Using and Configuring Security Onion to detect and prevent Web Application Attacks

Ashley Deuble
Detecting and Preventing Web Application Attacks with Security Onion

GIAC (GCIA) Gold Certification

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Abstract

Although web application attacks have existed for over the last 10 years, simple coding errors, failed input validation and output sanitization continue to exist in web applications that have led to disclosures for many well-known companies. The most prevalent web application attacks are SQL Injection, Cross Site Scripting and OS Command Injection. With an increased number of companies conducting business over the Internet, many attackers are taking advantage of lax security and poor coding techniques to exploit web applications for fame, notoriety and financial gain.

There are multiple ways to detect and prevent these vulnerabilities from being exploited and leaking corporate data on the Internet. One method involves using IDS/IPS systems to detect the attack and block or alert appropriate staff of the attack. Security Onion by Doug Burks contains a suite of tools that aid an analyst in detecting these events. Security Onion is a live Xubuntu based distribution containing many of the tools required to perform the detection and prevention of these exploits.
1. Introduction


This paper uses Security Onion release dated 20120405 and investigates how to alert and block on SQL Injection (SQLi), Cross Site Scripting (XSS), and command injection web application attacks. SQLi and XSS vulnerabilities were rated as OWASP’s number 1 and 2 risks in its 2010 report (The Open Web Application Security Project, 2010).

As shown below in figure 1, 37% of attacks for January to June 2011 were targeted towards web applications (Hewlett-Packard, 2011).

**Web application attacks versus non-Web application attacks, January–June 2011**

![Pie chart showing 63% non-web and 37% web application attacks]

Figure 1 – Comparison of attacks

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2. Test Lab Setup

The test lab consists of Security Onion\(^2\), the Damn Vulnerable Web Application (DVWA) distribution\(^3\) and the Samurai WTF distribution\(^4\) (refer to figure 2). Security Onion instances for Snort and Suricata were configured to analyze traffic between the vulnerable web applications in DVWA and the attacking machine (Samurai WTF). One of the main goals of the DVWA distribution is to aid security professionals in testing their skills and tools in a legal environment (Damn Vulnerable Web App, 2011), which makes it a great choice to demonstrate the capabilities of Security Onion.

\[\text{Figure 2 – Lab environment}\]

3. Security Onion for Detection

The latest version of Security Onion can be downloaded from the Security Onion website\(^5\). The recommended procedure for installing Security Onion to the hard drive of a system can be found on the Security Onion wiki site\(^6\).

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\(^3\) [http://www.dvwa.co.uk](http://www.dvwa.co.uk)


\(^5\) [http://securityonion.blogspot.com](http://securityonion.blogspot.com)

3.1. Basic Configuration of Security Onion

Configuring Security Onion can be done quickly using the provided setup tool. The setup tool has two modes when setting up Security Onion:

**Quick Setup**
The Quick Setup process automatically configures most of the applications using Snort and Bro to monitor all network interfaces by default. This setup method is used when the IDS server and the IDS sensor are configured on the same system. The Quick Setup process also configures and enables Sguil, Squert and Snorby.

**Advanced Setup**
Advanced Setup allows more control over the setup of Security Onion. This process is used when an analyst wants to configure a system to:

- Install either a Sguil server, Sguil sensor, or both
- Select either Snort or Suricata IDS engine
- Selecting an IDS ruleset, Emerging Threats, Snort VRT, or both
- Configure network interfaces monitored by the IDS Engine and Bro

Snort is the defacto standard of Open Source IDS engines, while Suricata is an emerging IDS developed by the Open Information Security Foundation. Suricata has many features of Snort, as well as unique capabilities such as multi-threading and additional detection protocols. More information on Suricata can be found on the Open Information Security Foundation website7.

3.2. Advanced Configuration of Security Onion

Advanced configurations of Security Onion may be required in larger complex environments. In these cases Sguil sensors may be distributed to multiple network segments. A conceptual design diagram may look similar to figure 3. In this scenario, the Advanced Setup wizard would be run to configure two Sguil sensors and a Sguil server. Snort or Suricata will monitor the network link for

security events and log them, Barnyard will forward events from the Snort or Suricata logs to the Sguil sensor agent. The Sguil sensor agent will record the entries in the Sguil server database and a separate instance of Snort or Suricata will log the packets to local disks. The Sguil sensors also listen for commands from the Sguil server that request previously logged packet data.

