Load Balancing VMware Horizon

Version 1.2.0
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1. About this Guide
This guide details the steps required to configure a load-balanced VMware Horizon environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any VMware Horizon configuration changes that are required to enable load balancing.

Note
If you want to load balance VMware Horizon v6.1 & earlier (with Security Server) please refer to our VMware View Deployment Guide.

For more information about initial appliance deployment, network configuration and using the Web User Interface (WebUI), please also refer to the Administration Manual.

2. Loadbalancer.org Appliances Supported
All our products can be used with VMware Horizon. For full specifications of available models please refer to https://www.loadbalancer.org/products. Some features may not be supported in all cloud platforms due to platform specific limitations, please check with Loadbalancer.org support for further details.

3. Loadbalancer.org Software Versions Supported
- v8.3.8 and later

4. VMware Horizon Versions Supported
- v6.2 & later

5. VMware Horizon
VMware Horizon (formerly VMware Horizon View) is a virtual desktop infrastructure (VDI) solution that simplifies desktop management and provides users with access to these desktops when needed, from virtually any device, whatever their location.

6. VMware Horizon Servers to be Load Balanced

<table>
<thead>
<tr>
<th>Server</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Server</td>
<td>Horizon Connection Server acts as a broker for client connections by authenticating and then directing incoming user requests to the appropriate remote desktops and applications.</td>
</tr>
<tr>
<td>Security Server</td>
<td>A security server is an instance of a Connection Server that is installed in the DMZ. It adds an additional layer of security between the Internet and the internal network. Each Security Server must be paired with a Connection Server and forwards all traffic to that instance.</td>
</tr>
<tr>
<td>Access Point</td>
<td>Access Point is a hardened Linux based appliance introduced in v6.2 as an alternatively to Security Server.</td>
</tr>
<tr>
<td>Unified Access Gateway</td>
<td>Access Point was renamed Unified Access Gateway in Horizon v7.0. UAG is now the preferred option over Security Server.</td>
</tr>
</tbody>
</table>
7. VMware Horizon Protocols

When a VMware Horizon Client user connects to a Horizon environment, several different protocols are used. The first connection is always the primary XML-API protocol over HTTPS. Following successful authentication, one or more secondary protocols are also made.

**Primary Horizon Protocol (Phase 1)**

The user enters a hostname at the Horizon Client and this starts the primary Horizon protocol. This is a control protocol for authentication, authorization and session management. It uses XML structured messages over HTTPS. This protocol is sometimes known as the Horizon XML-API control protocol. In a load balanced environment, the load balancer distributes client connections across the available set of UAGs.

**Secondary Horizon Protocols (Phase 2)**

After the Horizon Client has established secure communication to one of the UAG appliances, the user authenticates. If this authentication attempt is successful, then one or more secondary connections are made from the Horizon client. These secondary connections can include:

- HTTPS Tunnel used for encapsulating TCP protocols such as RDP, MMR/CDR and the client framework channel (TCP 443)
- Blast display protocol (TCP/UDP 443 & TCP/UDP 8443)
- PCoIP display protocol (TCP/UDP 4172)

These secondary Horizon protocols must be routed to the same UAG appliance to which the primary Horizon protocol was routed. The reason for this is so that UAG can authorize the secondary protocols based on the authenticated user session. If the secondary protocols were to be misrouted to a different UAG appliance to the primary protocol one, they would not be authorized and would therefore be dropped in the DMZ and the connection would fail.

8. Load Balancing VMware Horizon

**Note** It’s highly recommended that you have a working VMware Horizon environment first before implementing the load balancer.

The diagram below illustrates where the load balancers are positioned in a typical deployment. With the older VMware Horizon View architecture, each Security Server had to be paired with a Connection Server. This pairing required the Connection Server to be in tunnel mode, which meant it was not suitable for internal client connections, so two sets of Connection Servers were needed. UAG is not paired, so only one set of Connection Servers is needed for both external and internal clients.
We recommend that a clustered pair of load balancers is deployed rather than a single appliance to avoid introducing a single point of failure.

