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How To Implement SSL Termination With HAProxy on Ubuntu 14.04

Jul 10, 2014 Load Balancing, Security, Scaling, Apache, Nginx Ubuntu

Tutorial Series

This tutorial is part 4 of 4 in the series: Load Balancing WordPress with HAProxy

Introduction

HAProxy, which stands for High Availability Proxy, is a popular open source software TCP/HTTP Load Balancer and proxying solution which can be run on Linux, Solaris, and FreeBSD. Its most common use is to improve the performance and reliability of a server environment by distributing the workload across multiple servers (e.g. web, application, database). It is used in many high-profile environments, including: GitHub, Imgur, Instagram, and Twitter.

In this tutorial, we will go over how to use HAProxy for SSL termination, for traffic encryption, and for load balancing your web servers. We will also show you how to use HAProxy to redirect HTTP traffic to HTTPS.

Native SSL support was implemented in HAProxy 1.5.x, which was released as a stable version in June 2014.

Prerequisites

To complete this tutorial, you must have or obtain the following:

- At least one web server, with private networking, listening on HTTP (port 80)
- Root access to an additional VPS on which we will install HAProxy. Instructions to set up root access can be found here (steps 3 and 4): Initial Server Setup with Ubuntu 14.04.

 An SSL certificate and private key pair with a "common name" that matches your domain name or IP address

If you do not already have an SSL certificate and private key pair, please obtain one before continuing. Here are a few tutorials that contain steps that cover creating SSL certificates:

- Create an StartSSL Certificate (private.key and ssl.crt)
- Create a Self-Signed SSL Certificate on Ubuntu 14.04 (Step 2--apache.key and apache.crt)

Creating a Combined PEM SSL Certificate/Key File

To implement SSL termination with HAProxy, we must ensure that your SSL certificate and key pair is in the proper format, PEM. In most cases, you can simply combine your SSL certificate (.crt or .cer file provided by a certificate authority) and its respective private key (.key file, generated by you). Assuming your certificate file is called example.com.crt, and your private key file is called example.com.key, here is an example of how to combine the files:

```
cat example.com.crt example.com.key > example.com.pem
sudo cp example.com.pem /etc/ssl/private/
```

This creates the combined PEM file, called example.com.pem and copies it to /etc/ssl/private. As always, be sure to secure any copies of your private key file, including the PEM file (which contains the private key).

In some cases, you may need to copy your CA root certificate and CA intermediate certificates into your PEM file.

Our Starting Environment

Here is the environment that we are starting with:

Web Server on HTTP



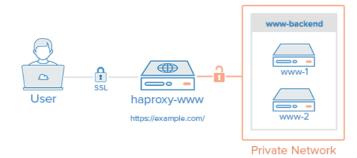
If your environment differs from the example, like if you are already using SSL on the web server or you have a separate database server, you should be able to adapt this tutorial to work with your environment.

If you are unfamiliar with basic load-balancing concepts or terminology, like layer 7 load balancing or backends or ACLs, here is an article that explains the basics: An Introduction to HAProxy and Load Balancing Concepts.

Our Goal

By the end of this tutorial, we want to have an environment that looks like this:

HAProxy SSL Termination (HTTPS)



That is, your users will access your website by connecting to your HAProxy server via HTTPS, which will decrypt the SSL session and forward the unencrypted requests to your web servers (i.e. the servers in www-backend) via their private network interfaces on port 80. Your web servers will then send their responses to your HAProxy server, which will encrypt the responses and send them back to the user that made the original request.

You can set up your *www-backend* with as many web servers as you want, as long as they serve identical content. In other words, you can set this up with a single server then scale it out later by adding as many servers as you want. Remember, as your traffic increases, your HAProxy server may become a performance bottleneck if it does not have enough system resources to handle your user traffic.

Note: This tutorial does not cover how to ensure that your web/application servers serve the same content because that is often application or web server dependent.