![Diagram of multiple sensors](image)

**Figure 3 – Multiple sensors**

### 3.3. Addition Setup Tasks

In-place upgrades should be performed regularly with the following command to ensure all tools, applications and functionalities are up to date. The upgrade script is cumulative and will upgrade older versions of Security Onion to the most recent version (including updates in between) (Burks, 2012).

```
```

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For installations in a virtual environment, it’s highly recommended the screen saver be disabled. This can be completed in Security Onion by clicking Applications -> Settings -> Screensaver. When the Screensaver Preferences window appears, click the Mode dropdown and select "Disable Screen Saver" or "Blank Screen Only", close the Screensaver Preferences window to save the settings.

3.4. Basic IDS Configuration

During setup, The Security Onion setup tool will configure the selected IDS engine. Important configuration files common to Snort and Suricata can be found in the following locations

/etc/nsm/rules/

This folder contains the IDS engine rules used for detection of events. All rules downloaded with pulledpork will be saved to downloaded.rules and will be specifically for the IDS engine that was selected. All user created rules should be saved into local.rules.

3.4.1. Basic Snort Configuration

Configuration files specific to Snort can be found at the following locations

/etc/nsm/name_of_sensor/Snort.conf

The Snort.conf file is used to configure Snort. Steps to customize the configuration in the Snort.conf file are as follows:

1. Set the network variables.
2. Configure the decoder
3. Configure the base detection engine
4. Configure dynamic loaded libraries
5. Configure preprocessors
6. Configure output plugins
7. Customize the rule set
8. Customize preprocessor and decoder rule set
9. Customize shared object rule set

The Snort sensor should be restarted after any changes have been made to any of the rules or configuration files. Issuing the following command will apply the changes:

```
sudo nsm --sensor --restart --only-Snort-alert
```

### 3.4.2. Basic Suricata Configuration

Important configuration files specific to Suricata can be found in the following locations

```
/etc/nsm/name_of_sensor/Suricata.yaml
```

The Suricata.yaml file is used to configure Suricata. The recommended steps to customize the configuration in the Suricata.yaml file are as follows:

1. Set the network variables of the home network at HOME_NET
2. Set EXTERNAL_NET to !HOME_NET (not the home network). It is also possible to set EXTERNAL_NET to ‘any’ (the same as the default Snort configuration) but this may increase the chances for false-positives.
3. Configure the settings for HTTP_SERVERS, SMTP_SERVERS, SQL_SERVERS, DNS_SERVERS and TELNET_SERVERS (these are set to HOME_NET by default)
4. Configure the HTTP_PORTS, SHELLCODE_PORTS, ORACLE_PORTS and SSH_PORTS port variables to suit the network

After changes have been made to the Suricata rules or configuration files the following command must be issued to restart the sensor:

```
sudo nsm --sensor --restart --only-Snort-alert
```

In this version of Security Onion the “--only-Snort-alert” command line switch applies to the IDS engine that is currently in use (either Snort or Suricata).
4. Writing Custom Rules for Snort and Suricata

Both Snort and Suricata use the same base rule language. Additionally, Suricata has the ability to use the additional protocol keywords HTTP, TLS, FTP and SMB. Rules are broken into two sections, the rule header and rule options (Figure 4). The rule header contains the rule's action, protocol, source IP address/netmask and port, destination IP address/netmask and port, and traffic direction. The rule options can contain alert messages, references (cve, bugtraq, Nessus etc.), revision etc. Information on writing Snort and Suricata rules, as well as detailed descriptions of all the fields can be found in the Snort manual\(^8\) and on the Suricata website\(^9\).

![Snort rule header and options](image)

**Figure 4 – Snort rule**

For a rule to function correctly, it must contain all elements of the rule header, a payload detection rule option (e.g. “content”), as well as the “msg” and "sid" rule options. Without these elements, the IDS engine will fail to parse the rule correctly and will not start.

4.1. Confirming Your IDS Engine is Working

A quick way to verify Snort or Suricata is working correctly, is to create the following rule in the `/etc/nsm/rules/local.rules` file. This alert will trigger on any

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ICMP traffic from the analyst’s workstation to another system (assuming that the analysts IP address is 10.1.1.1).

```
Alert icmp 10.1.1.1 any -> any any (msg:"ICMP"; sid:100002;)
```

From a command prompt on the analyst’s workstation, issue the required ping request and review the alerts in the Sguil console. If the IDS engine is configured and running correctly, the analyst should see a successful response similar to figure 5.

