ETH
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Efficient PRFs from Very Weak Assumptions

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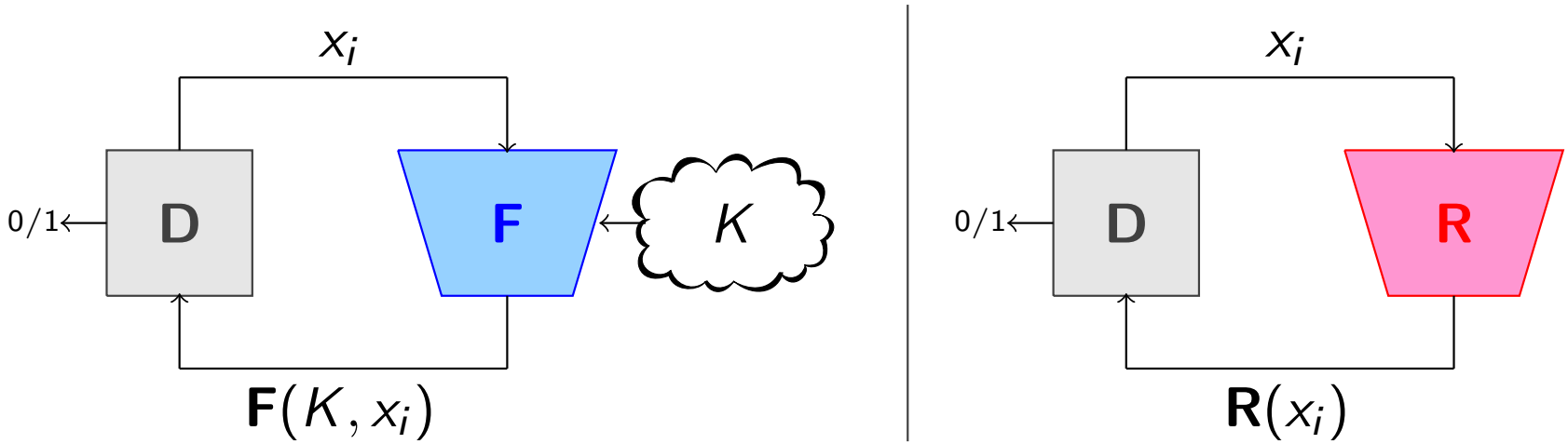
Rump Session

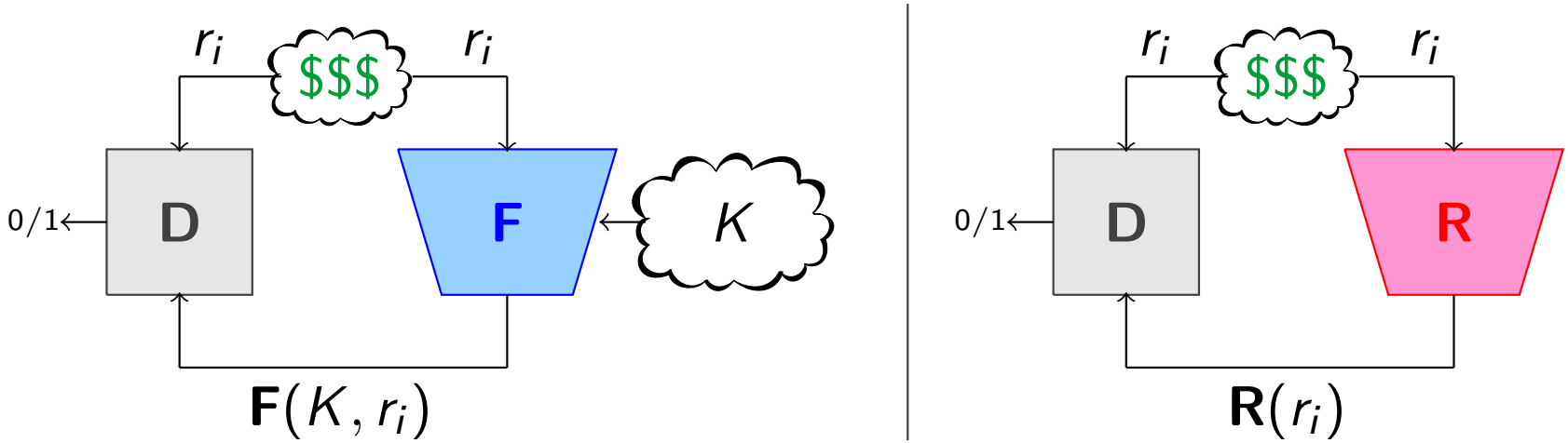
Chosen-Input Attack



$\forall$ efficient distinguishers **D**

$$|\Pr[\mathbf{D} \text{ outputs 1 left}] - \Pr[\mathbf{D} \text{ outputs 1 right}]| = \text{negligible}$$