Install HAProxy 1.5.x

Create a new VPS with private networking. For this tutorial, we will call it *haproxy-www*, but you may call it whatever you want.

In our haproxy-www VPS, add the dedicated PPA to apt-get:

```
sudo add-apt-repository ppa:vbernat/haproxy-1.5
```

Then update your apt cache:

```
sudo apt-get update
```

Then install HAProxy 1.5 with apt-get with the following command:

```
sudo apt-get install haproxy
```

Now that HAProxy 1.5 is installed, let's configure it!

HAProxy Configuration

HAProxy's configuration file is located at /etc/haproxy/haproxy.cfg and is divided into two major sections:

- Global: sets process-wide parameters
- Proxies: consists of defaults, listen, frontend, and backend sections

Again, if you are unfamiliar with HAProxy or basic load-balancing concepts and terminology, please refer to this link: An Introduction to HAProxy and Load Balancing Concepts.

HAProxy Configuration: Global

All of the HAProxy configuration should be done on your HAProxy VPS, haproxy-www.

Open haproxy.cfg in an editor:

```
sudo vi /etc/haproxy/haproxy.cfg
```

You will see that there are two sections already defined: global and defaults.

The first thing you will want to do is set *maxconn* to a reasonable number. This setting affects how many concurrent connections HAProxy will allow, which can affect QoS and prevent your web servers from crashing from trying to serve too many requests. You will need to play around with it to find what works for your environment. Add the following line (with a value you think is reasonable) to the *global* section of the configuration

```
maxconn 2048
```

Add this line, to configure the maximum size of temporary DHE keys that are generated:

```
tune.ssl.default-dh-param 2048
```

Next, in the defaults section, add the following lines under the line that says $mode\ http$:

```
option forwardfor option http-server-close
```

The *forwardfor* option sets HAProxy to add X-Forwarded-For headers to each request, and the *http-server-close* option reduces latency between HAProxy and your users by closing connections but maintaining keep-alives.

HAProxy Configuration: Stats

Using HAProxy stats can be useful in determining how HAProxy is handling incoming traffic. If you would like to enable the HAProxy stats page, add the following lines in the *defaults* section (substitute user and password with secure values):

```
stats enable
stats uri /stats
stats realm Haproxy\ Statistics
stats auth user:password
```

This will allow you to look at the HAProxy stats page by going to your domain on /stats (e.g. https://example.com/stats).

Do not close the config file yet! We will add the proxy configuration next.

HAProxy Configuration: Proxies

Frontend Configuration

The first thing we want to add is a frontend to handle incoming HTTP connections. At the end of the file, let's add a frontend called www-http. Be sure to replace haproxy_www_public_IP with the public IP of your haproxy-www VPS:

```
frontend www-http
bind haproxy_www_public_IP:80
regadd X-Forwarded-Proto:\ http
default_backend www-backend
```

Here is an explanation of what each line in the frontend config snippet above means:

- frontend www-http: specifies a frontend named "www-http"
- bind haproxy_www_public_IP:80: replace haproxy_www_public_IP with haproxy-www's public IP address. This tells HAProxy that this frontend will handle the incoming network traffic on this IP address and port 80 (HTTP)
- reqadd X-Forwarded-Proto:\ http: Adds http header to end of end of the HTTP request
- default_backend www-backend: this specifies that any traffic that this frontend receives will be forwarded to www-backend, which we will define in a following step

Next, we will add a frontend to handle incoming HTTPS connections. At the end of the file, let's add a frontend called *www-https*. Be sure to replace haproxy_www_public_IP with the **public IP** of your haproxy-www VPS:

```
frontend www-https
bind haproxy_www_public_IP:443 ssl crt /etc/ssl/private/example.com.pem
reqadd X-Forwarded-Proto:\ https
default_backend www-backend
```

