COLM

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CAESAR Overview

Table: CAESAR Round 3 Candidates. *Deoxys uses tweakable block cipher modes and creates a new tweakable block cipher.

Dedicated	Block Cipher Mode	Permutation-based
ACORN	AES-OTR	Ascon
AEGIS	CLOC and SILC	Ketje
AEZ	COLM	Keyak
MORUS	JAMBU	NORX
Tiaoxin	OCB	
	Deoxys*	

Block Cipher Mode Disadvantages

1. Usually birthday bound security

2. Efficiency cannot improve beyond block cipher
(see e.g. AEGIS vs. CTR)

Block Cipher Mode Advantages

1. Block ciphers are ubiquitous

2. Can be used with any block cipher

3. A safe bet: security reduction to underlying block cipher

Block size ≥ 128 bits $\Rightarrow$ Can process petabytes of data with success probability well below 2^{-30}

Block Cipher Modes in Candidates

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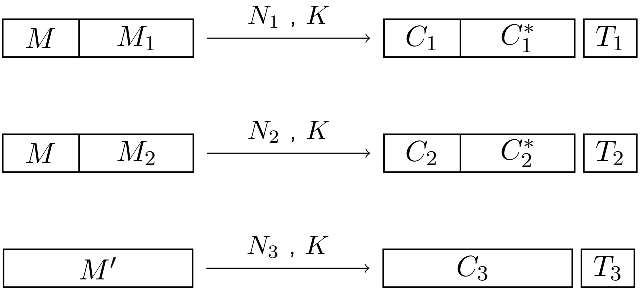
	Deoxys*	
	(ΘCB and SCT)	

Robustness

Table: Levels of resistance to nonce misuse.

Level 1	**Level 2**	**Level 3**
AES-OTR	COLM	Deoxys-II (SCT)
CLOC and SILC		
JAMBU		
OCB		
Deoxys-I		

Background: Online Nonce Misuse Resistance



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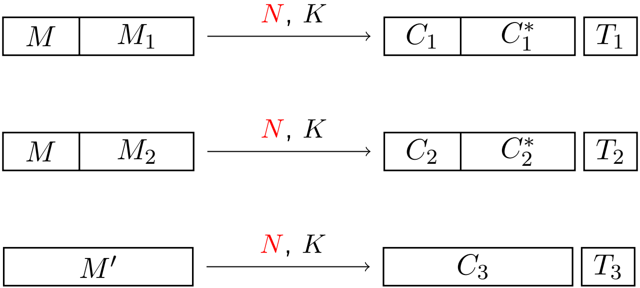

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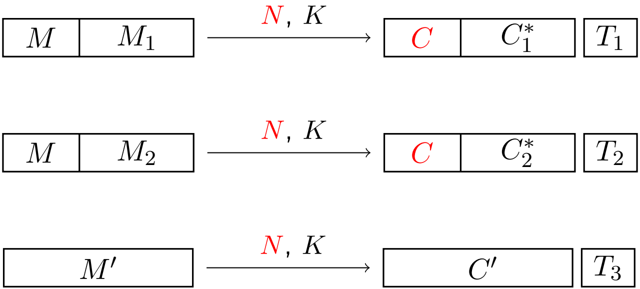

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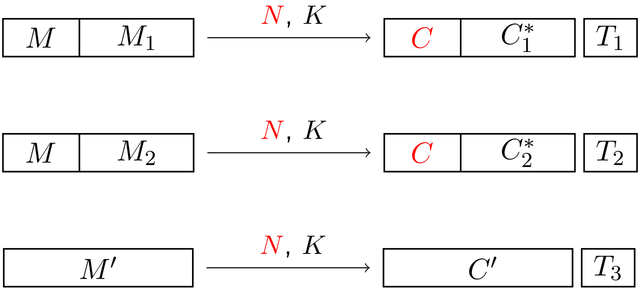

1. Equality of prefixes of messages determined

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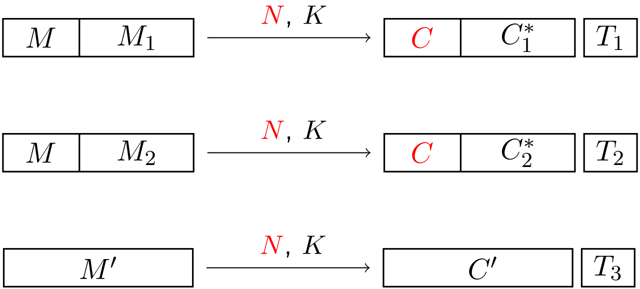

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2. No relationship past common prefix

