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CYBER SECURITY IN THE AGE OF LARGE-SCALE ADVERSARIES

Automated Generation and Evaluation of Masked Hardware

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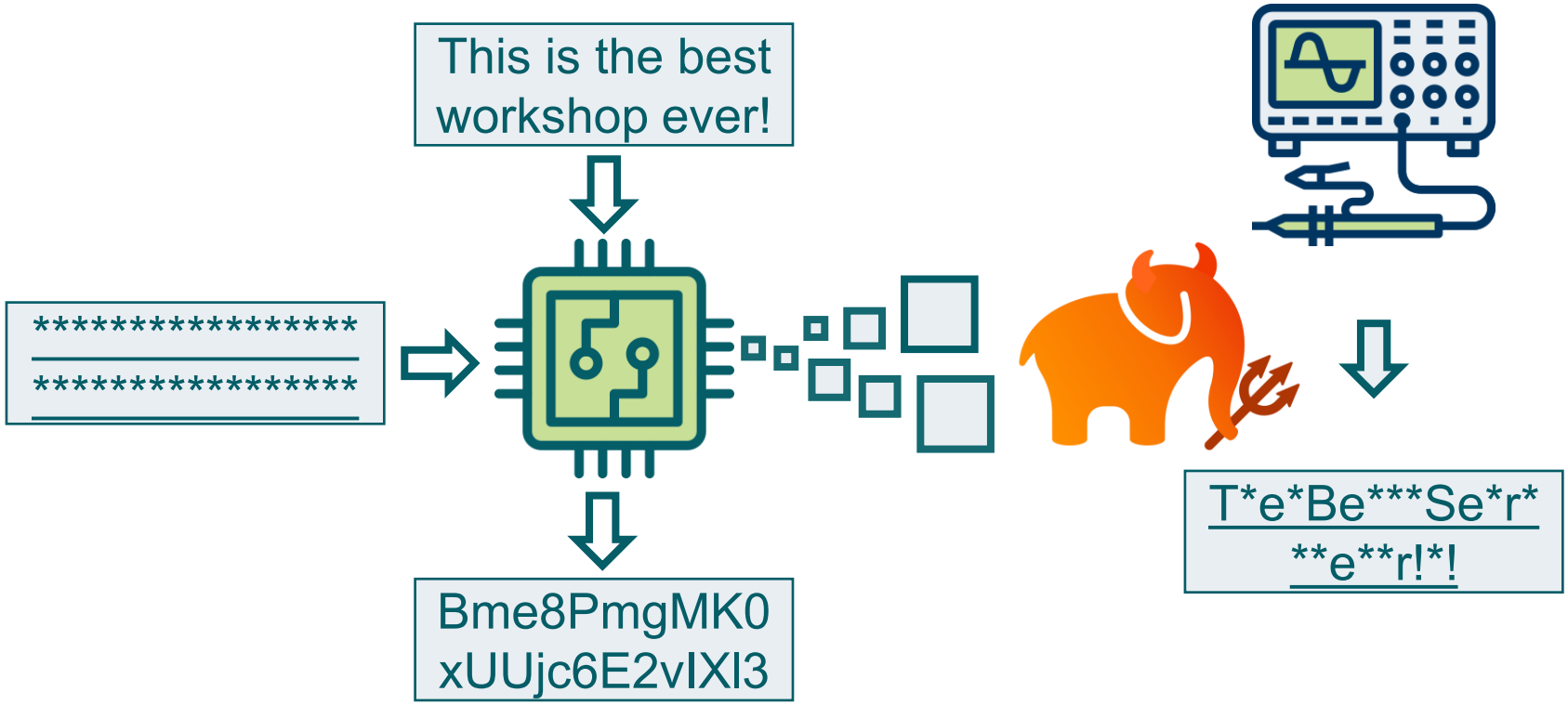
SIDE-CHANNEL ANALYSIS ATTACKS



