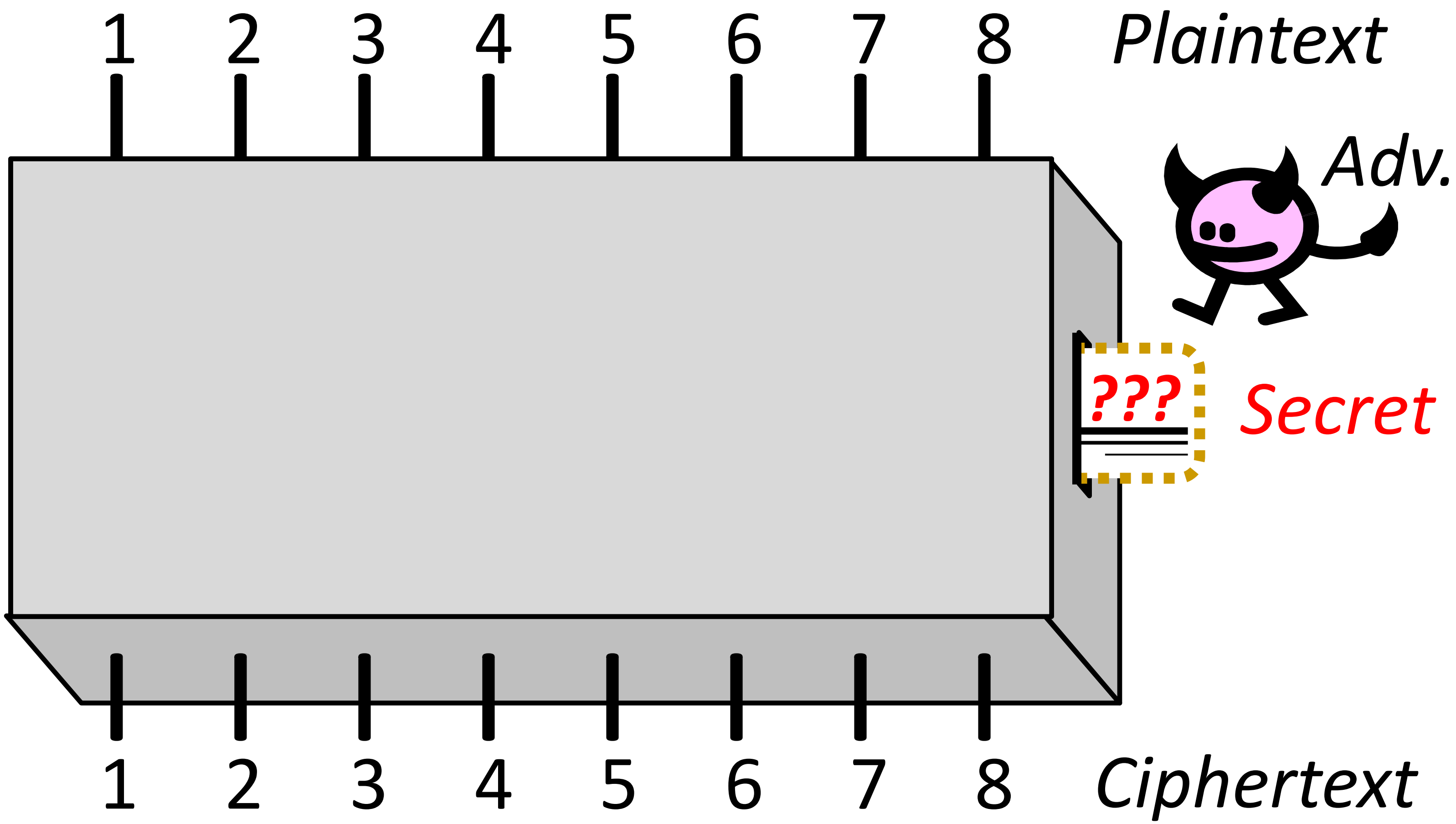
Attacker's Goal on Block Ciphers

Distinguish / Key Recovery



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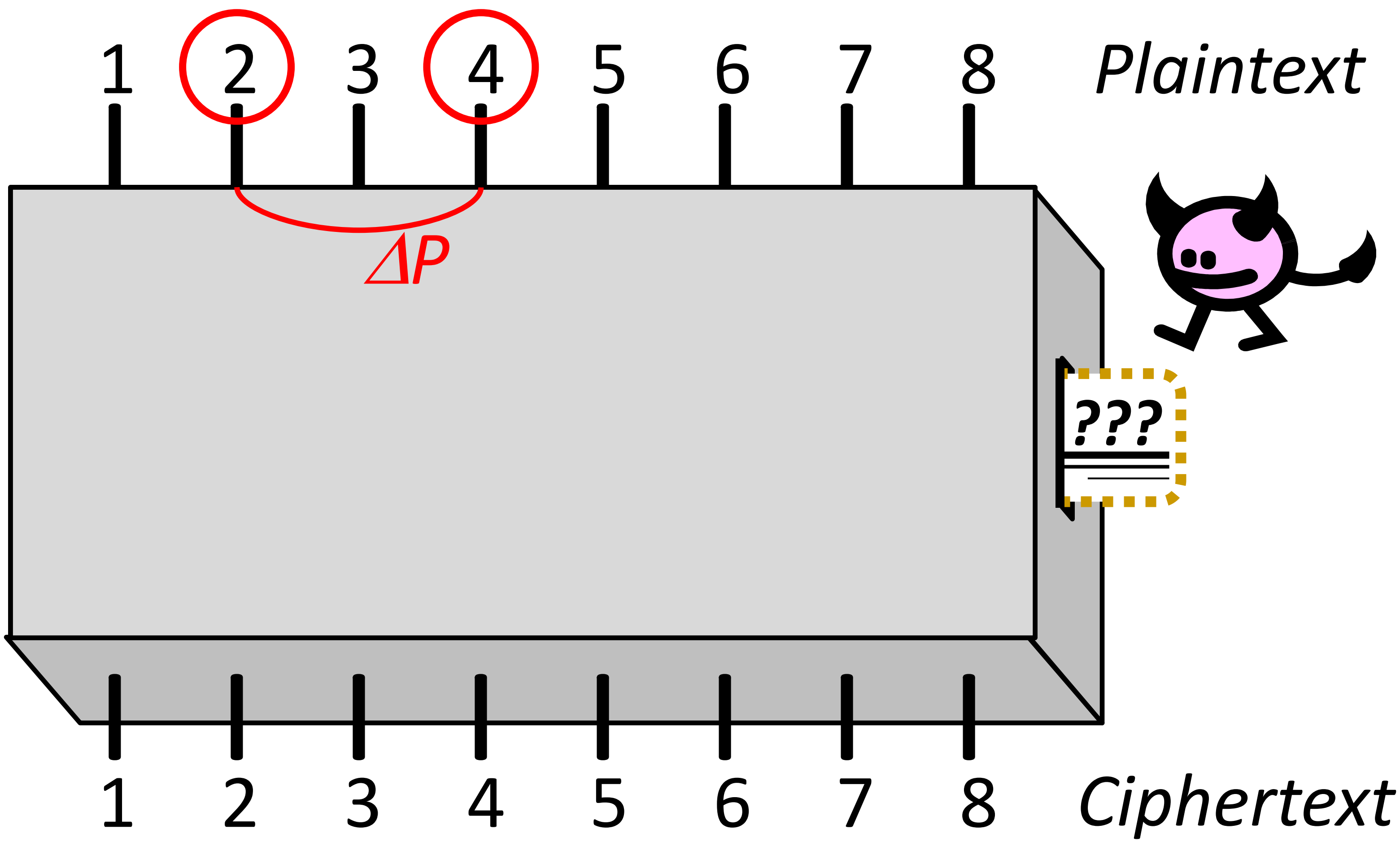
Attack Models (Classic)

Differential Attack



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Attack Models (Classic)

