Chapter 3(3.1 – 3.6)

User Authentication:

- ***Identification*** → means by which a user provides a claimed identity to the system
- ***User authentication*** → means of establishing the validity of the claim

The initial requirement for performing user authentication is that the **user must be registered with the system**.

An applicant applies to a **registration authority (RA)** to become a subscriber of a **credential service provider (CSP).**

- RA is a trusted entity
  - That **establishes and vouches for the identity of an applicant** to a CSP.
- The CSP then engages in an **exchange with the subscriber.**
  - The CSP issues some sort of electronic credential to the subscriber.
    - **The credential (a data structure) binds an identity to a token** possessed by the subscriber

Once a user is registered as a subscriber

- the actual authentication process can take place between the subscriber and one or more systems
  - that perform authentication and, subsequently, authorization

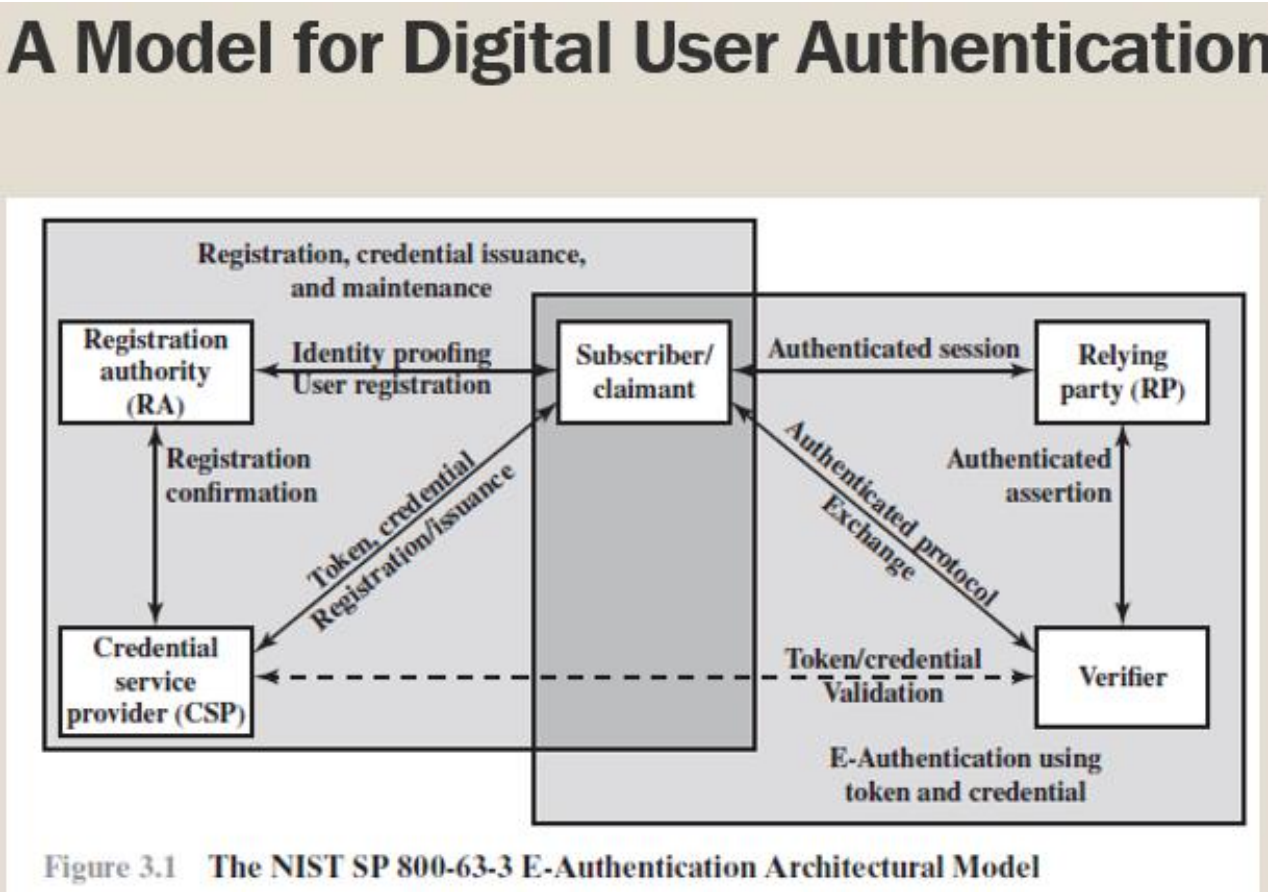


Figure 3.1 The NIST SP 800-63-3 E-Authentication Architectural Model

Authentication is the process of verifying the identity of a user, device, or system. It ensures that someone or something is who or what it claims to be. This is typically done by requiring a user to provide a set of credentials, such as a username and password, or by using other forms of identification such as a fingerprint or a security token.

