Apache Proxy Guide

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Licensee shall comply with all applicable laws and regulations, including without limitation those applicable to data privacy, intellectual property, trade secret, and fraud. Licensee is advised that the Technical Information is of U.S. origin and subject to the U.S. Export Administration Regulations ("EAR") and may be subject to applicable local country import/export laws and regulations. Diversion contrary to U.S. and/or applicable local country law and/or regulation is prohibited. Licensee agrees not to directly or indirectly export, re-export, import, download, or transmit the Technical Information to any country, end user or for any use that is contrary to applicable U.S. and/or local country regulation or statute (including but not limited to those countries embargoed by the U.S. government). Licensee represents that any governmental agency has not issued sanctions against Licensee or otherwise suspended, revoked or denied Licensee's import/export privileges. Licensee agrees not to use or transfer the Technical Information for any use relating to nuclear, chemical or biological weapons, or missile technology, unless authorized by the U.S. and/or any applicable local government by regulation or specific written license. Additionally, Licensee is advised that the Technical Information may contain encryption algorithm or source code that may not be exported to government or military end users without a license issued by the U.S. Bureau of Industry and Security and any other country's governmental agencies, where applicable.

13.0 WAIVER.

The failure to assert any rights under this Agreement, including, but not limited to, the right to terminate in the event of breach or default, will not be deemed to constitute a waiver of the right to enforce each and every provision of this Agreement in accordance with their terms.

14.0 SEVERABILITY.

If any provision of this Agreement is determined to be unenforceable or invalid, this Agreement will not be rendered unenforceable or invalid as a whole, and the provision will be changed and interpreted so as to best accomplish the objectives of the original provision within the limits of applicable law.

15.0 GOVERNING LAW AND DISPUTE RESOLUTION.

15.1 Governing Law. This Agreement and any dispute, claim or controversy arising out of or relating to this Agreement ("Dispute"), including without limitation the formation, interpretation, breach or termination of this Agreement, or any issue regarding whether a Dispute is subject to arbitration under this Agreement, will be governed by New York State laws, excluding conflict of law principles, and the United Nations Convention on Contracts for the International Sale of Goods.

15.2 Dispute Resolution. Any Dispute will be resolved in accordance with the provisions of this Section 15. The disputing party shall give the other party written notice of the Dispute in accordance with the notice provision of this Agreement. The parties will attempt in good faith to resolve each controversy or claim within 30 days, or such other longer period as the parties may mutually agree, following the delivery of such notice, by negotiations between designated representatives of the parties who have dispute resolution authority.

15.3 Arbitration of Non-US Disputes. If a Dispute that arose anywhere other than in the United States or is based upon an alleged breach committed anywhere other than in the United States cannot be settled under the procedures and within the timeframe set forth in Section 15.2, it will be conclusively determined upon request of either party by a final and binding arbitration proceeding to be held in accordance with the Rules of Arbitration of the International Chamber of Commerce by a single arbitrator appointed by the parties or (failing agreement) by an arbitrator appointed by the President of the International Chamber of Commerce (from time to time), except that if the aggregate claims, cross claims and counterclaims by any one party against the other party exceed One Million US Dollars at the time all claims, including cross claims and counterclaims are filed, the proceeding will be held in accordance with the Rules of Arbitration of the International Chamber of Commerce by a panel of three arbitrator(s) appointed in accordance with the Rules of Arbitration of the International Chamber of Commerce. The arbitration will be conducted in the English language, at a location agreed by the parties or (failing agreement) ordered by the arbitrator(s). The arbitrator(s) will have authority only to award compensatory damages within the scope of the limitations of Section 8 and will not award punitive or exemplary damages. The arbitrator(s) will not have the authority to limit, expand or otherwise modify the terms of this Agreement. The ruling by the arbitrator(s)) will be final and binding on the parties and may be entered in any court having jurisdiction over the parties or any of their assets. The parties will evenly split the cost of the arbitrator(s)' fees, but Avaya and Customer will each bear its own attorneys' fees and other costs associated with the arbitration. The parties, their representatives, other participants and the arbitrator(s) will hold the existence, content and results of the arbitration in strict confidence to the fullest extent permitted by law. Any disclosure of the existence, content and results of the arbitration will be as limited and narrowed as required to comply with the applicable law. By way of illustration, if the applicable law mandates the disclosure of the monetary amount of an arbitration award only, the underlying opinion or rationale for that award may not be disclosed.

