New Slide Attacks on Almost Self-Similar Ciphers

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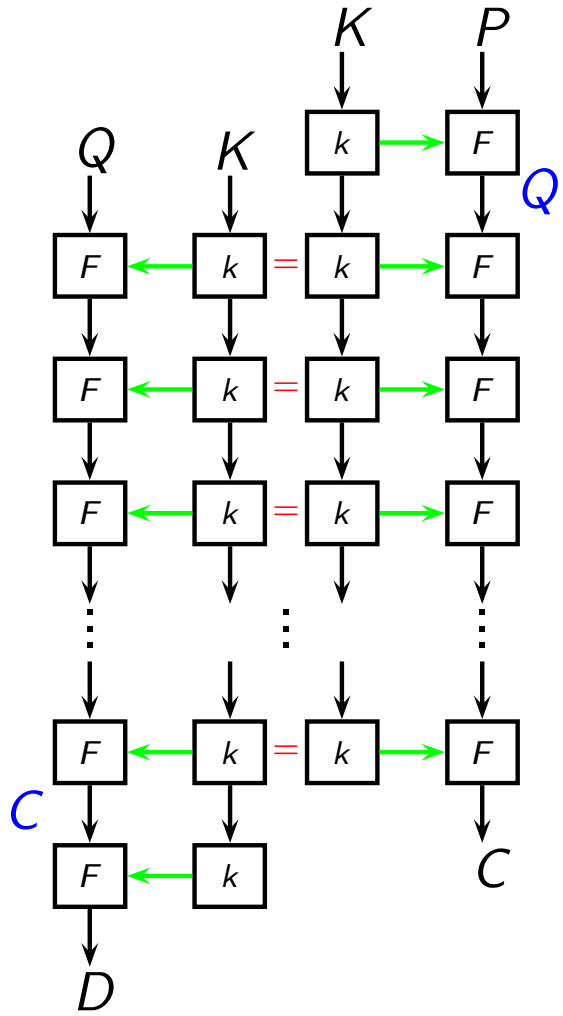
May 21th, 2019

Slide Attacks [BW99]

- Presented by Biryukov and Wagner in 1999
- Can be applied to ciphers with the same keyed permutation
- Independent of the number of rounds of the cipher



Slide Attacks [BW99] (cont.)

- Slid pair satisfies

$$\begin{cases} Q = f_k(P), \\ D = f_k(C), \end{cases} \tag{1}$$

- Slide attacks:
  - Find such a slid pair,
  - Use slid pair to extract key.

Extensions and Generalizations

- Slide with twist [BW00]
- Advanced slide [BW00]
- Chains [F01]
- Slidex [DKS12]
- Reflection [K08]
- Quantum [B+18]

Applications

- 1K-DES, 2K-DES, 4K-DES ([BW99,BW00])
- 3K-DES ([B+17])
- 1K-AES ([B+17])
- KeeLoq ([I+08,C+08])
- FF3 ([DV17,HMT19])
- ...

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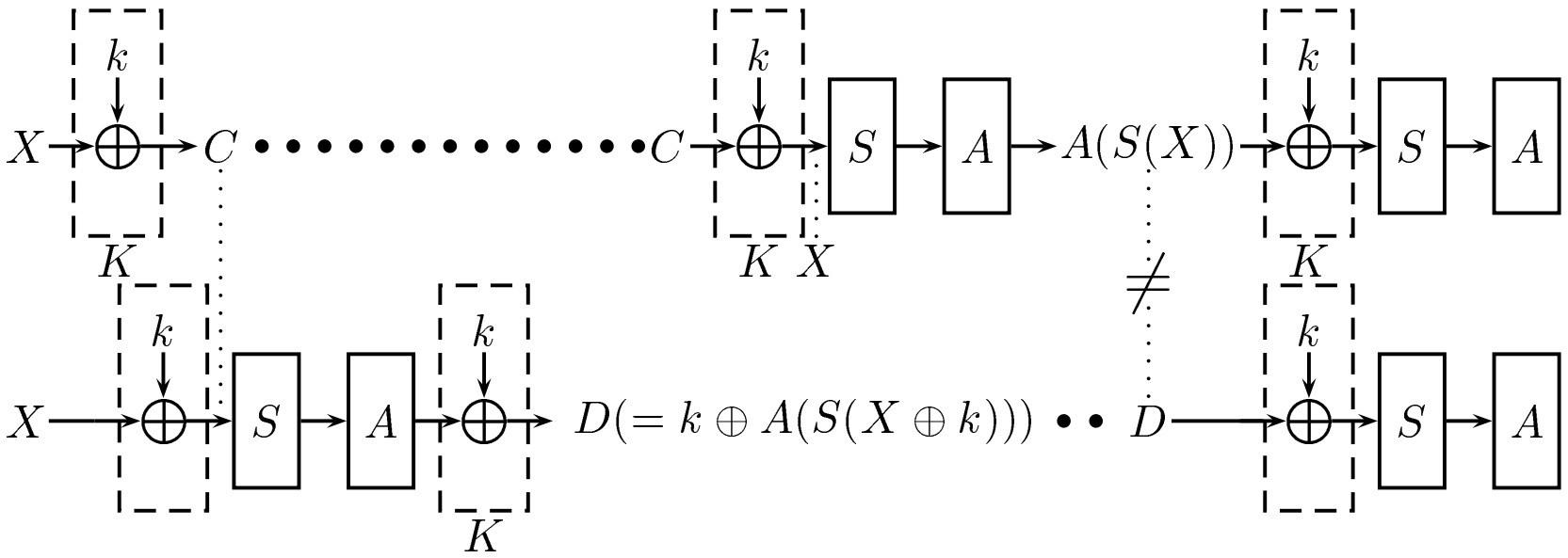
Problem: in AES the last round is different!