Random-Input Attack



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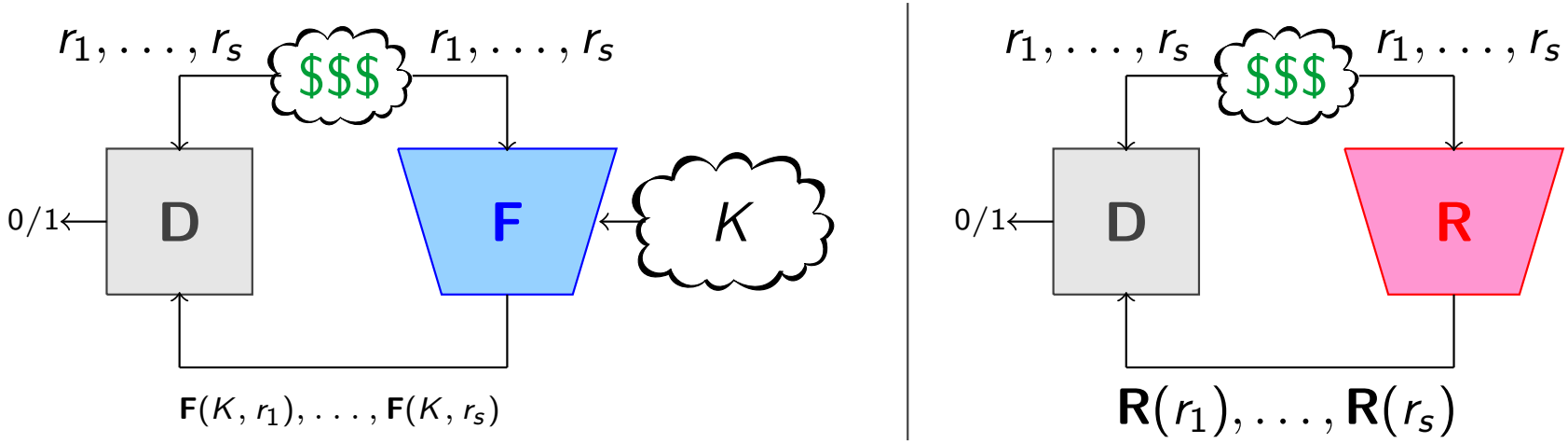
s-Random-Inputs Attack



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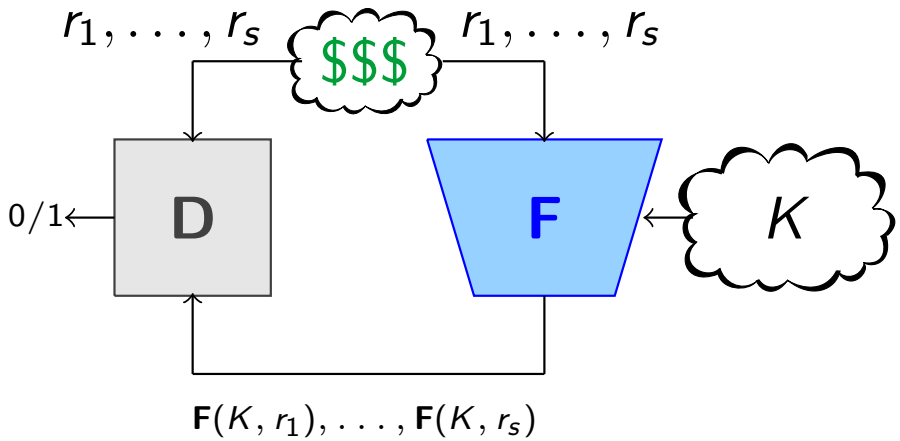
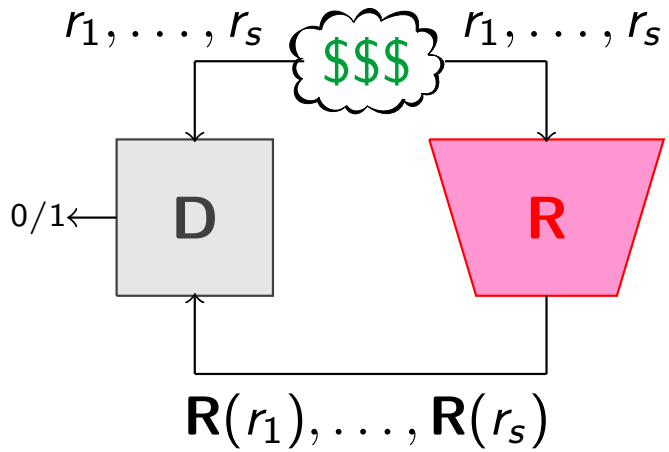
s-Random-Inputs Attack

