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Information Security 08

Authentication

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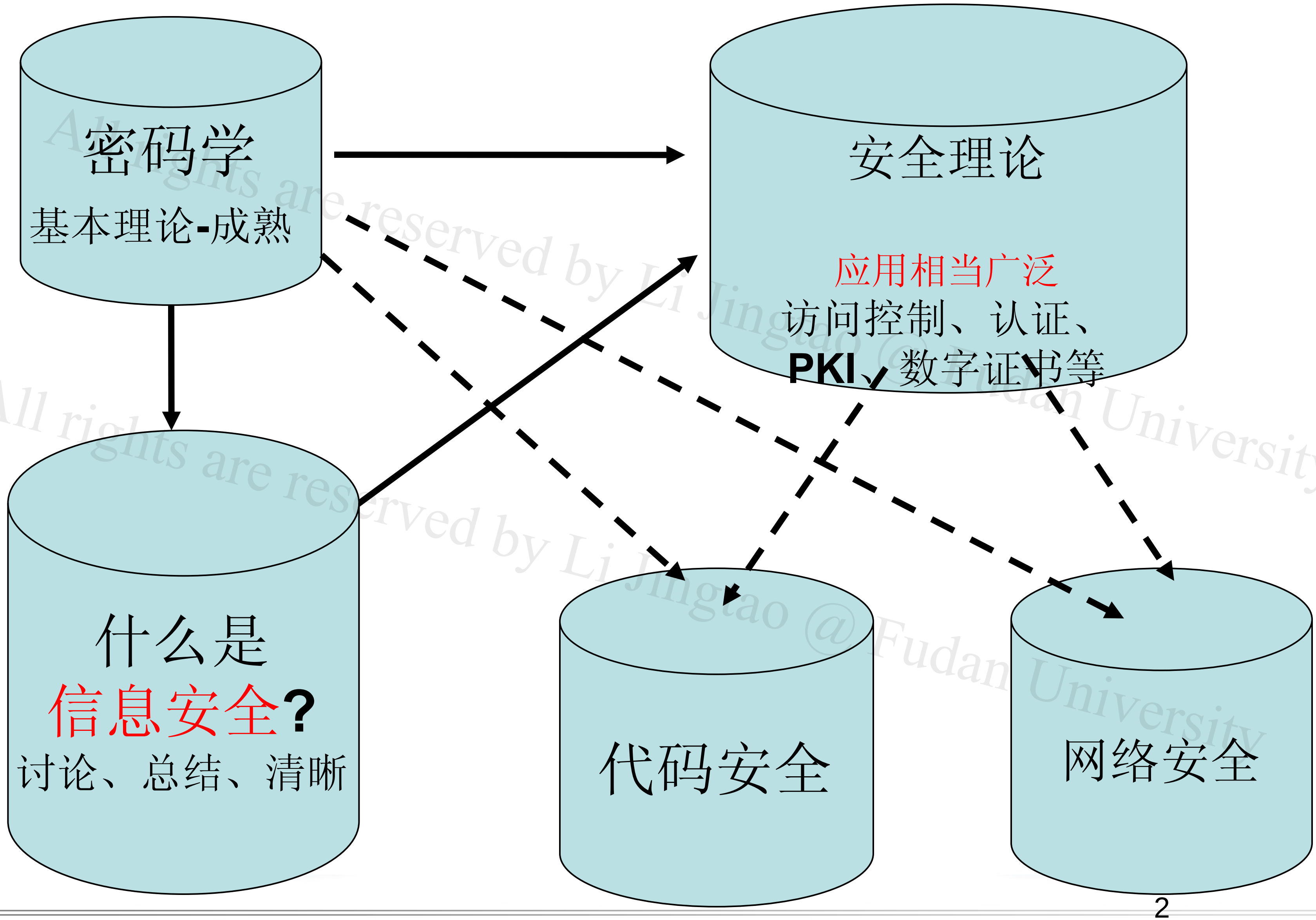
内容间的联系