15.4 Choice of Forum for US Disputes. If a Dispute by one party against the other that arose in the United States or is based upon an alleged breach committed in the United States cannot be settled under the procedures and within the timeframe set forth in Section 15.2, then either party may bring an action or proceeding solely in either the Supreme Court of the State of New York, New York County, or the United States District Court for the Southern District of New York. Except as otherwise stated in Section 15.3 each party consents to the exclusive jurisdiction of those courts, including their appellate courts, for the purpose of all actions and proceedings arising out of or relating to this Agreement.

15.5 Injunctive Relief. Nothing in this Agreement will be construed to preclude either party from seeking provisional remedies, including, but not limited to, temporary restraining orders and preliminary injunctions from any court of competent jurisdiction in order to protect its rights, including its rights pending arbitration, at any time. The parties agree that the arbitration provision in Section 15.3 may be enforced by injunction or other equitable order, and no bond or security of any kind will be required with respect to any such injunction or order.

15.6 Time Limit. Actions on Disputes between the parties must be brought in accordance with this Section within 2 years after the cause of action arises.

16.0 AGREEMENT IN ENGLISH.

The parties confirm that it is their wish that the Agreement, as well as all other documents relating hereto, including all notices, have been and shall be drawn up in the English language only. Les parties aux présentes confirment leur volonté que cette convention, de même que tous les documents, y compris tout avis, qui s'y rattachent, soient rédigés en langue anglaise.

17.0 ENTIRE AGREEMENT.

This Agreement, its exhibits, schedules and other agreements or documents referenced herein, constitute the full and complete understanding and agreement between the parties and supersede all contemporaneous and prior understandings, agreements and representations relating to the subject matter hereof. No modifications, alterations or amendments shall be effective unless in writing signed by both parties to this Agreement.

18.0 REDISTRIBUTABLE CLIENT FILES.

The list of SDK client files that can be redistributed, if any, are in the SDK in a file called Redistributable.txt.

Schedule 1 to Avaya SDK License Agreement
Third Party Notices

1. **CODECS**: WITH RESPECT TO ANY CODECS IN THE SDK, YOU ACKNOWLEDGE AND AGREE YOU ARE RESPONSIBLE FOR ANY AND ALL RELATED FEES AND/OR ROYALTIES, IF ANY. IT IS YOUR RESPONSIBILITY TO CHECK.

THE H.264 (AVC) CODEC IS LICENSED UNDER THE AVC PATENT PORTFOLIO LICENSE FOR THE PERSONAL USE OF A CONSUMER OR OTHER USES IN WHICH IT DOES NOT RECEIVE REMUNERATION TO: (I) ENCODE VIDEO IN COMPLIANCE WITH THE AVC STANDARD ("AVC VIDEO") AND/OR (II) DECODE AVC VIDEO THAT WAS ENCODED BY A CONSUMER ENGAGED IN A PERSONAL ACTIVITY AND/OR WAS OBTAINED FROM A VIDEO PROVIDER LICENSED TO PROVIDE AVC VIDEO. NO LICENSE IS GRANTED OR SHALL BE IMPLIED FOR ANY OTHER USE.   ADDITIONAL INFORMATION FOR THE H.264 (AVC) CODEC MAY BE OBTAINED FROM MPEG LA, L.L.C. SEE HTTP://WWW. MPEGLA.COM.

Overview and Intended Audience

This document is aimed at people who are deploying and configuring an Apache server to function as a reverse proxy for Avaya Oceana. It is intended to act as a rough guide; for more detailed advice, please consult the Apache documentation.

Disclaimers

This is an example implementation. Avaya is not responsible for any Apache-related issues. It is your responsibility to keep Apache up-to-date and patched. This has been tested with Apache 2.4.25 and 2.4.37.

Glossary and terms

This guide uses the following terms and conventions.

