

# **ADVANCED NETWORK SECURITY AND PROTOCOLS**

## **Simulasi Denial of Service (DOF) Attack dengan Hping3 dan Mitigasi Firewall**



**Disusun Oleh:**

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**2025**

## A. Download dan Setup awal

### 1. Instalasi DVWA di target VM

```
(root@Sukma)-[/home/sukma]
# sudo apt install -y apache2 mariadb-server php php-mysqli php-gd git
Note, selecting 'php8.4-mysql' instead of 'php-mysqli'
apache2 is already the newest version (2.4.65-3+b1).
apache2 set to manually installed.
php8.4-mysql is already the newest version (8.4.11-1+b1).
php8.4-mysql set to manually installed.
The following package was automatically installed and is no longer required:
  libconfig-inifiles-perl
Use 'sudo apt autoremove' to remove it.

Upgrading:
git mariadb-client-core mariadb-plugin-provider-lzo php
git-man mariadb-common mariadb-plugin-provider-snappy php-common
libapache2-mod-php mariadb-plugin-provider-bzip2 mariadb-server php-mysql
libmariadb3 mariadb-plugin-provider-lz4 mariadb-server-compat
mariadb-client mariadb-plugin-provider-lzma mariadb-server-core

Installing:
php-gd

Installing dependencies:
php8.4-gd

Summary:
  Upgrading: 18, Installing: 2, Removing: 0, Not Upgrading: 1424
  Download size: 28.1 MB
  Space needed: 715 kB / 7,726 MB available

Get:1 http://kali.download/kali kali-rolling/main amd64 mariadb-common all 1:11.8.5-3 [30.3 kB]
Get:4 http://kali.download/kali kali-rolling/main amd64 mariadb-server-core amd64 1:11.8.5-3 [8,038 kB]
Get:5 http://mirror.aktkn.sg/kali kali-rolling/main amd64 mariadb-client-core amd64 1:11.8.5-3 [918 kB]
6% [5 mariadb-client-core 96.9 kB/918 kB 11%] [Connecting to mirror.sg.gs] [4 mariadb-server-core 1,777 kB/8,038 kB]
Get:3 http://mirror.sg.gs/kali kali-rolling/main amd64 mariadb-server-compat all 1:11.8.5-3 [29.1 kB]
Get:6 http://kali.download/kali kali-rolling/main amd64 mariadb-client amd64 1:11.8.5-3 [3,162 kB]
Get:7 http://kali.download/kali kali-rolling/main amd64 mariadb-plugin-provider-snappy amd64 1:11.8.5-3 [30.6 kB]
Get:18 http://http.kali.org/kali kali-rolling/main amd64 php8.4-gd amd64 8.4.11-1+b1 [36.5 kB]
Get:9 http://kali.download/kali kali-rolling/main amd64 mariadb-plugin-provider-lzma amd64 1:11.8.5-3 [30.6 kB]
Get:10 http://kali.download/kali kali-rolling/main amd64 mariadb-plugin-provider-lz4 amd64 1:11.8.5-3 [30.6 kB]
Get:13 http://kali.download/kali kali-rolling/main amd64 git amd64 1:2.51.0-1 [9,259 kB]
Get:2 http://mirror.freedif.org/kali kali-rolling/main amd64 mariadb-server amd64 1:11.8.5-3 [3,922 kB]
Get:14 http://kali.download/kali kali-rolling/main amd64 git-man all 1:2.51.0-1 [2,286 kB]
```

*sudo apt update*

*sudo apt install -y apache2 mariadb-server php php-mysqli php-gd git*

Perintah ini memperbarui repositori dan memasang Apache, MariaDB, PHP, dan git.

```
(root@Sukma)-[/home/sukma]
# cd /var/www/html
sudo git clone https://github.com/digininja/DVWA.git

Cloning into 'DVWA' ...
remote: Enumerating objects: 5622, done.
remote: Total 5622 (delta 0), reused 0 (delta 0), pack-reused 5622 (from 1)
Receiving objects: 100% (5622/5622), 2.64 MiB | 24.00 KiB/s, done.
Resolving deltas: 100% (2809/2809), done.
```

*cd /var/www/html* memindahkan direktori kerja ke root dokumen default Apache, yaitu tempat file web disajikan.

*sudo git clone https://github.com/digininja/DVWA.git*

mendownload source code DVWA langsung dari GitHub ke dalam folder */var/www/html/DVWA*

```

Resolving deltas: 100% (2809/2809), done.

(root@Sukma)-[/var/www/html]
# cd /var/www/html/DVWA/config
sudo cp config.inc.php.dist config.inc.php

(root@Sukma)-[/var/www/html/DVWA/config]
# cd /var/www/html/DVWA/config
sudo cp config.inc.php.dist config.inc.php

(root@Sukma)-[/var/www/html/DVWA/config]
# cd /var/www/html/DVWA/config
# sudo cp config.inc.php.dist config.inc.php

(root@Sukma)-[/var/www/html/DVWA/config]
# cd /var/www/html
sudo chmod -R 777 DVWA/

```

- `cd /var/www/html/DVWA` masuk ke direktori DVWA.
- `sudo chmod -R 777`. memberikan permission penuh (read, write, execute) ke semua user pada seluruh isi folder DVWA; ini memang tidak aman untuk production tetapi umum dipakai pada lab DVWA agar tidak ada masalah permission saat menulis file atau upload.
- `cd config` masuk ke direktori konfigurasi DVWA.
- `sudo cp config.inc.php.dist config.inc.php` menyalin file template konfigurasi menjadi file konfigurasi aktif yang akan diedit.

