GEEK FLARE

Apache Web Server Hardening & Security Guide

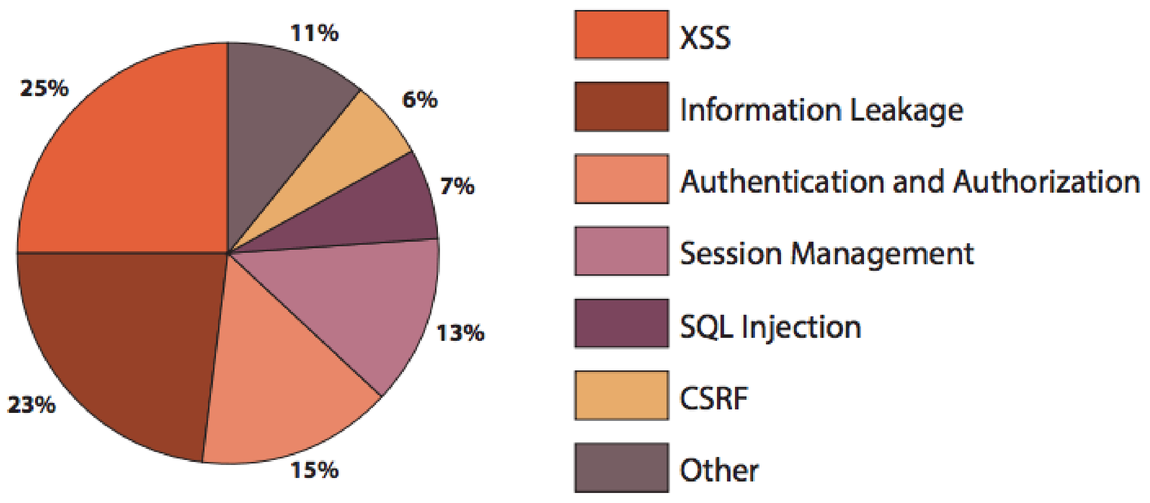
A practical guide to secure and harden Apache Web Server.

1. Introduction

The Web Server is a crucial part of web-based applications. Apache Web

Server is often placed at the edge of the network hence it becomes one of the most vulnerable services to attack. Having default configuration supply much sensitive information which may help hacker to prepare for an attack the web server.

The majority of web application attacks are through XSS, Info Leakage, Session Management and PHP Injection attacks which are due to weak programming code and failure to sanitize web application infrastructure. According to the security vendor Cenzic, 96% of tested applications have vulnerabilities. Below chart from Cenzic shows the vulnerability trend report of 2013.



This practical guide provides you the necessary skill set to secure Apache Web Server. In this course, we will talk about how to Harden & Secure Apache Web Server on Unix platform. Following are tested on Apache 2.4.x and I don't see any reason it won't work with Apache 2.2.x.

1. This assumes you have installed Apache on UNIX platform. If not, you can go through Installation guide. You can also refer very free video about how to Install Apache, MySQL & PHP.
2. We will call Apache installation directory /opt/apache as $Web_Server

throughout this course.

3. You are advised to take a backup of existing configuration file before any modification.

Contents

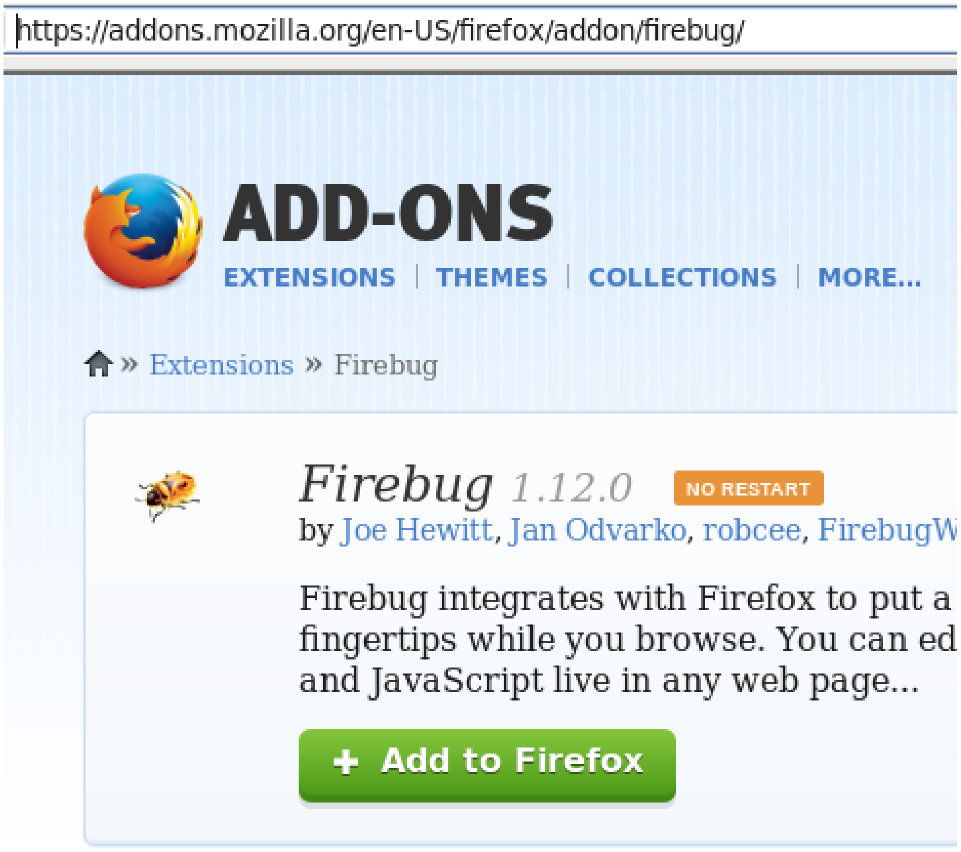
1.1 Audience

This is designed for Middleware Administrator, Application Support, System Analyst, or anyone working or eager to learn Hardening & Security guidelines. Fair knowledge of Apache Web Server & UNIX command is mandatory.

2. Information Leakage

In default Apache configuration you would have much sensitive information disclosures, which can be used to prepare for an attack. It's one of the most critical tasks for an administrator to understand and secure them. As per report by Cenzic, 16% of vulnerability is found in Info leakage. We require some tool to examine HTTP Headers for verification. Let's do this by install firebug add-on in Firefox.

- Open Firefox
- Access https://addons.mozilla.org/en-US/firefox/addon/firebug/
- Click on Add to Firefox


https://addons.mozilla.org/en-US/firefox/addon/firebug/

Firebug 1.12.0 NO RESTART
by Joe Hewitt, Jan Odvarko, robcee, FirebugW

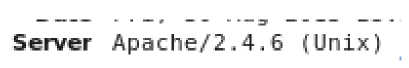
Firebug integrates with Firefox to put a
fingertips while you browse. You can ed
and JavaScript live in any web page...

- Click on Install Now
- Restart Firefox
- You can see firebug icon at right top bar

We will use this icon to open firebug console to view HTTP Headers information. There are many online tools also available which helps to check in HTTP header information.

2.1 Remove Server Version Banner

I would say this is one of the first things to consider, as you don't want to expose what web server version you are using. Exposing version means you are helping hacker to speedy the reconnaissance process. The default configuration will expose Apache Version and OS type as shown below.


```
Server  Apache/2.4.6 (Unix)
```

Implementation:

- Go to $Web_Server/conf folder
- Modify httpd.conf by using vi editor
- Add the following directive and save the httpd.conf

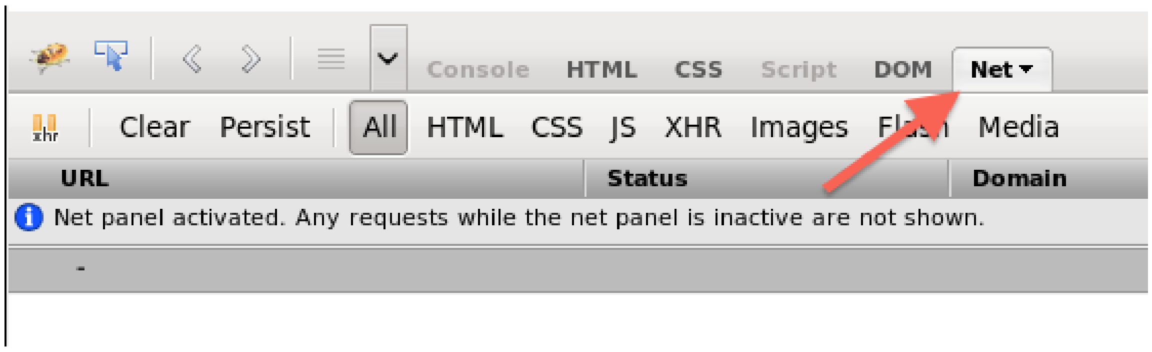
```
ServerTokens Prod
ServerSignature Off
```

- Restart apache

ServerSignature will remove the version information from the page generated like 403, 404, 502, etc. by apache web server. ServerTokens will change Header to production only, i.e. Apache

Verification:

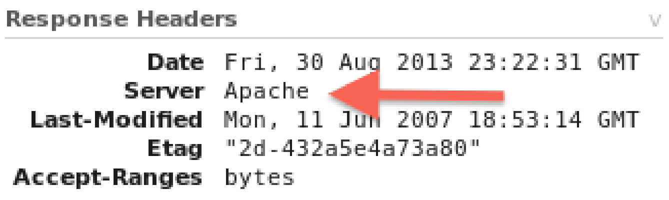
- Open Firefox
- Activate firebug by clicking firebug icon at top right side
- Click on Net tab



Net panel activated. Any requests while the net panel is inactive are not shown.