This paper!





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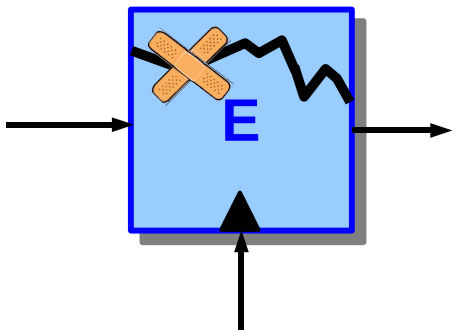
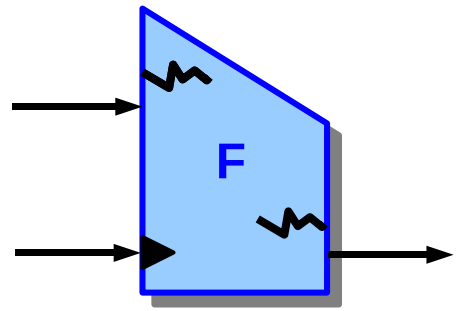
s-WPRF is a very weak assumption!

- Weak Block-Cipher



- Compression Function

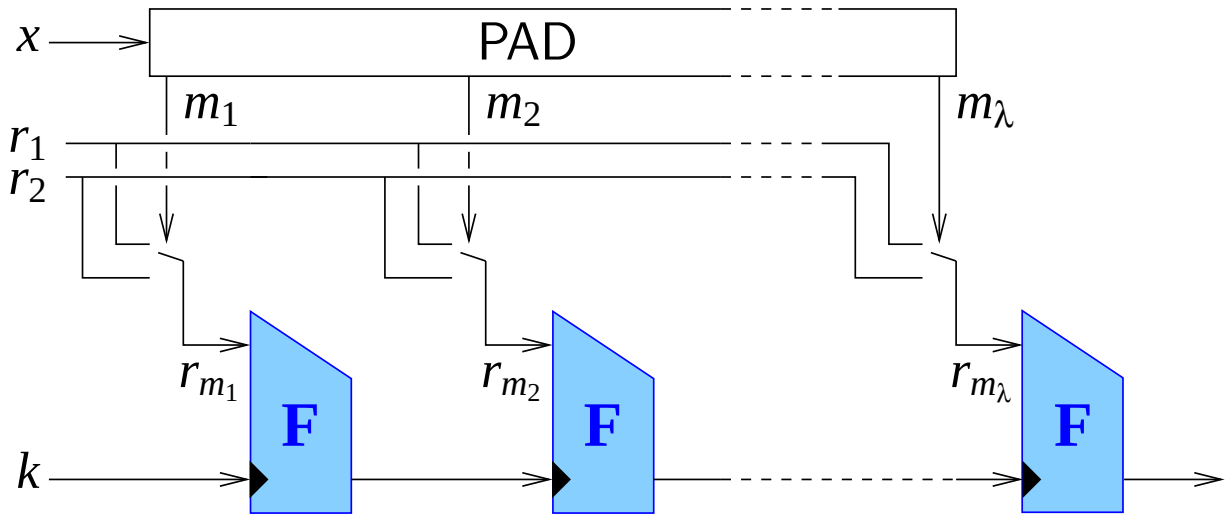


Question

Can we efficiently construct PRFs / MACs from s-WPRFs?