- The frontend refers to the Web User Interface, also referred to as the Web UI.
- The client refers to the customer's browser or mobile app.
- The backend refers to the server to which the proxy connects. This may refer to the inner proxy (from the outer proxy's perspective), or the Oceana system (from the inner proxy's perspective).
- "WSS" stands for a WebSocket connection that is served over HTTPS.
- "FQDN" stands for Fully-Qualified Domain Name.
- ${SRVROOT} is an Apache convention for defining the Apache root folder.

Reference Topology

The following image shows the reference network topology.
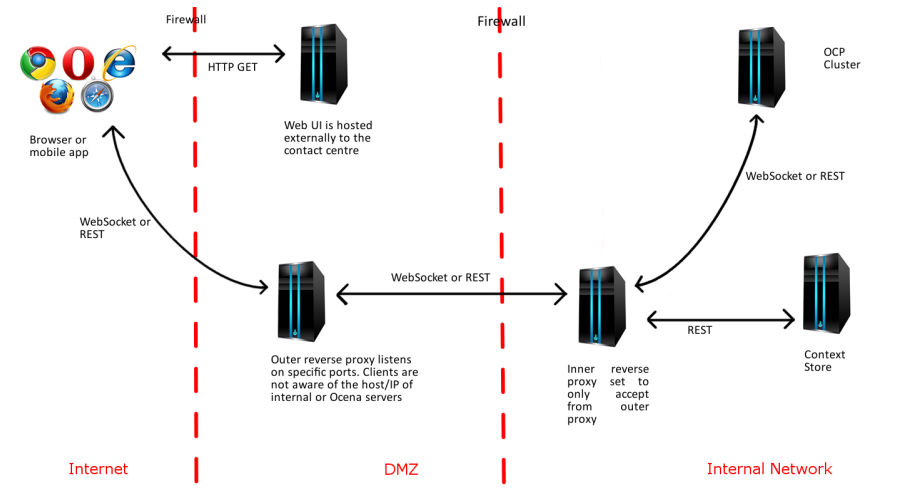
Rationale for the reference network topology

- The Web UI is hosted externally to Oceana. Ideally, the host for this is a dedicated host, i.e. its purpose is exclusively for storing the Web UI files.
- The outer proxy sits in the DMZ, and is the endpoint to which the client connects. Its purpose is to handle denial-of-service prevention and similar tasks.
- The inner proxy sits inside the Oceana network, and acts as a gateway from the DMZ. Its purpose is to verify that any WebSocket or REST calls from the wider Internet were passed through the outer proxy.

Installing Apache

This guide assumes you have installed Apache. If not, please follow **these steps** in the Apache documentation.

Configuring Apache

Where to find the configuration files

The main configuration file for Apache is usually the httpd.conf file or apache2.conf file. This may be located at any of the following, depending on installation details:

- `/etc/apache2/apache2.conf` (installed from e.g. the Ubuntu repositories)
- `/usr/local/apache2/conf/httpd.conf` (compiled from source on Linux)
- `C:/Apache24/conf/httpd.conf` (installed on Windows using a precompiled installer)

If installed from the Ubuntu repositories, there will also be the following files:

- `ports.conf` - defines the ports upon which to listen
- `sites-enabled/000-default.conf` - a default configuration for the HTTP port (80)
- `sites-enabled/default-ssl.conf` - a default configuration for the HTTPS port (443)

Configuring the ports and address

If you are using a standard Ubuntu installation, locate and edit the ports.conf file. If not:

1. Open the main configuration file.
2. Locate the commented out Listen directive.
3. Add your own address and ports below it. It should resemble the following:

```
## This line and the following are commented out; Apache ignores any line that starts with a '#' symbol.
#Listen 12.34.56.78:80

# This line instructs Apache to listen on port 80 (standard HTTP port) for IP address 1.2.3.4
Listen 1.2.3.4:80

# This line instructs Apache to listen on port 443 (standard HTTPS port)
Listen 1.2.3.4:443

# These lines instruct Apache to listen on port 80 for ALL IP addresses
Listen 80
Listen *:80
```

Required modules

The following modules are required to turn Apache into a proxy. These are included in a standard installation of Apache, but are not loaded by default.