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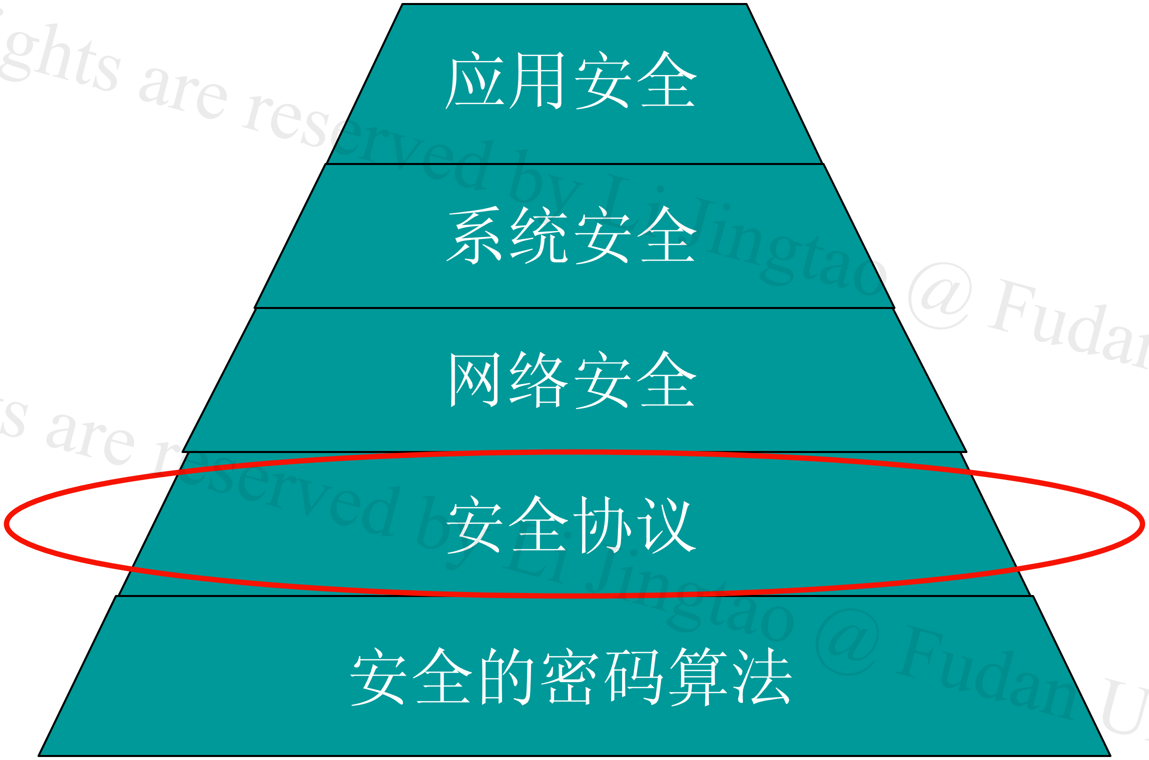
Review: 安全层次



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Outline of Talk

- Definitions
- Passwords
  - Unix Passwords
  - One time passwords
- Challenge-response techniques

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Definitions

Authentication:

- A *claimant* tries to show a *verifier* that the claimant is as declared
  - identification

- Different from *message authentication*
  - which enables the recipient to verify that messages have not been tampered with in transit (data integrity) and that they originate from the expected sender (authenticity).

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Definitions

Authentication

- 消息认证/报文的鉴别
- 身份认证
  - Message authentication has no *timeliness*
  - Entity authentication happens in *real time*
- 双向和单向认证

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A good authentication scheme is…

- ***Sound:*** an honest party can successfully authenticate him/herself
- ***Non-transferable***
- ***No impersonation***
- All this is true even when
  - A large number of authentications are observed
  - Eve is able to spoof/eavesdrop
  - Multiple instances are run simultaneously

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Basis of Authentication

- Something *known* - passwords, PINs, keys…
- Something *possessed* - cards, handhelds…
- Something *inherent* - biometrics

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PINs and keys

- Long key on physical device (card), short PIN to remember
- PIN unlocks long key
- Need possession of both card and PIN
- Provides ***two-level*** security

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Basic password authentication

- Setup
  - – User chooses password
  - – Hash of password stored in password file
- Authentication
  - – User logs into system, supplies password
  - – System computes hash, compares to file

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Passwords -weak authentication

- Usually fixed
- Stored either in the clear, or “encrypted” with a OWF
- *Rules* reduce the chance of easy passwords
- *Salt* increases search space for a dictionary attack

- There are many examples using password-based authentication
  - – how to manage passwords