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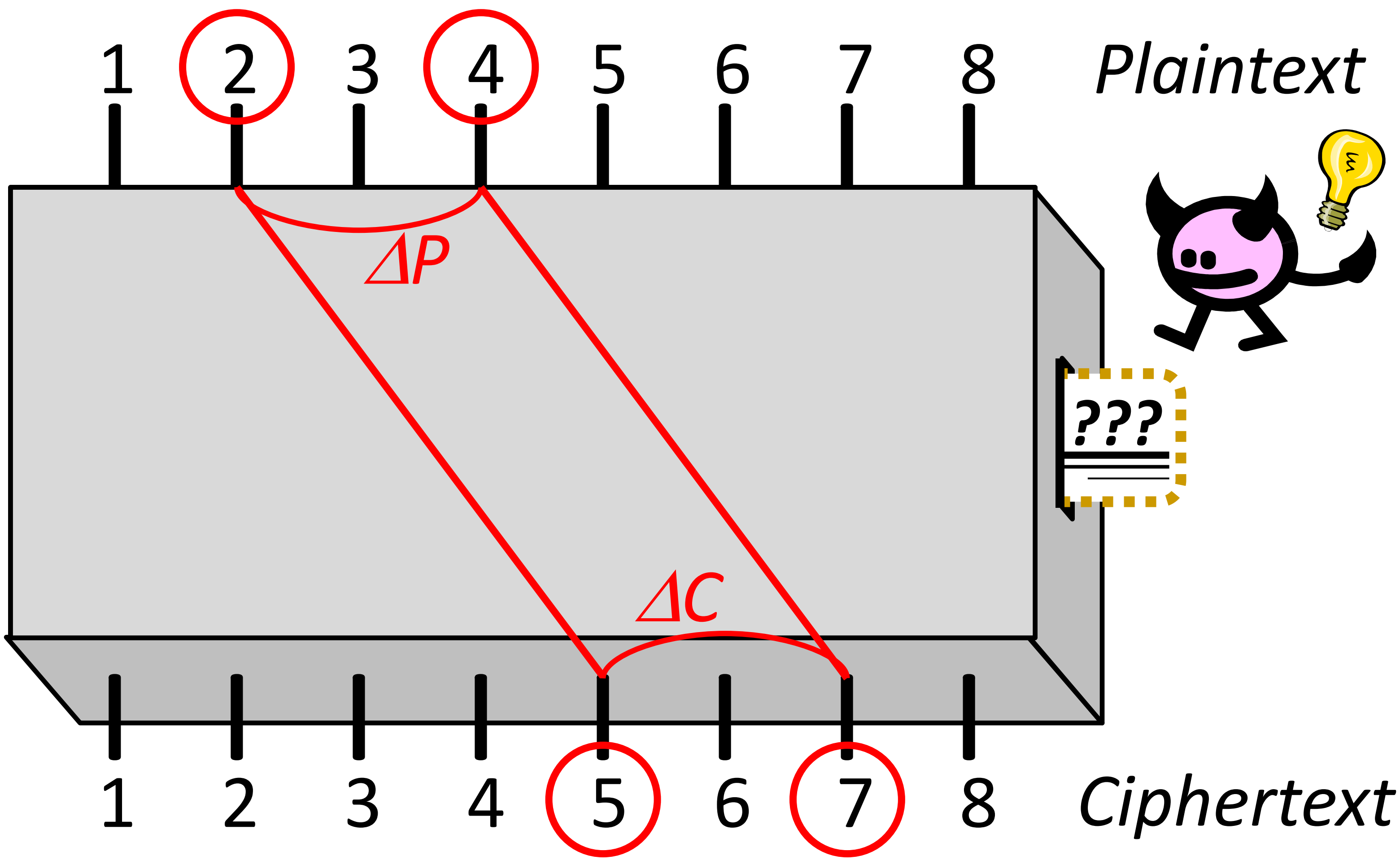

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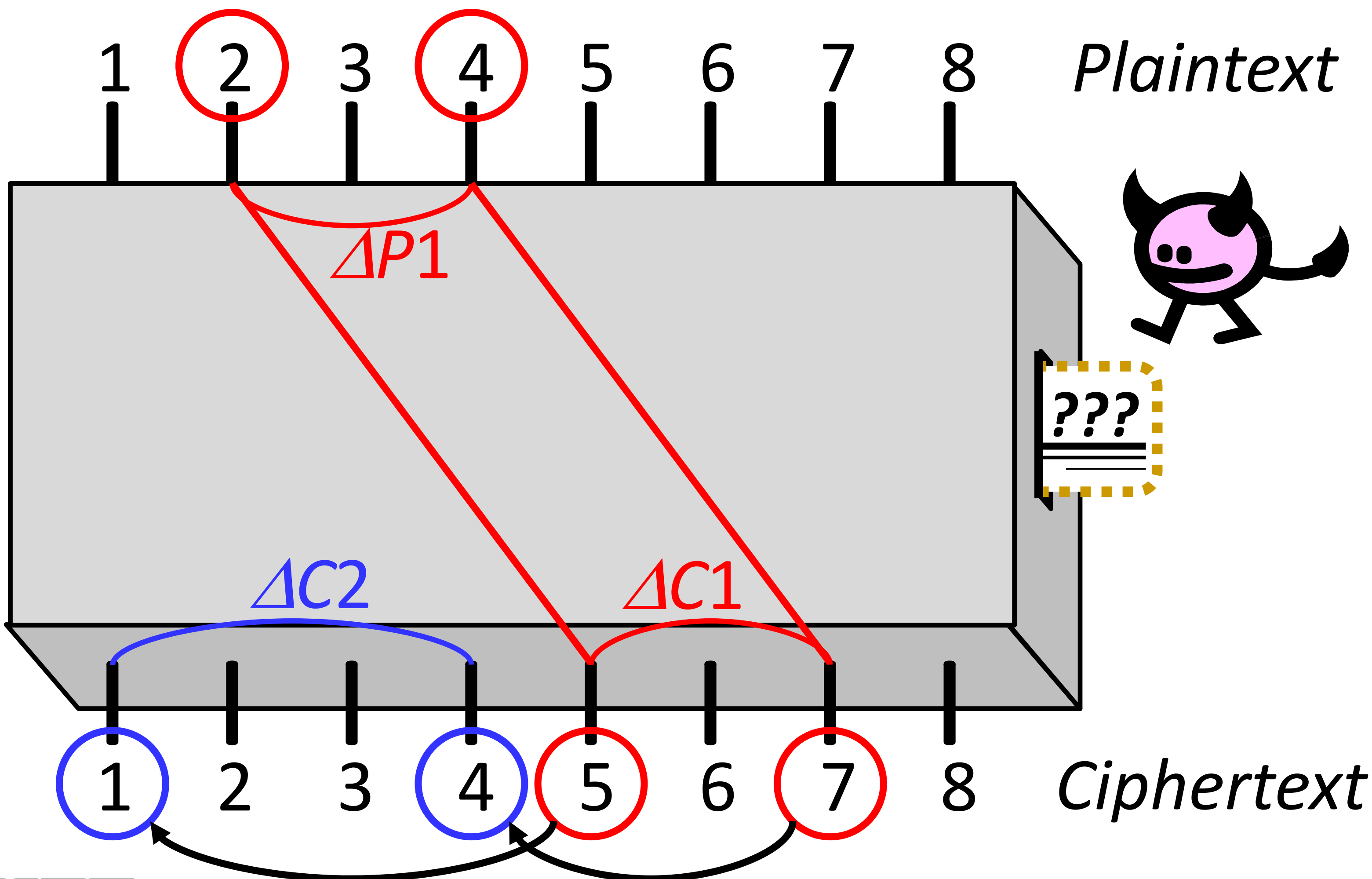
Attack Models (Adaptively Chosen)

