Lab 12 (Week 13)
Operational Security – Network Scanner, Firewall, and IDS

CAN201

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Scanner

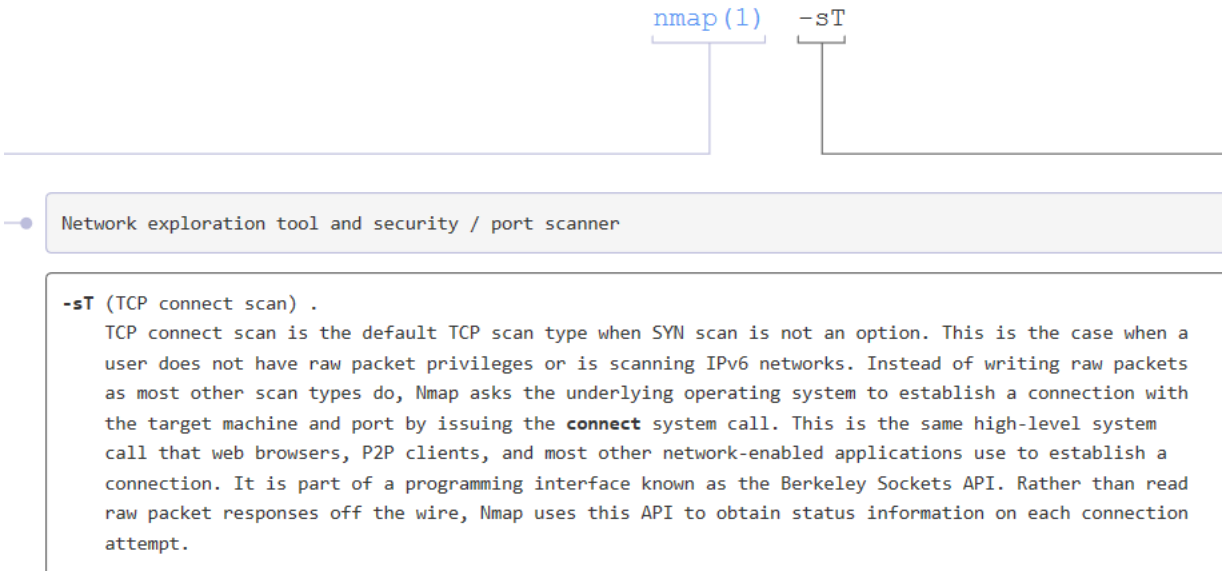
- A scanner can disclose the target's service as well as the corresponding open ports via sending probing traffic against the target (which is a node on the internet).
  - Recall the difference between scanner and sniffer.
- Nmap is a free and open source utility for network discovery (scanner). It uses raw IP packets in novel ways to determine:
  - what hosts are available on the network
  - what services (application name and version) those hosts are offering
  - what operating systems (and OS versions) they are running
  - what type of packet filters/firewalls are in use
  - dozens of other characteristics

Scanner

- How to install nmap on Ubuntu?
  - **sudo apt-get install nmap**
- How to use nmap?
  - **nmap [scan types] <options> {target specification}**
  - target specification: hostnames, IP addresses, networks, etc.
  - scan types + options:
    - scan techniques:
      - ✓ -sS/sT/sA/sW/sM: TCP SYN/Connect()/ACK/Window/Maimon scans
      - ✓ -sU: UDP Scan
    - service/version detection:
      - ✓ -sV: Probe open ports to determine service/version info
    - OS DETECTION:
      - ✓ -O: Enable OS detection

Scanner

- How to retrieve specific info about the nmap scan options?
  - use command-line “**man nmap**”
  - access to https://explainshell.com/



Firewall

- Firewall on Ubuntu
  - iptables (https://www.netfilter.org/)
  - ufw/gufw (https://wiki.ubuntu.com/UncomplicatedFirewall)
  - firewall builder (http://fwbuilder.sourceforge.net/)
  - etc.
- How to install ufw on Ubuntu
  - **sudo apt-get install ufw**

