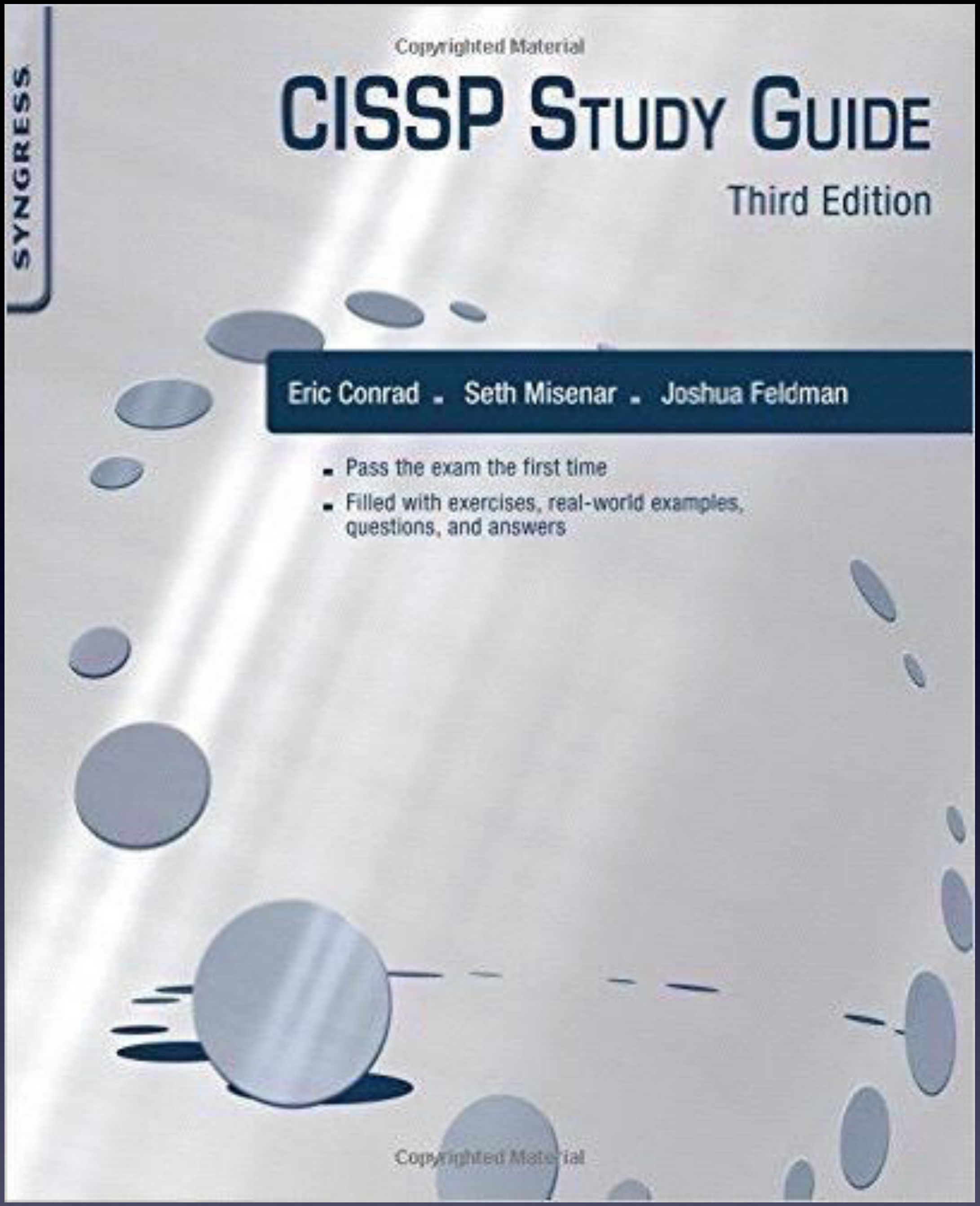
CNIT 125: Information Security Professional (CISSP Preparation)



SYNGRESS

CISSP STUDY GUIDE

Third Edition

Eric Conrad . Seth Misenar . Joshua Feldman

- Pass the exam the first time
- Filled with exercises, real-world examples, questions, and answers

Ch 6. Identity and Access Management

Authentication Methods

Authentication Methods

- Type 1: Something you know
  - Easiest and weakest method
- Type 2: Something you have
- Type 3: Something you are
- A fourth type is where you are

Passwords: Four Types

- **Static passords**
- **Passphrases**
- **One-time passwords**
- **Dynamic passwords**

Static Passwords

- **Reusable passwords that may or may not expire**
- **Typically user-generated**
- **Work best when combined with another authentication type, such as a smart card or biometric control**

Passphrases

- **Long static passwords comprised of words in a phrase or sentence**
  - **"I will pass the CISSP in 6 months!"**
- **Stronger if you use nonsense words, mix case, and use numbers and symbols**

One-Time Passwords

- Very secure but difficult to manage
- Impossible to reuse, valid only for one use

Dynamic Passwords

- **Change at regular intervals**
- **Tokens are expensive**

Strong Authentication

- **Also called Multifactor Authentication**
- **More than one authentication factor**
  - **Ex: ATM card and PIN**

Password Guessing

- **May be detected from system logs**
- ***Clipping levels*** **distinguish malicious attacks from normal users**
  - **Ex: more than five failed logins per hour**
- ***Account lockout*** **after a number of failed login attempts**