Boomerang Attack



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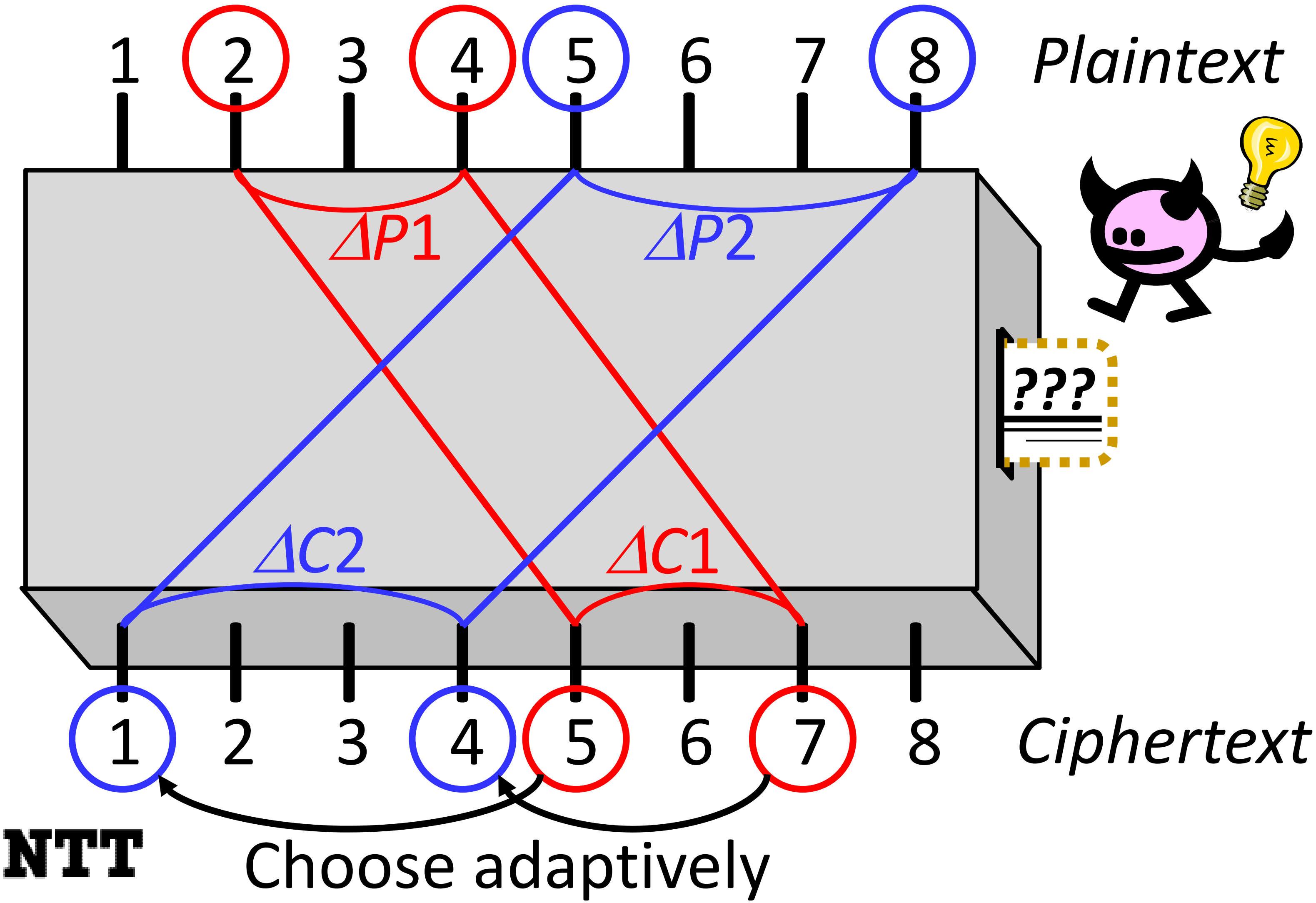
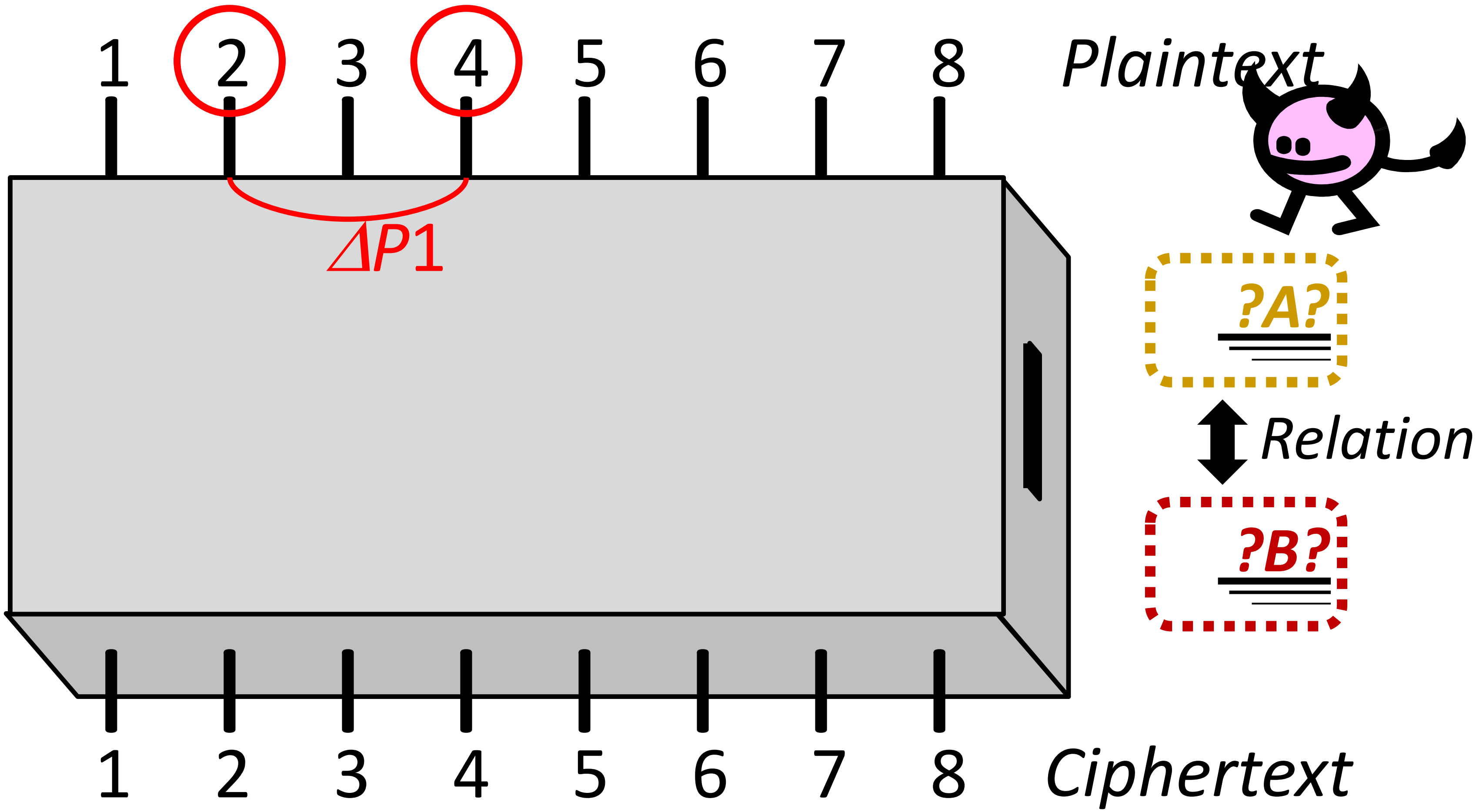
Attack Models (Adaptively Chosen)

Boomerang Attack



Attack Models (Related-Key)