IDS

- Intrusion Detection System (IDS)
  - Signature-based IDS
    - use well-known signature to detect attack
    - Snort (https://www.snort.org/)
  - Anomaly-based IDS
    - use normal behavior reference profile to detect anomaly
    - Zeek (https://zeek.org/)

IDS

- How to install Snort on Ubuntu
  - **sudo apt-get install snort**
  - if the installation screen ask you to type in the “interface” that snort will listen on, you should type the interface which your VM is using for connecting to the internet. You can check the interface by using the command “**ifconfig**”, in my case, it is “enp0s3” .
  - test if snort is installed, just type command “**snort -V**”.

```
root@bitcoinattacker:/home/wfan# snort -V

   ,,_     -*> Snort! <*-
  o"  )~   Version 2.9.7.0 GRE (Build 149)
   ''''    By Martin Roesch & The Snort Team: http://www.snort.org/contact#team
           Copyright (C) 2014 Cisco and/or its affiliates. All rights reserved.
           Copyright (C) 1998-2013 Sourcefire, Inc., et al.
           Using libpcap version 1.8.1
           Using PCRE version: 8.39 2016-06-14
           Using ZLIB version: 1.2.11
```

A test run involving nmap, ufw and snort

1) Start two VMs, i.e., A and B, and they locate on the same network (e.g., NAT network, or Host-only network). In my case VM A uses IP address 10.0.2.9, and VM B uses IP address 10.0.2.4 .
2) On VM A, open a terminal and create a simple http server by typing the command "**python3 -m http.server --bind 10.0.2.9 80**" .

```
root@bitcoinattacker:/home/wfan# python3 -m http.server --bind 10.0.2.9 80
Serving HTTP on 10.0.2.9 port 80 (http://10.0.2.9:80/) ...
```

3) On VM B, open a terminal and test if the http server on VM A is working correctly by using the following command "**wget -o - 10.0.2.9**" .

```
root@controller1:/home/wfan# wget -o - 10.0.2.9
--2021-12-09 14:32:24--  http://10.0.2.9/
Connecting to 10.0.2.9:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1937 (1.9K) [text/html]
Saving to: 'index.html.2'

     OK .                                                     100%  265M=0s

2021-12-09 14:32:24 (265 MB/s) - 'index.html.2' saved [1937/1937]
```

A test run involving nmap, ufw and snort

4) On VM B, scan the VM A by using "**nmap -sT -sV 10.0.2.9**".

```
root@controller1:/home/wfan# nmap -sT -sV 10.0.2.9

Starting Nmap 7.60 ( https://nmap.org ) at 2021-12-09 14:36 UTC
Nmap scan report for 10.0.2.9
Host is up (0.0023s latency).
Not shown: 999 closed ports
PORT   STATE SERVICE VERSION
80/tcp open  http    SimpleHTTPServer 0.6 (Python 3.6.9)
MAC Address: 08:00:27:7E:1F:C1 (Oracle VirtualBox virtual NIC)

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 7.50 seconds
```

Caution: refrain from using nmap to scan public network, which causes ethical issue.

A test run involving nmap, ufw and snort

5) On VM A, open a new terminal, and let's deny http traffic by using the ufw: "**ufw deny from 10.0.2.4 to 10.0.2.9 port 80**" and "**ufw enable**".

```
root@bitcoinattacker:/home/wfan# ufw deny from 10.0.2.4 to 10.0.2.9 port 80
Rules updated
root@bitcoinattacker:/home/wfan# ufw enable
Firewall is active and enabled on system startup
```

6) On VM B, try this command again "**wget -o - 10.0.2.9**", what will you see?

```
root@controller1:/home/wfan# wget -o - 10.0.2.9
--2021-12-09 14:51:20--  http://10.0.2.9/
Connecting to 10.0.2.9:80...
```

7) Go back to VM A, type the command "**ufw disable**" to stop the firewall.

```
root@bitcoinattacker:/home/wfan# ufw disable
Firewall stopped and disabled on system startup
```

A test run involving nmap, ufw and snort

8) On VM A, open a new terminal, and type the following command to edit the snort rule file "**vim /etc/snort/rules/local.rules**".

```
root@bitcoinattacker:/home/wfan# vim /etc/snort/rules/local.rules
```

9) In the vim editor, press "i" button to go to the edit mode (it will show "insert" at the bottom on the terminal), and thereafter you can insert a rule to the snort rule file.