- frontend www-https: specifies a frontend named "www-https"
- bind haproxy_www_public_IP:443 ssl crt ...: replace haproxy_www_public_IP with haproxy-www's public IP address, and example.com.pem with your SSL certificate and key pair in combined pem format. This tells HAProxy that this frontend will handle the incoming network traffic on this IP address and port 443 (HTTPS).
- reqadd X-Forwarded-Proto:\ https: Adds https header to end of end of the HTTPS request
- default_backend www-backend: this specifies that any traffic that this frontend receives will be forwarded to www-backend, which we will define in a following step

Backend Configuration

After you are finished configuring the frontends, continue adding your backend by adding the following lines. Be sure to replace the highlighted words with the respective private IP addresses of your web servers:

```
backend www-backend
  redirect scheme https if !{ ssl_fc }
  server www-1 www_l_private_IP:80 check
  server www-2 www_2_private_IP:80 check
```

Here is an explanation of what each line in the backend config snippet above means:

- backend www-backend: specifies a backend named www-backend
- redirect scheme https if !(ssl_fc): this line redirects HTTP requests to HTTPS, which makes your site HTTPS-only. If you want to allow both HTTP and HTTPS, remove this line
- server www-1 ...: specifies a backend server named www-1, the private IP (which you must substitute) and port that it is listening on, 80. The check option makes the load balancer periodically perform a health check on this server
- server www-2 ...: similar to the previous line. Add additional lines like this, with appropriate names and IP addresses to add more servers to the load balancer

Now save and exit haproxy.cfg. HAProxy is now ready to be started, but let's enable logging first.

Enable HAProxy Logging

Enabling logging in HAProxy is very simple. First edit the rsyslog.conf file:

```
sudo vi /etc/rsyslog.conf
```

Then find the following two lines, and uncomment them to enable UDP syslog reception. It should look like the following when you are done:

```
$ModLoad imudp
$UDPServerRun 514
$UDPServerAddress 127.0.0.1
```

Now restart rsyslog to enable the new configuration:

```
sudo service rsyslog restart
```

HAProxy logging is is now enabled! The log file will be created at /var/log/haproxy.log once HAProxy is started.

Start HAProxy

On haproxy-www, start HAProxy to put your configuration changes into effect:

```
sudo service haproxy restart
```

HAProxy is now performing SSL termination and load balancing your web servers! Your load balanced server is now accessible to your user via the public IP address or domain name of your load balancer, haproxy-www! There are a few things that you will want to check, to make sure everything is set up correctly.

Things to Check

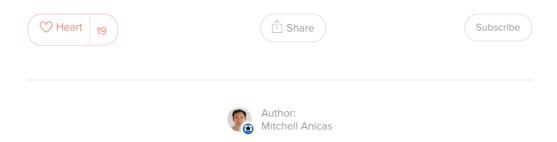
- If you haven't already, update your nameservers to point your domain to your haproxy-www server's public IP address
- If you want your servers to use only HTTPS, you will want to make sure that your web servers (e.g. www-1, www-2, etc.) are only listening on their private IP addresses on port 80. Otherwise, users will be able to access your web servers via HTTP (unencrypted) on their public IP addresses.

- Visit haproxy-www via HTTPS and ensure that it works
- Visit haproxy-www via HTTP and ensure that it redirects to HTTPS (unless you configured it to allow both HTTP and HTTPS)

Note: If you're using an application that needs to know its own URL, like WordPress, you need to change your URL setting from "http" to https". To follow the WordPress example, you would go to your WordPress General Settings, then change the WordPress Address (URL) and the Site Address (URL) from "http" to "https".

Conclusion

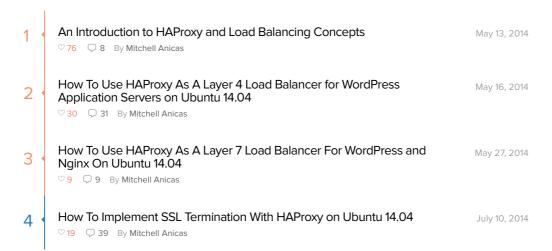
Now you have a load balancer solution that handles your SSL connections and can be used to horizontally scale out your server environment. Feel free to combine what you have learned in this guide with other HAProxy guides to improve your environment even further!

