Computer security Lecture 2

Identification and Authentication

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You will hear about:

- Authentication/identification
- Authentication procedures
- Ways of authentication – MFA/2FA
- Authentication at LiU
- Password + PIN
- Token, Smart cards, . . .
- Security issues
- Increase awareness/knowledge - educate

User authentication

- Authentication is the process of **verifying the identify** of a user
- There are two reasons to do this:
  To make access control decisions
  To enable audit trails
- Authorization is sometimes based on role, not identity
- Accountability is based on identity, since group accountability is ineffective

Authentication procedure

- The most common procedure is as follows:
  - An individual arrives at a checkpoint (login dialog, door, . . .)
  - The individual claims an identity (username, Smart Card, token,. . .)
  - The individual presents the item needed to prove the identity (password, PIN, . . .)

Authentication of use

- **Something you know**
  (passwords, PIN, . . .)
- **Something you have**
  (keys, badges, tokens, smart card, . .
- **Something you are**
  biometrics (handwriting, fingerprints, retina patterns, . . .)

Authentication of user

- **Something you know**
  (passwords, PIN, . . .)
- **Something you have**
  (keys, badges, tokens, smart card, . . .)
- **Something you are**
  biometrics (handwriting, fingerprints, retina patterns, . . .)
- Something you do
  (handwriting, . . .)
- Where you are

“Where you are”?

- does not verify identity, unless only one person can enter that location
- could reduce the number of possible identities
- but should rather be thought of as access restriction, than an authentication mechanism

Authentication of users by

- **Something you know**
  (passwords, PIN, . . .)
- **Something you have**
  (keys, badges, tokens, smart card, . . .)
- **Something you are**
  biometrics (handwriting, fingerprints, retina patterns, . . .)
- Something you do
  (handwriting, . . .)
- Where you are

Authentication modes

- **Something you know**
  (passwords, PIN, . . .)
- **Something you have**
  (keys, badges, tokens, smart card, . . .)
- **Something you are**
  biometrics (handwriting, fingerprints, retina patterns, . . .)

Something you know: Passwords

- Username+password is the standard first line of defense
- Widely accepted, not too difficult to implement
- Can be expensive to manage password securely
- Obtaining a valid password is a common attack

Maintaining passwords

- People can't remember infrequently used, frequently changed, many similar items
- We can't forget on demand
- Recall is harder than recognition
- Non-meaningful words are more difficult to remember

Ways for an attacker to obtain a valid password

- Intercept it at creation
- Guess it
- Steal the note where it is written down
- Watch user enter it, or use a keylogger
- Eavesdrop on transmission
- Find it in a memory buffer

Ways for an attacker to obtain a valid password

- Find it through a spoofing program, through phishing, or more general social engineering
- Find it reused in another system
- Password recovery

Ways for an attacker to obtain a valid password

Keylogger

Ways for an attacker to obtain a valid password

Guessing passwords

- Exhaustive search
- Intelligent search
  dictionary
  words associated with user

Password management

- Requires proper routines for issuing
- Requires properly trained staff, maybe round-the-clock helpdesk
- This can become a cost factor that needs to be taken into account

Selecting a secure password

In general, when you want to protect something, you lock it up with a key.

Houses, cars and bicycle locks all have physical keys; protected files have encryption keys; bank cards have PIN numbers; and email accounts have passwords.

All of these keys, physical and electronic, have one thing in common: they open their respective locks just as effectively in the hands of somebody else.

You can install advanced firewalls, secure email accounts, and encrypted disks, but if your password is weak, or if you allow it to fall into the wrong hands, they will not do you much good.

