Distributed Information Processing

17th Lecture

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Outline

- Information Protection
  - Security
- Q&A

Security [Silberschatz06]

- Introduction
  - Security
    - System protection
      - Controlled access to programs & data in a computer system
    - Protection environment
      - External environment for protection
  - Violation (or Misuse)
    - Intentional vs accidental
    - Threat (potential) vs attack (attempt)

Security (Cont'd)

- Violation Types
  - Breach of Confidentiality
    - Unauthorized reading of data
  - Breach of Integrity
    - Unauthorized modification of data
  - Breach of Availability
    - Unauthorized destruction of data
  - Theft of Service
    - Unauthorized use of resources
  - Denial of Service (DOS)
    - Preventing legitimate use of the system

Prevention vs Detection & Fix

Security (Cont'd)

- Attack Methods
  - Masquerading
    - Pretending to be another host or person in a communication for the breach of authentication
  - Replay
    - Malicious & fraudulent repeat of a valid data transmission frequently w/ message modification
  - Man-in-the-Middle
    - Masquerading as the sender to the receiver & vice versa, possibly preceded by a session hijacking (interception)

Security (Cont'd)

- System Protection Levels
  - Physical
    - Secured physical access to machines
  - Human
    - Authorized users
  - Operating System
    - Protection from security breaches
      - Runaway process constituting a DOS attack
      - Query to a service revealing passwords
      - Stack overflow possibly launching an unauthorized process
  - Network
    - Protection from intercepting transmitted data
    - Protection from interruption of communications

Security (Cont'd)

- Program Threats
  - Definition of a Trojan Horse
    - Code segment that misuses its environment
  - Types of a Trojan Horse
    - Being slipped into the user's path & executed
    - Emulating a login program
    - Spyware
      - Downloading ads to display on the user's system
      - Creating pop-up browser windows when certain sites are visited
      - Capturing information & returning it to a central site (covert channels)

Violation of the Principle of Least Privilege: Human Error (w/ More Privileges) & Poor Design of OS (Allowing More Privileges)

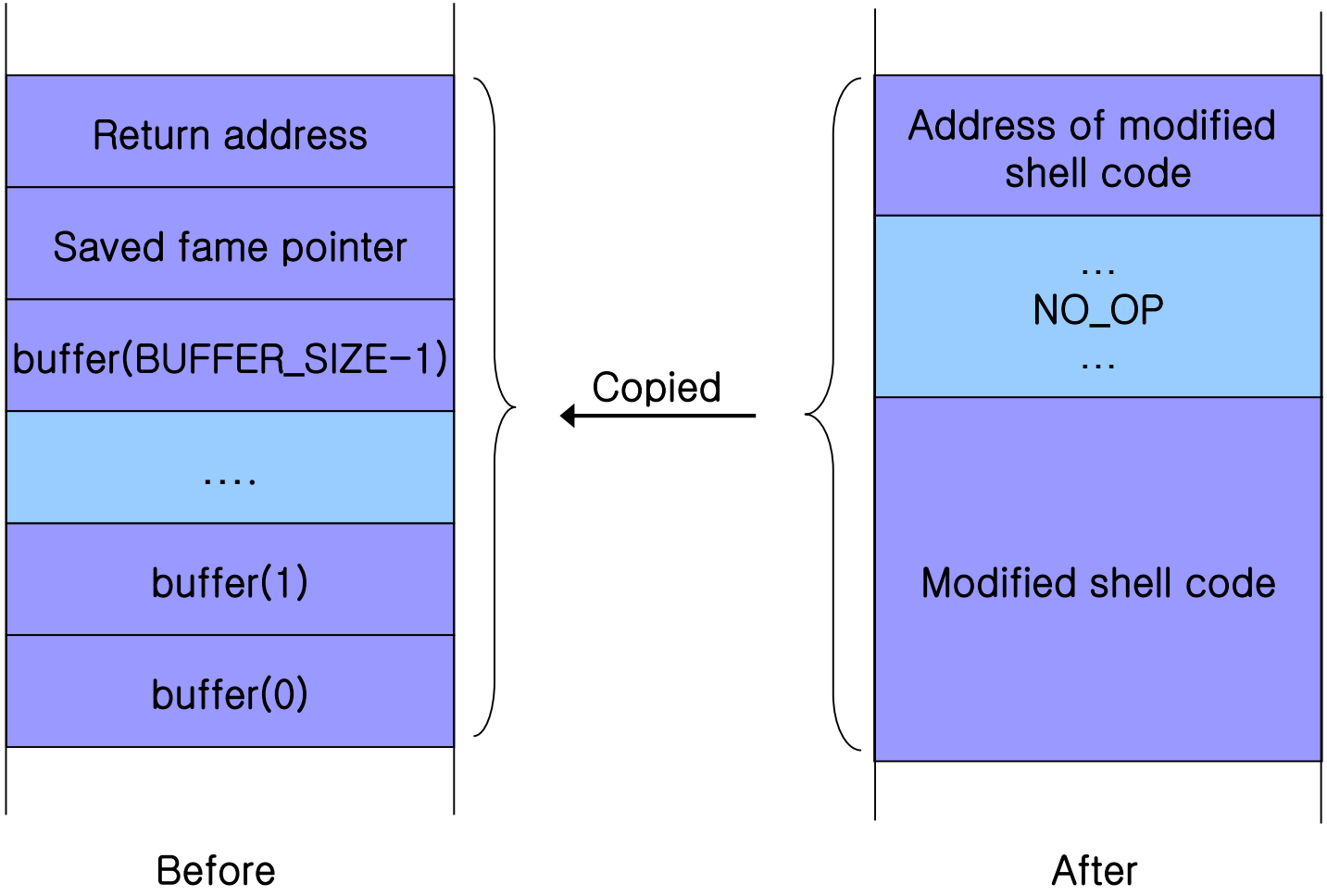
Security (Cont'd)