## 2. Setup database

```

bash

sudo systemctl start mariadb
sudo mysql <<EOF
CREATE DATABASE dvwa;
CREATE USER 'dvwa'@'localhost' IDENTIFIED BY 'dvwa123';
GRANT ALL PRIVILEGES ON dvwa.* TO 'dvwa'@'localhost';
FLUSH PRIVILEGES;
EXIT;
EOF

```

```

root@Subma:~/var/www/html# sudo mysql
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 36
Server version: 11.8.5-MariaDB-3 from Debian -- Please help get to 10k stars at https://github.com/MariaDB/Server

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> SELECT user, host FROM mysql.user WHERE user='dvwa';
+-----+-----+
| User | Host |
+-----+-----+
| dvwa | localhost |
+-----+-----+
1 row in set (0.010 sec)

MariaDB [(none)]> ALTER USER 'dvwa'@'localhost' IDENTIFIED BY 'dvwa123';
Query OK, 0 rows affected (0.044 sec)

MariaDB [(none)]> SHOW DATABASES;
+-----+
| Database |
+-----+
| dvwa |
| information_schema |
| mysql |
| performance_schema |
| sys |
+-----+
5 rows in set (0.060 sec)

MariaDB [(none)]> GRANT ALL PRIVILEGES ON dvwa.* TO 'dvwa'@'localhost';
Query OK, 0 rows affected (0.030 sec)

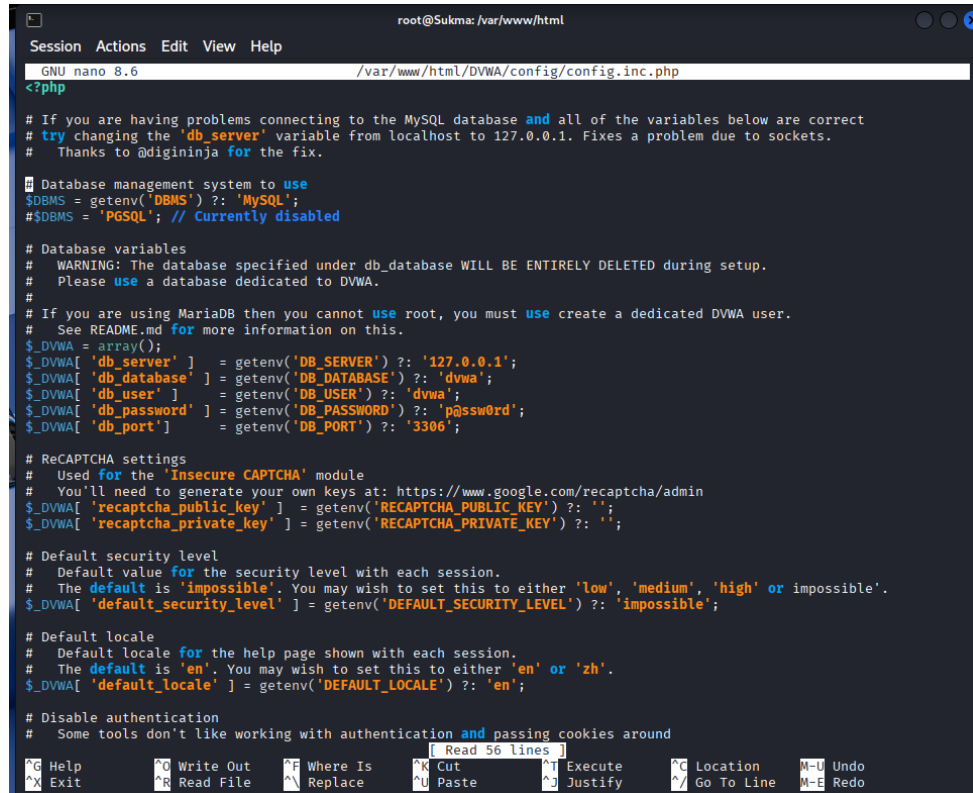
MariaDB [(none)]> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.001 sec)

MariaDB [(none)]> EXIT;
Bye

```

- `sudo systemctl start mariadb` menyalakan layanan database MariaDB sehingga dapat menerima koneksi.
- `sudo mysql <<EOF ... EOF` menjalankan beberapa perintah SQL sekaligus di dalam client MariaDB dengan hak root:
- `CREATE DATABASE dvwa;` membuat database baru bernama dvwa yang akan dipakai DVWA.
- `CREATE USER 'dvwa'@'localhost' IDENTIFIED BY 'dvwa123';` membuat user database bernama dvwa dengan password dvwa123 yang hanya boleh login dari local machine.
- `GRANT ALL PRIVILEGES ON dvwa.* TO 'dvwa'@'localhost';` memberikan semua hak akses (select, insert, update, dll.) pada database dvwa kepada user tersebut.
- `FLUSH PRIVILEGES;` memaksa MariaDB memuat ulang tabel hak akses sehingga perubahan segera berlaku.