![Figure 5 – Successful alert](image)

### 4.2. Cross-Site Scripting (XSS)

XSS attacks are a type of injection problem, in which malicious scripts is injected into otherwise benign and trusted web sites. XSS attacks occur when an attacker uses a web application to send malicious code, generally in the form of a client side script, to a different end user. Flaws that allow these attacks to succeed are quite widespread and occur anywhere a web application accepts input from a user in the output it generates without validating or encoding it. An attacker can use XSS to send a malicious script to an unsuspecting user. The end user’s browser has no way to know the script should not be trusted, and will execute the script (The Open Web Application Security Project, 2011).

The following code will exploit XSS vulnerabilities

```
<script>alert(1)</script>
```
To exploit this vulnerability the above code would be copied to a field within the vulnerable web application and produce a result similar to figure 6. The output of this attack in Wireshark is shown in figure 7.

![Figure 6 – XSS attack](image)

![Figure 7 – XSS Wireshark output](image)

As seen in the example, this XSS attack utilizes the `<script>` and `</script>` tags. The script tags have been decoded from ascii to hexadecimal format producing the following output.

```
%3Cscript%3Ealert%281%29%3C%2Fscript%3E
```

Both Suricata and Snort will detect and transcode ascii and hexadecimal characters.

There are other formats for XSS attacks, examples of which can be found on the ha.ckers.org XSS (Cross Site Scripting) Cheat Sheet\(^\text{10}\). An analyst can use these references to fine-tune or create additional rules for detecting and blocking other types of Cross Site Scripting attacks.

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\(^{10}\) [http://ha.ckers.org/xss.html](http://ha.ckers.org/xss.html)
4.2.1. Rules to Detect and Block XSS Attacks

Security Onion will detect and alert on the above example Cross Site Scripting attack using the Emerging Threats ruleset located in the downloaded.rules file. To alert and block on XSS attacks all rules must be configured to use the “drop” action as shown below.

**Snort**

```
drop tcp $EXTERNAL_NET any -> $HTTP_SERVERS $HTTP_PORTS
(msg:"ET WEB_SERVER Script tag in URI, Possible Cross Site Scripting Attempt"; flow:to_server,established; content:"</script>"); fast_pattern:only; nocase; http_uri;
reference:url,ha.ckers.org/xss.html;
reference:url,doc.emergingthreats.net/2009714;
classtype:web-application-attack; sid:2009714; rev:6;)
```

**Suricata**

```
drop http $EXTERNAL_NET any -> $HTTP_SERVERS $HTTP_PORTS
(msg:"ET WEB_SERVER Script tag in URI, Possible Cross Site Scripting Attempt"; flow:to_server,established; uricontent:"</script>"); nocase;
reference:url,ha.ckers.org/xss.html;
reference:url,doc.emergingthreats.net/2009714;
classtype:web-application-attack; sid:2009714; rev:5;)
```

4.3. SQL Injection

A SQL Injection attack consists of insertion or "Injection" of a SQL query via input data from the client into the application. A successful SQL Injection exploit can read sensitive data from the database, modify database data (Insert/Update/Delete), execute administration operations on the database (such as shutdown the DBMS), recover the content of a given file present on the DBMS file system and in some cases issue commands to the operating system.
SQL Injection attacks are a type of injection attack, in which SQL commands are injected into data-plane input in order to effect the execution of predefined SQL commands (The Open Web Application Security Project, 2011).

The following code will exploit SQL Injection vulnerabilities.

```sql
' UNION ALL SELECT load_file('C:\xampp\htdocs\dvwa\config\config.inc.php'), '1
```

Like Cross Site Scripting, the above code is entered into a field in the vulnerable application. In this example the page does not display any information to the screen (figure 8) but includes the information within the page source code (figure 9).

```html
<form action='' method='GET'>
    <input type='text' name='id'>
    <input type='submit' name='Submit' value='Submit'>
</form>
</pre>

<!-- 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 digisinja for the fix.
# Database management system to use
$DBMS = 'MySQL';
$DBMS = 'MySQL';
# Database variables
$_DBMS = array();
$_DBMS['db_server'] = 'localhost';
$_DBMS['db_database'] = 'dvwa';
$_DBMS['db_user'] = 'root';
$_DBMS['db_password'] = '';
# Only needed for MySQL
$_DBMS['db_port'] = '5432';
</pre>

`<br>`

Figure 8 – SQL Injection