Related-Key (Differential) Attack



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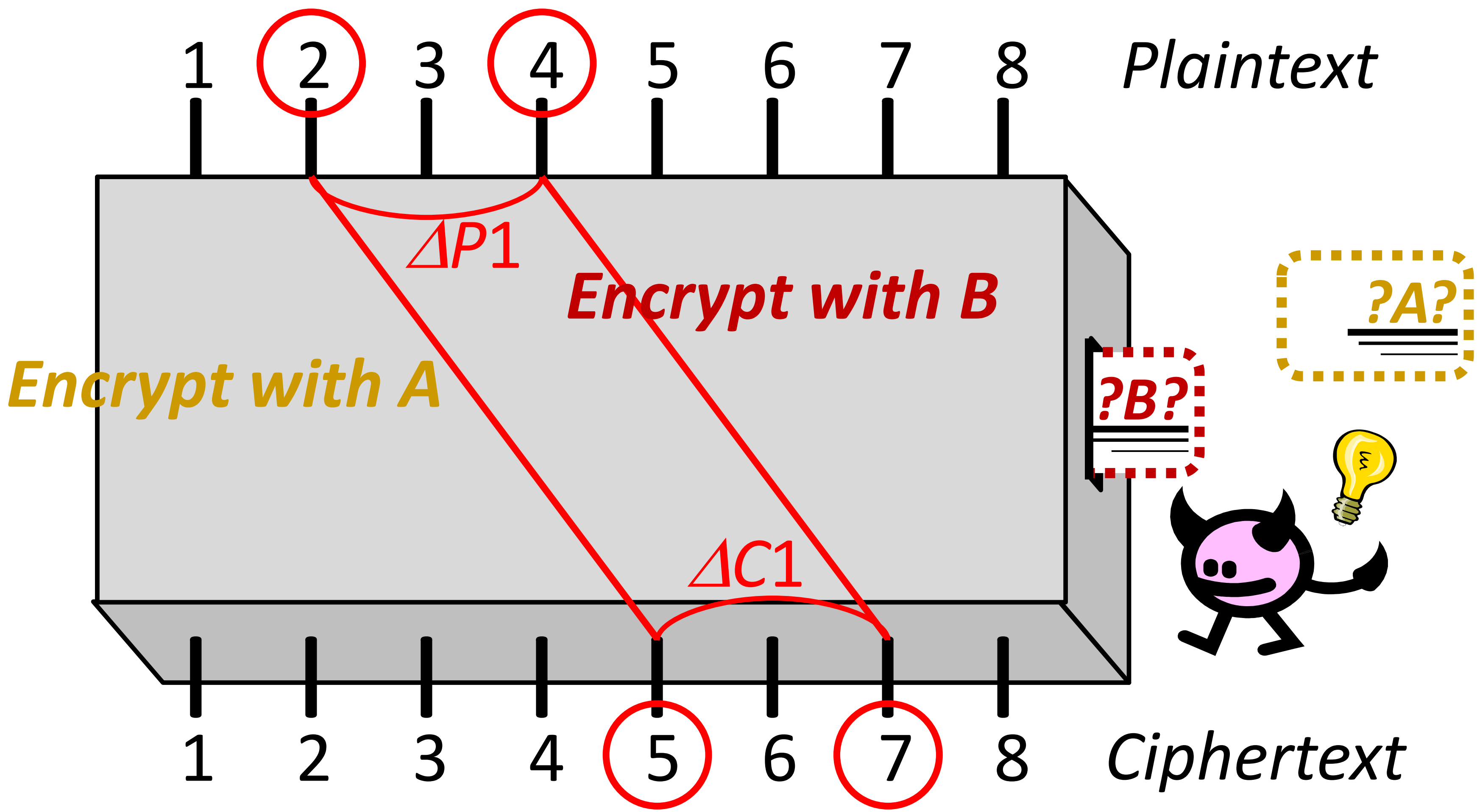
Attack Models (Related-Key)

Related-Key (Differential) Attack



- More and more complicated attack models are considered to recover the key.

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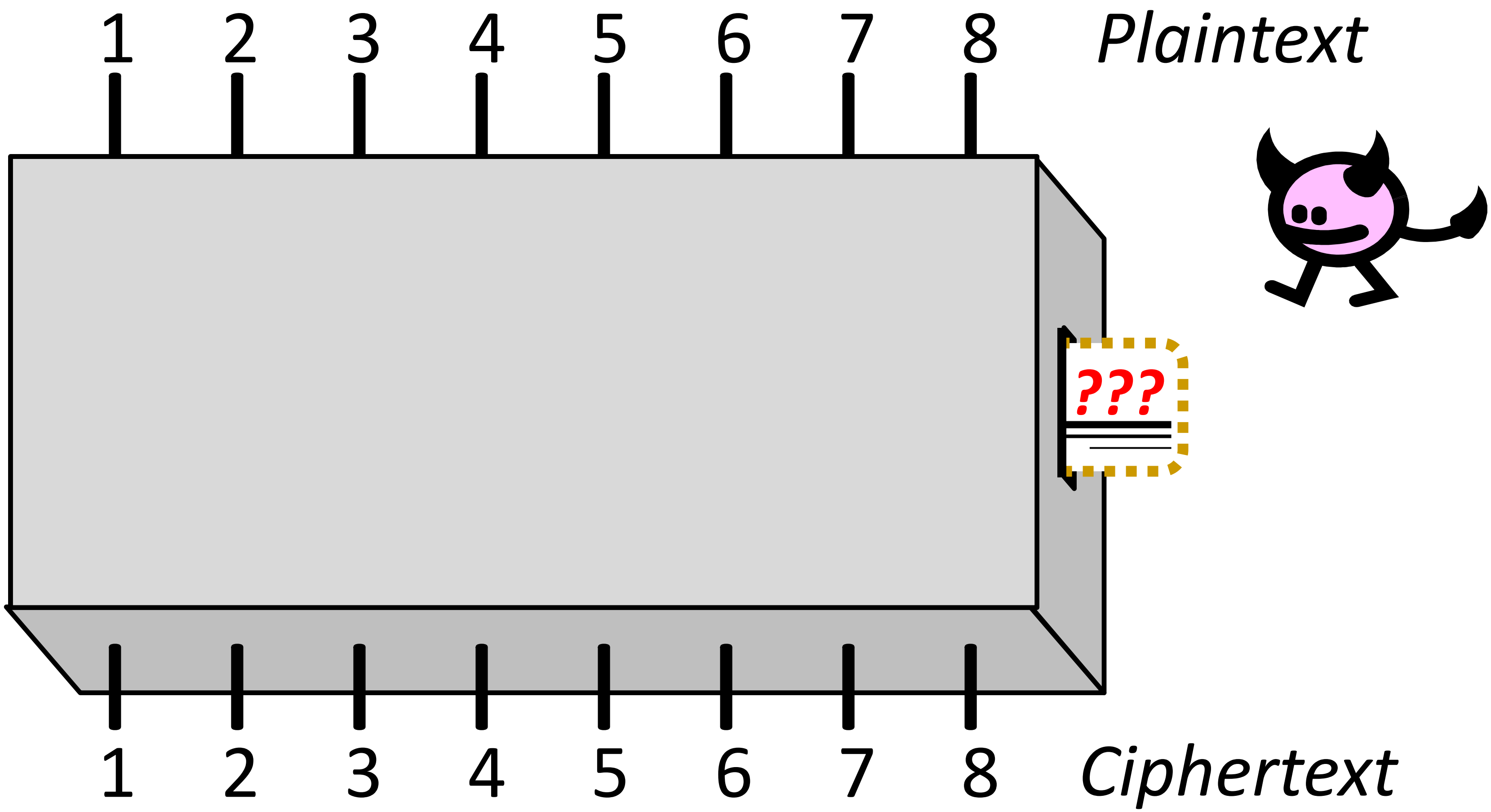
- Another simple attack model:

