Public-key and symmetric-key cryptology

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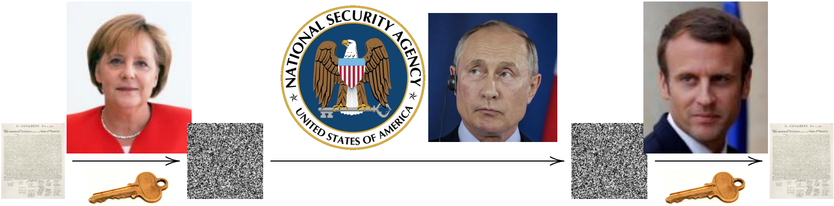
2WF80: Introduction to Cryptology

If you have a secret channel . . .

. . . you can agree on a shared key . . .

. . . and use that key to encrypt and authenticate



- Symmetric-key cryptography:
  Alice and Bob share a secret key 🔑.
- Prerequisite: Eve doesn't know 🔑.
- Alice and Bob exchange any number of messages.
- Encryption takes plaintext m and produces ciphertext c, decryption takes c and produces m so that $\mathrm{Dec}(\mathrm{Enc}(m)) = m$.
- Security goal #1: **Confidentiality** despite Eve's espionage.

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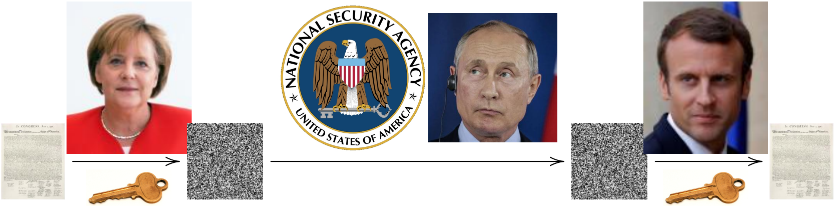

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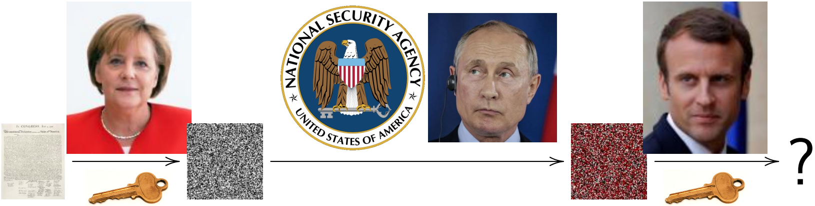

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- Security goal #2: **Integrity**, i.e., recognizing Eve's sabotage.
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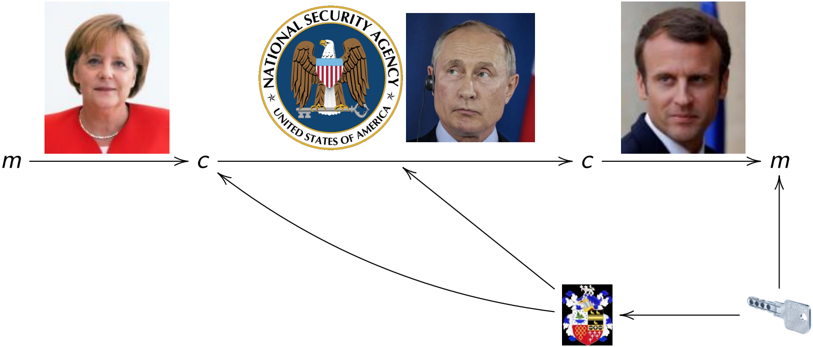
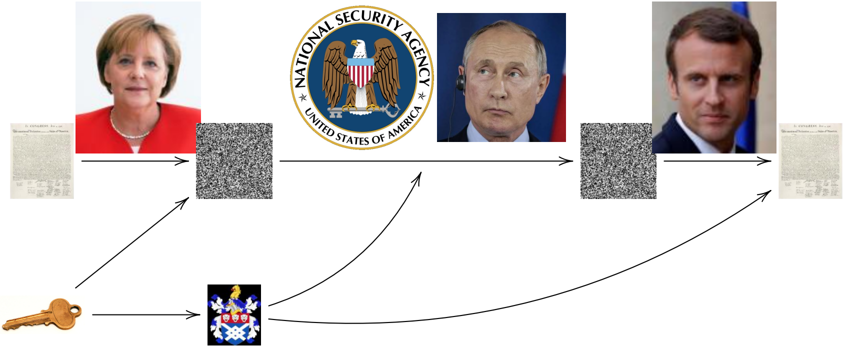
- Decryption fails for invalid ciphertexts.
  (This needs a definition of what "invalid" means).