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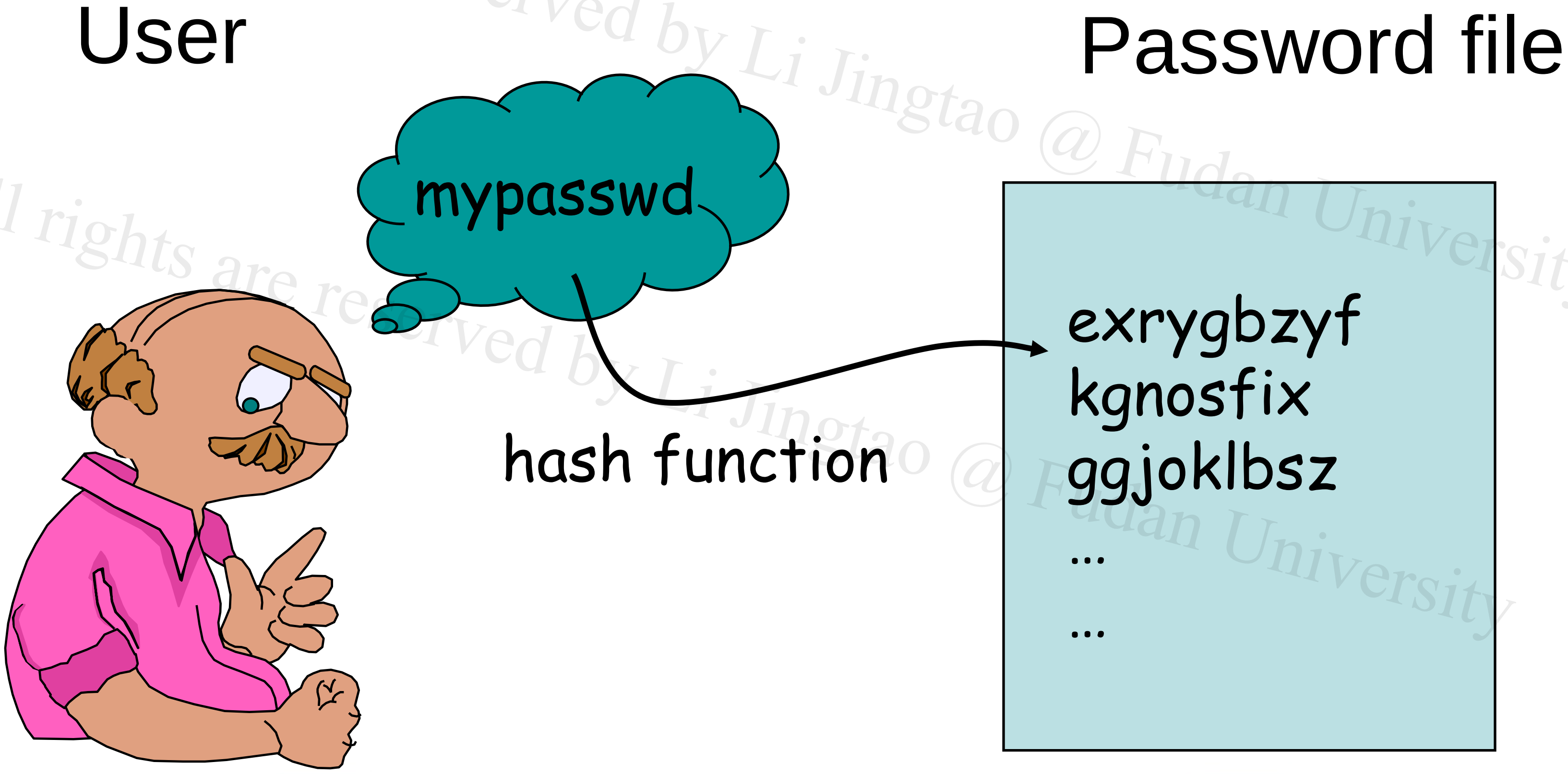
Example: UNIX passwords

/etc/passwd
/etc/shadow

Username: password: UID : GID: USERINFO: HOME: SHELL



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Attacks on password schemes

- ***Replay*** of fixed passwords
- Exhaustive ***search***
  - – 8 character password has 40-50 bits
- More directed ***dictionary*** *attacks*
  - – Crack - widely available tool for doing this
  - – Online dictionary attack
    - Guess passwords and try to log in
  - – Offline dictionary attack
    - Steal password file, try to find p with hash(p) in file

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Dictionary Attack – some numbers

- Typical password dictionary
  - 1,000,000 entries of common passwords
    - people's names, common pet names, and ordinary words.
  - Suppose you generate and analyze 10 guesses per second
    - This may be reasonable for a web site; offline is *much* faster
  - Dictionary attack in at most 100,000 seconds = 28 hours, or 14 hours on average
- If passwords were random
  - Assume six-character password
    - Upper- and lowercase letters, digits, 32 punctuation characters
    - 689,869,781,056 password combinations.
    - Exhaustive search requires 1,093 years on average

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UNIX passwords

- User password serves as key to encrypt known plaintext (64 bit zeroes)
- Encryption - modification of DES, iterated 25 times
- 12 bit salt added - total 64 + 12 = 76 bits
  - Salt taken from system clock, [a-zA-Z0-9./]
  - Alters expansion function of DES
  - char *crypt(const char *key, const char *salt);

