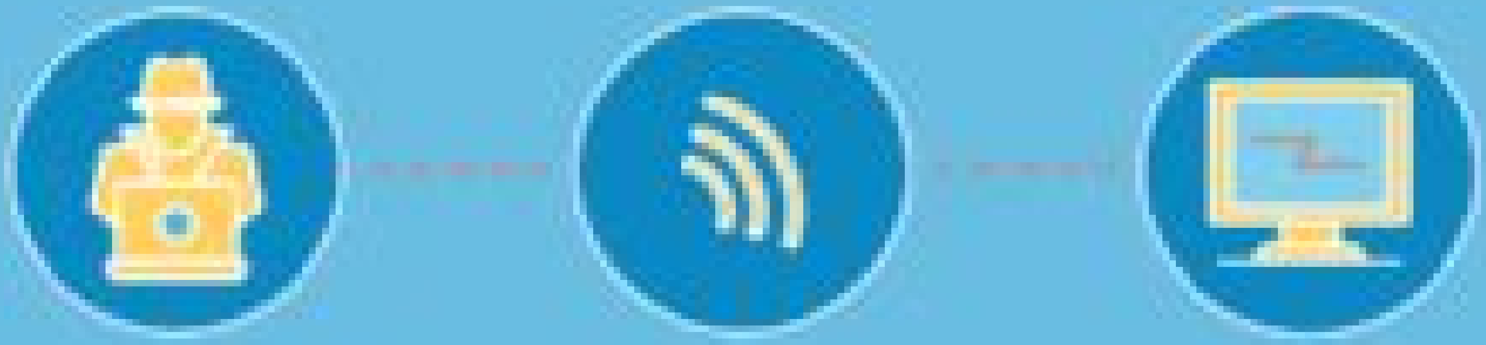
How a side-channel attack works



Attacker uses collected data to reconstruct target process

Attacker intercepts emissions

Target computer emits electro-magnetic wave

Side Channel Attacks And Countermeasures For Embedded Systems

Marc Joye,Jean-Jaques Quisquater

Side Channel Attacks And Countermeasures For Embedded Systems:

Side-Channel Analysis of Embedded Systems Maamar Ouladj,Sylvain Guilley,2021-07-28 It has been more than 20 years since the seminal publications on side channel attacks They aim at extracting secrets from embedded systems while they execute cryptographic algorithms and they consist of two steps measurement and analysis This book tackles the analysis part especially under situations where the targeted device is protected by random masking The authors explain advances in the field and provide the reader with mathematical formalizations They present all known analyses within the same notation framework which allows the reader to rapidly understand and learn contrasting approaches It will be useful as a graduate level introduction also for self study by researchers and professionals and the examples are taken from real world datasets

Side-channel Analysis Carlos Moreno,2013 Side Channel Analysis plays an important role in cryptology as it represents an important class of attacks against cryptographic implementations especially in the context of embedded systems such as hand held mobile devices smart cards RFID tags etc These types of attacks bypass any intrinsic mathematical security of the cryptographic algorithm or protocol by exploiting observable side effects of the execution of the cryptographic operation that may exhibit some relationship with the internal secret parameters in the device Two of the main types of side channel attacks are timing attacks or timing analysis where the relationship between the execution time and secret parameters is exploited and power analysis which exploits the relationship between power consumption and the operations being executed by a processor as well as the data that these operations work with For power analysis two main types have been proposed simple power analysis SPA which relies on direct observation on a single measurement and differential power analysis DPA which uses multiple measurements combined with statistical processing to extract information from the small variations in power consumption correlated to the data In this thesis we propose several countermeasures to these types of attacks with the main themes being timing analysis and SPA In addition to these themes one of our contributions expands upon the ideas behind SPA to present a constructive use of these techniques in the context of embedded systems debugging In our first contribution we present a countermeasure against timing attacks where an optimized form of idle wait is proposed with the goal of making the observable decryption time constant for most operations while maintaining the overhead to a minimum We show that not only we reduce the overhead in terms of execution speed but also the computational cost of the countermeasure which represents a considerable advantage in the context of devices relying on battery power where reduced computations translates into lower power consumption and thus increased battery life This is indeed one of the important themes for all of the contributions related to countermeasures to side channel attacks Our second and third contributions focus on power analysis specifically SPA We address the issue of straightforward implementations of binary exponentiation algorithms or scalar multiplication in the context of elliptic curve cryptography making a cryptographic system vulnerable to SPA Solutions previously proposed introduce a considerable performance penalty We propose a new method namely Square and Buffered

