Updated: Aug 12, 2025

Security Components

Chapter 2

Security Components

- ★ Security & Privacy: the definitions
- ★ Security Components
- ★ Supporting Concepts
- ★ Conclusion

Security and Privacy

PDPA ข้อมูลใด, ที่สามารถอ้างถึงตัวตนเราได้

"Security is the first cause of misfortune."
Old German Proverb

มีความต่างไหม : ใช้สิทธิ์ต่างกันได้

★ Though often mentioned together,
Security & Privacy is not the same thing.

★ However, they both need the control over information.

★ Security
  - Who can do what when?

★ Privacy
  - The freedom to control access to our personal information

control → Security

Security and Privacy (ctd.)

- ★ This is
  Security or Privacy issue?
- ★ a hacker is able to **compromise** a **computer** system and find out that **a person is a homosexual**
  or
  is infected with a bad disease.

compromise บก : ทำให้เสียหาย, เสียหาย → security

privacy depend on owner's mind
→ เมื่อ เจ้าของไม่อยากบอก

A picture from https://en.wikipedia.org/wiki/Homosexuality_in_China

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Security

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Security

may
or
may not
be **Privacy**

picture from https://en.wikipedia.org/wiki/Homosexuality_in_China

Privacy

- ★ Privacy is depending on intent.
- ★ If a homosexual person is willing to go public, it is not a privacy issue.

เช่นให้ข้อมูลหมอเมื่อตรวจหาเชื้อ ประสิทธิภาพ

- ★ In reality, we always trade privacy for services.
- ★ As long as the provider conforms to the privacy policy, this should be fine.
- ★ An person may deny to share his/her age with others. However, he/she may share this information with a physical doctor for a better treatment.

Solution to Privacy

- ★ a naïve solution for a privacy-concerned application is to give a user a choice to release his or her personal information
- ★ Disclaimer, Agreement, Privacy Policy
- ★ HIPAA ?

Fact

Google Privacy said they may access your information to improve Google's services.

We (Google) **may combine the information** we collect among our services and across your devices for the purposes described above. ….. Depending on your account settings, your activity on other sites and apps **may be associated with your personal information in order to improve Google's services** and the ads delivered by Google.

Taken from https://policies.google.com/privacy?hl=en-US#intro

Fact

What Facebook's privacy policy allows may surprise you.

"If you start typing something and change your mind and delete it, Facebook keeps those and analyzes them too," Zeynep Tufekci, a prominent techno-sociologist, said in a 2017 TED talk .

Taken from https://www.chicagotribune.com/business/ct-facebook-privacy-policy-20180325-story.html

Security Components

Security in Action: ATM

★ Is this a secure system?

★ If yes, what does it have?

Security in Action: Security Deposit Box (Safe box)

- ★ To access a security deposit box, there are several steps.
- ★ Is it a secure system?
- ★ If yes, what does it have?

Strong room : with a standard

Uncopyable key , some time double key

Look around yourself to find more examples.

- Is it secure?
  - Your home?
  - You computer?

Security Components :สิ่งที่ทำให้เกิด security

- ★ Authentication เป็นใคร
  - "Who are you? Are you really the person whom you claim to be?"
- ★ Authorization ทำได้มั้ย
  - "Do you have the authority to do what you are trying to do?"
- ★ Accounting (Auditing) ทำอะไร
  - "What did you do?"

มี Security → มี 3A

but มี 3A ไม่เท่ากับมี security

การมี Integrity ด้วย ≠ มี Authenticity (อันนอกมาบุ่มไม่ได้)

the AAA of Security

Analogy

- ★ The AAA is usually compared to three headed dogs (Kerberos). (One head for each component)
- ★ The Athena project from MIT named it Authentication Project “Kerberos”.

Cerberus or Kerberos (Greek Κέρβερος, Kerberos, "demon of the pit") was the hound of Hades, a monstrous three-headed dog with a snake for a tail (sometimes said to have 50 or 100 heads) called a hellhound.