Port Requirements
The following table shows the ports that are load balanced:

<table>
<thead>
<tr>
<th>Port</th>
<th>Transport Protocol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>443</td>
<td>TCP</td>
<td>Various HTTPS traffic</td>
</tr>
<tr>
<td>443</td>
<td>TCP &amp; UDP</td>
<td>Blast</td>
</tr>
<tr>
<td>4172</td>
<td>TCP &amp; UDP</td>
<td>PCoIP</td>
</tr>
<tr>
<td>8443</td>
<td>TCP &amp; UDP</td>
<td>Blast</td>
</tr>
</tbody>
</table>

Note: Some of the above ports may not be used in all scenarios. For simplicity when setting up the load balancer and to ensure all scenarios are covered, all are included.

For full details of ports used under various scenarios, please refer to the following URLs:

TCP and UDP Ports Used by Clients and Agents

UAG Documentation Reference

Persistence (aka Server Affinity)

External Clients
Source IP address or cookie based persistence can be used to ensure all primary protocol connections are handled by the same UAG. For simplicity, source IP address persistence is recommended where possible. Typically, the only time source IP persistence is not appropriate is when clients are located behind a NAT device that hides their IP addresses. Secondary protocol connections must be handled by the same UAG to which the primary protocol was routed. This can be achieved in various ways as described in Load Balancer Deployment Options:External Clients.

Internal Clients
Source IP address or cookie based persistence can be used to ensure all primary protocol connections are handled by the same Connection Server. For simplicity, source IP address persistence is recommended where possible. Typically, the only time source IP persistence is not appropriate is when clients are located behind a NAT.
device that hides their IP addresses. Secondary protocol connections are direct from client to Connection Server.

**SSL Certificates**

Wild card certificates and SAN based certificates are supported for VMware Horizon. In this guide, the SSL certificate was obtained from an internal CA. The common name was set to `horizon.lbtestdom.com` and SANs were added for the hostname of each Connection Server and UAG. For more information on using, configuring and troubleshooting SSL certificates for Horizon servers, please refer to the following links: Configuring SSL Certificates for Horizon 7 Servers , Setting Up SSL Certificates for Horizon

**SSL Offload**

Terminating SSL on the load balancer is only necessary when using cookie based persistence for the primary protocol connections. Cookie based persistence is only needed when source IP address persistence cannot be used due to inline NAT/proxy devices hiding client source IP addresses. If SSL offload is used, the load balancer and the UAGs *must* have the same certificate as mentioned here.

**Load Balancer Deployment Modes**

The primary protocol is TCP/HTTPS based, so either layer 7 or layer 4 methods can be used. The secondary protocols use both TCP & UDP so only layer 4 methods are supported. Layer 4 NAT mode and layer 7 SNAT mode are used for the configurations presented in this guide.

| Note | Layer 4 DR mode is not supported for UAG. This is because UAG is a hardened appliance based on Linux which has been locked down by VMware. This means that modifying the UAGs to solve the ARP issue becomes more complex and may cause unforeseen issues. |

**Server Health Checks**

The load balancer is configured to check the health of each Connection Server and UAG by periodically sending an HTTPS GET `/favicon.ico` request. It will perform this HTTPS GET and expect a "200 OK" response. If it receives a response other than "200 OK" or doesn’t get any response, that server will be marked as down and will not attempt to route client requests to it. It will continue to poll so that it can detect when it is available again.

**9. Load Balancer Deployment Options**

The load balancer can be configured in various ways to support internal and external clients.

**External Clients**

As explained in Secondary Horizon Protocols (Phase 2) the key requirement for external clients is that the secondary protocols must be sent to the same UAG as the primary protocol. This guide presents 3 options to achieve this. These are explained below. Please also refer to this VMware URL for additional information.

**External Clients – Option 1**

The load balancer uses a single VIP configured with source IP address persistence to load balance the primary protocol to one of the UAGs. The client connection URLs on each UAG (Option 1: UAG Configuration) are configured so that secondary protocols are also sent to the VIP for load balancing to the same UAG.

