ECS 235B Module 55
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