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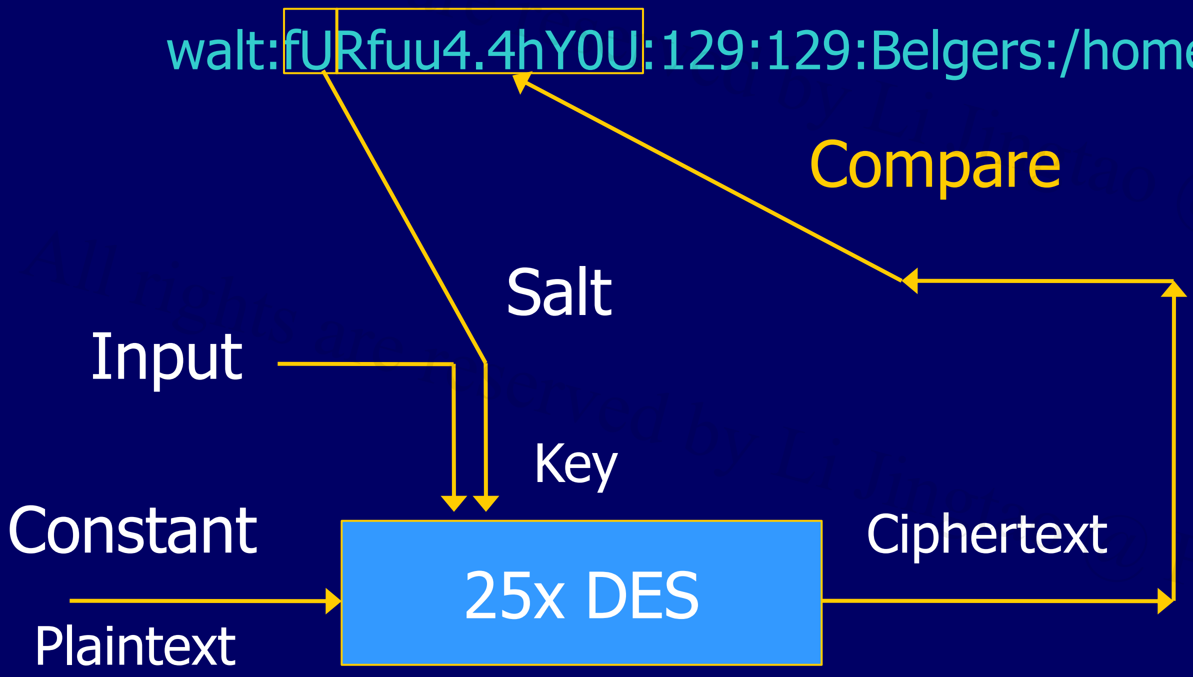
Salt(使用加密技术生成的随机数)

- Unix password line


walt:fURfuu4.4hY0U:129:129:Belgers:/home/walt:/bin/csh

When password is set, salt is chosen randomly

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Advantages of salt

- Without salt
  - – Same hash functions on all machines
    - Compute hash of all common strings once
    - Compare hash file with all known password files
- With salt
  - – One password hashed 2^{12} different ways
    - Precompute hash file?
      - – Need much larger file to cover all common strings
    - Dictionary attack on known password file
      - – For each salt found in file, try all common strings
- Now, SHA1 is recommended

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Summary: Passwords

  - Easy to implement
  - Easy to use
- But, The Weakest form of Authentication
  - ???
  - 窃取A的password，将在很长一段时间拥有A的权限，直到A发现
  - 特别的，网络环境下远程认证
    - 远程登录Unix主机，password传递形式？