This option is recommended for all environments where source IP address persistence is possible. Where it’s not possible (typically due to in-line NAT devices hiding client source IP addresses), then either option 2 or option 3 should be used.
Key Points:

- Requires a single public IP address
- All traffic passes via the load balancer

Notes

1. The load balancer requires one network interface.
2. The UAGs are configured with 2 NICs.
3. The VIP is configured in Layer 4 NAT mode using source IP persistence.
4. The default gateway of the UAGs must be the load balancer, for a clustered pair of load balancers (Primary & Secondary) this should be a floating IP address to allow failover.
5. The default gateway of the load balancer is the external firewall.
6. Please refer to Configuring for External Clients: Option 1 for UAG and load balancer configuration guidance.

External Clients – Option 2

The load balancer uses a single VIP configured with either source IP address or cookie persistence to load balance the primary protocol to one of the UAGs. The client connection URLs on each UAG (Option 2: UAG Configuration) are configured so that secondary protocols are sent directly to the same UAG, bypassing the load balancer.
Key Points:

- Requires multiple public IP addresses – one for the VIP, one for each UAG.
- Only the primary protocol is load balanced, secondary protocols go direct to the UAGs.

Notes

1. The load balancer requires one network interface.
2. The UAGs are configured with 2 NICs.
3. The VIP is configured in Layer 7 SNAT mode using either source IP address or cookie based persistence.
4. The default gateway of the UAGs is the external firewall.
5. The default gateway of the load balancer is the external firewall.
6. Please refer to Configuring for External Clients: Option 2 for UAG and load balancer configuration guidance.

External Clients – Option 3

The load balancer uses one VIP configured with either source IP address or cookie persistence to load balance the primary protocol to one of the UAGs. The client connection URLs on each UAG (Option 3: UAG Configuration) are configured so that secondary protocols are sent to the same UAG via additional VIPs on unique port numbers.
Key Points:

- Requires a single public IP address (VIP1 – VIP7 use the same IP address).
- All traffic passes via the load balancer.
- Uses non standard ports for external client connections (example ports are shown, any appropriate ports can be used).

Notes

1. The load balancer requires one network interface.
2. The UAGs are configured with 2 NICs.
3. VIP1 is configured in Layer 7 SNAT mode using either source IP address or cookie based persistence.
4. VIPs 2 to 7 are configured in Layer 4 NAT mode.
5. The default gateway of the UAGs must be the load balancer, for a clustered pair of load balancers (Primary & Secondary) this should be a floating IP address to allow failover.
6. The default gateway of the load balancer is the external firewall.
7. Please refer to Configuring for External Clients: Option 3 for UAG and load balancer configuration guidance.

Internal Clients

Internal clients connect directly to the Connection Servers located on the LAN.

Key Points:

- Only the primary protocol is load balanced, secondary protocols go direct to the virtual desktops.

Notes

1. The load balancer requires one interface.
2. The VIP is configured in Layer 7 SNAT mode using either source IP address or cookie based persistence.
3. Please refer to Configuring for Internal Clients for server and load balancer configuration guidance.
10. Network Topology Used for this Guide

The diagram below shows the network topology used for this deployment guide. Clustered Pair 1 in the DMZ is used to load balance external clients connecting to the UAGs, and clustered Pair 2 on the LAN is used to load balance internal clients connecting to the Connection Servers.

11. Loadbalancer.org Appliance – the Basics

Virtual Appliance

A fully featured, fully supported 30 day trial is available if you are conducting a PoC (Proof of Concept) deployment. The VA is currently available for VMware, Virtual Box, Hyper-V, KVM, XEN and Nutanix AHV and has been optimized for each Hypervisor. By default, the VA is allocated 2 vCPUs, 4GB of RAM and has a 20GB virtual disk. The Virtual Appliance can be downloaded here.

