PBKDF2: performance matters

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PBKDF2: quick intro

Purpose

Slowly convert a password + salt into a symmetric key of some length

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Origin

RSA labs, 1999. Described in PKCS#5 and then RFC2898

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PBKDF2 can produce arbitrary length output

We're going to ignore this capability from here on in: only considering the first block of output.

PBKDF2: how it was described

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\text{and typically} & \\
\mathrm{PRF}(\mathrm{pw}, \mathrm{x}) &= \text{HMAC-H}(\mathrm{pw}, \mathrm{x}) \\
H &= \text{SHA-1, SHA-256 or SHA-512}
\end{aligned}
$$

Zoom, enhance

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Assumption: password and salt much shorter than SHA-256's 64-byte block size.

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Therefore, we need to compute 4i SHA-256 blocks.

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How many times?

Actually, we only need compute $2 + 2i$ SHA-256 blocks.

Our survey says...

Good: compute $2 + 2i$ blocks

- OpenSSL (after Nov 2013)
- Python core ($\geq$3.4)
- Django (CVE-2013-1443)
- SJCL
- BouncyCastle ($\geq$1.49)

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- GRUB
- Android (BouncyCastle)

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- Python (pypi pbkdf2)
- Ruby (pbkdf2 gem)
- Go (go.crypto)
- OpenBSD
- PolarSSL
- CyaSSL
- Java (OpenJDK)
- Common Lisp (ironclad)
- Perl (Crypt::PBKDF2)
- PHP
- C#

Parting thoughts...

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- PBKDF2 is not wonderfully designed.
- Described in an unhelpful way by its authors.
- Most implementations gift a 2x advantage to attackers.

Thank you!

Questions?

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