Selecting a secure password

Common advice on passwords

Passwords should

- be long enough, and
- …have enough variation to make guessing hard
- be easy to remember, without violating the points above
- be changed at reasonable intervals

Should not

- be anything you reveal outside authentication
- be the same for two sites
- if one site is more sensitive
- if one site is less trusted
- be stored in plaintext
- be sent in plaintext
- be connectable to you

Selecting a secure password

Bruce Schneier (cryptographer, computer security)

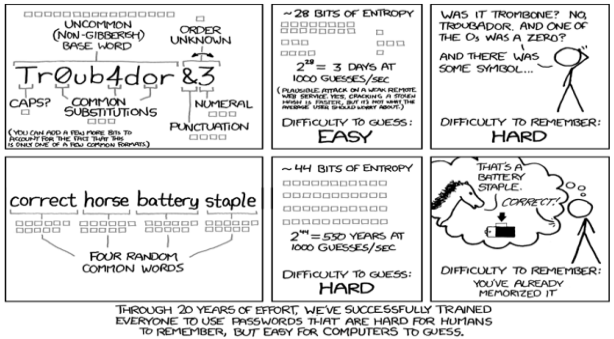
1. Generate (a real) random password
2. Write it on a piece of paper
3. Keep the now valuable piece of paper with the other valuable pieces of paper you own in your wallet

Security by obscurity (aka *Security through obscurity STO*)
Can work but should only be used as one of many layers of security.

Selecting a secure password

https://xkcd.com/936/

Selecting a secure password



Diceware:

https://en.wikipedia.org/wiki/Diceware

Selecting a secure password

Is naive password choice really a problem?

(Yes!)

- An old (1992) study by D. Klein found that 25% of passwords could be guessed, roughly
  Dictionary words: 7.4%
  Common names: 4%
  Combination of user and account name: 2.7%
  …
- Frequent password changes often backfire
  monthly changes: alice01, alice02, …
  checking against old passwords: rapid changes until the old password can be used
  post-it notes on the screen
  …

Ref: “Foiling the Cracker” by Daniel V. Klein http://www.klein.com/dvk/publications/passwd.pdf

Selecting a secure password

Is naive password choice really a problem?

2020

Selecting a secure password

Is naive password choice really a problem?

LiUs password policy (and more)

https://www.student.liu.se/studentstod/itsupport/it-sakerhet?l=en

Do not use your LiU password at any other location than LiU.

10 useful tips

If you prefer to use a classic password, there are a number of things to think about.

1. Passwords must be sufficiently long. Nowadays, ten characters is a reasonable minimum length, but it is preferable to use at least fifteen characters.

2. Passwords must contain different types of character. Use at least one number, one special character (plus, minus, slash, full stop, etc.) and one uppercase letter. On the other hand, it is a good idea to avoid such characters as "å", "ä", "ö", etc., which can cause problems on certain systems.

3. Do not use your username, name or other personal information as a password or even part of a password. It is far too easy to find such information.

4. Avoid words from dictionaries and the names of other people, places, countries, etc. People who try to crack password use long lists of common words and names from several languages.

5. A good way to create a password can be to make up a chant that is easy to remember. Then take the first letter of each word to make the password, and remember to use both uppercase and lowercase letters with some numbers and special characters. And the

Passphrases

It can be a good idea to use a passphrase as an alternative to a classical password. Passphrases are often easier to remember and easier to type in (despite being longer), while giving increased safety.

Passphrases consist of a number of randomly chosen words. As long as the words have been chosen truly randomly, numbers, special symbols or similar characters are not necessary.

There are around 6×10^{19} different passwords of length ten characters. If five words are chosen at random from a list of 10,000 words, 1020 possible passphrases can be formed – even if only lowercase letters are used.

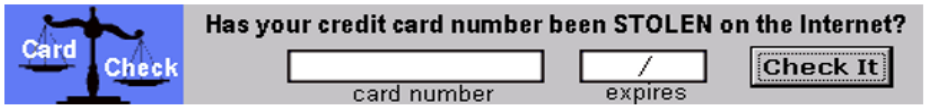
A simple way of creating passphrases is to use diceware. A passphrase constructed using diceware should have at least six words. Se more **information about Diceware at Wikipedia**.

