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Feb. 15, 2024

CSCI 400 Textbook Notes

Chapter 4: Access Control

4.1: Access Control Principles

- There are two prevalent definitions of access control in the realm of computer science
    - NISTIR 7298 defines access control as the process of granting or denying specific requests to
        1. obtain and use information and related information processing services
        2. enter specific physical facilities
    - RFC 4949 defines access control as a process by which use of system resources is regulated according to a security policy and is permitted only by authorized entities according to that policy
- **Basic Security Requirements**
    - Limit information system access to authorized users, processes acting on behalf of authorized users, or devices
    - Limit information system access to the types of transactions and functions that authorized users are permitted to execute
- **Derived Security Requirements**
    - Control the flow of controlled unclassified information (CUI) in accordance with approved authorizations
    - Separate the duties of individuals to reduce the risk of malevolent activity without collusion
    - Employ the principle of least privilege, including for specific security functions and privileged accounts
    - Use non-privileged account roles when accessing non-security functions

    - Prevent non-privileged users from executing privileged functions and audit the execution of such functions
    - Limit unsuccessful logon attempts
    - Provide privacy and security notices consistent with applicable CU rules
- **Access Control Policies**
    - Discretionary Access Control, which. controls access based don the identity of the requestor and on access rules
    - Role-Based Access Control, which controls access based various roles assigned to individuals within an organization
    - Mandatory Access Control compares security labels with security clearances
    - Attribute-Based Access Control, which controls access based on the attributes of the requesting user

4.2: Subjects, Objects, and Access Rights

- A **subject** is an entity that is capable of accessing objects
- There are three classes of subject
    - Owner
    - Group
    - World/Everyone
- An **object** is a resource to which access is controlled, and it is used to contain and/or receive information
- An **access right** describes the way in which a subject may access an object
- Access rights could include the following
    - Read
    - Write
    - Execute
    - Delete

- Create
- Search

4.3: Discretionary Access Control (DAC)

- DAC is a scheme in which an entity may be granted access rights that permit the entity, by its own violation, to enable another entity to access some matrix
- DAC is often provided using an access matrix, where
  - One dimension consists of identified subjects that may attempt data access to the resources
  - The other dimension lists the objects that may be accessed
- Each entry in the matrix indicates the access rights of a particular subject for a particular object
- The following is depiction of an access matrix

		OBJECTS			
		File 1	File 2	File 3	File 4
SUBJECTS	User A	Own Read Write		Own Read Write	
	User B	Read	Own Read Write	Write	Read
	User C	Read Write	Read		Own Read Write

- Most often, access matrices are implement through decomposition in one of two ways
  - Breaking the matrix down column by column yields **Access Control Lists (ACLs)** for each object stating every user's access right
  - Breaking the matrix down row by row yields **Capability Tickets** for each user stating their access rights for every object
- To represent the protection state of a matrix, we should extend the universe of objects within the access control matrix to include all of the following
  - **Processes**

- Devices
- Memory Locations
- Subjects

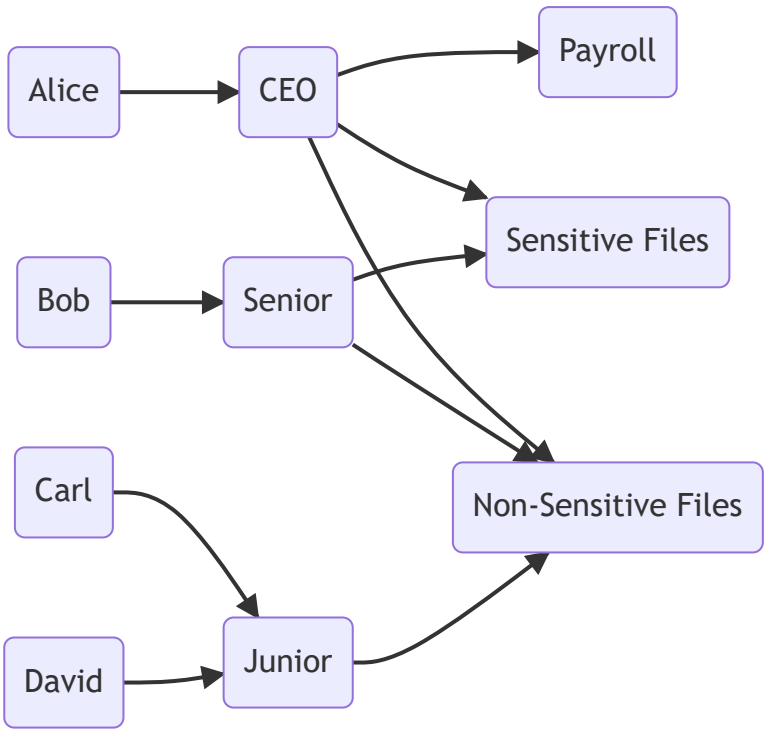
- This will leave us with an extended access control matrix in the following form