Supporting Concepts

- ★ AAA is not enough?
- ★ Integrity Authenticity
  - Integrity (n) “the quality or state of being complete or undivided”
- ★ Software Engineering & Threat Modeling
  - “Threat modeling is a method of addressing and documenting the security risks associated with an application.”
- ★ Validation of Input worm/virus
  - “All input is evil until proven otherwise”

Conclusion

- ★ 3 Security Components
  - Authentication
  - Authorization
  - Auditing
- ★ 2 Supporting Concepts
  - Integrity
  - Input Validations
- ★ Missing a component means a system is not secure.
- ★ Having all components does not mean the system is secure.

End of Chapter 2

Authentication

Chapter 3

Authentication

- ★ Definition
- ★ Authentication Methods
  - What do you know?
  - What do you have?
  - What do you trust?
- ★ Authentication Protocol
- ★ Zero-Knowledge Password Proof
- ★ Good Password and Bad Password
- ★ Password Hacking
  - Rainbow Table
- ★ Implementation Issues

Definition of Authentication

"It's easy to know men's faces, not their hearts."
Chinese Proverb

★ In a computer system, authentication is the process of verifying identity of a user.

In a communication system, authentication is the process of verifying the stated source of a message [dictionary.com].

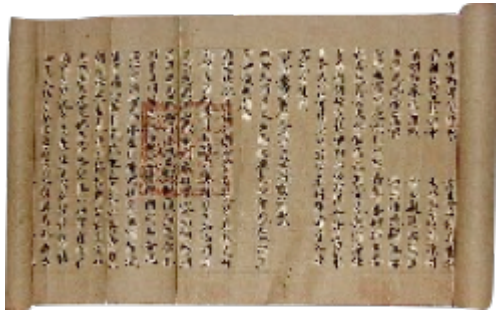
- validating the quality or condition of being trustworthy, genuine, or creditable
- examination of a token or investigation of some property of the subject itself

How to Authenticate?

- ★ Validating authenticity of a document (e.g. transcript, bank note, cheque ....)
- ★ Identifying a person (student, member of a group, ...)
- ★ The source of data (e.g. network packet, email, ...)
- ★ Owner of (house, car, ...)
- ★ How about software or computer systems?

Authentication Methods

★ What do you know? อย่างหนึ่ง
★ What do you have? อีกอย่าง
★ Who do you trust? คนอื่นที่ไหน



★ Every authentication method has its own strength and weakness, and there is no such thing as a perfect authentication method.

What do you know?

A secret between two is God's secret, a secret between three is everybody's.
Spanish Proverb

- ★ Prearrange questions ตั้งคำถามล่วงหน้าก่อน
- ★ Password or Passphrase
- ★ One-time pad : Password ที่ใช้ได้ครั้งเดียว, Highest security Password
- ★ Challenge and Response
  - How much is 1+1 ?

In the past, an american soldier has to state a prearrange question with the army for identifying himself in case of emergency.

Challenge and Response

- ★ Knowledge of a method
- ★ Alice > Bob : N
- ★ Bob > Alice: {N,B}k
- ★ Prevent replay attacks

- ★ To avoid replay attack, car remote is now a challenge and response.

What do you have?

Japan ต้องทำ stamp แทน ลายเซ็น

- ★ Tokens
  - ○ ID
  - ○ Seal
- ★ Smart Tokens
- ★ Biometrics
  - ○ Fingerprints
  - ○ Hand/Palm geometry
  - ○ Handwriting
  - ○ Face Recognition
  - ○ Dental biometrics
  - ○ Retinal
  - ○ Vein
  - ○ Voice
  - ○ Pattern (walking/typing rhythms)

What do you trust?

