

Learning Near-Optimal Intrusion Responses Against Dynamic Attackers

Supplementary Material

IEEE Transactions on Network and Service Management

Attacker Action Commands

<i>Action</i>	<i>Command</i>
TCP SYN scan	<code>nmap -sS -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
UDP port scan	<code>nmap -sU -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
TCP null scan	<code>nmap -sN -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
TCP xmas scan	<code>nmap -sX -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
TCP FIN scan	<code>nmap -sF -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
Ping scan	<code>nmap -sP -min-rate 100000 -max-retries 1 -T5 -n</code>
TCP connection scan	<code>nmap -sT -p- -min-rate 100000 -max-retries 1 -T5 -n</code>
Vulscan	<code>nmap -sV -script=vulscan/vulscan.nse -max-retries 1 -T5 -n</code>
Telnet-brute force	<code>nmap -p 23 -script telnet-brute</code>
SSH brute-force	<code>nmap -p 22 -script ssh-brute</code>
FTP brute-force	<code>nmap -p 21 -script ftp-brute</code>
Cassandra brute-force	<code>nmap -p 9160 -script cassandra-brute</code>
IRC brute-force	<code>nmap -p 6667 -script irc-brute</code>
MongoDB brute-force	<code>nmap -p 27017 -script mongo-brute</code>
MySQL brute-force	<code>nmap -p 27017 -script mysql-brute</code>
SMTP brute-force	<code>nmap -p 25 -script smtp-brute</code>
Postgres brute-force	<code>nmap -p 5432 -script postgres-brute</code>
CVE-2017-7494	<code>python samba_exploit.py</code>
CVE-2015-3306	<code>python /cve_2015_3306_exploit.py</code>
CVE-2010-0426	<code>/cve_2010_0426_exploit.sh</code>
CVE-2015-5602	<code>/cve_2015_5602_exploit.sh</code>
CVE-2014-6271	<code>/cve_2014_6271_exploit.sh</code>
CVE-2016-10033	<code>/cve_2016_10033_exploit.sh</code>
CVE-2015-1427	<code>/cve_2015_1427_exploit.sh</code>
Exploit of the CWE-89 weakness on DVWA [5]	<code>/sql_injection_exploit.sh</code>

Table 1: Attacker commands executed on the emulation system; actions that exploit vulnerabilities in specific software products are identified according to the corresponding vulnerability identifier in the Common Vulnerabilities and Exposures (CVE) database [1]; actions that exploit vulnerabilities that are not available in the CVE database are identified according to the type of the vulnerability they exploit based on the Common Weakness Enumeration (CWE) list [2]; the auxiliary Bash and Python scripts are available at [4].

Defender Action Commands

<i>Stop index</i>	<i>Action</i>	<i>Command</i>
1	Revoke user certificates	<code>openssl ca -revoke <certificate></code>
2	Blacklist IPs	<code>iptables -A INPUT -s <ip> -j DROP</code>
3	Drop traffic that generates IDPS alerts of priority 1	<code>pulledpork.pl -c /pulledpork/etc/1.conf -l -P -E -H SIGHUP</code>
4	Drop traffic that generates IDPS alerts of priority 2	<code>pulledpork.pl -c /pulledpork/etc/2.conf -l -P -E -H SIGHUP</code>
5	Drop traffic that generates IDPS alerts of priority 3	<code>pulledpork.pl -c /pulledpork/etc/3.conf -l -P -E -H SIGHUP</code>
6	Drop traffic that generates IDPS alerts of priority 4	<code>pulledpork.pl -c /pulledpork/etc/4.conf -l -P -E -H SIGHUP</code>
7	Block gateway	<code>iptables -A INPUT -i eth0 -j DROP</code>

Table 2: Defender commands executed on the emulation system; “Pulledpork” is a software framework for rule management in Snort, for more information see [3].

Client Population Commands

<i>Functions</i>	<i>Application servers</i>	<i>Commands</i>
HTTP	N_2, N_3, N_{10}, N_{12}	<code>curl <url></code>
SSH	N_2, N_3, N_{10}, N_{12}	<code>sshpass -p <pw> ssh -oStrictHostKeyChecking=no <hostname></code>
SNMP	$N_2, N_3, N_{10}, N_{12}, N_{31}, N_{13}, N_{14}, N_{15}, N_{16}$	<code>snmpwalk -v2c <hostname></code>
ICMP	N_2, N_3, N_{10}, N_{12}	<code>ping <hostname></code>
IRC	$N_{31}, N_{13}, N_{14}, N_{15}, N_{16}$	<code>./irc_login_test.sh</code>
Postgres	$N_{31}, N_{13}, N_{14}, N_{15}, N_{16}$	<code>psql -h <hostname></code>
FTP	N_{10}, N_{22}, N_4	<code>ftp <hostname></code>
DNS	N_{10}, N_{22}, N_4	<code>nslookup <hostname></code>
Telnet	N_{10}, N_{22}, N_4	<code>telnet <hostname></code>

Table 3: Emulated client population; each client invokes functions on application servers; the auxillary Bash scripts are available at [4].

References

- [1] The MITRE Corporation. Cve database, 2022. <https://cve.mitre.org/>.
- [2] The MITRE Corporation. Cwe list, 2023. <https://cwe.mitre.org/index.html>.
- [3] JJ Cummings and Michael Shirk. Pulledpork, 2023. <https://github.com/shirkdog/pulledpork>.
- [4] Kim Hammar and Rolf Stadler. Supplementary material - learning near-optimal intrusion responses against dynamic attackers, 2023. https://github.com/Limmen/TNSM_Learning_IRS_Supplementary.
- [5] The DVWA team. Damn vulnerable web application (dvwa), 2023. <https://github.com/digininja/DVWA>.