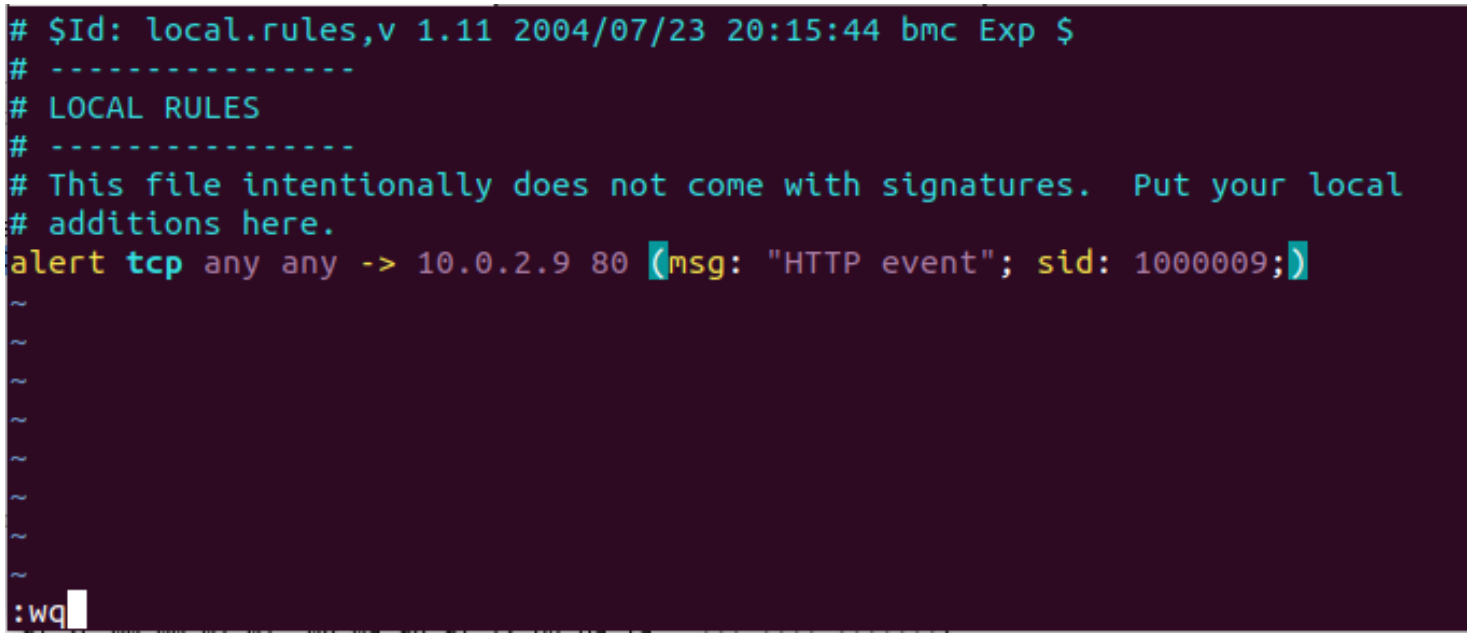
Here we insert the following rule:

alert tcp any any -> 10.0.2.9 80

(msg: "HTTP event"; sid: 1000009;)

A test run involving nmap, ufw and snort

10) With the vim editor, first, press the “Esc” button on your keyboard; second, press “shift” + “:” button on your keyboard; third, type “wq” after the “:” and press “enter” button to write the inserted rule into the rule file and quit the vim editor. Right after that, you will go back to the terminal.



A test run involving nmap, ufw and snort

11) On VM A, once you go back to the terminal, type the following command to run the snort IDS: "**snort -l ./ -c /etc/snort/rules/local.rules**".