```html
Figure 9 – Page source from SQL Injection
```

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The Wireshark output of this attack (figure 10) shows this SQL Injection exploit utilizes the “UNION” and “SELECT” functions within SQL.

![Wireshark Output](image)

**Figure 10 – SQL Injection Wireshark output**

### 4.3.1. Rules to Detect and Block SQLi Attacks

Security Onion will detect and alert on SQL Injection attacks using rules from the Emerging Threats ruleset located in the downloaded.rules file.

To alert and block on SQL Injection attacks all rules must be configured to use the “drop” action as shown below.

**Snort**

```snort
drop tcp $EXTERNAL_NET any -> $HTTP_SERVERS $HTTP_PORTS (msg:"ET WEB_SERVER Possible SQL Injection Attempt UNION SELECT"; flow:established,to_server; content:"UNION"; nocase; http_uri; content:"SELECT"; nocase; http_uri; pcre:/UNION.+SELECT.UI"; reference:url,en.wikipedia.org/wiki/SQL_injection; reference:url,doc.emergingthreats.net/2006446; classtype:web-application-attack; sid:2006446; rev:11;)
```
4.4. OS Command Injection

In this example, an application designed to ping an IP address is vulnerable to command execution exploits (figure 11).

The application lets the user enter an IP address, run the ping command and return the result to the screen (figure 12).

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However, with a little bit of basic command line knowledge an attacker can append other commands that will execute on the local machine (figure 13).

The attacker is no longer bound by the programmed intention of this script and can use it for other purposes. In the following example (figure 14), the attacker has run a command to copy netcat to the web server and executed it to create a remote shell to connect to.
Once executed, the attacker has a remote shell connected to the web server where they can issue commands.

Security Onion will detect the transmission of the windows netcat binary over tftp (figure 15).

![Figure 15 – Detection in Sguil](image)

If the analyst has detected a netcat remote shell connection (this is denoted in netcat with the "-e cmd" switch) they could create an IDS rule to trigger on the "-e cmd" switch. To write this rule, they need to know the data to look for in the packets. They can get this information from a Wireshark sample of the http post request when the web application is getting exploited, as shown in figure 16. It is important to note the data of the POST command.

![Figure 16 – Post request](image)

The transfer of traffic captured by Wireshark can be seen in figure 17.

![Figure 17 – Wireshark traffic capture](image)

Using this information, the analyst can create a rule (figure 18) to detect when a command is issued that contains "-e cmd". It is important to note this rule is very
basic and will be prone to generating false alerts. Further tuning of this rule would be required before it could be used on a production environment.