Password Hashes and Password Cracking

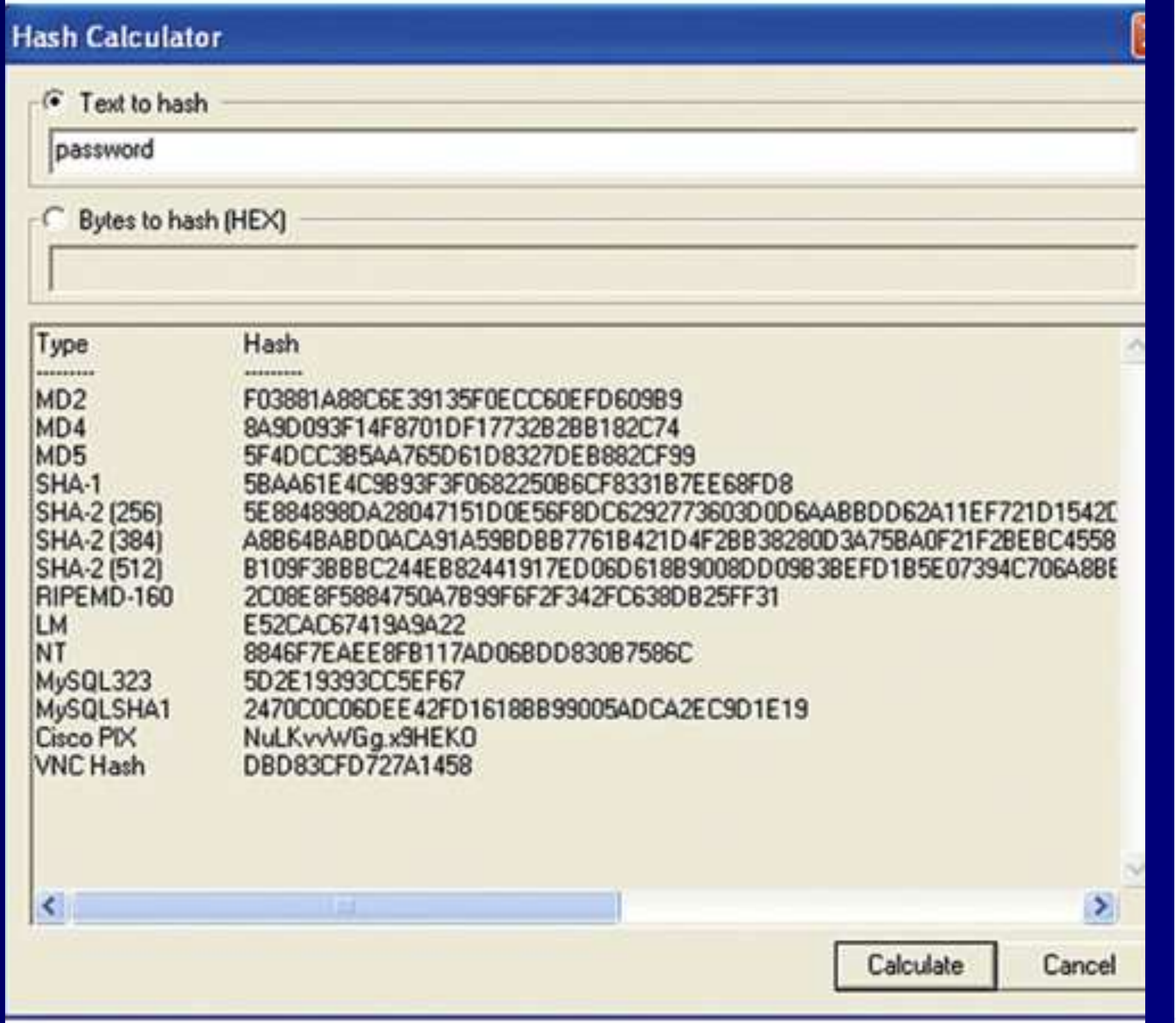
- **Plaintext passwords are not usually stored on a system anymore**
- **Password hash is stored instead**
- **Password cracking**
  - **Calculating hash for a long list of passwords, trying to match the hash value**

Password Hashes

- Stored in /etc/shadow on Unix systems
- In SAM (Security Accounts Manager) file (part of the Registry) on Windows
  - Local account hashes stored on local system drive
  - Domain account hashes stored on domain controller
  - Hashes also cached on the local system after a domain login

Capturing Hashes

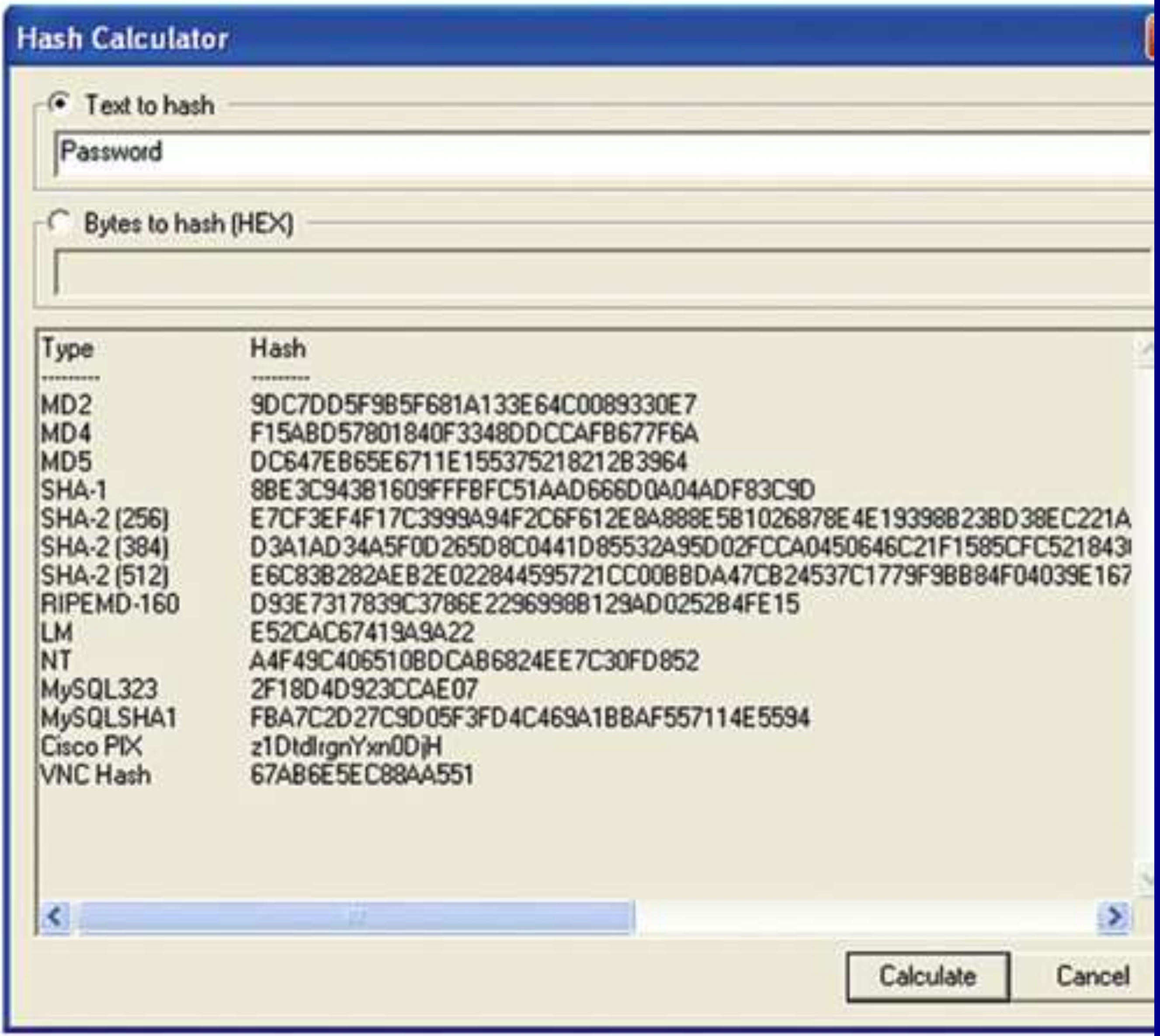
- May be sniffed from network traffic
- Or read from RAM with fgdump or Metasploit's hashdump
- SAM file is locked while the operating system is running



