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UNIVERSITY INSTITUTEOF ENGINEERING

Bachelor of Engineering (Computer Science & Engineering)

Operating System (20CST/ITT-313)

Subject Coordinator: Er. Puneet Kaur(E6913)

Introduction to Operating System

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System Protection and Security

The Security Problem

- System **secure** if resources used and accessed as intended under all circumstances
  - Unachievable
- Intruders (crackers) attempt to breach security
- **Threat** is potential security violation
- **Attack** is attempt to breach security
- Attack can be accidental or malicious
- Easier to protect against accidental than malicious misuse

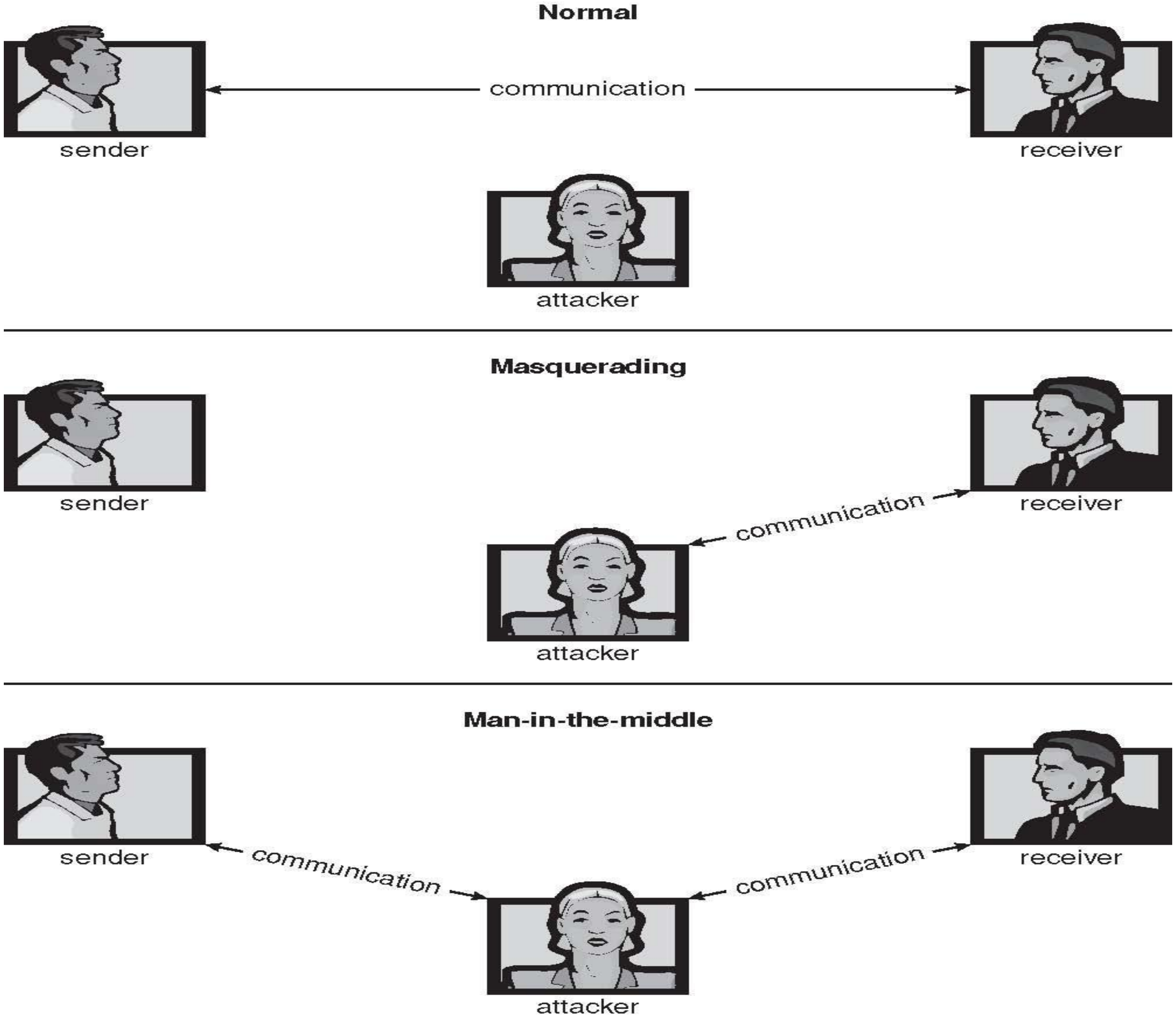
Security Violation Categories

- **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)**
  - Prevention of legitimate use

