Revealing the Secrets of Success
Theoretical Efficiency of Side-Channel Distinguishers

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Extended Abstract

Different side-channel distinguishers may have different efficiencies, however, their fair comparison is a difficult task, since many factors come into play. In particular, their intrinsic statistical properties and the quality of their estimation are significant factors. So far, two frameworks have been introduced in order to compare and highlight these features individually.

First, Standaert et al. proposed in [8] a framework consisting of several metrics to evaluate the efficiency of side-channel distinguishers or the strength of cryptographic implementations from a practical point of view. These metrics, namely *success rate* (formerly introduced in [3, 7]), *guessing entropy* and *information theoretic metric*, capture several intended aspects concerning the efficiencies of distinguishers, e.g., the power to distinguish, the quality of the estimation. However, when performed on power measurement traces these metrics tend to include very specific qualities of the measurement setup itself that may not be specific to the resistance of the implementation. Moreover, the evaluation process may become very expensive in terms of time, complexity and memory.

Second, in [10] Whitnall et al. suggested a purely theoretic evaluation framework, in which the theoretic behavior of distinguishers is compared when provided with full information about the leakage distribution. Even though this approach reflects new interesting insights into several qualities of distinguishers, the results may differ from the results achieved due to practical evaluation.

Apart from formulating a framework that can be carried out for various distinguishers, several works concentrated on the evaluation of the efficiency of certain attacks individually. More precisely, first works concentrated on finding a link between the Signal-to-noise ratio (SNR) of the power measurements and the effectiveness of the attack. E.g. in [5] the author presents a statistical model for CPA [1], finding an approximation of the success rate. An extension of this work has been given in [9]. While these works only focused on the correct key guess, Rivain first determined the exact success rate of CPA in [6] assuming an uniform setting in terms of the leakage model.

Recently, Fei et al. introduced a new methodology to evaluate side-channel distinguishers [2] giving the example of DPA [4]. Their approach consists in estimating the success rate of DPA due to the characterization of the physical implementation as well as the cryptographic algorithm. In particular, the authors provided an estimation of the success rate depending on the relationship between

the correct and incorrect key hypothesis (named as *confusion*), the number of measurements and the SNR.

In this talk, we generalize the idea of [2], that has been restricted to the application of one-bit DPA, to any additive distinguishers and show an application to CPA. Moreover, given the generalized estimation results, we further highlight a new framework to classify distinguishers, which may close the gap between purely practical and purely theoretical evaluations.

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