Reverse-Proxy Configuration

Introduction

This section describes how to configure a reverse-proxy and access the Cisco Finesse desktop without connecting to a VPN based on Unified CCX and Customer Collaboration Platform..

Note

- The content in this chapter is provided as a guidance for customers to install and configure reverse-proxy. Cisco does not support requests for reverse-proxy installation and configuration issues. Queries that are related to this subject can be discussed on Cisco community forums.

- For 12.5(1) SU2 deployments of VPN-less Finesse, see the Cisco Finesse 12.6 ES04 Readme.

Note The OpenResty Nginx configurations provided as part of Release 12.5(1) SU2 need to be manually edited and applied to match your deployment, along with requiring a manual install of the OpenResty Nginx.

Prerequisites

Cisco recommends that you have knowledge of the following:

- Cisco Unified Contact Center Express Release
- Cisco Finesse

- Linux administration

- Network administration and Linux network administration

Components Used

The information in this document is based on these software and hardware versions:

- Unified CCX - 12.5(1) SU2

- Customer Collaboration Platform - 12.5(1) SU2

- IdS - 12.5(1) SU2

The information in this document was created from the devices in a specific lab environment. All the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

This deployment model is supported for Unified CCX and Customer Collaboration Platform.

Deployment of a reverse-proxy is supported (available from Release 12.5(1) SU2) as an option to access the Cisco Finesse desktop without connecting to a VPN. This feature provides the flexibility for agents to access the Finesse desktop from anywhere through the Internet.

To enable this feature, a reverse-proxy pair must be deployed in the Demilitarized Zone (DMZ).

Media access remains unchanged in reverse-proxy deployments. To connect to the media, agents and supervisors can use Cisco Jabber or Webex over Mobile and Remote Access solution (MRA). This diagram shows how the network deployment will look like when you access two Finesse clusters and two Unified IC nodes through a single high availability (HA) pair of reverse-proxy nodes.

Concurrent access from agents on the Internet and agents who connect from LAN is supported as shown in the following image:
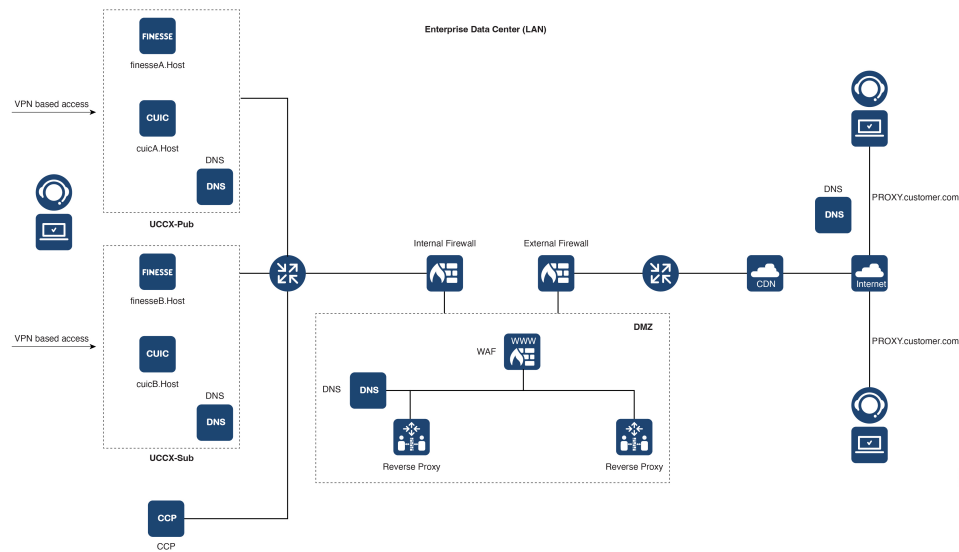
Note See the Reverse-Proxy Selection and Configurations section to select an appropriate reverse-proxy that supports this deployment. The *Solution Design Guide for Cisco Unified Contact Center Express, Release 12.5(1) SU2* at https://www.cisco.com/c/en/us/support/customer-collaboration/unified-contact-center-express/products-implementation-design-guides-list.html provides security configuration guidelines for the reverse-proxy deployment.

Before you read this section, it is recommended to review the following sections:

- VPN-less Access to Finesse Desktop section in this guide

- Security Guidelines for Reverse-Proxy Deployment section in the *Solution Design Guide for Cisco Unified Contact Center Express, Release 12.5(1) SU2*

Validating Unauthenticated Static Resources

All valid endpoints that can be accessed without any authentication are actively tracked in the Release 12.5(1) SU2. Requests to these unauthenticated paths are rejected without sending these requests to the components servers, if an invalid URI is requested.

Brute Force Attack Prevention

Unified CCX Release 12.5(1) SU2 authentication scripts actively prevent brute force attacks that can be used to guess the user password. The scripts do this by blocking the IP address used to access the service, after a certain number of failed attempts in a short time. These requests will be rejected by **418 client error**. The number of failed requests, time interval, and blocking duration are configurable.

Caching CORS Headers

When the first options request is successful, the response headers **access-control-allow-headers, access-control-allow-origin, access-control-allow-methods, access-control-expose-headers,** and **access-control-allow-credentials** are cached at the proxy for five minutes. These headers are cached for each respective upstream server.

Reverse-Proxy Configuration

This section describes the configuration of OpenResty Nginx as the reverse-proxy to be used to enable VPN-less access to Finesse. The Unified CCX component, proxy, and OS versions used to verify the instructions are provided. The relevant instructions have to be adapted to the OS or proxy of your choice.

- OpenResty Nginx version used - OpenResty 1.19.9.1

- OS used for configuration - CentOS 7.4.1708

Any of the following Nginx versions can be used for this purpose, as long as they are based on Nginx 1.19+ and support Lua:

- Nginx Plus

- Nginx Open Source (Nginx open source must be compiled along with OpenResty-based Lua modules)

- OpenResty

- GetPageSpeed Extras

Note   The OpenResty Nginx configuration described can be downloaded from the Software Download page.

Install OpenResty as a Reverse-Proxy in DMZ

This section details the OpenResty-based proxy installation steps. The reverse-proxy is typically configured as a dedicated device in the network demilitarized zone (DMZ) as shown in the deployment diagram in *Background Information*.

1. Install the OS of your choice with the required hardware specification. Kernel and IPv4 parameter tweaks might differ depending on the OS selected. Users are advised to reverify these aspects if the chosen OS version is different from CentOS 7.

2. Configure two network interfaces. One interface will be required for public access from the Internet clients and another to communicate with the servers in the internal network.

3. Install OpenResty.

Note   The configuration provided has been tested with OpenResty 1.19 and is expected to work with other distributions with only minor updates, if any.

Install OpenResty

SUMMARY STEPS

1. Install OpenResty. See OpenResty Linux Packages.
2. Start or stop OpenResty Nginx

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	Install OpenResty. See OpenResty Linux Packages.	As part of the OpenResty installation, Nginx will be installed in this location. Add the OpenResty path to the ***PATH*** variable by adding the following line in the ***~/.bashrc*** file. `export PATH=/usr/local/openresty/bin:$PATH`
Step 2	Start or stop OpenResty Nginx	• To start OpenResty Nginx, enter `openresty`. • To stop OpenResty Nginx, enter `openresty -s stop`.