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基于口令的认证+明文传输！！！

- Telnet远程登录
  - 逐个字母发送，明文方式
- POP3邮件登录
- Ftp服务
- ……

- 嗅探（Sniffer）相当容易

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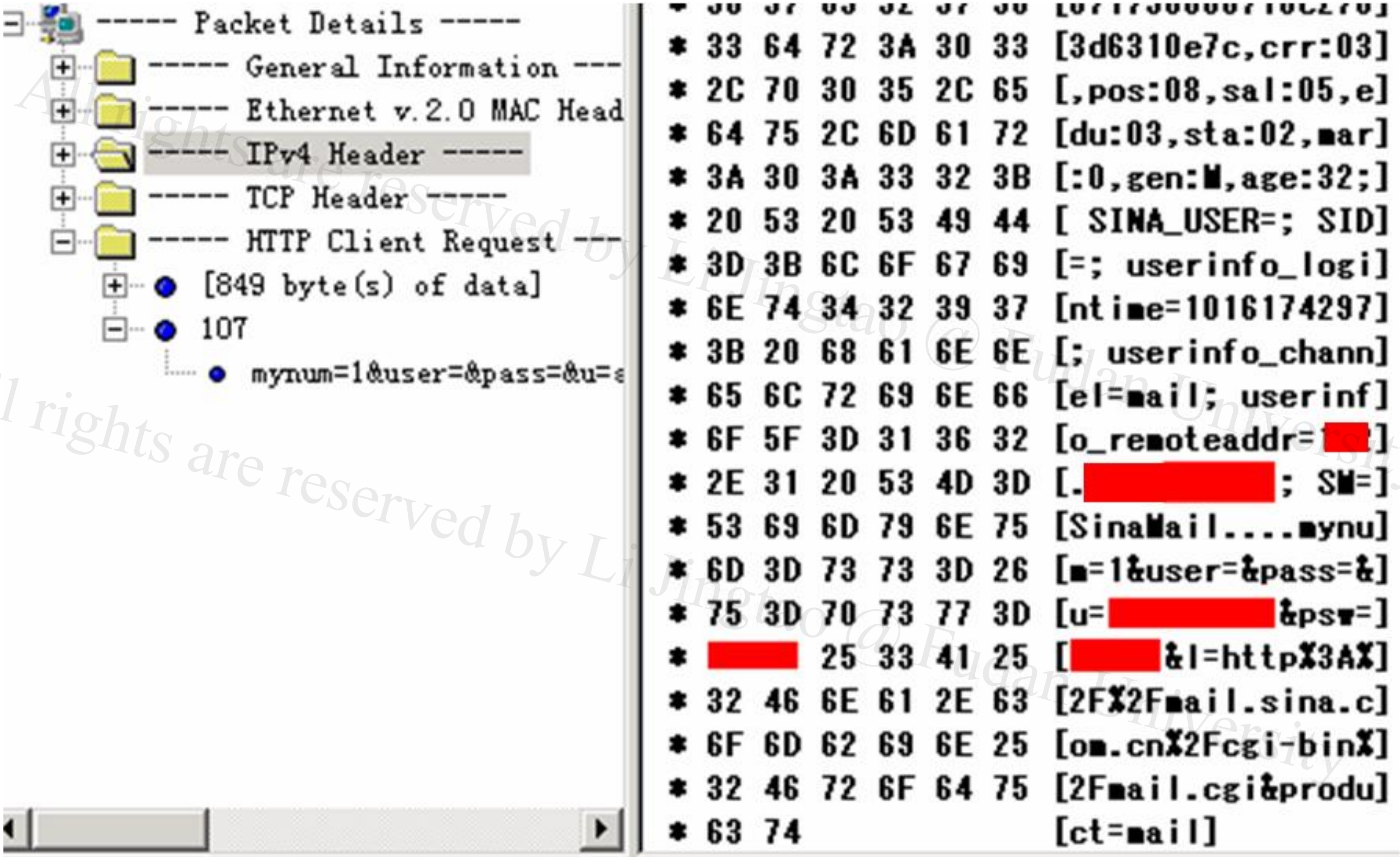
认证例子：sina的邮件登录



```
----- Packet Details -----
  ----- General Information ---
  ----- Ethernet v.2.0 MAC Head
  ----- IPv4 Header -----
  ----- TCP Header -----
  ----- HTTP Client Request ---
      [849 byte(s) of data]
      107
        mynum=1&user=&pass=&u=s
```

```
* 33 64 72 3A 30 33 [3d6310e7c,crr:03]
* 2C 70 30 35 2C 65 [,pos:08,sal:05,e]
* 64 75 2C 6D 61 72 [du:03,sta:02,mar]
* 3A 30 3A 33 32 3B [:0,gen:M,age:32;]
* 20 53 20 53 49 44 [ SINA_USER=; SID]
* 3D 3B 6C 6F 67 69 [=; userinfo_logi]
* 6E 74 34 32 39 37 [ntime=1016174297]
* 3B 20 68 61 6E 6E [; userinfo_chann]
* 65 6C 72 69 6E 66 [el=mail; userinf]
* 6F 5F 3D 31 36 32 [o_remoteaddr=[redacted]]
* 2E 31 20 53 4D 3D [.[redacted]; SM=]
* 53 69 6D 79 6E 75 [SinaMail....mynu]
* 6D 3D 73 73 3D 26 [m=1&user=&pass=&]
* 75 3D 70 73 77 3D [u=[redacted]&psw=]
* [redacted] 25 33 41 25 [[redacted]&l=http%3A%]
* 32 46 6E 61 2E 63 [2F%2Fmail.sina.c]
* 6F 6D 62 69 6E 25 [om.cn%2Fcgi-bin%]
* 32 46 72 6F 64 75 [2Fmail.cgi&produ]
* 63 74             [ct=mail]
```