● Text to hash: password

```
Type          Hash
---------     ---------
MD2           F03881A88C6E39135F0ECC60EFD609B9
MD4           8A9D093F14F8701DF17732B2BB182C74
MD5           5F4DCC3B5AA765D61D8327DEB882CF99
SHA-1         5BAA61E4C9B93F3F0682250B6CF8331B7EE68FD8
SHA-2 (256)   5E884898DA28047151D0E56F8DC6292773603D0D6AABBDD62A11EF721D1542D
SHA-2 (384)   A8B64BABD0ACA91A59BDBB7761B421D4F2BB38280D3A75BA0F21F2BEBC4558
SHA-2 (512)   B109F3BBBC244EB82441917ED06D618B9008DD09B3BEFD1B5E07394C706A8BB
RIPEMD-160    2C08E8F5884750A7B99F6F2F342FC638DB25FF31
LM            E52CAC67419A9A22
NT            8846F7EAEE8FB117AD06BDD830B7586C
MySQL323      5D2E19393CC5EF67
MySQLSHA1     2470C0C06DEE42FD1618BB99005ADCA2EC9D1E19
Cisco PIX     NuLKvvWGg.x9HEKO
VNC Hash      DBD83CFD727A1458
```

FIGURE 6.1 "password" Hash Output



● Text to hash: Password

```
Type          Hash
---------     ---------
MD2           9DC7DD5F9B5F681A133E64C0089330E7
MD4           F15ABD57801840F3348DDCCAFB677F6A
MD5           DC647EB65E6711E155375218212B3964
SHA-1         8BE3C943B1609FFFBFC51AAD666D0A04ADF83C9D
SHA-2 (256)   E7CF3EF4F17C3999A94F2C6F612E8A888E5B1026878E4E19398B23BD38EC221A
SHA-2 (384)   D3A1AD34A5F0D265D8C0441D85532A95D02FCCA0450646C21F1585CFC521843
SHA-2 (512)   E6C83B282AEB2E022844595721CC00BBDA47CB24537C1779F9BB84F04039E167
RIPEMD-160    D93E7317839C3786E2296998B129AD025284FE15
LM            E52CAC67419A9A22
NT            A4F49C406510BDCAB6824EE7C30FD852
MySQL323      2F18D4D923CCAE07
MySQLSHA1     FBA7C2D27C9D05F3FD4C469A1BBAF557114E5594
Cisco PIX     z1DtdlrgnYxn0DjH
VNC Hash      67AB6E5EC88AA551
```

FIGURE 6.2 "Password" Hash Output

- **LANMAN (LM) hash doesn't change**

Dictionary Attack

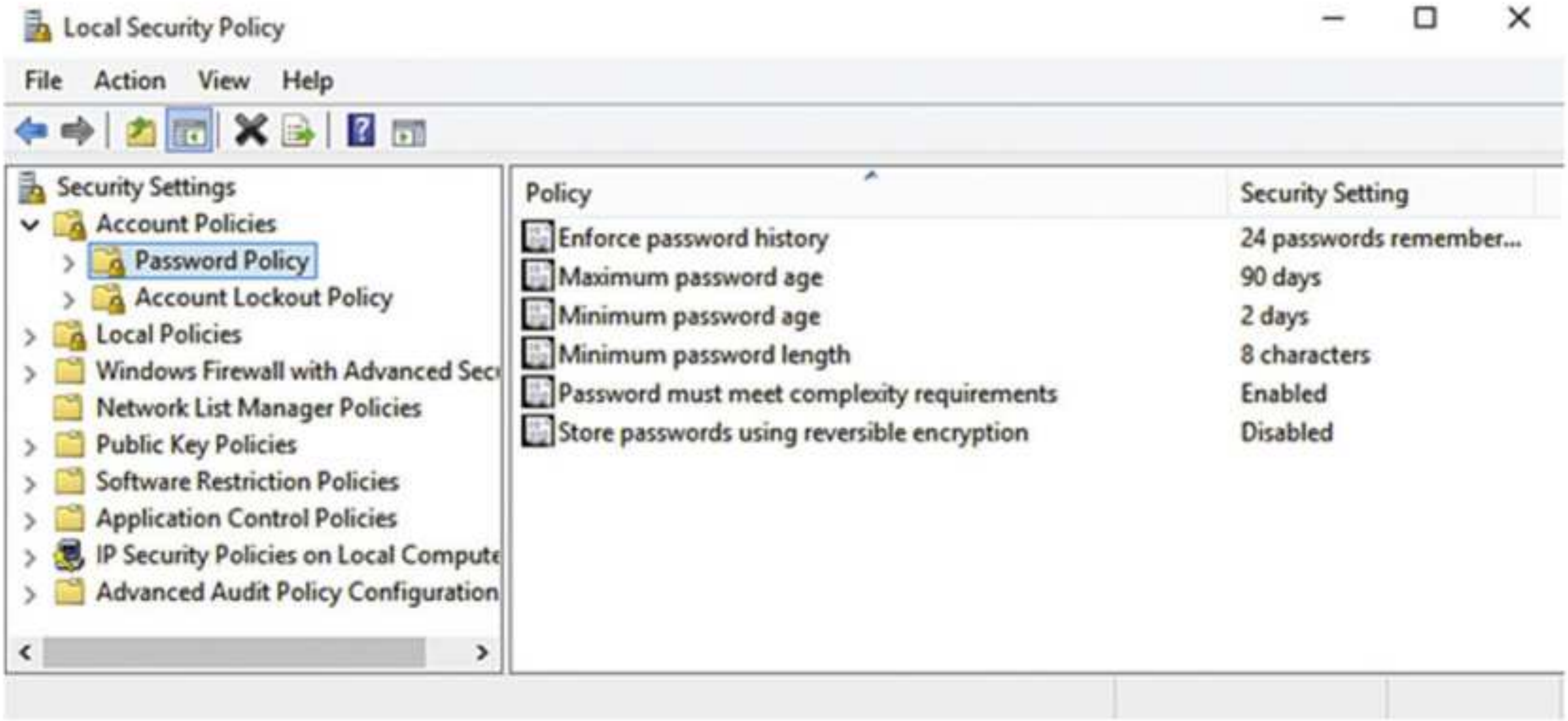
- Use a list of possible passwords
- Fast and efficient technique
- Countermeasure: password complexity and length rules

Brute Force and Hybrid Attacks

- Brute Force: try all possible combinations of characters
- Slow, but much faster with GPUs (Graphical Processing Units)
- Rainbow tables trade time for memory
  - Most effective on unsalted passwords, like Microsoft's
- Hybrid attack
  - Uses a dictionary and modifications of the words, like 1337sp33k

Salts

- A random value added to the password before hashing
- If two users have the same password, the hash is different
- Makes rainbow tables less useful



Local Security Policy
File
Action
View
Help
Security Settings
Account Policies
Password Policy
Account Lockout Policy
Local Policies
Windows Firewall with Advanced Sec
Network List Manager Policies
Public Key Policies
Software Restriction Policies
Application Control Policies
IP Security Policies on Local Compute
Advanced Audit Policy Configuration

Policy	Security Setting
Enforce password history	24 passwords remember...
Maximum password age	90 days
Minimum password age	2 days
Minimum password length	8 characters
Password must meet complexity requirements	Enabled
Store passwords using reversible encryption	Disabled