Something you know: PIN

- Financial PINs are often four digits
- Some banks force PIN on the user, other allows you to choose
- Avoid 1111, 2222, and 1234, 2345, or birthdates and suchlike
- Many systems allow three attempts before locking card, giving a 0.06% chance of guessing it
- PIN generation through the IBM 3624 standard uses the account number to generate the PIN (through encryption)
- Despite the encryption key being secret, the connection to the account number allows guessing the PIN on the average in 15 attempts (Zielinski and Bond, 2002)

Ways for an attacker to obtain a PIN

- Phishing: Ask user for login and password under false pretense
- Spoofing: Present false but genuine-looking login screen
- Other social engineering: Directed personal attacks aimed to extract password, often aimed at support staff



- One problem is that even big banks (or indeed PayPal) train customers in unsafe behaviour

How to avoid phishing, spoofing and social engineering

Educate users, or even better: don't miseducate them

- Check the English (better English)
- Look for the lock symbol (use TLS or put a lock symbol on the page)
- Look for the last four numbers in your account number (put the first four numbers there)
- Don't click on URLs but pictures are OK? (hidden executables within picture data)
- Use mouse hover to show the real URL (insert nonprinting chars, or use extremely long URLs)

How to avoid phishing, spoofing and social engineering

The need for repeated authentication (vs SSO)

- Some systems require repeated authentication
- This is to stop attackers from using an already logged-in computer, later
- This can also be used to authenticate again when a user wants to perform a security-critical operation
- The book* mentions TOCTTOU, time-of-check-to-time-of-use

* This course

Authentication modes

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Something you have

- can be stolen
- can be found by others, if lost
- can be copied, if you know their correct properties
  - Skimming
  - guessing valid properties
  - radio eavesdropping on RFID
  - taking photos of metal key
    http://www.flir.se/

Something you have

Secure object: eg Yubikey

- Connects as a USB keyboard or via NFC
- Issues one-time passwords
- Contains secret AES key used to encrypt a counter
- The AES key cannot be retrieved, so the key cannot be copied
- Slightly better security than a physical, ordinary key

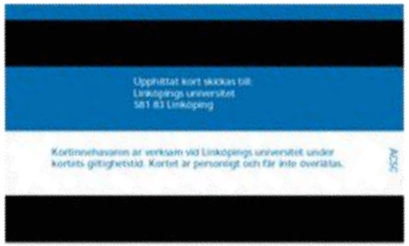
Something you have

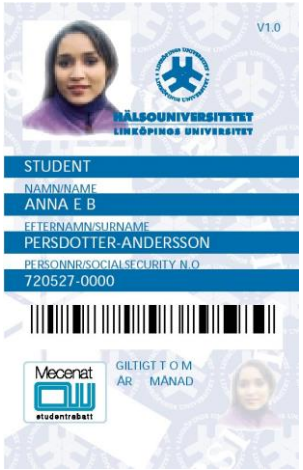
Other (more or less) secure objects

- Modern car keys
- Passports
- Credit cards
- Mobile phone SIM
- Mobile BankID (Sweden)
- Identity cards
- Smart card
- Bank identification device (“bankdosa”)

LiU-card 2002

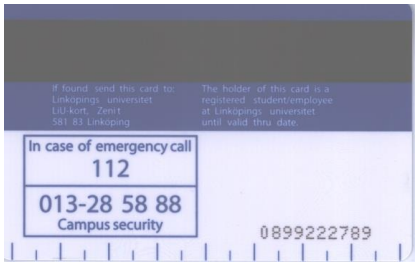
The beginning:





LiU-card 2004

LiU-card 2006



LiU-card 2015

LiU-card 2019

Two-factor authentication 2FA

- Today, secure applications are using at least two-factor authentication
- All online banks today use this (afaik)
- Also, ranked computer games, online Bitcoin wallets, hospital systems (SITHS-card), etc.
- Often password + a device
- Gives some protection against phishing and simple password capture
- Still vulnerable to man-in-the-middle attacks (man-in-the-browser)
- Vulnerable when users don’t understand MFA