- Hit the URL in address bar
- Expand the GET request and you could see Server directive is just

showing Apache, which is much better than exposing version and OS type.



```
Response Headers
         Date  Fri, 30 Aug 2013 23:22:31 GMT
       Server  Apache
Last-Modified  Mon, 11 Jun 2007 18:53:14 GMT
         Etag  "2d-432a5e4a73a80"
Accept-Ranges  bytes
```

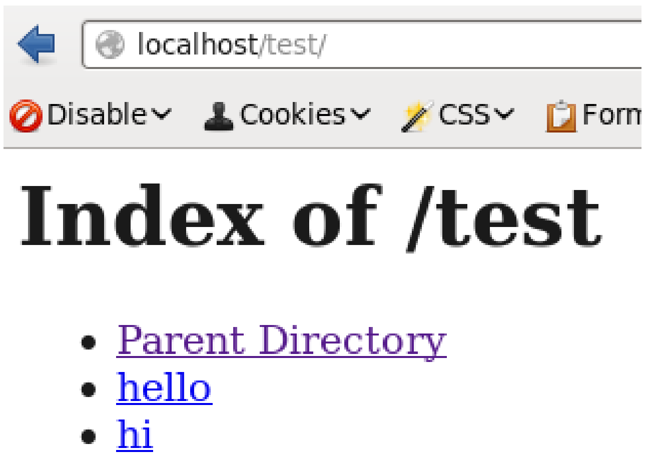
2.2 Disable directory browser listing

Disable directory listing in a browser so the visitor doesn't see what all file and folders you have under root or subdirectory. Let's test how does it look like in default settings.

- Go to $Web_Server/htdocs directory
- Create a folder and few files inside that

```
# mkdir test
# touch hi
# touch hello
```

Now, let's try to access Apache by http://localhost/test



Index of /test

- Parent Directory
- hello
- hi

As you could see it reveals what all file/folders you have which are certainly you don't want to expose.

Implementation:

- Go to $Web_Server/conf directory
- Open httpd.conf using vi
- Search for Directory and change Options directive to **None** or **–Indexes**

```
<Directory /opt/apache/htdocs>
Options None
Order allow,deny
Allow from all
</Directory>
```

(or)

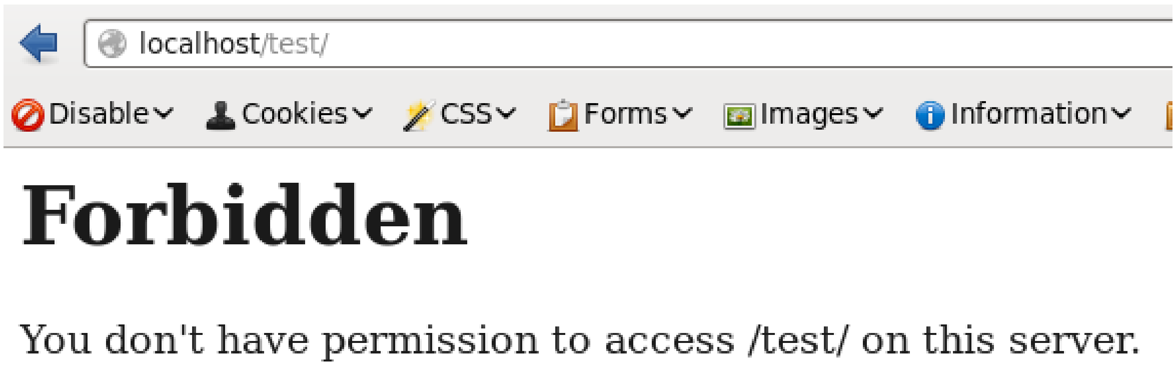
```
<Directory /opt/apache/htdocs>
Options -Indexes
Order allow,deny
Allow from all
</Directory>
```

- Restart Apache

Note: if you have multiple Directory directives in your environment, you should consider doing the same for all.

Verification:

Now, let's try to access Apache by http://localhost/test



Forbidden

You don't have permission to access /test/ on this server.

As you could see, it displays forbidden error instead showing test folder listing.

2.3 Etag

It allows remote attackers to obtain sensitive information like inode number, multipart MIME boundary, and child process through Etag header. To prevent this vulnerability, let’s implement it as below. This is required to fix for PCI compliance.

Implementation:

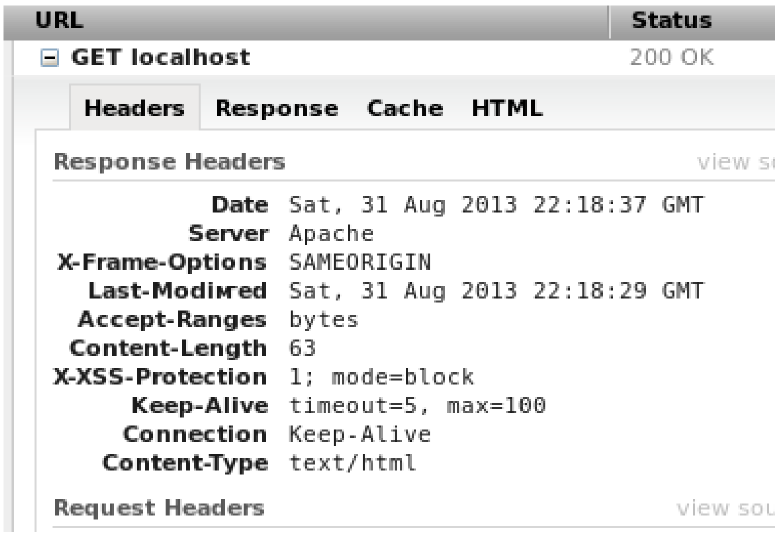
- Go to $Web_Server/conf directory
- Add the following directive and save the httpd.conf

```
FileETag None
```

- Restart apache

Verification:

- Open Firefox and access your application
- Check HTTP response headers in firebug, you should not see Etag at all.


URL | Status
GET localhost 200 OK
Headers Response Cache HTML

```
Response Headers
             Date  Sat, 31 Aug 2013 22:18:37 GMT
           Server  Apache
  X-Frame-Options  SAMEORIGIN
    Last-Modified  Sat, 31 Aug 2013 22:18:29 GMT
    Accept-Ranges  bytes
   Content-Length  63
 X-XSS-Protection  1; mode=block
       Keep-Alive  timeout=5, max=100
       Connection  Keep-Alive
     Content-Type  text/html
Request Headers
```

3. Authorization

3.1 Run Apache from non-privileged account

Default apache configuration is to run as nobody or daemon. It's good to use a separate non-privileged user for Apache. The idea here is to protect other services running in case of any security hole.

Implementation:

- Create a user and group called apache

```
#groupadd apache
# useradd –G apache apache
```

- Change apache installation directory ownership to newly created non-privileged user

```
# chown –R apache:apache /opt/apache
```

- Go to $Web_Server/conf
- Modify httpd.conf using vi

- Search for User & Group Directive and change as non-privileged account apache

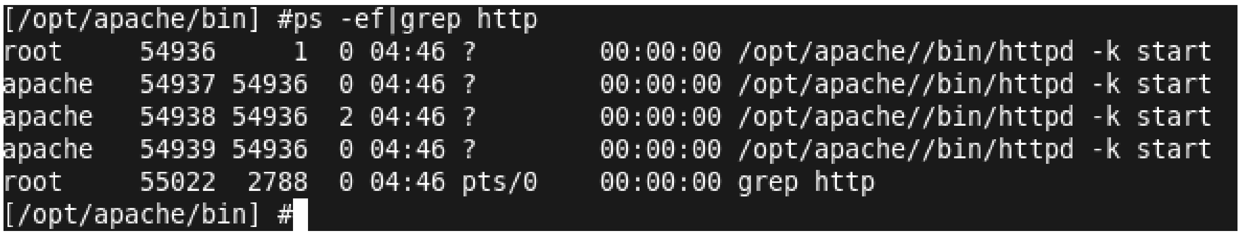
```
User apache
Group apache
```

- Save the httpd.conf
- Restart Apache

Verification:

grep for running http process and ensure it's running with apache user

```
# ps –ef |grep http
```



```
[/opt/apache/bin] #ps -ef|grep http
root     54936     1  0 04:46 ?        00:00:00 /opt/apache//bin/httpd -k start
apache   54937 54936  0 04:46 ?        00:00:00 /opt/apache//bin/httpd -k start
apache   54938 54936  2 04:46 ?        00:00:00 /opt/apache//bin/httpd -k start
apache   54939 54936  0 04:46 ?        00:00:00 /opt/apache//bin/httpd -k start
root     55022  2788  0 04:46 pts/0    00:00:00 grep http
[/opt/apache/bin] #
```

Note: You could see one process is running with root. That's because Apache is listening on port 80 and it has to be started with root. We will talk about how to change port number later in this course.

3.2 Protect binary and configuration directory permission

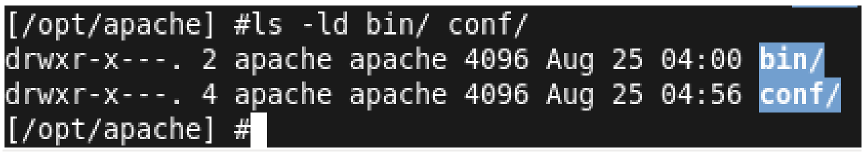
By default, permission for binary and configuration is 755 that mean any user on a server can view the configuration. You can disallow another user to get into conf and bin folder.

Implementation:

- Go to $Web_Server directory
- Change permission of bin and conf folder

```
# chmod –R 750 bin conf
```

Verification:



```
[/opt/apache] #ls -ld bin/ conf/
drwxr-x---. 2 apache apache 4096 Aug 25 04:00 bin/
drwxr-x---. 4 apache apache 4096 Aug 25 04:56 conf/
[/opt/apache] #
```

3.3 System Settings Protection

In a default installation, users can override apache configuration using .htaccess. if you want to stop users changing your apache server settings, you can add AllowOverride to None as shown below. This must be done at the root level.

Implementation:

- Go to $Web_Server/conf directory
- Open httpd.conf using vi
- Search for Directory at root level

```
<Directory />
Options -Indexes
AllowOverride None
</Directory>
```

- Save the httpd.conf
- Restart Apache

3.4 HTTP Request Methods

HTTP 1.1 protocol support many request methods which may not be required and some of them are having potential risk. Typically you may just need GET, HEAD, POST request methods in a web application, which can be configured in the respective Directory directive. Default apache configuration support OPTIONS, GET, HEAD, POST, PUT, DELETE, TRACE, CONNECT method in HTTP 1.1 protocol.