- Program Threats
  - Definition of Trap Door
    - Hole in software that only the designer can use
  - Example of Trap Door
    - Circumvention of normal security procedures for a specific user ID & password
  - Generator of Trap Door
    - Designer vs Compiler
  - Definition of Logic Bomb
    - Creation of a security hole only under certain circumstances

Security (Cont'd)

- Program Threats
  - Goals of Stack & Buffer Overflow
    - To gain unauthorized access to the target system
    - To escalate privileges
  - Essence of Stack & Buffer Overflow
    - Exploiting a (no bounds checking) program bug
      - Writing into a daemon's stack via overflowing an input field, command-line argument, or input buffer
      - Overwriting the current return address with the address of the exploit code
      - Writing a simple set of code for the next space in the stack: e.g., code for spawning a shell

Illustration: Stack & Buffer Overflow



Security (Cont'd)

- Program Threats
  - Definition of Viruses
    - Fragment of code embedded in a legitimate program
      - Self-replicating
  - Characteristic of Viruses
    - Particular problem for Windows PC users
      - Protection of executables from writing by UNIX & other multiuser OS's
  - Common Forms of Virus Transmission
    - Email
    - Download of viral programs
    - Macros (or Visual Basic Programs) in MS documents

Works via a Virus Dropper, Usually a Trojan Horse

Security (Cont'd)

- Program Threats
  - Categories of Viruses
    - File
    - Boot
    - Macro
    - Source code
    - Polymorphic
      - Changing the virus's signature each installation time
    - Encrypted
    - Stealth
    - Tunneling
      - Bypassing detection
    - Multipartite
    - Armored

Security (Cont'd)

- System & Network Threats
  - Characteristics of System & Network Threats
    - Abuse of services & network connections
  - Definition of Worms
    - Processes that use the spawn mechanism ravaging system performance
  - Definition of Port Scanning
    - Means to detect a system's vulnerabilities
  - Denial of Service
    - Means to disrupt legitimate use of a system
  - Categories of Denial of Service
    - Using many facility resources
    - Disrupting the network of the facility

In Contrast to Program Threats Typically Using a Breakdown in System Protection Mechanisms

Reference

- [Silberschatz06] A. Silberschatz, P.B. Galvin, and G. Gagne, *Operating System Principles, 7th Edition*, John Wiley and Sons (Asia), 2006