Multiplications SABM that implements an SPA resistant binary exponentiation exhibiting optimal execution time at the cost of a small amount of storage O sqrt ell where ell is the bit length of the exponent The technique is optimal in the sense that it adds SPA resistance to an underlying binary exponentiation algorithm while introducing zero computational overhead We then present several new SPA resistant algorithms that result from a novel way of combining the SABM method with an alternative binary exponentiation algorithm where the exponent is split in two halves for simultaneous processing showing that by combining the two techniques we can make use of signed digit representations of the exponent to further improve performance while maintaining SPA resistance We also discuss the possibility of our method being implemented in a way that a certain level of resistance against DPA may be obtained In a related contribution we extend these ideas used in SPA and propose a technique to non intrusively monitor a device and trace program execution with the intended application of assisting in the difficult task of debugging embedded systems at deployment or production stage when standard debugging tools or auxiliary components to facilitate debugging are no longer enabled in the device One of the important highlights of this contribution is the fact that the system works on a standard PC capturing the power traces through the recording input of the sound card **ECCWS2014-Proceedings of the 13th European Conference on Cyber warefare and Security** Andrew Liaropoulos,George Tsihrintzis,2014-03-07 **Securing Cyber-Physical Systems** Al-Sakib Khan Pathan,2015-10-06 Think about someone taking control of your car while you re driving Or someone hacking into a drone and taking control Both of these things have been done and both are attacks against cyber physical systems CPS Securing Cyber Physical Systems explores the cybersecurity needed for CPS with a focus on results of research and real world deploy