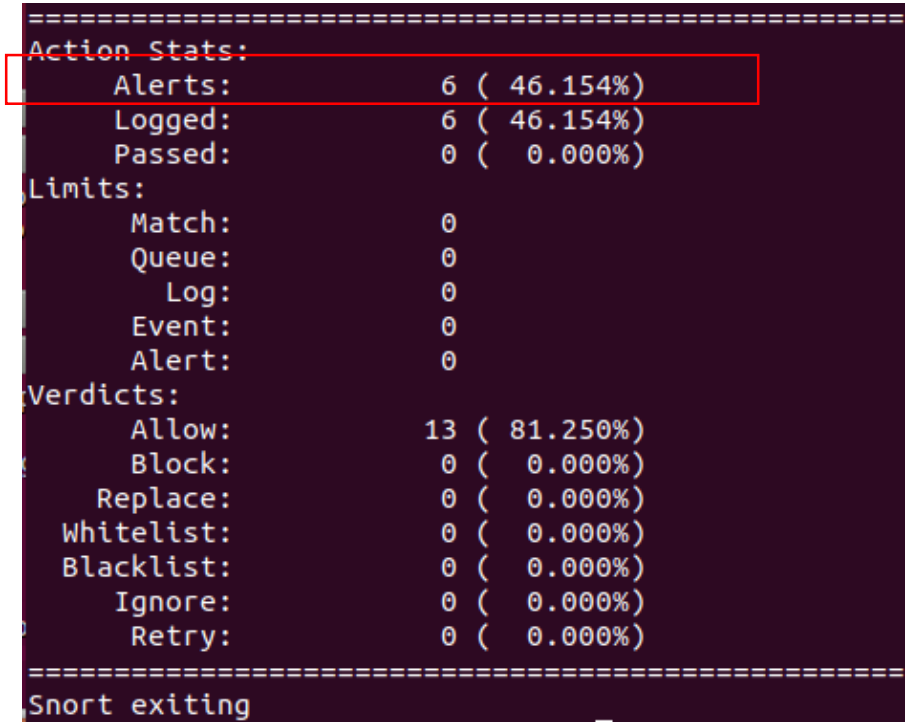
```
root@bitcoinattacker:/home/wfan# snort -l ./ -c /etc/snort/rules/local.rules
Running in IDS mode

        --== Initializing Snort ==--
Initializing Output Plugins!
Initializing Preprocessors!
Initializing Plug-ins!
Parsing Rules file "/etc/snort/rules/local.rules"
Tagged Packet Limit: 256
Log directory = ./
```