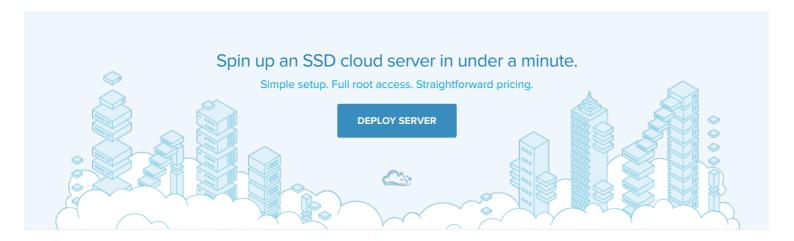


Tutorial Series

Load Balancing WordPress with HAProxy

Adding a load balancer to your server environment is a great way to increase reliability and performance. The first tutorial in this series will introduce you to load balancing concepts and terminology, followed by two tutorials that will teach you how to use HAProxy to implement layer 4 or layer 7 load balancing in your own WordPress environment. The last tutorial covers SSL termination with HAProxy.





Related Tutorials

How to Set Up Let's Encrypt Certificates for Multiple Apache Virtual Hosts on Ubuntu 14.04

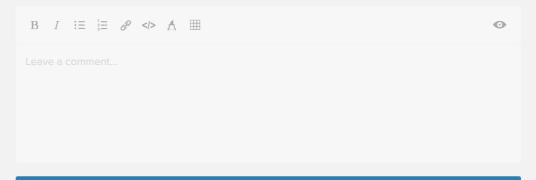
How To Fix OpenSSH's Client Bug CVE-0216-0777 and CVE-0216-0778 by Disabling UseRoaming

How To Route Web Traffic Securely Without a VPN Using a SOCKS Tunnel

How to Create a High Availability Setup with Pacemaker, Corosync and Floating IPs on CentOS 7

How To Install and Configure Naxsi on Ubuntu 14.04

38 Comments



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ssullivan July 18, 2014

Did you mean '443' instead of 80 in the "Things to Check" section?

"[...] want your servers to use only HTTPS, you will want to make sure that your web servers (e.g. www-1, www-2, etc.) are only listening on their private IP addresses on port 80. Otherwise, users will be able to access your web servers via HTTP (unencrypted) [...]"

It's a small matter. I'm thoroughly reading the articles you are hosting here! I've been hearing a lot of great things about your droplets from several friends; not to mention TechSnap, one of my favorite podcasts. The team I'm working with now is using, I won't say it outright, a competitor... linear poems... an ode... to a line... a line... a line... anyway.

Keep up the great work.

I don't think you will hear this much, but I'm convinced. **Run from docker like the plague**. I don't have anything against them in particular, but there is going to be some sad *suckers*, docents in a sense I suppose, when china haz root on their servers; at least, it was easy though, right?

I'm of the opinion that any management / provisioning frameworks that require a running process (Puppet and Chef included) will all introduce the same basic risk; increased attack surface -

unnecessarily. SSH based provisioning frameworks are not as popular; but frameworks like Ansible or Python's Fabric are less risky. Nothing is risk free, but they do not increase your system's attack surface nor do they use computational resources beyond those resources used **doing** their assigned task, as opposed to, *waiting / listening* for a client to assign them a task.

I'd love to see an article from you guys on Ansible or Fabric... or maybe write one for you?

 \odot



kamaln7 July 19, 2014

@ssullivan: Thank you for the feedback :) Glad to hear you're enjoying our tutorials!

