FROM RESEARCH TO INDUSTRY

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# Feature Extraction for Side-Channel Attacks

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05/12/2018, Paris

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## Contents

## Secure Component and Embedded Cryptography

**A piece of hardware with security properties.**
**It usually embeds cryptography to provide security services (authentication, signature, secure messaging with terminals...)**

- Sensitive applications: ID cards, credit cards, transport cards, health cards, SIM
- Pervasive aspect: several billion smartcards sold par year
- Hard to update
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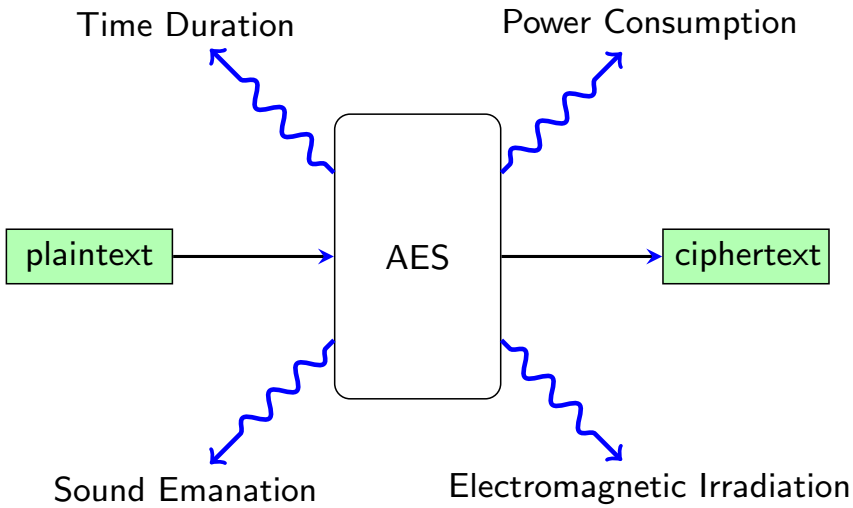
$\Rightarrow$ Requires protection against very high-level attacker

# Security Certification


- Standardized Evaluation (*e.g.* ISO/IEC 15408 - Common Criteria)
- Assigns an Evaluation Assurance Level (EAL)
- The evaluator checks the Security Assurance Requirements (SAR), *e.g.* ADV, ALC, AVA, ...
- AVA: vulnerability assessment (penetration testing $\rightarrow$ attack potential rating)

# Side-Channel Vulnerability of Embedded Cryptography




## Classical Cryptanalysis

- Black box (input, output)
- Formal attacker model (oracle, knowledge, ...)
- Computational complexity to perform the attack (*e.g.* $2^{126.1}$ operations to break AES-128 [BKR11])

## Side-Channel Cryptanalysis

- White box (input, output, side-channel observations of intermediate computations)
- Attacker with a certain equipment, expertise, knowledge of the embedded device, available time...
- In Common Criteria: the cotation table of the attack

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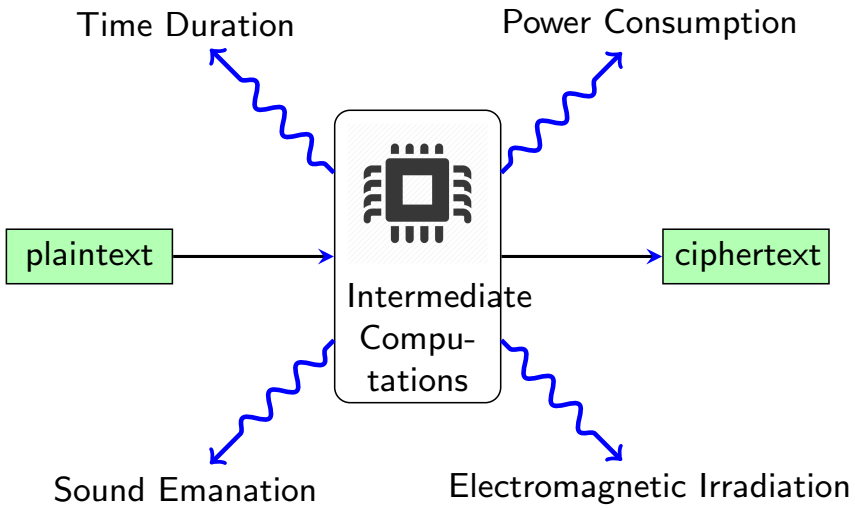


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## Side-Channel Attacks

- **the physical nature of the exploited signals**: power consumption, electromagnetic irradiation, time, sound, temperature, ...
- **the chosen sensitive variable/s** $Z$:
  - $Z = K$ a secret key chunk
  - $Z = f(K, E)$ a variable depending on a secret key chunk and on a piece of public information
  - an operation (*e.g.* $Z \in \{square, multiply, \dots\}$)
  - a register
  - $Z' = \varphi(Z)$ a non-injective function of any sensitive variable (*e.g.* $f = \mathrm{HW}$ Hamming Weight)
- **the strategy family**: simple attacks, collision attacks, differential/advanced attacks
- **the shape of the attack**: horizontal attacks, vertical attacks
- **the attacker knowledge**: profiling, non-profiling attacks