- mod_proxy is the base proxy module. All proxy modules require this.
- mod_proxy_http is used to proxy HTTP or HTTPS requests such as requests for estimated wait time, downloading a transferred file, etc.
- mod_proxy_wstunnel is used to specifically proxy WebSocket requests. This is required for chat.

The following are required for secure connections. You may leave this unloaded until you have a certificate ready.

- mod_ssl

The following are optional:

- mod_headers - this is used for editing HTTP response headers

To load these modules, locate the following lines in the main configuration file, and uncomment them (remove the # symbol from the start of the line).
Restart Apache when the required lines are uncommented.

```
#LoadModule proxy_module modules/mod_proxy.so
#LoadModule proxy_http_module modules/mod_proxy_http.so
#LoadModule proxy_wstunnel_module modules/mod_proxy_wstunnel.so
#LoadModule ssl_module modules/mod_ssl.so
#LoadModule headers_module modules/mod_headers.so
```

Alternatively, if you have installed Apache from the Ubuntu repositories, you may use the `a2enmod` utility as follows:

```
sudo a2enmod proxy_module proxy_http_module proxy_wstunnel_module ssl_module headers_module

## You will be prompted to restart afterwards. The command is as follows
sudo service apache2 restart
```

Creating a VirtualHost for proxying

The proxy configuration should be done inside a VirtualHost entry. The following code block shows the bare minimum required to work; you may copy this into your configuration file(s) and replace the placeholder addresses. The only differences between the outer and inner proxy are the values of the placeholder addresses: for the outer proxy, these would be the address of the inner proxy; for the inner proxy, these would be the relevant cluster or node in Oceana.

```
## This is for anything on port 80 (non-HTTPS or non-WSS connections)
<VirtualHost *:80>

    # turning off ProxyRequests turns this into a closed server - recommended for security reasons
    # ProxyPreserveHost passes the Host: line from the incoming request to the proxied host

        # ProxyVia controls the use of the Via: HTTP header. If turned on, each request and reply has a Via:
header added for this host
    ProxyRequests Off
    ProxyPreserveHost On
    ProxyVia Off

    # turn on full logging. These will be stored in the regular.log file, inside the log folder.
    LogLevel debug
    ErrorLog "logs/regular.log"

    # Redirection for the WebSocket for chat. Replace ${Omnichannel-address} with the IP address or FQDN of the
backend
        # The "backend" here may be an Oceana system or an inner proxy
        <Location /services/customer/chat >
        ProxyPass            ws://${Omnichannel-address}/services/customer/chat
        ProxyPassReverse     ws://${Omnichannel-address}/services/customer/chat
    </Location>

    ## Estimated wait time. As before, replace ${Omnichannel-address} with the IP address or FQDN of the backend
    <Location /services/CustomerControllerService/gila/ewt/request >
        ProxyPass            http://${Omnichannel-address}/services/CustomerControllerService/gila/ewt/request
        ProxyPassReverse     http://${Omnichannel-address}/services/CustomerControllerService/gila/ewt/request
    </Location>

    ## This is for OceanaCoreDataService; it uses a regular expression that matches any URL
    ## whose path starts with "services/OceanaCoreDataService/oceana/data"
    ## Replace ${ContextStore-address} with the IP address or FQDN of the Context Store cluster
    <LocationMatch "^/(services/OceanaCoreDataService/oceana/data)/*" >
        ProxyPass            http://${ContextStore-address}
        ProxyPassReverse     http://${ContextStore-address}
    </LocationMatch>

    ## Accessing CustomerManagement.
    ## Replace ${ContextStore-address} with the IP address or FQDN of the Context Store cluster
    <Location /services/CustomerManagement/rest/customers/customerId >
        ProxyPass                http://${ContextStore-address}/services/CustomerManagement/rest/customers
/customerId
        ProxyPassReverse         http://${ContextStore-address}/services/CustomerManagement/rest/customers
/customerId
    </Location>

    ## Allow customers to download files that were sent to them by an agent in a chat
    <LocationMatch "^/(services/customer/rest/attachment)/*" >
        ProxyPass            http://${Omnichannel-address}
        ProxyPassReverse     http://${Omnichannel-address}
    </LocationMatch>


        ## Proxying connections to the CoBrowsing service. Replace ${CoBrowse-address} with the IP address or
FQDN of the cluster that hosts Co-Browsing
        <LocationMatch "^/(services/CoBrowse)/*">
        ProxyPass            http://${CoBrowse-address}
        ProxyPassReverse     http://${CoBrowse-address}
    </LocationMatch>

</VirtualHost>
```