Known-Key Attack

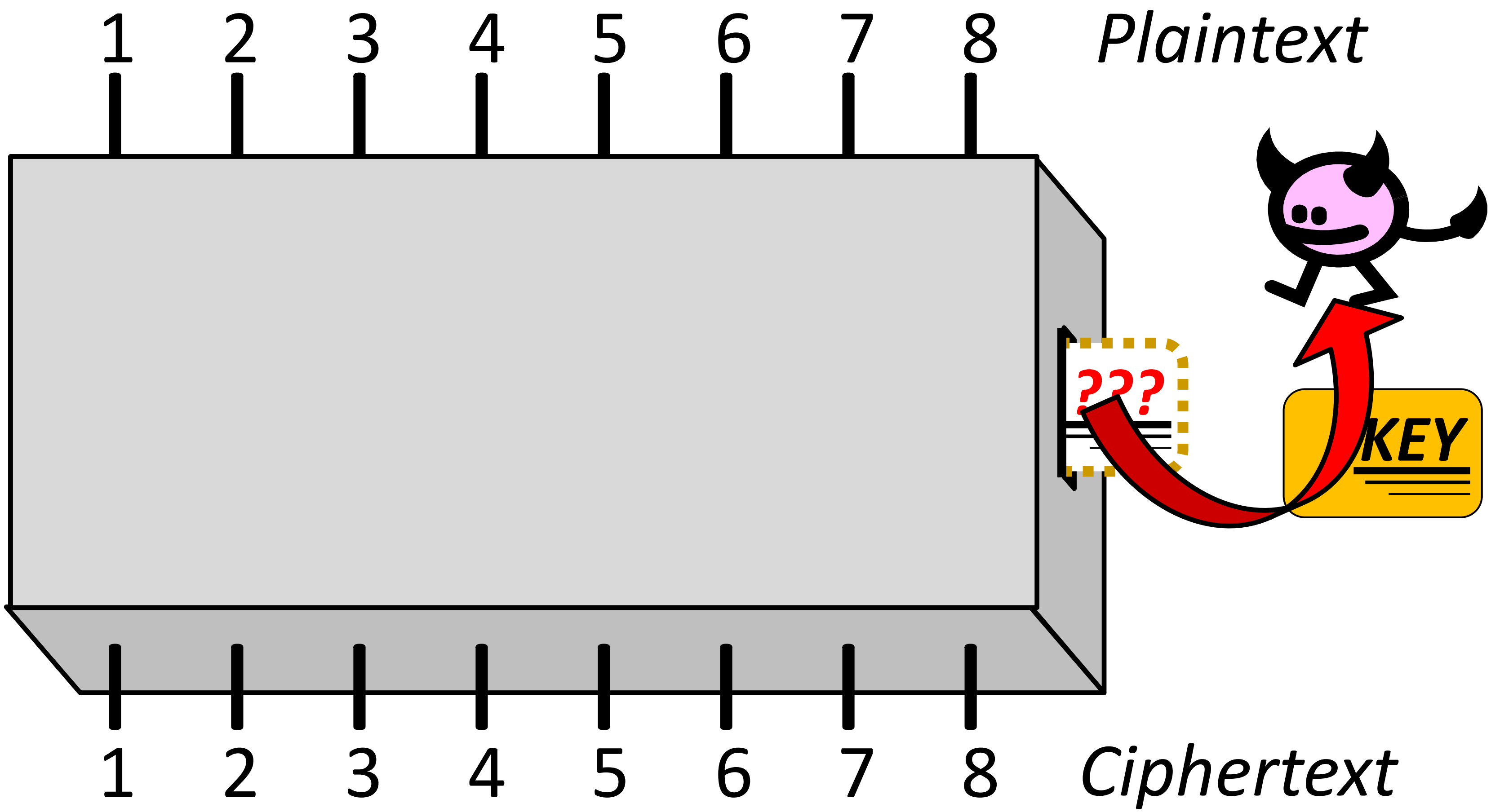
The concept was proposed by Knudsen and Rijmen at Asiacrypt 2007.

Known-Key Model



Known-Key Model

The key is given to the attacker !!



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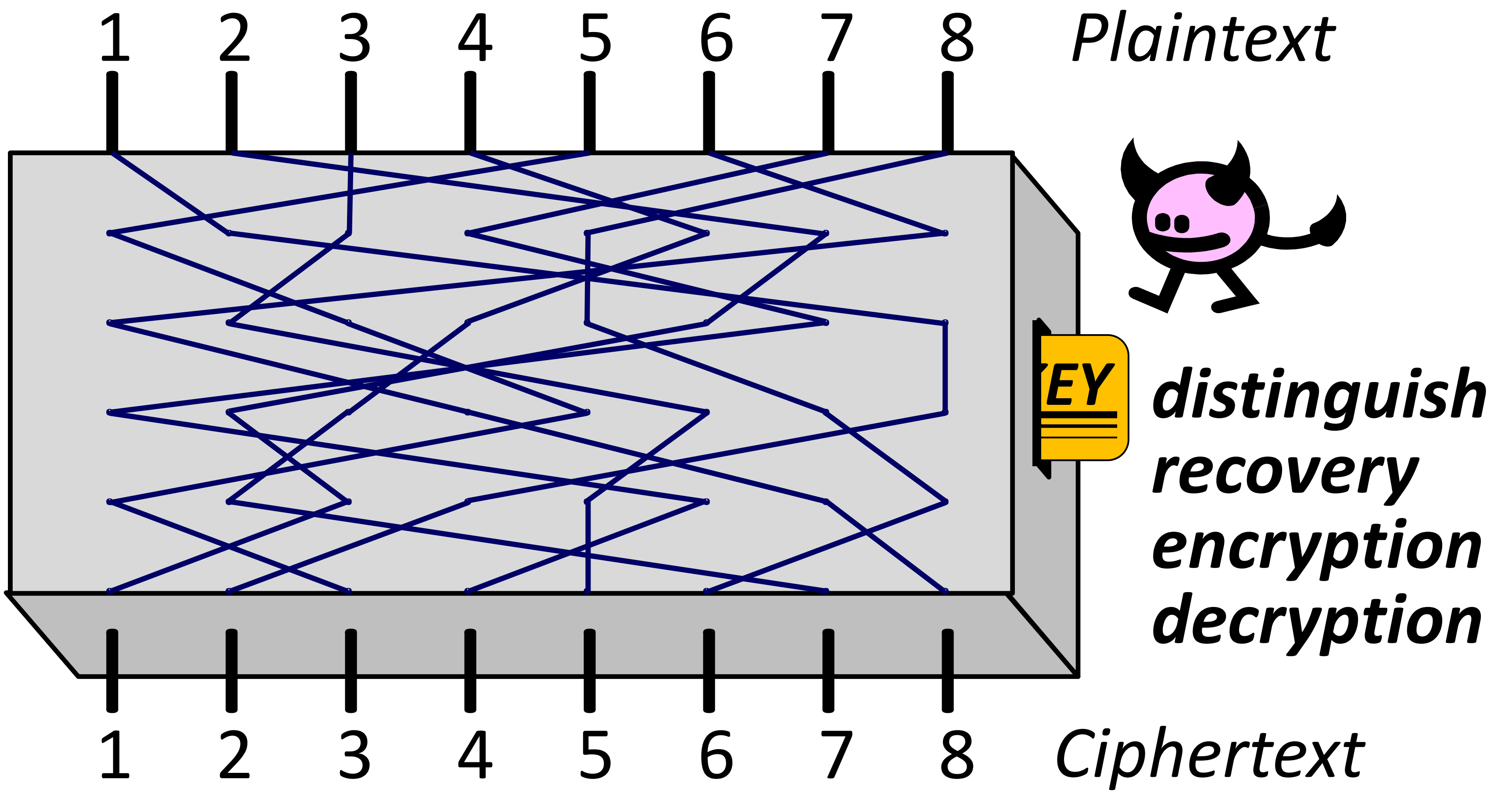
Known-Key Model

The attacker can do everything !!