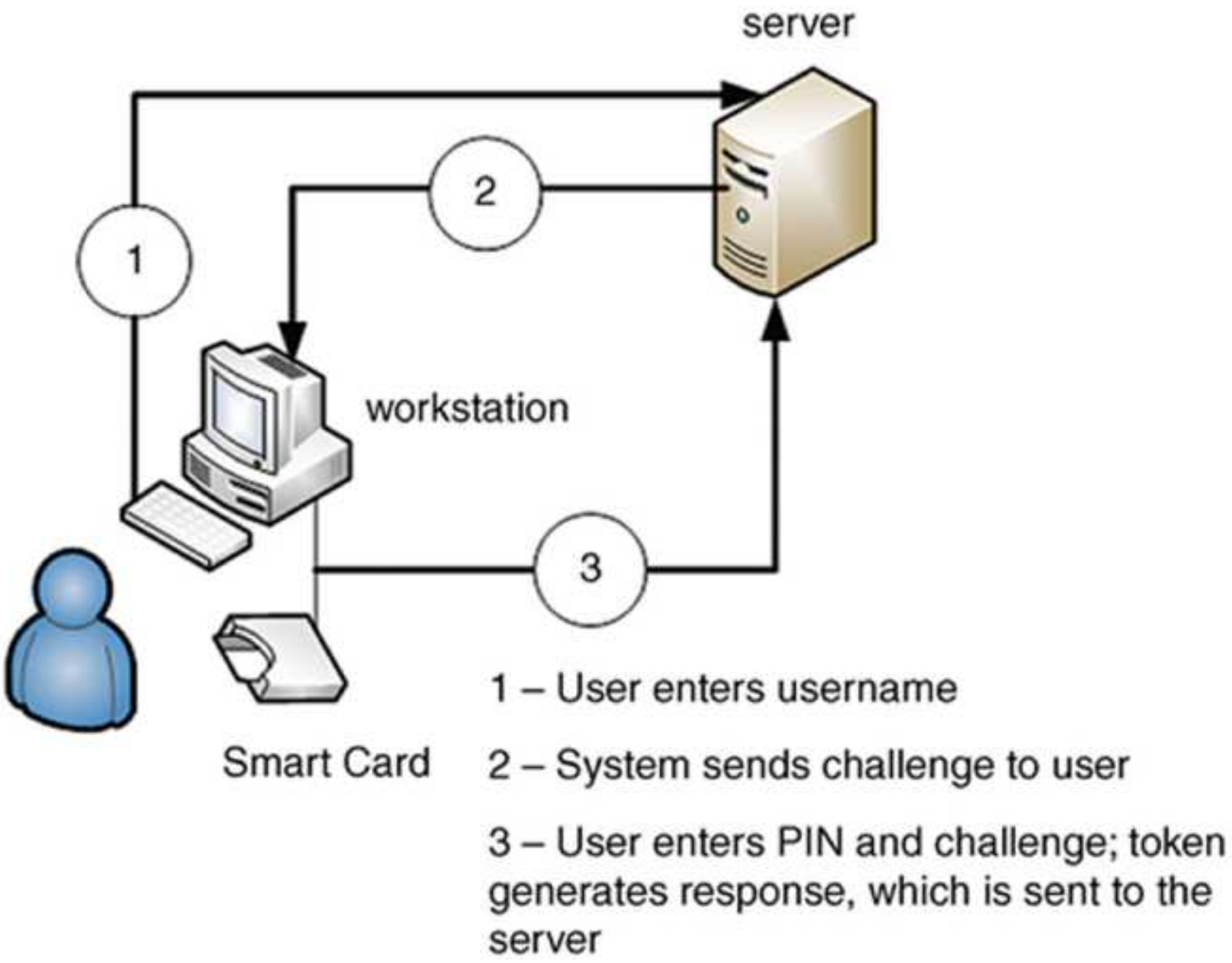
FIGURE 6.4 Windows 10 Password Settings

Password Control

- Users often write down passwords and place them somewhere unsafe
- Like sticky notes on monitors

Type 2 Authentication
Something You Have

- Synchronous Dynamic Token
  - Synchronized with a central server
  - Uses time or counter to change values
  - Ex: RSA's SecureID, Google Authenticator
- Asynchronous Dynamic Token
  - Not synchronized with a central server
  - Ex: Challenge-response token
  - User must enter challenge and PIN



1 – User enters username

2 – System sends challenge to user

3 – User enters PIN and challenge; token generates response, which is sent to the server

FIGURE 6.6 **Asynchronous Challenge-Response**

Type 3 Authentication
Something You Are

- Enrollment
  - Registering users with a biometric system
  - Ex: taking fingerprints
  - Should take 2 minutes or less
- Throughput
  - Time required to authenticate a user
  - Typically 6-10 seconds

Accuracy of Biometric Systems

- **False Reject Rate (FRR) -- Type I errors**
- **False Accept Rate (FAR) -- Type II errors**
- **Crossover Error Rate (CER)**