I believe Mitchell meant to emphasize the "private IP addresses" bit. Because SSL is handled by HAProxy, the webservers don't need to bother about it. They accept unencrypted connections from HAProxy over the private network, so they listen on port 80 on the private interface. If they were listening on the public interface instead, anyone would be able to access them directly without passing through HAProxy first and as a result not using HTTPS.

As for Ansible and Fabric, we have some tutorials on them as well: Configuration Management Tutorials & Popular Questions. But you're welcome to write an article (or more) and get paid for it!

 \bigcirc



manicas July 24, 2014

@ssullivan / kamal: Sorry for the late reply. Yes, Kamal is correct. All the SSL is handled by HAProxy in this setup.

 \odot



dougs July 28, 2014

@Kamal / Michell: Thanks for the great info.

I imagine you would want to have the proper iptables rules in place to limit communications between only the haproxy and www-1 / www-2 boxes as per: how-to-isolate-servers-within-a-private-network-using-iptables

Could someone still listen to the unencrypted port 80 traffic on the private interface using something like wireshark from another node on the shared private network? Or would the iptables rules be enough? If not how can I have SSL all the way to www-1/ www-2?

Thanks again for your great work!

 \circ



manicas July 28, 2014

@dougs:

The most important thing is that your web servers are listening on port 80 on the private interface only (via web server configuration), or the public interface port 80 is blocked. You may also block out other connections, like in the tutorial you linked, but that's not strictly necessary.

If you want to pass SSL through HAProxy to your web servers, one way to do it is to change the HAProxy mode to layer 4 tcp (vs. the default layer 7 http) and install the identical SSL cert on each of your web server backends (in the web server configuration). With this setup, HAProxy would not look at the contents of the packets and just send them to the backends, which would have to handle the SSL.

C



arun_shop July 30, 2014
Thanks for the tutorial.

How could we serve mutiple domains with ssl?

 \odot



manicas July 30, 2014

@arun_shop: can you add more detail to your question?

 \odot

arun_shop July 31, 2014

If haproxy had to server different https domain how could we configure?



Lets say i have https://:abc.com and https://:xyz.com to be served by haproxy.

How could we configure the front end for https? can we provide both the certificate for abc.com and xyz.com in one file?

Thanks!

 \odot



ayelet July 31, 2014

Thank you very much! It was very hard to find a good tutorial on this subject. I tried the configuration you suggested and it worked perfectly. :)

0



manicas July 31, 2014

@arun_shop: I'm not 100% sure, but I think you need two different public IP addresses to use two
different SSL certificates in the same HAProxy server. Because the ssl cert parameter is part of the
bind parameter, which binds to an IP address. I would guess you need two different frontends, which
bind to separate IP addresses.

If your domains are subdomains (e.g. xyz.abc.com and abc.com), you use a wildcard SSL cert, you can redirect the traffic to the proper subdomains using ACLs.

Without SSL, you can definitely server two different hosts with the same frontend, using ACLs. Something like this would do that:

```
frontend www-https

bind haproxy_www_public_IP:80

acl is_abc hdr_end(host) -i abc.com

acl is_xyz hdr_end(host) -i xyz.com

use_backend abc-backend if is_abc

use_backend xyz-backend if is_xyz

default_backend abc-backend

backend abc-backend

backend abc-backend

server abc-1 abc_1_private_IP:80 check

server abc-2 abc_2_private_IP:80 check

backend xyz-backend

server xyz-1 xyz_1_private_IP:80 check

server xyz-2 xyz_2_private_IP:80 check
```



jmccabeVA September 29, 2014

Looking to do some testing with EMC's Syncplicity. Their storage compute nodes connect to Isilon on the backend (I'm using 2) and trying to load balance them with HAProxy. The requirement from their cloud side is to terminate SSL on the load balancer and then forward to the compute nodes on port 9000. Can I terminate on haproxy and load balance tcp connections on the backend? I'm attempting to use haproxy 1.5

Here's the config so far:

checking the config, I'm getting errors on the ssl command in the bind statement: I want to terminate ssl on load balancer.

```
frontend syncplb

bind 1.1.1.1:443 accept-proxy ssl crt /etc/ssl/certs/sslcerthere.pem

mode tcp
option httpclose

# option forwardfor <----I commented out thinking it was forwarding https
log global
option tcplog

# reqadd X-Forwarded-Proto:\ https <----commented out.
default_backend syncp-storage
```

balance roundrobin

mode tcp

server isilon143 x.x.x.x:9000 check

server isilon144 x.x.x.x:9000 check

Any help would be greatly appreciated.