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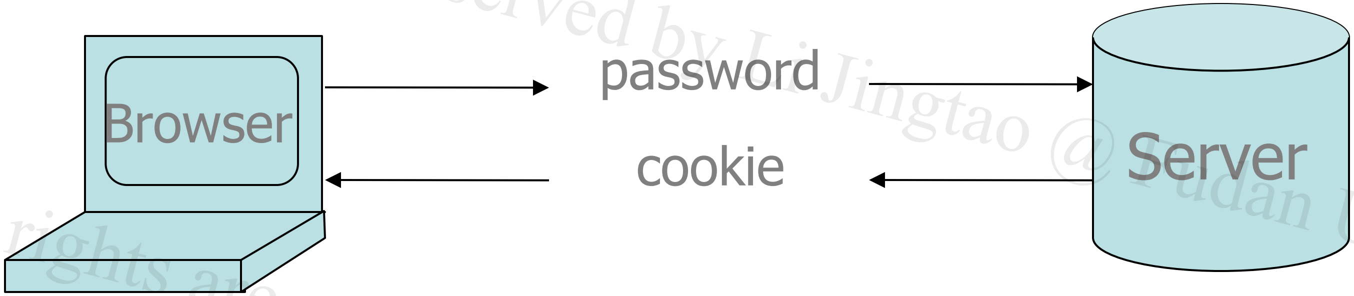
网络环境下的认证

- 基本假设：
  - C/S 模型



- 多server，
  - 同样的口令，还是不同的？
- 单向->双向，
  - Server需要对每个user出示独特的口令吗？

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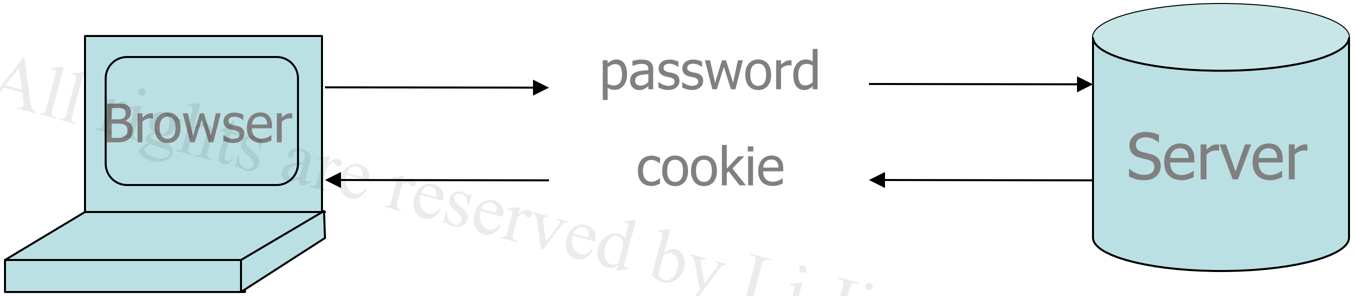
Authentication Problems



- Problems
  - Network sniffing → Encryption, but key distribution problems
  - Malicious or weak-security website → OWF, hashing
    - Phishing
    - Common password problem
    - Pharming – DNS compromise

    } next few slides
  - Malware on client machine
    - Spyware
    - Trojan Horse

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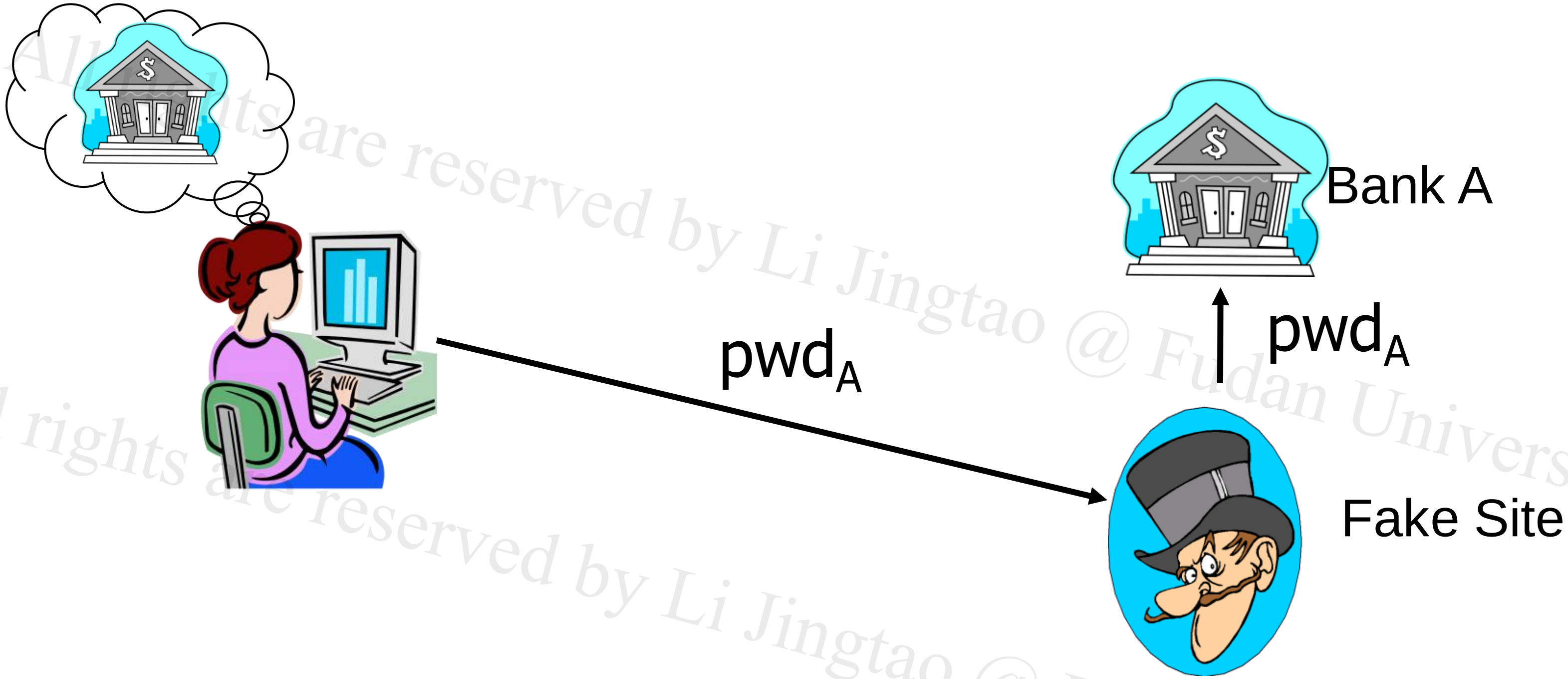
Password Phishing Problem