Known-Key Model

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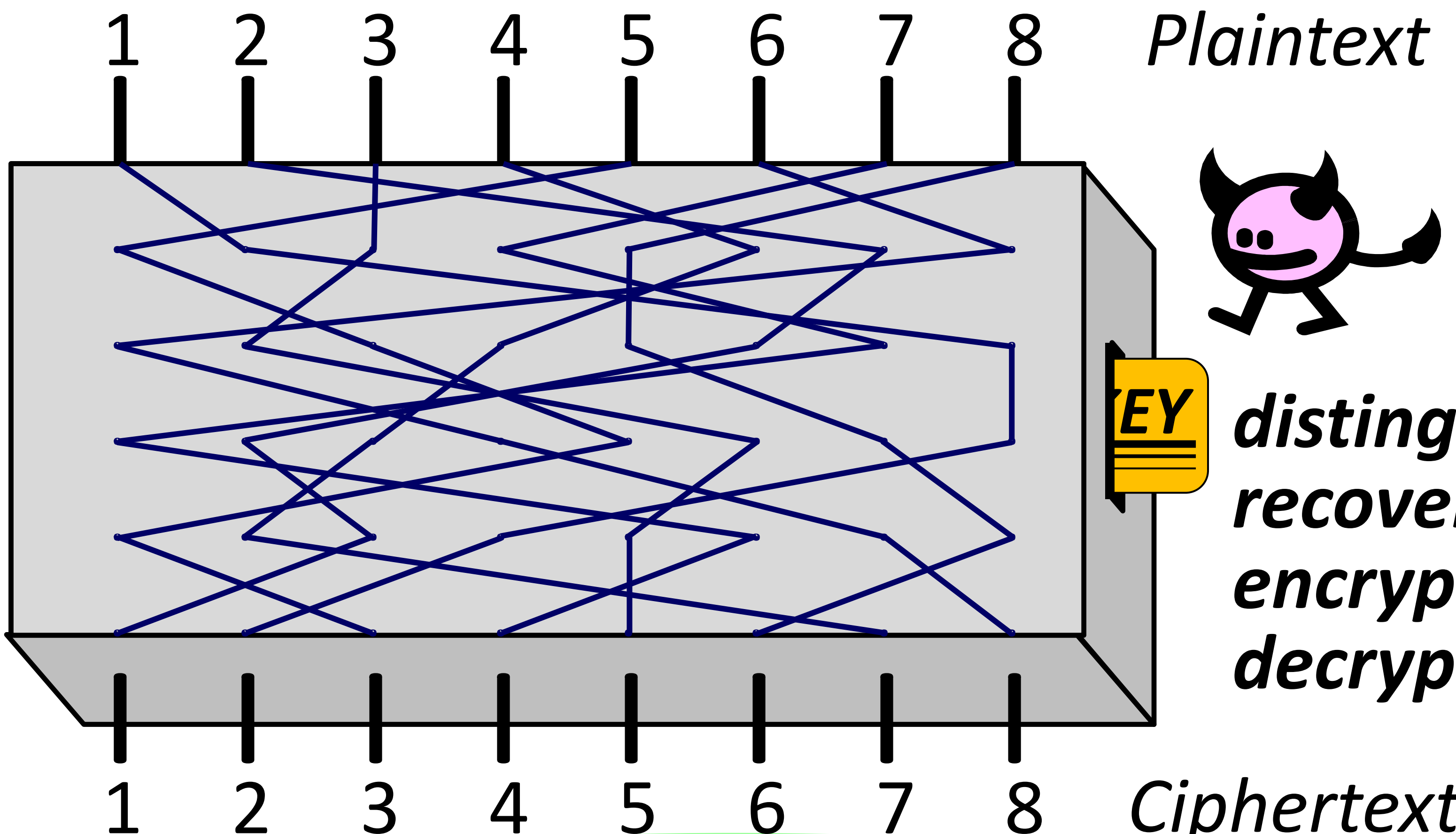

distinguish
recovery
encryption
decryption

What's the point??

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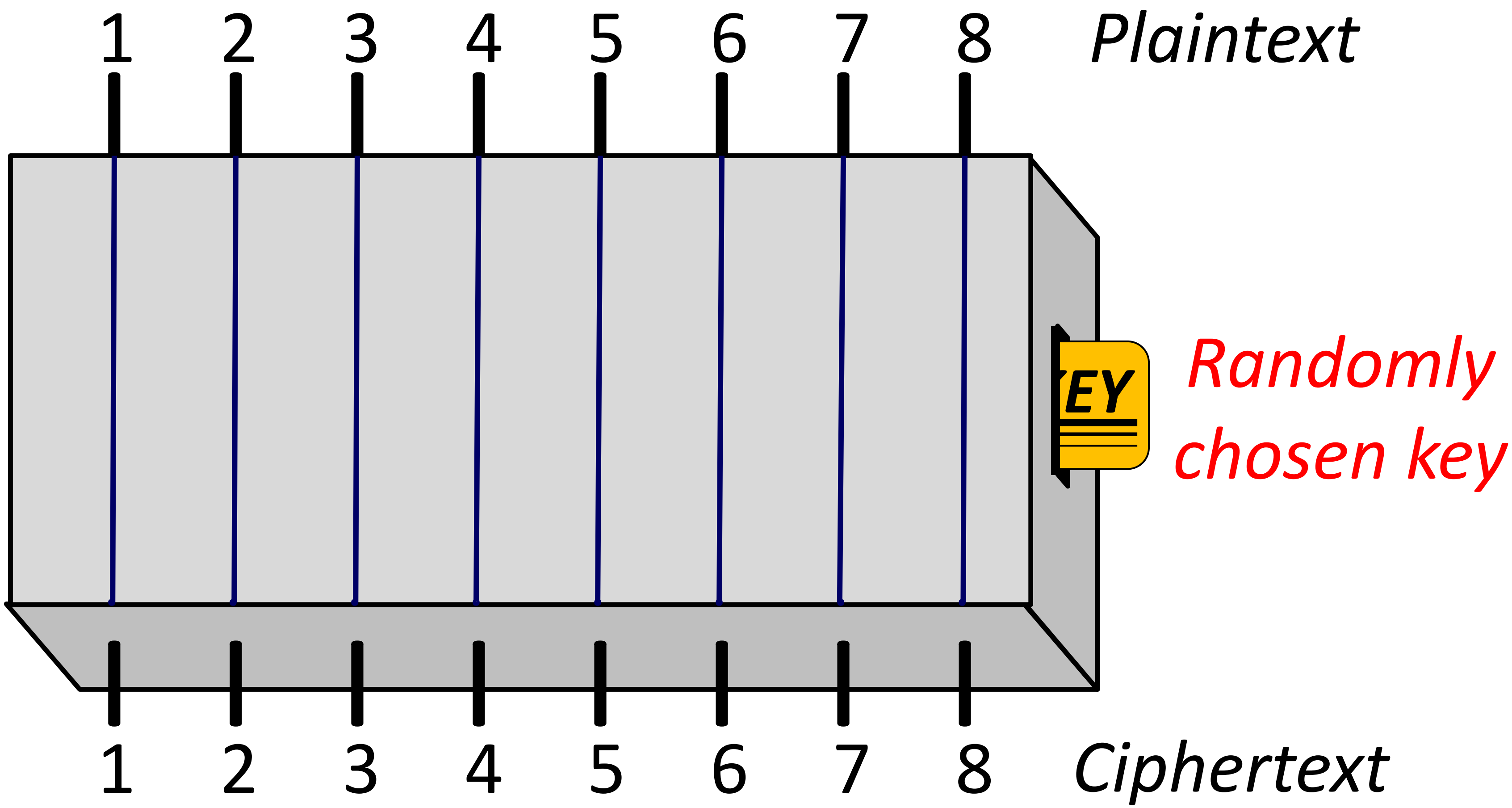
Undesired Situation