### 3. Edit konfigurasi DVWA



```
root@Sukma: /var/www/html
Session Actions Edit View Help
GNU nano 8.6 /var/www/html/DVWA/config/config.inc.php
<?php

# If you are having problems connecting to the MySQL database and all of the variables below are correct
# try changing the 'db_server' variable from localhost to 127.0.0.1. Fixes a problem due to sockets.
# Thanks to @digininja for the fix.

# Database management system to use
$DBMS = getenv('DBMS') ?: 'MySQL';
#$DBMS = 'PGSQL'; // Currently disabled

# Database variables
# WARNING: The database specified under db_database WILL BE ENTIRELY DELETED during setup.
# Please use a database dedicated to DVWA.
#
# If you are using MariaDB then you cannot use root, you must use create a dedicated DVWA user.
# See README.md for more information on this.
$_DVWA = array();
$_DVWA['db_server'] = getenv('DB_SERVER') ?: '127.0.0.1';
$_DVWA['db_database'] = getenv('DB_DATABASE') ?: 'dvwa';
$_DVWA['db_user'] = getenv('DB_USER') ?: 'dvwa';
$_DVWA['db_password'] = getenv('DB_PASSWORD') ?: 'p@ssw0rd';
$_DVWA['db_port'] = getenv('DB_PORT') ?: '3306';

# ReCAPTCHA settings
# Used for the 'Insecure CAPTCHA' module
# You'll need to generate your own keys at: https://www.google.com/recaptcha/admin
$_DVWA['recaptcha_public_key'] = getenv('RECAPTCHA_PUBLIC_KEY') ?: '';
$_DVWA['recaptcha_private_key'] = getenv('RECAPTCHA_PRIVATE_KEY') ?: '';

# Default security level
# Default value for the security level with each session.
# The default is 'impossible'. You may wish to set this to either 'low', 'medium', 'high' or impossible'.
$_DVWA['default_security_level'] = getenv('DEFAULT_SECURITY_LEVEL') ?: 'impossible';

# Default locale
# Default locale for the help page shown with each session.
# The default is 'en'. You may wish to set this to either 'en' or 'zh'.
$_DVWA['default_locale'] = getenv('DEFAULT_LOCALE') ?: 'en';

# Disable authentication
# Some tools don't like working with authentication and passing cookies around
```

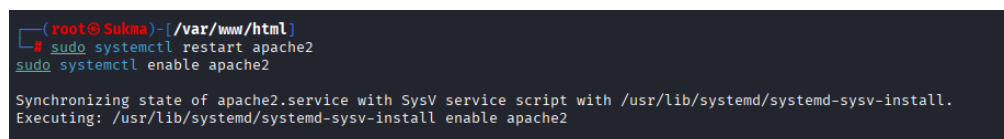
*sudo nano /var/www/html/DVWA/config/config.inc.php*

Perintah ini membuka file konfigurasi DVWA di text editor nano agar parameter koneksi database dapat disesuaikan.

```
$_DVWA['db_server'] = '127.0.0.1';
$_DVWA['db_database'] = 'dvwa';
$_DVWA['db_user'] = 'dvwa';
$_DVWA['db_password'] = 'dvwa123';
```

Ini yang kita pakai untuk menggunakan database local dvwa dengan user dan password yang baru di buat.

### 4. Restart apache



```
(root@Sukma)-[/var/www/html]
# sudo systemctl restart apache2
sudo systemctl enable apache2

Synchronizing state of apache2.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable apache2
```

- *sudo systemctl restart apache2* me-restart layanan Apache sehingga meng-load konfigurasi baru dan mulai menyajikan DVWA.
- *sudo systemctl enable apache2* membuat Apache otomatis start setiap kali sistem boot, sehingga server web selalu aktif tanpa perlu start manual.