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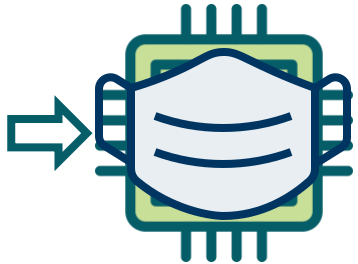
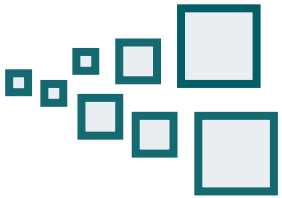
COUNTERMEASURES

$$x^0, \ldots, x^d$$
$$x = x^0 \oplus \cdots \oplus x^d$$

$$k^0, \ldots, k^d$$
$$k = k^0 \oplus \cdots \oplus k^d$$





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$$c^0, \ldots, c^d$$
$$c = c^0 \oplus \cdots \oplus c^d$$

SECURITY-AWARE HARDWARE DESIGN FLOW

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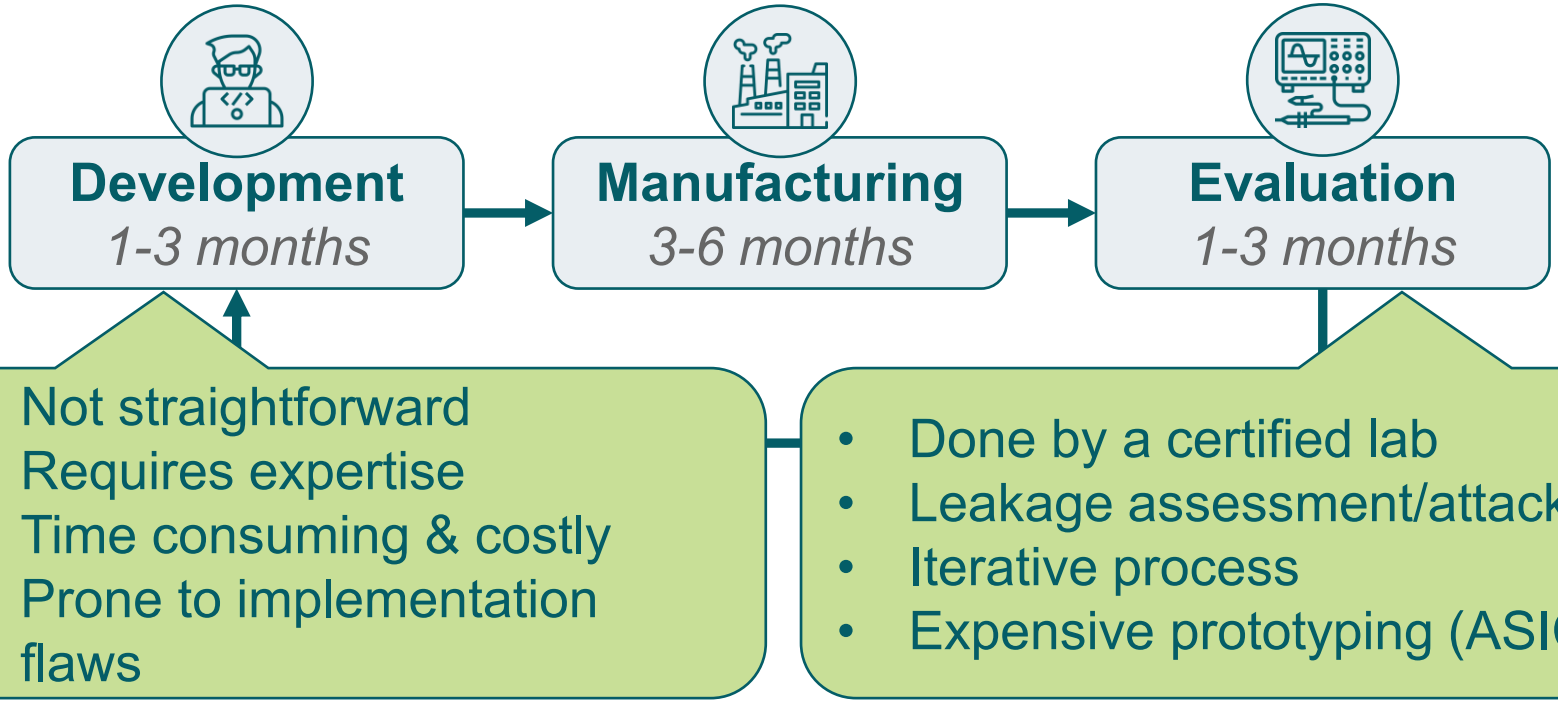
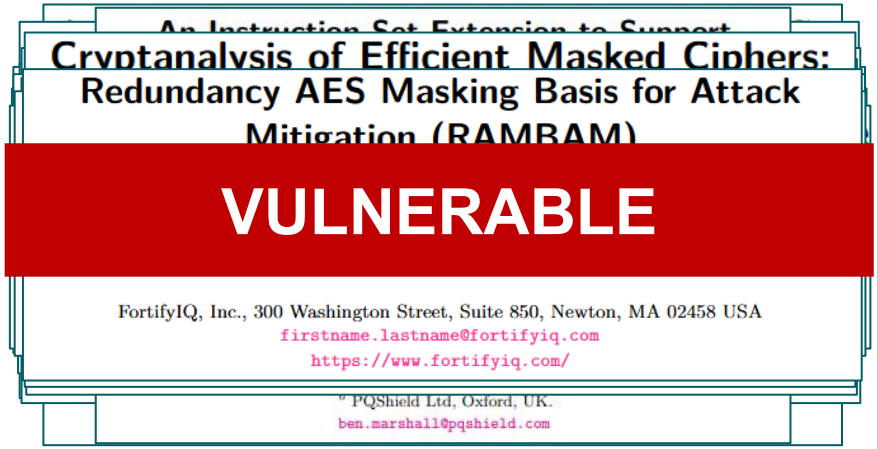