Security Violation Methods

- **Masquerading** (breach **authentication**)
  - Pretending to be an authorized user to escalate privileges
- **Replay attack**
  - As is or with message modification
- **Man-in-the-middle attack**
  - Intruder sits in data flow, masquerading as sender to receiver and vice versa
- **Session hijacking**
  - Intercept an already-established session to bypass authentication

Standard Security Attacks



Security Measure Levels

- Impossible to have absolute security, but make cost to perpetrator sufficiently high to deter most intruders
- Security must occur at four levels to be effective:
  - **Physical**
    - Data centers, servers, connected terminals
  - **Human**
    - Avoid **social engineering**, **phishing**, **dumpster diving**
  - **Operating System**
    - Protection mechanisms, debugging
  - **Network**
    - Intercepted communications, interruption, DOS
- Security is as weak as the weakest link in the chain
- But can too much security be a problem?

Program Threats

- Many variations, many names
- **Trojan Horse**
  - Code segment that misuses its environment
  - Exploits mechanisms for allowing programs written by users to be executed by other users
  - Spyware, pop-up browser windows, covert channels
  - Up to 80% of spam delivered by spyware-infected systems
- **Trap Door**
  - Specific user identifier or password that circumvents normal security procedures
  - Could be included in a compiler
  - How to detect them?

Program Threats (Cont.)

- **Logic Bomb**
  - Program that initiates a security incident under certain circumstances
- **Stack** and **Buffer Overflow**
  - Exploits a bug in a program (overflow either the stack or memory buffers)
  - Failure to check bounds on inputs, arguments
  - Write past arguments on the stack into the return address on stack
  - When routine returns from call, returns to hacked address
    - Pointed to code loaded onto stack that executes malicious code
  - Unauthorized user or privilege escalation

Program Threats (Cont.)

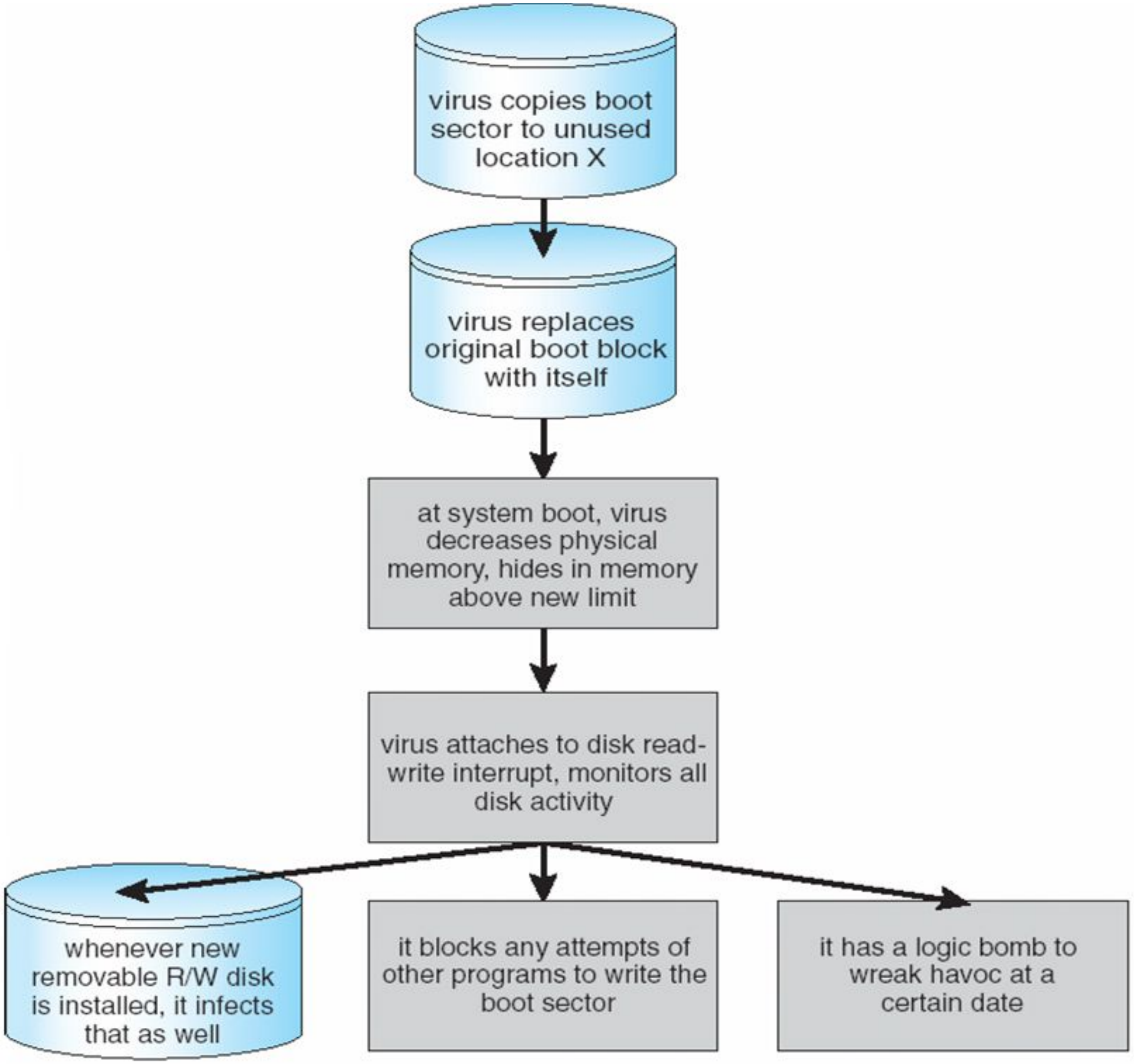
- **Viruses**
  - Code fragment embedded in legitimate program
  - Self-replicating, designed to infect other computers
  - Very specific to CPU architecture, operating system, applications
  - Usually borne via email or as a macro
    - Visual Basic Macro to reformat hard drive

```
Sub AutoOpen()
Dim oFS
  Set oFS =
  CreateObject(’’Scripting.FileSystemObject’’)
  vs = Shell(’’c:command.com /k format
  c:’’,vbHide)
End Sub
```