		OBJECTS								
		subjects			files		processes		disk drives	
		S_1	S_2	S_3	F_1	F_2	P_1	P_2	D_1	D_2
SUBJECTS	S_1	control	owner	owner control	read *	read owner	wakeup	wakeup	seek	owner
	S_2		control		write *	execute			owner	seek *
	S_3			control		write	stop			

* - copy flag set

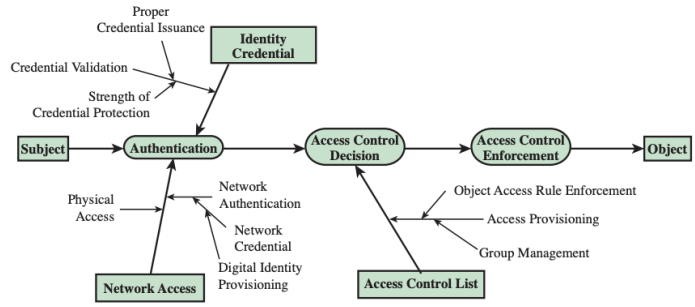
4.5: Role-Based Access Control (RBAC)

- This is when a company or organization uses predefined roles for each individual user rather than implementing different access rights for every individual user
- This can be understood very simply from the following diagram

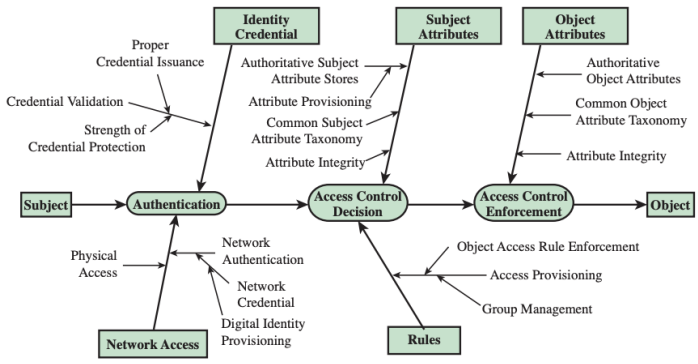


4.6: Attribute-Based Access Control (ABAC)

- There are three key attributes to an ABAC model
    - **Attributes**
        - The following are the three types of attributes in the ABAC model
            - **Subject Attributes**, which define the identity and characteristics of a subject
            - **Object Attributes** which have attributes that are commonly used in making access control decisions
            - **Environment Attributes**, which are largely ignored in ABAC models
    - **Access Policy Models**
    - **Architecture Models**
- Below we can see how ACLs and ABACs differ in their relationship between credentials and trust



(a) ACL Trust Chain



(b) ABAC Trust Chain

4.7: Identity, Credential, and Access Management (ICAM)

- ICAM refers to a comprehensive approach to managing and implementing digital identities, credentials, and access control

- This was developed by the US Government
- ICAM is designed to
    - Create trust digital identity representations
    - Bind those identities to credentials that may serve as a proxy for the individual in access transactions
    - Use the credentials to provide authorized access to resources
- **Identity Management**
    - This is concerned with assigning attributes to a digital identity and connecting that entity to a person or non person entity
    - The goal is to establish a trustworthy digital identity that is independent of a specific application or context
    - The most common approach is to use specified digital identities for each application or context rather than an independent one
- **Credential Management**
    - This includes the management of the life cycle of the credential
    - A credential could be a smart card, cryptographic key, digital certificate, etc.
    - Credential management encompasses five logistical goals
        - An authorized individual sponsors another for a credential
        - The sponsored individual then enrolls for the credential
        - The credential is produced
        - The credential is issued to the individual or NPE
        - A credential must be maintained over its life cycle
- **Access Management**
    - Deals with the management of how access rights are granted
    - Covers both the physical and logical access
    - May be internal to a system or an external element

- Three support elements are needed for an enterprise-wide access control facility
    - Resource management, which is concerned with defining the rules for a resource which requires access control
    - Privilege management, which is concerned with establishing and maintaining the attributes that comprise an individual's access profile
    - Policy management, which governs what is allowable and unallowable in an access transaction

4.8: Trust Frameworks

- **Identity Federation** is a term used. to describe the technology, standards, policies, and processes that allow an organization to trust digital identities, attributes, and credentials created and issued by another organization
- This addresses the following two questions
    - How can one trust identities of individuals from external organizations who need access to your systems
    - How do you vouch for identities of individuals in your organization when they need to collaborate with external organizations