OpenBSD: Where crypto is heading?

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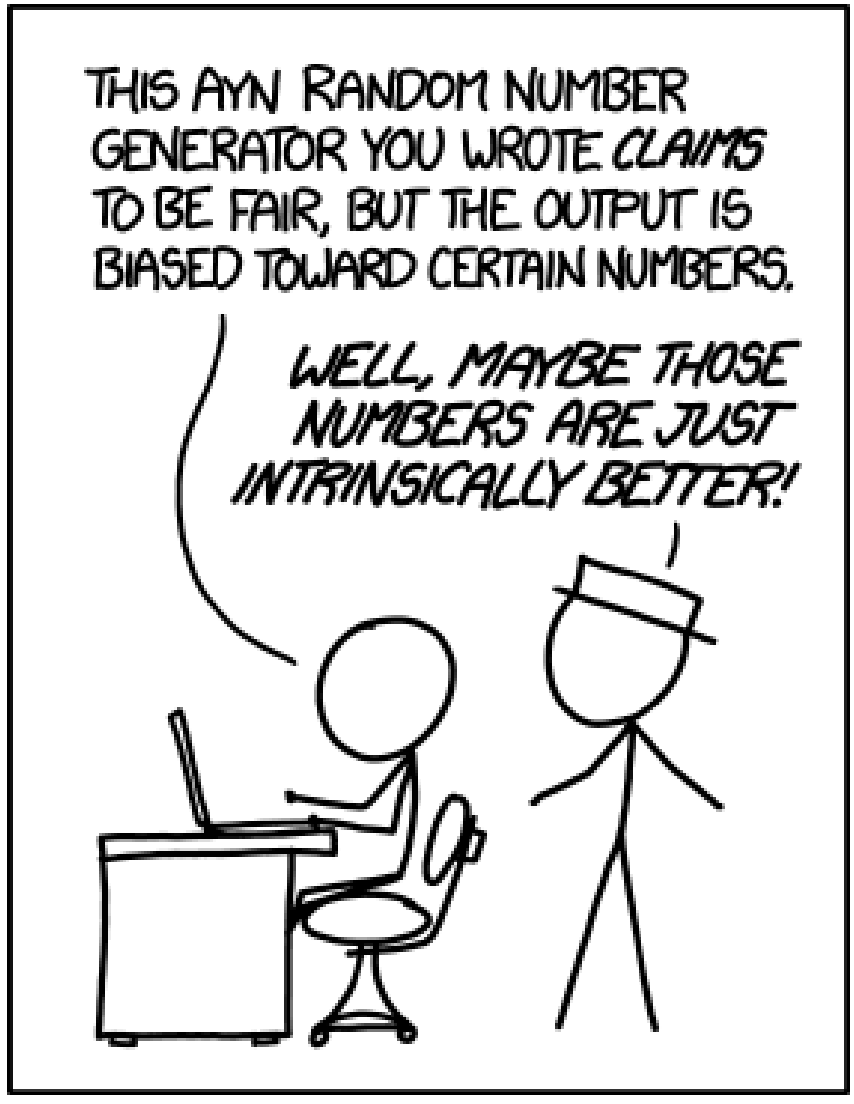
Moscow, December 14 2013



http://xkcd.com/1277

Pseudo-random number generator

rand (ANSI C, POSIX)

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arc4random (OpenBSD)

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arc4random in Linux! (libbsd)

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arc4random (RC4?)

RC4 security

2001 Fluhrer, Mantin and Shamir attack [1]

2005 Klein attack [2]

2013 AlFardan, Bernstein, Paterson, et. al. [3]

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[1] Weaknesses in the Key Scheduling Algorithm of RC4

[2] Attacks on the RC4 stream cipher

[3] On the Security of RC4 in TLS and WPA

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arc4random (ChaCha?!)

ChaCha20 stream cipher

http://cr.yp.to/chacha.html

Based on Salsa20 (in eSTREAM portfolio)

Used in BLAKE (SHA-3 finalist)

4 cpb on modern x86

128/256 bit key

ChaCha versus Salsa

Improved diffusion

But no performance hit

IETF Crypto Forum Research Group (CFRG) "is confident that the analysis was sufficiently thorough that ChaCha is an acceptable alternative to SALSA-20." [4]

[4] Synopsis of CFRG discussions on new stream ciphers and MACs for TLS

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goodrandom?

SSL/TLS

SSL/TLS ciphers

RC4	SSL 2.0+
AES-CBC	SSL 3.0+
AES-GCM	TLS 1.2

SSL/TLS in Chrome

Undocumented option `--cipher-suite-blacklist`

0x0004	TLS_RSA_WITH_RC4_128_MD5
0x0005	TLS_RSA_WITH_RC4_128_SHA
0x000a	TLS_RSA_WITH_3DES_EDE_CBC_SHA
0x0032	TLS_DHE_DSS_WITH_AES_128_CBC_SHA
0xc007	TLS_ECDHE_ECDSA_WITH_RC4_128_SHA
0xc011	TLS_ECDHE_RSA_WITH_RC4_128_SHA

