Protecting Information Assets

- Unit 5a -

Identity Management and Access Control

Agenda

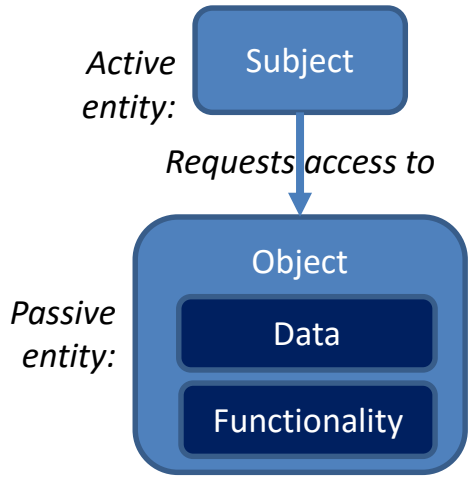
- Overview
- Identity management
- Authentication
- Authorization
- Access control models

Access to information…

Access is the ability to create a flow of information between user and system

The flow of information between a subject and an object

- Subject
  - Is an active entity that requests access to an object or the data within the object
  - Can be a user, program, or process
- Object
  - Can be a computer, computer directory, file, program, database or field within a table within a database

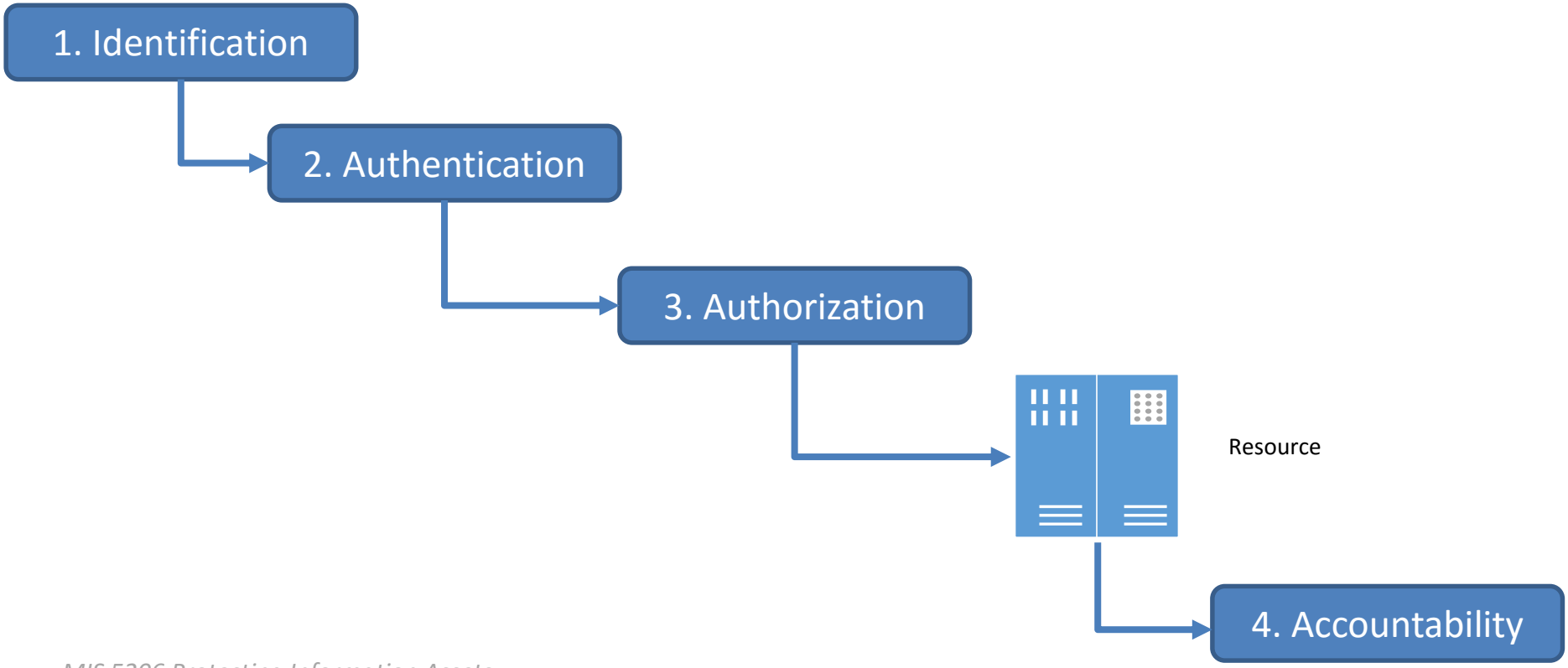


Identity and Authentication

- First line of defense in battling unauthorized access to network resources and systems
- Broad term covering several types of mechanisms that control access to features of networks, computers and information stored and flowing within them