Authorization, on the other hand, is the process of granting or denying access to resources or actions based on the authenticated identity. Once a user has been authenticated, the system can use authorization to determine what actions the user is allowed to perform.

Means of Authentication:

- **Something the individual knows:**
  - *Examples include a password, a personal identification number (PIN), or answers to a prearranged set of questions.*
- **Something the individual possesses:**
  - *Examples include electronic keycards, smart cards, and physical keys.*
    - This type of authenticator is referred to as a *token*.
- **Something the individual is (static biometrics):**
  - *Examples include recognition by fingerprint, retina, and face.*
- **Something the individual does (dynamic biometrics):**
  - *Examples include recognition by voice pattern, handwriting characteristics, and typing rhythm*

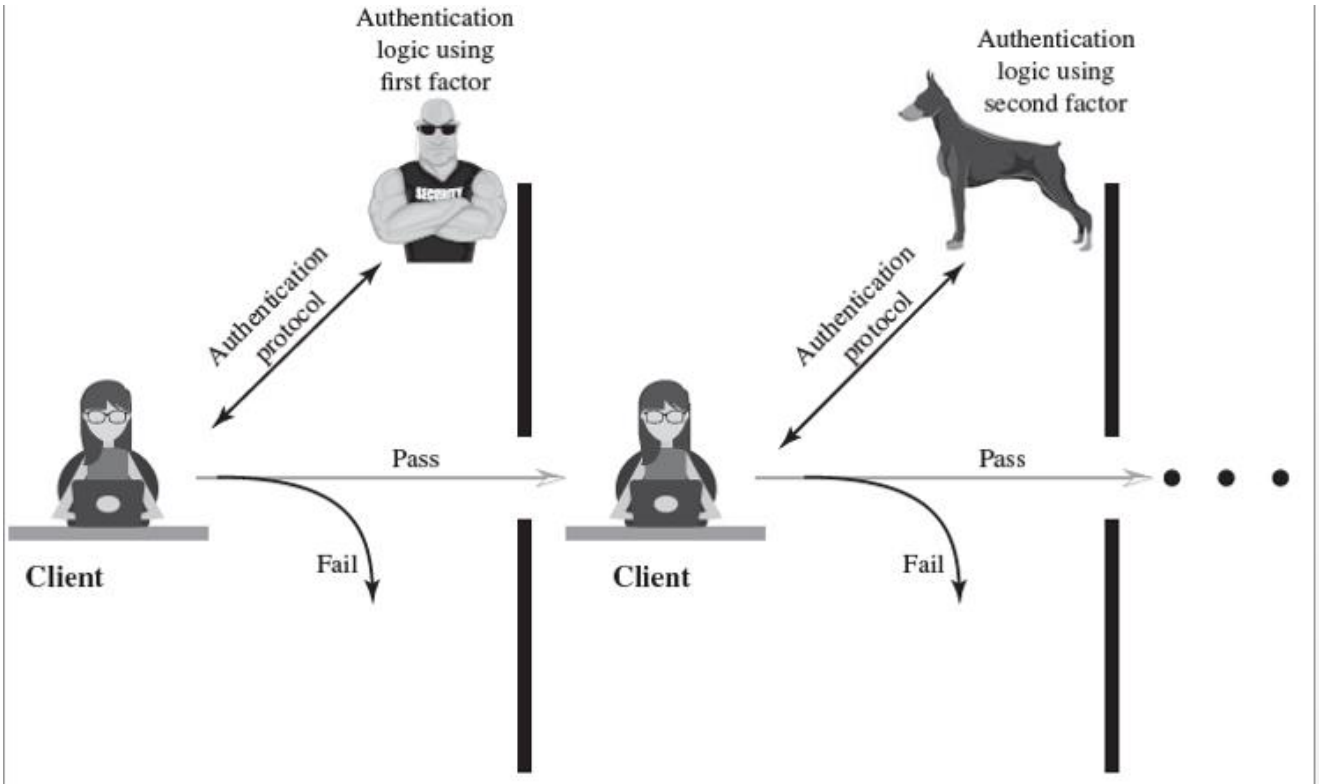


Figure 3.2 **Multifactor Authentication**

PASSWORD-BASED AUTHENTICATION:

- A widely used line of defense against intruders is the password system
  - *User provides name/login and password*
  - *System compares password with the one stored for that specified login*
- The user ID:
  - ***Determines that the user is authorized to access the system***
  - ***Determines the user's privileges***
  - ***Is used in discretionary access control***

The Vulnerability of Passwords:

1. **Offline dictionary attack:** The attacker obtains the ***system password file*** and ***compares*** the password hashes ***against*** of commonly used passwords.
   Countermeasures*:*
   a. *Controls to prevent unauthorized access to the password file*
   b. *Intrusion detection measures to identify a compromise*
   c. *Rapid reissuance of passwords should the password file be compromised.*
2. **Specific account attack:** *The attacker targets a **specific account** and **submits password guesses** until the correct password is discovered.*
   Countermeasure*:*
   a. An **account lockout mechanism,** which locks out access to the ***account after a number of failed login attempts. Typical practice*** *is no more than **five** access **attempts.***
3. **Popular password attack (against a wide range of IDs)**: *A variation of the preceding attack is to use **a popular password and try it against a wide range of user IDs.***
   Countermeasures*:*
   a. policies to inhibit the selection by users of common passwords and
   b. Scanning the IP addresses of authentication requests and client cookies for submission patterns.
4. **Password guessing against single user:** *The attacker attempts to **gain knowledge** about **the account holder and system password policies** and uses that knowledge to **guess** the password.*
   Countermeasures:
   a. Training in and **enforcement of password policies** that make passwords **difficult** to guess.
   b. Such policies address the secrecy
      i. *minimum length of the password*
      ii. *character set*
      iii. *prohibition against using well-known user identifiers, and*
      iv. *length of time before the password must be changed.*