-James

 \odot



kamaln7 September 30, 2014

I'm getting errors on the ssl command in the bind statement:

Can you post the exact errors that you are getting?

0



pierreozoux October 29, 2014

Hey! Thanks for your tutorial:)

I have a similar set up, meaning HAproxy in front of a single wordpress instance. The difference is that I'm using apache instead of nginx. Anyway, I have some troubles making wordpress working well with https. It's maybe outside the scope of this article, but this is the only serious article I found about my problem.

So after adding the following to wp-config.php (from:

[http://codex.wordpress.org/AdministrationOverSSL](wordpress.org documentation):

```
define('FORCE_SSL_ADMIN', true);
if ($_SERVER['HTTP_X_FORWARDED_PROTO'] == 'https')
    $_SERVER['HTTPS']='on';
```

I don't manage to log in... I get a miserable You do not have sufficient permissions to access this page. I'm trying to debug, but I have to admit, I get some troubles doing so... I suspect the cookie getting lost somewhere..

If you have any clue, I'd be really greatful!

Thanks a lot for your work!

Pierre

 \bigcirc



manicas October 29, 2014

Hey Pierre, I'm glad you liked the tutorial.

Keep in mind that the SSL/TLS is being terminated at the HAProxy level, so the communication between HAProxy and Apache/WordPress is unencrypted. As such, you shouldn't use SSL on your WordPress server. Instead, make sure that your Apache/WP server is only communicating with HAProxy via a private network.

C



pierreozoux *October 29, 2014*Thanks for the quick reply.

But well, the thing is that internally, wordpress thinks it is on http. So it ends up writing in the html to get the css over http for instance.

So I have 3 options and none are good..

- 1. Have no specific on wordpress, and the css doesn't load
- 2. Add the specific wp-config.php code, and get the ugly warning
- 3. Add an aweful plugin that does more or less the job..

I'm sad ;) I'll try to post the question on some wordpress stack exchange, can have better luck there ;) If you have a better idea?

Thanks again!

 \bigcirc



manicas April 9, 2015

This is a late reply, but just adding it in here in case anyone else runs into the same problem.

Try adjusting your WordPress General Settings. Change the WordPress Address (URL) and the Site Address (URL) from "http" to "https".

 $^{\circ}$



jcollins November 24, 2014

I followed your other article on load balancing wordpress. Got it working runs great. How would i apply this tutorial to that schema?





manicas November 24, 2014

You need to make sure that your version of HAProxy is 1.5.x or greater. Then you need an SSL certificate (this is in the prerequisites). Then you need to add the relevant SSL lines to your HAProxy configuration (in the frontend and backend).

Also, make sure you are using http mode (layer 7), and not tcp.

 \odot



jcollins November 25, 2014

So i would also omit the "redirect scheme https if $\{\{ss | c \}^{n} \}$ if i do not want all connections to be https right?

 \odot



manicas November 25, 2014



00



nxqd.inbox December 10, 2014

'bind *:443': inconsistencies between private key and certificate loaded from

I have this error after combining the crt key and unencrypted private .key file from startSSL. When I try to verify the .pem file (which is combined from crt key and unencrypted key above), it's failed :

openssl verify -CAfile ca.pem myfile.pem error 20 at 0 depth lookup:unable to get local issuer certificate

Do you know what's wrong?