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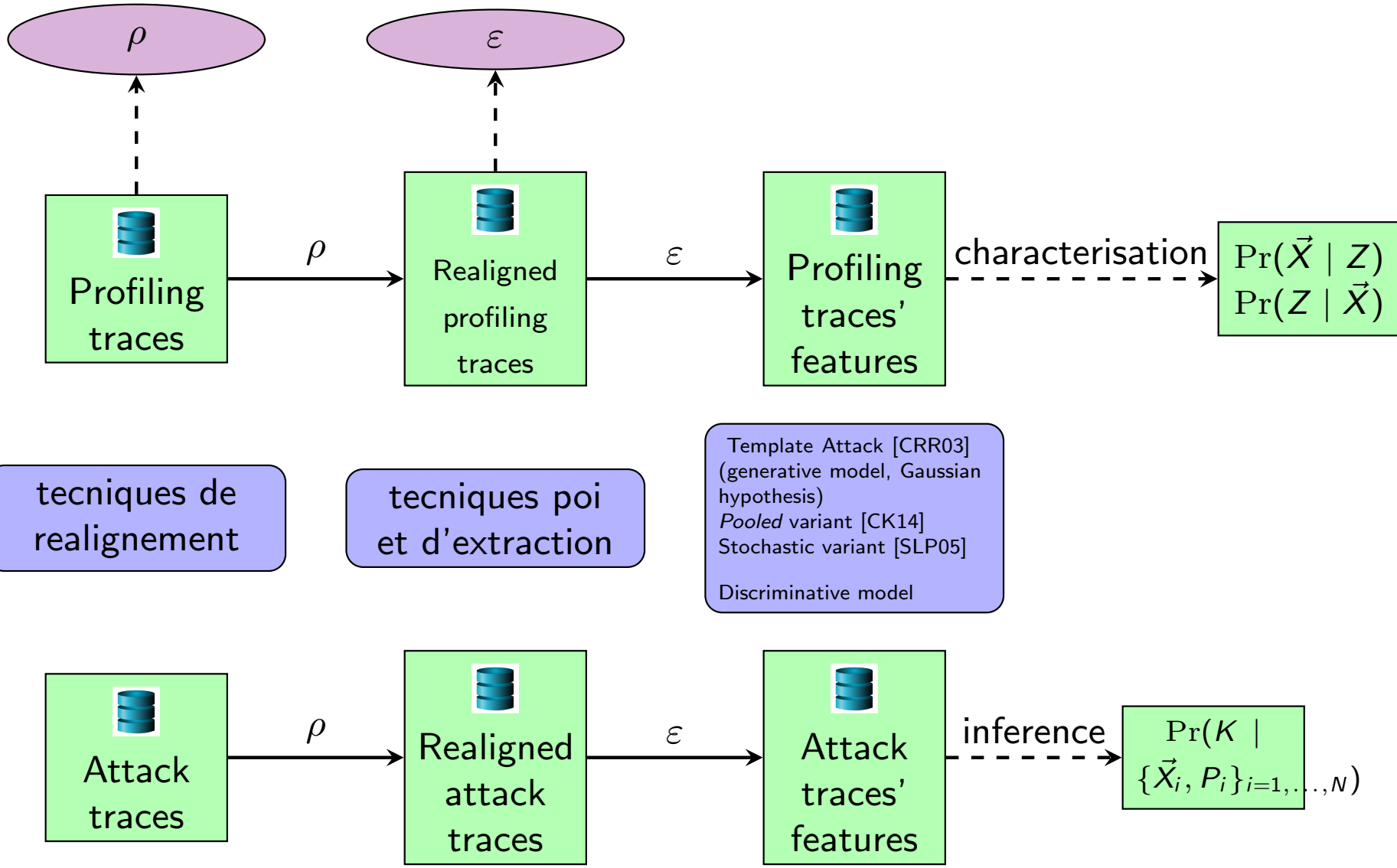
# Notations

# Template Attack



## Contributions

### Objective

# References I

[BKR11] Andrey Bogdanov, Dmitry Khovratovich, and Christian Rechberger. *Biclique Cryptanalysis of the Full AES*. Cryptology ePrint Archive, Report 2011/449. https://eprint.iacr.org/2011/449. 2011.

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[CK14] Omar Choudary and Markus G Kuhn. "Efficient template attacks". In: *Smart Card Research and Advanced Applications*. Springer, 2014, pp. 253–270.

# References II

[SLP05] Werner Schindler, Kerstin Lemke, and Christof Paar. "A stochastic model for differential side channel cryptanalysis". In: *International Workshop on Cryptographic Hardware and Embedded Systems*. Springer. 2005, pp. 30–46.