Configure OpenResty Nginx

The configuration is explained for an OpenResty-based Nginx installation. The default directories for OpenResty are:

- <nginx-install-directory> = /usr/local/openresty/nginx

- <Openresty-install-directory> = /usr/local/openresty

1. Download and extract the 12.5(1) SU2-reverse-proxy-config.zip that contains the reverse-proxy configuration for OpenResty Nginx. This file is available on the Software Download page.

2. Copy `nginx.conf, nginx/conf.d/,` and `nginx/html/` from the extracted reverse-proxy configuration directory to `<nginx-install-directory>/conf, <nginx-install-directory>/conf/conf.d/,` and `<nginx-install-directory>/html/` respectively.

3. Copy the `nginx/lua` directory from the extracted reverse-proxy configuration directory inside the `<nginx-install-directory>`.

4. Copy the contents of lualib to `<Openresty-install-directory>/lualib/resty`.

5. Configure OpenResty Nginx log rotation by copying the `nginx/logrotate/saproxy` file to the `<nginx-install-directory>/logrotate/` folder. Modify the file contents to point to the correct log directories if OpenResty Nginx defaults are not used.

6. OpenResty Nginx must be run with a dedicated non-privileged service account, which must be locked and have an invalid shell (or as applicable for the chosen OS).

7. Find the **Must-change** string in the files under the extracted folders named `html` and `conf.d` and replace the indicated values with the appropriate entries.

8. Ensure that all mandatory replacements are done, which are described with the **Must-change** comments in the config files.

9. Make sure that the cache directories configured for Cisco Unified Intelligence Center and Finesse are created under `<nginx-install-directory>/cache` along with these temporary directories.

   - <nginx-install-directory>/cache/client_temp

   - <nginx-install-directory>/cache/proxy_temp

Note The configuration provided is for a sample 400 agent deployment and has to be expanded appropriately for a larger deployment.

Configure OpenResty Nginx Cache

By default, the proxy cache paths are stored in the file system. We recommend changing them to in-memory drives by creating a cache location in tmpfs as shown here.

1. Create directories for the different proxy cache paths under /home.

   As an example, these directories must be created for the primary Unified CCX and Customer Collaboration Platform servers. The same steps should be followed for the secondary Unified CCX server.

   ```
   mkdir -p /home/primaryCCX/rest
   mkdir -p /home/primaryCCX/desktop
   mkdir -p /home/primaryCCX/shindig
   mkdir -p /home/primaryCCX/openfire
   mkdir -p /home/CCP/ccp
   mkdir -p /home/CCP/ccpopenfire
   mkdir -p /home/primaryCUIC/cuic
   mkdir -p /home/primaryCUIC/cuicdoc
   mkdir -p /home/client_temp
   mkdir -p /home/proxy_temp

   echo "tmpfs /home/primaryFinesse/rest tmpfs
   size=1510M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab
   echo "tmpfs /home/primaryFinesse/desktop tmpfs
   size=20M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab echo
    "tmpfs /home/primaryFinesse/shindig tmpfs
   size=500M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >>
   /etc/fstab echo "tmpfs /home/primaryFinesse/openfire tmpfs
   size=10M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab echo
    "tmpfs /home/primaryCUIC/cuic tmpfs
   size=100M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab
   echo "tmpfs /home/primaryCUIC/cuicdoc tmpfs
   size=100M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab
   echo "tmpfs /home/client_temp tmpfs
   size=2048M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab
   echo "tmpfs /home/proxy_temp tmpfs
   size=2048M,rw,auto,noexec,nodev,nosuid,gid=root,uid=root,mode=1700 0 0" >> /etc/fstab
   ```

   Note Increase the client and proxy_temp caches by 1 GB for each new Finesse cluster added to the configuration.

2. Mount the new mount points with the `mount -av` command.

3. Validate that the file system has mounted the new mount points with the `df -h` command.

4. Change the proxy_cache_path locations in the Unified CCX and Customer Collaboration Platform cache configuration files. For example, to change the paths for the Finesse primary, go to `to<nginx-installdirectory>/conf.d/finesse/caches` and change the existing cache location `/etc/nginx/cache/<ccx_server_name>/` to the newly created filesystem location `/home/primaryCCX`.

```
##Must-change /etc/nginx/cache/ location would change depending on folder extraction ##
 Nginx config file to cache the desktop/shindig and notification service related static
 files.
proxy_cache_path /home/primaryCCX/desktop levels=1:2 use_temp_path=on
keys_zone=desktop_cache_primary:10m max_size=15m inactive=3y use_temp_path=off;
proxy_cache_path /home/primaryCCX/shindig levels=1:2 use_temp_path=on
keys_zone=shindig_cache_primary:10m max_size=500m inactive=3y use_temp_path=off;
proxy_cache_path /home/primaryCCX/openfire levels=1:2 use_temp_path=on
keys_zone=openfire_cache_primary:10m max_size=10m inactive=3y use_temp_path=off;
proxy_cache_path /home/primaryCCX/rest levels=1:2 use_temp_path=on
keys_zone=rest_cache:10m max_size=1500m inactive=40m use_temp_path=off;
```

5. Follow the same steps for the Unified CCX secondary server.

> **Note** Ensure that sum of all the tmpfs drive sizings created in all the previous steps is added to the final memory sizing for the deployment. This is because these drives are memory blocks that are configured to look like disks to the application and they consume that much memory space.

Use Self-Signed Certificates—Test Deployments

Use self-signed certificates until the reverse-proxy is ready to be rolled out into production. On a production deployment, use only a Certificate Authority-signed (CA-signed) certificate.

1. Generate OpenResty Nginx certificates for SSL folder content. Before you generate certificates, you must create a folder called **ssl** under `/usr/local/openresty/nginx`. Generate two certificates (one for `<reverseproxy_primary_fqdn>` and another for `<reverseproxy_secondary_fqdn>`) with the help of the following commands:

    a. `sudo openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout /usr/local/openresty/nginx/ssl/nginx.key -out /usr/local/openresty/nginx/ssl/nginx.crt` (pass hostname as: <reverseproxy_primary_fqdn>)

    b. `sudo openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout /usr/local/openresty/nginx/ssl/nginxnode2.key -out /usr/local/openresty/nginx/ssl/nginxnode2.crt` (pass hostname as: <reverseproxy_secondary_fqdn>)

    c. Ensure that the certificate path is `/usr/local/openresty/nginx/ssl/nginx.crt` and `/usr/local/openresty/nginx/ssl/nginxnode2.crt`.

2. Change the permission of the private key **400 (r--------)**.

3. Configure the firewall and iptables on the reverse-proxy to enable the firewall to communicate with the ports that are configured to listen to the OpenResty Nginx server.

4. Add the IP address and hostname of all the configured servers in the `/etc/hosts` file of the reverse-proxy server.

> **Note** The provided configuration is for a sample 400 agent deployment and must be expanded appropriately for larger deployments.

Use CA-Signed Certificate—Production Deployments

A CA-signed certificate can be installed on the reverse-proxy with these steps:

1. Generate the certificate signing request (CSR).

    To generate the CSR and private key, enter `openssl req -new -newkey rsa:4096 -keyout nginx.key -out nginx.csr` after you log in to the proxy. Follow the prompt, and provide the details. This generates the CSR (nginx.csr in the example) and the RSA private key (nginx.key in the example) of 4096 bits.

