Lab Understanding TCP/IP based Attacks

Lab Overview

The learning objective of this lab is to gain first-hand experience on TCP/IP vulnerabilities, as well as attacks against these vulnerabilities. The vulnerabilities in the TCP/IP protocols represent a special genre of vulnerabilities in protocol designs and implementations. They provide an invaluable lesson as to why security should be designed in from the beginning, rather than being added as an afterthought. Moreover, studying these vulnerabilities help students understand the challenges of cyber security and why many cyber security measures are needed. Vulnerabilities of the TCP/IP protocols occur at several layers. This lab is designed to learn them step-by-step.

Lab Environment Setup

To conduct this lab, we are following last week lab (i.e. Lab 3) virtual environment on the same host computer. The tools being used for this lab are Wireshark/Tshark, Netwox/Netwag.

Netwox/Netwag

We need tools to send out network packets of different types and with different contents. We can use Netwag to do that. However, the GUI interface of Netwag makes it difficult for us to automate our process. Therefore, we strongly suggest that you use its command-line version, the Netwox command, which is the underlying command invoked by Netwag.

Netwox consists of a suite of tools, each having a specific number. You can run the command as following (the parameters depend on which tool you are using). For some of the tools, you have to run it with the root privilege:

➢

```
netwox <number> [parameters ...]
```

If you are not sure how to set the parameters, you can look at the manual by issuing **`"netwox <number> --help"`**. You can also learn the parameter settings by running Netwag for each command you execute from the graphic interface, Netwag actually invokes a corresponding Netwox command, and it displays the parameter settings. Therefore, you can simply copy and paste the displayed command.

Wireshark Tool.

You also need a good network-traffic sniffer tool for this lab. Although Netwox comes with a sniffer, you will find that another tool called Wireshark is a much better sniffer tool.

Both Netwox and Wireshark can be downloaded. If you are using our pre-built virtual machine, both tools are already installed. To sniff all the network traffic, both tools need to be run with root privilege.

Tshark Tool.

It is a terminal based network packet analyzer. You also need a good command line network-traffic sniffer tool for this lab.

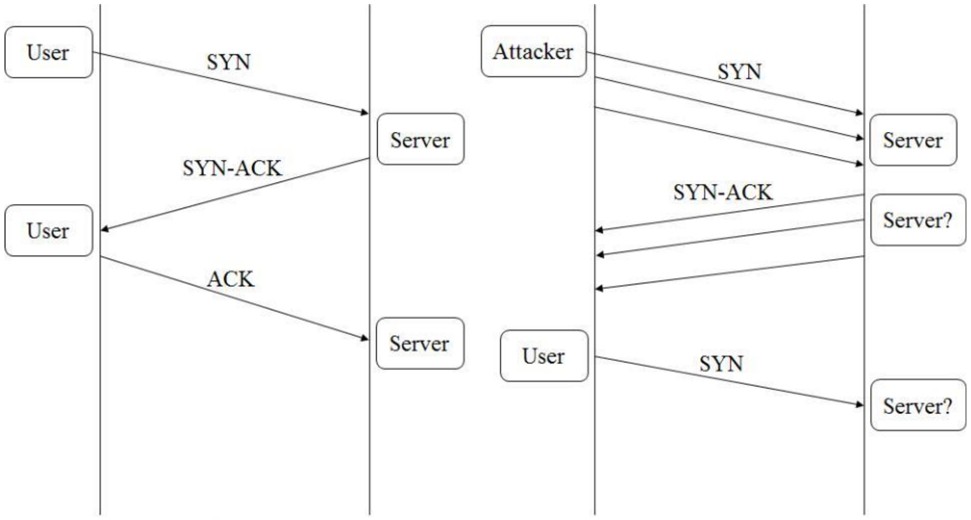
Lab Tasks

In this lab, you need to conduct attacks on the TCP/IP protocols. You can use the Netwox, Wireshark, Tshark tools in the attacks. All the attacks are performed on Linux operating systems. However, you can also conduct the same attack on the other operating system and compare the observations after lab classes. You are supposed to use all the above three different tolls for the experiments.

To simplify the "guess" of TCP sequence numbers and source port numbers, we assume that attacks are on the same physical network as the victims (Think of where such attacks may happen?). Therefore, you can use sniffer tools to get that information. The following is the list of attacks that need to be implemented and studied in this lab.

Task 1: SYN Flooding Attack

SYN flood is a form of DoS attack in which attackers send many SYN requests to a victim's TCP port, but the attackers have no intention to finish the 3-way handshake procedure. Attackers either use spoofed IP address or do not continue the procedure. Through this attack, attackers can flood the victim's queue that is used for half-opened connections, i.e. the connections that has finished SYN, SYN-ACK, but has not yet got a final ACK back. When this queue is full, the victim cannot take any more connection. Following figure illustrates the attack.



Normal TCP3 way handshake between user and server

SYNC flood: Attacker sends many SYN to server without ACK. The server is not able to process request from user.

The size of the queue has a system-wide setting. In Linux, you can check the system queue size setting using the following command:

➢
```
sysctl -q net.ipv4.tcp_max_syn_backlog
```

You can use command **`netstat -na`** to check the usage of the queue, i.e., the number of half opened connection associated with a listening port.

Use the **`Netwag Tool 76`** to conduct the attack, and then use **`tshark`** tool to capture the packets.

Task 2: ARP cache poisoning

The ARP cache is an important part of the ARP protocol. Once a mapping between a MAC address and an IP address is resolved as the result of executing the ARP protocol, the mapping will be cached. Therefore, there is no need to repeat the ARP protocol if the mapping is already in the cache. However, because the ARP protocol is stateless, the cache can be easily poisoned by maliciously crafted ARP messages. Such an attack is called the ARP cache poisoning attack.

Attackers may use spoofed ARP messages to trick the victim to accept an invalid MAC-to IP mapping, and store the mapping in its cache. There can be various types of consequences depending on the motives of the attackers. For example, attackers can launch a DoS attack against a victim by associating a non-existent MAC address to the IP address of the victim's default gateway; attackers can also redirect the traffic to and from the victim to another machine, etc.

Use the `Netwag Tool 80` to conduct the attack, and then use `wireshark` tool to capture the packets.

HINTS: In this task, you need to demonstrate how the ARP cache poisoning attack work. In Linux we can use the command `arp -a` to check the current mapping between IP address and MAC address.

Task 3: ICMP Redirect Attack

The ICMP redirect message is used by routers to provide the up-to-date routing information to hosts, which initially have minimal routing information. When a host receives an ICMP redirect message, it will modify its routing table according to the message.

Because of the lack of validation, if attackers want the victim to set its routing information in a particular way, they can send spoofed ICMP redirect messages to the victim and trick the victim to modify its routing table.

Use the `Netwag Tool 86` to conduct the attack, and then use `wireshark` tool to capture the packets.

HINTS: In this task, you should demonstrate how the ICMP redirect attack works, and describe the observed consequence. To check the routing information in Linux, you can use the command `route`