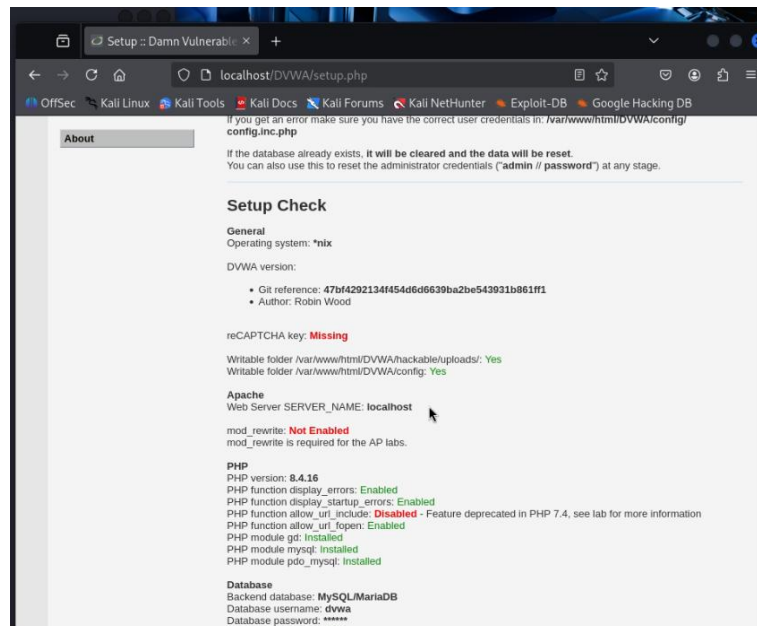
```

root@Sukma:~/home/sukma# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:98:4c:bd brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.101/24 brd 192.168.56.255 scope global dynamic noprefixroute eth0
        valid_lft 527sec preferred_lft 527sec
    inet6 fe80::a00:27ff:fe98:4cbd/64 scope link noprefixroute
        valid_lft forever preferred_lft forever

```

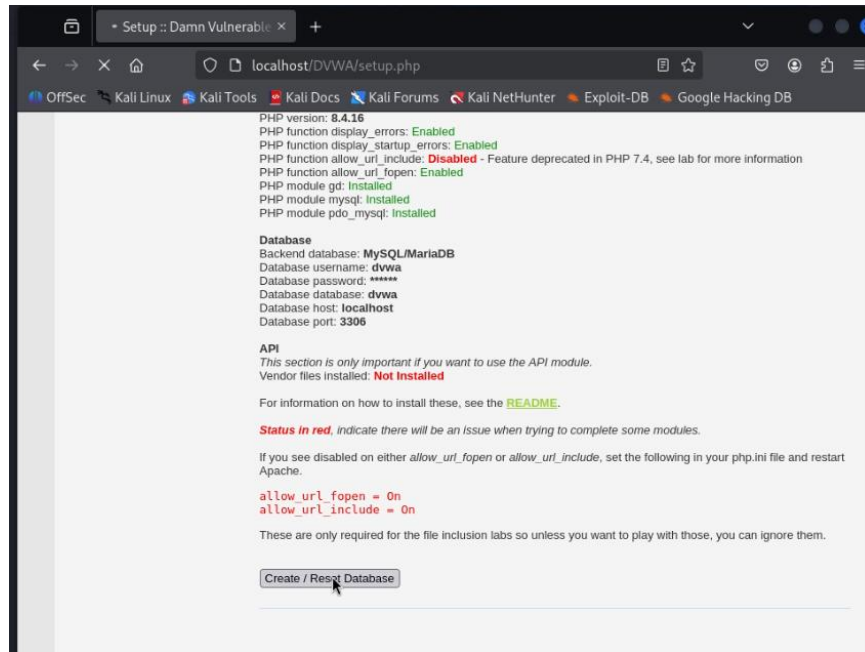
ip a digunakan untuk melihat alamat IP yang didapat pada setiap interface; di sini digunakan untuk memastikan attacker dan target berada di jaringan yang sama.

## 5. Setup DVWA via Web (Browser)

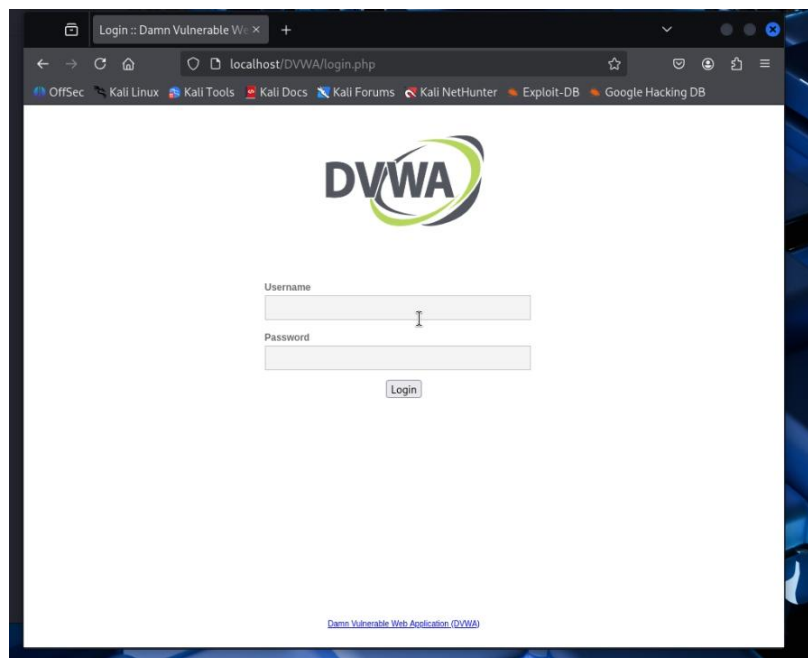


<http://localhost/DVWA/setup.php> DVWA Setup Check merupakan halaman awal yang digunakan untuk memastikan bahwa seluruh komponen yang

dibutuhkan oleh aplikasi **Damn Vulnerable Web Application (DVWA)** telah terpasang.