    For example:

    ```
    [root@reverseproxyhost.companyname.com ssl]# openssl req -new -newkey rsa:4096 -keyout
    nginx.key -out nginx.csr
    Generating a RSA private key
    .....+++++
    ..............................................................................................................+++
    writing new private key to 'nginx.key'
    Enter PEM pass phrase:passphrase
    Verifying - Enter PEM pass phrase:passphrase
    -----
    You are about to be asked to enter information that will be incorporated
    into your certificate request.
    What you are about to enter is what is called a Distinguished Name or a DN.
    There are quite a few fields but you can leave some blank
    For some fields there will be a default value,
    If you enter '.', the field will be left blank.
    -----
    Country Name (2 letter code) [XX]:US
    State or Province Name (full name) []:CA
    Locality Name (eg, city) [Default City]:Orange County
    Organization Name (eg, company) [Default Company Ltd]:CompanyName
    Organizational Unit Name (eg, section) []:BusinessUnit
    Common Name (eg, your name or your server's hostname)
    []:reverseproxyhostname.companydomain.com
    Email Address []:john.doe@comapnydomain.com
    Please enter the following 'extra' attributes
    to be sent with your certificate request
    A challenge password []:challengePWD
    An optional company name []:CompanyName
    ```

    Write down the PEM passphrase. This is used to decrypt the private key during the deployment.

2. Obtain the signed certificate from the CA.

    Send the CSR to the certificate authority and obtain the signed certificate.

    > **Note** If the certificate received from the CA is not a certificate chain containing all the respective certificates, compose all the relevant certificates into a single certificate chain file.

3. Deploy the certificate and key.

Decrypt the key generated in the first step with the `openssl rsa -in nginx.key -out nginx_decrypted.key` command. Place the CA-signed certificate and the decrypted key inside the folder `/usr/local/openresty/nginx/ssl` in the reverse-proxy machine. Update or add the following SSL configurations related to the certificate in the OpenResty Nginx configurations in the following file: `/usr/local/openresty/nginx/conf/conf.d/ssl/ssl.conf`:

```
ssl_certificate /usr/local/openresty/nginx/ssl/ca_signed_cert.crt;
ssl_certificate_key/usr/local/openresty/nginx/ssl/nginx_decrypted.key;
```

4. Configure permissions for the certificates.

   Enter `chmod 400 /usr/local/openresty/nginx/ssl/ca_signed_cert.crt` and `chmod 400 /usr/local/openresty/nginx/ssl/nginx_decrypted.key`, so that the certificate has read-only permission and is restricted to the owner.

5. Reload OpenResty Nginx.

Create Custom Diffie-Hellman Parameter

1. Create a custom Diffie-Hellman parameter by using the following commands:

   ```
   openssl dhparam -out /usr/local/openresty/nginx/ssl/dhparam.pem 2048
   ```

   ```
   chmod 400 /usr/local/openresty/nginx/ssl/dhparam.pem
   ```

2. Modify the server configuration to use the new parameters in the file `/usr/local/openresty/nginx/conf/conf.d/ssl/ssl.conf` by using the following command:

   ```
   ssl_dhparam /usr/local/openresty/nginx/ssl/dhparam.pem;
   ```

Enable OCSP Stapling

Note In order to enable the Online Certificate Status Protocol (OCSP) stapling, the server should be using a CA-signed certificate and the server should have access to the CA which signed the certificate.

Add or update this configuration in the file: `/usr/local/openresty/nginx/conf/conf.d/ssl/ssl.conf`:

- `ssl_stapling on;`

- `ssl_stapling_verify on;`

Modify the Common OpenResty Nginx Configuration

The default OpenResty Nginx configuration file (`/usr/local/openresty/nginx/conf/nginx.conf`) has to be modified to contain these entries to enforce security and enhance performance. This content should be used to modify the default configuration file which is created during the OpenResty Nginx installation.

```
#user  nobody;
# Increasing number of worker processes will not increase the processing the request. The
number of worker process will be same as number of cores
```

```
# in system CPU. Nginx provides "auto" option to automate this, which will spawn one worker
 for each CPU core.
worker_processes  auto;

# Process id file location
pid /usr/local/openresty/nginx/logs/nginx.pid;

# Binds each worker process to a separate CPU
worker_cpu_affinity auto;

#Defines the scheduling priority for worker processes. This should be calculated by "nice"
 command. In our proxy set up the value is 0
worker_priority 0;


error_log  /usr/local/openresty/nginx/logs/error.log info;
error_log  /usr/local/openresty/nginx/logs/blocking.log emerg;

#user root root;
#user nginxuser nginxuser;
# current limit on the maximum number of open files by worker processes, keeping 10 times
of worker_connections
worker_rlimit_nofile 102400;

events {
    multi_accept on;

    # Sets the maximum number of simultaneous connections that can be opened by a worker
process.
    # This should not be more the current limit on the maximum number of open files i.e.
hard limit of the maximum number of open files for the user (ulimit -Hn)
    # The appropriate setting depends on the size of the server and the nature of the
traffic, and can be discovered through testing.
    worker_connections  10240;
    #debug_connection 10.78.95.21;
}


http {
    include       mime.types;

    default_type  text/plain;

    ## Must-change Change with DNS resolver ip in deployment
    ;
    resolver X.X.X.X;
    lua_package_path
"/usr/local/openresty/lualib/resty/?.lua;/usr/local/openresty/nginx/lua/?.lua;;";


    ## Must-change change proxy_temp folder as per cache directory configurations
    proxy_temp_path /usr/local/openresty/nginx/cache/proxy_temp 1 2;
    ## Must-change change client_temp folder as per cache directory configurations
    client_body_temp_path /usr/local/openresty/nginx/cache/client_temp 1 2;


    lua_shared_dict userlist 50m;
    lua_shared_dict credentialsstore 100m;
    lua_shared_dict userscount 100k;
    lua_shared_dict clientstorage 100m;
    lua_shared_dict blockingresources 100m;
    lua_shared_dict tokencache_ccxproxy 10M;
    lua_shared_dict tokencache_ccxproxy99 10M;
    lua_shared_dict ipstore 10m;
```

```
    lua_shared_dict desktopurllist 10m;
    lua_shared_dict desktopurlcount 100k;
    lua_shared_dict thirdpartygadgeturllist 10m;
    lua_shared_dict thirdpartygadgeturlcount 100k;
    lua_shared_dict corsheadersstore 100k;
    lua_shared_dict timerthreadsstore 100k;

    init_worker_by_lua_block {
        local UsersListManager = require('users_list_manager')
        local UnauthenticatedDesktopResourcesManager =
require("unauthenticated_desktopresources_manager")
        local UnauthenticatedResourcesManager =
require("unauthenticated_thirdpartyresources_manager")
        --  Must-change Replace saproxy.cisco.com with reverseproxy fqdn
        -- This is done so that all the apis required are prepopulated with data before the
 first request by starting required timers.
        if  ngx.worker.id() == 0 then
        UsersListManager.getUserList("ccx-rproxy-finesse.cisco.com",
"https://ccx-rproxy-finesse.cisco.com:8445/finesse/api/Users")

UnauthenticatedDesktopResourcesManager.getDesktopResources("ccx-rproxy-finesse.cisco.com",
 "https://ccx-rproxy-finesse.cisco.com:8445/desktop/api/ResourceURLs?type=desktop")

UnauthenticatedResourcesManager.getThirdPartyGadgetResources("ccx-rproxy-finesse.cisco.com",
 "https://ccx-rproxy-finesse.cisco.com:8445/desktop/api/ResourceURLs?type=3rdParty")
        end
    }


    include conf.d/*.conf;

    sendfile        on;

    tcp_nopush      on;

    server_names_hash_bucket_size 512;

}
```

Configure Reverse Proxy Port

By default, the OpenResty Nginx configuration listens on port 8445 for Unified CCX requests. At a time, only one port can be enabled from a reverse proxy to support finesse requests e.g., 8445. If 443 port needs to be supported, then check the `<NGINX_HOME>/conf.d/finesse.`conf in order to enable listening on 443 and disable listening on 8445.