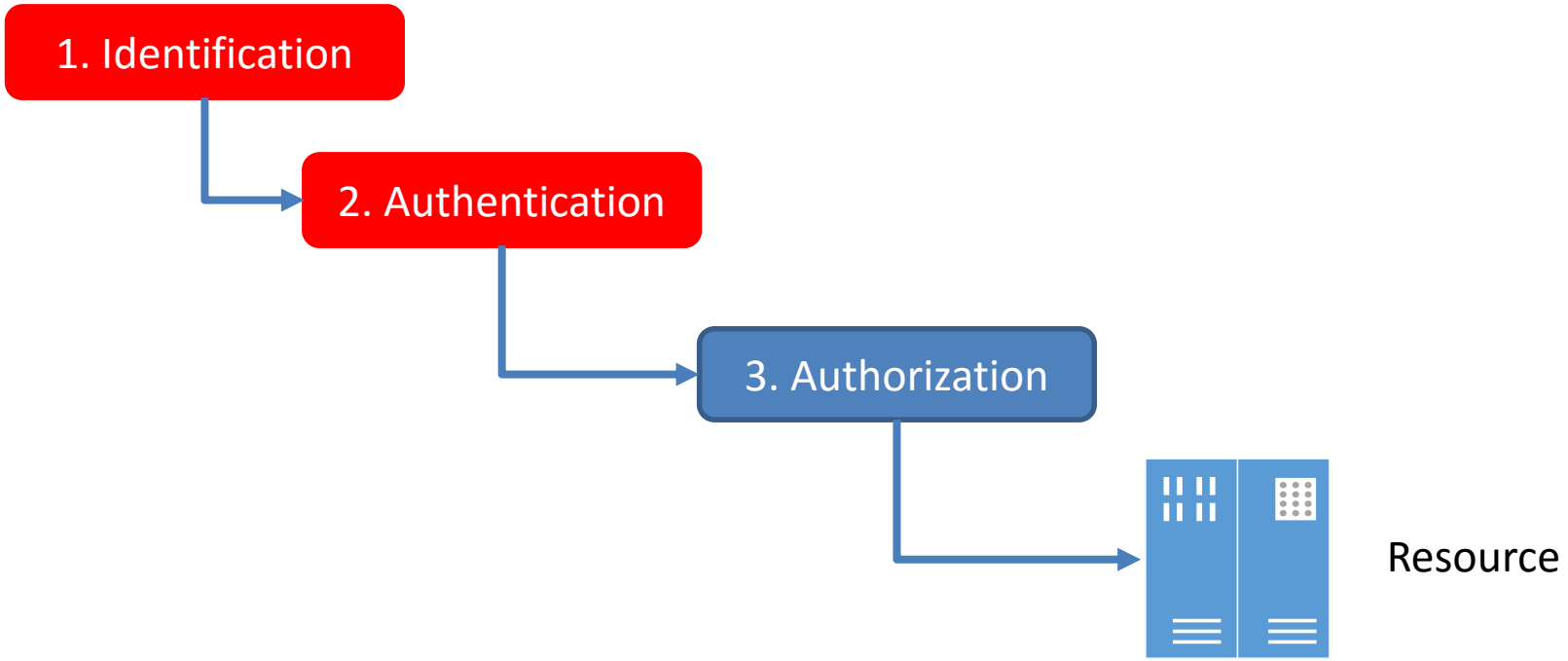
Identification, Authentication, Authorization, and Accountability

To access an information system resource, a user must pass through the following logical steps:



To access a network's resource, a user must:

Prove their identity (i.e. has the necessary credentials)



Identity Management

Identification and Authentication are distinct functions

Identification: Who you say you are

Authentication: Confirmation that you are who you say you are

Identification and Authentication

Usually involves a two-step process:

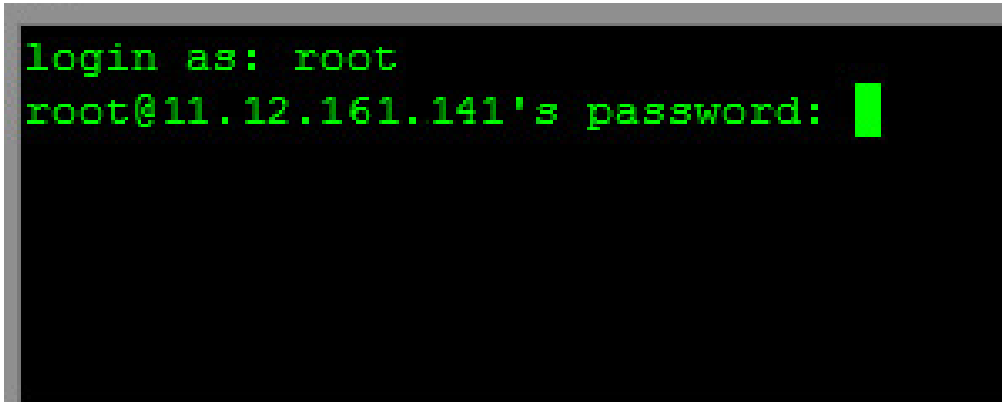
1. **Identification:** Entering public information
   - Method by which a subject (user, program or process) claims to have a specific identity
     - *Username, employee number, account number, or email address*