Values from RFC 2246

AES-GCM

NIST standard of authenticated encryption

AES-CTR + GHASH

NSA Suite B, SSH, TLS, IPsec, MACsec, FC-SP, WiGig

Experimental support in the OpenBSD IPsec stack

AES-NI and CLMUL

Available in Intel Westmere and newer

7 new SSE instructions

Implemented in OpenSSL and OCF

FPU “locks” in the kernel

CBC, CTR, XTS, GCM

ChaCha20-Poly1305 for TLS draft

Google have proposed draft-agl-tls-chacha20poly1305

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E5-2690 2.9GHz	
AES-128-GCM	131 MB/s
AES-128-GCM with AES-NI	311 MB/s
ChaCha20+Poly1305	420 MB/s

Cortex-A9 1.2GHz	
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Expected in Chrome 32, bug was filed against NSS, Firefox

Salsa20-SHA1 for TLS draft

RedHat et al. draft-josefsson-salsa20-tls

Revision	Changes
01	Salsa20/12 with 128-bit key removed
02	UMAC-96 added
03	UMAC-96 removed

Poly1305 MAC

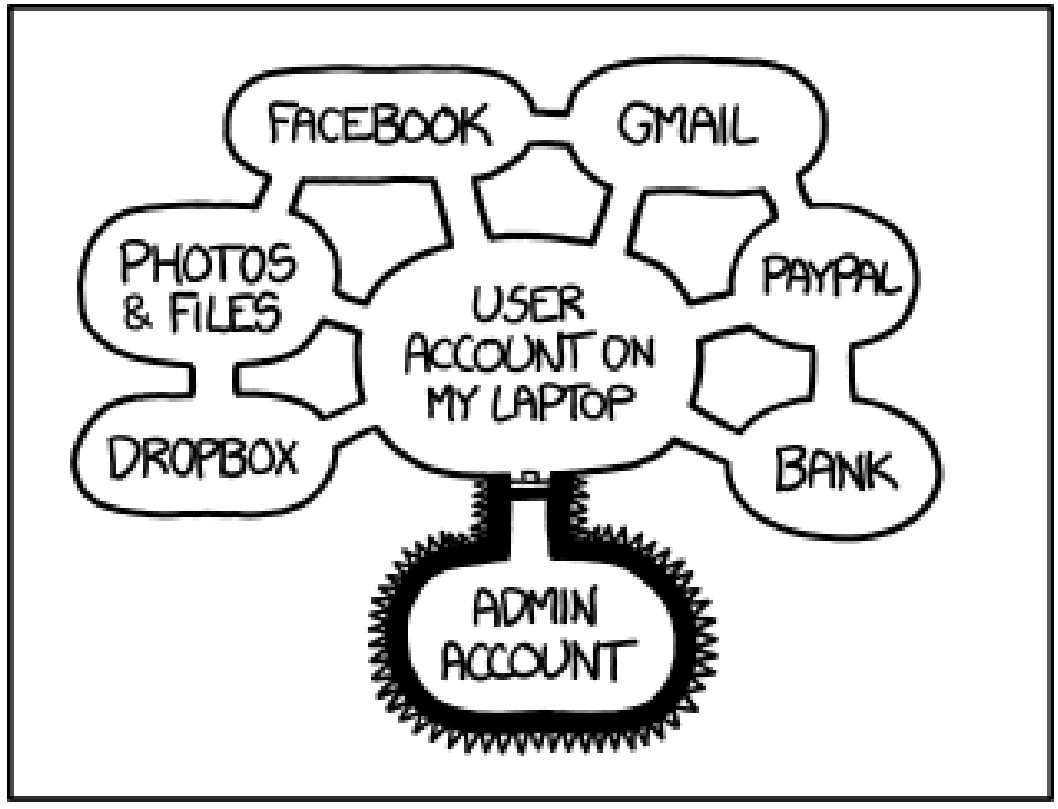
http://cr.yp.to/mac.html

"Poly1305 can be written in a tweet" [5]

About 4 cpb w/o the cipher

Security mainly depends on a chosen cipher (AES, ChaCha, etc.)

[5] Salsa20 and Poly1305 in TLS



IF SOMEONE STEALS MY LAPTOP WHILE I'M LOGGED IN, THEY CAN READ MY EMAIL, TAKE MY MONEY, AND IMPERSONATE ME TO MY FRIENDS,

BUT AT LEAST THEY CAN'T INSTALL DRIVERS WITHOUT MY PERMISSION.

http://xkcd.com/1200

NIST curves

2013 Bernstein, Lange "Security dangers of NIST curves" [6]

http://safecurves.cr.yp.to/

[6] Security dangers of the NIST curves

Curve25519 Diffie-Hellman

http://cr.yp.to/ecdh.html

Does not infringe Certicom patents

Executes in constant time

32 byte private and public keys

Ed25519 EdDSA signatures

http://ed25519.cr.yp.to/

Comparable to RSA3072, NIST P-256

32 byte private and public keys

64 byte signatures

Uses PRF (SHA512)

NIST-free cryptography in OpenSSH

Support in OpenBSD-current:

Cipher/MAC	chacha20-poly1305@openssh.com
Key exchange	curve25519-sha256@libssh.org
Public keys	ssh-ed25519-cert-v01@openssh.com

IPsec/IKEv2 possibilities

It's possible to use "Private Range" in IKEv2

ChaCha20-Poly1305 AEAD for ESP

Questions?

If this story leaves you confused, join the club.

Bruce Schneier