Configure Mutual TLS Authentication Between Reverse-Proxy and Components

Client SSL certificate authentication for connections from reverse-proxy hosts can be enabled on Unified CCX and Customer Collaboration Platform by using the new CVOS CLI option `utils system reverse-proxy client-auth enable/disable/status`.

By default this is disabled and has to be enabled by the administrator by executing the CLI on each upstream server independently. After this option is enabled, Cisco Web proxy Service running on upstream host will start authenticating client certificates in TLS handshake for connections originating from trusted reverse-proxy hosts added by using the CLI `utils system reverse-proxy allowed-hosts add <proxy-host>`.

The following is the configuration block for the same in proxy config files named **ssl.conf** and **ssl2.conf**.

```
#Must-change /usr/local/openresty/nginx/ssl/nginx.crt change this location accordingly
proxy_ssl_certificate /usr/local/openresty/nginx/ssl/nginx.crt;
```

```
#Must-change /usr/local/openresty/nginx/ssl/nginx.key change this location accordingly
proxy_ssl_certificate_key /usr/local/openresty/nginx/ssl/nginx.key;
```

The SSL certificate used for outbound traffic (proxy to upstream) can be the same as the SSL certificate that is configured for inbound traffic (SSL connector for component server blocks). If self-signed certificate is used as **proxy_ssl_certificate**, it has to be uploaded to the tomcat trust store of the upstream components (Finesse/IdS/Cisco Unified Intelligence Center/Livedata) for it to be authenticated successfully.

Upstream server certificate validation by reverse-proxy is optional and disabled by default. If you wish to achieve full TLS mutual auth between reverse-proxy and upstream hosts, the following configuration has to be uncommented in the **ssl.conf** and **ssl2.conf** files.

```
#Enforce upstream server certificate validation at proxy ->
#this is not mandated as per CIS buit definitely adds to security.
#It requires the administrator to upload all upstream server certificates to the proxy
certificate store
#Must-Change Uncomment below lines IF need to enforce upstream server certificate validation
 at proxy
#proxy_ssl_verify on;
#proxy_ssl_trusted_certificate /usr/local/openresty/nginx/ssl/finesse25.crt;
proxy_ssl_trusted_certificate: This file should contain the all upstream certificate enteries
 concatenated together
```

Caveats for Configuring mutual TLS Authentication

mutual TLS (mTLS) is a standard security requirement for connections established from DMZ into the data center. For more information, see Nginx CIS behcmarks-https://www.cisecurity.org/benchmark/nginx

mTLS requires that both the server and client be pre-configured with mutual information about each other, as well as that the mutual certificates be properly verified. Hence the term Mutual TLS. A properly configured proxy server will be able to circumvent TCP rate limits and provide the client IP to the server for logging purposes. As a result, it is critical that the proxy identity be verified before connecting as a reverse proxy. For security reasons, it is therefore recommended that this feature be used and turned on.

This requires the upstream component certificates to be made available to the proxy and vice versa. Reverse proxy by default establishes verified TLS connections to the upstream server and it is the proxy verification at the client which is optional. Therefore this needs to be enabled at the upstream client server as described below

Enabling mutual TLS

The mutual TLS needs to be enabled at the upstream component servers using the provided CLI.

Use the CLI "utils system reverse-proxy client-auth enable" to enable proxy certificate verification at the upstream component server.

Then, upload the proxy SSL certificate corresponding to the reverse proxy hostname used to connect to the same server, so that it can be used to verify TLS connections when the reverse proxy attempts to establish an upstream connection.

Clear Cache

The reverse-proxy cache can be cleared with the `<NGINX_HOME>/clearCache.sh` command.

Standard Guidelines

This section briefly describes the standard guidelines that must be followed when you set up OpenResty Nginx as a proxy server. The guidelines for the OpenResty Nginx server software is derived from the Center for Internet Security.

1. Use the latest stable versions of OpenResty and OpenSSL version.

2. Install OpenResty Nginx in a separate disk mount.

3. The OpenResty Nginx process id must be owned by the root user (or as applicable for the chosen OS) and must have permission **644 (rw-------)** or stricter.

4. OpenResty Nginx must block requests for unknown hosts. Ensure that each server block contains the server_name directive explicitly defined. To verify, search all server blocks in the `nginx.conf` and `nginx/conf.d` files and verify that all server blocks contain the server_name.

5. OpenResty Nginx must listen only on the authorized ports. Search all server blocks in the `nginx.conf` and `nginx/conf.d` files and check for the `listen` directives to verify that only the authorized ports are open for requests.

6. Block the proxy server HTTP port, because Cisco Finesse does not support HTTP.

7. The OpenResty Nginx SSL protocol must be TLS 1.2. Remove support for legacy SSL protocols. Disable weak SSL ciphers.

8. Send the OpenResty Nginx error and access logs to the remote syslog server.

9. Install the **mod_security** module that works as a web application firewall. See the ModSecurity manual for more information. Note that OpenResty Nginx load has not been verified within the **mod_security** module in place.

Configure the Mapping File

Refer to the *Host Mapping File for Network Translation* section in the *Solution Design Guide for Cisco Unified Contact Center Express* at https://www.cisco.com/c/en/us/support/customer-collaboration/ unified-contact-center-express/products-implementation-design-guides-list.html.

Use Reverse-Proxy as the Mapping File Server

✎

Note This appendix has the configuration details, for more information about the pre-requisites, refer to Use Reverse-Proxy as the Mapping File Server, on page 13.

These steps are required only if the reverse-proxy is also used as the proxy mapping file host.

1. Configure the reverse-proxy hostname in the domain controller used by the Unified CCX and Customer Collaboration Platformhosts such that its IP address can be resolved.

2. Upload the generated OpenResty Nginx signed certificates on both the nodes under tomcat-trust of cmplatform and restart the server.

