Security

CS 256/456

Dept. of Computer Science, University of Rochester

The Security Environment

Security goals:
- Data confidentiality
- Data integrity
- System availability

Threats of intruders or adversaries:
- Exposing data
- Tampering with data
- Denial of service attacks

We focus on OS-related security issues.

User Authentication

```
LOGIN: ken
PASSWORD: FooBar
SUCCESSFUL LOGIN
```

(a)

```
LOGIN: carol
INVALID LOGIN NAME
LOGIN:
```

(b)

```
LOGIN: carol
PASSWORD: Idunno
INVALID LOGIN
LOGIN:
```

(c)

(a) A successful login
(b) Login rejected after name entered
(c) Login rejected after name and password typed

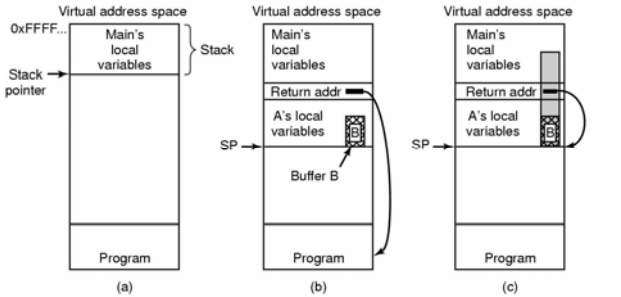
User Authentication

- UNIX user passwords are mapped using a one-way function "e()"; and then stored in a globally readable file "/etc/passwd"
  - Bobbie, e(Dog)
  - Tony, e(6%%TaeFF)
  - … …
- Attacks:
  - used a precomputed common password list
  - exhaustive attack
- Countermeasure?
  - salt
  - Bobbie, 4238, e(Dog4238)
  - Tony, 2918, e(6%%TaeFF2918)

Login Spoofing

- Login spoofing
  - A program running by the attacker displays a login screen (like the real one)
  - After a legitimate user types in username and password, it records those, kills itself, and a real login screen is shown
  - The user thinks she typed in a wrong password and tries again, which works
- Countermeasure?
  - Start each login session with a non-user-catchable key combination "Ctl-Alt-Delete"

Buffer Overflow



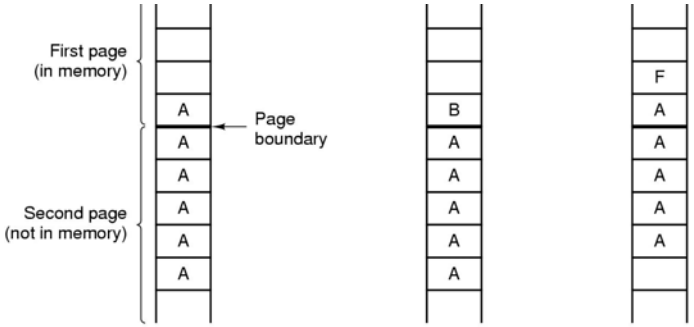
(a) Situation when main program is running
(b) After program *A* called
(c) Buffer overflow shown in gray

Countermeasures:

- boundary checks, non-executable stack/data segment, …

The TENEX Password Problem

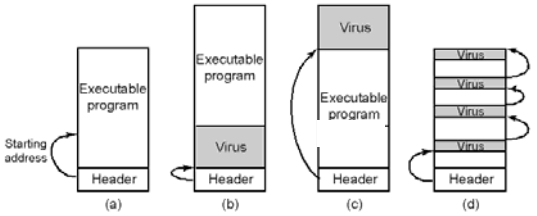
Files are accessed with passwords. At each access, the password is checked byte-by-byte and an error is returned as soon as a byte is mismatched.



Virus

- Virus
  - program can reproduce itself
    - e.g., when invoked, traverse the file system and attach it to randomly selected executables
  - additionally, do harm
    - denial of service by using all available system resources
    - permanently damage data or hardware
- "Good" virus:
  - quickly spreading virus
  - difficult to detect
  - hard to get rid of

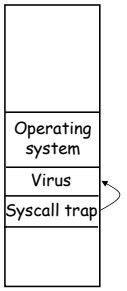
Infecting An Executable (Trojan Horses)



(a) An executable program
(b) With a virus at the front
(c) With the virus at the end
(d) With a virus spread over free space within program

Memory Resident Viruses

- Virus resides in memory; intercepting system calls
- Where to put the virus?
- How to load virus there in the first place?



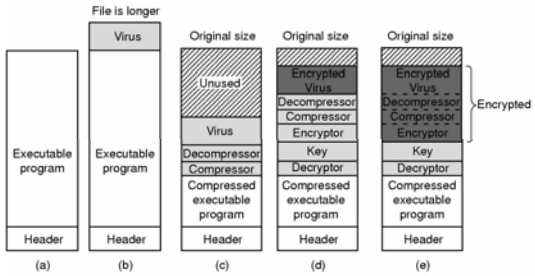
How Viruses Spread

- Try to infect programs on
  - networks: exploiting buffer overflow errors in network server daemons
  - floppy drives
- Attach to innocent looking email
  - when it runs, use mailing list to replicate

Antivirus Techniques

- Signature scanning
  - maintain a database of patterns of common viruses
  - scan disk files for these patterns
- Size checkers
  - keep a record on the size of disk files and scan them periodically for any size changes
  - apply on readonly executables.

Anti-Antivirus Techniques

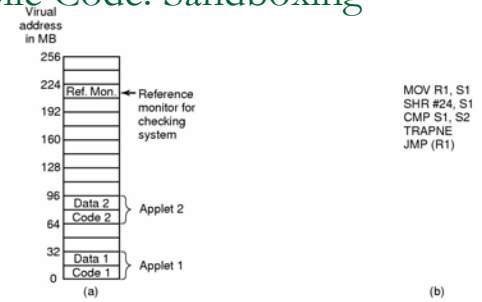


(a) A program
(b) Infected program
(c) Compressed infected program
(d) Encrypted virus
(e) Compressed virus with encrypted compression code

More Antivirus Techniques

- Integrity checkers
  - similar to size checkers, but this time we compute a checksum for file and store them somewhere; we periodically check all files to see whether the checksum still matches
- Behavioral checkers (memory-resident anti-virus program)
  - intercept system calls and detect suspicious activities: overwriting the boot sector, overwriting executables, …

Mobile Code: Sandboxing



Memory divided into 16-MB sandboxes
- applet can't jump out of its code sandbox
- applet can't access data out of its data sandbox

Limited system call capabilities
- all system calls must go through a reference monitor

Enforcement: binary rewriting or interpretation

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