Implementation:

- Go to $Web_Server/conf directory
- Open httpd.conf using vi
- Search for Directory and add following

```
<LimitExcept GET POST HEAD>
deny from all
</LimitExcept>
```

4. Web Application Security

Apache web server misconfiguration or not hardened properly can exploit web application. It’s critical to harden your web server configuration.

4.1 Cookies

4.1.1 Disable Trace HTTP Request

By default Trace method is enabled in Apache web server. Having this enabled can allow Cross Site Tracing attack and potentially giving an option to a hacker to steal cookie information. Let’s see how it looks like in default configuration.

- Do a telnet web server IP with listening port
- Make a TRACE request as shown below

```
#telnet localhost 80
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
TRACE / HTTP/1.1 Host: test
HTTP/1.1 200 OK
Date: Sat, 31 Aug 2013 02:13:24 GMT
Server: Apache
Transfer-Encoding: chunked
Content-Type: message/http 20
TRACE / HTTP/1.1
Host: test 0
Connection closed by foreign host.
#
```

As you could see in above TRACE request it has responded my query. Let's disable it and test it.

Implementation:

- Go to $Web_Server/conf directory
- Add the following directive and save the httpd.conf

```
TraceEnable off
```

- Restart apache

Verification:

- Do a telnet web server IP with listen port and make a TRACE request as shown below

```
#telnet localhost 80
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
TRACE / HTTP/1.1 Host: test
HTTP/1.1 405 Method Not Allowed
Date: Sat, 31 Aug 2013 02:18:27 GMT
Server: Apache Allow:
Content-Length: 223
Content-Type: text/html; charset=iso-8859-1 <!DOCTYPE HTML PUBLI
C "-//IETF//DTD HTML 2.0//EN"> <html><head> <title>405 Method Not
Allowed</title> </head><body> <h1>Method Not Allowed</h1>
<p>The requested method TRACE is not allowed for the URL /.</p> </b
ody></html>
Connection closed by foreign host.
#
```

As you could see in above TRACE request it has blocked my request with HTTP 405 Method Not Allowed. Now, this web server doesn't allow TRACE request and help in blocking Cross Site Tracing attack.

4.1.2 Set cookie with HttpOnly and Secure flag

You can mitigate most of the common Cross Site Scripting attack using HttpOnly and Secure flag in a cookie. Without having HttpOnly and Secure, it is possible to steal or manipulate web application session and cookies and it's dangerous.

Implementation:

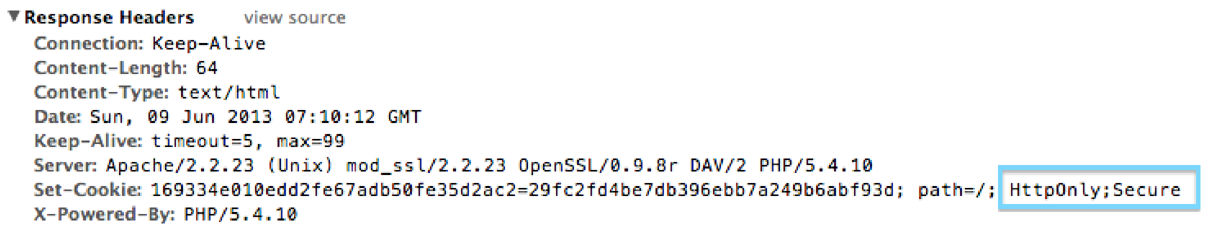
- Ensure mod_headers.so is enabled in your httpd.conf
- Go to $Web_Server/conf directory
- Add the following directive and save the httpd.conf

```
Header edit Set-Cookie ^(.*)$ $1;HttpOnly;Secure
```

- Restart apache

Verification:

- Open Firefox and access your application
- Check HTTP response headers in firebug, you should see Set-Cookie is flagged with HttpOnly and Secure as shown below.



```
▼Response Headers        view source
  Connection: Keep-Alive
  Content-Length: 64
  Content-Type: text/html
  Date: Sun, 09 Jun 2013 07:10:12 GMT
  Keep-Alive: timeout=5, max=99
  Server: Apache/2.2.23 (Unix) mod_ssl/2.2.23 OpenSSL/0.9.8r DAV/2 PHP/5.4.10
  Set-Cookie: 169334e010edd2fe67adb50fe35d2ac2=29fc2fd4be7db396ebb7a249b6abf93d; path=/; HttpOnly;Secure
  X-Powered-By: PHP/5.4.10
```

4.2 Clickjacking Attack

Clickjacking is well-known web application vulnerabilities. You can refer my previous post Secure Your Web Site from Clickjacking Attack.

Implementation:

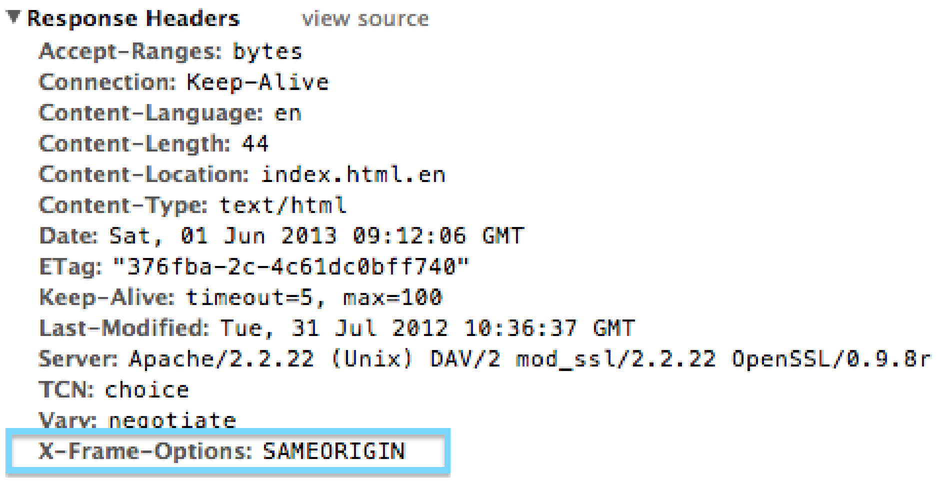
- Ensure mod_headers.so is enabled in your httpd.conf
- Go to $Web_Server/conf directory
- Add the following directive and save the httpd.conf

```
Header always append X-Frame-Options SAMEORIGIN
```

- Restart apache

Verification:

- Open Firefox and access your application
- Check HTTP response headers in firebug, you should see X-Frame-Options as shown below.



```
▼ Response Headers        view source
    Accept-Ranges: bytes
    Connection: Keep-Alive
    Content-Language: en
    Content-Length: 44
    Content-Location: index.html.en
    Content-Type: text/html
    Date: Sat, 01 Jun 2013 09:12:06 GMT
    ETag: "376fba-2c-4c61dc0bff740"
    Keep-Alive: timeout=5, max=100
    Last-Modified: Tue, 31 Jul 2012 10:36:37 GMT
    Server: Apache/2.2.22 (Unix) DAV/2 mod_ssl/2.2.22 OpenSSL/0.9.8r
    TCN: choice
    Vary: negotiate
    X-Frame-Options: SAMEORIGIN
```

4.3 Server Side Include

Server Side Include (SSI) has a risk of increasing the load on the server. If you have shared the environment and heavy traffic web applications you should consider disabling SSI by adding Includes in Options directive. SSI attack allows the exploitation of a web application by injecting scripts in HTML pages or executing codes remotely.

Implementation:

- Go to $Web_Server/conf directory
- Open httpd.conf using vi
- Search for Directory and add Includes in Options directive

```
<Directory /opt/apache/htdocs>
Options –Indexes -Includes
Order allow,deny
Allow from all
</Directory>
```

- Restart Apache

Note: if you have multiple Directory directives in your environment, you should consider doing the same for all.

4.4 X-XSS Protection

Cross Site Scripting (XSS) protection can be bypassed in many browsers. You can apply this protection for a web application if it was disabled by the user. This is used by a majority of giant web companies like Facebook, twitter, Google, etc.

Implementation:

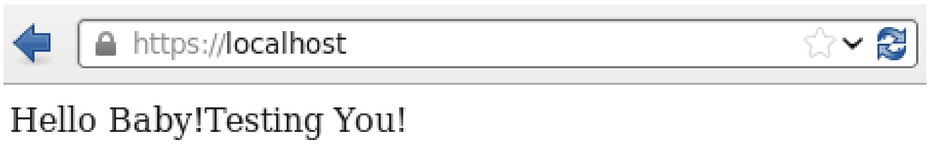
- Go to $Web_Server/conf directory
- Open httpd.conf using vi and add following Header directive

```
Header set X-XSS-Protection “1; mode=block”
```

- Restart Apache

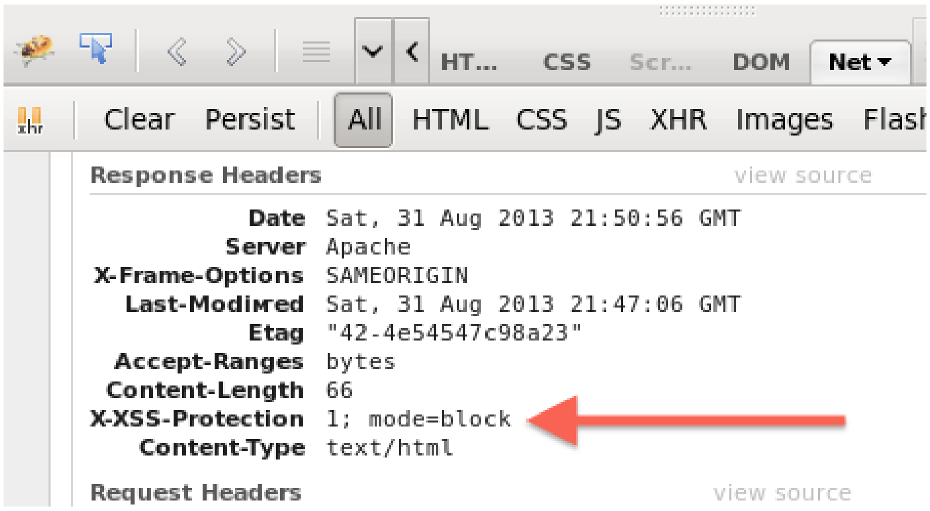
Verification:

- Open Firefox and access your application
- Check HTTP response headers in firebug, you should see XSS Protection is enabled and a mode is blocked.



https://localhost

Hello Baby!Testing You!



```
Response Headers                                view source
            Date  Sat, 31 Aug 2013 21:50:56 GMT
          Server  Apache
 X-Frame-Options  SAMEORIGIN
   Last-Modified  Sat, 31 Aug 2013 21:47:06 GMT
            Etag  "42-4e54547c98a23"
   Accept-Ranges  bytes
  Content-Length  66
X-XSS-Protection  1; mode=block
    Content-Type  text/html
Request Headers                                 view source
```

4.5 Disable HTTP 1.0 Protocol

When we talk about security, we should protect as much we can. So why do we use older HTTP version of the protocol, let's disable them as well? HTTP 1.0 has security weakness related to session hijacking. We can disable this by using the mod_rewrite module.

