SSL, X.509, HTTPS

How to configure your HTTPS server

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HTTPS

- It's complex
- Two protocols involving crypto – X.509 (for the certificates) and SSL/TLS (for the data transport)
- Many things can go wrong
- Often issues in the protocols themselves, not just application bugs
- Test by Qualys:

  https://www.ssllabs.com/ssltest/

The Problem

- I configured a host with everything like “you want it to be – as secure as possible”: https://fancyssl.hboeck.de/
- But you won't be able to access it – at least not if you're using Internet Explorer, Firefox, Chrome, Safari, Opera or the Android-Browser
- w3m and lynx work
- If you don't want to wait till your browser supports modern ssl standards: http://fancynossl.hboeck.de/

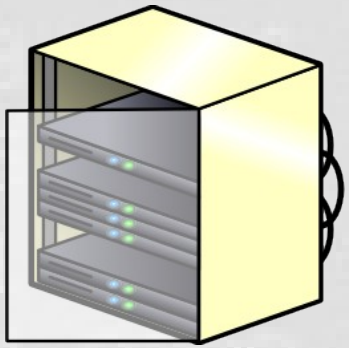
X.509

CA

signs cert

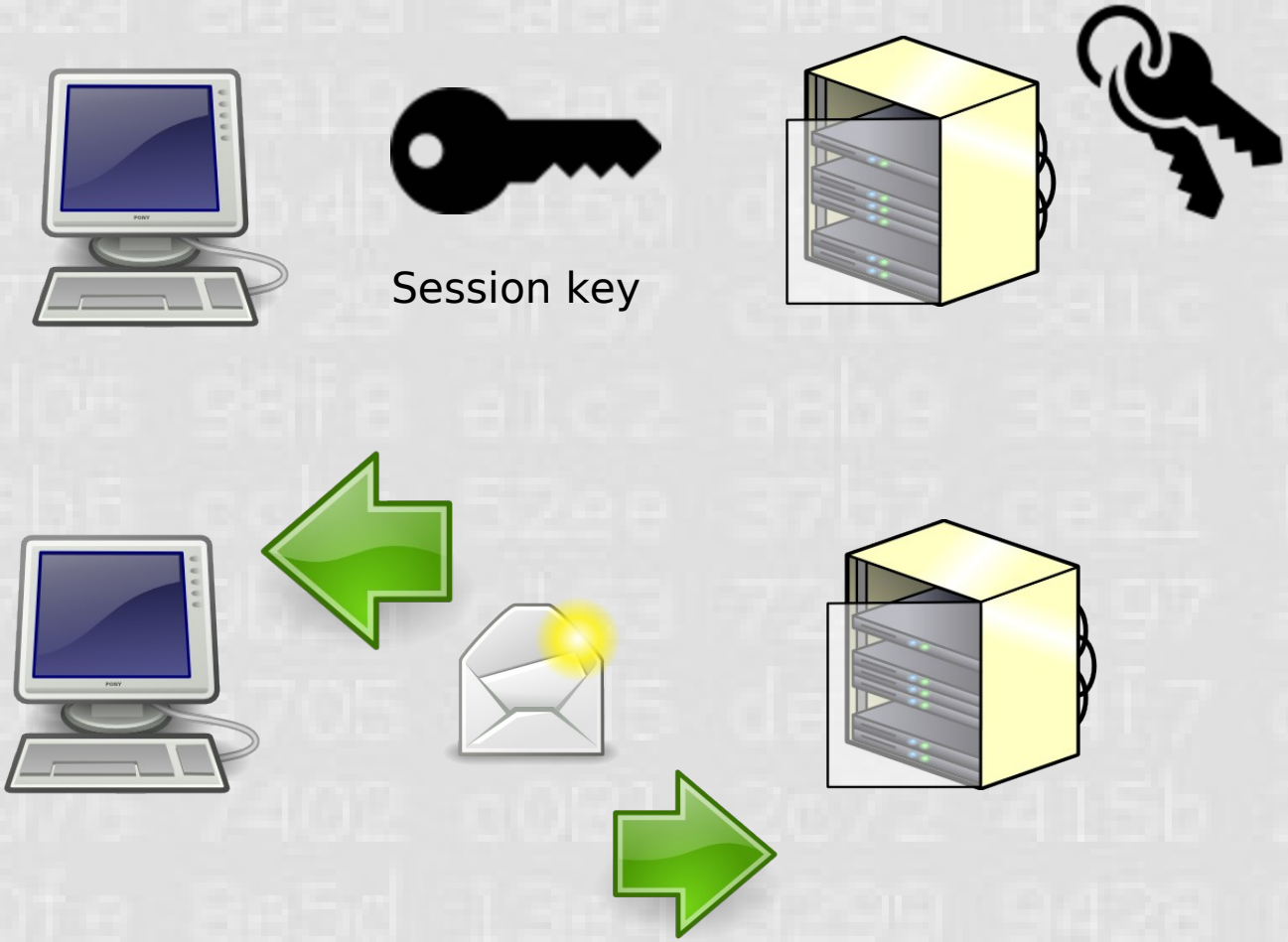
User

shows cert



HTTPS
Server

SSL / TLS



The certificate

- Contains public key
- Can be RSA, DSA, ECDSA, RSA-PSS... (NTRU draft) – but in practice it's RSA