Public-key encryption



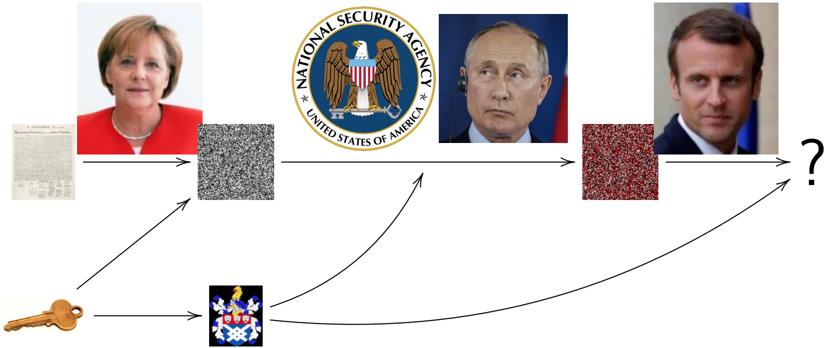
- Public-key cryptography: each user has two keys, a public key and a private key.
- Everybody, including Eve, knows the public key.
- Secure systems make it computationally impossible to recover the private key from the public key.
- Alice uses Bob's public key $K =$ to encrypt plaintext m.
- Bob uses his private key $k =$ to decrypt ciphertext c.

Public-key signatures



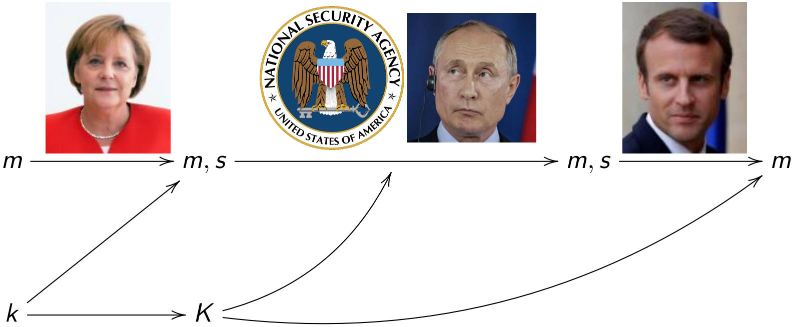
- Prerequisite: Alice has a private key 🔑 and public key 🛡.
- Prerequisite: Everyone knows 🛡 as belonging to Alice.
- Alice signs messages using 🔑. Other people verify using 🛡.

Public-key signatures



- Prerequisite: Alice has a private key 🔑 and public key 🛡.
- Prerequisite: Everyone knows 🛡 as belonging to Alice.
- Alice signs messages using 🔑. Other people verify using 🛡.
- Security goals: Integrity and authenticity.
- Nobody can produce signatures valid under 🛡 without 🔑.
- Modifications to signed message get caught.