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- User cannot reliably identify fake sites
- Captured password can be used at target site

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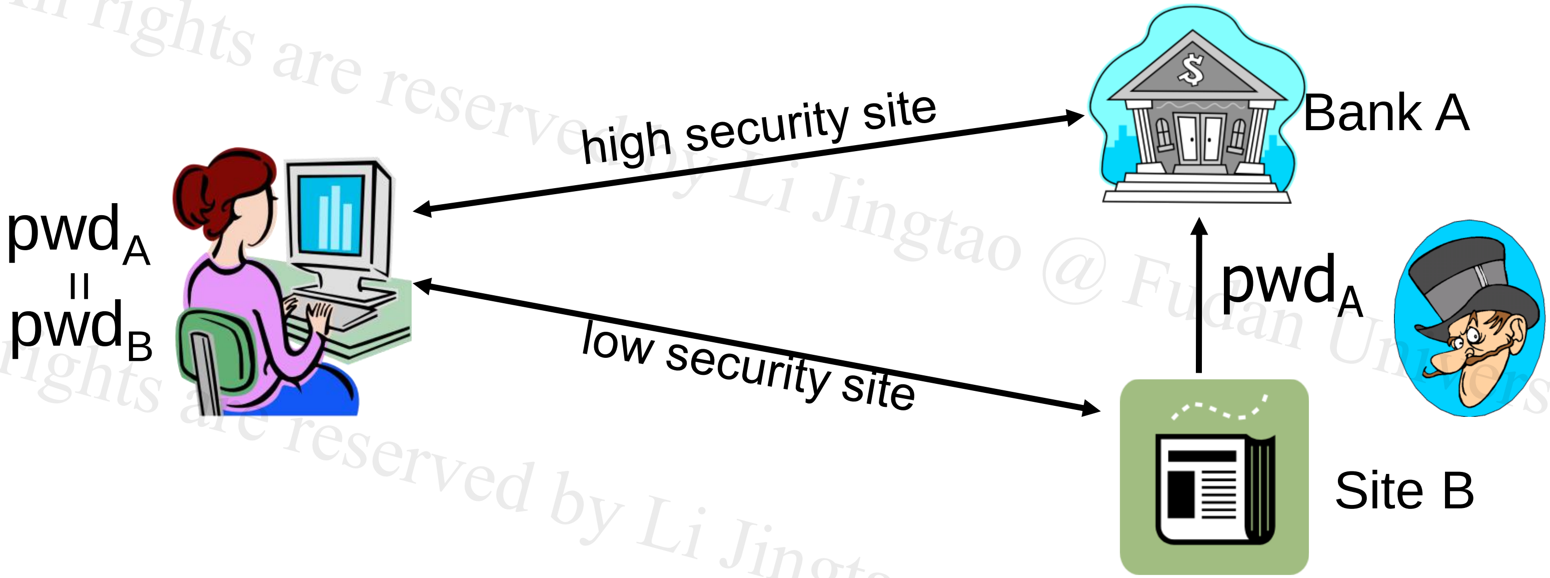
Common Password Problem



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- Phishing attack or break-in at site B reveals pwd at A
  - Server-side solutions will not keep pwd safe
  - Solution: Strengthen with client-side support