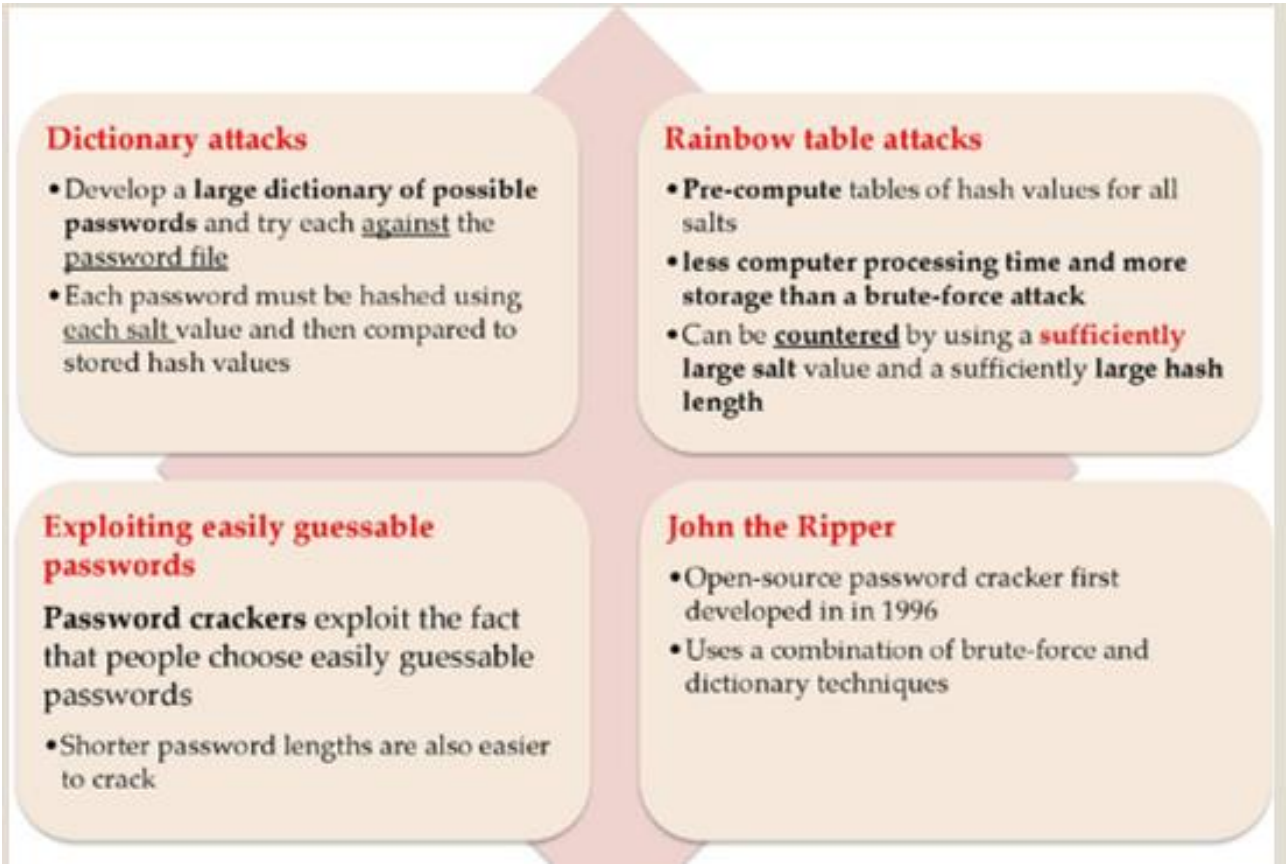
5. **Workstation hijacking:** *The attacker waits until **a logged-in workstation is unattended.***
   ***Countermeasure**:*
   a. Automatically logging the workstation out after a period of inactivity.
   b. **Intrusion detection** schemes can be used to detect changes in **user behavior.**
6. **Exploiting user mistakes:** *If the system assigns a password, then the user is more likely to **write it down because it is difficult to remember***
   ***Countermeasures**:*
      i. User training
      ii. intrusion detection, and
      iii. Simpler passwords combined with MFA.
7. **Exploiting multiple password use:** *Attacks can also become much more effective or **damaging if different network devices share the same or a similar password for a given user.***
   Countermeasures
   - *Include a policy that forbids the same or similar password on particular network devices.*
8. **Electronic monitoring:** *If a password is **communicated across a network** to log on to a remote system, it is vulnerable **to eavesdropping (E.g. sniffing).***
   Countermeasures:
   - **We need additional techniques**

UNIX File System:

---------- already came in mid 1----------

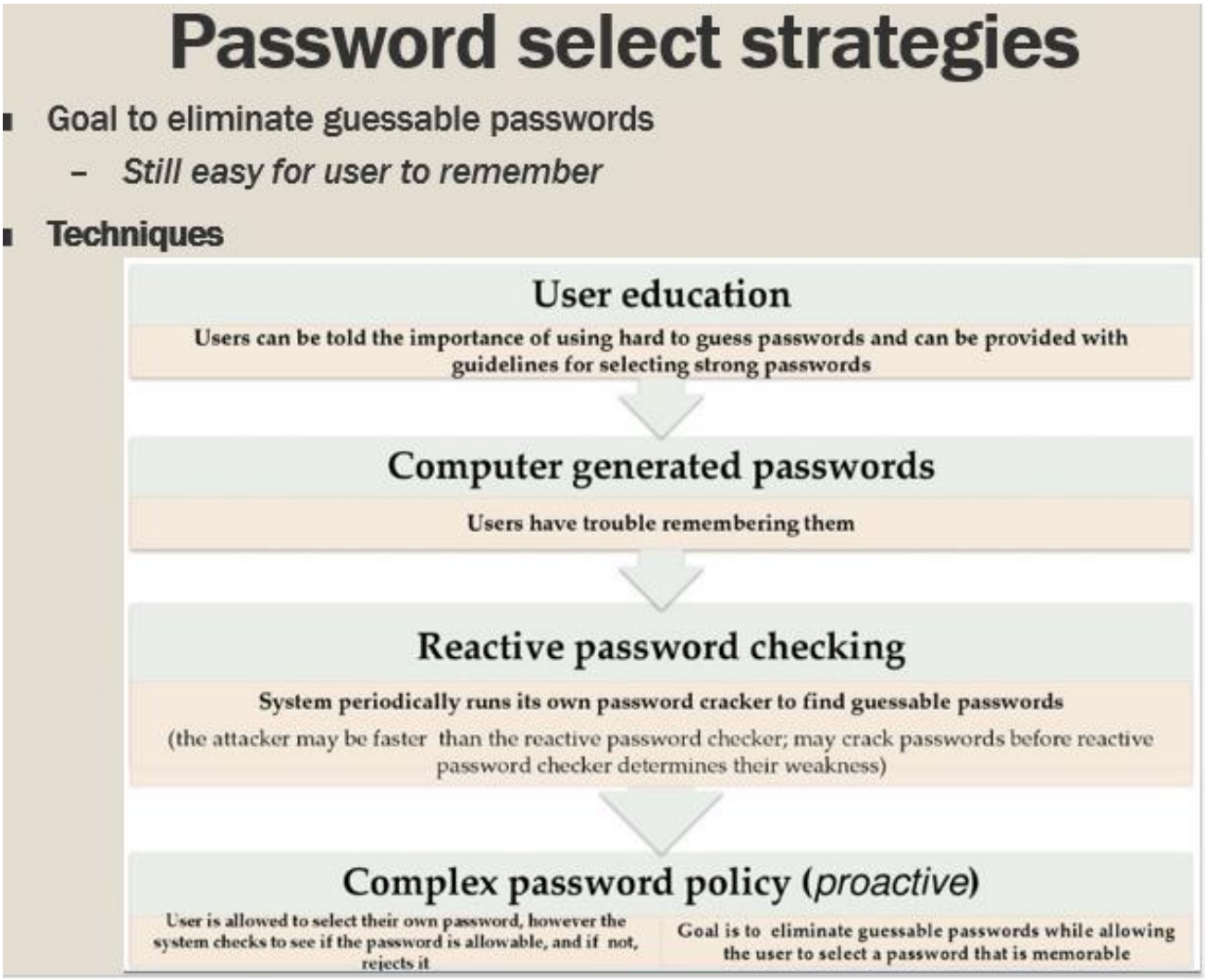
- Many systems now use MD5
  - *with 48-bit salt*
  - *password length is unlimited*
  - *is hashed with 1000 times inner loop*
  - *produces 128-bit hash*
- OpenBSD uses Blowfish block cipher based and hash algorithm called Bcrypt
  - *uses 128-bit salt to create 192-bit hash value*

Password vulnerabilty of hashed password using salt:



Password File Access Control

- Can block offline guessing attacks by denying access **to encrypted passwords**
  - ***make available only to privileged users***
  - ***often using a separate shadow password***
- Still have vulnerabilities
  - *Weakness in the OS that allows access to the file*
  - *Accident with permissions making it readable*
  - *Users with same password on other systems*
  - *Access from unprotected backup media*
  - *Sniff passwords in unprotected network traffic*



Proactive Password Checking:

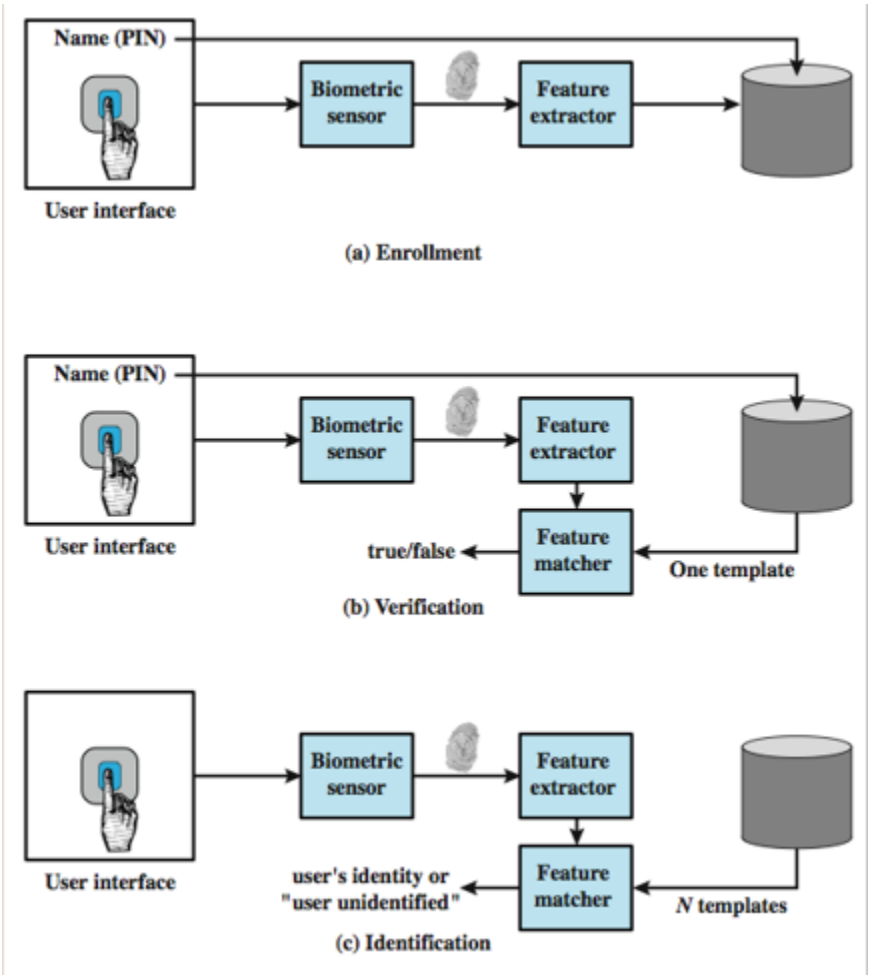
- Rule enforcement plus user advice, e.g.
  - *8+ chars, upper/lower/numeric/punctuation*
  - *may not suffice*
- Password cracker
  - *Procedure is simply to compile a large dictionary of possible "bad" passwords.*
  - *When a user selects a password, the system checks to make sure that it is not on the disapproved list.*
    - time and space issues
- Bloom Filter
  - *use to build table based on dictionary using hashes*
  - *check desired password against this table*