Last Round Function ⇒ No Slid Chains



Overcoming the Last Round

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Introducing **4** new slide techniques:

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Introducing **4** new slide techniques:

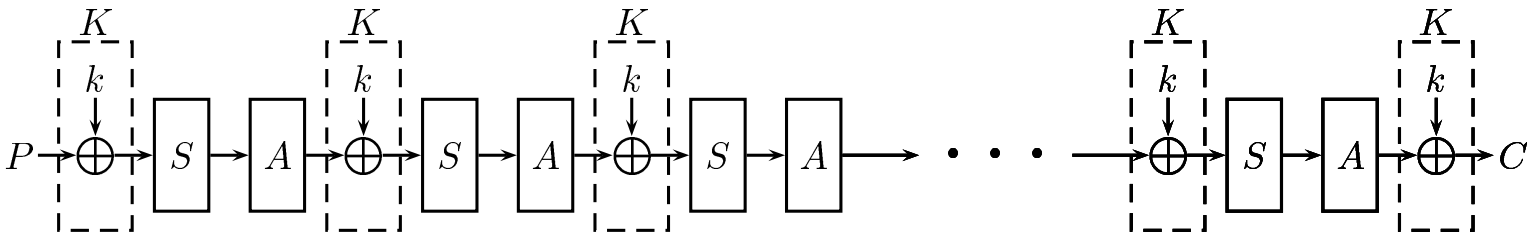
- Slid Sets
- Hypercube of slid pairs
- Suggestive plaintext structures
- Substitution slide

Slid Sets

- Two sets of λ-structures $\{\mathcal{P}\}$ and $\{\mathcal{Q}\}$ such that

$$f_k(\{\mathcal{P}\}) = \{\mathcal{Q}\}$$

- Cool detection techniques!
- Can be used to attack 2K-AES with complexity 2^{68}
- General 2-KSA — $2^{(n+s)/2}$
- Can be used to attack 1K-AES with secret S-boxes with complexity $2^{70.3}$



Results

Cipher	Technique	Complexity (general)		AES-like	
		Data/Memory	Time	Data/Memory	Time
Known S-Boxes					
1-KSAf	Slide [B+17]	$2^{n/2}$ (KP)	$2^{n/2}$	2^{64} (KP)	2^{64}
1-KSAt	Suggestive str.	$3 \cdot 2^{n/2}$ (CP)	$4 \cdot 2^{n/2}$	$2^{65.6}$ (CP)	2^{66}
1-KSAt	Sub. slide	$2^{n/2}$ (KP)	$2^{3n/4}$	2^{64} (KP)	2^{96}
2-KSAf	Slid sets	$2^{(n+s)/2+1}$ (CP)	$2^{(n+s)/2+1}$	2^{69} (CP)	2^{69}
2-KSAf	Slide + Key Guessing	$(n/s)2^{n/2}$ (CP)	$2^{n/2+s}$	2^{68} (CP)	2^{72}
2-KSAtpi †	Slid sets	$2^{(n+m)/2+1}$ (CP)	$\max\{2^{(n+m)/2+1}, 2^{2m}\}$	2^{78} (CP)	2^{78}
3-KSAfi †	Slid sets	$2^{(n+m)/2+1}$ (CP)	$\max\{2^{(n+m)/2+1}, 2^{2m}\}$	2^{81} (CP)	2^{81}
Secret S-Boxes					
1-KSAf	Slid sets	$1.17\sqrt{s}2^{(n+s)/2}$ (CP)	$1.17\sqrt{s}2^{(n+s)/2}$	$2^{70.3}$ (CP)	$2^{70.3}$
1-KSAf	Hypercube	$\sqrt{s}2^{n/2+s(s+3)/4+1}$ (CP)	$\sqrt{s}2^{n/2+s(s+3)/4+1}$	2^{88} (CP)	2^{88}

KP – Known Plaintext; CP – Chosen Plaintext; For AES-like $n = 128, s = 8$

† – this version has incomplete diffusion layer, m denotes the "word" size of the linear operation.