2. **Authentication:** Entering private information
   - Individual's identify must be verified during authentication process
   - Method by which subject proves it is who it says it is
     - *Static password, smart token, one-time password, or PIN*

Identification

Method of establishing the subject's identity

- Subject can be a human user, program or process
- **Identity** – A set of attributes that uniquely describe a person within a given context
- Typically a user name, email address or other public information



Identification

USER ID

means

User Identification

Identification: Entering public information

- Method by which a subject (user, program or process) supplies identifying information to claim they have a specific identity
  - *Username, employee number, account number, or email address*

- Creating secure identities involves 3 key aspects:
  1. **Uniqueness** – every user, program or process must be identified with an identifier (i.e. unique ID) that is specific to the individual for accountability
  2. **Non-descriptive** – Identifier should not indicate the purpose of the account nor the user's position nor tasks done with the account
  3. **Issuance** – provided by an authority as a formal/official means of proving identity

Authentication

The process of establishing confidence in the identity of users or information systems

Method of proving identity

- Something a person:
  1. **Knows** – a secret password
  2. **Has** – a token
  3. **Is or does** – biometrics

Authentication – Classic 3 factor paradigm

…for authentication systems

Subject provides information to prove it is who it says it is and authentication system verifies the identification information

1. **Something the subject knows** ("authentication by knowledge")
   - Examples: password, PIN, combination to a lock…
   - Usually least expensive method to implement
   - Vulnerability: Someone else may acquire this knowledge and gain unauthorized access to a resource

2. **Something the subject has** ("authentication by ownership")
   - Examples: Key, swipe card, access card, badge…
   - Common for accessing facilities, sensitive areas, and authenticate holder
   - Vulnerability: Can be lost or stolen and result in unauthorized access

3. **Something the subject is** ("authentication by characteristic")
   - Examples: Fingerprint, palm scan, retina scan…
   - Based on biometrics – a way to identify the subject by a unique physical attribute
   - Vulnerability: Can be expensive, cumbersome/troubling to users and associated with false acceptance or rejection

Authentication – something you know

Passwords

- A secret shared between user authentication system
- User name + password most common identification, authentication scheme
  - *A weak security mechanism – requiring implementation of strong password protections*

Authentication

Passphrase

- Is a sequence of characters that is longer than a password
- Takes the place of a password
- Can be more secure than a password because it is more complex

Techniques to attack passwords

- Guessing
- Social engineering
- Dictionary attacks
- Electronic monitoring
- Access the password file
- Brute force attacks
- Rainbow tables

10 Best Password Cracking Tools Of 2016 | Windows, Linux, OS X

BY ADARSH VERMA ON JUL 28, 2016 – IN LIST / SECURITY

Short Bytes: *Password cracking is an integral part of digital forensics and pentesting. Keeping that in mind, we have prepared a list of the top 10 best password cracking tools that are widely used by ethical hackers and cybersecurity experts. These tools–including the likes of Aircrack, John the Ripper, and THC*

Authentication

Something you have,

e.g.

- Your phone
- Card
- Synchronous token
  - Time Based
  - Counter Synchronization

Signing in to your account will work a little differently

1 **You'll enter your password**
Whenever you sign in to Google, you'll enter your password as usual.