Public-key signatures

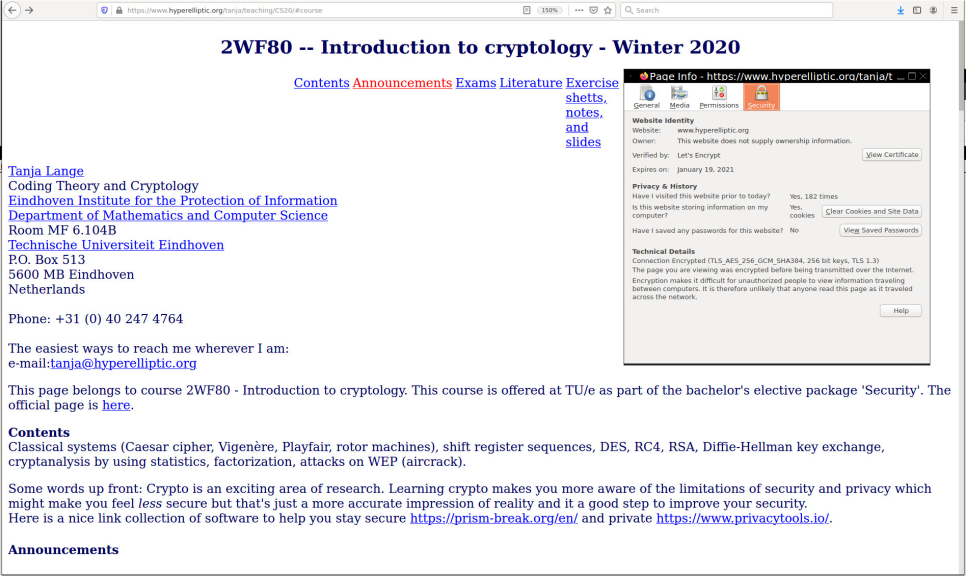


$$\begin{tikzcd}
m \arrow[r] & m, s \arrow[rr] & & m, s \arrow[r] & m \\
k \arrow[r] \arrow[ur] & K \arrow[ur, bend right] \arrow[urrr, bend right] & & &
\end{tikzcd}$$

Private key $k =$, public key $K =$.

Older systems, and that includes PGP/GPG, send m, s, i.e., let the user see m before/without verifying S.

Modern systems send a signed message s and the verification algorithm returns m or "invalid".



2WF80 -- Introduction to cryptology - Winter 2020

Contents Announcements Exams Literature Exercise shetts, notes, and slides

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This page belongs to course 2WF80 - Introduction to cryptology. This course is offered at TU/e as part of the bachelor's elective package 'Security'. The official page is here.

Contents
Classical systems (Caesar cipher, Vigenère, Playfair, rotor machines), shift register sequences, DES, RC4, RSA, Diffie-Hellman key exchange, cryptanalysis by using statistics, factorization, attacks on WEP (aircrack).

Some words up front: Crypto is an exciting area of research. Learning crypto makes you more aware of the limitations of security and privacy which might make you feel *less* secure but that's just a more accurate impression of reality and it a good step to improve your security.
Here is a nice link collection of software to help you stay secure https://prism-break.org/en/ and private https://www.privacytools.io/.

Announcements

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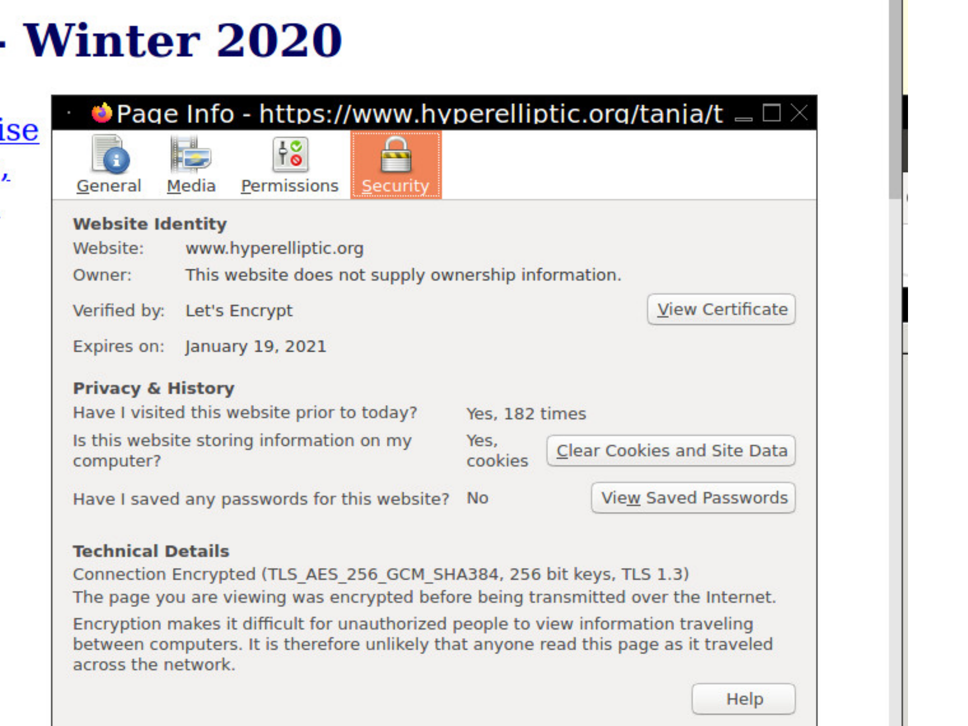

- Winter 2020

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