‡ – the memory complexity of this attack is 2^{47}.

Thank you for your Attention!

https://eprint.iacr.org/2019/059

A Formal Complaint: Wrongful Rejection from Rump Session

Orr Dunkelman

May 21th, 2019

Facts

- Eran Lambooij and me wanted to give another rump session presentation

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- Eran Lambooij and me wanted to give another rump session presentation
- As you can see, it is not in the schedule
- The fact that **we missed** the deadline by **13 hours and 27 minutes** seems to be of little relevance!

(Rump) Session Hijacking Attack

- New attack against timing constraints!

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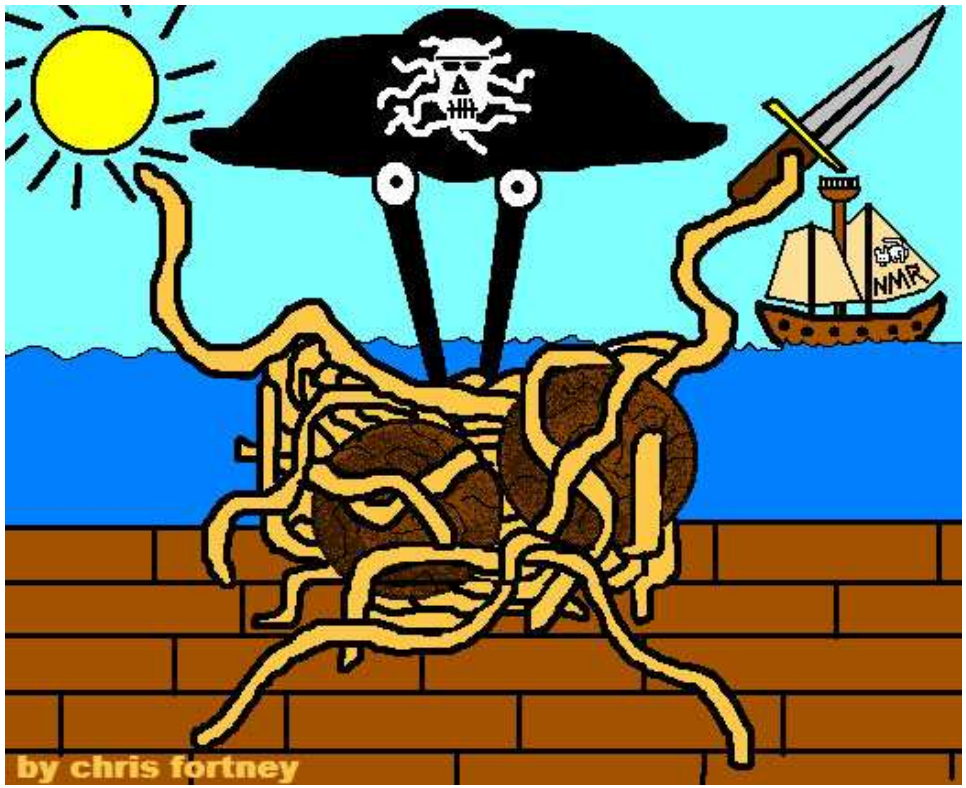
- CaML + (rump session talk) MR + Time-Travel attack

(Rump) Session Hijacking Attack

- New attack against timing constraints!
- CaML + (rump session talk) MR + Time-Travel attack
- Also works in the "wrong time zone" model

Thank you for your Support!



A Practical Cryptanalysis Competition

A Cycling Approach

Orr Dunkelman and Eran Lambooij

Eurocrypt, Rumpsession, 2019

What do Cryptographers like the Most?

What do Cryptographers like the Most?

Blockchain

What do Cryptographers like the Most?

~~BlockKette~~

Free Drinks

What do Cryptographers like the Most?

~~BlockKette~~

Competitions!

~~Freie Getränke~~

The practical LWC competition

Yellow

Most broken ciphers.

Green

Most points.

Polka dot

Highest broken rounds.

What can **you** do?

- Go to the competition website:
  `https://cryptanex.hideinplainsight.io/lwc/`
- Compute key
- Celebrate
- Submitters - you can help us (contact Eran)