- Key length below 1024 (512 bit, 768 bit) – you're screwed
- Key length 1024 bit – not good (CAcert still allows it)
- Low exponents (like e=3, e=5) – can cause issues, but only if implementation is broken – better use e = 65537 (default today)

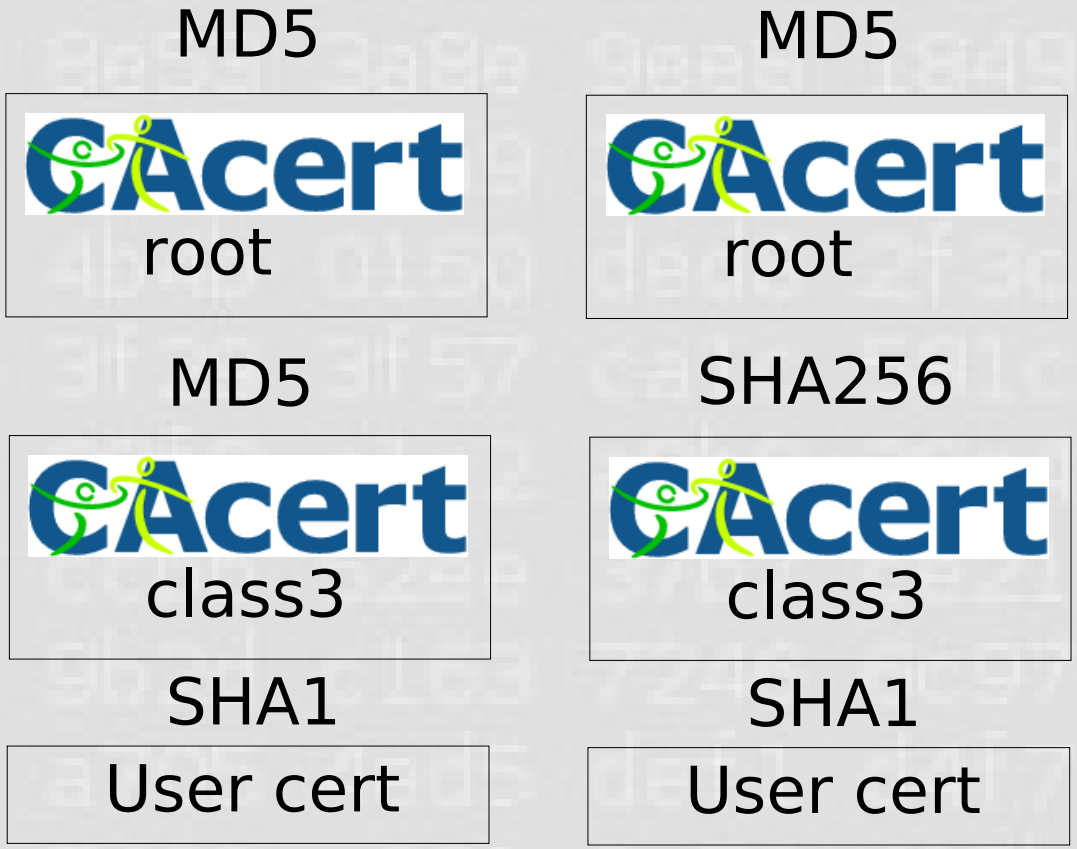
RSA – random numbers?

- Did you create your key with openssl on Debian/Ubuntu between 2006 and 2008?
- They accidently reduced randomness to PID resulting in 15 bit key entropy
- Batch GCD-attack found 0,2 % of keys factorable due to multiple keys using same primes
- Check it: https://factorable.net/ (29C3 “FactHacks” talk)

Hashes

- MD5 almost-broken since 1996, broken 2004
- But some people had to learn it the hard way – 2008 fake RapidSSL subcert (25C3 talk: “MD5 considered harmful today”), FLAME-virus attacked Windows Update via MD5
- SHA1 almost-broken since 2004, broken 201X
- But some people will learn it the hard way (like, for example, CAcert.org)
- For now, SHA-2 (SHA256, SHA512 etc.) is good, SHA-3 not yet usable

