

ECS 235B Module 56

Design Principles

Overview

- Simplicity, restriction
- Principles
 - Least Privilege
 - Fail-Safe Defaults
 - Economy of Mechanism
 - Complete Mediation
 - Open Design
 - Separation of Privilege
 - Least Common Mechanism
 - Least Astonishment

Overview

- **Simplicity**
 - Less to go wrong
 - Fewer possible inconsistencies
 - Easy to understand
- **Restriction**
 - Minimize access
 - Inhibit communication

Least Privilege

- A subject should be given only those privileges necessary to complete its task
 - Function, not identity, controls
 - Rights added as needed, discarded after use
 - Minimal protection domain

Related: Least Authority

- Principle of Least Authority (POLA)
 - Often considered the same as Principle of Least Privilege
 - Some make distinction:
 - *Permissions* control what subject can do to an object directly
 - *Authority* controls what influence a subject has over an object (directly or indirectly, through other subjects)

Fail-Safe Defaults

- Default action is to deny access
- If action fails, system as secure as when action began

Economy of Mechanism

- Keep it as simple as possible
 - KISS Principle
- Simpler means less can go wrong
 - And when errors occur, they are easier to understand and fix
- Interfaces and interactions

Complete Mediation

- Check every access
- Usually done once, on first action
 - UNIX: access checked on open, not checked thereafter
- If permissions change after, may get unauthorized access

Open Design

- Security should not depend on secrecy of design or implementation
 - Popularly misunderstood to mean that source code should be public
 - “Security through obscurity”
 - Does not apply to information such as passwords or cryptographic keys

Separation of Privilege

- Require multiple conditions to grant privilege
 - Separation of duty
 - Defense in depth

Least Common Mechanism

- Mechanisms should not be shared
 - Information can flow along shared channels
 - Covert channels
- Isolation
 - Virtual machines
 - Sandboxes

Least Astonishment

- Security mechanisms should be designed so users understand why the mechanism works the way it does, and using mechanism is simple
 - Hide complexity introduced by security mechanisms
 - Ease of installation, configuration, use
 - Human factors critical here

Related: Psychological Acceptability

- Security mechanisms should not add to difficulty of accessing resource
 - Idealistic, as mechanisms add *some* difficulty
 - Even if only remembering a password
 - Principle of Least Astonishment accepts this
 - Asks whether the difficulty is unexpected or too much for relevant population of users

Key Points

- Principles of secure design underlie all security-related mechanisms
- Require:
 - Good understanding of goal of mechanism and environment in which it is to be used
 - Careful analysis and design
 - Careful implementation