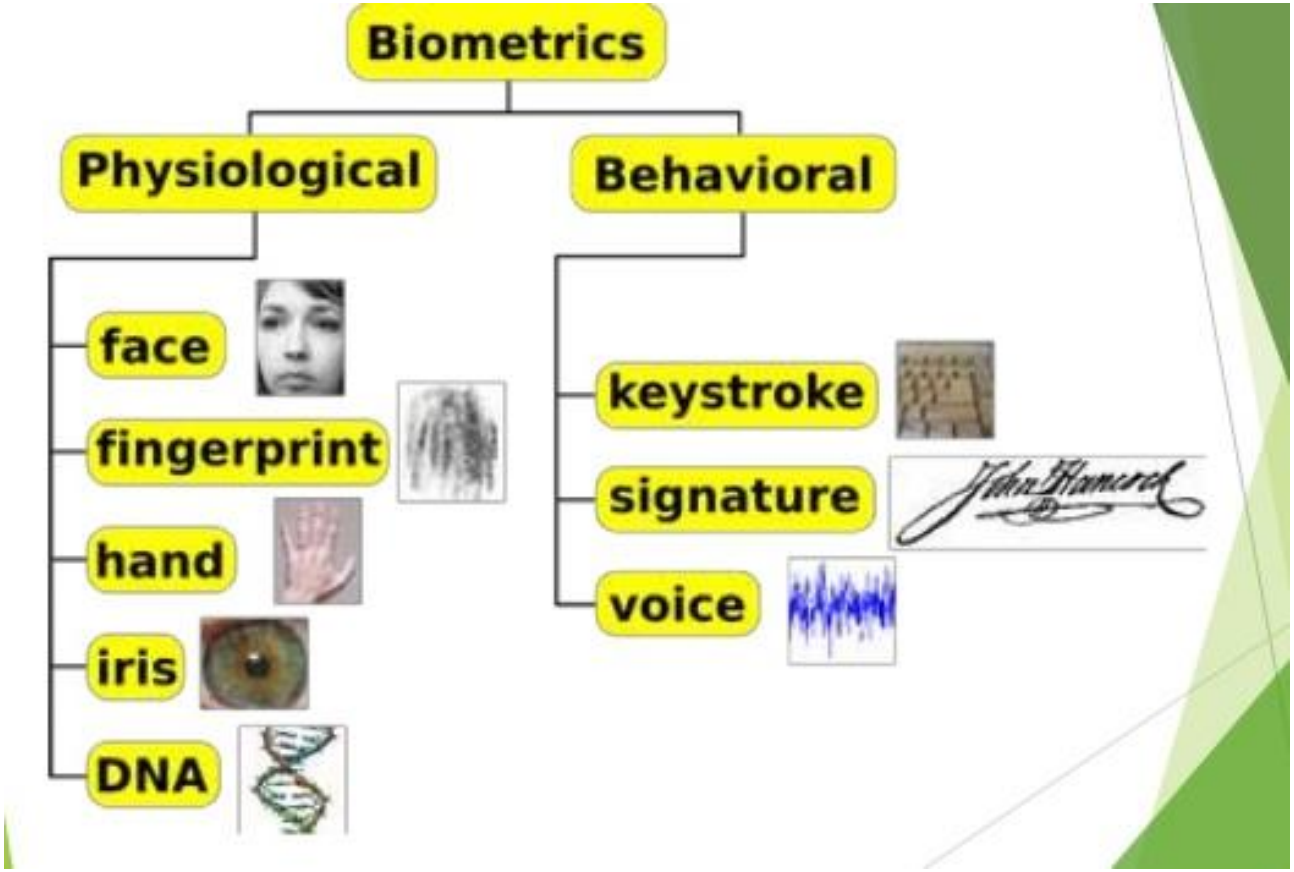
2 **You'll be asked for something else**
Then, a code will be sent to your phone via text, voice call, or our mobile app. Or, if you have a Security Key, you can insert it into your computer's USB port.

Authentication - Biometrics

- Verifies an identity by analyzing a unique person attribute or behavior
- Most expensive way to prove identity, also has difficulties with user acceptance
- Many different types of biometric systems

Authentication

Most common biometric systems:



Authentication – Biometrics

During identity verification (i.e. authentication) the biometric system scans personal's physiological attribute or behavioral trait and compares the captured data to a record created in an earlier enrollment process

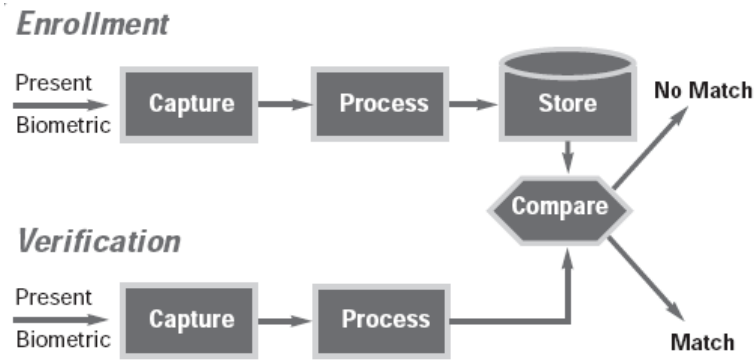
Biometric system

- Must be capable of repeatedly taking accurate measurements of anatomical or behavioral characteristics
- Error types:
  - **False negative** – incorrect rejection of the identity of authorized individual
    - Called a **Type I error**
      - False Rejection Rate (FRR) is a measurement of the likelihood that biometric device will result in Type I errors
  - **False positive** – incorrect match and identity acceptance of unauthorized individual ("imposter")
    - Called a **Type II error**
      - False Acceptance Rate (FAR) is a measurement of the likelihood that biometric device will result in Type II errors