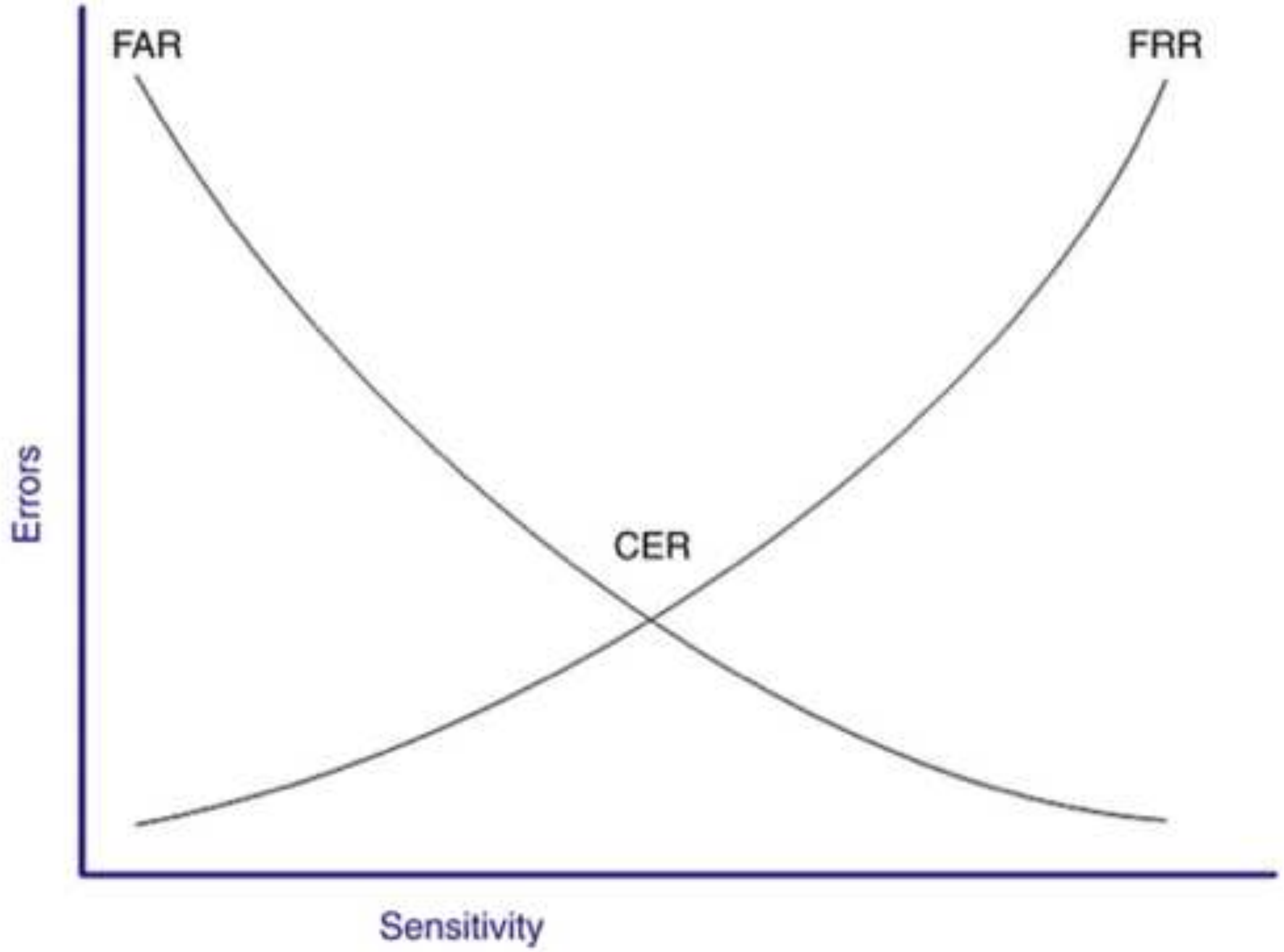


FIGURE 6.7 **CrossOver Error Rate**

Types of Biometric Controls

- **Fingerprints are most common**
  - **Data is mathematical representation of *minutiae* -- details of fingerprint whorls, ridges, bifurcation, etc.**

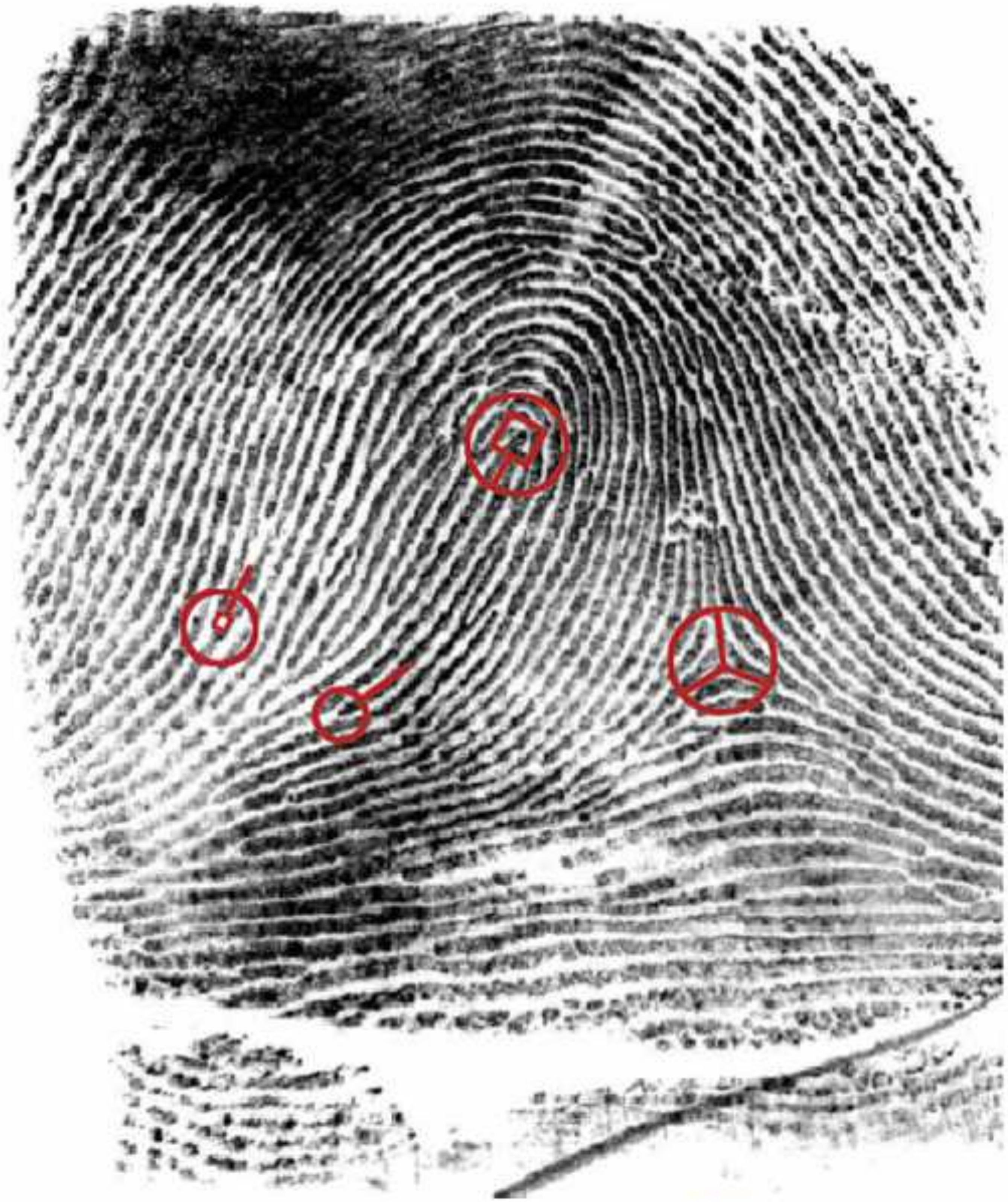


FIGURE 6.8 Fingerprint Minutiae [7]

Retina Scan

- **Laser scan of the capillaries that feed the retina in the back of the eye**
- **Rarely used because of health risks and invasion-of-privacy issues**
- **Exchange of bodily fluids should be avoided**

Iris Scan

- Passive biometric control
  - Can be done without subject's knowledge
- Camera photographs the iris (colored portion of the eye)
- Compares photo to database
- Works through contact lenses and glasses
- High accuracy, no exchange of bodily fluids

Hand Geometry

- Measure length, width, thickness, and surface area of hand
- Simple, can require as little as 9 bytes of data

Keyboard Dynamics

- **How hard a person presses each key**
- **Rhythm of keypresses**
- **Cheap to implement and effective**

Dynamic Signature

- Process of signing with a pen
- Similar to keyboard dynamics

Voiceprint

- Vulnerable to replay attack
- So other access controls must be combined with it
- Voices may change due to illness, leading to a false rejection

Facial Scan

- Also called facial recognition
- Passive but expensive
- Not commonly used for authentication
- Law enforcement and security agencies use facial recognition at high-value, publicly accessible targets
- Superbowl XXXV was the first major sporting event to use facial recognition to look for terrorists in 2001 (link Ch 6a)

Someplace You Are

- **Location found from GPS or IP address**
- **Can deny access if the subject is in the incorrect location**
- **Credit card companies use this technique to detect fraud**
- **Transactions from abroad are rejected, unless the user notifies the credit card company of the trip**

Access Control Technologies

Centralized Access Control

- One logical point for access control
- Can provide Single Sign-On (SSO)
  - One authentication allows access to multiple systems
- Can centrally provide AAA services
  - Authentication
  - Authorization
  - Accountability