Thanks for writing the fantastic guide:)

 \odot



manicas December 10, 2014

StartSSL has intermediate certificates that need to be combined into your certificate file to complete the trust chain.

Download the CA certs into the same directory as your SSL cert/key:

wget http://www.startssl.com/certs/ca.pem
wget http://www.startssl.com/certs/sub.classl.server.ca.pem

 $\label{lem:continuous} \textbf{Create a unified certificate from your certificate, the CA certificates, and your private key:}$

cat example.com.crt sub.class1.server.ca.pem ca.pem example.com.key > exa

 \Diamond



nxqd.inbox December 11, 2014

thanks for helping me out. After doing so, I tried to verify the new combined pem key with

openssl verify example.com.pem
error 20 at 0 depth lookup:unable to get local issuer certificate

It's weird -_-

 \bigcirc



tersmitten October 29, 2015

You need to specify the -CAfile option

m



pejman21 January 27, 2015

Hey! Thanks for your tutorial :)

I have a similar setup in my environment. SSL terminates on Haproxy. So Haproxy communicates with Nginx encrypted. Once a client open https://website.com, the page loads with content and images but it misses the page format. When I permit http through Haproxy, http://website.com loads without any problem.

Appreciate if you have any suggestion.

 \odot



slamdunq February 9, 2015

..

We are planning to enable SSL for backend servers also as backend servers are in public domain . Please suggest how to configure the backend servers with SSL after SSL termination .

Thanks in advance

0



sslkalpesh February 16, 2015

@pierreozoux were you able to find solution to the sufficient privileges login issue? I am facing same issue dong haproxy->nginx->wordpress setup. The site works fine but the /wp-admin/ login page gives "You do not have sufficient permissions to access this page."

 \odot



pierreozoux February 16, 2015

Well, I have the ugly plugin and the specific code in wp-config.php.

Actually, I think the last version of wordpress fixed some stuff because, I managed to log in just with the wp-config.

I believe the plugin is necessary because of the bad behavior of wordpress in general. It's a wild world, and people have bad habbits to guess the url. So if you don't use the https plugin, you can be sure that you will have mixed content warning somewhere...

 \bigcirc



sslkalpesh February 16, 2015

Thanks for the answer.

I am not a php guy but after pondering for 6-8 hours I was able to locate it to this line in function wp_validate_logged_in_cookie at /wp-includes/user.php. If I change line

if (**is_blog_admin()** || is_network_admin() || empty(\$_COOKIE[LOGGED_I

to

```
if ( is_network_admin() || empty( $_COOKIE[LOGGED_IN_COOKIE] ) ) {
```

Its working fine. The full code of function is

```
function wp_validate_logged_in_cookie( $user_id ) {
    if ( $user_id ) {
        return $user_id;
    }
    //kpatel disabled this to get admin page working
    //if ( is_blog_admin() || is_network_admin() || empty( $_COOKIE[L
    if ( is_network_admin() || empty( $_COOKIE[LOGGED_IN_COOKIE] ) )
        return false;
    }
    return wp_validate_auth_cookie( $_COOKIE[LOGGED_IN_COOKIE], 'logg'
}
```

the function <code>is_blog_admin</code> doesnt do any validation it just checks that the page is an admin page or not. I am clueless as to why validate is returning false if its an admin page. The real cookie validation happens on the next line in <code>wp_validate_auth_cookie</code>.

If I remove Haproxy and just do nginx->wordpress then all this works fine. Let me post to wordpress support to see if this is indeed a bug.

 \odot



cylehunter33 November 24, 2015

I love you. I was banging my head against the desk all day today trying to resolve this.

0



DeepakAjay April 9, 2015

Hai i have followed above steps, finally my https://www.abc.com only show html format page pls help me out

 \odot



manicas April 9, 2015

Go to the WordPress General Settings and change the WordPress Address (URL) and the Site Address (URL) from http to https.

 \odot

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