FROM RESEARCH TO INDUSTRY

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Feature Extraction for Side-Channel Attacks

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1. Context

2. State of the Art, Objectives, Contributions

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
- Hostile environment

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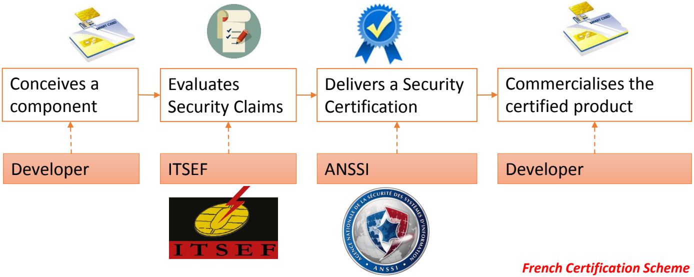
⇒ Requires protection against very high-level attacker

Security Certification


Conceives a component

Evaluates Security Claims

Delivers a Security Certification

Commercialises the certified product

Developer

ITSEF

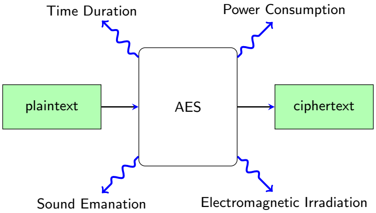
ANSSI

Developer

French Certification Scheme

- 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 → 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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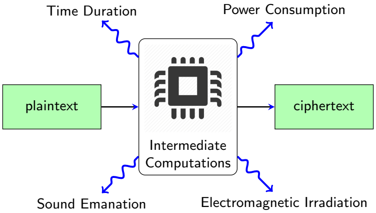

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Side-Channel Attacks

- **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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Objective

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[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.