Denial of Service

COMP620

Resources and Credits

- Information on Denial of Service attacks can be found on Wikipedia.
  - Graphics and some text in these slides was taken from the Wikipedia site
- The textbook discusses denial of service in several locations
- There are many websites with information on denial of service

Definition

- Denial of Service (DoS) is an attempt to make a computer's resource unavailable to its intended users
- Distributed Denial of Service (DDoS) is an attack involving a large number of computers
- "Crashing" the computer to keep others from using it

Symptoms

CERT defines symptoms of denial-of-service attacks to include:

- Unusually slow network performance (opening files or accessing web sites)
- Unavailability of a particular web site
- Inability to access any web site
- Dramatic increase in the number of spam emails received—(an e-mail bomb)

Ways to Generate a DoS Attack

- Consumption of a resource (CPU, network bandwidth, file space, etc.)
- Causing a application to fail (stack overflow, integer overflow, etc.)
- Malicious change in configuration (i.e. routing tables)
- Disruption of the physical system (i.e. power, wiring, etc.)

Ping

- The ping network utility sends an ICMP echo packet to a remote computer. When received, the remote computer sends an ICMP echo-reply packet. This is very useful for checking network function and performance.
- There are special network addresses to broadcast a message to all computers

Ping Flood

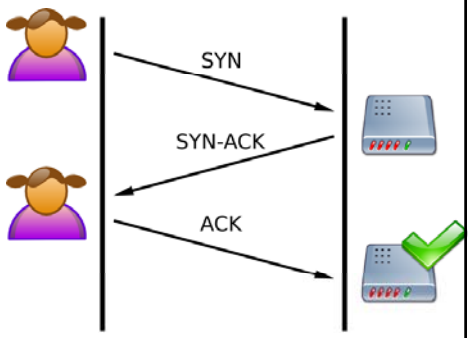
- A ping flood attack broadcasts an ICMP echo packet to all computers on a network
- The return address of the packet is improperly set to the address of a victim computer
- All computers on the network send an ICMP echo-reply to the victim computer
- The large volume of packets can consume the victim's network resources

Ping Flood Mitigation

- A computer should not accept an ICMP echo packet sent with a broadcast address

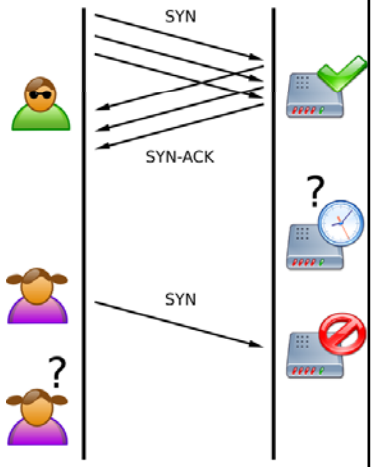
TCP Connections

- Establishing a TCP connection requires three messages
- After the connection, the systems may exchange data



SYN Flood

- An attacker can send many SYN packets to a victim
- The attacker does not send an ACK
- The half established connection consumes ports until the victim times out the attempt
- Others may not be able to establish a connection



SYN Flood Mitigation

- Decrease the timeout waiting for an ACK
- Networks should filter packets with obvious incorrect source addresses
- Minimize the amount of information saved from the SYN message
- Increase the memory available to hold information about connections

Attacks on Poor Network Stacks

- Some early implementations of TCP/IP were not created with security in mind.
- Errors in network packets could cause the software to fail
  - Ping with larger than allowed packets
  - mangled IP fragments with overlapping, over-sized payloads
  - Invalid value in the rarely used TCP urgent pointer

fork Bomb

- If a programmer has access to a system, they may be able to run a program that starts and endless number of processes

```
while (true) fork();
```

- This will create many processes consuming system resources, particularly PID numbers
- The problem can be mitigated by limiting the number of processes a user can own

Userid Lock Out Attack

- Some systems that request a userid and password will lock the account if they receive more than X bad passwords
- If an attacker can get a list of users or enumerate the possible account numbers, they can send many invalid passwords locking out all users
- Temporarily removing the lock out may open the system to other password attacks

Permanent Denial of Service Attacks

- Permanent denial-of-service (PDoS or phlashing) changes a devices firmware
- Rebooting or reloading the software will not correct the problem
- Systems should be designed to carefully restrict how the firmware can be changed

Distributed Denial of Service Attack

- Malware can infect a large number of computers to form a **botnet** that can be used in a DDoS attack.
- Many machines can generate more network traffic
- Attacks from a widely distributed botnet can be hard to filter by a firewall

DDOS Control

A botnet can be controlled in many ways:

- The attack mechanism, time and victim can be hard coded into the malware
- A control system can send messages to the botnet telling who to attack
- Attack code can be downloaded to the bots. This provides the most versatile attack mechanism

Unintentional DoS

- Sometimes a site may be overwhelmed by legitimate traffic
- An extremely popular website could post a prominent link to a second, less well-prepared site causing it to receive many requests
- The Universal Tube & Rollform Equipment Corporation's website, utube.com, became heavily hit when youtube became popular

Firewall Defense

- Firewalls can be configured when an attack occurs to stop specific addresses
- DoS attack may use random return addresses
- DDoS attack may involve traffic from many locations
- A traffic bottleneck can occur in the network before the firewall

Intrusion Prevention Systems

- An intrusion prevention system can sometimes detect a signature or similarity in the attach packets