Create a VirtualHost for secure Proxying

To enable secure connections, you may adapt the previous example as follows:

- Listen on port 443
- Add directives to use TLS
- Add directives to link to the private key and certificate for this server.
- Add directives to link to the certificate from the certificate authority.
- Replace all mentions of "http" or "ws" with "https" and "wss", respectively.

The following code block is essentially the previous example with adaptations to use a strong set of ciphers, and other improvements.

```
## Configuration for a HTTPS-only host
<VirtualHost *:443>

        # turning off ProxyRequests turns this into a closed server - recommended for security reasons
        # ProxyPreserveHost passes the Host: line from the incoming request to the proxied host

                # ProxyVia controls the use of the Via: HTTP header. If turned on, each request and reply has
a Via: header added for this host
        ProxyRequests Off
        ProxyPreserveHost On
        ProxyVia Off

        # turn on full logging, and use a different log file
        LogLevel debug
        ErrorLog "logs/secureOperation.log"

        # Set up Cross-Origin Resource Sharing. Note: this does NOT apply to the WebSocket for chat
        # The allowed methods are the only ones that are currently used for customer-facing REST calls.
        Header set Access-Control-Allow-Origin "*"
        Header set Access-Control-Allow-Headers "Origin, X-Requested-With, Content-Type, Accept"
        Header set Access-Control-Allow-Methods "POST, GET, OPTIONS, PUT"

        # unset the response headers, so users do not get as much details about the proxy or the backend
        # These are de-facto headers; not officially defined by the IETF
        Header unset X-Forwarded-For
        Header unset X-Forwarded-IP
        Header unset X-Forwarded-Server
        Header unset X-Powered-By

        # hinders CVE-2016-5387 (httpoxy). Apache 2.4.23 and later have a built-in mitigation.
        # However, the Proxy header is not defined, so disabling it should have no impact
        RequestHeader unset Proxy early

        # prevent the CRIME attack by preventing OpenSSL from using DEFLATE compression
        # See https://en.wikipedia.org/wiki/CRIME
        SSLCompression Off

        # Tell Apache to support TLS on this port
        SSLEngine On

        # Turns the SSLProxyEngine on so that the proxy can use secure connections
        SSLProxyEngine On

        # Disable everything but TLSv1.2 and TLSv1.3
        SSLProtocol ALL -SSLv2 -SSLv3 -TLSv1 -TLSv1.1

        # Specifiy the ciphersuites. The following are a very strong set of ciphers
        # The "SSLHonorCipherOrder" directive tells Apache to use it's own preferences, not the client's
        SSLCipherSuite EECDH+AESGCM:EDH+AESGCM:AES256+EECDH:AES256+EDH
        SSLHonorCipherOrder On

        # link to the certificate and key for this server
        SSLCertificateFile        "conf/server.pem"
        SSLCertificateKeyFile     "conf/server.key"

        ## This links to the file that contains the root certificates from any remote servers to which this
```

```
proxy connects
                ## You must also create a symlink to the file - simply placing it in the directory does not
work by itself
                SSLProxyCACertificateFile   "path/to/cert"

        # Redirection for the WebSocket for chat. Replace ${Omnichannel-address} with the IP address or FQDN of
the backend
        <Location /services/customer/chat >
            ProxyPass               wss://${Omnichannel-address}/services/customer/chat
            ProxyPassReverse        wss://${Omnichannel-address}/services/customer/chat
        </Location>

        ## Estimated wait time. As before, replace ${Omnichannel-address} with the IP address or FQDN of the
backend
        <Location /services/CustomerControllerService/gila/ewt/request >
            ProxyPass               https://${Omnichannel-address}/services/CustomerControllerService/gila/ewt
/request
            ProxyPassReverse        https://${Omnichannel-address}/services/CustomerControllerService/gila/ewt
/request
        </Location>

        ## This is for OceanaCoreDataService; it uses a regular expression that matches any URL
        ## whose path starts with "services/OceanaCoreDataService/oceana/data"
        ## Replace ${ContextStore-address} with the IP address or FQDN of the Context Store cluster
        <LocationMatch "^/(services/OceanaCoreDataService/oceana/data)/*" >
            ProxyPass               https://${ContextStore-address}
            ProxyPassReverse        https://${ContextStore-address}
        </LocationMatch>

        ## Accessing CustomerManagement
        ## Replace ${ContextStore-address} with the IP address or FQDN of the Context Store cluster
 <Location /services/CustomerManagement/rest/customers/customerId >
                                    ## If you are using a single proxy, you can remove the path - Apache
will stick that to the end
                    ProxyPass               https://${ContextStore-address}/rest/customers/customerId
            ProxyPassReverse        https://${ContextStore-address}/rest/customers/customerId
        </Location>

        ## Allow customers to download files that were sent to them by an agent in a chat
        <LocationMatch "^/(services/customer/rest/attachment)/*" >
            ProxyPass               https://${Omnichannel-address}
            ProxyPassReverse        https://${Omnichannel-address}
        </LocationMatch>


             ## Proxying connections to the CoBrowsing service.
            ## Replace ${CoBrowse-address} with the IP address or FQDN of the cluster that hosts Co-Browsing
        <LocationMatch "^/(services/CoBrowse)/*">
            ProxyPass               https://${CoBrowse-address}
            ProxyPassReverse        https://${CoBrowse-address}
        </LocationMatch>

</VirtualHost>
```