Decentralized Access Control

- **Local sites maintain independent systems**
- **Provides more local power over data**
- **Risks: adherence to policies may vary**
- **Attackers may find the weakest link**
- **Note: DAC is Discretionary Access Control; not Decentralized Access Control**

Single Sign-On (SSO)

- One central system for authentication
- More convenient for users and administrators
- Risks: single point of attack, and increased damage from a compromise or unattended desktop

Session Management of Single Sign On

- SSO should always be combined with dual-factor authentication
- But an attacker might hijack an authenticated session
- Session timeouts and locking screensavers should be used
- Users should be trained to lock their workstations when they leave their desks

Access Provisioning Lifecycle

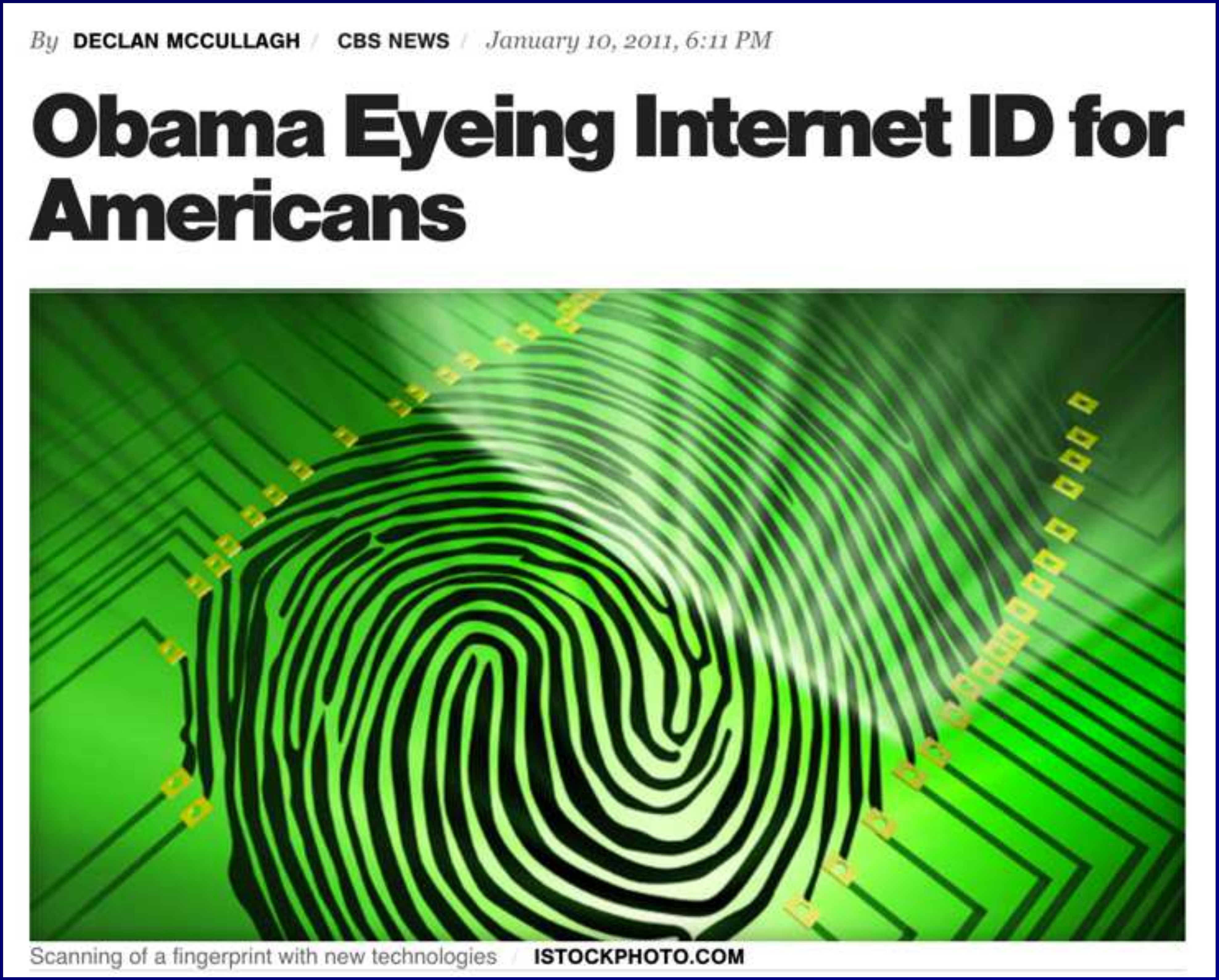
- **Password policy compliance checking**
- **Notify users when passwords are about to expire**
- **Identify life cycle changes, such as accounts inactive for 30 days or new accounts that are unused for 10 days**
- **Revoke access rights when contracts expire**
- **Coordinate account revocation with human resources; include termination, horizontal, and vertical moves**

User Entitlement, Access Review, and Audit

- ***Access aggregation*** **occurs when a user gains more access to more systems**
- ***Authorization creep*** **--users gain more entitlement without shedding the old ones**
- **Can defeat least privilege and separation of duties**
- **Entitlements must be regularly reviewed and audited**

Federated Identity Management

- **Applies Single Sign-On across organizations**
- **A trusted authority provides a digital identity above the enterprise level**
- **In practice, Facebook seems to be the world's identity authority**



By DECLAN MCCULLAGH / CBS NEWS / January 10, 2011, 6:11 PM

Obama Eyeing Internet ID for Americans

Scanning of a fingerprint with new technologies / ISTOCKPHOTO.COM

- **Link Ch 6b**

SAML

- Security Assertion Markup Language
- XML-based framework for exchanging security information
- Including authentication data
- Enables SSO at Internet scale

Identity as a Service (IDaaS)

- Also called "Cloud Identity"
- Integrates easily with cloud hosted applications and third party services
- Easier deployment of two-factor auth.
- Compounds challenges with internal identity management and account/ access revocation
- Larger attack services
- Ex: Microsoft Accounts (formerly Live ID)

Credential Management Systems

- **Password managers, may offer:**
- **Secure password generation**
- **Secure password storage**
- **Reduction in the number of passwords users must remember**
- **Multifactor authentication to unlock credentials**
- **Audit logging of all interactions**