Two-factor authentication 2FA

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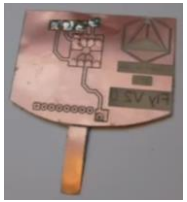
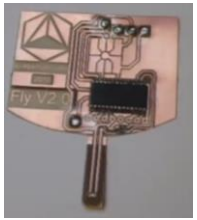
- Still vulnerable to **man-in-the-middle** attacks

Bruce Schneier, 2005: "Too Little, Too Late"

Ways for an attacker to obtain a PIN

Example EMV and PIN broken



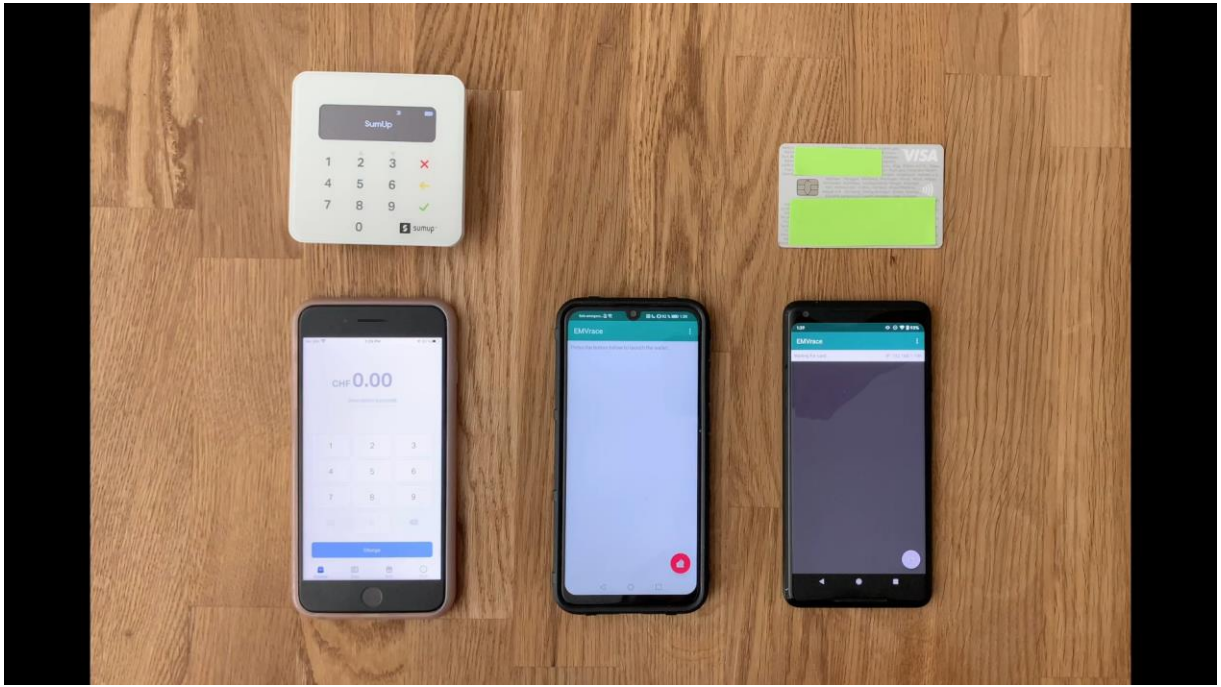


DEFCON 19: Chip & PIN is Definitely Broken
https://youtu.be/6lI56XXeV8g https://youtu.be/6lI56XXeV8g?t=2037 (PIN)
https://dev.inversepath.com/download/emv/emv_2011.pdf

PIN bypass

The EMV Standard: Break, Fix, Verify

https://emvrace.github.io/



Link collection 2021

- https://www.schneier.com/
- https://xkcd.com/936/
- https://www.student.liu.se/studentstod/itsupport/it-sakerhet?l=en
- https://emvrace.github.io/
- https://en.wikipedia.org/wiki/Diceware
- https://www.bleepingcomputer.com/news/security/credit-card-pins-can-be-guessed-even-when-covering-the-atm-pad/
- https://www.bleepingcomputer.com/news/security/new-ransomware-encrypts-files-then-steals-your-discord-account/

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