Implementation:

- Ensure to load mod_rewrite module in httpd.conf file
- Enable RewriteEngine directive as following and add Rewrite condition to allow only HTTP 1.1

```
RewriteEngine On
RewriteCond %{THE_REQUEST} !HTTP/1.1$
RewriteRule .* - [F]
```

4.6 Timeout value configuration

By default Apache time-out value is 300 seconds, which can be a victim of Slow Loris attack and DoS. To mitigate this you can lower the timeout value to maybe 60 seconds.

Implementation:

- Go to $Web_Server/conf directory
- Open httpd.conf using vi
- Add following in httpd.conf

```
Timeout 60
```

5. SSL

Having SSL is an additional layer of security you are adding into Web Application. However, default SSL configuration leads to certain vulnerabilities and you should consider tweaking those configurations. We require some tool to verify SSL settings. There are much available however, I would use SSL-Scan free tool. You can download from http://sourceforge.net/projects/sslscan/

5.1 SSL Key

Breaching SSL key is hard, but not impossible. It’s just matter of computational power and time. As you might know using a 2009-era PC cracking away for around 73 days you can reverse engineer a 512-bit key. So the higher key length you have, the more complex it becomes to break SSL key. The majority of giant Web Companies use 2048 bit key, as below so why don’t we?

- Outlook.com
- Microsoft.com

- Live.com
- Skype.com
- Apple.com
- Yahoo.com
- Bing.com
- Hotmail.com
- Twitter.com

Implementation:

- You can use openssl to generate CSR with 2048 bit as below.
- Generate self-signed certificate

```
openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout localhost.
key -out localhost.crt
```

- Generate new CSR and private key

```
openssl req -out localhost.csr -new -newkey rsa:2048 -nodes -keyout loc
alhost.key
```

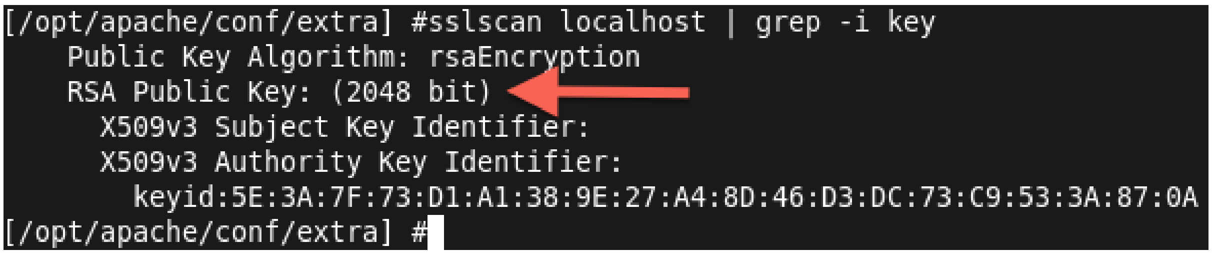
- Add Personal Cert, Signer Cert and Key file in httpd-ssl.conf file under below directive

```
SSLCertificateFile # Personal Certificate
SSLCertificateKeyFile # Key File
SSLCACertificateFile # Signer Cert file
```

Verification:

Execute sslscan utility with the following parameter. Change localhost to your actual domain name.

```
sslscan localhost | grep –i key
```



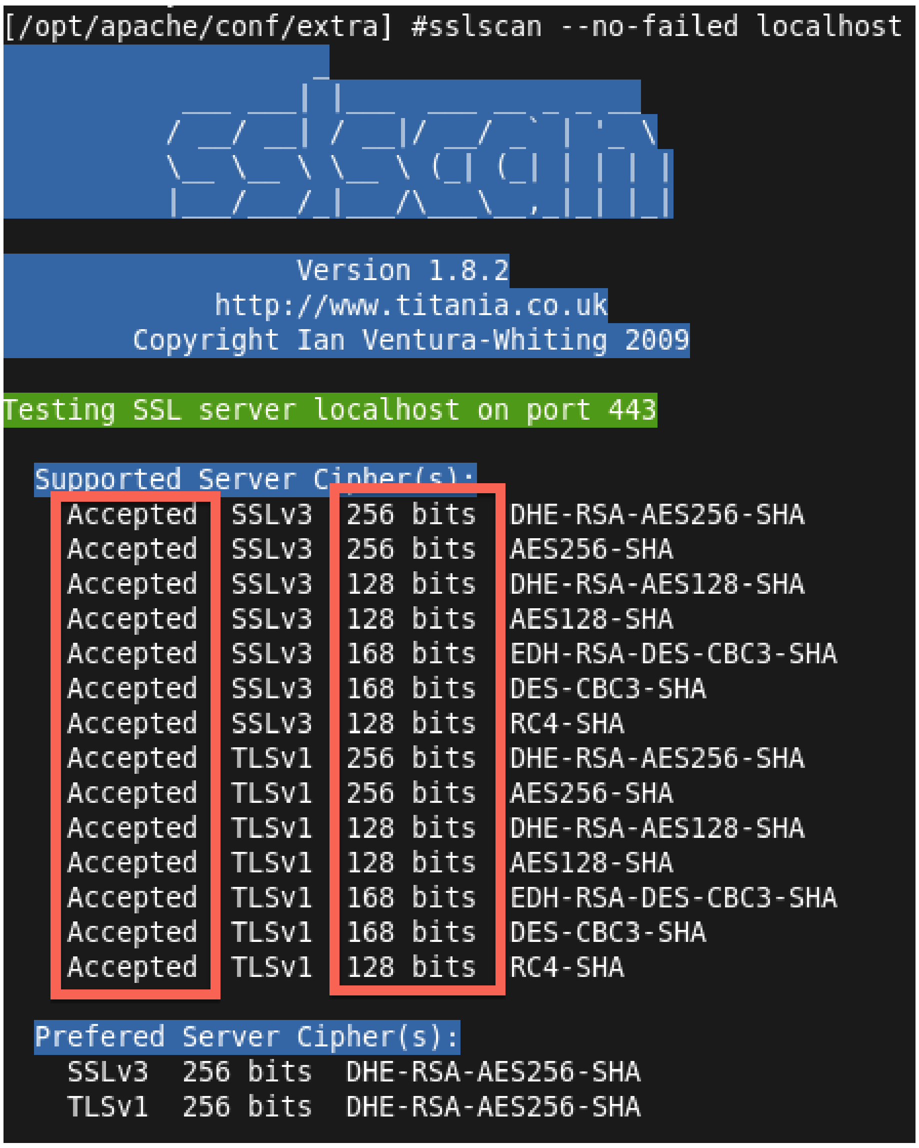
```
[/opt/apache/conf/extra] #sslscan localhost | grep -i key
    Public Key Algorithm: rsaEncryption
    RSA Public Key: (2048 bit)
      X509v3 Subject Key Identifier:
      X509v3 Authority Key Identifier:
        keyid:5E:3A:7F:73:D1:A1:38:9E:27:A4:8D:46:D3:DC:73:C9:53:3A:87:0A
[/opt/apache/conf/extra] #
```

- As you can see current SSL key is 2048 bit, which is stronger.

5.2 SSL Cipher

SSL Cipher is an encryption algorithm, which is used as a key between two computers over the Internet. Data encryption is the process of converting plain text into secret ciphered codes. It’s based on your web server SSL Cipher configuration the data encryption will take place. So it’s important to configure SSL Cipher, which is stronger and not vulnerable. Let’s validate the Cipher accepted in current SSL configuration. We will use sslscan utility to validate as below command. Change localhost to your actual domain name.

```
sslscan –no-failed localhost
```



```
[/opt/apache/conf/extra] #sslscan --no-failed localhost
                   _
           ___ ___| |___  ___ __ _ _ __
          / __/ __| / __|/ __/ _` | '_ \
          \__ \__ \ \__ \ (_| (_| | | | |
          |___/___/_|___/\___\__,_|_| |_|

                  Version 1.8.2
             http://www.titania.co.uk
        Copyright Ian Ventura-Whiting 2009

Testing SSL server localhost on port 443

  Supported Server Cipher(s):
    Accepted  SSLv3  256 bits  DHE-RSA-AES256-SHA
    Accepted  SSLv3  256 bits  AES256-SHA
    Accepted  SSLv3  128 bits  DHE-RSA-AES128-SHA
    Accepted  SSLv3  128 bits  AES128-SHA
    Accepted  SSLv3  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  SSLv3  168 bits  DES-CBC3-SHA
    Accepted  SSLv3  128 bits  RC4-SHA
    Accepted  TLSv1  256 bits  DHE-RSA-AES256-SHA
    Accepted  TLSv1  256 bits  AES256-SHA
    Accepted  TLSv1  128 bits  DHE-RSA-AES128-SHA
    Accepted  TLSv1  128 bits  AES128-SHA
    Accepted  TLSv1  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  TLSv1  168 bits  DES-CBC3-SHA
    Accepted  TLSv1  128 bits  RC4-SHA

  Prefered Server Cipher(s):
    SSLv3  256 bits  DHE-RSA-AES256-SHA
    TLSv1  256 bits  DHE-RSA-AES256-SHA
```

As you could see above, in current configuration DHE, AES, EDH, RC4 cipher is accepted. Now if you are performing penetration test or PCI compliance test, your report will say RC4 Cipher detected. Lately, it was found that RC4 is a weak cipher and to pass certain security test, you must not accept RC4 or any weak cipher. You should also ensure not to accept any cipher, which is less than 128 bits.