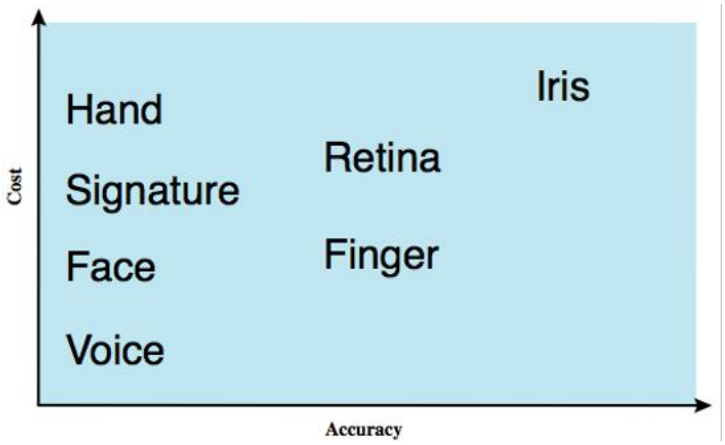
TOKEN-BASED AUTHENTICATION:

Objects that a user possesses for the purpose of user authentication are ***called tokens.***

1. **Memory Card:**
    a. **Can store but do not process data**
    b. **Provides significantly greater security when combined with a password or PIN**
    c. **Drawbacks of memory cards include:**
        i. ***Requires a special reader***
        ii. ***Loss of token***
        iii. ***User dissatisfaction:***
2. **Smart token:**
    a. ***Smart tokens include an embedded microprocessor.***
    b. **Other tokens can look like calculators, keys, or other small portable objects**
    c. ***Has an electronic interface***
    d.
    e. **Authentication protocol:**
        i. ***Static:***
            1. **The user authenticates himself or herself to the token and then the token authenticates the user to the computer.**
        ii. ***Dynamic password generator***
            1. **The token generates a unique password periodically (e.g., every minute).**
        iii. ***Challenge-response:***
            1. **The computer system generates a challenge, such as a random string of numbers. The smart token generates a response based on the challenge.**
            2. ***For example, public-key cryptography could be used and the token could encrypt the challenge string with the token's private key.***
            3. ***The simplest example of a challenge–response protocol is password authentication, where the challenge is asking for the password and the valid response is the correct password.***

3. **Biometric Authentication:**
    a. **Authenticate an individual based on unique physical characteristics**
    b. **complex and expensive**