CHALLENGES

MASKING SCHEME



An Instruction Set Extension to Support

Cryptanalysis of Efficient Masked Ciphers:

Redundancy AES Masking Basis for Attack Mitigation (RAMBAM)

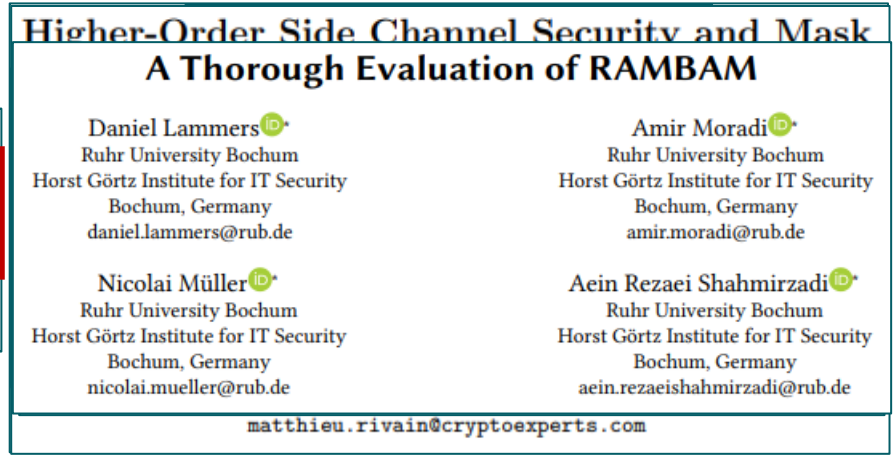
VULNERABLE

FortifyIQ, Inc., 300 Washington Street, Suite 850, Newton, MA 02458 USA
firstname.lastname@fortifyiq.com
https://www.fortifyiq.com/

