

Boring crypto

Daniel J. Bernstein

University of Illinois at Chicago &
Technische Universiteit Eindhoven

Ancient Chinese curse: “May you
live in interesting times, so that
you have many papers to write.”

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Improved attacks!

Proposed fixes!

Even better attacks!

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“Applications which pre-process the encryption key and IV by using hashing and/or which discard the first 256 bytes of pseudo-random output **should be considered secure** from the proposed attacks. . . . The ‘heart’ of RC4 is its **exceptionally simple and extremely efficient** pseudo-random generator. . . . RC4 is likely to remain the algorithm of choice for many applications and embedded systems.”

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Even more RC4 cryptanalysis:

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- 2002 Mironov,
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- 2004 Paul–Preneel,
- 2004 KoreK,
- 2004 Devine,
- 2005 Maximov,
- 2005 Mantin,
- 2005 d’Otreppe,
- 2006 Klein,
- 2006 Doroshenko–Ryabko,
- 2006 Chaabouni.

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WEP **blamed** for 2007 theft

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WEP **blamed** for 2007 theft of 45 million credit-card numbers from T. J. Maxx. Subsequent lawsuit **settled** for \$40900000.

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2002 Mironov,
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Cryptanalysis continues:

2007 Paul–Maitra–Srivastava,
2007 Paul–Rathi–Maitra,
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2007 Vaudenay–Vuagnoux,
2007 Tews–Weinmann–Pyshkin,
2007 Tomasevic–Bojanic–
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2007 Maitra–Paul,
2008 Basu–Ganguly–Maitra–Paul.

More RC4 cryptanalysis:

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Cryptanalysis continues:

[2007](#) Paul-Maitra-Srivastava,

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2012 Akamai [blog](#)

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- [2008](#) Biham–Carmeli,
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- [2011](#) Maitra–Paul–Sen Gupta,
- [2011](#) Sen Gupta–Maitra–Paul–
Sarkar,
- 2011 Paul–Maitra [book](#).

2012 Akamai [blog entry](#):

“Up to 75% of SSL-enabled web sites are vulnerable [to BEAST] ... OpenSSL v0.9.8 is the current version in broad use and it only supports TLS v1.0. ... the interim fix is to prefer the RC4-128 cipher for TLS v1.0 and SSL v3. ... RC4-128 is faster and cheaper in processor time ... approximately 15% of SSL/TLS negotiation on the Akamai platform use RC4 ... most browsers can support the RC4 fix for BEA

And more:

- [2008](#) Biham–Carmeli,
- [2008](#) Golic–Morgari,
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2012 Akamai [blog entry](#):
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RC4 cryptanalysis
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RC4 cryptanalysis continues

[2013](#) Lv–Zhang–Lin,

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RC4 cryptanalysis continues:

[2013](#) Lv–Zhang–Lin,

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[2013](#) Sarkar–Sen Gupta–Paul–Maitra,

[2013](#) Isobe–Ohigashi–Watanabe–Morii,

[2013](#) AlFardan–Bernstein–Paterson–Poettering–Schuldt,

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- [2013](#) Lv–Zhang–Lin,
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Maybe the final straws:

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RC4 cryptanalysis continues:

2013 Lv–Zhang–Lin,

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Meanwhile IETF publishes

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RC4 cryptanalysis continues:

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“ 2^{80} security” is interesting.

2^{80} mults on mass-market GPUs:

about 2^{22} watt-years.

Bluffdale: 2^{26} watts.

Is “ 2^{80} security” really 2^{85} ? 2^{75} ?

Are the individual ops harder than single-precision mults? Easier?

Can the attack cost be shared across targets, as in Logjam?

Every speedup is important.

“ 2^{128} security” is boring.

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