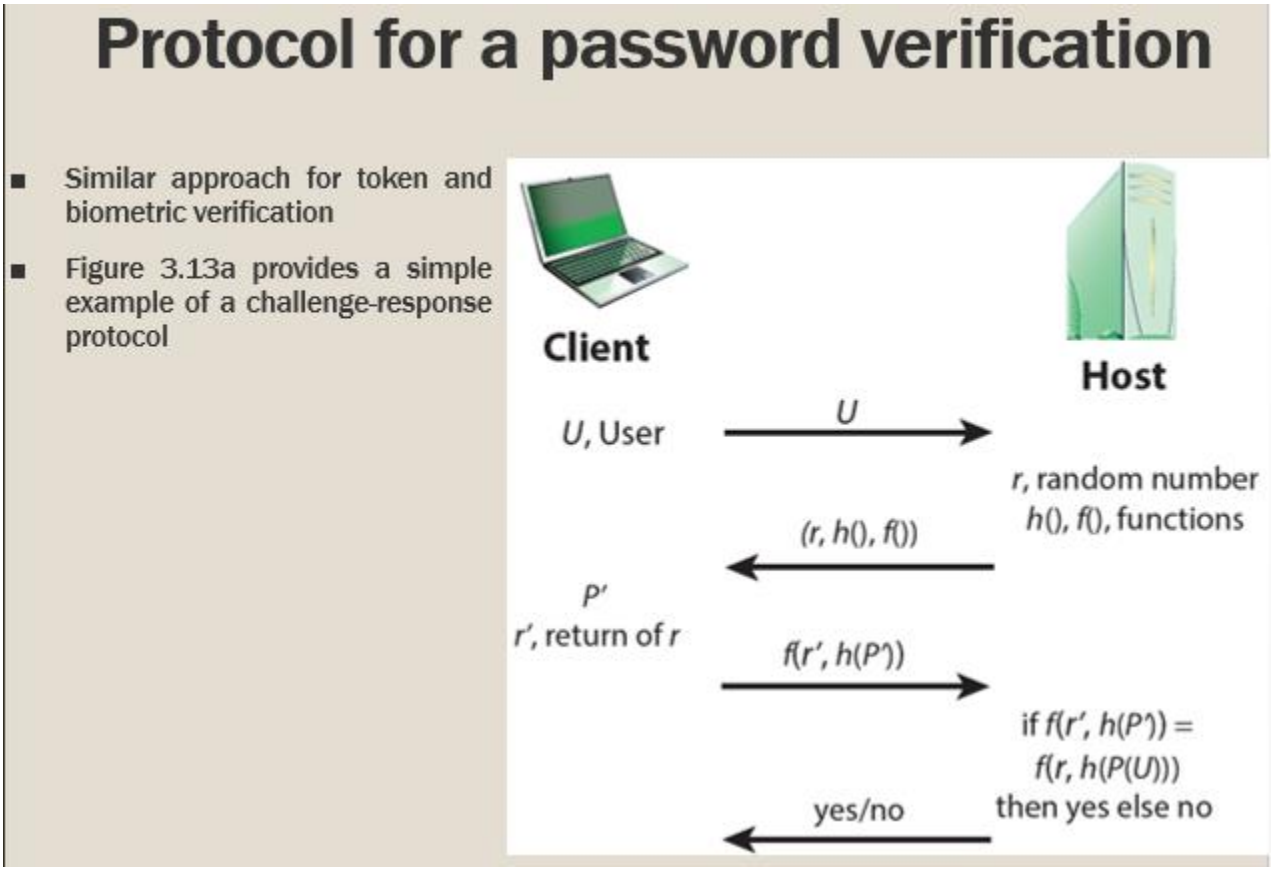
REMOTE USER AUTHENTICATION:

Authentication over a network, the Internet, or a communications link is more complex

Additional security threats such as:

- ***Eavesdropping, capturing a password, replaying an authentication sequence that has been observed***

Challenge Response Protocol:



- The host generates a random number *r*, often called a **nonce**, and returns this nonce to the user. In addition, the host specifies two functions, *h*() and *f*(), to be used in the response. This transmission from host to user is the challenge.
- The user's response is the quantity $f(r, h(P))$, where $r = r$ and P is the user's password. The function *h* is a hash function, so the response consists of the hash function of the user's password combined with the random number using the function *f*.
- The host stores the hash function of each registered user's password, depicted as $h(P(U))$ for user *U*.
- When the response arrives, the host compares the incoming $f(r, h(P))$ to the calculated $f(r, h(P(U)))$. If the quantities match, the user is authenticated.

SECURITY ISSUES FOR USER AUTHENTICATION