First Construction

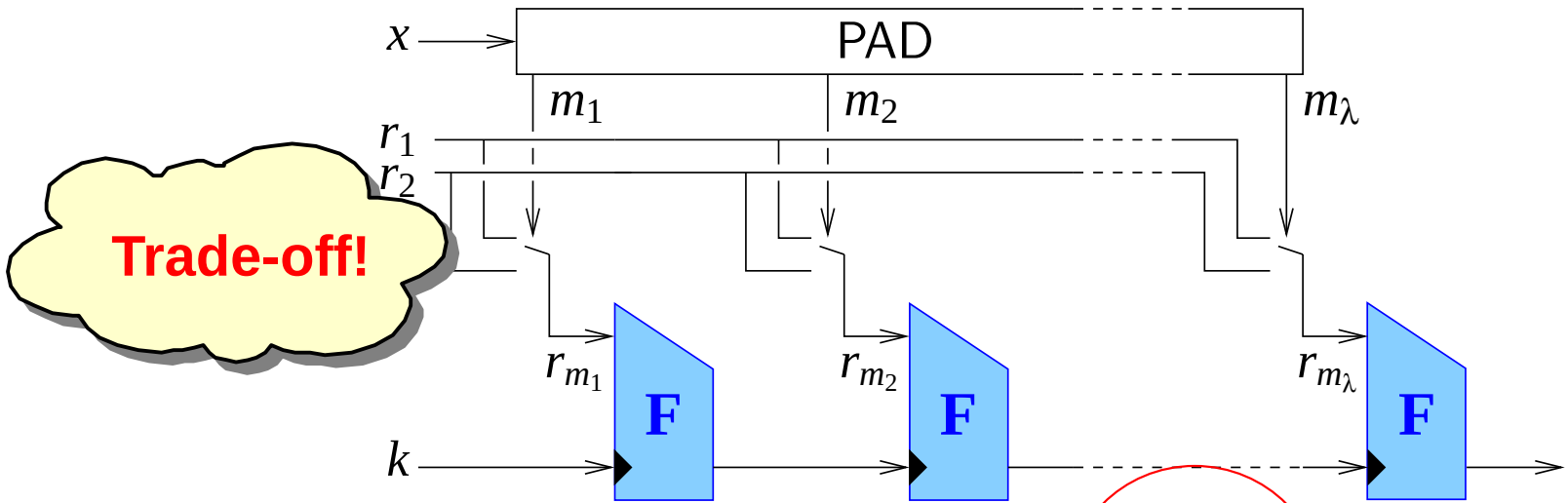
- Relies on 2-WPRF $F : \{0,1\}^\kappa \times \{0,1\}^n \to \{0,1\}^\kappa$
- Key material: κ bits (private part) + $2n$ bits (public part)



- # F-calls for processing input x: $\approx |x|$

First Construction

- Relies on s-WPRF $F : \{0,1\}^\kappa \times \{0,1\}^n \to \{0,1\}^\kappa$
- Key material: κ bits (private part) + sn bits (public part)



- # F-calls for processing input x: $\approx |x| / \log s$

First Construction

- Relies on s-WPRF $F : \{0,1\}^\kappa \times \{0,1\}^n \to \{0,1\}^\kappa$
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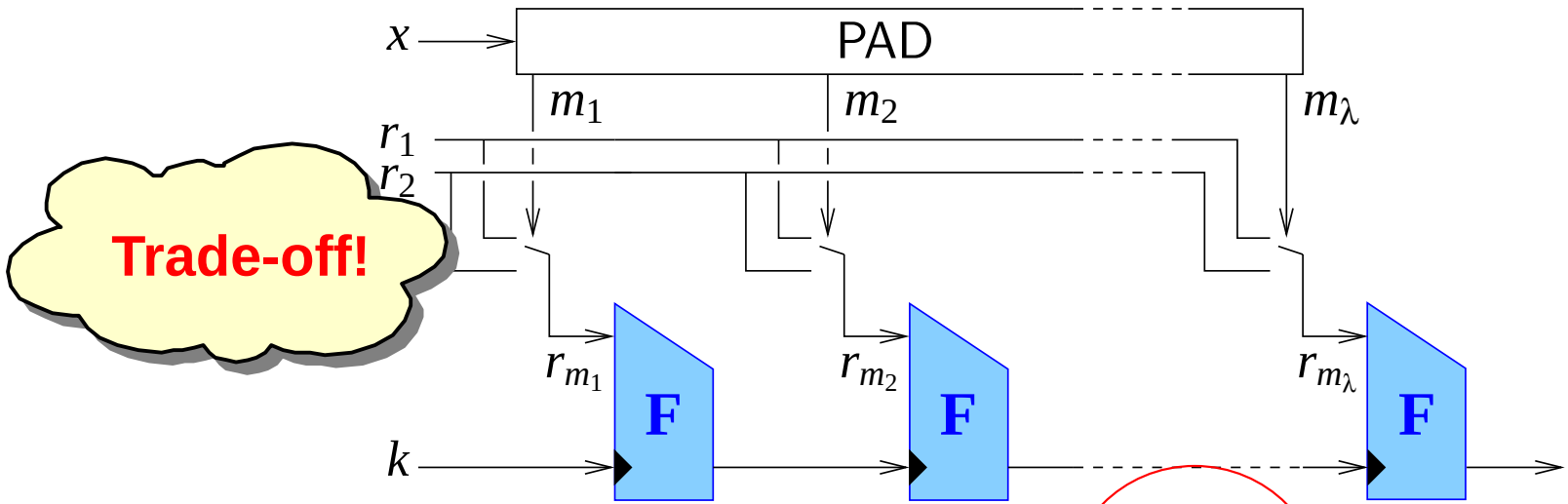