Cryptographic Hardware and Embedded Systems ,2003 **Software Defined Chips** Leibo Liu,Shaojun Wei,Jianfeng Zhu,Chenchen Deng,2022-11-14 This book is the second volume of a two volume book set which introduces software defined chips In this book the programming model of the software defined chips is analyzed by tracing the coevolution of modern general purpose processors and programming models The enhancement in hardware security and reliability of the software defined chips are described from the perspective of dynamic and partial reconfiguration The challenges and prospective trends of software defined chips are also discussed Current applications in the fields of artificial intelligence cryptography 5G communications etc are presented in detail Potential applications in the future including post quantum cryptography evolutionary computing etc are also discussed This book is suitable for scientists and researchers in the areas of electrical and electronic engineering and computer science Postgraduate students practitioners and professionals in related areas are also potentially interested in the topic of this book *Smart Card Research and Advanced Applications* Josep Domingo-Ferrer,2006-04-03 This volume constitutes the refereed proceedings of the 7th International Conference on Smart Card Research and Advanced Applications CARDIS 2006 held in Tarragona Spain in April 2006 The 25 revised full papers presented were carefully reviewed and updated for inclusion in this book The papers are organized in topical sections on smart card applications side channel attacks smart card networking cryptographic protocols RFID security and formal methods **Topics in Cryptology -- CT-RSA 2003** Marc Joye,2003-07-01 This book constitutes the refereed proceedings of the Cryptographers Track at the RSA Conference 2003 CT RSA 2003 held in San Francisco CA USA in April 2003 The 26 revised full papers presented together with abstracts of 2 invited talks were carefully reviewed and selected from 97 submissions The papers are organized in topical sections on key self protection message authentication digital signatures pairing based cryptography multivariate and lattice problems cryptographic architectures new RSA based cryptosystems chosen ciphertext security broadcast encryption and PRF sharing authentication structures elliptic curves and pairings threshold cryptography and implementation issues Intelligent Computing and Networking Valentina Emilia Balas,Vijay Bhaskar Semwal,Anand Khandare,2022-02-08 This book gathers high quality peer reviewed research papers presented at the International Conference on Intelligent Computing and Networking IC ICN 2021 organized by the Computer Department Thakur College of Engineering and Technology in Mumbai Maharashtra India on February 26 27 2021 The book includes innovative and novel papers in the areas of intelligent computing artificial intelligence machine learning deep learning fuzzy logic natural language processing human machine interaction big data mining data science and mining applications of intelligent systems in health care finance agriculture and manufacturing high performance computing computer networking sensor and wireless networks Internet of Things IoT software defined networks cryptography mobile computing digital forensics and blockchain technology *Computer Aided Verification* Swarat Chaudhuri,Azadeh Farzan,2016-07-12 The two volume set LNCS 9779 and LNCS 9780 constitutes the refereed proceedings of the 28th International Conference on Computer Aided Verification CAV 2016 held in Toronto ON USA in July 2016 The total of 46 full and 12 short papers presented in the proceedings was carefully reviewed and selected from 195 submissions The papers were organized in topical sections named probabilistic systems synthesis constraint solving model checking program analysis timed and hybrid systems verification in practice concurrency and automata and games **Information Security Practice and Experience** ,2005 *Attacks and Defenses of Ubiquitous Sensor Networks* Tanya Gazelle Roosta,2008 Intentional and Unintentional Side-channels in Embedded Systems Georg Tobias Becker,2014 Side channel attacks have become a very important and well studied area in computer security Traditionally side channels are unwanted byproducts of implementations that can be exploited by an attacker to reveal secret information In this thesis we take a different approach towards side channels Instead of exploiting already existing side channels they are inserted intentionally into designs These intentional side channels have the nice property of being hidden in the noise Only their implementer can make use of them This makes them a very interesting building block for different applications especially since they can also be implemented very efficiently In this thesis techniques to build intentional side channels for embedded software designs RTL level hardware designs as well as layout level hardware implementations are presented The usefulness of these techniques is demonstrated by building efficient side channel based software and hardware watermarks for intellectual property protection These side channel based watermarks can also be extended to be used as a tool to detect counterfeit ICs another problem the embedded system industry is facing However intentional side channels also have malicious applications In this thesis an extremely stealthy approach to build hardware Trojans is introduced By only modifying the IC below the transistor level meaningful hardware Trojans can be built without adding a single transistor Such hardware Trojans are especially hard to detect with currently proposed Trojan detection mechanisms and highlight not only the fact that new Trojan detection mechanisms are needed but also how stealthy intentional side channels can be Besides intentional side channels this thesis also examines unintentional side channels in delay based Physically Unclonable Functions PUFs PUFs have emerged as an alternative to traditional cryptography and are believed to be especially well suited for counterfeit protection They are also often believed to be more resistant to side channel attacks than traditional cryptography However by combining side channel analysis with machine learning we demonstrate that delay based PUFs can be attacked using both active as well as passive side channels The results not only raise strong doubt about the side channel resistance and usefulness of delay based PUFs but also show how powerful combining side channel analysis techniques with machine learning can be in practice Progress in Cryptology ,2005 *Power Analysis Side Channel Attacks* Jude Ambrose,Alexandar Ignjatovic,Sri Parameswaran,2010-01 Embedded Systems are ubiquitous used in various applications ranging from low end electronic appliances to high end rockets Security on such systems is a major concern where any useful insight gained by the adversary is harmful Side Channel Attacks SCAs are performed by observing properties such as power usage processing time and electro magnetic EM emissions to correlate these external manifestations with internal computations These properties are used to obtain critical information such as a secret key of a secure application Power analysis has been the most effective technique to extract secret keys during the execution of cryptographic algorithms using SCAs This book elaborates on power analysis based side channel attacks detailing all the common attacks and the countermeasures proposed in the past It also presents novel processor designs to combat against such attacks *Cryptographic Hardware and Embedded Systems - CHES 2004* Marc Joye,Jean-Jaques Quisquater,2004-07-08 These are the proceedings of CHES 2004 the 6th Workshop on Cryptographic Hardware and Embedded Systems For the first time the CHES Workshop was sponsored by the International Association for Cryptologic Research IACR This year the number of submissions reached a new record One hundred and twenty five papers were submitted of which 32 were selected for presentation Each submitted paper was reviewed by at least 3 members of the program committee We are very grateful to the program committee for their hard and efficient work in assembling the program We are also grateful to the 108 external referees who helped in the review process in their area of expertise In addition to the submitted contributions the program included three invited talks by Neil Gershenfeld Center for Bits and Atoms MIT about Physical Information Security by Isaac Chuang Medialab MIT about Quantum Cryptography and by Paul

Kocher Cryptography Research about Phy cal Attacks It also included a rump session chaired by Christof Paar which featured informal talks on recent results As in the previous years the workshop focused on all aspects of cryptographic hardware and embedded system security We sincerely hope that the CHES Workshop series will remain a premium forum for intellectual exchange in this area Topics in Cryptology, CT-RSA ... ,2006 **Proceedings of CARDIS '02** ,2002

IEEE/ACM/IFIP International Conference on Hardware/Software Codesign & System Synthesis ,2005

Information Security and Privacy ,2002

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