```
alert tcp any any -> any 80 (msg:"netcat command shell switch"; content:"-e=cmd"; std:1000000001;)
```

Figure 18 – Rule to detect netcat command shell

When the rule is triggered the following alert is generated in Sguil (figure 19)

![Sguil alert](image)

Figure 19 – Sguil alert

Further analysis of the malicious traffic will help the analyst write a more robust rule that is less prone to generating false alerts.

### 5. Security Onion for Monitoring and Reporting

#### 5.1. Sguil

Sguil is a graphical interface providing realtime access to events, session data and packet data captured by the Snort or Suricata IDS systems (see figure 20). Sguil facilitates the practice of Network Security Monitoring and event driven analysis (Visscher, 2007).
Figure 20 – Sgui interface

5.1.1. Classifying Events

Classification of detected events makes interpretation of the Sgui and Squert dashboards easier for the analyst. When events are correctly classified and baselined it’s easier to see increases in reconnaissance, or potential unauthorized access traffic. Classification of events is an ongoing task, however the majority of the work can be completed during the initial implementation process. This can be done through the Sgui interface, or by editing the autocat.conf file in /etc/nsm/securityonion to automate the process.

From the Sgui interface, the user can select a function key for the appropriate event classification (shown in Appendix A).

Categorizing Alerts

Both Sgui and Squert classify events into categories. These categories can group similar events together to help an analyst review triggered alerts. For example, any form of ping sweep or port scan could be classified as Category 6 - Reconnaissance/Probes/Scans. All category 6 alerts can be removed from the main console windows allowing the analyst to concentrate other important alerts without having to review noisy traffic.

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Sguil

To manually classify an event in the console, the analyst would highlight the alert and press the appropriate function key associated with the event classification, or right click on the event and choose the appropriate event status. Similarly, if an analyst determines the alerts in the console can be classified as normal traffic, they can highlight the event and press the F8 key to indicate no further action is necessary and the event will be cleared from the console.

Sguil uses the following categories with associated function keys to classify events in the console.

- **F1**: Category I: Unauthorized Root/Admin Access
- **F2**: Category II: Unauthorized User Access
- **F3**: Category III: Attempted Unauthorized Access
- **F4**: Category IV: Successful Denial-of-Service Attack
- **F5**: Category V: Poor Security Practice or Policy Violation
- **F6**: Category VI: Reconnaissance/Probes/Scans
- **F7**: Category VII: Virus Infection
- **F8**: No action necessary
- **F9**: Escalate

If an analyst can't determine how to classify the event, they can escalate the alert by pressing F9. This will move the event into the "Escalated Events" tab in Sguil for further analysis (see figure 21).

Figure 21 – Escalated events in Sguil

In the below scenario (figure 22), the analyst has classified "package management" events as a Category 5 alert (Poor Security Practice or Policy Practice)....
Violation). The analyst can run a query for category 5 events by selecting "Query" -> "Query by Category" -> "Cat V" from the Sguil console.

![Figure 22 – Query by category in Sguil](image)

The analyst can also CTRL-Right Click on an alert ID for full ascii transcript options of the selected event (output shown in figure 23).
Figure 23 – Full ascii transcript for an event

AUTOCAT.CONF
To automate classification of events, an analyst can use the /etc/nsm/securityonion/autocat.conf file. Automated classification of events should be reserved for special cases and not used to classify all the events in the analyst's console.

A standard rule in the autocat.conf file has the following properties

```
erase time||sensor name||source IP||source port||dest IP||dest port||protocol||signature message||category value
```
For the event in Sguil as shown in figure 24, the following basic example rule has been written:

```
none || ANY || ANY || ANY || ANY || ANY || ANY || %REGEXP%%GPL SHELLCODE || 13
```

This rule uses the following options:
- erase time - none (the rule is permanent)
- sensor name - any of the sensors
- source IP - any source IP
- source port - any source port
- destination IP - any destination IP
- destination port - any destination port
- protocol - any protocol
- sig message - a regular expression for any event with "GPL SHELLCODE" in the signature
- category value - Category 3 Attempted Unauthorized Access

Once the sensor is restarted, the categories will start to populate with alerts configured by autocat.conf. Figure 25 displays how a Cross Site Scripting alert gets automatically classified as a category 2 event.
Email Alerting with Sguil

Another functionality Sguil provides is the ability to send email alerts on particular SIDs or Classes when they have been triggered. To configure email alerting, the analyst must perform the following actions:

1. edit /etc/nsm/securityonion/Sguild.email
   a. set Email_Events 1 <- enables email alerts
   b. set SMTP_SERVER mail.domain.com <- configures the SMTP mail server
   c. set EMAIL_RCPT_TO "analyst@company.com" <- configures the email recipient
   d. set EMAIL_FROM "Snort_sensor@company.com" <- configures the email sender
   e. set EMAIL_CLASSES "successful-admin trojan-activity attempted-admin attempted-user" <- class of events that triggered email alerts
   f. set EMAIL_ENABLE_SIDS "2009714" <- specific SID's to generate email alert for

2. restart Sguil with - "sudo nsm_server_ps-restart"

3. check the email configuration with the following command - "head -20 /var/log/nsm/securityonion/Sguild.log"

An example output of a configured Sguild.email configuration file can be found in Appendix B.

Once a SID or class is triggered, Sguil will email an alert to the configured recipients. An example email is shown in figure 26.
5.2. Squert

Squert is a web application used to query and view event data stored in a Sguil database (typically IDS alert data). Squert is a visual tool providing additional context to events through the use of metadata, time series representations and weighted and logically grouped result sets (Halliday, 2011). Squert is not a replacement for the Sguil client, and is not intended to be a realtime (or near realtime) event console.

Squert has the following views to help in the interpretation of data

**Overview Events/Traffic**

![Figure 27 – Squert overview](image)

**Overview of Event Distribution/Classifications**

![Figure 28 – Squert event distribution](image)
Overview of Top Detected Signatures

<table>
<thead>
<tr>
<th>Signature</th>
<th>ID</th>
<th>Last Event</th>
<th>Src</th>
<th>Dist</th>
<th>Count</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET SCAN Sqlmap SQL Injection Scan</td>
<td>2009358</td>
<td>01:59:45</td>
<td>1 1</td>
<td>114</td>
<td>33.43%</td>
<td></td>
</tr>
<tr>
<td>ET WEB_SERVER Possible SQL Injection Attempt SELECT FROM</td>
<td>2006445</td>
<td>01:59:45</td>
<td>1 1</td>
<td>55</td>
<td>16.13%</td>
<td></td>
</tr>
<tr>
<td>ET WEB_SERVER SELECT USER SQL Injection Attempt in URI</td>
<td>2010963</td>
<td>01:59:45</td>
<td>1 1</td>
<td>44</td>
<td>12.9%</td>
<td></td>
</tr>
<tr>
<td>[DDoS] Integrity checksum changed</td>
<td>550</td>
<td>00:59:31</td>
<td>1 1</td>
<td>34</td>
<td>9.97%</td>
<td></td>
</tr>
<tr>
<td>ET WEB_SERVER MYSQL SELECT CONCAT SQL Injection Attempt</td>
<td>2011042</td>
<td>01:59:45</td>
<td>2 2</td>
<td>24</td>
<td>7.04%</td>
<td></td>
</tr>
<tr>
<td>ET SCAN Possible SQLMAP Scan</td>
<td>2012755</td>
<td>01:59:01</td>
<td>1 1</td>
<td>13</td>
<td>3.81%</td>
<td></td>
</tr>
<tr>
<td>GPL NETBROS SMB-D-S IPCs unicode share access</td>
<td>2102466</td>
<td>02:24:31</td>
<td>2 1</td>
<td>9</td>
<td>2.64%</td>
<td></td>
</tr>
<tr>
<td>ET NETBROS Microsoft SRV2 SYS SMB Negotiate ProcessID Function Table Dereference</td>
<td>2012063</td>
<td>03:34:40</td>
<td>1 1</td>
<td>8</td>
<td>2.35%</td>
<td></td>
</tr>
<tr>
<td>GPL WEB_SERVER .htpasswd access</td>
<td>1071</td>
<td>02:53:02</td>
<td>1 1</td>
<td>7</td>
<td>2.05%</td>
<td></td>
</tr>
<tr>
<td>GPL NETBROS SMB IPCs unicode share access</td>
<td>2100538</td>
<td>02:45:09</td>
<td>1 1</td>
<td>5</td>
<td>1.47%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 29 – Squert top signatures

Percentages of Detected Signatures

- ET SCAN Sqlmap SQL Injection Scan (114)
- ET WEB_SERVER Possible SQL Injection Attempt SELECT FROM (55)