3. Update the **Must-change** values in `<NGINX_HOME>/html/proxymap.txt`.

4. Reload OpenResty Nginx configurations with the below commands:

- `openresty -s stop`

- `openresty`

5. Use the `curl` command to validate if the configuration file is accessible from another network host.

CentOS 7 Kernel Hardening

If the operating system is Cent OS 7 and the installations use a dedicated server for hosting the proxy, harden the kernel by using these `sysctl` configurations:

```
## Configurations for kernel hardening - CentOS 7. The file path is /etc/sysctl.conf
## Note that the commented configurations denote that CentOS 7's default value matches
## the recommended/tested value, and are not security related configurations.


# Avoid a smurf attack
net.ipv4.icmp_echo_ignore_broadcasts = 1

# Turn on protection for bad icmp error messages
net.ipv4.icmp_ignore_bogus_error_responses = 1

# Turn on syncookies for SYN flood attack protection
net.ipv4.tcp_syncookies = 1


# Turn on and log spoofed, source routed, and redirect packets
net.ipv4.conf.all.log_martians = 1
net.ipv4.conf.default.log_martians = 1

# Turn off routing
net.ipv4.ip_forward = 0
net.ipv4.conf.all.forwarding = 0
net.ipv6.conf.all.forwarding = 0

net.ipv4.conf.all.mc_forwarding = 0
net.ipv6.conf.all.mc_forwarding = 0

# Block routed packets
net.ipv4.conf.all.accept_source_route = 0
net.ipv4.conf.default.accept_source_route = 0
net.ipv6.conf.all.accept_source_route = 0
net.ipv6.conf.default.accept_source_route = 0


# Block ICMP redirects
net.ipv4.conf.all.accept_redirects = 0
net.ipv4.conf.default.accept_redirects = 0
net.ipv6.conf.all.accept_redirects = 0
net.ipv6.conf.default.accept_redirects = 0
net.ipv4.conf.all.secure_redirects = 0
net.ipv4.conf.default.secure_redirects = 0
net.ipv4.conf.all.send_redirects = 0
net.ipv4.conf.default.send_redirects = 0

# Filter routing packets with inward-outward path mismatch(reverse path filtering)
net.ipv4.conf.all.rp_filter = 1
net.ipv4.conf.default.rp_filter = 1
```

```
# Router solicitations & advertisements related.
net.ipv6.conf.default.router_solicitations = 0
net.ipv6.conf.default.accept_ra_rtr_pref = 0
net.ipv6.conf.default.accept_ra_pinfo = 0
net.ipv6.conf.default.accept_ra_defrtr = 0
net.ipv6.conf.default.autoconf = 0
net.ipv6.conf.default.dad_transmits = 0
net.ipv6.conf.default.max_addresses = 1
net.ipv6.conf.all.accept_ra = 0
net.ipv6.conf.default.accept_ra = 0

# Backlog - increased from default 1000 to 5000.
net.core.netdev_max_backlog = 5000

# Setting syn/syn-ack retries to minimum value, so that they don't stay in the queue.
net.ipv4.tcp_syn_retries = 1
net.ipv4.tcp_synack_retries = 0

# Max tcp listen backlog. Setting it to 511 to match nginx config
net.core.somaxconn = 511


# Reduce the duration of connections held in TIME_WAIT(seconds)
net.ipv4.tcp_fin_timeout = 6


# Maximum resources allotted
# fs.file-max = 2019273
# kernel.pid_max = 4194304
# net.ipv4.ip_local_port_range = 32768 60999

# TCP window size tuning
# net.ipv4.tcp_window_scaling = 1
# net.core.rmem_default = 212992
# net.core.rmem_max = 212992
# net.ipv4.tcp_rmem = 4096 87380 6291456
# net.ipv4.udp_rmem_min = 4096
# net.core.wmem_default = 212992
# net.core.wmem_max = 212992
# net.ipv4.tcp_wmem = 4096 16384 4194304
# net.ipv4.udp_wmem_min = 4096
# vm.lowmem_reserve_ratio = 256 256 32 0 0
# net.ipv4.tcp_mem = 236373 315167 472746

# Randomize virtual address space
kernel.randomize_va_space = 2


# Congestion control
# net.core.default_qdisc = fq_codel
# net.ipv4.tcp_congestion_control = cubic

# Disable SysReq
kernel.sysrq = 0

# Controls the maximum size of a message, in bytes
kernel.msgmnb = 65536

# Controls the default maximum size of a message queue
kernel.msgmax = 65536

# Controls the eagerness of the kernel to swap.
vm.swappiness = 1
```

Reboot after you make the recommended changes.

IPtables Hardening

IPtables is an application that allows a system administrator to configure the IPv4 and IPv6 tables, chains, and rules provided by the Linux kernel firewall.

The IPtables rules are configured to secure the proxy application from brute force attacks by restricting the access in the Linux kernel firewall.

The comments in the configuration indicate which service is being rate-limited by using the rules.

Note If administrators use a different port or expand access to multiple servers using the same ports, they must do appropriate sizing for these ports accordingly.