Organizations have their own security requirements which will dictate how many Type I and Type II errors are acceptable:

- Organizations prioritizing confidentiality would accept a certain rate of Type I errors to achieve no Type II errors

  Calibration of biometric systems would enable lowering Type II error rate by adjusting system sensitivity which will increase Type I error rate



Authentication – Biometrics

Crossover error rate (CER) also called Equal error rate (EER)

- Objective measurement of biometric system accuracy, useful for comparing different biometric system products
- Is a rating, stated as a percentage
- CER is the point at which false rejection rate equals the false acceptance rate: FRR = FAR
- ***Most important metric in determining a biometric system's accuracy!***

Authentication

Multi-factor authentication refers to use of >1 factor:

Something the subject knows (“authentication by knowledge”)

+

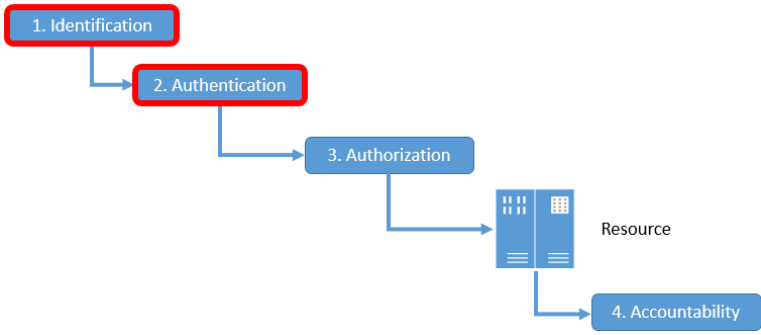
Something the subject has (“authentication by ownership”)

+

Something the subject is (“authentication by characteristic”)

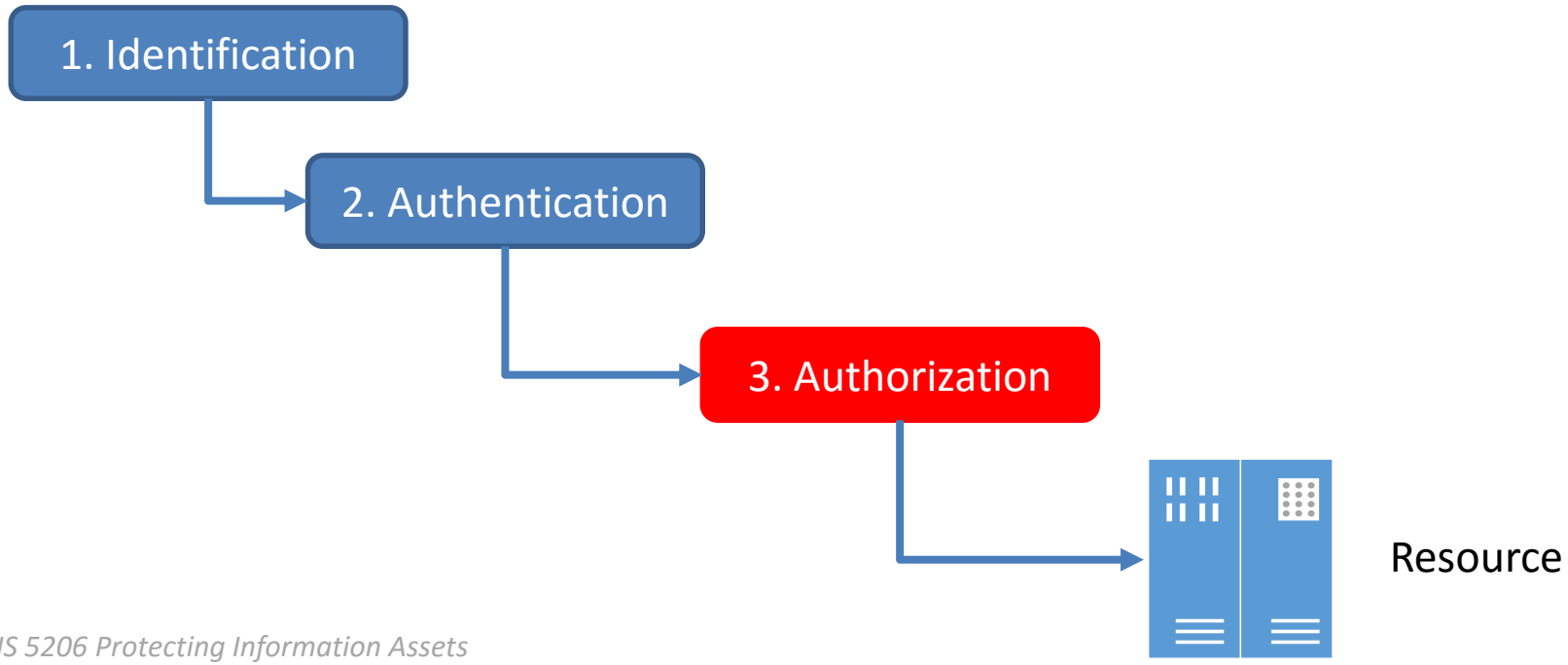
Authentication system strength determined by the number of factors incorporated into the systems

