Advanced Code Based Cryptography Daniel J Bernstein

Code-Based CryptographyQC-LDPC Code-Based CryptographyCode-Based CryptographyCode-Based CryptographyCode-Based CryptographyCode-Based CryptographyImproving the Efficiency of Code-based CryptographyCode-Based CryptographyImplementational Aspects of Code-based CryptographyCode Based CryptographyCode-Based CryptographyMore Than Error CorrectionPost-Quantum CryptographyCryptography and CodingA Course in CryptographyCode Based Secret Sharing Schemes: Applied Combinatorial Coding TheoryPost-Quantum CryptographyPost-Quantum CryptographyEfficient and Secure Computations of Code Based Cryptography on Reconfigurable HardwareTwo Approaches for Achieving Efficient Code-based Cryptosystems Andre Esser Marco Baldi Violetta Weger Marco Baldi Antonia Wachter-Zeh Marco Baldi Edoardo Persichetti Jean-Christophe Deneuville Bhaskar Biswas Marco Baldi Andre Esser Yao Chen Daniel J. Bernstein Kenneth G. Paterson Heiko Knospe Patrick Sole Philippe Gaborit Ruben Niederhagen □□□ Rafael Misoczki

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this book constitutes the refereed proceedings of the 11th international conference on code based cryptography cbcrypto 2023 held in lyon france during april 22 23 2023 the 8 full papers included in this book were carefully reviewed and selected from 28 submissions the conference offers a wide range of many important aspects of code based cryptography such as cryptanalysis of existing schemes the proposal of new cryptographic systems and protocols as well as improved decoding algorithms

this book describes the fundamentals of cryptographic primitives based on quasi cyclic low density parity check qc ldpc codes with a special focus on the use of these codes in public key cryptosystems derived from the mceliece and niederreiter schemes in the first part of the book the main characteristics of qc ldpc codes are reviewed and several techniques for their design are presented while tools for assessing the error correction performance of these codes are also described some families of qc ldpc codes that are best suited for use in cryptography are also presented the second part of the book focuses on the mceliece and niederreiter cryptosystems both in their original forms and in some subsequent variants the applicability of qc ldpc codes in these frameworks is investigated by means of theoretical analyses and numerical tools in order to assess their benefits and drawbacks in terms of system efficiency and security several examples of qc ldpc code based public key cryptosystems are presented and their advantages over classical solutions are highlighted the possibility of also using qc ldpc codes in symmetric encryption schemes and digital signature algorithms is also briefly examined

this book constitutes the refereed proceedings of the 12th international conference on code based cryptography cbcrypto 2024 held in zurich switzerland during may 25 26 2024 the 5 full papers presented in this book were carefully reviewed and selected from 41 submissions the conference offers a wide range of many important aspects of code based cryptography such as cryptanalysis of existing schemes the proposal of new cryptographic systems and protocols as well as improved decoding algorithms

this book constitutes the refereed and revised post conference proceedings of the 7th international workshop on code based cryptography cbc 2019 held in darmstadt germany in may 2019 the eight papers presented in this book were carefully reviewed and selected from numerous submissions these contributions are divided into two groups the first four papers deal with the design of code based cryptosystems while the following four papers are on cryptanalysis of code based cryptosystems

this book constitutes the proceedings of the 9th international workshop on code based cryptography cbcrypto 2021 which was held during june 21 22 2021 the workshop was initially planned to take place in munich germany but changed to an online event due to the covid 19 pandemic the 6 papers presented in this volume were carefully reviewed and selected from 14 submissions these contributions span all aspects of code based cryptography from design to implementation and including studies of security new systems and improved decoding algorithms this book constitutes the refereed and revised post conference proceedings of the 8th international workshop on code based cryptography cbcrypto 2020 held in zagreb croatia in may 2020 the seven papers presented in this book were carefully reviewed and selected from numerous submissions these contributions focus on various topics such as code based cryptography from design to implementation security new systems and improved decoding algorithms the conference was held virtually due to the covid 19 pandemic

recent public key cryptography is largely based on number theory problems such as factoring or computing of discrete logarithm these systems constitute an excellent choice in many applications and their security is well defined and understood one of the major drawbacks though is that they will be vulnerable once quantum computers of an appropriate size are available there is then a strong need for alternative systems that would resist attackers equipped with quantum technology one of the most well known systems of this kind is the mceliece cryptosystem introduced in 1978 that is based on algebraic coding theory there are no known vulnerabilities against quantum computers and it has a very fast and efficient encryption procedure however it has also one big flaw the size of the public key that makes it impractical for many applications the first part of this thesis is dedicated to finding a way to significantly reduce the size of the public key latest publications achieve very good results by using codes with particular structures obtaining keys as small as 4 096 bits unfortunately almost all of the variants presented until now have been broken or proven to be insecure against the so called structural attacks i e attacks that aim to exploit the hidden structure in order to recover the private key my work is based on generalized srivastava codes and represents a generalization of the quasi dyadic scheme proposed by misoczki and barreto with two advantages a better flexibility and improved resistance to all the known attacks an efficient implementation of the above scheme is also provided as a result of a joint work with p l cayrel and g hoffmann in the next chapters other important aspects of code based cryptography are investigated these include the study of a higher security standard called indistinguishability under a chosen ciphertext attack in the standard model and the design of a code based key encapsulation mechanism kem which is an essential component of the hybrid encryption protocol the last chapter is about digital signatures a fundamental protocol in modern cryptography existing code based signatures schemes are reviewed and a negative result is obtained showing that the design of an efficient signature scheme based on coding theory is still an open problem