CAcert signatures



From SSLv1 to TLSv1.2

- SSL by Netscape
- SSLv2 (1995) is heavily broken, disabled in most apps today, replaced by SSLv3 (1996)
- TLS – successor of SSL, standard by IETF
- TLS 1.0 (1999), 1.1 (2006), 1.2 (2008)
- TLS 1.0 somewhat broken, TLS 1.1 not good
- If you want to avoid SHA1 you need TLS 1.2
- BUT: Browser support widely only TLS 1.0

SSL-Algorithms

- ECDHE-RSA-AES256-GCM-SHA384
- This means: RSA-signed key exchange with Elliptic Curve Ephemeral DH, symmetric AES encryption with 256 bit, Galois/Counter Mode, SHA384 hash
- RC4-SHA
- This means: RSA-signed symmetric RC4 encryption with SHA1 hash

Problems

- If the server provides many algos, user may choose weak ones – out of server admins control
- If the server is restrictive, connections may fail (old browsers)
- Fine-granular tuning sometimes impossible in common software like Apache
- In theory, everyone wants TLS 1.2 to avoid MD5/SHA1. In practice, almost nothing supports TLS 1.2.

Key exchange

- Key exchange – create session key that never gets transmitted
- Diffie Hellman or Elliptic Curve Diffie Hellman
- Provides Perfect Forward Secrecy
- If at some point in the future your server key gets compromised, attacker cannot decrypt previously recorded messages
- Problem: Apache defaults to 1024 bit DH and this cannot be changed (experimental patch)

BEAST-attack

- BEAST-attack against AES in CBC mode
- Weakness was known for a long time, but impractical – BEAST-attack just brought it to the real world
- Fixed in TLS 1.1 (but: the browsers…)
- Mitigation – client-side
- Server can offer RC4-ciphers (unaffected)
- But: RC4+DHE not well supported (no forward secrecy)

Apache config

- This is my Qualys-100 points setting:
  SSLProtocol -SSLv2 -SSLv3 -TLSv1 -TLSv1.1 +TLSv1.2
  SSLCipherSuite TLSv1:!AES128:!AES256-GCM-SHA384:!AES256-SHA256:!SSLv3:!SSLv2:HIGH:!MEDIUM:!MD5:!LOW:!EXP:!NULL:!aNULL@STRENGTH

Apache config

- A more reasonable setting:

  SSLProtocol -SSLv2 -SSLv3 +TLSv1 +TLSv1.1 +TLSv1.2

  SSLHonorCipherOrder on

  SSLCipherSuite ECDHE-ECDSA-AES256-GCM-SHA384:ECDHE-RSA-AES256-GCM-SHA384:ECDH-RSA-AES256-GCM-SHA384:ECDH-ECDSA-AES256-GCM-SHA384:ECDH-RSA-RC4-SHA:RC4-SHA:TLSv1:!AES128:!3DES:!CAMELLIA:!SSLv2:HIGH:MEDIUM:!MD5:!LOW:!EXP:!NULL:!aNULL

TLS Compression / CRIME attack

- CRIME attack by the authors of the BEAST attack
- TLSCompression is broken
- But nobody uses it anyway (limited browser support), so just disable it
- Apache Config (only 2.4 / unreleased 2.2.24):

  SSLCompression off
- Compression can still happen on the HTTP level

HSTS / Strict Transport Security

- HTTP-header
- Basically telling the browser:
  - Don't connect if anything is wrong (e. g. wrong certificate – this is a problem for CAcert!)
  - Only connect through SSL for timespan X (e. g. 6 months)
  - Can prevent SSL-Stripping
- HTTP-header:

  Strict-Transport-Security max-age=31536000;

Revocation / OCSP stapling

- Old method: CRL, doesn't scale
- New method: OCSP, Problem: Privacy
- Problem: What to do when OCSP responder not available? In theory: fail. In practice: pass.
- Chrome disabled OCSP, because it's broken anyway
- OCSP stapling encodes OCSP response in TLS communication
- Good idea: enable it (apache 2.4)

SNI

- Old problem of SSL: Only one certificate per IP
- But: Server Name Indication (SNI) allows to change that
- Almost every browser supports it! (except... still widely used Android 2.x)
- Requires TLS 1.0
- Fallback of Firefox and other browsers to SSLv3 causes problems with unreliable connections

The elephant in the room

- Not focus of this talk, but:
- The SSL-system based on centralized CAs is broken
- Horribly broken
- You trust an unknown number of entities and each one of them can attack every connection
- It is easy to say that it's broken – it's much harder to tell how it should be
- EFF tries: https://www.eff.org/sovereign-keys

Further info

- SSL Observatory (talk at 27C3)
  https://www.eff.org/observatory
- Check your Server:
  https://www.ssllabs.com/ssltest/
  https://factorable.net/
- Use HTTPS everywhere:
  https://www.eff.org/https-everywhere