Implementation:

- Go to $Web_Server/conf/extra folder
- Modify SSLCipherSuite directive in httpd-ssl.conf as below to reject RC4

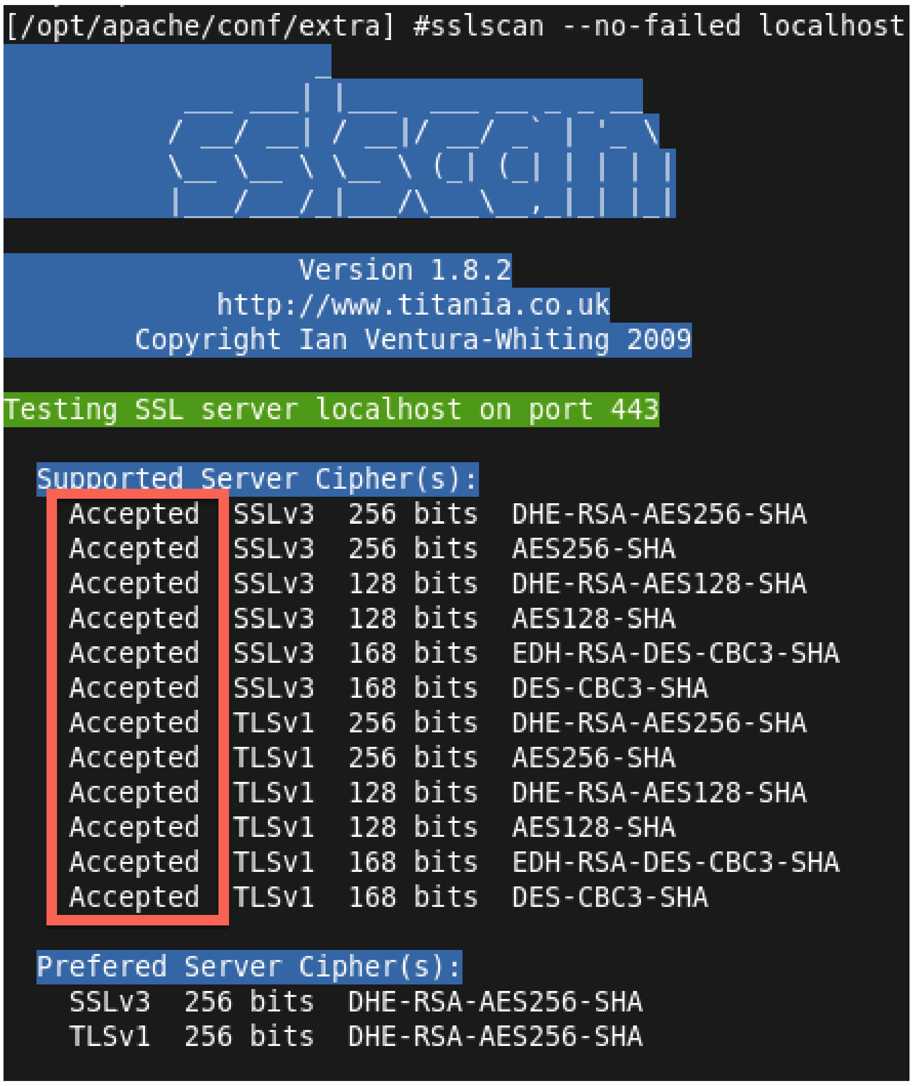
```
SSLCipherSuite HIGH:!MEDIUM:!aNULL:!MD5:!RC4
```

- Save the configuration file and restart apache server

Note: if you have many weak ciphers in your SSL auditing report, you can easily reject them adding ! at beginning. For ex – to reject RC4: **!RC4**

Verification: Again, we will use sslscan utility to validate as below command. Change localhost to your actual domain name.

```
sslscan –no-failed localhost
```



```
[/opt/apache/conf/extra] #sslscan --no-failed localhost

                   Version 1.8.2
             http://www.titania.co.uk
        Copyright Ian Ventura-Whiting 2009

Testing SSL server localhost on port 443

  Supported Server Cipher(s):
    Accepted  SSLv3  256 bits  DHE-RSA-AES256-SHA
    Accepted  SSLv3  256 bits  AES256-SHA
    Accepted  SSLv3  128 bits  DHE-RSA-AES128-SHA
    Accepted  SSLv3  128 bits  AES128-SHA
    Accepted  SSLv3  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  SSLv3  168 bits  DES-CBC3-SHA
    Accepted  TLSv1  256 bits  DHE-RSA-AES256-SHA
    Accepted  TLSv1  256 bits  AES256-SHA
    Accepted  TLSv1  128 bits  DHE-RSA-AES128-SHA
    Accepted  TLSv1  128 bits  AES128-SHA
    Accepted  TLSv1  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  TLSv1  168 bits  DES-CBC3-SHA

  Prefered Server Cipher(s):
    SSLv3  256 bits  DHE-RSA-AES256-SHA
    TLSv1  256 bits  DHE-RSA-AES256-SHA
```

So now we don't see RC4 anymore as accepted Cipher. It's good to reject any low, medium, null or vulnerable cipher to keep yourself tension free from getting attacked. You can also scan your domain against Qualys SSL Labs to check if you have weak or vulnerable cipher in your environment.

5.3 Disable SSL v2

SSL v2 has many security flaws and if you are working towards penetration test or PCI compliance then you are expected to close security finding to disable SSL v2. Any SSL v2 communication may be vulnerable to a Man-in-The-Middle attack that could allow data tampering or disclosure. Let’s implement apache web server to accept only latest SSL v3 and reject SSL v2 connection request.

Implementation:

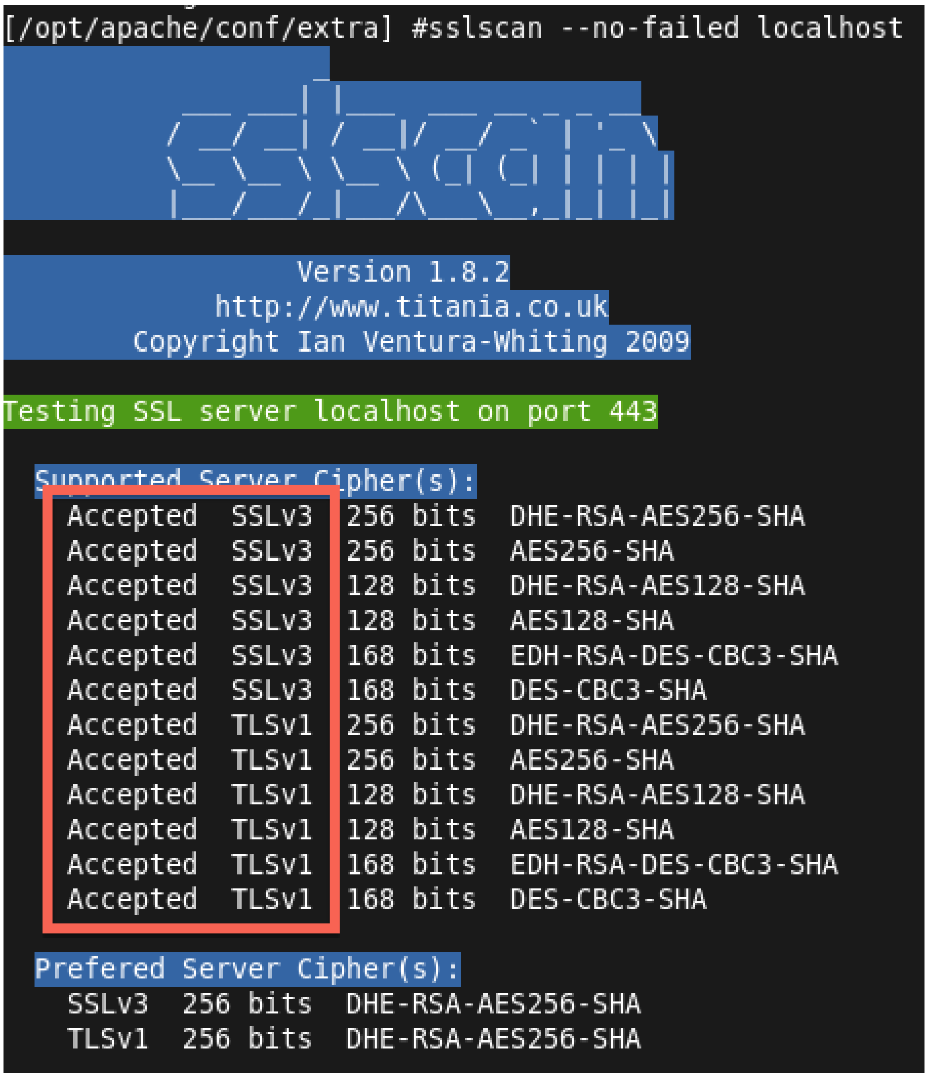
- Go to $Web_Server/conf/extra folder
- Modify SSLProtocol directive in httpd-ssl.conf as below to accept only SSL v3 and TLS v1

```
SSLProtocol –ALL +SSLv3 +TLSv1
```

Verification:

Let’s use sslscan utility to validate as below command. Change localhost to your actual domain name.

```
sslscan –no-failed localhost
```



```
[/opt/apache/conf/extra] #sslscan --no-failed localhost
                   _
           ___ ___| |___  ___ __ _ _ __
          / __/ __| / __|/ __/ _` | '_ \
          \__ \__ \ \__ \ (_| (_| | | | |
          |___/___/_|___/\___\__,_|_| |_|

                  Version 1.8.2
             http://www.titania.co.uk
        Copyright Ian Ventura-Whiting 2009

Testing SSL server localhost on port 443

  Supported Server Cipher(s):
    Accepted  SSLv3  256 bits  DHE-RSA-AES256-SHA
    Accepted  SSLv3  256 bits  AES256-SHA
    Accepted  SSLv3  128 bits  DHE-RSA-AES128-SHA
    Accepted  SSLv3  128 bits  AES128-SHA
    Accepted  SSLv3  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  SSLv3  168 bits  DES-CBC3-SHA
    Accepted  TLSv1  256 bits  DHE-RSA-AES256-SHA
    Accepted  TLSv1  256 bits  AES256-SHA
    Accepted  TLSv1  128 bits  DHE-RSA-AES128-SHA
    Accepted  TLSv1  128 bits  AES128-SHA
    Accepted  TLSv1  168 bits  EDH-RSA-DES-CBC3-SHA
    Accepted  TLSv1  168 bits  DES-CBC3-SHA

  Prefered Server Cipher(s):
    SSLv3  256 bits  DHE-RSA-AES256-SHA
    TLSv1  256 bits  DHE-RSA-AES256-SHA
```

As you could see above, accepted is only SSLv3 and TLSv1, which is safe from SSLv2 vulnerabilities.