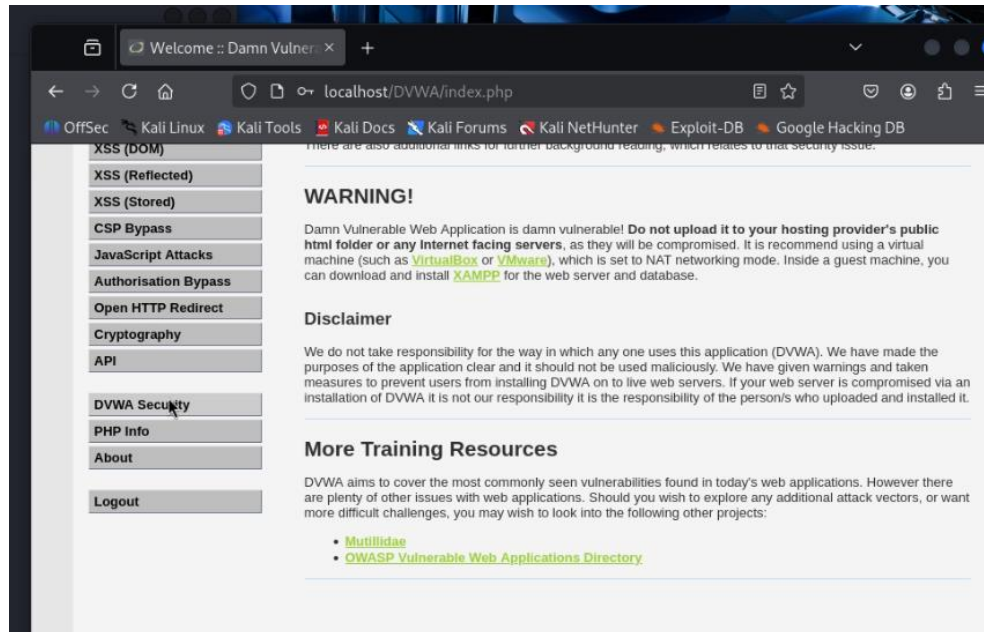


Masih di subbab yang sama, setelah langkah reset database sebelum login pertama.

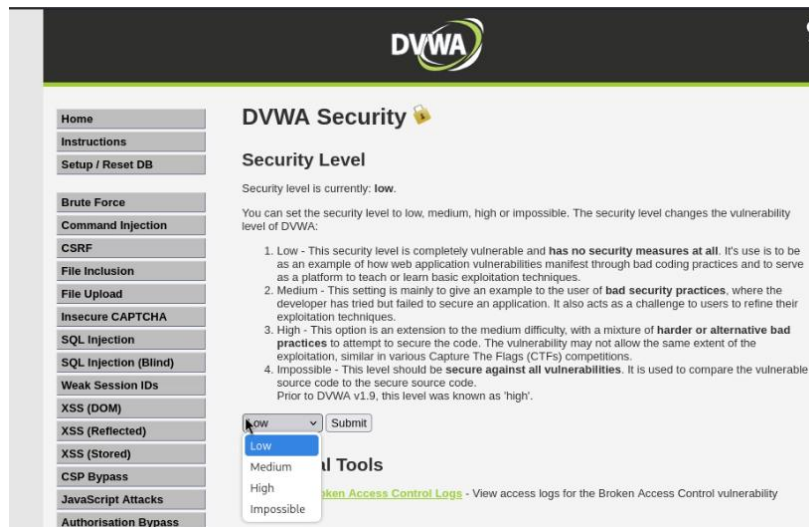




Login sesuai dengan edit konfigurasi yang di ganti tadi, jika berhasil login berarti DvWA sudah bisa di akses.



Ini tampilan setelah berhasil masuk, setelah itu atur DvWA security



Lalu atur keamanan di level Low DVWA sebelum kamu mulai serangan DoS.

## 6. Port Scanning dengan Nmap



```
(root@Sukma)-[/home/sukma]
# nmap -p 1-100 192.168.56.101

Starting Nmap 7.95 ( https://nmap.org ) at 2025-12-28 20:17 WITA
mass_dns: warning: Unable to determine any DNS servers. Reverse DNS is disabled. Try using --system-dns or specify v
alid servers with --dns-servers
Nmap scan report for 192.168.56.101
Host is up (0.0000090s latency).
Not shown: 99 closed tcp ports (reset)
PORT      STATE SERVICE
80/tcp    open  http

Nmap done: 1 IP address (1 host up) scanned in 0.07 seconds
```

- `nmap -p 1-100 192.168.56.101` adalah tool untuk scanning port dan deteksi service.
- Opsi `-p 1-100` membatasi scanning pada port TCP 1 sampai 100.
- `80/tcp open http` menunjukkan port 80 terbuka.