PQShield Ltd, Oxford, UK.
ben.marshall@pqshield.com

CHES 2022

SECURITY ANALYSIS



Higher-Order Side Channel Security and Mask

A Thorough Evaluation of RAMBAM

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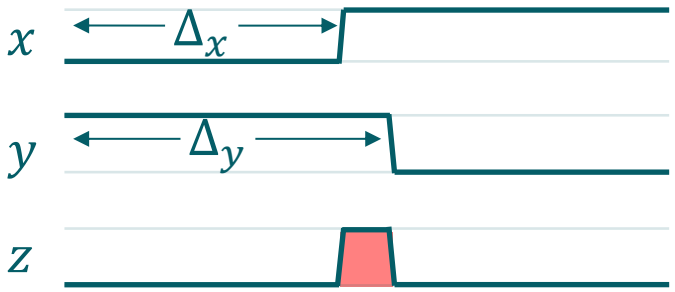
PROBLEMS

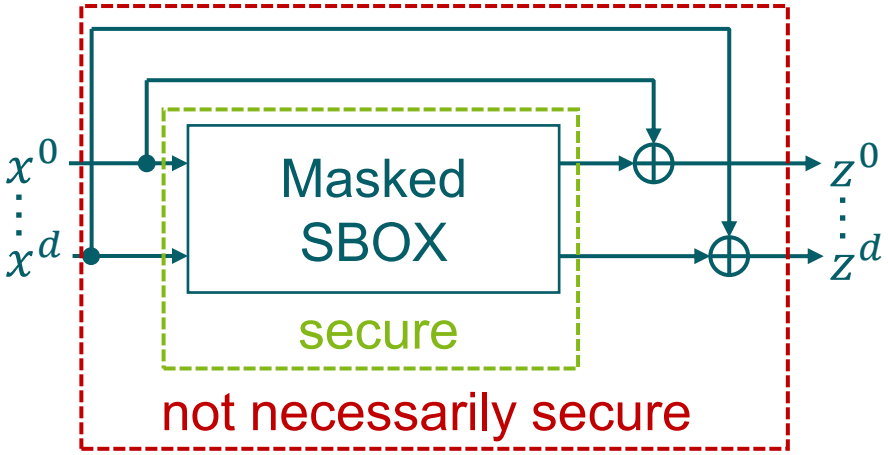
Physical Defaults

$$z = x \cdot y, \qquad x, y, z \in GF(2)$$



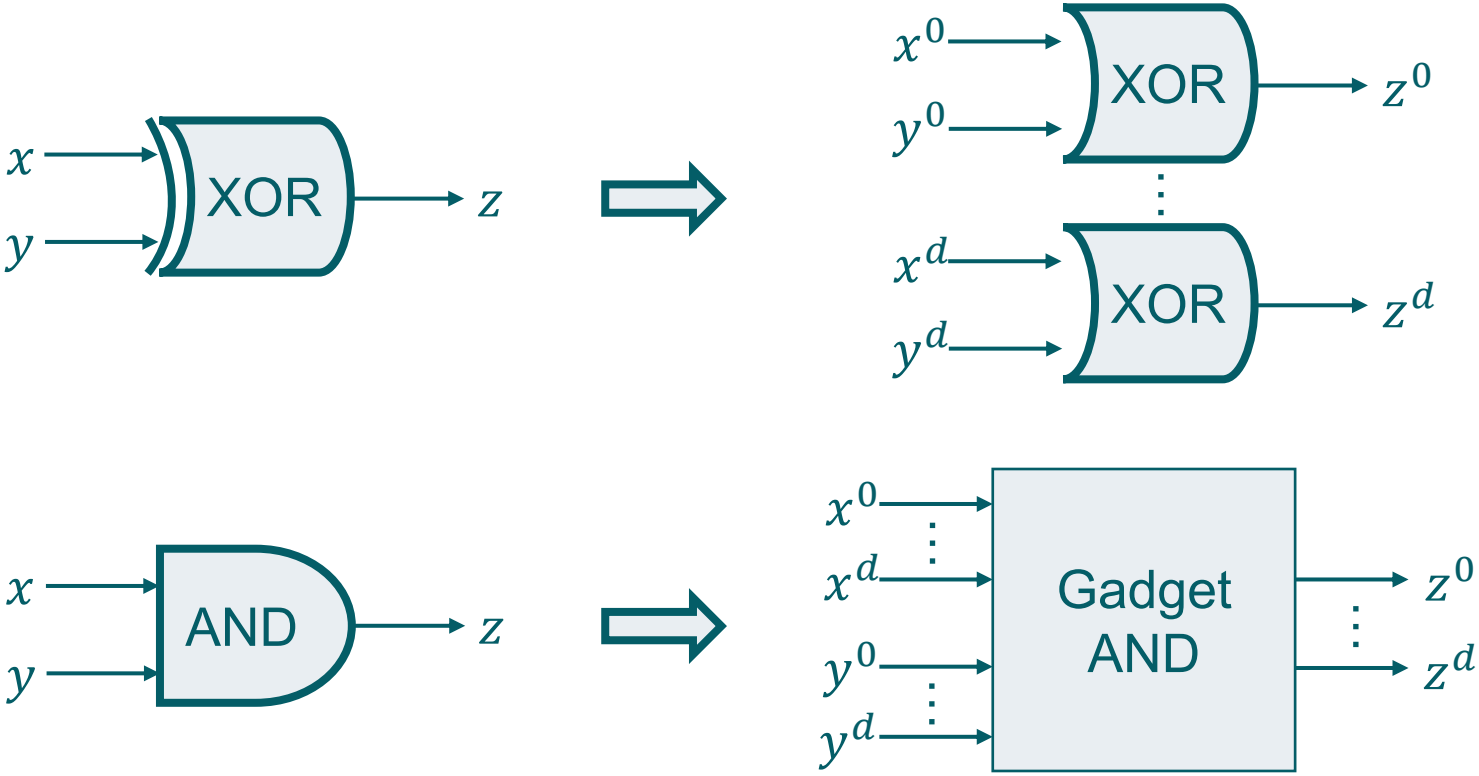
Requires proofs under robust adversary models!