A sample IPtable is as follows:

```
# Configuration for iptables service
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]

# Ensure loopback traffic is configured
-A INPUT -i lo -j ACCEPT
-A OUTPUT -o lo -j ACCEPT
-A INPUT -s 127.0.0.0/8 -j DROP

# Ensure ping openeded only for the particular source and blocked for rest
# Must-Change: Replace the x.x.x.x with valid ip address
-A INPUT -p ICMP --icmp-type 8 -s x.x.x.x -j ACCEPT

# Ensure outbound and established connections are configured
-A INPUT -p tcp -m state --state RELATED,ESTABLISHED -j ACCEPT
-A OUTPUT -p tcp -m state --state NEW,RELATED,ESTABLISHED -j ACCEPT

# Block ssh for external interface
# Must-Change: Replace the ens224 with valid ethernet interface
-A INPUT -p tcp -i ens224 --dport 22 -j DROP
# Open inbound ssh(tcp port 22) connections
-A INPUT -p tcp -m state --state NEW -m tcp --dport 22 -j ACCEPT

# Configuration to allow connection from CDN without any limiting
# Must-Change: Uncomment and replace the x.x.x.x/xx and  ens224 with valid IP address and
ethernet interface respectively.
# Add similar lines for all CDN IP addresses
# iptables -A INPUT -i ens224 -s x.x.x.x/xx -j ACCEPT

# Configuration for finesse 8445 port
-A INPUT -p tcp -m tcp --dport 8445 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " Connections to 8445 exceeded connlimit "
-A INPUT -p tcp -m tcp --dport 8445 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
--connlimit-mask 32 --connlimit-saddr -j DROP
 -A INPUT -p tcp -m tcp --dport 8445 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 6/sec
 --hashlimit-burst 8 --hashlimit-mode srcip,dstport --hashlimit-name TCP_8445_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 8445 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 8445 hashlimit "
-A INPUT -p tcp -m tcp --dport 8445 --tcp-flags SYN SYN -j DROP
```

```
# Configuration for finesse 8442 port
-A INPUT -p tcp -m tcp --dport 8442 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " Connections to 8442 exceeded connlimit "
-A INPUT -p tcp -m tcp --dport 8442 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
--connlimit-mask 32 --connlimit-saddr -j DROP
 -A INPUT -p tcp -m tcp --dport 8442 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 6/sec
 --hashlimit-burst 8 --hashlimit-mode srcip,dstport --hashlimit-name TCP_8445_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 8442 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 8442 hashlimit "
-A INPUT -p tcp -m tcp --dport 8442 --tcp-flags SYN SYN -j DROP

# Configuration for IdS 8553 port
-A INPUT -p tcp -m tcp --dport 8553 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " IdS connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 8553 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 8553 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 2/sec
 --hashlimit-burst 4 --hashlimit-mode srcip,dstport --hashlimit-name TCP_8553_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 8553 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 8553 hashlimit "
-A INPUT -p tcp -m tcp --dport 8553 --tcp-flags SYN SYN -j DROP

# Configuration for IdP 443 port
-A INPUT -p tcp -m tcp --dport 443 --tcp-flags SYN SYN -m connlimit --connlimit-above 8
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " IdP connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 443 --tcp-flags SYN SYN -m connlimit --connlimit-above 8
--connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 443 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 4/sec
 --hashlimit-burst 6 --hashlimit-mode srcip,dstport --hashlimit-name TCP_443_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 443 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 443 hashlimit "
-A INPUT -p tcp -m tcp --dport 443 --tcp-flags SYN SYN -j DROP


# Must-Change: A2A file transfer has not been considered for below IMNP configuration.
# For A2A for support, these configuration must be recalculated to cater different file
transfer scenarios.

# Configuration for IMNP 5280 port
-A INPUT -p tcp -m tcp --dport 5280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " IMNP connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 5280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
--connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 5280 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 20/sec
 --hashlimit-burst 25 --hashlimit-mode srcip,dstport --hashlimit-name TCP_5280_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 5280 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 5280 hashlimit "
-A INPUT -p tcp -m tcp --dport 5280 --tcp-flags SYN SYN -j DROP

# Configuration for IMNP 15280 port
-A INPUT -p tcp -m tcp --dport 15280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
 --connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " IMNP connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 15280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
 --connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 15280 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto
20/sec --hashlimit-burst 25 --hashlimit-mode srcip,dstport --hashlimit-name TCP_15280_DOS
-j ACCEPT
-A INPUT -p tcp -m tcp --dport 15280 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 15280 hashlimit "
```

```
-A INPUT -p tcp -m tcp --dport 15280 --tcp-flags SYN SYN -j DROP


# Configuration for IMNP 25280 port
-A INPUT -p tcp -m tcp --dport 25280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
 --connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " IMNP connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 25280 --tcp-flags SYN SYN -m connlimit --connlimit-above 30
 --connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 25280 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto
20/sec --hashlimit-burst 25 --hashlimit-mode srcip,dstport --hashlimit-name TCP_25280_DOS
-j ACCEPT
-A INPUT -p tcp -m tcp --dport 25280 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 25280 hashlimit "
-A INPUT -p tcp -m tcp --dport 25280 --tcp-flags SYN SYN -j DROP


# Configuration for CUIC 8444 port
-A INPUT -p tcp -m tcp --dport 8444 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " CUIC connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 8444 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 8444 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 2/sec
 --hashlimit-burst 4 --hashlimit-mode srcip,dstport --hashlimit-name TCP_8444_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 8444 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 8444 hashlimit "
-A INPUT -p tcp -m tcp --dport 8444 --tcp-flags SYN SYN -j DROP

# Configuration for CUIC 8447 port
-A INPUT -p tcp -m tcp --dport 8447 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " CUIC connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 8447 --tcp-flags SYN SYN -m connlimit --connlimit-above 6
--connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 8447 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 2/sec
 --hashlimit-burst 4 --hashlimit-mode srcip,dstport --hashlimit-name  TCP_8447_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 8447 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 8447 hashlimit "
-A INPUT -p tcp -m tcp --dport 8447 --tcp-flags SYN SYN -j DROP

# Configuration for LiveData 12005  port
-A INPUT -p tcp -m tcp --dport 12005 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
 --connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " LD connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 12005 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
 --connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 12005 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 6/sec
 --hashlimit-burst 8 --hashlimit-mode srcip,dstport --hashlimit-name TCP_12005_DOS -j ACCEPT
-A INPUT -p tcp -m tcp --dport 12005 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 12005 hashlimit "
-A INPUT -p tcp -m tcp --dport 12005 --tcp-flags SYN SYN -j DROP

# Configuration for LiveData 12008  port
-A INPUT -p tcp -m tcp --dport 12008 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
 --connlimit-mask 32 --connlimit-saddr -m limit --limit 1/min --limit-burst 1 -j LOG
--log-prefix " LD connection limit exceeded"
-A INPUT -p tcp -m tcp --dport 12008 --tcp-flags SYN SYN -m connlimit --connlimit-above 10
 --connlimit-mask 32 --connlimit-saddr -j DROP
-A INPUT -p tcp -m tcp --dport 12008 --tcp-flags SYN SYN -m hashlimit --hashlimit-upto 6/sec
 --hashlimit-burst 8 --hashlimit-mode srcip,dstport --hashlimit-name  TCP_12008_DOS -j
ACCEPT
-A INPUT -p tcp -m tcp --dport 12008 --tcp-flags SYN SYN -m limit --limit 1/min --limit-burst
 1 -j LOG --log-prefix " Exceeded 12008 hashlimit "
```

```
-A INPUT -p tcp -m tcp --dport 12008 --tcp-flags SYN SYN -j DROP

# Block all other ports
-A INPUT -j REJECT --reject-with icmp-host-prohibited
-A FORWARD -j REJECT --reject-with icmp-host-prohibited

COMMIT
```

Note   The rules that are provided block the DNS resolution at the proxy. So, all the hostnames of the components that are configured in the proxy must be explicitly added to the host resolution file `/etc/hosts`.

Interface level rules must be added to restrict access to only users accessing via LAN and to block public access to port 10000, which is used for accessing the proxy map file. For example,

```
-A INPUT -p tcp -m tcp -i <PRIVATE_INTERFACE> --dport 10000 --tcp-flags SYN SYN -m hashlimit
--hashlimit-upto 35/sec --hashlimit-burst 2000 --hashlimit-mode srcip,dstport --hashlimit-name
TCP_10000_DOS -j ACCEPT -A INPUT -p tcp -m tcp -i <PRIVATE_INTERFACE> --dport 10000
--tcp-flags SYN SYN -m limit --limit 1/min --limit-burst 1 -j LOG --log-prefix " Exceeded
hashlimit " -A INPUT -p tcp -m tcp -i <PRIVATE_INTERFACE> --dport 10000 --tcp-flags SYN SYN
-j DROP
```

These rules could be applied directly by editing the `/etc/sysconfig/iptables` file manually. Alternatively, save the configuration into a file such as `iptables.conf` and execute cat `iptables.conf` `>>/etc/sysconfig/iptables` to apply the rules.

Restart the IPtables service after you apply the rules. To restart the IPtables service, enter `systemctl restart iptables`.

Restrict Client Connections

In addition to the previous IPtables configuration, installations that know the address range for clients who use the proxy must use this knowledge to secure the proxy access rules. This helps to secure the proxy from malicious botnets which are often created in the IP address range of countries that have more lax rules with regards to online security. Restrict the IP address ranges to country-based, state-based, or ISP-based IP ranges if you are sure of the access patterns.

Block Client Connections

Block the specific range of addresses when an attack is identified to be made from an IP address or a range of IP addresses. In such cases, the requests from those IP addresses can be blocked with **iptable** rules.

Block Distinct IP Addresses

To block multiple distinct IP addresses, add a line to the **IPTables** configuration file for each IP address.