- ET WEB_SERVER SELECT USER SQL Injection Attempt in URI (44)
- [DDoS] Integrity checksum changed (34)
- ET WEB_SERVER MYSQL SELECT CONCAT SQL Injection Attempt (24)
- ET SCAN Possible SQLMAP Scan (13)
- GPL NETBROS SMB-D-S IPCs unicode share access (9)
- ET NETBROS Microsoft SRV2 SYS SMB Negotiate ProcessID Function Table Dereference (8)
- GPL WEB_SERVER .htpasswd access (7)
- GPL NETBROS SMB IPCs unicode share access (5)

Figure 30 – Squert percentage of detected signatures

Overview of Top IPs and Ports

Figure 31 – Squert top IPs
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5.3. Tuning Security Onion

After a sensor has been deployed for a while, an analyst will likely find a few events causing Sguil to fill up, or lots of false positives. These events make it hard for the analyst to determine an actual attack.

5.3.1. Thresholds

One way to deal with excessive events is to adjust alerting threshold settings with the threshold.conf file.

Figure 32 – Squert top ports

Figure 33 – Squert detailed view of detected traffic

Query View of all Detected Traffic

<table>
<thead>
<tr>
<th>Count</th>
<th>Src</th>
<th>Dst</th>
<th>Signature</th>
<th>SigID</th>
<th>Port</th>
<th>Last Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>2</td>
<td>1</td>
<td>GPI NETBIOS SMB-OS IPCs unicode share access</td>
<td>2300446</td>
<td>TCP</td>
<td>12-01-04 05:34:43</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>1</td>
<td>ET NETBIOS Microsoft SRV2 SYS SMB Negotiate ProcessID Function Table Dereference</td>
<td>2102683</td>
<td>TCP</td>
<td>12-01-04 05:34:42</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>PADS New Asset - unknown unknown</td>
<td>1071</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>GPL WEB SERVER - unknown access</td>
<td>2004184</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
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<td>3</td>
<td>32</td>
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<td>URL 172.16.198.337</td>
<td>420642</td>
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<td>5</td>
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<td>1</td>
<td>GPL NETBIOS SMB IPCs unicode share access</td>
<td>2300358</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>ET WEB_SERVER Possible SQL Injection Attempt SELECT FROM</td>
<td>2004184</td>
<td>PP</td>
<td>12-01-04 02:59:52</td>
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<tr>
<td>4</td>
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<td>1</td>
<td>ET WEB_SERVER SELECT USER SQL Injection Attempt in (UN)</td>
<td>2013002</td>
<td>PP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>ET SCAN SQL Injection Scan</td>
<td>2003003</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
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<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>ET WEB_SERVER MYSQL SELECT CONCAT SQL Injection Attempt</td>
<td>2013002</td>
<td>PP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>ET SCAN Possible SQLMAP Scan</td>
<td>2013002</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>ET SHIELD Code Refiling Shellcode</td>
<td>2004184</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>GPI NETBIOS SMB-OS IPCs share access</td>
<td>2300446</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>ET POLICY HTTP traffic on port 443 (OPTIONS)</td>
<td>2013002</td>
<td>TCP</td>
<td>12-01-04 02:59:52</td>
</tr>
</tbody>
</table>

Report Period: Between Friday Jan 6, 2012 00:00:00 and Friday Jan 6, 2012 23:59:59 (2 day)
Distinct Event(s): 30
Total Event(s): 503
Last Event: 12-01-04 05:34:42 (9.55 minutes ago)
Query Time: 0.000 seconds
Initial Configuration

The required file to be edited is located at `/etc/nsm/sensor-name/threshold.conf`. Once a change has been made, it is important to restart the sensor.

For Suricata users, ensure that the threshold-file config variable is uncommented and set in the `/etc/nsm/sensor-name/Suricata.yaml` file.

For Snort users, ensure that "include threshold.conf" has been added to `/etc/nsm/sensor-name/Snort.conf`.

Setting the Thresholds

In figure 34, a rule triggered an alert 111 times from the same source IP address. Depending on the elapsed time frame this could be seen as being excessive.

Figure 34 – Alert to threshold

The first thing the analyst needs to do is note the signature ID (in this example, sid:2013504) and if they want to make advance configurations, the source and destination addresses.
Threshold commands in the configuration file follow the format of

