Classic McEliece:
conservative code-based cryptography

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Key sizes and key-generation speed

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  1047319 bytes for public key.
  13908 bytes for secret key.

mceliece8192128 parameter set:
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Very fast in hardware (PQCrypto 2018; CHES 2017):
a few million cycles at 231MHz
using 129059 modules, 1126 RAM blocks
on Altera Stratix V FPGA.

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Can tweak parameters for even smaller ciphertexts, not much penalty in key size.
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McEliece’s system prompted huge amount of followup work.

Some work improves efficiency while clearly preserving security:

- Niederreiter’s dual PKE
  (use parity check matrix instead of generator matrix);
- many decoding speedups; . . .

Classic McEliece uses all this, with constant-time implementations.

- Write $H = (I_{n-k} | T)$, public key is $(n-k) \times k$ matrix $T$,
  $n-k = w \log_2 q$. $H$ constructed from binary Goppa code.
- Encapsulate using $e$ of weight $w$.

$q = 8192$, $n = 6960$, $w = 119$.

mceliece8192128 parameter set:
$q = 8192$, $n = 8192$, $w = 128$.

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Further features of system that simplify attack analysis:

5. Ciphertext is deterministic function of input $e$: i.e., inversion recovers all randomness used to create ciphertexts.
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Further features of system that simplify attack analysis:

5. Ciphertext is deterministic function of input $e$: i.e., inversion recovers all randomness used to create ciphertexts.
6. There are no inversion failures for legitimate ciphertexts.
Classic McEliece highlights

- Security asymptotics unchanged by 40 years of cryptanalysis.
- Short ciphertexts.
- Efficient and straightforward conversion of OW-CPA PKE into IND-CCA2 KEM.
- Constant-time software implementations.
- FPGA implementation of full cryptosystem.
- Open-source (public domain) implementations.
- No patents.

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