Implementing Post-Quantum Cryptography on the Cortex M4

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RIOT Summit 2018

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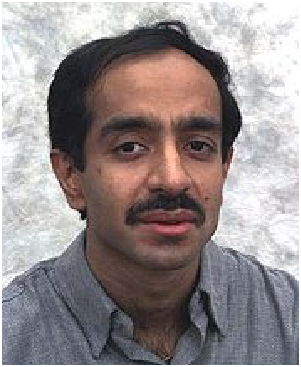
- ECC is broken.
- Symmetric crypto is broken.. but easily fixed.



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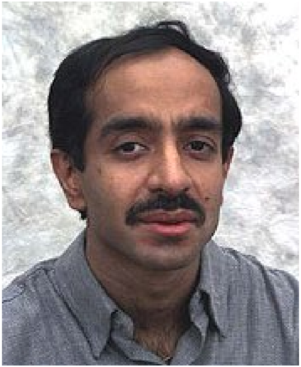

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post-quantum RSA	*‘What if we used 1 GiB keys?’*

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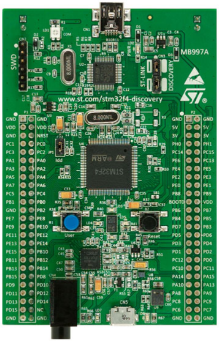
- This project: where do we stand? How do we improve?

PQM4 framework

- Deliverable of the EU H2020 PQCRYPTO project
  - ‘Small devices’
- Target platform: Cortex M4 (STM32 M4 discovery board)
  - `STM32F407VG`
- ‘PQC on M4’ framework
  - Testing
  - Benchmarking



STM32 F4

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FrodoKEM-640-cSHAKE, KINDI-256-3-4-2, Kyber-768, NewHope-1024-CCA-KEM, NTRU-HRSS-KEM-701, Saber, SIKE-p571, Streamlined NTRU Prime 4591761, Dilithium-III, qTesla-I, qTesla-III-size, qTesla-III-speed, SPHINCS+-SHAKE256-128s

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- Crypto schemes are **not ready for production use**

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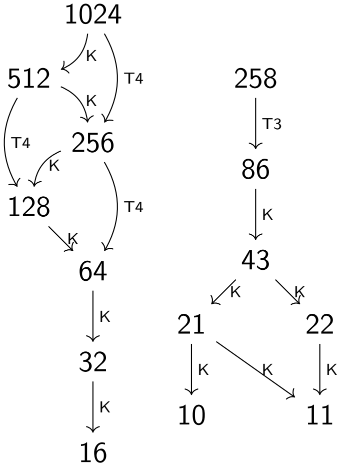
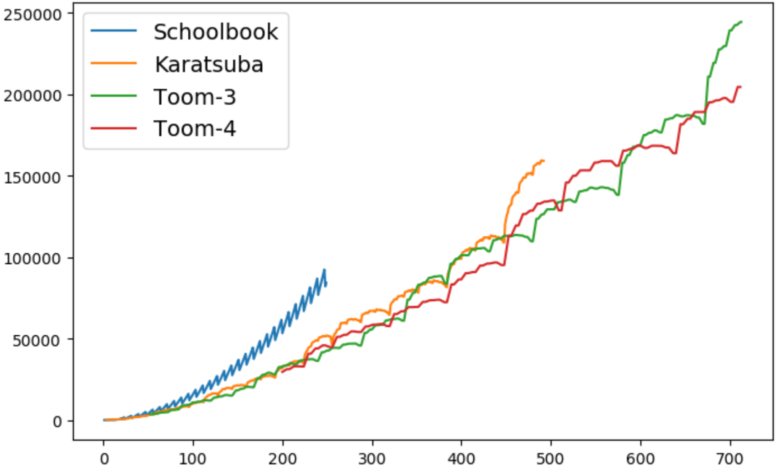


Preliminary results

- Arbitrary degree n (≤ 1024)
- Python scripts generate ARMv7M assembly



Speed records

- Directly applies to several NIST submissions
  - Work in progress

scheme	params	impl	key gen	encaps	decaps
KINDI	$n = 256$ $q = 2^{14}$	ref	22,942k	29,656k	37,817k
		ours	**1,101k**	**1,494k**	**1,726k**
NTRU-HRSS	$n = 701$ $q = 2^{13}$	ref	204,854k	5,166k	15,067k
		ours	**164,090k**	**451k**	**917k**
NTRU-KEM	$n = 743$ $q = 2^{11}$	ref	53,326k	7,144k	12,782k
		ours	**5,445k**	**1,825k**	**2,145k**
SABER	$n = 256$ $q = 2^{13}$	ref	7,123k	9,471k	12,304k
		[1]	1,147k	1,444k	1,543k
		ours	**982k**	**1,277k**	**1,323k**
RLizard	$n = 1024$ $q = 2^{11}$	ref	26,428k	32,211k	57,344k
		ours	**626k**	**1,513k**	**1,986k**

[1] Karmakar, A., Mera, J. M. B., Roy, S. S., & Verbauwhede, I. (2018). Saber on ARM. IACR Transactions on Cryptographic Hardware and Embedded Systems, 243-266.

Interested?

Find us at https://github.com/mupq/pqm4

All code available as public domain where possible.