McBits:
fast constant-time
code-based cryptography

D. J. Bernstein
University of Illinois at Chicago &
Technische Universiteit Eindhoven

Joint work with:

Tung Chou
Technische Universiteit Eindhoven
(original speaker,
still waiting for U.S. visa)

Peter Schwabe
Radboud University Nijmegen

Objectives

Set new speed records
for public-key cryptography.

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`mceliece` encrypt (2008 Biswas–Sendrier, $\approx 2^{80}$)	61440
`gls254` DH (binary elliptic curve; CHES 2013)	77468
`kumfp127g` DH (hyperelliptic; Eurocrypt 2013)	116944
`curve25519` DH (conservative elliptic curve)	182632
`mceliece` **decrypt**	1219344
`ronald1024` decrypt	1340040

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(Decryption is slightly slower:
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Similar improvements for CFS.

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Low-end smartphone CPU: 128-bit XOR every cycle.

Ivy Bridge: 256-bit XOR every cycle, or three 128-bit XORs.

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Not as slow as it sounds!
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Low-end smartphone CPU:
128-bit XOR every cycle.

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Big overlap between $f(\alpha) = f_0(\alpha^2 + \alpha) + \alpha f_1(\alpha^2 + \alpha)$ and $f(\alpha + 1) = f_0(\alpha^2 + \alpha) + (\alpha + 1) f_1(\alpha^2 + \alpha)$.

"Twist" to ensure $1 \in$ space. Then $\{\alpha^2 + \alpha\}$ is a size-$(n/2)$ $\mathbf{F}_2$-linear space. Apply same idea recursively.

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