Which URLs should point where

All URLs in the chat client should point at the outer proxy. The URLs in the outer proxy should all point at the inner proxy, which in turn points at the relevant Oceana clusters.

Using the WebChat URLs as an example:

- Set the value of the *webChatHost* variable in the client's **links.js** file to the outer proxy hostname or IP address.
- Outer proxy Apache config: the */services/customer/chat* mapping should be **ProxyPass ws://${inner-proxy-address}/services /customer/chat**
- Inner proxy Apache config: the */services/customer/chat* mapping should be **ProxyPass   ws://${Omnichannel-address}/services /customer/chat.**

Extra security configuration

The following configuration is not strictly required, but is recommended. Many of these are documented by the Apache Foundation here.

Hindering Denial-of-Service attacks

There is no single component that can stop or hinder a Denial-of-Service attack. However, the following may help, in addition to configuring the firewall of the operating system that underlies Apache. Configure these on the outer proxy at minimum; configuring them on the inner proxy is optional, but not likely to cause any harm.

- Limiting request sizes. This helps by preventing excessively large requests from reaching Oceana, only to be rejected.
- Limiting timeouts as follows:
    - Configure the ProxyTimeout directive to limit the time a client may use to send requests via a proxy. The default value is 60 seconds (1 minute).
    - Configure the KeepAliveTimeout directive to limit the time Apache will wait for a subsequent request before closing a connection. The default value is 5 seconds.

Configuring error responses

Apache includes default responses for various HTTP error statuses. To configure these, locate the "ErrorDocument" directive inside the configuration file, and adjust it for each error code. The response can be either plain text, a redirect to a local page, or a redirect to an external site. Configure these on the outer proxy at minimum; configuring them on the inner proxy is optional, but not likely to cause any harm.

These may also be added to a VirtualHost, making them specific to that particular instance.

Access control

Access control in this context refers to the inner proxy rejecting any connections that were not passed through the outer proxy. This may be done by using either of the following directives:

- Require ip 1.2.3.4 (e.g. if this request did not come from IP address 1.2.3.4, reject it)
- Require host example.host.org (e.g. if the request did not come from example.host.org, reject it)

> ⓘ Note: This only applies if you have two proxies; ignore this if you are using a single one. These directives must be place inside a Location or LocationMatch entry.