Lacks of Composability



Requires dedicated proofs of composability!

COMPOSABLE GADGETS



AUTOMATED GENERATION OF MASKED HARDWARE

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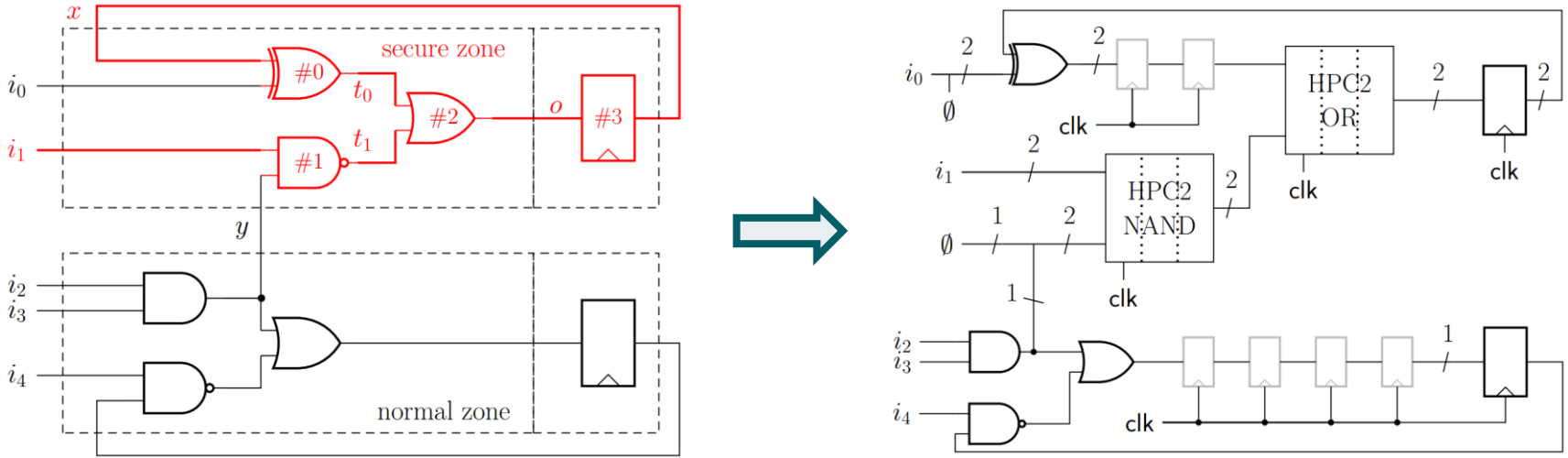