## B. Eksekusi serangan DoS dengan HPING3

### 1. Monitoring baseline di target.

```
(root@Sukma)-[/home/sukma]
# sudo apt install htop
The following package was automatically installed and is no longer required:
  libconfig-inifiles-perl
Use 'sudo apt autoremove' to remove it.

Installing:
  htop

Suggested packages:
  strace

Summary:
  Upgrading: 0, Installing: 1, Removing: 0, Not Upgrading: 1429
  Download size: 171 kB
  Space needed: 434 kB / 7,630 MB available

Get:1 http://xsrv.moratelindo.io/kali kali-rolling/main amd64 htop amd64 3.4.1-5 [171 kB]
Fetched 171 kB in 2s (104 kB/s)
Selecting previously unselected package htop.
(Reading database ... 416683 files and directories currently installed.)
Preparing to unpack .../htop_3.4.1-5_amd64.deb ...
Unpacking htop (3.4.1-5) ...
Setting up htop (3.4.1-5) ...
Processing triggers for kali-menu (2025.3.2) ...
Processing triggers for desktop-file-utils (0.28-1) ...
Processing triggers for hicolor-icon-theme (0.18-2) ...
Processing triggers for man-db (2.13.1-1) ...
```

Melakukan pendownload tan terlebih dahulu jika dalam kali linux nya blm terdownload.

## 2. Melakukan Htop

```
root@Sukma: /home/sukma

Session Actions Edit View Help

CPU[||||| 2.3%] Tasks: 115, 446 thr, 66 kthr; 1 running
Mem[||||| 1.24G/1.93G] Load average: 0.24 0.12 0.09
Swp[||||| 136M/1.33G] Uptime: 07:01:48

Main I/O
PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
179763 root 20 0 437M 152M 74944 S 1.9 7.7 4:59.84 /usr/lib/xorg/Xorg :0 -seat seat0 -auth /var/run/
678 root 20 0 8812 5176 3512 R 0.8 0.3 0:00.51 htop
690 root 20 0 437M 152M 0 S 0.8 7.7 0:08.95 /usr/lib/xorg/Xorg :0 -seat seat0 -auth /var/run/
1072 sukma 20 0 282M 33320 21112 S 0.8 1.6 0:56.99 /usr/lib/x86_64-linux-gnu/xfce4/panel/wrapper-2.0
1035 sukma 20 0 210M 3352 0 S 0.4 0.2 0:04.60 /usr/bin/VBoxClient --vmsvga
1062 sukma 20 0 572M 56904 35452 S 0.4 2.8 0:07.49 xfdesktop
172883 sukma 20 0 559M 59096 49720 S 0.4 2.9 0:01.14 /usr/bin/qterminal
1 root 20 0 24800 15416 10796 S 0.0 0.8 0:04.38 /sbin/init splash
537 root 20 0 8380 4660 1772 S 0.0 0.2 0:01.57 /usr/sbin/haveged --Foreground --verbose=1
541 messagebus 20 0 301M 7328 6560 S 0.0 0.4 0:00.07 /usr/libexec/accounts-daemon
543 polkitd 20 0 10264 7452 4380 S 0.0 0.4 0:09.09 /usr/bin/dbus-daemon --system --address=systemd:
545 root 20 0 373M 10108 7544 S 0.0 0.5 0:00.17 /usr/lib/polkit-1/polkitd --no-debug --log-level=
551 root 20 0 19032 9260 8108 S 0.0 0.5 0:01.73 /usr/lib/systemd/systemd-logind
552 root 20 0 6888 2632 2504 S 0.0 0.1 0:00.11 /usr/sbin/cron -f
553 root 20 0 301M 7328 0 S 0.0 0.4 0:00.00 /usr/libexec/accounts-daemon
553 root 20 0 301M 7328 0 S 0.0 0.4 0:00.00 /usr/libexec/accounts-daemon
587 polkitd 20 0 373M 10108 0 S 0.0 0.5 0:00.72 /usr/lib/polkit-1/polkitd --no-debug --log-level=
588 polkitd 20 0 373M 10108 0 S 0.0 0.5 0:00.00 /usr/lib/polkit-1/polkitd --no-debug --log-level=
589 polkitd 20 0 373M 10108 0 S 0.0 0.5 0:00.04 /usr/lib/polkit-1/polkitd --no-debug --log-level=
591 root 20 0 328M 19188 16244 S 0.0 0.9 0:00.57 /usr/sbin/NetworkManager --no-daemon
592 root 20 0 301M 7328 0 S 0.0 0.4 0:00.01 /usr/libexec/accounts-daemon
608 root 20 0 309M 12176 10256 S 0.0 0.6 0:00.13 /usr/sbin/ModemManager
620 root 20 0 309M 12176 0 S 0.0 0.6 0:00.00 /usr/sbin/ModemManager
625 root 20 0 309M 12176 0 S 0.0 0.6 0:00.00 /usr/sbin/ModemManager
627 root 20 0 309M 12176 0 S 0.0 0.6 0:00.00 /usr/sbin/ModemManager
631 root 20 0 348M 3420 3028 S 0.0 0.2 0:00.00 /usr/sbin/VBoxService
633 root 20 0 348M 3420 0 S 0.0 0.2 0:00.00 /usr/sbin/VBoxService
634 root 20 0 348M 3420 0 S 0.0 0.2 0:00.16 /usr/sbin/VBoxService
635 root 20 0 348M 3420 0 S 0.0 0.2 0:00.47 /usr/sbin/VBoxService
636 root 20 0 348M 3420 0 S 0.0 0.2 0:06.05 /usr/sbin/VBoxService
637 root 20 0 348M 3420 0 S 0.0 0.2 0:00.00 /usr/sbin/VBoxService
638 root 20 0 348M 3420 0 S 0.0 0.2 0:00.49 /usr/sbin/VBoxService
639 root 20 0 348M 3420 0 S 0.0 0.2 0:00.84 /usr/sbin/VBoxService
640 root 20 0 348M 3420 0 S 0.0 0.2 0:00.19 /usr/sbin/VBoxService
641 root 20 0 328M 19188 0 S 0.0 0.9 0:00.00 /usr/sbin/NetworkManager --no-daemon
642 root 20 0 328M 19188 0 S 0.0 0.9 0:00.00 /usr/sbin/NetworkManager --no-daemon
644 root 20 0 328M 19188 0 S 0.0 0.9 0:00.02 /usr/sbin/NetworkManager --no-daemon

F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice F8Nice F9Kill F10Quit
```