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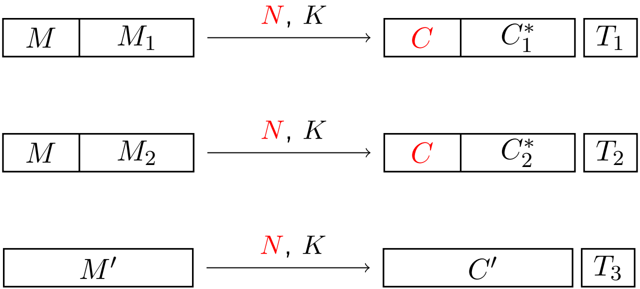

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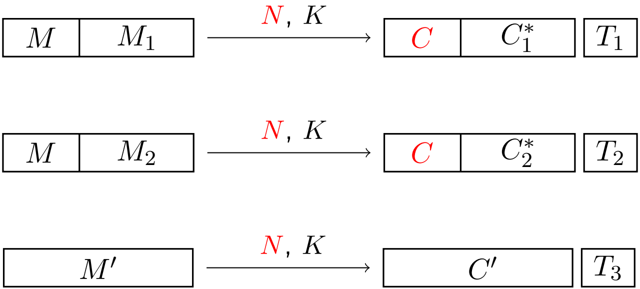
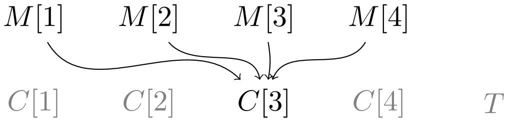


1. Equality of prefixes of messages determined
2. No relationship past common prefix
3. Hoang et al. CRYPTO 2015 attack. . .
4. but still much more robust than GCM, OCB, OTR, . . .

Advantage over SCT: *Online* Scheme

1. High latency (receive full message before first output)
2. Storage issues (large internal state)



Dependency in SCT.

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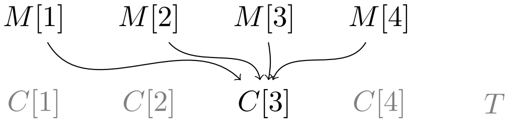

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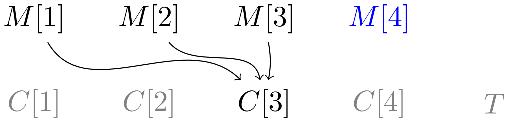
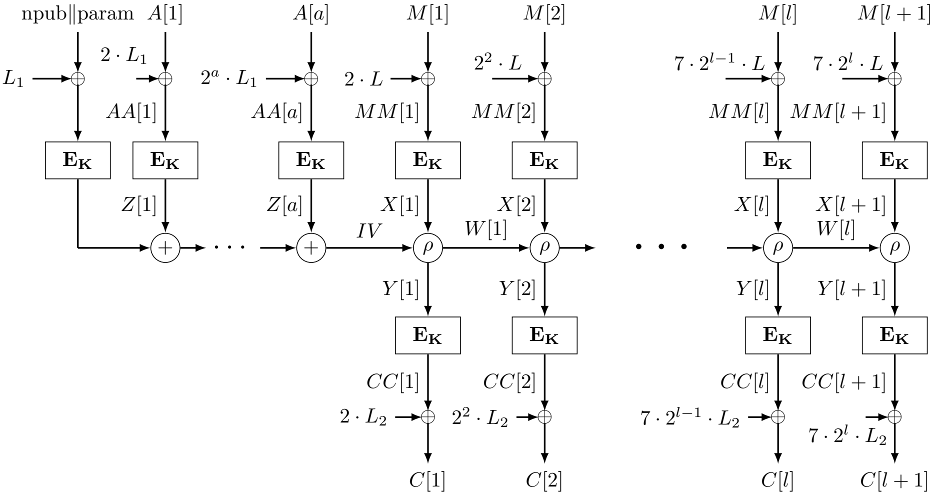


Dependency in COLM.

COLM Comparison with ELmD and COPA

	COPA	ELmD	COLM
Simplified masking			✓
Fully parallelizable authentication		✓	✓
XOR mixing for authentication	✓		✓
ρ mixing for encryption		✓	✓
Bottom layer encryption	✓		✓
Intermediate tags		✓	✓

COLM Description



Summary

COLM: strengths of COPA + ELmD

1. security reduction to block cipher
2. online misuse resistance: most robust AES-mode in the competition
3. highly parallelizable

Thank you for your attention.

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3. Dobraunig et al. “Related-Key Forgeries for Proest-OTR” FSE 2015
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8. Bogdanov et al “Comb to Pipeline: Fast Software Encryption Revisited” FSE 2015
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