6. Mod Security

Mod Security is an open-source Web Application Firewall, which you can use with Apache. It comes as a module which you have to compile and install. If you can't afford commercial web application firewall, this would be a good choice to go for it. Mod Security says: In order to provide generic web applications protection, the Core Rules use the following techniques:

- **HTTP Protection** – detecting violations of the HTTP protocol and a locally defined usage policy
- **Real-time Blacklist Lookups** – utilizes 3rd Party IP Reputation

- **Web-based Malware Detection** – identifies malicious web content by check against the Google Safe Browsing API.
- **HTTP Denial of Service Protections** – defense against HTTP Flooding and Slow HTTP DoS Attacks.
- **Common Web Attacks Protection** – detecting common web application security attack
- **Automation Detection** – Detecting bots, crawlers, scanners and another surface malicious activity
- **Integration with AV Scanning for File Uploads** – detects malicious files uploaded through the web application.
- **Tracking Sensitive Data** – Tracks Credit Card usage and blocks leakages.
- **Trojan Protection** – Detecting access to Trojans horses.
- **Identification of Application Defects** – alerts on application misconfigurations.
- **Error Detection and Hiding** – Disguising error messages sent by the server.

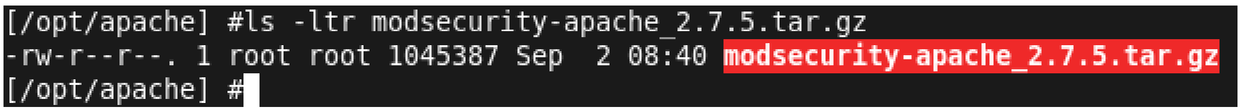
6.1 Download & Installation

Following prerequisites must be installed on the server where you wish to use Mod Security with Apache. If any one of these doesn't exist then Mod Security compilation will fail. You may use yum install on Linux or Centos to install these packages.

- apache 2.x or higher
- libpcre package
- libxml2 package
- liblua package
- libcurl package
- libapr and libapr-util package
- mod_unique_id module bundled with Apache web server

Now, let's download the latest stable version of Mod Security 2.7.5 from http://www.modsecurity.org/download/

- Transfer downloaded file to /opt/apache



```
[/opt/apache] #ls -ltr modsecurity-apache_2.7.5.tar.gz
-rw-r--r--. 1 root root 1045387 Sep  2 08:40 modsecurity-apache_2.7.5.tar.gz
[/opt/apache] #
```

- Extract modsecurity-apache_2.7.5.tar.gz

```
# gunzip –c modsecurity-apache_2.7.5.tar.gz | tar xvf –
```

- Go to extracted folder modsecurity-apache_2.7.5

```
# cd modsecurity-apache_2.7.5
```

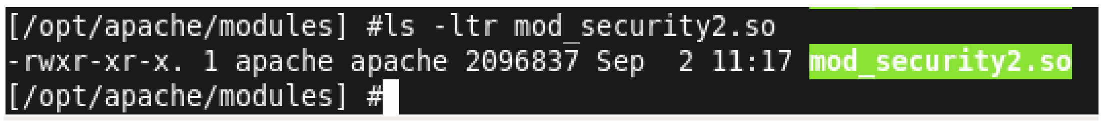
- Run the configure script including apxs path to existing Apache

```
# ./configure –with-apxs=/opt/apache/bin/apxs
```

- Compile & install with make script

```
# make
#make install
```

- Once installation is done, you would see **mod_security2.so** in modules folder under /opt/apache as shown below



```
[/opt/apache/modules] #ls -ltr mod_security2.so
-rwxr-xr-x. 1 apache apache 2096837 Sep  2 11:17 mod_security2.so
[/opt/apache/modules] #
```

Now this concludes, you have installed Mod Security module in existing

Apache web server.

6.2 Configuration

In order to use Mod security feature with Apache, we have to load mod security module in httpd.conf. **The mod_unique_id** module is pre-requisite for Mod Security. This module provides an environment variable with a unique identifier for each request, which is tracked and used by Mod Security.

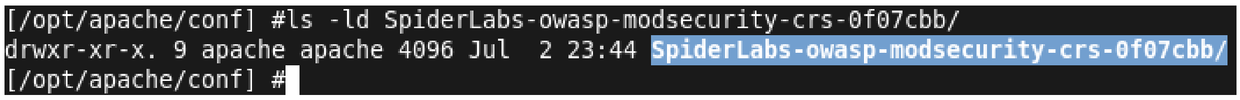
- Add following a line to load module for Mod Security in httpd.conf and save the configuration file

```
LoadModule unique_id_module modules/mod_unique_id.so
LoadModule security2_module modules/mod_security2.so
```

- Restart apache web server

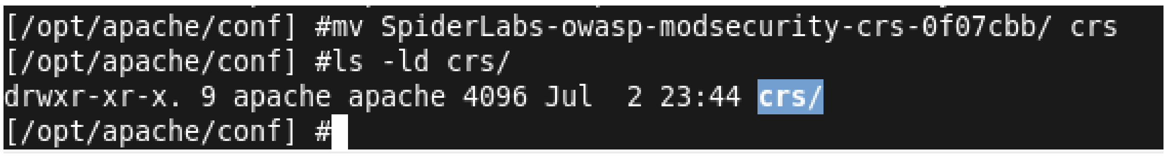
Mod Security is now installed! Next thing you have to do is to install Mod Security core rule to take a full advantage of its feature. Latest Core Rule can be downloaded from following a link, which is free.
https://github.com/SpiderLabs/owasp-modsecurity-crs/zipball/master

- Copy downloaded core rule zip to /opt/apache/conf folder
- Unzip core rule file, you should see the extracted folder as shown below

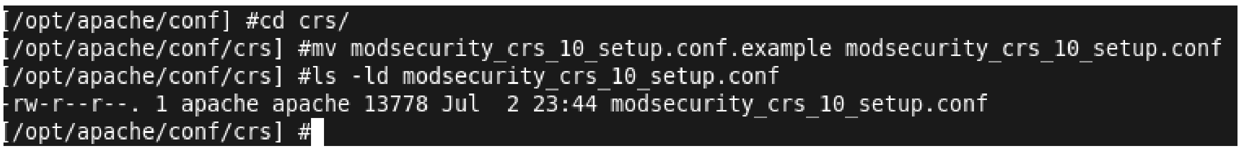


```
[/opt/apache/conf] #ls -ld SpiderLabs-owasp-modsecurity-crs-0f07cbb/
drwxr-xr-x. 9 apache apache 4096 Jul  2 23:44 SpiderLabs-owasp-modsecurity-crs-0f07cbb/
[/opt/apache/conf] #
```

- You may wish to rename the folder to something short and easy to remember. In this example, I will rename to crs.


```
[/opt/apache/conf] #mv SpiderLabs-owasp-modsecurity-crs-0f07cbb/ crs
[/opt/apache/conf] #ls -ld crs/
drwxr-xr-x. 9 apache apache 4096 Jul  2 23:44 crs/
[/opt/apache/conf] #
```

- Go to crs folder and rename
  modsecurity_crs10_setup.conf.example to
  modsecurity_crs10_setup.conf


```
[/opt/apache/conf] #cd crs/
[/opt/apache/conf/crs] #mv modsecurity_crs_10_setup.conf.example modsecurity_crs_10_setup.conf
[/opt/apache/conf/crs] #ls -ld modsecurity_crs_10_setup.conf
-rw-r--r--. 1 apache apache 13778 Jul  2 23:44 modsecurity_crs_10_setup.conf
[/opt/apache/conf/crs] #
```

Now, let's enable these rules to get it working with Apache web server.

- Add following in httpd.conf

```
<IfModule security2_module>
Include conf/crs/modsecurity_crs_10_setup.conf
Include conf/crs/base_rules/*.conf
</IfModule>
```

In above configuration, we are loading Mod Security main configuration file **modsecurity_crs_10_setup.conf** and base rules **base_rules/*.conf** provided by Mod Security Core Rules to protect web applications.

- Restart apache web server

You have successfully configured Mod Security with Apache! **Well done**. Now, Apache Web server is protected by Mod Security web application firewall.

6.3 Getting Started

Lets get it started with some of the important configuration in Mod Security to harden & secure web applications. In this section, we will do all configuration modification in **/opt/apache/conf/crs/modsecurity_crs_10_setup.conf** We will refer **/opt/apache/conf/crs/modsecurity_crs_10_setup.conf** as **setup.conf** in this section for example purpose. It's important to understand what are the OWASP rules are provided in free. There are two types of rules provided by OWASP.

Base Rules – these rules are heavily tested and probably false alarm ratio is less.

Experimental Rules – these rules are for an experimental purpose and you may have the high false alarm. It's important to configure, test and implement in UAT before using these in a production environment.

Optional Rules – these optional rules may not be suitable for the entire environment. Based on your requirement you may use them. If you are looking for CSRF, User tracking, Session hijacking, etc. protection then you may consider using optional rules. We have the base, optional and experimental rules after extracting the downloaded crs zip file from OWASP download page. These rules configuration file is available in crs/base_rules, crs/optional_rules and crs/experimental_rules folder. Let's get familiar with some of the base rules.