Saat melakukan Htop CPU Cuma sekitar 2-3%, load average 0.24/0.12/0.09, hamper tidak ada proses yang berat

## 3. Saat melakukan serangan

```
root@Sukma: /home/sukma

Session Actions Edit View Help

CPU[||||||||||||||||||||||||||||||||||||||||| 82.0%] Tasks: 117, 451 thr, 66 kthr; 1 running
Mem[||||||||||||||||||||||||||||||||||||||||| 1.25G/1.93G] Load average: 0.99 1.11 0.80
Swp[||||||||||||||||| 307M/1.33G] Uptime: 07:18:37

Main I/O
PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
142726 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.00 /usr/sbin/mariadb
142727 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.00 /usr/sbin/mariadb
142728 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.00 /usr/sbin/mariadb
142741 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.00 /usr/sbin/mariadb
142747 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.00 /usr/sbin/mariadb
158808 root 20 0 269M 19248 12192 S 0.0 1.0 0:00.36 /usr/sbin/apache2 -k start
158818 www-data 20 0 270M 10908 3728 S 0.0 0.5 0:00.00 /usr/sbin/apache2 -k start
158823 www-data 20 0 270M 10908 3728 S 0.0 0.5 0:00.00 /usr/sbin/apache2 -k start
158824 www-data 20 0 270M 10908 3728 S 0.0 0.5 0:00.00 /usr/sbin/apache2 -k start
158825 www-data 20 0 270M 10908 3728 S 0.0 0.5 0:00.00 /usr/sbin/apache2 -k start
158829 www-data 20 0 270M 10908 3728 S 0.0 0.5 0:00.00 /usr/sbin/apache2 -k start
172884 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
172885 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.37 /usr/bin/qterminal
172886 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
172887 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
172888 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
172889 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
172890 sukma 20 0 10304 6396 4376 S 0.0 0.3 0:00.10 /usr/bin/zsh
172924 root 20 0 20692 7964 6684 S 0.0 0.4 0:00.19 sudo su
172952 root 20 0 20692 2604 1312 S 0.0 0.1 0:00.00 sudo su
172953 root 20 0 11064 5132 4620 S 0.0 0.3 0:00.00 su
172955 root 20 0 10432 6748 4480 S 0.0 0.3 0:00.88 zsh
181426 mysql 20 0 1095M 128M 0 S 0.0 6.5 0:00.04 /usr/sbin/mariadb
185537 sukma 20 0 2892M 254M 0 S 0.0 12.9 0:00.00 /usr/lib/firefox-esr/firefox-esr
186862 sukma 20 0 559M 58712 0 S 0.0 2.9 0:00.00 /usr/bin/qterminal
188342 root 20 0 21228 8132 6852 S 0.0 0.4 0:00.01 sudo hping3 -S -p 80 -i u10 10.0.2.15
188344 root 20 0 21228 2808 1496 S 0.0 0.1 0:00.00 sudo hping3 -S -p 80 -i u10 10.0.2.15
188490 sukma 20 0 2355M 87752 0 S 0.0 4.3 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188491 sukma 20 0 2359M 97596 0 S 0.0 4.8 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188492 sukma 20 0 2343M 73364 0 S 0.0 3.6 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188493 sukma 20 0 2407M 108M 0 S 0.0 5.5 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188494 sukma 20 0 2343M 62516 0 S 0.0 3.1 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188495 sukma 20 0 2343M 73444 0 S 0.0 3.6 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188496 sukma 20 0 2360M 96336 0 S 0.0 4.8 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188497 sukma 20 0 2370M 79716 0 S 0.0 3.9 0:00.00 /usr/lib/firefox-esr/firefox-esr -contentproc -ch
188650 sukma 20 0 2892M 254M 0 S 0.0 12.9 0:00.04 /usr/lib/firefox-esr/firefox-esr
188651 sukma 20 0 2892M 254M 0 S 0.0 12.9 0:00.01 /usr/lib/firefox-esr/firefox-esr
F1Help F2Setup F3SearchF4FilterF5Free F6SortByF7Nice -F8Nice +F9Kill F10Quit
```