- Implementations that use 2 factors are considered stronger than those that only use 1 factor
- Systems that incorporate all 3 factors are stronger than systems that incorporate 2 factors



Authorization

Determines that the proven identity has some set of characteristics associated with it that gives it the right to access the requested resources



Authorization

Advantages of centralized administration and single sign on:

- User provisioning
- Password synchronization and reset
- Self service
- Centralized auditing and reporting
- Integrated workflow (increase in productivity)
- Regulatory compliance

Access Control Models

1. Discretionary (DAC)
2. Mandatory (MAC)
3. Role-Based (RBAC)
4. …other methods

Discretionary Access Control (DAC)

- Access control is at the discretion of the owner
- Used in Windows, Linux, Unix, OSX…

When using DAC method, the **owner decides** who has access to the resource - decisions are made directly for each user

Access Control Lists (ACL) and File system permissions are used to control access

The permissions identify the actions the subject can perform on the object

E.g. DAC method in NTFS permissions on Windows operating systems

- On NTFS file system each file and folder has an owner
- The owner can use ACL and decide which users or group of users have access to the file or folder
- Many operating systems use DAC method to limit access to resources

Linux/OSX/Unix file permissions

```
[root@localhost home]# ls -l
total 16
drwx------.  5 ali      sales          4096 May 10 22:30 ali
-rw-r--r--.  1 root     root              0 May 20 20:33 file.txt
-rw-r-xr-x.  1 root     root              0 May 26 15:32 fileuid.txt
drwxrwx---.  5 root     itdepartment   4096 May 26 15:51 itdepartment
drwx------.  3 mohtork  mohtork          74 May  9 10:20 mohtork
drwx------. 14 mtork    mtork          4096 May 26 15:24 mtork
drwx------.  5 ramy     ramy           4096 May 26 15:25 ramy
drwxrwxr-x.  3 root     sales            50 May 16 19:53 sales
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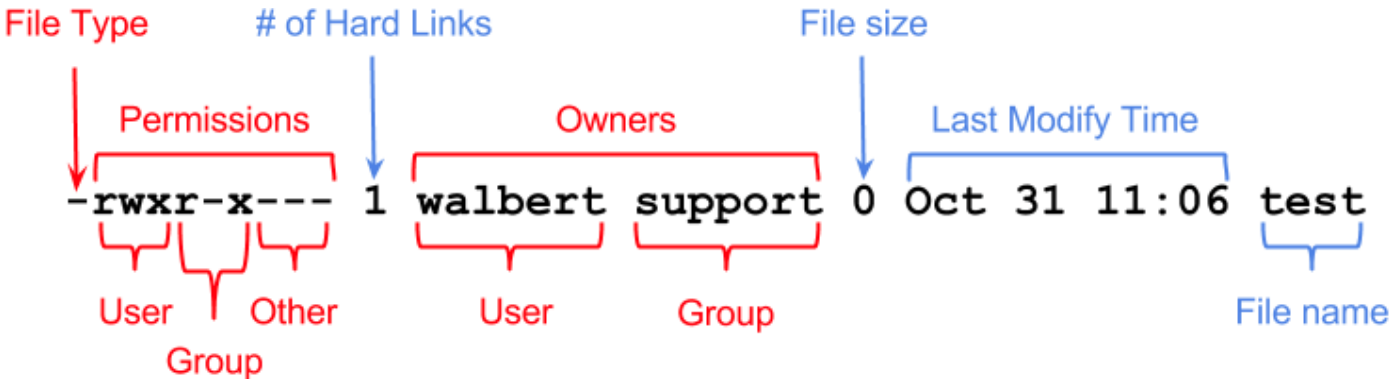
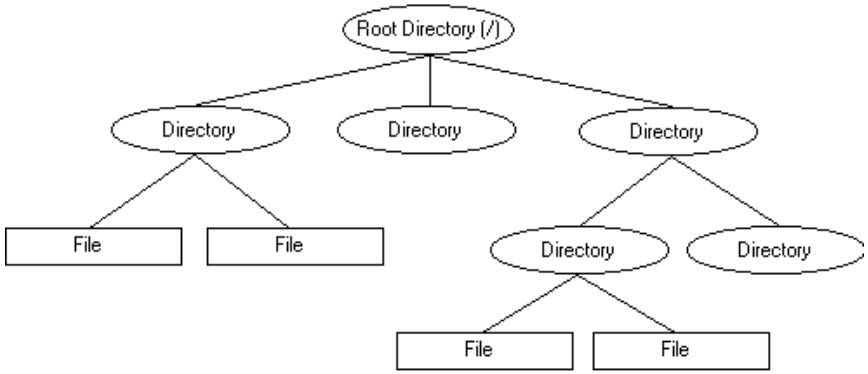




Discretionary Access Control (DAC)

Provides a huge tradeoff:

- Strengths
  - Flexibility to user
  - Less administrative overhead to IT
- Weaknesses
  - Achilles' heel (i.e. weakness) to the operating system
  - Malware can work under the identity (security context) of the user
    - If a user opens an virus infected file, code can install itself in the background without user awareness
    - Code inherits all rights and permissions of the user, can carry out all activities the user can on the system
      - » Send copies of itself to all contacts in user's email client, install a back-door, attack other systems, delete files on hard drive…
      - » If the user is a local administrator or has root accounts then once installed malware can do anything

Discretionary Access Control (DAC)

Security administrators can counter the downside of DAC and protect critical assets by removing user control by implementing “nondiscretionary access control” within a DAC Operating System by:

- Setting up workstations with pre-configured and loaded user profiles specifying the level of control the user does and does not have:
  - With permissions on files (including OS command files) and folders set to block discretionary access control to users from:
    - Changing the system’s time
    - Altering system configuration files