Program Threats (Cont.)

- **Virus dropper** inserts virus onto the system
- Many categories of viruses, literally many thousands of viruses
  - File / parasitic
  - Boot / memory
  - Macro
  - Source code
  - Polymorphic to avoid having a **virus signature**
  - Encrypted
  - Stealth
  - Tunneling
  - Multipartite
  - Armored

A Boot-sector Computer Virus


virus copies boot sector to unused location X
virus replaces original boot block with itself
at system boot, virus decreases physical memory, hides in memory above new limit
virus attaches to disk read-write interrupt, monitors all disk activity
whenever new removable R/W disk is installed, it infects that as well
it blocks any attempts of other programs to write the boot sector
it has a logic bomb to wreak havoc at a certain date

The Threats Cont…

Attacks are still common, still occurring

Attacks moved over time from science experiments to tools of organized crime

- Targeting specific companies
- Creating botnets to use as tool for spam and DDOS delivery
- **Keystroke logger** to grab passwords, credit card numbers

Why is Windows the target for most attacks?

- Most common
- Everyone is an administrator
  - Licensing required?
- Monoculture considered harmful

System and Network Threats

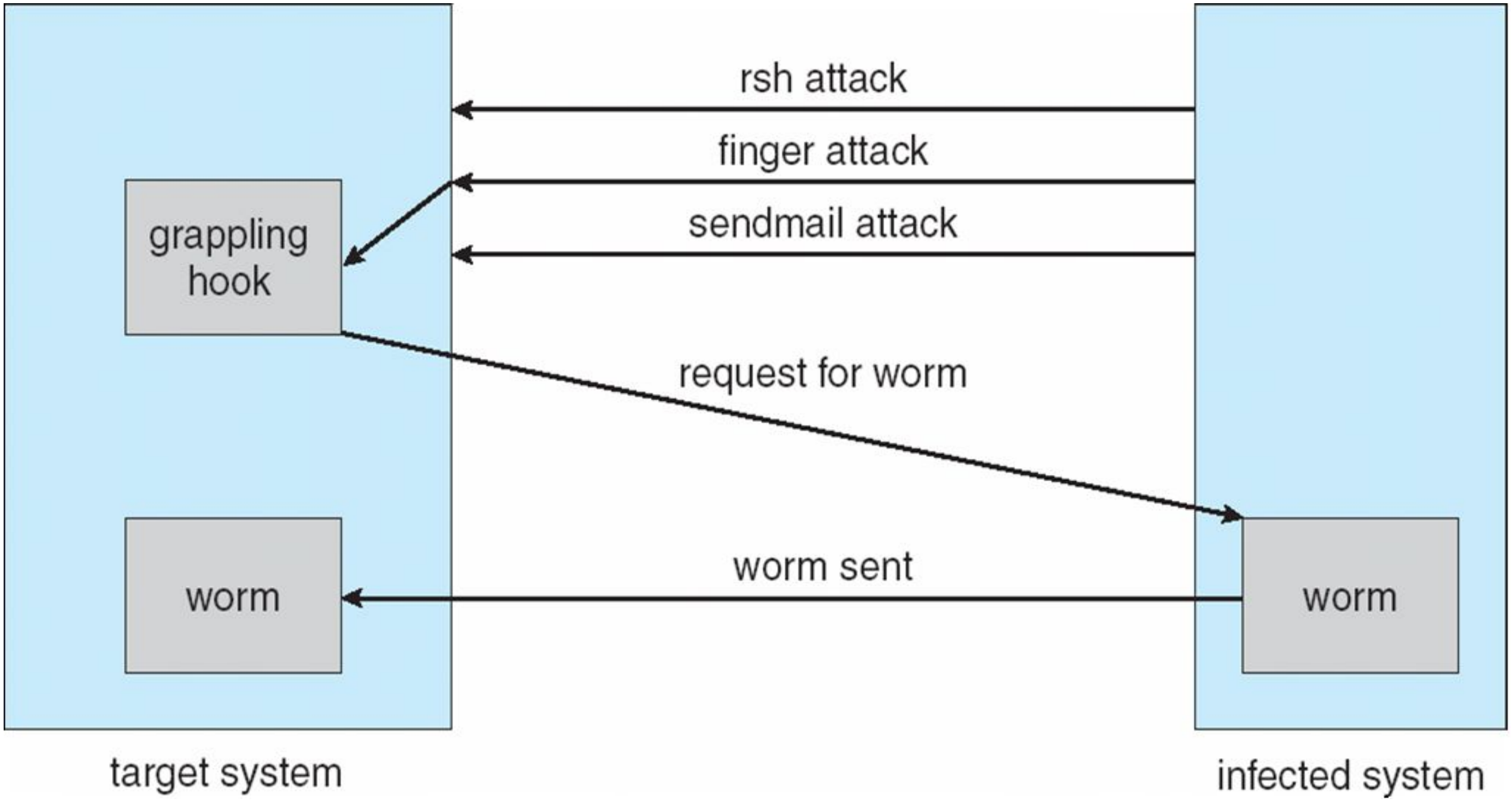
- Some systems “open” rather than secure by default
  - Reduce attack surface
  - But harder to use, more knowledge needed to administer

- Network threats harder to detect, prevent
  - Protection systems weaker
  - More difficult to have a shared secret on which to base access
  - No physical limits once system attached to internet
    - Or on network with system attached to internet
  - Even determining location of connecting system difficult
    - IP address is only knowledge

System and Network Threats (Cont.)