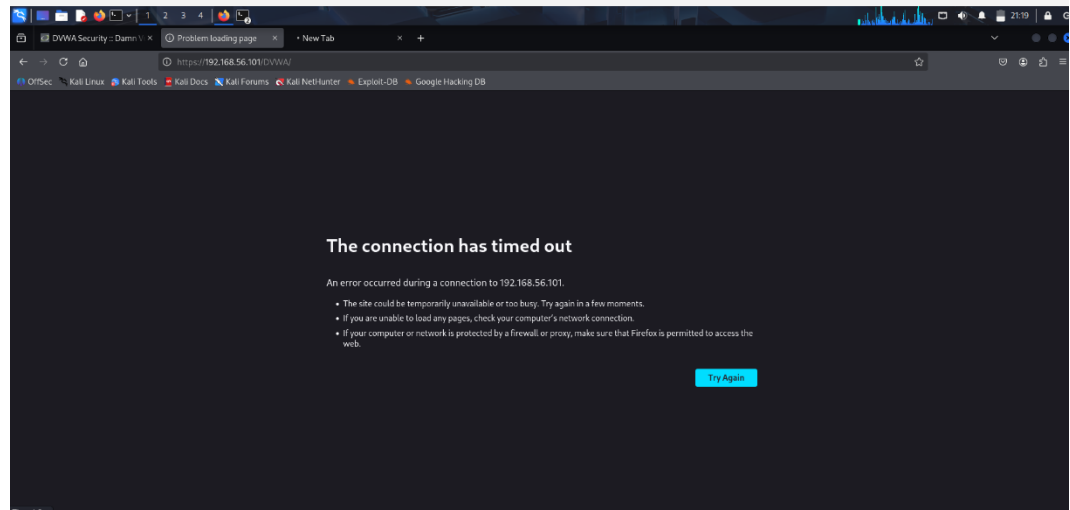
Ini peningkatan CPU 82.0% saat serangan sedang berjalan

```
(root@Sukma)-[/var/www/html]
# watch -n 1 'ss -tn state syn-recv sport = :80 | wc -l'

(root@Sukma)-[/var/www/html]
# sudo hping3 -S -p 80 -i u10 10.0.2.15
HPING 10.0.2.15 (eth0 10.0.2.15): S set, 40 headers + 0 data bytes
```

- Perintah ini menjalankan `ss -tn state syn-recv sport = :80 | wc -l` setiap satu detik, di mana `ss -tn` menampilkan koneksi TCP dalam bentuk numerik, `state syn-recv` memfilter hanya koneksi yang berada pada status SYN-RECV (half-open), `sport = :80` membatasi pada port sumber 80, dan `wc -l` menghitung jumlah baris sehingga diperoleh total koneksi half-open pada port 80; nilai yang kecil pada tahap ini menunjukkan kondisi normal sebelum serangan.

- `sudo hping3 -I -i u10 192.168.56.101` mengirim ICMP echo request berkecepatan sangat tinggi ke 192.168.56.101 untuk melakukan ping flood / ICMP DoS, biasanya dipakai di lab untuk menguji bagaimana server atau firewall merespons serangan ICMP flood.



Pada saat serangan berjalan web di kali itu tidak bisa di buka karena hping3 (SYN flood) mengirim sangat banyak paket SYN ke port 80 sehingga server sibuk membuka koneksi palsu dan tabel koneksinya penuh, Akibatnya permintaan normal dari browser tidak mendapat respon tepat waktu.

```
(root@Sukma)-[/home/sukma]
# sudo iptables -A INPUT -p tcp --syn --dport 80 -m limit --limit 20/second --limit-burst 100 -j ACCEPT
sudo iptables -A INPUT -p tcp --syn --dport 80 -j DROP
sudo iptables -L -n

Chain INPUT (policy ACCEPT)
target    prot opt source                destination
DROP      all  --  192.168.56.102        0.0.0.0/0
ACCEPT    tcp  --  0.0.0.0/0             0.0.0.0/0          tcp dpt:80 flags:0x17/0x02 limit: avg 20/sec burst 100
DROP      tcp  --  0.0.0.0/0             0.0.0.0/0          tcp dpt:80 flags:0x17/0x02

Chain FORWARD (policy ACCEPT)
target    prot opt source                destination

Chain OUTPUT (policy ACCEPT)
target    prot opt source                destination
```

Pada tahap ini diterapkan aturan firewall iptables yang membatasi paket SYN ke port 80 maksimal 20 paket per detik dan menjatuhkan sisanya, sehingga traffic flood dari hping3 tidak lagi membebani web server secara berlebihan. Setelah itu, htop dijalankan kembali untuk mengamati penurunan penggunaan CPU dan stabilitas sistem setelah mitigasi.