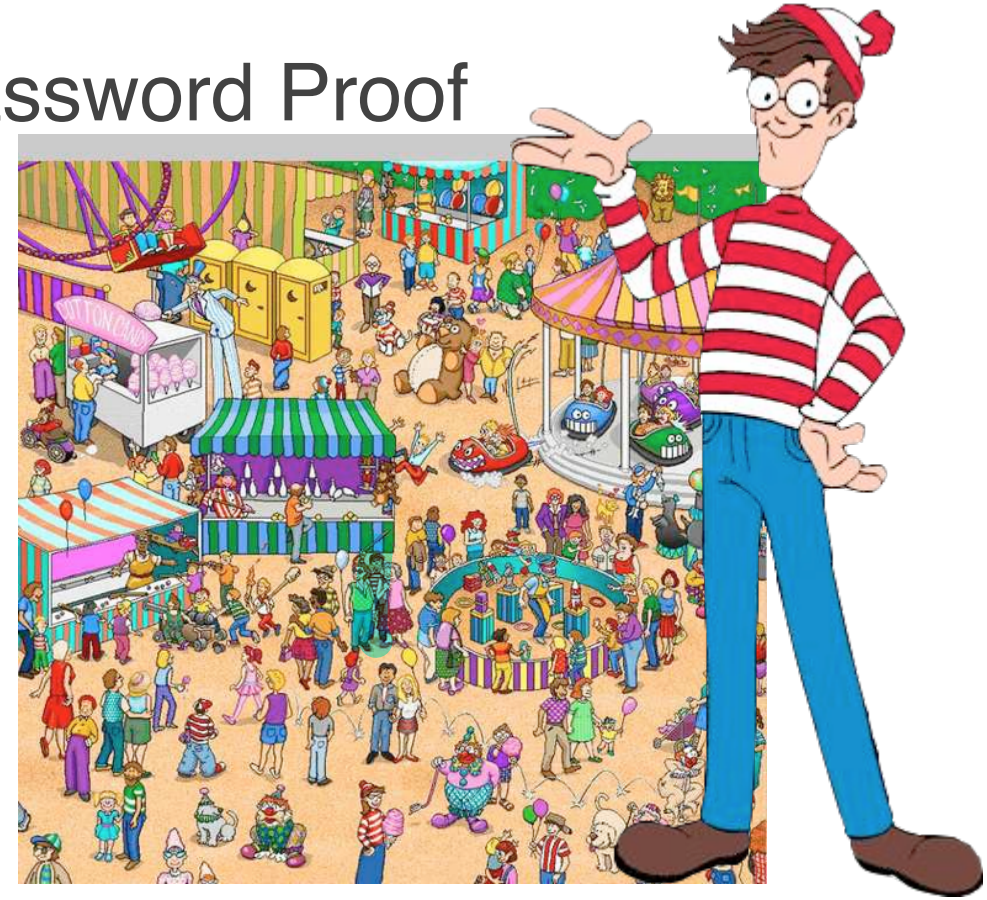
- ★ Third party authentication
  - Facebook Login
  - Google Login
  - ChulaSSO
- ★ Proximity/Trusted Zone
  - Dress like a student on the campus

Authentication Protocol

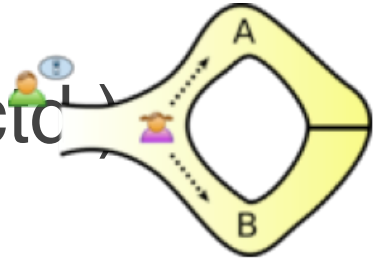
- ★ A combination of methods for authentications
- ★ Use a combination of password and smart tokens
- ★ Example
  - Login with SSH to a gateway
  - Server challenges with a nounce
  - Use crypto card to generate a one-time password
  - Use it to access the system.

Zero-Knowledge-Password Proof

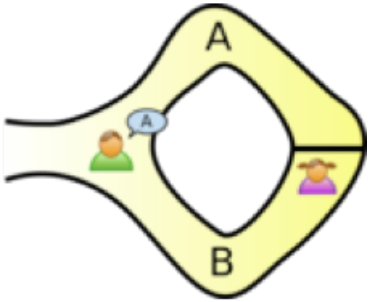
- ★ An authentication protocol.
- ★ Proof the knowledge of password without saying it out loud.
- ★ Where is Waldo?
- ★ Both parties share a same picture. Use a coordinate of Waldo to validate the knowledge.
- ★ Modern authentications are based on ZKPP.

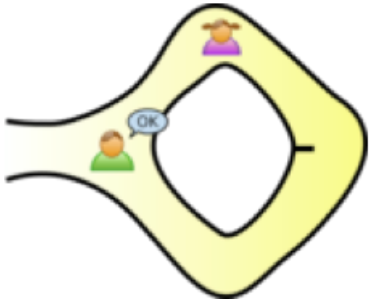


Zero-Knowledge-Password Proof (ctd.)



- ★ Proof that the little girl got a key to the gate at the end of the tunnel.
- ★ Let the girl walk into the tunnel.
- ★ Ask her to get out at a random direction.
- ★ Repeat the steps several time.
- ★ If that girl always come out at the right direction, she got a key.