- **Worms** – use **spawn** mechanism; standalone program
- Internet worm
  - Exploited UNIX networking features (remote access) and bugs in *finger* and *sendmail* programs
  - Exploited trust-relationship mechanism used by *rsh* to access friendly systems without use of password
  - **Grappling hook** program uploaded main worm program
    - 99 lines of C code
  - Hooked system then uploaded main code, tried to attack connected systems
  - Also tried to break into other users accounts on local system via password guessing
  - If target system already infected, abort, except for every 7th time

The Morris Internet Worm



System and Network Threats (Cont.)

Port scanning

- Automated attempt to connect to a range of ports on one or a range of IP addresses
- Detection of answering service protocol
- Detection of OS and version running on system
- `nmap` scans all ports in a given IP range for a response
- `nessus` has a database of protocols and bugs (and exploits) to apply against a system

Frequently launched from **zombie systems**

- To decrease trace-ability

System and Network Threats (Cont.)

Denial of Service

- Overload the targeted computer preventing it from doing any useful work
- **Distributed denial-of-service** (**DDOS**) come from multiple sites at once
- Consider the start of the IP-connection handshake (SYN)
  - How many started-connections can the OS handle?
- Consider traffic to a web site
  - How can you tell the difference between being a target and being really popular?
- Accidental – CS students writing bad `fork()` code
- Purposeful – extortion, punishment

Video Links

https://www.coursera.org/lecture/cyber-threats-attack-vectors/operating-systems-BZcHK

https://www.youtube.com/watch?v=f5v9fdcRe_E

References

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