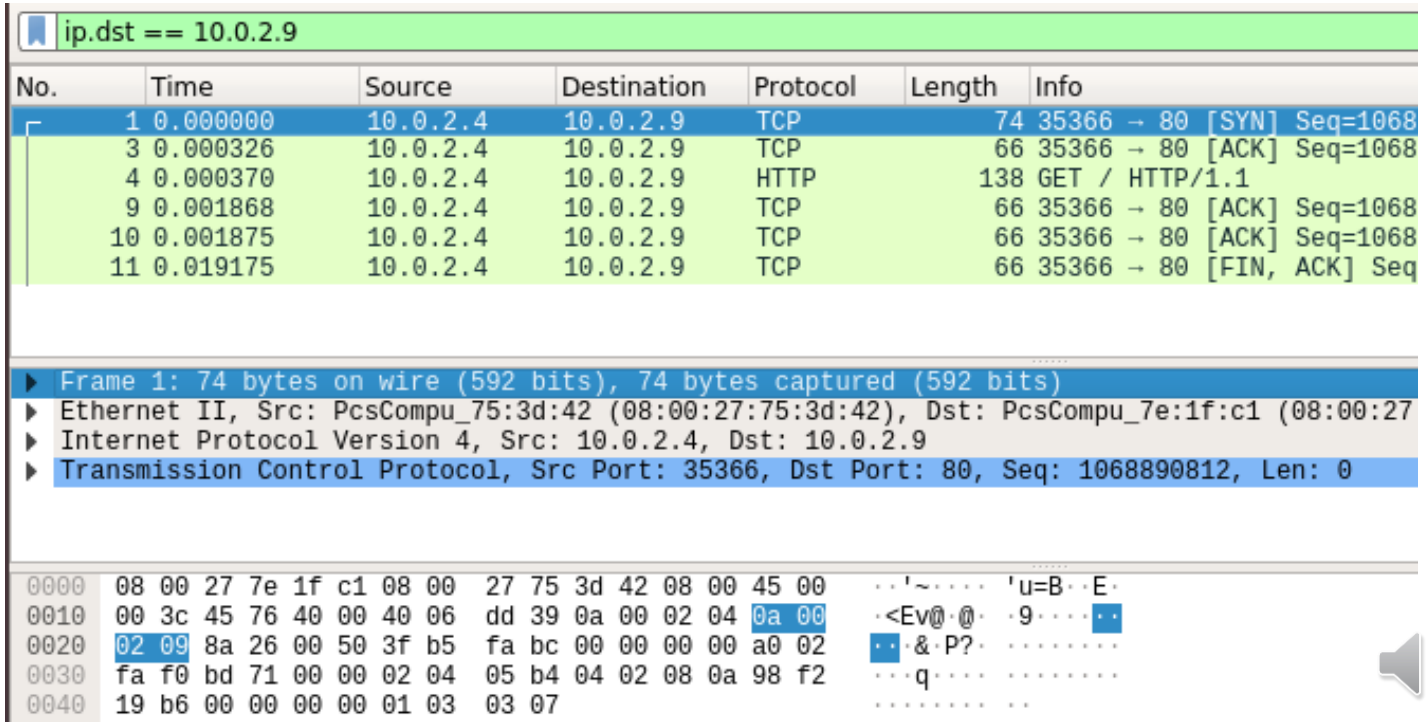
12) Then go to VM B, execute the command "**wget -o - 10.0.2.9**" again to access the http service running on VM A (assuming the simple HTTP server is still running on VM A).

```
root@controller1:/home/wfan# wget -o - 10.0.2.9
--2021-12-11 10:23:01--  http://10.0.2.9/
Connecting to 10.0.2.9:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2117 (2.1K) [text/html]
Saving to: 'index.html.9'

     OK ..                                                    100%  277M=0s

2021-12-11 10:23:01 (277 MB/s) - 'index.html.9' saved [2117/2117]
```

A test run involving nmap, ufw and snort

13) Go to VM A, stop snort by press button “Ctrl” + “C”, then you will see it generated six alerts. If you used wireshark on VM A to capture the packets when VM B is accessing VM A’s HTTP service, you can verify that there were actually six inbound TCP segments sent to the IP address 10.0.2.9





A test run involving nmap, ufw and snort

14) On VM A, you can also view the alerts by read the alert log file which is under the current folder. You can use the command "**less alert**" to read detail of the alerts.

```
root@bitcoinattacker:/home/wfan# ls
Desktop    Downloads  Pictures  Templates  alert
Documents  Music      Public    Videos     attack_
root@bitcoinattacker:/home/wfan# less alert
```

```
[**] [1:1000009:0] HTTP event [**]
[Priority: 0]
12/11-10:23:02.114108 10.0.2.4:35370 -> 10.0.2.9:80
TCP TTL:64 TOS:0x0 ID:12409 IpLen:20 DgmLen:60 DF
******S* Seq: 0x90561E16  Ack: 0x0  Win: 0xFAF0  TcpLen: 40
TCP Options (5) => MSS: 1460 SackOK TS: 2566531822 0 NOP WS: 7

[**] [1:1000009:0] HTTP event [**]
[Priority: 0]
12/11-10:23:02.114478 10.0.2.4:35370 -> 10.0.2.9:80
TCP TTL:64 TOS:0x0 ID:12410 IpLen:20 DgmLen:52 DF
***A**** Seq: 0x90561E17  Ack: 0x69741B23  Win: 0x1F6  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2566531822 3671983928

[**] [1:1000009:0] HTTP event [**]
[Priority: 0]
12/11-10:23:02.114883 10.0.2.4:35370 -> 10.0.2.9:80
:
```

Thank you!