Password Security

We still rely on Username/Password, but how strong is it?

Good Password and Bad Password

- ★ Substitution (Good?)
  - act10n
  - 0wn3r
  - 4U&m3
  - p3nc1l
- ★ Guessable pattern (Bad?)
  - Qwerty
  - Q1w2e3r4t5y
  - Password1
  - Password2

How does a password get stored?

A brief History

- The beginning - Plaintext (1960s)
  - @MIT (1961), A programmer accidentally printed the password file to a shared printer. **Can we do better?**
- The First Leap - Hashing (Early 1970s)
  - One-way function, deterministic ?
- The attacker's response - Salted Hashing (1980s+)
  - We will try this in the activity.
- Modern Day - Slow, Adaptive Hashing (2000s+)
  - Bcrypt, Scrypt, Argon2
  - Slow, memory intensive, expensive, even with powerful hardware

How secure is a password?

- ★ Assume that:
  - n is the length of the password (e.g. digits or characters).
  - k is the number of characters in the set of possible characters.
  - C is the constant amount of time requires for testing a password (e.g. seconds).
  - t is the number of times allowed to guess the password before locking the account.
- ★ Given n characters in a password, each character is taken from the k characters in the set,
  How long will it take to test all possibilities?

Password Hacking

- ★ Dictionary attack : ใช้ทุกคำใน dict มาผ่าน hash function → หาตัวที่ match
- ★ Brute-force attack : every possible
- ★ Rainbow table : Memory, map (hash, string) rainbow-table, lookup table
  - ↳ จะได้ไม่ต้องผ่าน hash ทุกครั้งทุกคำ
- ★ Replay attack
- ★ Social Engineering (Phishing)

Watch this

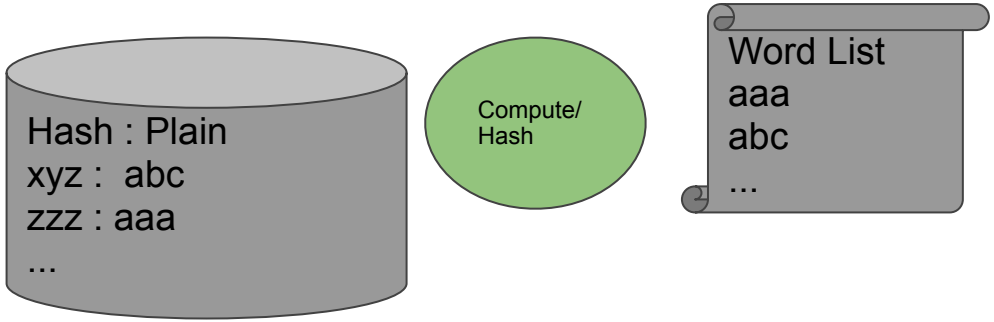
https://www.youtube.com/watch?v=6bNtMPKafk0

https://www.youtube.com/watch?v=f-Dogvyn9ZU

Rainbow Table

- ★ Password is based on one-way hash function. (Theoretically, irreversible).
- ★ Rainbow Table is the use of idle processing power to precompute possible results.
- ★ Change from tring to looking up from the table. (Instant result)

Obtain a hashed value xyz.
Look up for xyz -> **abc**



Fact

Rainbow Table
- free download
- (Was) indexed by Search Engine

★ Try search hashed values of simple words in google.
$ echo "security" lmd5
e46d69abde01f581f79cd4ec029a8469
echo "online" lmd5
747a43298e195448246825207a9364b6

★ Rainbow Table can be downloaded for free. (http://project-rainbowcrack.com/table.htm)

★ Try it with your password.
If it is in the rainbow table, change your password.

Defensive Measures & Best Practices

- Multi-Factor Authentication
  - SMS?, Authenticator Apps?
- Password Policies
  - Combination of uppercase letters, lowercase letters, numbers, symbols
- Rate Limiting and Account Lockouts
  - See fail2ban
- Human Factor
  - Password Managers

Implementation Issues

- ★ Issues not covered in this slide
  - Management Cost
  - Communication Channel
  - Human Factor/Social Engineering
  - Accuracy
  - Transferability
  - Centralize vs. Distributed
  - Single Sign-On

Highest risk

End of Chapter 3