Integrating Third-party Identity Services

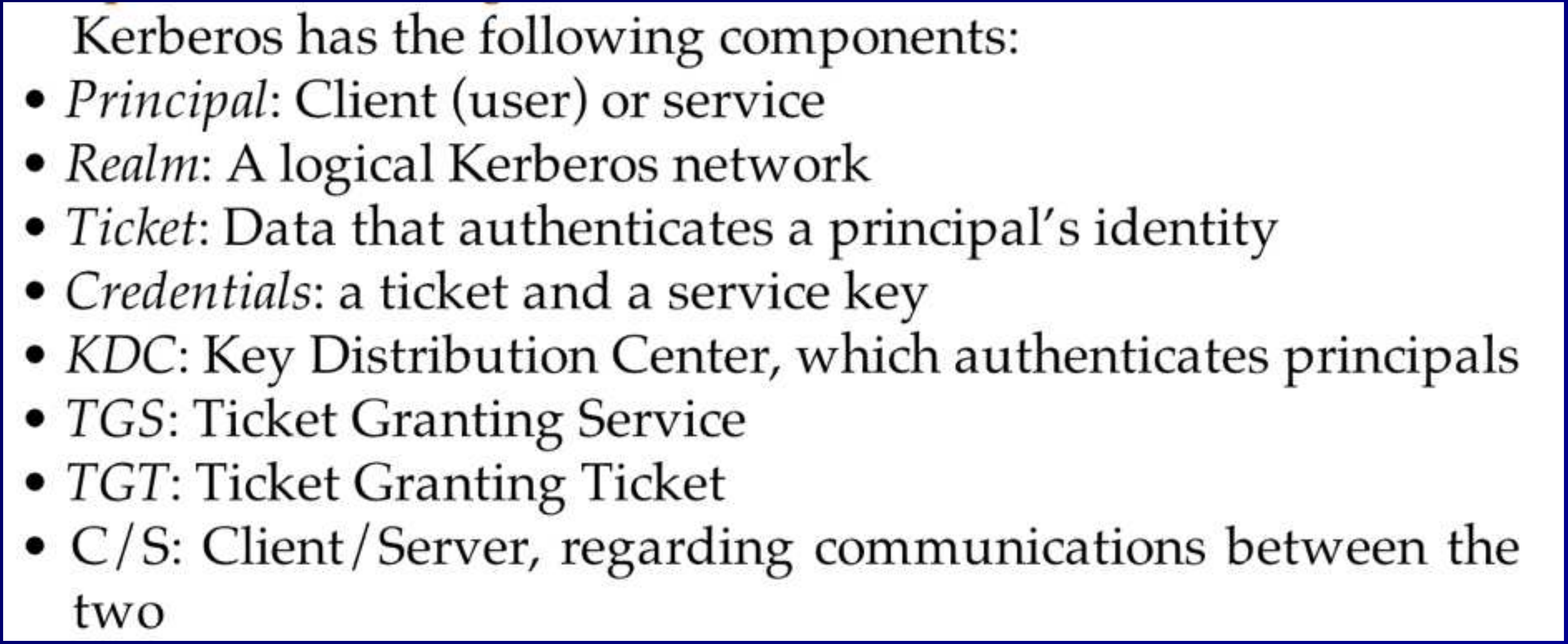
- **Hosting a third-party ID service locally, within an enterprise**
- **Allows internal applications to integrate with a cloud identity**

LDAP

- Lightweight Directory Access Protocol
- Used by most internal identity services
- Including Active Directory
- LDAP uses TCP or UDP 389
- Can use plaintext transmission
- Supports authenticated connection and secure transmissions with TLS

Kerberos

- Third-party authentication service developed at MIT
- Prevents eavesdropping and replay attacks
- Provides integrity and secrecy
- Uses symmetric encryption and mutual authentication



Kerberos has the following components:

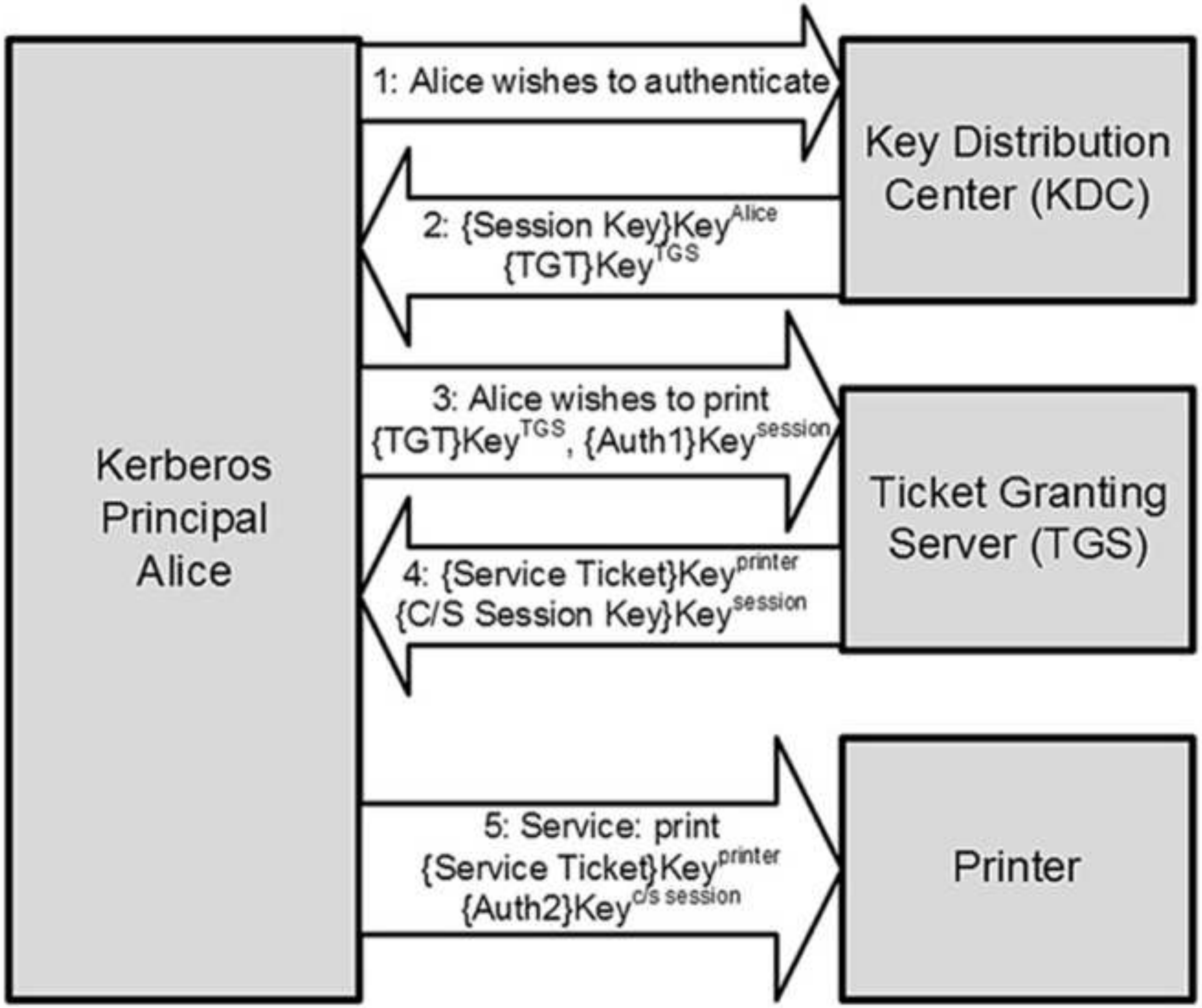
- *Principal*: Client (user) or service
- *Realm*: A logical Kerberos network
- *Ticket*: Data that authenticates a principal's identity
- *Credentials*: a ticket and a service key
- *KDC*: Key Distribution Center, which authenticates principals
- *TGS*: Ticket Granting Service
- *TGT*: Ticket Granting Ticket
- C/S: Client/Server, regarding communications between the two