Example

The following snippet shows a few examples of these, using the example shown above.

```
## This is a plain text response for the HTTP 403 status code
## These can also be moved into the VirtualHost
ErrorDocument 403 "You are not permitted to access this"
ErrorDocument 404 "This cannot be found"
ErrorDocument 500 "Internal Server Error"
ErrorDocument 503 "We are currently undergoing maintenance, please return later"

## Using the secure version as an example; the following improvements may also apply to the HTTP-only version
<VirtualHost *:443>

  # Configure the general proxy timeout. The default is 60 seconds (1 minute); this can be changed to suit your
needs
  ProxyTimeout 120

  <Location /services/customer/chat >
      ProxyPass               ws://${Omnichannel-address}/services/customer/chat
      ProxyPassReverse        ws://${Omnichannel-address}/services/customer/chat

      ## Limit the request body to 1MB. This exceeds the maximum length of a chat message (10000 characters)
      ## to allow some leeway for the message metadata
      LimitRequestBody             1024000

      ## For the inner proxy, this would result in any WebSocket requests that did not come via the outer proxy
being rejected
      ## Do not include this line in the outer proxy configuration.
      Require ip 1.2.3.4
  </Location>

</VirtualHost>
```

Troubleshooting

The first step when troubleshooting is to examine the Apache logs. These will be available under Apache's log folder. A full list of the possible error codes can be found **here**; this guide will only touch on the most common issues.

Validating the configuration syntax

Apache comes with an utility programme, **apachectl**. This can be used to perform a sanity check on the syntax of the configuration files by running either of the following commands (both are syntactically equivalent):

```
apachectl -t
apachectl configtest
```

Log folder location

If installed on Windows, or compiled from source on Linux, this will be **${SRVROOT}/logs**, e.g. C:/Apache24/logs.

If installed from the Ubuntu repositories, the main log directory will be **/var/log/apache2**.

Logs to look at

The following are general logs to look at. If you have specific logs for specific VirtualHosts, they will be located in the directory specified by their ErrorLog directive.

Log name	Purpose
access.log	Log HTTP requests to specific endpoints
error.log	General-purpose log
other_vhosts_access.log	May appear if you have the server status endpoint enabled - see the status module for details.

Incorrect hostnames/URLs

After examining the logs, make sure that the hostnames and addresses are correct. If not, correct them and restart Apache. Note that clients should point at the *outer* proxy, even if hosted on it.

Incorrect URLs in a Location entry

This is likely to occur if a <Location> or <LocationMatch> entry does not include a correct path. Check that these are correct and restart Apache.

No protocol handler was valid for the URL (scheme 'ws')

This error may occur if you attempt to visit the proxy WebSocket URL for chat in the browser as a sanity check. However, if a WebSocket request works, then this error is not incorrect.

Firewall/port issues

This covers one of the following:

- Apache is not configured to listen on a particular port. Check that the Listen directives are configured properly, and restart Apache.
- The port has not been opened in the underlying operating system firewall. This particularly applies if Apache is installed on a Windows server; Apache must be configured to listen on a different port (i.e. not 80 or 443) to avoid conflicts with IIS. However, this requires those ports to be opened in the Windows firewall.

Certificate issues

The most likely cause of certificate issues is that Apache, or the OpenSSL library that it uses, cannot verify the certificate of the backend server. This may be caused by any of the following:

- The FQDN in the certificate does not match the address used in the request. Make sure that they match.
- The certificate may have expired. This will require a new certificate to be generated.
- The root certificate for the certificate authority is not loaded. Make sure it is included in the file designated by the SSLProxyCACertificateFile directive.

For testing, you can work around these by setting the following directives inside a VirtualHost. Do **not** do this in production!

```
SSLProxyVerify None
SSLProxyCheckPeerCN off
SSLProxyCheckPeerName off
SSLProxyCheckPeerExpire off
```

Certificate installed on Linux

This is separate to the above. If Apache is installed on Linux and configured to support SSL/TLS connections from clients, you will need to enter the passphrase for the private key when starting it up via the command line. This has not been observed to occur if Apache is installed on Windows.