Comparing proofs of security for lattice-based encryption

Daniel J. Bernstein

Primary objective of this paper: Make a **complete plan** for thorough security reviews of 36 target KEMs.

Much harder: Do the reviews! Complete plan is framework to evaluate which pieces are done, and to coordinate further efforts. KEMs vary in what's needed.

The target KEMs (all proposed for wide deployment, IND-CCA2): frodo kyber lac newhope ntru ntrulpr round5n1 round5nd saber sntrup threebears

- 640, 976, 1344.
- 512, 768, 1024.
 - 128, 192, 256.
 - 512, 1024.
- hps2048509, hps2048677,
 - hps4096821, hrss701.
 - 653, 761, 857.
 - 1, 3, 5.
 - 1.0d, 3.0d, 5.0d,
 - 1.5d, 3.5d, 5.5d.
 - light, main, fire. 653, 761, 857.
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Revised plan:

- 1. Verify the "security proofs". 2. Verify the cryptanalysis of the risks left by the proofs. Again clean up; check by hand; track failure categories.

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Risk #3: There are faster attacks outside type T.

- Risk #1: P does not reach

Plan without proofs is simpler: Verify cryptanalysis of the KEMs.

But sometimes the proofs reduce cost of cryptanalysis.

Sometimes this outweighs cost to verify proofs: reduces cost of thorough security review. Hopefully less chance of disaster.

This paper's verification plan skips proofs that clearly fail to reduce cost of cryptanalysis: e.g., frodo seed "reduction".

Risks not ruled out by proofs

8

A "security proof" guarantees security level λ for system X against all attacks of type Tassuming security level λ' for underlying problem P.

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Risk #2 (looseness): λ is below claimed security level of X.

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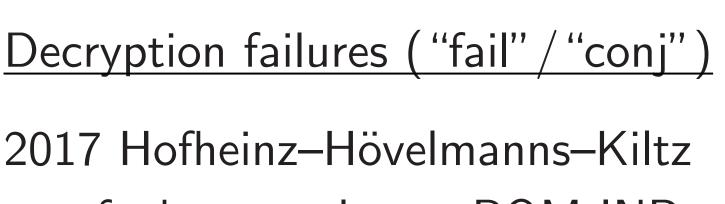
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As far as I can tell, none of the target KEMs claim higher U-user security.