Kerberos Operational Steps

1. **Principal (Alice) contacts the KDC (Key Distribution Center) requesting authentication**
2. **KDC sends user a session key, encrypted with Alice's secret key. KDC also sends a TGT (Ticket Granting Ticket) encrypted with the TGS's secret key.**
3. **Alice decrypts the session key and uses it to request permission from the TGS (Ticket Granting Service)**

Kerberos Operational Steps

4. TGS verifies Allice's session key and sends her a second session key "C/S session key" to use to print. TGS also sends a service ticket, encrypted with the printer's key
5. Alice connects to the printer. Printer sees a valid C/S session key, so provides service



Kerberos Principal Alice

Key Distribution Center (KDC)

Ticket Granting Server (TGS)

Printer

1: Alice wishes to authenticate

2: {Session Key}Key^{Alice}
{TGT}Key^{TGS}

3: Alice wishes to print
{TGT}Key^{TGS}, {Auth1}Key^{session}

4: {Service Ticket}Key^{printer}
{C/S Session Key}Key^{session}

5: Service: print
{Service Ticket}Key^{printer}
{Auth2}Key$^{c/s\ session}$

Time in Kerberos

- TGT lifetime is typically 10 hours
- Authenticators contain a timestamp
- Will be rejected if more than 5 minutes ol
- Clocks must be synchronized on all systems

Kerberos Weaknesses

- KDC stores all keys
  - Compromise of KDC exposes them all
- KDC and TGS are single points of failure
- Replay attacks possible for lifetime of authenticator
- Kerberos 4 allowed one user to request a session key for another user, which could be used to guess a password
  - A weakness closed in Kerberos 5
- Plaintext keys can be stolen from a client's RAM

SESAME

- Secure European System for Applications in a Multi-vendor Environment
- Has new features not present in Kerberos
  - Most important: public-key encryption
  - This avoids Kerberos' plaintext storage of symmetric keys

RADIUS and Diameter

- **Remote Authentication Dial In User Service**
- **Uses UDP ports 1812 and 1813**
- **An AAA server**
- **Diameter is RADIUS' successor**
- **Uses TCP and can manage policies for many services from a single server**

TACACS and TACACS+

- Terminal Access Controller Access Control System
  - Uses UDP port 49 and may use TCP port 49
- TACACS+ is newer
  - Allows two-factor authentication
  - Encrypts all data (RADIUS only encrypts the password)
  - Not backwards-compatible with TACACS

PAP and CHAP

- **Password Authentication Protocol**
  - **Plaintext transmission**
  - **Vulnerable to sniffing**
- **Challenge Handshake Authentication Protocol**
  - **Server sends client a challenge**
  - **Client adds challenge to secret and hashes it, and transmits that**
  - **Resists sniffing attacks**

Microsoft Active Directory Domains

- Groups users and network access into *domains*
- Uses Kerberos
- Domains can have trust relationships
  - One-way or two-way
  - Nontransitive or transitive
    - A *transitive* trust extends to any other domain either partner trusts
    - "Friend of a friend"

Access Control Models

Three Models

- **Discretionary Access Control (DAC)**
- **Mandatory Access Control (MAC)**
- **Non-Discretionary Access Control**

Discretionary Access Control (DAC)

- **Owners have full control over assets**
- **Can share them as they wish**
- **Unix and Windows file systems use DAC**
- **User errors can expose confidential data**

Mandatory Access Control (MAC)

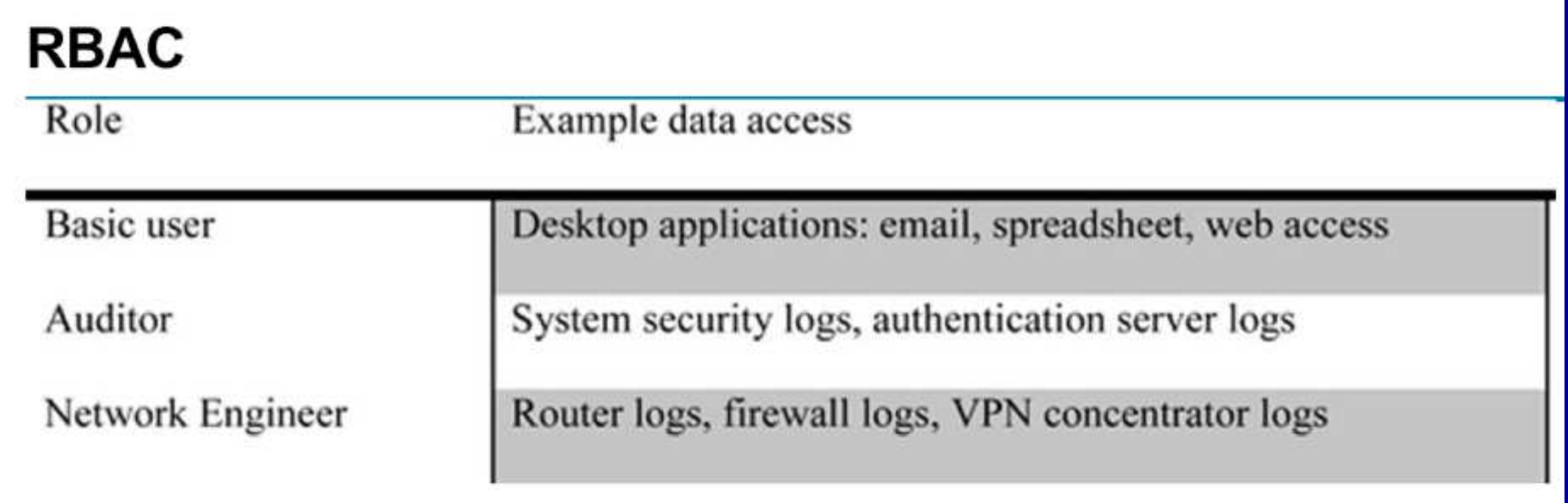
- **Subjects have *clearance***
- **Objects have *labels***
- **Typically Confidential, Secret, and Top Secret**
- **MAC is expensive and difficult to implement**

Non-Discretionary Access Control

- **Users don't have discretion when accessing objects**
- **Cannot transfer objects to other subjects**
- **Two types:**
  - **Role-Based Access Control (RBAC)**
  - **Task-based access control**

Role-Based Access Control (RBAC)

- **Subjects have roles, like Nurse, Backup Administrator, or Help Desk Technician**
- **Permissions are assigned to roles, not individuals**



RBAC

Role	Example data access
Basic user	Desktop applications: email, spreadsheet, web access
Auditor	System security logs, authentication server logs
Network Engineer	Router logs, firewall logs, VPN concentrator logs

Task-Based Access Control

- **Works like RBAC, but focuses on the tasks each subject must perform**
- **Such as writing prescriptions, restoring data from a backup tap,or opening a help desk ticket**

Rule-Based Access Control

- **Uses a set of rules, in "it/then" format**
- **Ex: firewall rules**

Content- and Context-Dependent Access Controls

- **May be added to other systems for defense-in-depth**
- **Content-dependent access control**
  - **Additional criteria beyond identification and authorization**
  - **Employees may be allowed to see their own HR data, but not the CIO's data**
- **Context-dependent access controls**
  - **Applies additional context, such as time of day**