For example, to block the addresses 192.0.2.3 and 192.0.2.4, enter:

```
iptables -A INPUT -s 192.0.2.3 -j DROP iptables -A INPUT -s 192.0.2.4 - j DROP.
```

Block a Range of IP Addresses

Block multiple IP addresses in a range and add a single line to the **IPTables** configuration file with the IP address range.

For example, to block the addresses from 192.0.2.3 to 192.0.2.35, enter:

```
iptables -A INPUT -m iprange --src-range 192.0.2.3-192.0.2.35 -j DROP.
```

Block All IP Addresses in a Subnet

Block all IP addresses in an entire subnet by adding a single line to the **IPTables** configuration file by using the classless inter-domain routing notation for the IP address range. For example, to block all class **C addresses**, enter:

```
iptables -A INPUT -s 192.0.0.0/16 -j DROP.
```

SELinux

Security-Enhanced Linux (SELinux) is a platform security framework integrated as an enhancement into the Linux OS. The procedure to install and add SELinux policies to run OpenResty as the reverse-proxy is provided next.

1. Stop the process with the `openresty -s stop` command.

2. Configure and start or stop OpenResty Nginx server with the `systemctl` command so that during boot up the OpenResty process will start automatically. Enter these commands as root user.

    a. Go to `/usr/lib/systemd/system`.

    b. Open the file called `openresty.service`.

    c. Update the content of the file as per `PIDFile` location.

    ```
    [Unit]
    Description=The OpenResty Application Platform
    After=syslog.target network-online.target remote-fs.target nss-lookup.target
    Wants=network-online.target

    [Service]
    Type=forking
    PIDFile=/usr/local/openresty/nginx/logs/nginx.pid
    ExecStartPre=/usr/local/openresty/nginx/sbin/nginx -t
    ExecStart=/usr/local/openresty/nginx/sbin/nginx
    ExecReload=/bin/kill -s HUP $MAINPID
    ExecStop=/bin/kill -s QUIT $MAINPID
    PrivateTmp=true

    [Install]
    WantedBy=multi-user.target
    ```

    d. As root user, enter `sudo systemctl enable openresty`.

    e. Start or stop the OpenResty service with the `systemctl start openresty / systemctl stop openresty` command and ensure that the process starts or stops as root user.

1. **Install SElinux**

    • By default, only some SELinux packages will be installed in CentOS.

    • The **policycoreutils-devel** package and its dependencies must be installed in order to generate the SELinux policy.

    • Enter the following command to install **policycoreutils-devel**

```
yum install policycoreutils-devel
```

- Ensure that after you install the package, the `sepolicy` command works.

```
usage: sepolicy [-h] [-P POLICY]


{booleans,communicate,generate,gui,interface,manpage,network,transition}
                ...

SELinux Policy Inspection Tool
```

2. **Create a New Linux User and Map with SElinux User**

   a. Enter `semanage login -l` to view the mapping between Linux users and SELinux users.

   ```
   [root@loadproxy-cisco-com ~]# semanage login -l

   Login Name              SELinux User            MLS/MCS Range           Service

   __default__             unconfined_u            s0-s0:c0.c1023          *                       *
   root                    unconfined_u            s0-s0:c0.c1023          *
   ```

   b. As root, create a new Linux user (**nginx** user) that is mapped to the SELinux **user_u** user.

   ```
   useradd -Z user_u nginxuser
   [root@loadproxy-cisco-com ~]# passwd nginxuser
   Changing password for user nginxuser.
   New password:
   Retype new password:
   passwd: all authentication tokens updated successfully.
   ```

   c. In order to view the mapping between **nginxuser** and **user_u**, enter this command as root:

   ```
   [root@loadproxy-cisco-com ~]# semanage login -l

   Login Name              SELinux User            MLS/MCS Range           Service

   __default__             unconfined_u            s0-s0:c0.c1023          *
   nginxuser               user_u                  s0                      *
   root                    unconfined_u            s0-s0:c0.c1023          *
   ```

   d. SELinux **__default__** login is by default mapped to the SELinux **unconfined_u** user. By default, it is required to confine **user_u** by using the following command:

   ```
   semanage login -m -s user_u -r s0 __default__
   ```

   In order to check if the command worked properly, enter `semanage login -l`. It should produce this output:

   e. Modify nginx.conf and perform change ownership for nginxuser.

      1. Enter `chown -R nginxuser:nginxuser` * in the `<Openresty-install-directory>` directory.

   2. Modify the **nginx.conf** file to include nginxuser as the user for running worker processes.

```
........

user nginxuser nginxuser;

..........
```

3. **Write the SELinux Policy for OpenResty Nginx**

   a. Instead of generating a new default custom policy for OpenResty Nginx with the `sepolicy generate --init /usr/bin/nginx` command, start with an existing policy.

      The **nginx.fc** file (File Contexts file) and **nginx.te** (Type Enforcement file) files, that are downloaded from the following location, are modified for reverse-proxy usage:
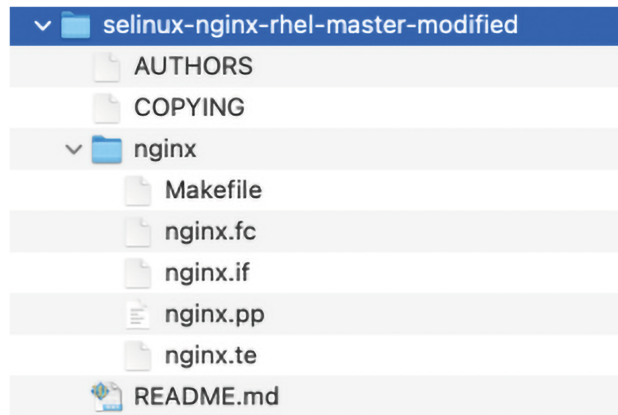
      This modified version can be used as a reference because it is updated for a particular use case.

   b. Download the **selinux-nginx-rhel-master-modified.tar** file from the Software Download page.

   c. Extract the **.tar** file and navigate to the **nginx** directory within it.

   d. Open the **.fc** file and verify the required file paths of **Nginx installer**, **cache**, and **pid** files.

   e. Compile the configuration with the `make` command.

   f. The **nginx.pp** file is generated.

   g. Load the policy with the `semodule` command.

      ```
      semodule -i nginx.pp
      ```

   h. Go to **/root** and create an empty file called `touch /.autorelabel`.

   i. Reboot the system.

   j. Enter the following command to verify that the policy is loaded successfully:

      ```
      semodule --list-modules=full
      ```

k. OpenResty Nginx should run without any violation. (Violation logs will be available in **/var/log/messages** and **/var/log/audit/audit.log**).

l. Enter the following command to check the status of OpenResty Nginx:

```
ps -aefZ | grep nginx
```


m. Now the Finesse agent desktop or supervisor desktop should be accessible.

Verifying Reverse-Proxy Configuration

Finesse

Step 1 From the DMZ, open *https://<reverseproxy:port>/finesse/api/SystemInfo* and check if it is reachable.

Step 2 Check if the **<host>** values in both **<primaryNode>** and **<secondaryNode>** are valid in reverse-proxy hostnames. It should not be Finesse hostnames.

Unified CCX and Customer Collaboration Platform

1. If the Unified CCX hostnames are seen in the response instead of the reverse-proxy hostnames, validate proxy-mapping configurations and check if allowed hosts are added in the Unified CCX servers as described in the Populate Network Translation Data section.