- **modsecurity_crs_20_protocol_violations.conf:**This rule is protecting from Protocol vulnerabilities like response splitting, request smuggling, using non-allowed protocol (HTTP 1.0).
- **modsecurity_crs_21_protocol_anomalies.conf:**This is to protect from a request, which is missing with Host, Accept, User-Agent in the header.
- **modsecurity_crs_23_request_limits.conf:**This rule has the

dependency on application specific like request size, upload size, a length of a parameter, etc.

- **modsecurity_crs_30_http_policy.conf:**This is to configure and protect allowed or disallowed method like CONNECT, TRACE, PUT, DELETE, etc.
- **modsecurity_crs_35_bad_robots.conf:**Detect malicious robots
- **modsecurity_crs_40_generic_attacks.conf:**This is to protect from OS command injection, remote file inclusion, etc.
- **modsecurity_crs_41_sql_injection_attacks.conf:**This rule to protect SQL and blind SQL inject request.
- **modsecurity_crs_41_xss_attacks.conf:**Protection from Cross Site Scripting request.
- **modsecurity_crs_42_tight_security.conf:**Directory traversal detection and protection.
- **modsecurity_crs_45_trojans.conf:**This rule to detect generic file management output, uploading of http backdoor page, known signature.
- **modsecurity_crs_47_common_exceptions.conf:**This is used as an exception mechanism to remove common false positives that may be encountered suck as Apache internal dummy connection, SSL pinger, etc.

6.3.1 Logging

Logging is one of the first things to configure so you can have logs created for what Mod Security is doing. There are two types of logging available; Debug & Audit log.

Debug Log: this is to duplicate the Apache error, warning and notice messages from the error log.

Audit Log: this is to write the transaction logs that are marked by Mod Security rule Mod Security gives you the flexibility to configure Audit, Debug or both logging. By default configuration will write both logs. However, you can change based on your requirement. The log is controlled in SecDefaultAction directive. Let’s look at default logging configuration in setup.conf

```
SecDefaultAction “phase:1,deny,log”
```

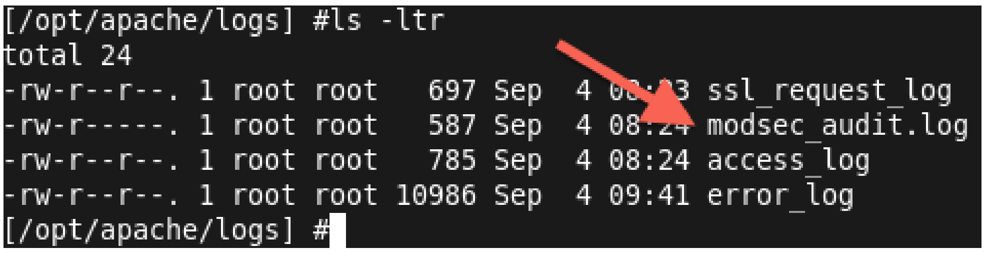
To log Debug, Audit log – use “log” To log only audit log – use “nolog,auditlog” To log only debug log – use “log,noauditlog” You can specify the Audit Log location to be stored which is controlled by SecAuditLog directive. Let’s write audit log into /opt/apache/logs/modsec_audit.log by adding as shown below.

Implementation:

- Add SecAuditLog directive in setup.conf and restart Apache Web Server

```
SecAuditLog /opt/apache/logs/modsec_audit.log
```

- After the restart, you should see modsec_audit.log getting generated as shown below.



```
[/opt/apache/logs] #ls -ltr
total 24
-rw-r--r--. 1 root root   697 Sep  4 08:23 ssl_request_log
-rw-r-----. 1 root root   587 Sep  4 08:24 modsec_audit.log
-rw-r--r--. 1 root root   785 Sep  4 08:24 access_log
-rw-r--r--. 1 root root 10986 Sep  4 09:41 error_log
[/opt/apache/logs] #
```

6.3.2 Enable Rule Engine

By default Engine Rule is Off that means if you don’t enable Rule Engine you are not utilizing all the advantages of Mod Security. Rule Engine enabling or disabling is controlled by SecRuleEngine directive.

Implementation:

- Add SecRuleEngine directive in setup.conf and restart Apache Web Server

```
SecRuleEngine On
```

There are three values for SecRuleEngine:

- **On** – to enable Rule Engine
- **Off** – to disable Rule Engine
- **DetectionOnly** – enable Rule Engine but never executes any actions like block, deny, drop, allow, proxy or redirect

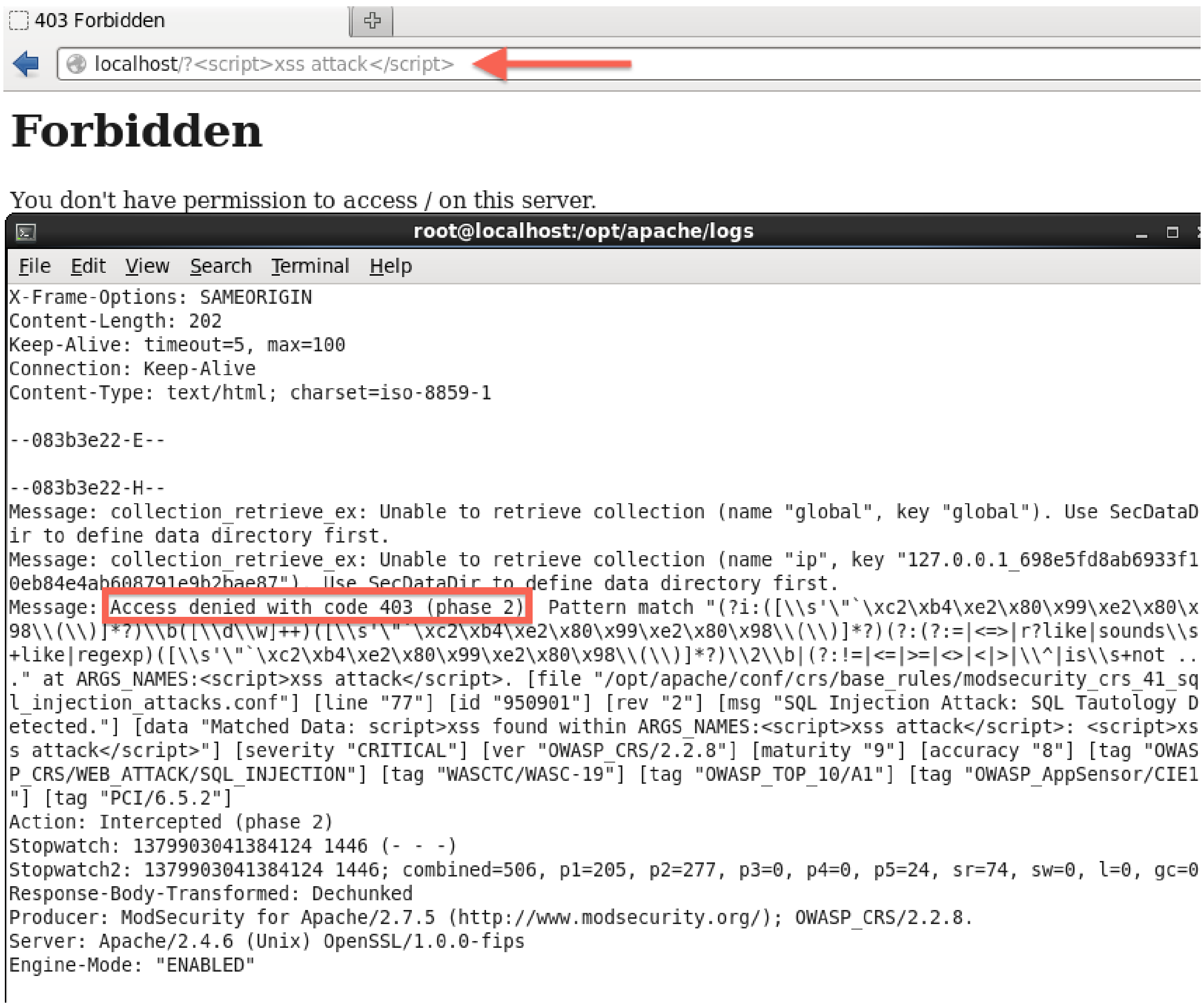
Once Rule Engine is on – Mod Security is ready to protect with some of the common attack types.

6.3.3 Common Attack Type Protection

Now web server is ready to protect with common attack types like XSS, SQL Injection, Protocol Violation, etc. as we have installed Core Rule and turned on Rule Engine. Let’s test few of them.

XSS Attack:-

- Open Firefox and access your application and put <script> tag at the end or URL as shown below
- Monitor the modsec_audit.log in apache/logs folder


403 Forbidden
root@localhost:/opt/apache/logs
File Edit View Search Terminal Help

localhost/?<script>xss attack</script>

Forbidden

You don't have permission to access / on this server.