secure? if the fixed permutation is identity map



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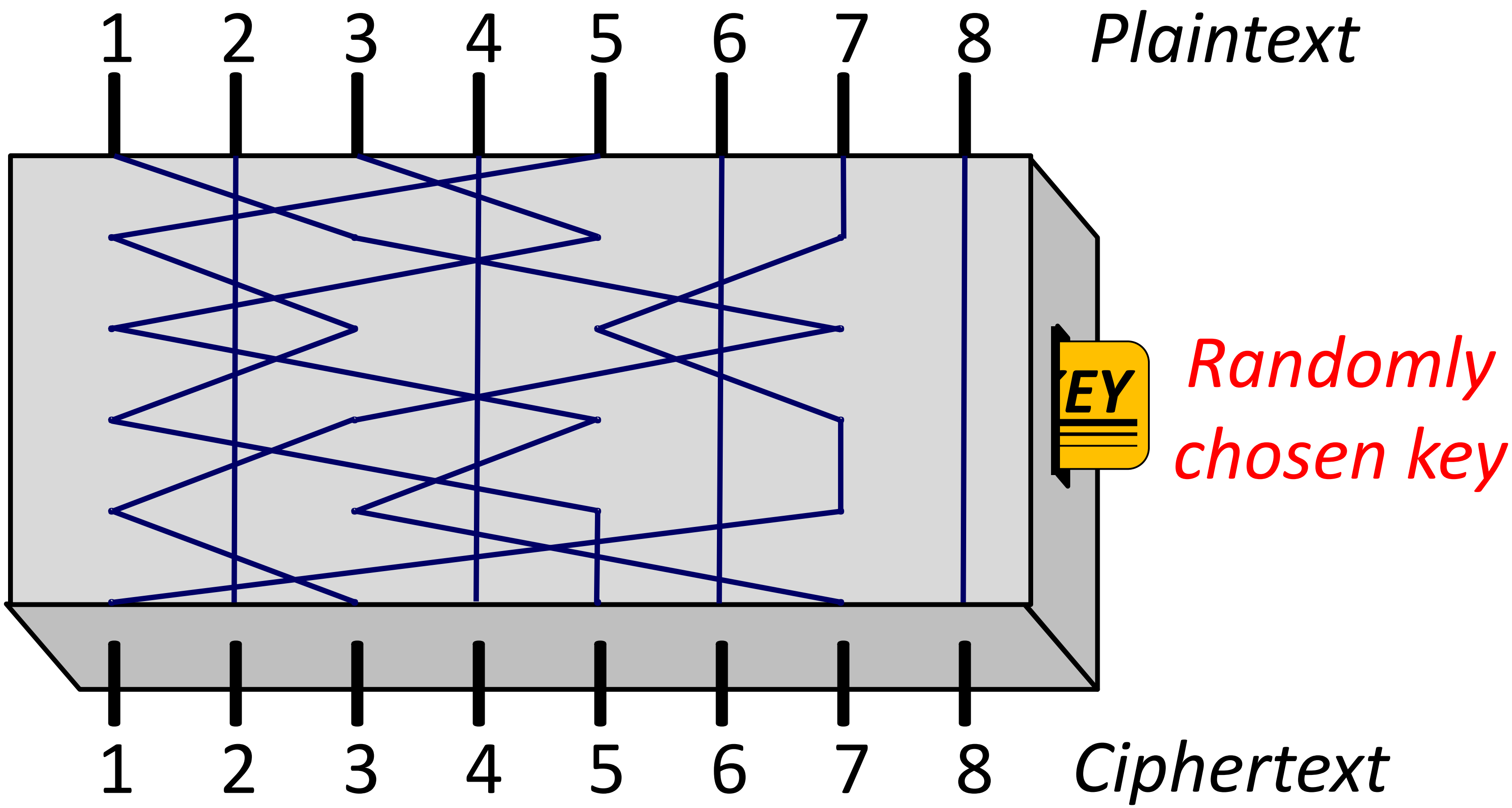
Undesired Situation

secure? if the fixed permutation has strong bias



Undesired Situation

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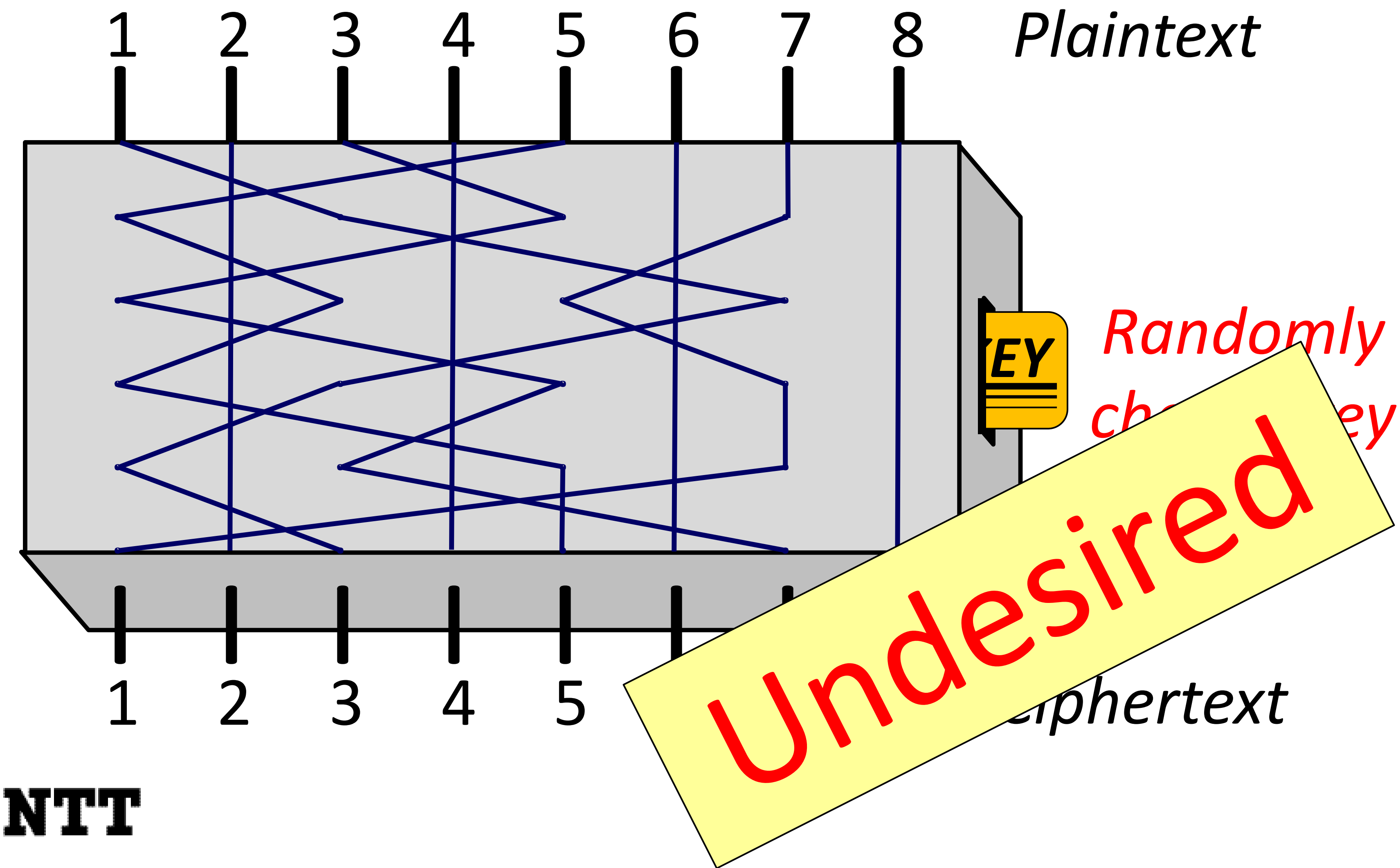
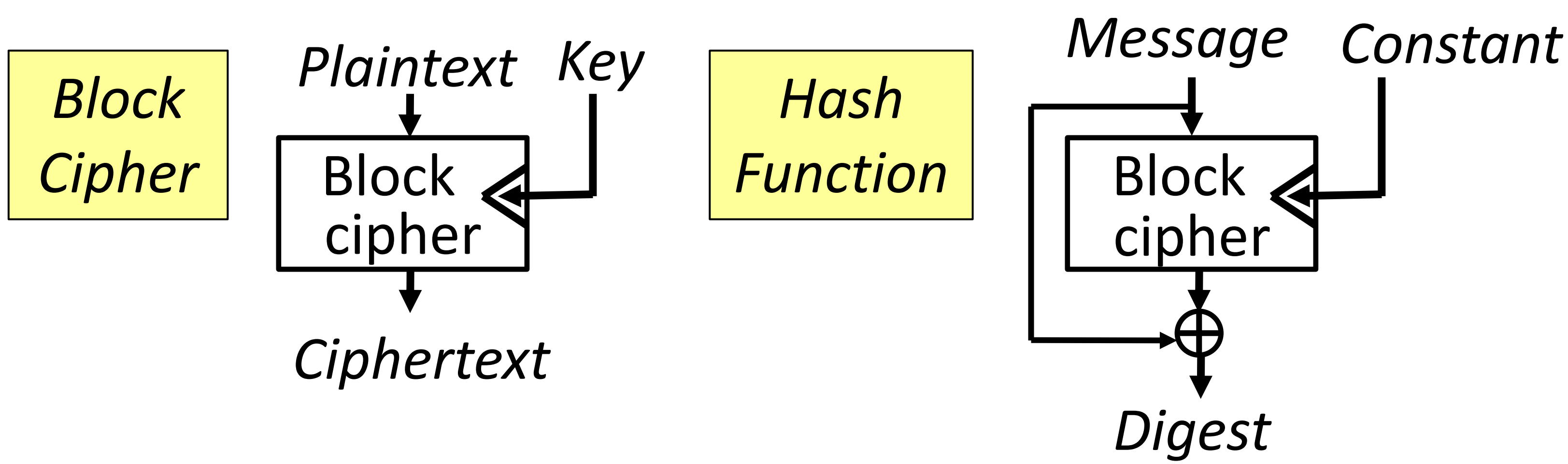