Note: The same download is used for the licensed product, the only difference is that a license key file (supplied by our sales team when the product is purchased) must be applied using the appliance’s WebUI.

Note: Please refer to The Virtual Appliance - Hypervisor Deployment and the ReadMe.txt text file included in the VA download for more detailed information on deploying the VA using various Hypervisors.

Note: For the VA, 4 NICs are included but only eth0 is connected by default at power up. If the other NICs are required, these should be connected using the network configuration screen within the Hypervisor.

Initial Network Configuration

After boot up, follow the instructions on the console to configure the IP address, subnet mask, default gateway, DNS and other network settings.

Important: Be sure to set a secure password for the load balancer, when prompted during the setup routine.
Accessing the WebUI

The WebUI is accessed using a web browser. Appliance authentication is based on Apache .htaccess files. User admin tasks such as adding users and changing passwords can be performed using the WebUI menu option: Maintenance > Passwords.

Note
A number of compatibility issues have been found with various versions of Internet Explorer and Edge. The WebUI has been tested and verified using both Chrome & Firefox.

Note
If required, users can also be authenticated against LDAP, LDAPS, Active Directory or Radius. For more information please refer to External Authentication.

1. Using a browser, access the WebUI using the following URL:


2. Log in to the WebUI:

   **Username:** loadbalancer  
   **Password:** <configured-during-network-setup-wizard>

   *Note* To change the password, use the WebUI menu option: Maintenance > Passwords.

Once logged in, the WebUI will be displayed as shown below:
3. You'll be asked if you want to run the Setup Wizard. If you click **Accept** the Layer 7 Virtual Service configuration wizard will start. If you want to configure the appliance manually, simple click **Dismiss**.

**Main Menu Options**

- **System Overview** - Displays a graphical summary of all VIPs, RIPv2 and key appliance statistics
- **Local Configuration** - Configure local host settings such as IP address, DNS, system time etc.
- **Cluster Configuration** - Configure load balanced services such as VIPs & RIPv2
- **Maintenance** - Perform maintenance tasks such as service restarts and taking backups
- **View Configuration** - Display the saved appliance configuration settings
- **Reports** - View various appliance reports & graphs

---

*Note* The WebUI for the VA is shown, the hardware and cloud appliances are very similar. The yellow licensing related message is platform & model dependent.
12. Configuring for External Clients

Option 1
The configuration presented in this section relates to the topology described in External Clients – Option 1.

Connection Server Configuration
For each Connection Server, complete the following steps:

Step 1 – Configure General Settings

Un-check the 3 boxes as shown above. These options are not required when using UAG. These options only need to be set when a security server is paired with the Connection Server.

Step 2 - Enable HTML Access via the Load Balancer
Connection Servers that are directly behind a load balancer or load-balanced gateway must know the address by which browsers will connect to the load balancer when users use HTML Access. On each Connection Server
complete the following steps:

1. Create or edit the **locked.properties** file in the SSL gateway configuration folder, i.e. :

   software Install folder\VMware\VMware View\Server\sslgateway\conf\locked.properties

2. Add the **balancedHost** property and set it to the address that users type for HTML Access. For example, if users type https://horizon.example.com, add the following entry to the file:

   ```
   balancedHost=horizon.example.com (Note: "balancedHost" is case sensitive! )
   ```

3. Save the **locked.properties** file.

4. Restart the Connection Server service to apply the changes.

If the above steps are not completed, you’ll receive the following error when connecting via a browser:

```text
Failed to connect to the Connection Server.
```