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the first code based cryptosystem mceliece was invented in the very early development of public key cryptography yet code based cryptosystems received little attention for decades due to their relatively large key sizes but recently they are re discovered for their potentials to provide efficient post quantum cryptographic tools and homomorphic encryption schemes and the development of large storage and fast internet have made these schemes closer to practice than ever through our review of the revolution of code based cryptography we will demonstrate the usage of codes in cryptographic applicaitons we will follow the path of the development from the design analysis and implementation of mceliece cryptosystem and the quantum attack resistance to the latest fully homomorphic encryption scheme based on learning with errors a code related problem designed by brakerski et al we will also cover algebraic manipulation detection codes a newly proposed extension of error correcting codes and a lightweight alternative to macs as an authentication component embedded in security protocols

quantum computers will break today s most popular public key cryptographic systems including rsa dsa and ecdsa this book introduces the reader to the next generation of cryptographic algorithms the systems that resist quantum computer attacks in particular post quantum public key encryption systems and post quantum public key signature systems leading experts have joined forces for the first time to explain the state of the art in quantum computing hash based cryptography code based cryptography lattice based cryptography and multivariate cryptography mathematical foundations and implementation issues are included this book is an essential resource for students and researchers who want to contribute to the field of post quantum cryptography this book constitutes the refereed proceedings of the 9th ima international conference on cryptography and coding held in cirencester uk in december 2003 the 25 revised full papers presented together with 4 invited contributions were carefully reviewed and selected from 49 submissions the papers are organized in topical sections on coding and applications applications of coding in cryptography cryptography cryptanalysis network security and protocols

this book provides a compact course in modern cryptography the mathematical foundations in algebra number theory and probability are presented with a focus on their cryptographic applications the text provides rigorous definitions and follows the provable security approach the most relevant cryptographic schemes are covered including block ciphers stream ciphers hash functions message authentication codes public key encryption key establishment digital signatures and elliptic curves the current developments in post quantum cryptography are also explored with separate chapters on quantum computing lattice based and code based cryptosystems many examples figures and exercises as well as sagemath python computer code help the reader to understand the concepts and applications of modern cryptography a special focus is on algebraic structures which are used in many cryptographic constructions and also in post quantum systems the essential mathematics and the modern approach to cryptography and security prepare the reader for more advanced studies the text requires only a first year course in mathematics calculus and linear algebra and is also accessible to computer scientists and engineers this book is suitable as a textbook for undergraduate and graduate courses in cryptography as well as for self study

secret sharing schemes form one of the most important topic in cryptography these protocols are used in many areas applied mathematics computer science electrical engineering a secret is divided into several pieces called shares each share is given to a user of the system each user has no information about the secret but the secret can be retrieved by certain authorized coalition of users this book is devoted to such schemes inspired by coding theory the classical schemes of shamir blakley massey are recalled survey is made of research in combinatorial coding theory they triggered mostly self dual codes and minimal codes applications to engineering like image processing and key management of manets are highlighted

this book constitutes the refereed proceedings of the 5th international workshop on post quantum cryptography pqcrypto 2013 held in limoges france in june 2013 the 17 revised full papers presented were carefully reviewed and selected from 24 submissions the papers cover all technical aspects of cryptographic research related to the future world with large quantum computers such as code based cryptography lattice based cryptography multivariate cryptography cryptanalysis or implementations the two volume set lncs 15577 15578 constitutes the proceedings of the 16th international workshop on post quantum cryptography pqcrypto 2025 held in taipei taiwan during april 8 10 2025 the 25 full papers presented in the proceedings were carefully selected and reviewed from 59 submissions the papers have been organized in the following topical sections part i code based cryptography multivariate cryptography lattice based cryptography part ii isogeny based cryptography cryptanalysis quantum security side channel attacks security notions

code based cryptography is not widely deployed in practice mostly due to its important drawback huge key sizes in this thesis we propose two different approaches to address this issue the first one uses algebraic codes presenting a way to construct goppa codes that admit compact representation these are the p adic goppa codes we show how to construct these codes to instantiate public key encryption schemes how to extend this approach to a signature scheme and finally how to generalize the approach to codes defined over characteristic greater or equal to two in summary we managed to produce very compact keys based on the reputable family of goppa codes although efficient p adic goppa codes have a non desirable property strong algebraic structure this leads to our second approach using ldpc codes of increased density or simply mdpc codes these are graph based codes which are free of algebraic structure it is quite reasonable to assume that mpdc codes are only distinguishable by finding their dual low weight codewords this is an important advantage not only in comparison to all previous compact keys mceliece like variants but also regarding the classical mceliece based on binary goppa codes here compact keys are obtained by using a quasi cyclic structure

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