Known-Key Attacks

Goal is different. No secret any more!!

- Evaluate whether or not the fixed permutation with a randomly chosen key is ideal.
- Useful because block ciphers are often used as key-less primitives such as hash functions.

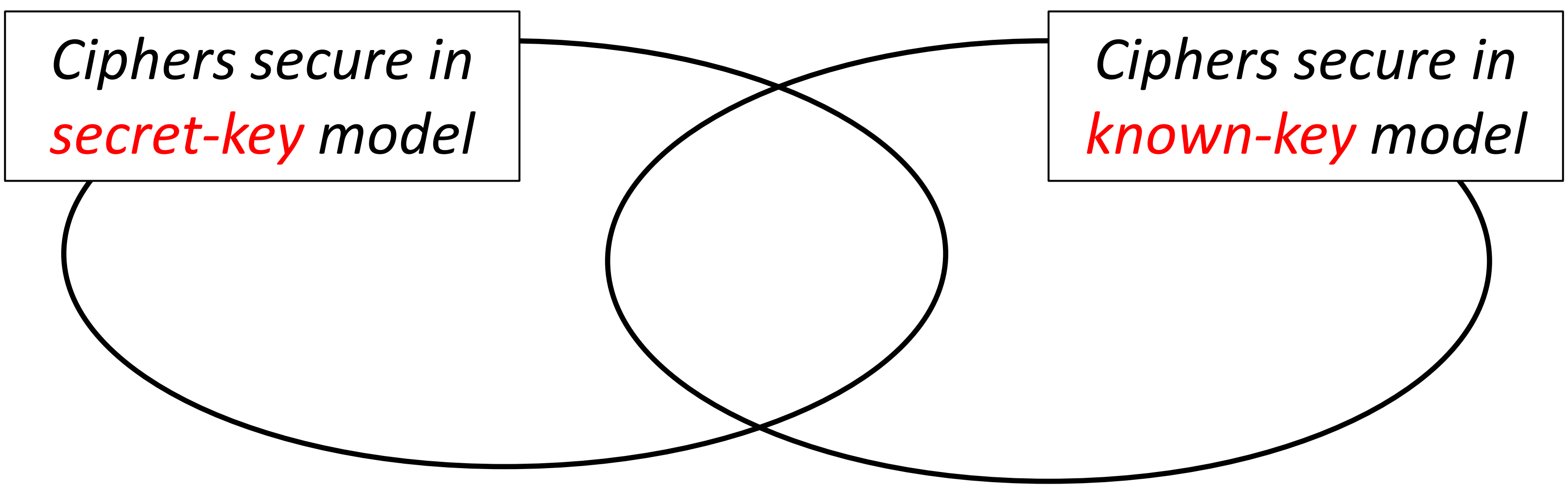


Secure ⇏ Secure

Our Recent Results

Our Results 1

- Give a formalization of known-key attacks which can cover all previous results.
- Show the separation of known-key and secret-key settings.



security in one $\not\Rightarrow$ security in the other

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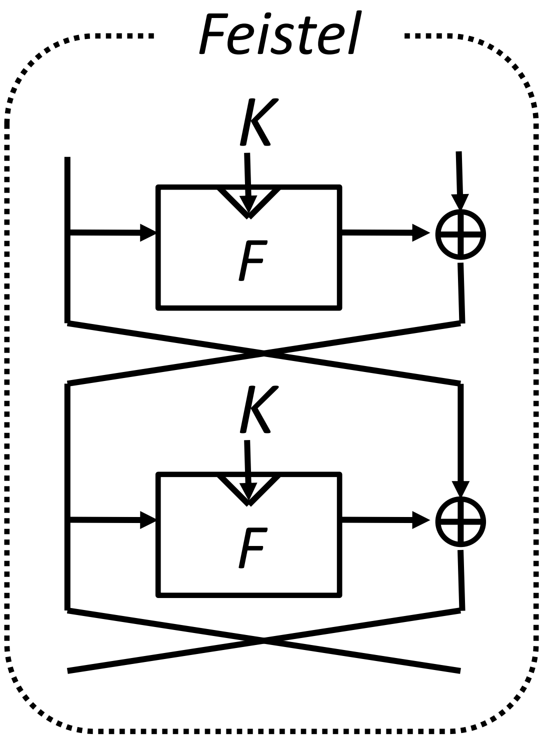
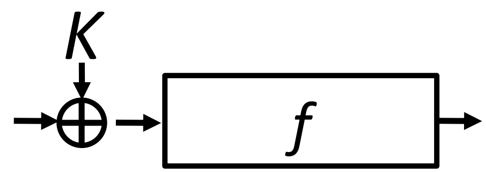
Our Results 2

- Known-key attacks up to 11-rounds of *Feistel-SP*



Previous [KR07]

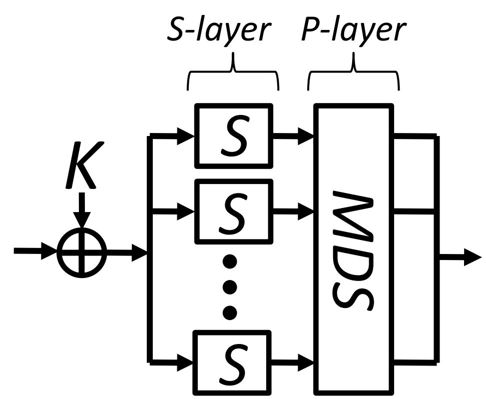
- Round function *F* :



- 7 rounds are not ideal.

Ours

- Round function *F* :



- 11 rounds are not ideal.

Conclusions

- Known-key distinguishers are useful tools to evaluate the security of key-less primitives.

- Our recent work
  - Formalization
  - Separation of secret/known key settings
  - Attacks on 11-rounds of Feistel-SP

Thank you for your attention !!

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