Source: Knichel, D., Moradi, A., Müller, N., & Sasdrich, P. (2021). Automated Generation of Masked Hardware. *IACR Transactions on Cryptographic Hardware and Embedded Systems*, *2022*(1), 589-629. https://doi.org/10.46586/tches.v2022.i1.589-629

OPTIMIZED SECURITY-AWARE HARDWARE DESIGN FLOW

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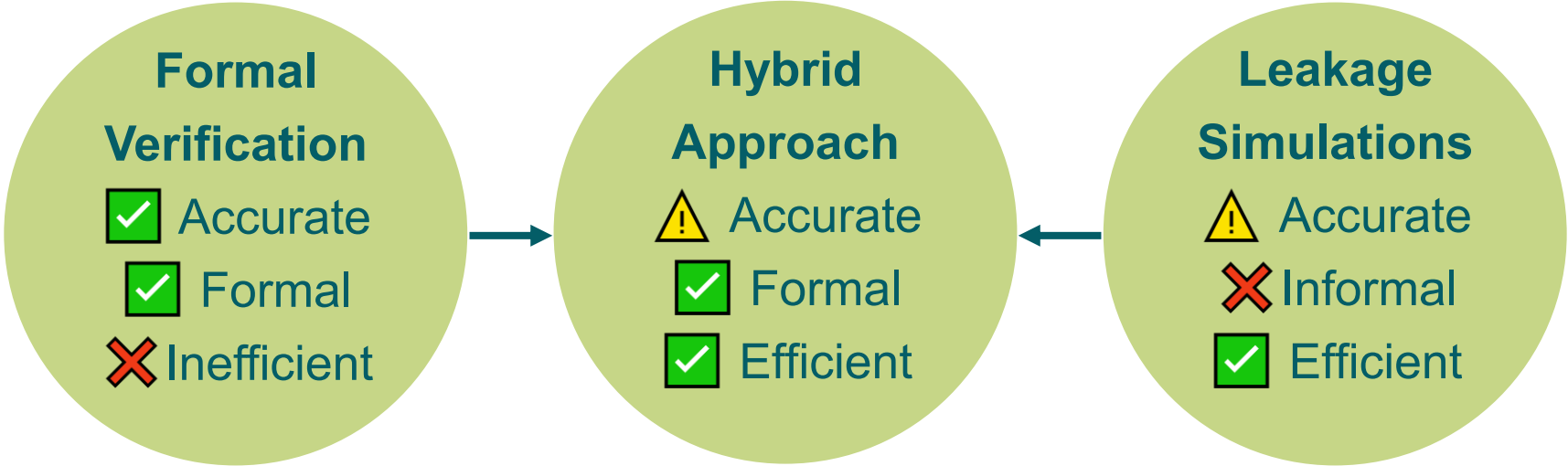
- Done by AGEMA
- Provably secure results
- No knowledge required

- Gadget composability proven
- Manual or automated proofs
- No dedicated verification

Inefficient compared to manual masked circuits!

LEAKAGE EVALUATION



Source: Müller, N., & Moradi, A. (2022). PROLEAD: A Probing-Based Hardware Leakage Detection Tool. *IACR Transactions on Cryptographic Hardware and Embedded Systems*, *2022*(4), 311-348. https://doi.org/10.46586/tches.v2022.i4.311-348

CONCLUSIONS

Take Home Messages:

- Masking gives provable security but is difficult to implement
- Gadgets offer a systematic way to generate masked designs
- The overhead of gadgets is high compared to hand-made masking
- Manually masked designs should be evaluated with tools

Additional Resources:

https://www.informatik.tu-darmstadt.de/impsec/publications_impsec/index.en.jsp

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Thanks! Any Questions?

Or maybe later:
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