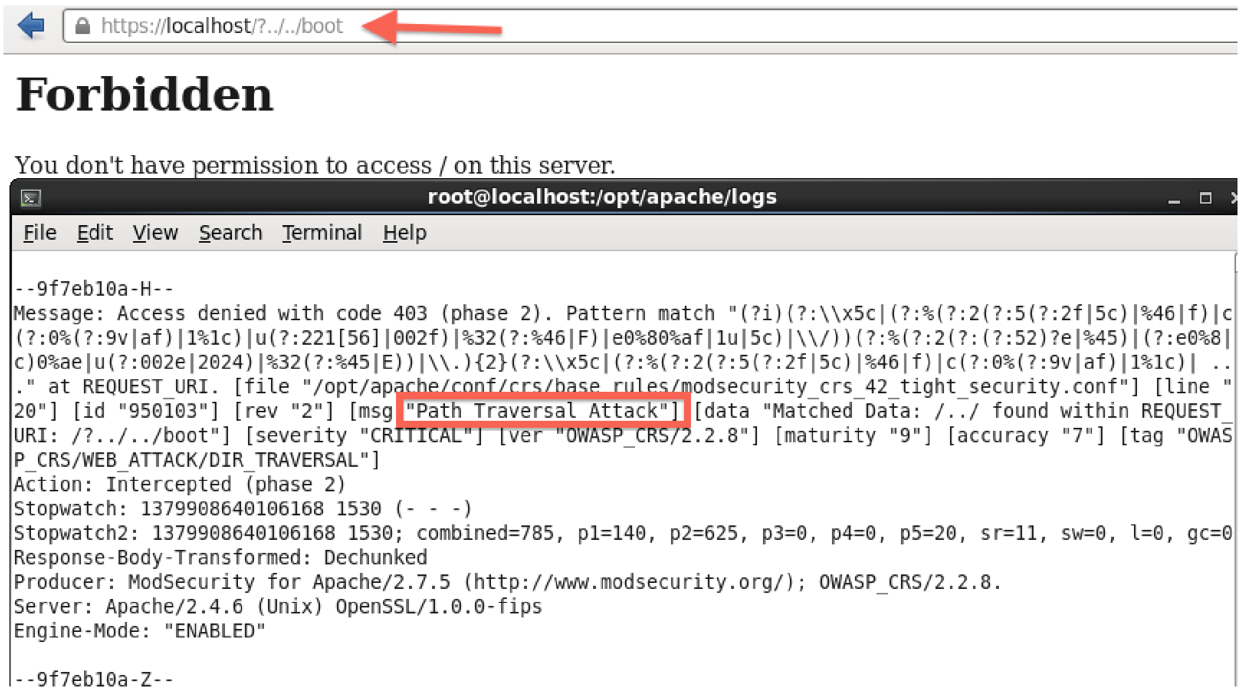
```
X-Frame-Options: SAMEORIGIN
Content-Length: 202
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html; charset=iso-8859-1

--083b3e22-E--

--083b3e22-H--
Message: collection_retrieve_ex: Unable to retrieve collection (name "global", key "global"). Use SecDataD
ir to define data directory first.
Message: collection_retrieve_ex: Unable to retrieve collection (name "ip", key "127.0.0.1_698e5fd8ab6933f1
0eb84e4ab608791e9b2bae87"). Use SecDataDir to define data directory first.
Message: Access denied with code 403 (phase 2). Pattern match "(?i:([\\s'\"`\xc2\xb4\xe2\x80\x99\xe2\x80\x
98\\(\\)]*?)\\b([\\d\\w]++)([\\s'\"`\xc2\xb4\xe2\x80\x99\xe2\x80\x98\\(\\)]*?)(?:(?:=|<=>|r?like|sounds\\s
+like|regexp)([\\s'\"`\xc2\xb4\xe2\x80\x99\xe2\x80\x98\\(\\)]*?)\\2\\b|(?:!=|<=|>=|<>|<|>|\\^|is\\s+not ..
." at ARGS_NAMES:<script>xss attack</script>. [file "/opt/apache/conf/crs/base_rules/modsecurity_crs_41_sq
l_injection_attacks.conf"] [line "77"] [id "950901"] [rev "2"] [msg "SQL Injection Attack: SQL Tautology D
etected."] [data "Matched Data: script>xss found within ARGS_NAMES:<script>xss attack</script>: <script>xs
s attack</script>"] [severity "CRITICAL"] [ver "OWASP_CRS/2.2.8"] [maturity "9"] [accuracy "8"] [tag "OWAS
P_CRS/WEB_ATTACK/SQL_INJECTION"] [tag "WASCTC/WASC-19"] [tag "OWASP_TOP_10/A1"] [tag "OWASP_AppSensor/CIE1
"] [tag "PCI/6.5.2"]
Action: Intercepted (phase 2)
Stopwatch: 1379903041384124 1446 (- - -)
Stopwatch2: 1379903041384124 1446; combined=506, p1=205, p2=277, p3=0, p4=0, p5=24, sr=74, sw=0, l=0, gc=0
Response-Body-Transformed: Dechunked
Producer: ModSecurity for Apache/2.7.5 (http://www.modsecurity.org/); OWASP_CRS/2.2.8.
Server: Apache/2.4.6 (Unix) OpenSSL/1.0.0-fips
Engine-Mode: "ENABLED"
```

As you can see Mod Security blocks request as it contains <script> tag which is the root of XSS attack.

Directory Traversal Attack:- Directory traversal attacks can create a lot of damage by taking advantage of this vulnerabilities and access system related file. Ex – /etc/passwd, .htaccess, etc.

- Open Firefox and access your application with directory traversal
- Monitor the modsec_audit.log in apache/logs folder

```
http://localhost/?../.../boot
```


https://localhost/?../../boot

Forbidden

You don't have permission to access / on this server.

root@localhost:/opt/apache/logs
File Edit View Search Terminal Help

```
--9f7eb10a-H--
Message: Access denied with code 403 (phase 2). Pattern match "(?i)(?:\\x5c|(?:%(?:2(?:5(?:2f|5c)|%46|f)|c
(?:0%(?:9v|af)|1%1c)|u(?:221[56]|002f)|%32(?:%46|F)|e0%80%af|1u|5c)|\\/))(?:%(?:2(?:(?:52)?e|%45)|(?:e0%8|
c)0%ae|u(?:002e|2024)|%32(?:%45|E))|\\.){2}(?:\\x5c|(?:%(?:2(?:5(?:2f|5c)|%46|f)|c(?:0%(?:9v|af)|1%1c)| ..
." at REQUEST_URI. [file "/opt/apache/conf/crs/base_rules/modsecurity_crs_42_tight_security.conf"] [line "
20"] [id "950103"] [rev "2"] [msg "Path Traversal Attack"] [data "Matched Data: /../ found within REQUEST_
URI: /?../../boot"] [severity "CRITICAL"] [ver "OWASP_CRS/2.2.8"] [maturity "9"] [accuracy "7"] [tag "OWAS
P_CRS/WEB_ATTACK/DIR_TRAVERSAL"]
Action: Intercepted (phase 2)
Stopwatch: 1379908640106168 1530 (- - -)
Stopwatch2: 1379908640106168 1530; combined=785, p1=140, p2=625, p3=0, p4=0, p5=20, sr=11, sw=0, l=0, gc=0
Response-Body-Transformed: Dechunked
Producer: ModSecurity for Apache/2.7.5 (http://www.modsecurity.org/); OWASP_CRS/2.2.8.
Server: Apache/2.4.6 (Unix) OpenSSL/1.0.0-fips
Engine-Mode: "ENABLED"

--9f7eb10a-Z--
```

- As you can see Mod Security blocks request as it contains directory traversal.

6.3.4 Change Server Banner

Earlier in this guide, you learned how to remove Apache and OS type, version help of ServerTokens directive. Let’s go one step ahead, how about keeping server name whatever you wish? It’s possible with SecServerSignature directive in Mod Security. You see it’s an interesting.

Note: in order to use Mod Security to manipulate Server Banner from a header, you must set ServerTokesn to Full in httpd.conf of Apache web server.

Implementation:

- Add SecServerSignature directive with your desired server name in setup.conf and restart Apache Web Server

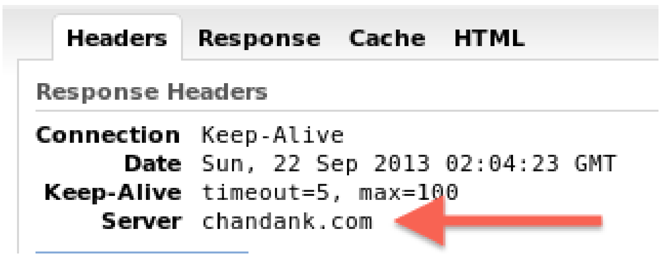
```
SecServerSignature YourServerName
```

Ex:

```
[/opt/apache/conf/crs] #grep SecServer modsecurity_crs_10_setup.conf
SecServerSignature chandank.com
[/opt/apache/conf/crs] #
```

Verification:

- Open Firefox and access your application
- Check HTTP response headers in firebug, you should see Server banner is changed now as shown below.



```
Response Headers
Connection  Keep-Alive
      Date  Sun, 22 Sep 2013 02:04:23 GMT
Keep-Alive  timeout=5, max=100
    Server  chandank.com
```

7. General Configuration

We will talk about some of the general configuration as best practice.

7.1 Configure Listen

When you have multiple interface and IP's on a single server, it's recommended to have Listen directive configured with absolute IP and Port number. When you leave apache configuration to Listen on all IP's with some port number, it may create the problem in forwarding HTTP request to some other web server. This is quite common in the shared environment.

Implementation:

- Configure Listen directive in httpd.conf with absolute IP and port as shown example below

```
Listen 10.10.10.1:80
```

7.2 Access Logging

It's essential to configure access log properly in your web server. Some of the important parameter to capture in the log would be the time taken to serve the request, SESSION ID. By default, apache is not configured to capture these data. You got to configure them manually as following.

Implementation:

- To capture time taken to serve the request and SESSION ID in access log
- Add **%T** & **%sessionID** in httpd.conf under LogFormat directive

```
LogFormat "%h %l %u %t "%{sessionID}C" "%r" %>s %b %T" common
```

You can refer http://httpd.apache.org/docs/2.2/mod/mod_log_config.html for a complete list of parameter supported in LogFormat directive in Apache Web Server.

7.3 Disable Loading unwanted modules

If you have compiled and installed with all modules then there are high chances you will have many modules loaded in Apache, which may not be required. Best practice is to configure Apache with required modules in your web applications. Following modules are having security concerns and you might be interested in disabling in httpd.conf of Apache Web Server.

WebDAV (Web-based Distributed Authoring and Versioning) This module allows remote clients to manipulate files on the server and subject to various denial-of-service attacks. To disable comment following in httpd.conf

```
#LoadModule dav_module modules/mod_dav.so
#LoadModule dav_fs_module modules/mod_dav_fs.so
#Include conf/extra/httpd-dav.conf
```

Info Module The mod_info module can leak sensitive information using .htaccess once this module is loaded. To disable comment following in httpd.conf

```
#LoadModule info_module modules/mod_info.so
```

Reference: This wouldn't be possible without guidance from the following link:

- http://httpd.apache.org/docs/2.4/
- http://www.modsecurity.org/documentation/
- https://www.owasp.org/index.php/Category:OWASP_ModSecurity_Core_Rule_S

So that was some of the best practices you can use to secure your Apache web server. I hope they are useful to you.