Chapter 19: Security

- The Security Problem
- Authentication
- Program Threats
- System Threats
- Securing Systems
- Intrusion Detection
- Encryption
- Windows NT

The Security Problem

- Security must consider external environment of the system, and protect it from:
  - unauthorized access.
  - malicious modification or destruction
  - accidental introduction of inconsistency.
- Easier to protect against accidental than malicious misuse.

Authentication

- User identity most often established through *passwords*, can be considered a special case of either keys or capabilities.
- Passwords must be kept secret.
  - Frequent change of passwords.
  - Use of “non-guessable” passwords.
  - Log all invalid access attempts.
- Passwords may also either be encrypted or allowed to be used only once.

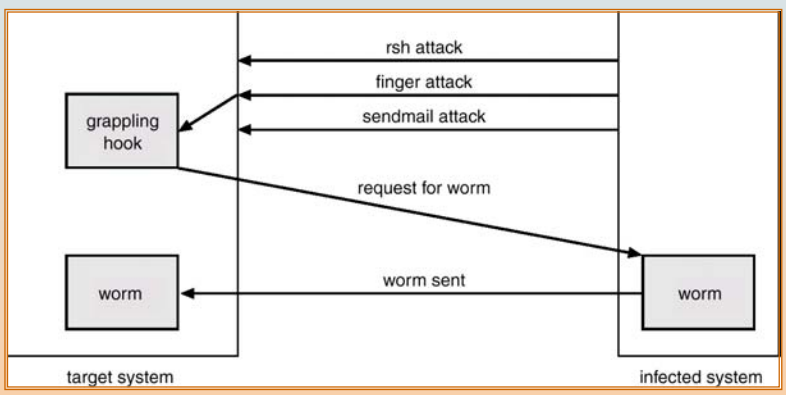
Program Threats

- Trojan Horse
  - Code segment that misuses its environment.
  - Exploits mechanisms for allowing programs written by users to be executed by other users.
- Trap Door
  - Specific user identifier or password that circumvents normal security procedures.
  - Could be included in a compiler.
- Stack and Buffer Overflow
  - Exploits a bug in a program (overflow either the stack or memory buffers.)

System Threats

- Worms – use spawn mechanism; standalone program
- Internet worm
  - Exploited UNIX networking features (remote access) and bugs in *finger* and *sendmail* programs.
  - Grappling hook program uploaded main worm program.
- Viruses – fragment of code embedded in a legitimate program.
  - Mainly effect microcomputer systems.
  - Downloading viral programs from public bulletin boards or exchanging floppy disks containing an infection.
  - *Safe computing*.
- Denial of Service
  - Overload the targeted computer preventing it from doing any sueful work.

The Morris Internet Worm



Threat Monitoring

- Check for suspicious patterns of activity – i.e., several incorrect password attempts may signal password guessing.
- Audit log – records the time, user, and type of all accesses to an object; useful for recovery from a violation and developing better security measures.
- Scan the system periodically for security holes; done when the computer is relatively unused.

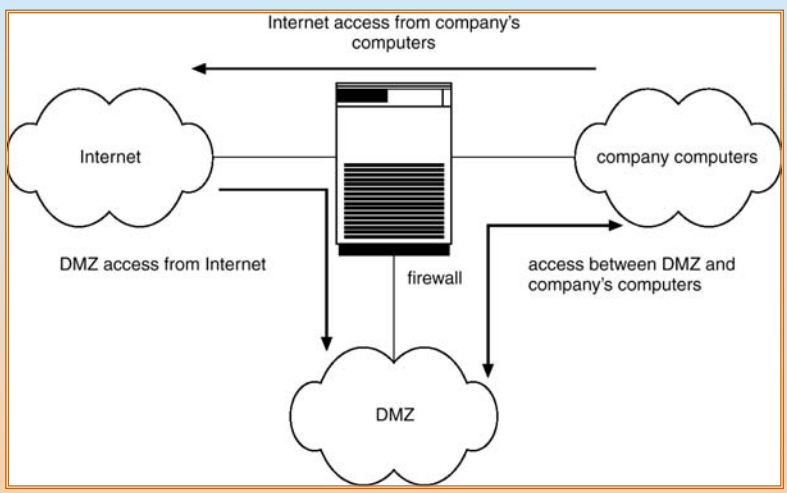
Threat Monitoring (Cont.)

- Check for:
  - Short or easy-to-guess passwords
  - Unauthorized set-uid programs
  - Unauthorized programs in system directories
  - Unexpected long-running processes
  - Improper directory protections
  - Improper protections on system data files
  - Dangerous entries in the program search path (Trojan horse)
  - Changes to system programs: monitor checksum values

FireWall

- A firewall is placed between trusted and untrusted hosts.
- The firewall limits network access between these two security domains.

Network Security Through Domain Separation Via Firewall



Intrusion Detection

- Detect attempts to intrude into computer systems.
- Detection methods:
  - Auditing and logging.
  - Tripwire (UNIX software that checks if certain files and directories have been altered – I.e. password files)
- System call monitoring

Data Structure Derived From System-Call Sequence

system call	distance = 1	distance = 2	distance = 3
open	read getrlimit	mmap	mmap close
read	mmap	mmap	open
mmap	mmap open close	open getrlimit	getrlimit mmap
getrlimit	mmap	close	
close			

Encryption

- Encrypt clear text into cipher text.
- Properties of good encryption technique:
  - Relatively simple for authorized users to incrypt and decrypt data.
  - Encryption scheme depends not on the secrecy of the algorithm but on a parameter of the algorithm called the encryption key.
  - Extremely difficult for an intruder to determine the encryption key.
- *Data Encryption Standard* substitutes characters and rearranges their order on the basis of an encryption key provided to authorized users via a secure mechanism. Scheme only as secure as the mechanism.

Encryption (Cont.)

- Public-key encryption based on each user having two keys:
  - public key – published key used to encrypt data.
  - private key – key known only to individual user used to decrypt data.
- Must be an encryption scheme that can be made public without making it easy to figure out the decryption scheme.
  - Efficient algorithm for testing whether or not a number is prime.
  - No efficient algorithm is know for finding the prime factors of a number.

Encryption Example - SSL

- SSL – Secure Socket Layer
- Cryptographic protocol that limits two computers to only exchange messages with each other.
- Used between web servers and browsers for secure communication (credit card numbers)
- The server is verified with a **certificate**.
- Communication between each computers uses symmetric key cryptography.

Computer Security Classifications

- U.S. Department of Defense outlines four divisions of computer security: **A**, **B**, **C**, and **D**.
- **D** – Minimal security.
- **C** – Provides discretionary protection through auditing. Divided into **C1** and **C2**. **C1** identifies cooperating users with the same level of protection. **C2** allows user-level access control.
- **B** – All the properties of **C**, however each object may have unique sensitivity labels. Divided into **B1**, **B2**, and **B3**.
- **A** – Uses formal design and verification techniques to ensure security.

Windows NT Example

- Configurable security allows policies ranging from D to C2.
- Security is based on user accounts where each user has a security ID.
- Uses a subject model to ensure access security. A subject tracks and manages permissions for each program that a user runs.
- Each object in Windows NT has a security attribute defined by a security descriptor. For example, a file has a security descriptor that indicates the access permissions for all users.