    - Accessing a command prompt
    - Installing unapproved applications
    - …

Access Control Models

1. Discretionary
2. **Mandatory**
3. Role-based

Mandatory Access Control (MAC)

- Used in very specialized systems by government-oriented agencies:
  - To protect and maintain highly classified data
  - For focused and specific purposes – and nothing more
- Users do not have discretion to determine who can access objects
- Systems are "locked down" for security purposes with
  - Reduced amount of user rights, permissions and functionality
    - *Users cannot install software, change file permissions, add new users*

DAC systems are discretionary and MAC systems are considered non-discretionary because users are unable to make access decisions based on their own choice (discretion) – Exam Tip

Mandatory Access Control (MAC)

- Access control is based on a security labeling system and two policy models
  - Users and resources have security labels that contain data classifications
- This model is used in environments where information classification and confidentiality is very important (e.g., the military)
- With MAC method the data owner can't decide which individuals have access to the data
  - Data owner can only decide what level of clearance to give data
  - This model is not based on identity
    - it is based on policies and matching of labels

Mandatory Access Control (MAC)

Based on a system of multi-level security policies and security labels

- Subjects (users, processes) and objects (data, devices) are classified and labeled with their classification:
  - ***For example: Top Secret, Secret, Confidential, Restricted, Official, Unclassified…***

- MAC systems decide whether or not to fulfill a request to access an object based on:
  - Its security policy (e.g. confidentiality or integrity), and
  - Clearance of the subject and classification of the object

Mandatory Access Control (MAC)

Security policy models

- **Bell-LaPadula** model enforces confidentiality in access control
  - Goal: Prevent secret information from unauthorized access
    - Provides and addresses confidentiality only
      - » Who can and cannot access the data, and what operations can be carried out on the data
      - » Does not address integrity of data the system maintains
  - First mathematical model for multilevel security policy – based on modes of access and provides rules of access
  - A systems based on Bell-LaPadula model is called a multilevel security system because its users have different clearances and it processes data at different classification levels

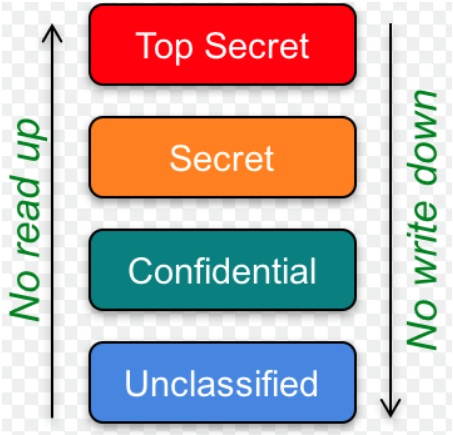
Mandatory Access Control (MAC)

Security policy models

- **Bell-LaPadula** model enforces confidentiality in access control
  - 3 main rules:
    1. **"No read up"** rule

       A subject at a particular security level cannot read data that resides at a higher security level
    2. **"No write down"** rule

       A subject in a given security level cannot write information to a lower security level
    3. **Strong star property rule**
       - » A subject who has read and write capabilities can only perform both functions at the same security level; nothing higher and nothing lower
       - » For a subject to be able to read and write to an object, the subject's clearance and the object classification must be equal



Mandatory Access Control (MAC)

Security policy models

- **Biba** model enforces integrity of data within a system