- # F-calls for processing input x: $\approx |x| / \log s$

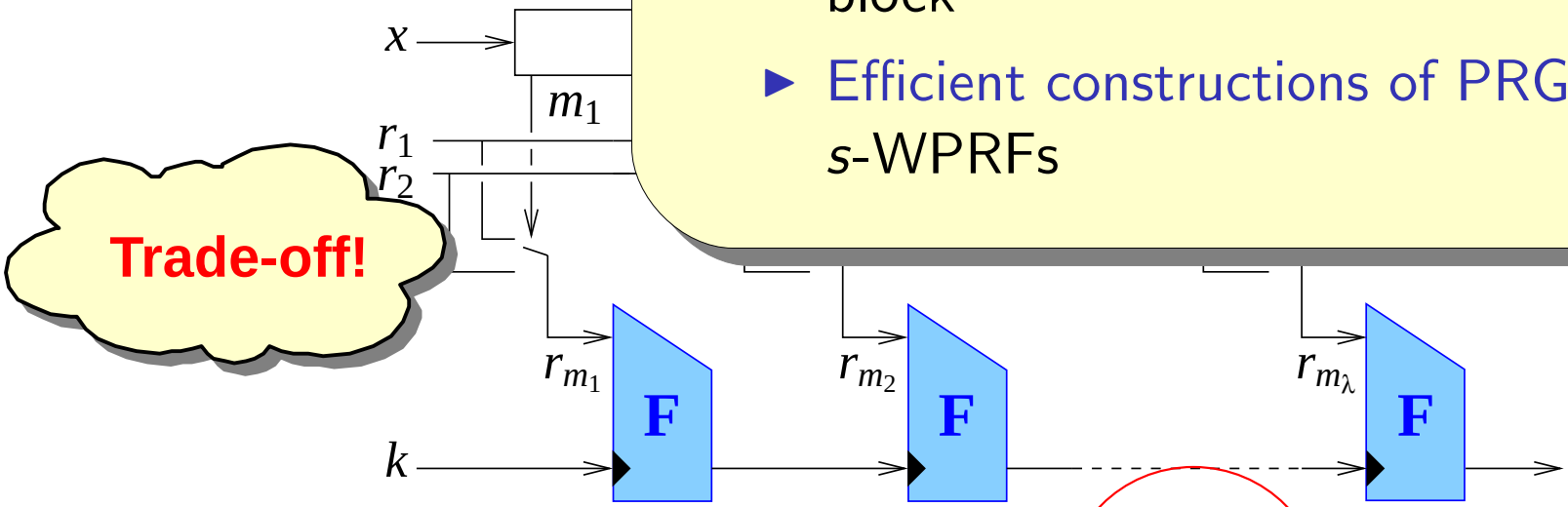
Same as best construction of PRF from WPRF

First Construction

- Relies on s-WPRF
- Key material: κ b

Corollaries:

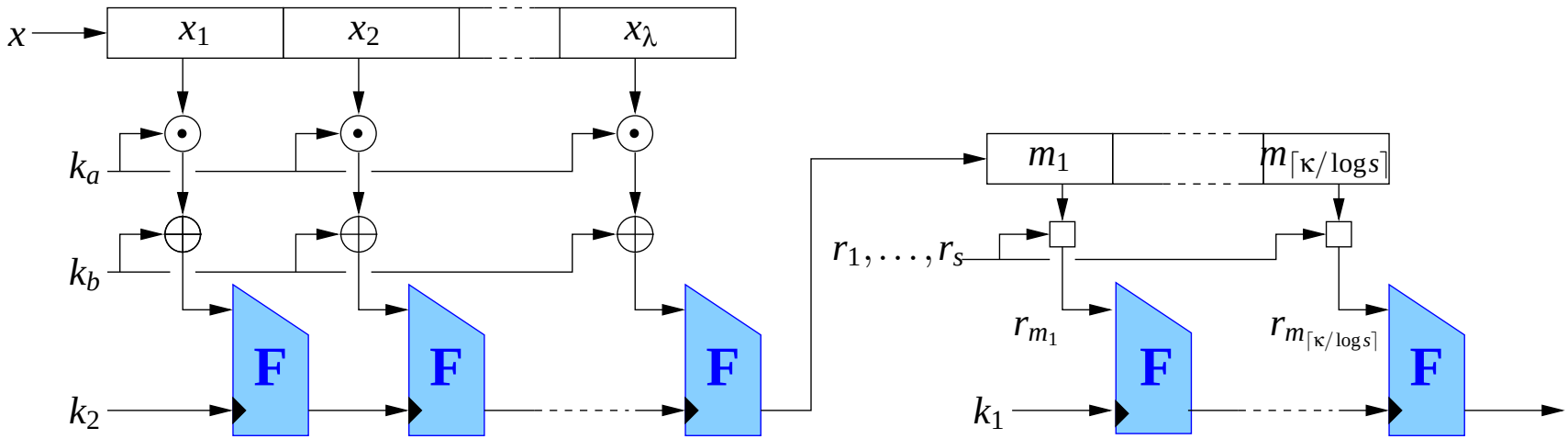
- s-WPRF-based counter-mode encryption: $1 + \frac{1}{s-1}$ calls / encrypted block
- Efficient constructions of PRGs from s-WPRFs



- # F-calls for processing input x: $\approx |x| / \log s$

Same as best construction of PRF from WPRF

Improved Construction – Long Messages

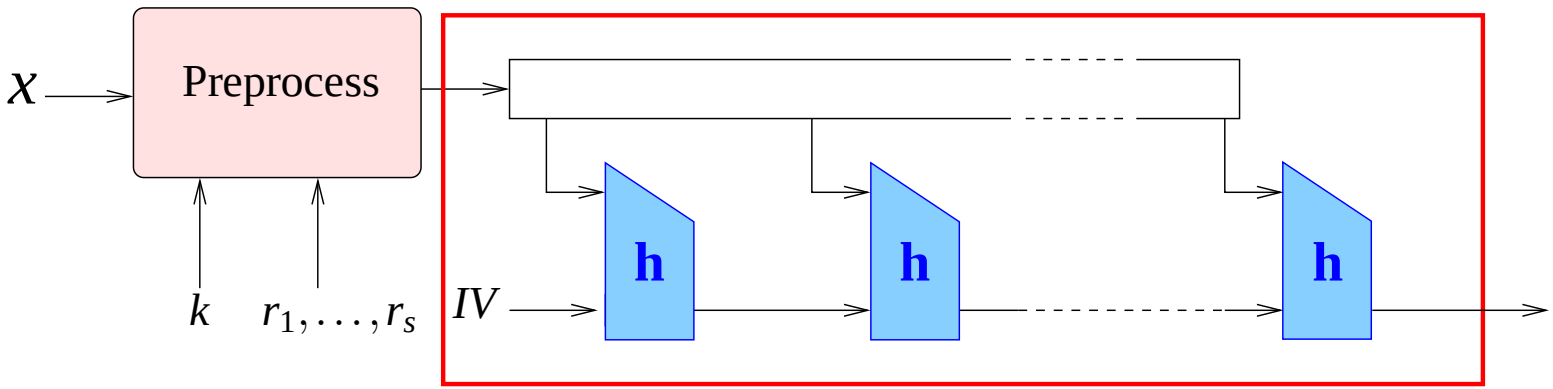


Improves # F-calls for long messages to $|x|/n + \kappa/\log s$

Hash Functions

Constructions can be obtained with black-box access to iterated hash functions (similar to HMAC) provided

- compression function **h** is s-WPRF (key = chaining value)
- compression function **h** is sufficiently regular



$\Rightarrow$ Key-based message preprocessing

Paper

Ueli Maurer and Stefano Tessaro

"Basing PRFs on Constant-Query Weak PRFs: Minimizing Assumptions in Iterated MACs"

ASIACRYPT '08