```plaintext
threshold gen_id gen-id, sig_id sig-id, type limit|threshold|both, track by_src|by_dst, count n , seconds m
```

To limit alerts for the event detected in figure 42, the analyst would configure the following threshold rule

```plaintext
threshold gen_id 1, sig_id 2013504, type limit, track by_src, count 1, seconds 60
```

This rule will ensure only 1 alert is generated by each source IP every 60 seconds. To limit alerts generated for source IP address 192.168.44.137 the following rule would be written

```plaintext
threshold gen_id 1, sig_id 2013504, type limit, track by_src, ip 192.168.44.137, count 1, seconds 60
```

To suppress this event completely the following threshold is configured.

```plaintext
suppress gen_id 1, sig_id 2013504
```

### 5.3.2. Disabling Rules with Pulledpork

Another way to prevent events from triggering an alert would be use Pulledpork. Pulledpork disable’s signatures when a new ruleset is downloaded. To disable this rule, the following line would be added to `/etc/pulledpork/disablesid.conf` file:

```plaintext
1:2013504
```
After this change, the pulledpork_update.sh script must be run and the IDS engine is restarted for the changes to take effect.

6. Conclusion

Although web applications have been around for over 10 years, new and old vulnerable applications are still being found that are trivial to exploit. Implementing robust IPS/IDS solution such as those found on Security Onion is a viable solution to detect and block these attacks, which should be incorporated into a larger layered security approach.

Security Onion is quickly evolving and adding many new tools on a regular basis, largely in part to their very active user base. The distribution allows an analyst to configure and run an intrusion detection system with full monitoring and reporting capability in just a matter of minutes.
7. References


http://code.google.com/p/dvwa/wiki/README

http://www.Squertproject.org/


The Open Web Application Security Project. (2011, August 12). *Cross-site Scripting (XSS).* Retrieved from OWASP:
https://www.owasp.org/index.php/Cross-site_Scripting_(XSS)

The Open Web Application Security Project. (2011, June 12). *SQL Injection.* Retrieved from OWASP:
https://www.owasp.org/index.php/SQL_Injection

http://Sguil.sourceforge.net/
8. Appendix

8.1. Appendix A

Function keys used with Sguil to categorize events shown in the console

<table>
<thead>
<tr>
<th>Function Key</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Category I - Unauthorized Root/Admin Access</td>
</tr>
<tr>
<td>F2</td>
<td>Category II - Unauthorized User Access</td>
</tr>
<tr>
<td>F3</td>
<td>Category III - Attempted Unauthorized Access</td>
</tr>
<tr>
<td>F4</td>
<td>Category IV - Successful Denial of Service</td>
</tr>
<tr>
<td>F5</td>
<td>Category V - Poor Security Practice or Policy Violation</td>
</tr>
<tr>
<td>F6</td>
<td>Category VI - Reconnaissance/Probes/Scans</td>
</tr>
<tr>
<td>F7</td>
<td>Category VII - Virus Infection</td>
</tr>
<tr>
<td>F8</td>
<td>No Action Necessary</td>
</tr>
<tr>
<td>F9</td>
<td>Escalate</td>
</tr>
</tbody>
</table>
8.2. Appendix B

Output of a configured squild.email configuration file

```
root@SecOnionSnort:/etc/nsm/securityonion# head -20 /var/log/nsm/securityonion/Sguild.log
Executing: Sguild -c /etc/nsm/securityonion/Sguild.conf -a /etc/nsm/securityonion/autocat.conf -g /etc/nsm/securityonion/Sguild.queries -A /etc/nsm/securityonion/Sguild.access -C /etc/nsm/securityonion/certs
2012-04-28 06:58:03 pid(5248)  Loading access list: /etc/nsm/securityonion/Sguild.access
2012-04-28 06:58:03 pid(5248)  Sensor access list set to ALLOW ANY.
2012-04-28 06:58:03 pid(5248)  Client access list set to ALLOW ANY.
2012-04-28 06:58:03 pid(5248)  Adding AutoCat Rule:
     ||ANY||ANY||ANY||ANY||ANY||ANY||%%REGEXP%%^URL||1
2012-04-28 06:58:03 pid(5248)  Adding AutoCat Rule:
     ||ANY||ANY||ANY||ANY||ANY||ANY||ET WEB_SERVER Script tag in URI, Possible Cross Site Scripting Attempt||12
2012-04-28 06:58:03 pid(5248)  Email Configuration:
2012-04-28 06:58:03 pid(5248)    Config file: /etc/Sguild/Sguild.email
2012-04-28 06:58:03 pid(5248)    Enabled: Yes
2012-04-28 06:58:03 pid(5248)    Server: mail.domain.com
2012-04-28 06:58:03 pid(5248)    Rcpt To: analyst@company.com
2012-04-28 06:58:03 pid(5248)    From: Snort_sensor@company.com
2012-04-28 06:58:03 pid(5248)    Classes: successful-admin trojan-activity attempted-admin attempted-user
2012-04-28 06:58:03 pid(5248)    Priorities: 0
```
Detecting and Preventing Web Application Attacks with Security Onion

Ashley Deuble, ash@ash-d.net

<table>
<thead>
<tr>
<th>Time</th>
<th>PID</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>Disabled Sig IDs: 0</td>
</tr>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>Enabled Sig IDs: 2009714</td>
</tr>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>Connecting to localhost on 3306 as Sguil</td>
</tr>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>MySQL Version: version 5.1.41-3ubuntu12.10</td>
</tr>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>SguilDB Version: 0.13</td>
</tr>
<tr>
<td>06:58:03</td>
<td>5248</td>
<td>Creating event MERGE table.</td>
</tr>
<tr>
<td>Training Name</td>
<td>City, Country</td>
<td>Dates</td>
</tr>
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<td>---------------</td>
<td>------------------------</td>
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<td>Feb 25, 2019 - Mar 03, 2019</td>
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<tr>
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<tr>
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<td>Arlington, VAUS</td>
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<tr>
<td>SANS Muscat April 2019</td>
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<td>Apr 27, 2019 - May 02, 2019</td>
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