  - Goal: Prevents data at any integrity level from flowing to a higher integrity level
  - Uses integrity levels
  - Is not concerned with security levels nor confidentiality

Mandatory Access Control (MAC)-**Security policy models**

Biba model enforces integrity of data within a system

3 main rules:

1. **"No write up" rule**

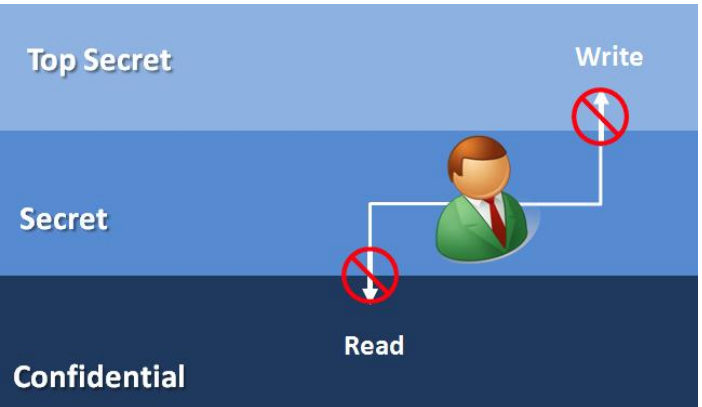
   A subject cannot write data to an object at higher integrity level

2. **"No read down" rule**

   A subject cannot read data from a lower integrity level

3. **Invocation property**

   A subject cannot communicate by calling on or initializing another subject (invoke a service) at a higher integrity. Subjects are only allowed to invoke services at a lower integrity level



Mandatory Access Control (MAC)-**Security policy models**

Bell-LaPadula versus Biba

- Both information flow models concerned with data flowing from one level to another
  - Bell-Lapdula uses security levels to provide data confidentiality
    - *“no read up” “no write down”*
  - Biba uses integrity levels to provide data integrity
    - *“no write up” “no read down”*

DAC versus MAC Systems

- Administrators cannot simply switch on MAC and switch off DAC in an operating system
- DAC systems
  - System access decisions by comparing subject's identity to the ACL on the object (i.e. resource)
  - Very flexible and dynamic
  - Malware usually targets
  - Viruses, worms, and rootkits can be installed and run as applications on DAC systems

- MAC systems
  - System access decisions by comparing subject's clearance to the object's security label
  - Are very constrained and have very limited functionality
  - OS does block users from installing software including malware
  - Special types of Unix systems are developed based on the MAC model
    - SE Linux is a publicly released MAC system developed by NSA and Secure Computing
    - Trusted Solaris is a product based on the MAC model

Access Control Models

1. Discretionary
2. Mandatory
3. **Role-based**

Role-Based Access Control (RBAC)

Traditional access control administration is based on just the DAC model

- Access control is specified explicitly to subjects at the object level with ACLs
- Becomes complex
  - As administrators translate organizational policy into ACL configuration permissions
  - As number of objects and users grow, and users change responsibilities, users tend to be granted or retain unnecessary access to some objects
    - Violating least-privilege rule, increasing organizational risk
  - Addressed by Role-Based Access Model…

Role-Based Access Control (RBAC)

- Uses a centrally administered set of controls to determine how subjects and objects interact
- Roles defined in terms of operations and tasks the role will carry out
- Access to resources is implicitly assigned (inherited) based on the role the user holds within the organization
- Best system for organizations with high employee turnover
  - Assignment of users to roles is changed by administrators
  - Administrators do not need to continually change the ACLs on individual objects

Authorization concepts

- Authorization Creep
- Default to Zero
- Principle of “Need to Know”
- Access Control List (ACL)

Test Taking Tip

Look at the facts and ask yourself, so what?

- The issue that jumps out is likely to be the issue that the correct response addresses.
- Non-relevant answers can be eliminated more readily.
- Especially useful in questions that ask for the “Best” answer.

Quiz