2. If MSC, NV and ASC gadgets load properly in Finesse Desktop, then the Unified CCX and Customer Collaboration Platform proxy configurations are correct.

Cisco Identity Service

To validate Cisco IdS configuration, perform the following steps:

Step 1   Log in to the IdSAdmin interface at **https://<ids_LAN_host:ids_port>:8553/idsadmin** from the LAN because the admin interface is not exposed over reverse-proxy.

Step 2   Choose **Settings** > **IdS Trust**.

Step 3   Validate that the proxy cluster publisher node is listed on Download SP metadata page, and click **Next**.

Step 4   Validate that the IDP proxy is correctly displayed if configured on Upload IDP metadata page, and click **Next**.

Step 5   Initiate test SSO via all proxy cluster nodes from the Test SSO page and validate that all are successful. This requires client machine connectivity to reverse-proxy nodes.

Brute Force Attack Prevention Configuration

Unified CCX Release 12.5(1) SU2 authentication scripts actively prevent brute force attacks that can be used to guess the user password. The scripts do this by blocking the IP address used to access the service, after a certain number of failed attempts in a short time. These requests will be rejected by **418 client error**. The number of failed requests, time interval, and blocking duration are configurable.

Attack Detection Parameters

Configurations are present in the **<nginx-install-directory>/conf/conf.d/maps.conf** file.

```
## These two constants indicate five auth failures from a client can be allowed in thirty
seconds.
## if the threshold is crossed,client ip will be blocked.
map $host $auth_failure_threshold_for_lock {
## Must-change Replace below two parameters as per requirement
default 5 ;
}
map $host $auth_failure_counting_window_secs {
## Must-change Replace below two parameters as per requirement
default 30;
}
## This indicates duration of blocking a client to avoid brute force attack
map $host $ip_blocking_duration {
## Must-change Replace below parameter as per requirement
default 1800;
}
```

Logging

The details of the blocked IP addresses can be accessed from the files **<nginx-install-directory>/logs/blocking.log** and **<nginx-install-directory>/logs/error.log**. To find the IP addresses that are blocked, run the following commands from the directory **<nginx-install-directory>/logs.**

```
grep "will be blocked for" blocking.log
grep "IP is already blocked." error.log
2021/10/29 17:30:59 [emerg] 1181750#1181750: *19 [lua] block_unauthorized_users.lua:153:
```

```
_redirectAndSendError(): 10.68.218.190
will be blocked for 30 minutes for exceeding retry limit., client: 10.68.218.190, server:
saproxy.cisco.com, request: "GET
/finesse/api/SystemInfo?nocache=1636456574482 HTTP/2.0", host: "saproxy.cisco.com:8445",
referrer:
"https://saproxy.cisco.com:8445/desktop/container/?locale=en_US&"

2021/10/29 19:21:00 [error] 943068#943068: *43 [lua] block_unauthorized_users.lua:53:
10.70.235.30 :: IP is already blocked...,
client: 10.70.235.30, server: saproxy.cisco.com, request: "GET
/finesse/api/SystemInfo?nocache=1635591686497 HTTP/2.0", host:
"saproxy.cisco.com:8445", referrer:
"https://saproxy.cisco.com:8445/desktop/container/?locale=en_US"
```

It is recommended that customers integrate with **Fail2ban** or a similar intrusion prevention system to add the blocked IP addresses to the IPtable or firewall rules.

Install and Configure Fail2ban

Fail2ban can be configured to monitor the `blocking.log` to identify the IP addresses that are blocked by OpenResty Nginx on detecting brute force attacks, and ban the IP addresses for a configurable duration. Do the following to install and configure Fail2ban on a CentOS reverse-proxy:

SUMMARY STEPS

1. Install Fail2ban using yum
2. Create a local jail
3. Configure a filter
4. Start Fail2ban

DETAILED STEPS

Step 1   Install Fail2ban using yum

```
yum update && yum install epel-release yum install fail2ban
```

Step 2   Create a local jail

Jail configurations allow the administrator to configure various properties such as the ports that are to be banned from being accessed by any blocked IP address, the duration for which the IP address stays blocked, the filter configuration used for identifying the blocked IP address from the log file monitored, and so on. Steps to add a custom configuration for banning IP addresses that are blocked from accessing the upstream servers are as follows:

a. Go to Fail2ban installation directory (in this example /etc/fail2ban)

```
cd /etc/fail2ban
```

b. Make a copy of jail.conf into jail.local to keep the local changes isolated.

```
cp jail.conf jail.local
```

c. Add the following jail configurations to the end of the file jail.local, and substitute the ports in the template with the actual ones. Update ban time configurations as required.

```
# Jail configurations for HTTP connections.
[finesse-http-auth]
enabled = true
```

```
# The ports to be blocked. Add any additional ports.
port = http,https,<finesse-ports>,<cuic-ports>,<any-other-ports-to-be-blocked>
# Path to nginx blocking logs.
logpath = /usr/local/openresty/nginx/logs/blocking.log
# The filter configuration.
filter = finesseban
# Block the IP from accessing the port, once the IP is blocked by lua.
maxretry= 1
# Duration for retry set to 3 mins. Doesn't count as the maxretry is 1
findtime= 180
# Lock time is set to 3 mins. Change as per requirements.
bantime = 180
```

Step 3   Configure a filter

A filter tells Fail2ban what to look for in the logs to identify the host to be banned. The steps to create a filter is as follows:

a. Create filter.d/finesseban.conf

```
touch filter.d/finesseban.conf
```

b. Add the following lines into the file filter.d/finesseban.conf

```
[Definition] # The regex match that would cause blocking of the host. failregex = <HOST> will be
blocked for
```

Step 4   Start Fail2ban

Run the following command to start fail2ban:

```
fail2ban-client start
```

Open fail2ban log files and verify that there are no errors. By default, logs for fail2ban go into the file
`/var/log/fail2ban.log`.

Troubleshoot

Troubleshoot SELinux

Step 1   If OpenResty Nginx is not started by default or the Finesse Agent Desktop is not accessible, set SELinux to **permissive** mode with this command:

```
setenforce 0
```

Step 2   Try to restart OpenResty Nginx with the `systemctl restart nginx` command.

Step 3   All the violations will be available in **/var/log/messages** and **/var/log/audit/audit.log**.

Step 4   You are required to regenerate the **.te** file with allow rules for addressing those violations by executing any one of the following commands:

- `cat /var/log/audit/audit.log | audit2allow -m nginx1 > nginx1.te. # this will create nginx1.te file`

```
• ausearch -c 'nginx' --raw | audit2allow -M  my-nginx  # this will create my-nginx.te file
```

Step 5   Update the original **nginx.te** file present in the **selinux-nginx-rhel-master-modified/nginx** directory with the newly generated allow rules.

Step 6   Compile the **nginx.te** file by using the `make` command.

Step 7   The **nginx.pp** file is regenerated.

Step 8   Load the policy by using the **semodule** command.

```
semodule -i nginx.pp
```

Step 9   Change SELinux to **enforce** mode by using the **setenforce** command.

Step 10   Reboot the system.

Step 11   Repeat this procedure until all the violations are fixed.