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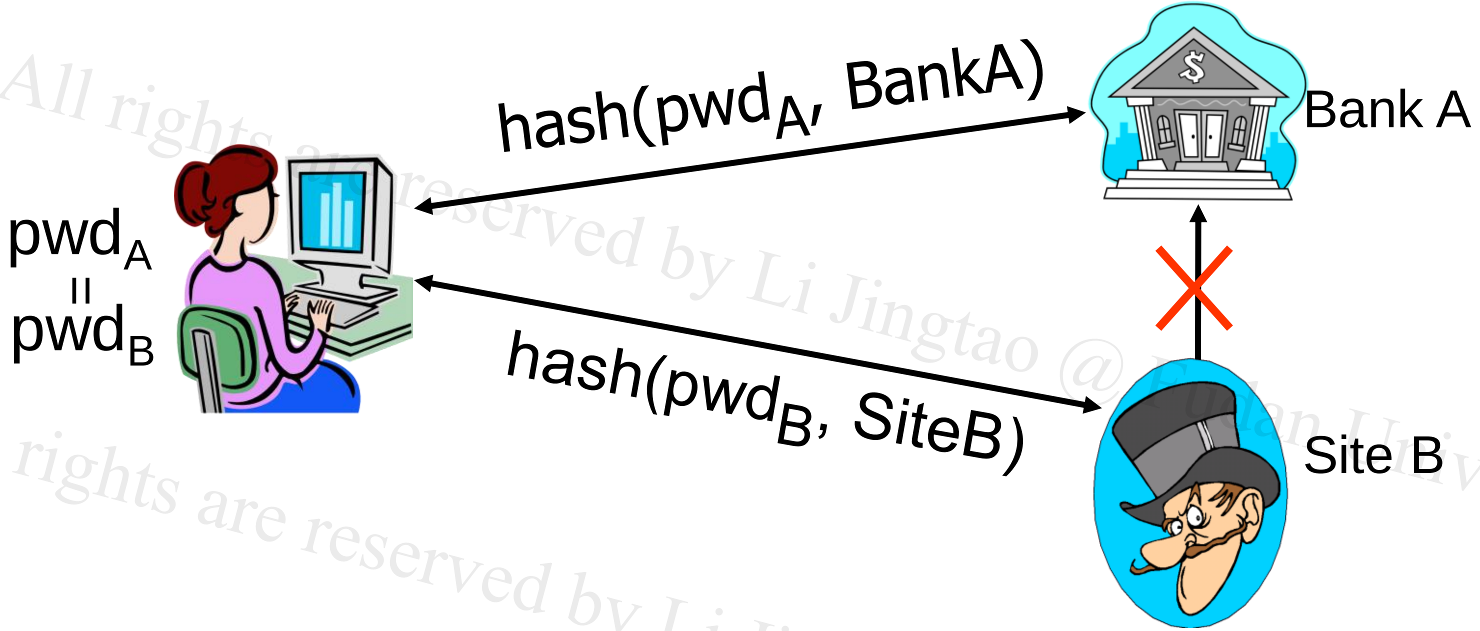
Defense: Password Hashing



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- Generate a unique password per site
  - HMAC$_{fido:123}$(banka.com) ® Q7a+0ekEXb
  - HMAC$_{fido:123}$(siteb.com) ® OzX2+ICiqc
- Hashed password is not usable at any other site
  - Protects against password phishing
  - Protects against common password problem

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One time passwords

- Avoids *replay attacks*
- ***Shared lists*** - pre-distribute list
- ***Sequentially updated*** - create next password while entering current password
- ***Based on one way functions*** - Lamport's scheme…

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Lamport’s One Time Passwords

- 1981, by Lamport
- Initialization
  - User has a secret *w*
  - Using a OWF *h*, create the password sequence:

$$w, h(w), h(h(w)), \ldots, h^t(w)$$

  - Bob knows only $h^t(w)$
- Authentication：
  - Password for i^{th} identification is:

$$w_i = h^{t-i}(w)$$

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S/KEY One-Time Password System

- Based on Lamport's OTP
- Initialization
  - User has a secret: *w*, *seed* (non-secret)
  - Using a OWF *h*, create the password sequence:

    $w, h(w,seed), h(h(w), seed), \ldots, h^t = h(h^{t-1}, seed)$
  - Bob server knows: *seed*, Sequence#, h^t
- Authentication：
  - Password for i^{th} identification is:

    $$w_i = h^{t-i} = h(w_{i-1}, seed)$$

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使用seed, Sequence#

- 多个server，Password 可重用(使用不同seed即可)

- Server 可发起Challenge:
  - [seed, sequence#]

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Attacks on OTPs..

- ***Pre-play attack*** - Eve intercepts an unused password and uses it later
- Make sure you're giving password to the right party
- Bob server must be *authenticated*

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Shortcomings of OTPs..

- 使用500-1000次需要Reinitialization
  - 开销不小
- 不支持双向认证
- 保密性没考虑

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