


## Chapter 19: Security

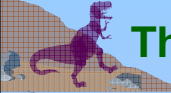

- The Security Problem
- Authentication
- Program Threats
- System Threats
- Securing Systems
- Intrusion Detection
- Encryption
- Windows NT



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## 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.

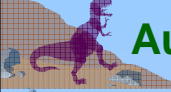


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## Authentication

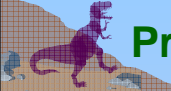

- User identity most often established through *passwords*, can be considered a special case of either keys or capabilities.
- Passwords must be kept secret.
  - Frequent change of passwords.
  - Use of “non-guessable” passwords.
  - Log all invalid access attempts.
- Passwords may also either be encrypted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



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## 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.)



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# 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.

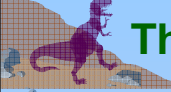
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# The Morris Internet Worm

The diagram illustrates the infection process of the Morris Internet Worm. It shows two systems: a 'target system' on the left and an 'infected system' on the right. On the target system, there is a 'grappling hook' and a 'worm' box. On the infected system, there is a 'worm' box. The process is as follows:


- The infected system sends three attacks to the target system: 'rsh attack', 'finger attack', and 'sendmail attack'.
- These attacks cause the 'grappling hook' to be installed on the target system.
- The 'grappling hook' then sends a 'request for worm' to the 'worm' box on the infected system.
- The infected system responds by sending the 'worm sent' to the 'worm' box on the target system.

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## Threat Monitoring

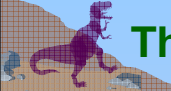

- Check for suspicious patterns of activity – i.e., several incorrect password attempts may signal password guessing.
- Audit log – records the time, user, and type of all accesses to an object; useful for recovery from a violation and developing better security measures.
- Scan the system periodically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



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## 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



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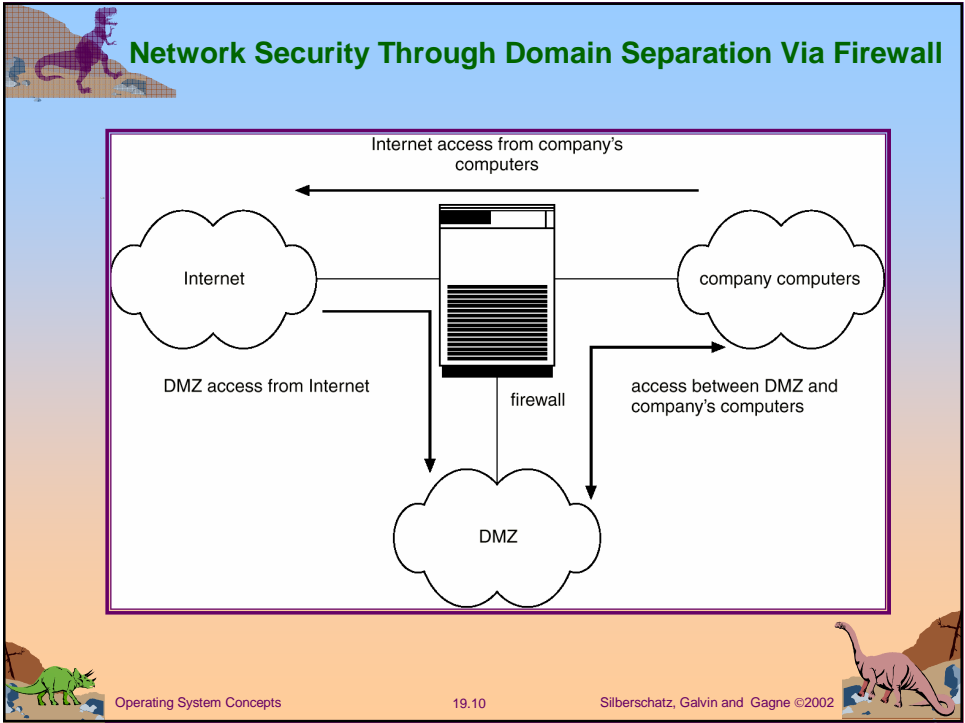
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# FireWall

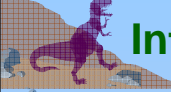

- A firewall is placed between trusted and untrusted hosts.
- The firewall limits network access between these two security domains.

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## Intrusion Detection

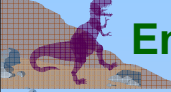
- Detect attempts to intrude into computer systems.
- Detection methods:
  - Auditing and logging.
  - Tripwire (UNIX software that checks if certain files and directories have been altered – I.e. password files)
- System call monitoring

## 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

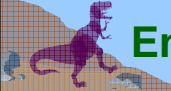

- Encrypt clear text into cipher text.
- Properties of good encryption technique:
  - Relatively simple for authorized users to incrypt and decrypt data.
  - Encryption scheme depends not on the secrecy of the algorithm but on a parameter of the algorithm called the encryption key.
  - Extremely difficult 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.



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## 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.

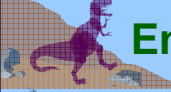


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## Encryption Example - SSL

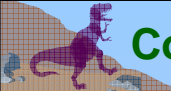

- SSL – Secure Socket Layer
- Cryptographic protocol that limits two computers to only exchange messages with each other.
- Used between web servers and browsers for secure communication (credit card numbers)
- The server is verified with a **certificate**.
- Communication between each computers uses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



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## 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.



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