**OK**

### UAG Configuration

**Horizon Settings**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable Horizon</td>
<td>YES</td>
</tr>
<tr>
<td>Connection Server URL *</td>
<td><a href="https://192.168.112.206">https://192.168.112.206</a></td>
</tr>
<tr>
<td>Connection Server URL Thumbprint</td>
<td>sha1=8c0d867c596214a3d27a024e8505bfdd8e843</td>
</tr>
<tr>
<td>Enable PCOIP</td>
<td>YES</td>
</tr>
<tr>
<td>PCOIP External URL</td>
<td>10.200.251.206:4172</td>
</tr>
<tr>
<td>Enable Blast</td>
<td>YES</td>
</tr>
<tr>
<td>Blast External URL</td>
<td><a href="https://horizon.lboastdom.com:8443">https://horizon.lboastdom.com:8443</a></td>
</tr>
<tr>
<td>BSG UDP Tunnel Server</td>
<td>YES</td>
</tr>
<tr>
<td>Enable Tunnel</td>
<td>YES</td>
</tr>
<tr>
<td>Tunnel External URL</td>
<td><a href="https://horizon.lboastdom.com:443">https://horizon.lboastdom.com:443</a></td>
</tr>
</tbody>
</table>

**More ▼**

**Step 1 – Configure URLs**

The various URLs must be configured on each UAG as shown above. To access the UAG Web Interface use:
1. Configure the Connection Server URL to be the VIP address of the load balanced Connection Servers on the internal load balancer, in this guide https://192.168.112.206.

2. Configure the PColIP External URL to be the public IP address of the VIP on the load balancer, in this guide 10.200.251.206:4172.

3. Configure the Blast External URL to be the FQDN that external clients use to connect, in this guide https://horizon.lbtestdom.com:8443, this should resolve to the public IP address of the VIP on the load balancer.

4. Configure the Tunnel External URL to be the FQDN that external clients use to connect, in this guide https://horizon.lbtestdom.com:443, this should resolve to the public IP address of the VIP on the load balancer.

Note Steps 2 – 4 above illustrate that clients connect via the load balancer for all secondary protocols.

Step 2 - Configure the Default Gateway on the UAGs

Note Return traffic MUST pass back via the load balancer for layer 4 NAT mode to operate.

1. Set the default gateway on each UAG to be an address on the load balancer. This address should be a floating IP address to enable failover when using a clustered pair as described in the LoadBalancer Configuration section (Step 2) below.

Note The default gateway can be set at UAG deployment, or later by using the UAG’s Admin UI as mentioned here.

Load Balancer Configuration
The load balancer is used for both the primary and secondary protocols.

Port Requirements
The following table shows the ports that are load balanced:

<table>
<thead>
<tr>
<th>Port</th>
<th>Transport Protocol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>443</td>
<td>TCP</td>
<td>Various HTTPS traffic</td>
</tr>
<tr>
<td>443</td>
<td>TCP &amp; UDP</td>
<td>Blast</td>
</tr>
<tr>
<td>4172</td>
<td>TCP &amp; UDP</td>
<td>PColIP</td>
</tr>
<tr>
<td>8443</td>
<td>TCP &amp; UDP</td>
<td>Blast</td>
</tr>
</tbody>
</table>

Step 1 - Configure the Virtual Service & Real Servers

a) Setting up the Virtual Service

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 – Virtual Service and click Add a New Virtual Service.

2. Enter the following details:
3. Enter an appropriate label (name) for the VIP, e.g. HorizonExternal.

4. Set the Virtual Service IP address field to the required IP address, e.g. 10.200.251.206.

5. Set the Virtual Service Ports field to 443,4172,8443.

6. Set the Protocol to TCP/UDP.

7. Set the Forwarding Method to NAT.

8. Click Update.

9. Now click Modify next to the newly created VIP.

10. Ensure Persistence is enabled and set Persistence Timeout to 36000 (i.e. 10 hour).

   **Note**  As mentioned here the value set should match the Forcibly disconnect users setting under Global Settings for the Connection Server (the default value for this is 10 hours).

11. Set Check Type to Negotiate.

12. Set Check Port to 443.

13. Set Protocol to HTTPS.

14. Set Request to send to favicon.ico.

15. Leave Response expected blank.

16. Click Update.

**b) Setting up the Real Servers**

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 – Real Servers and click Add a New Real Server next to the newly created VIP.

2. Enter the following details:
3. Enter an appropriate label for the RIP, e.g. UAG1.

4. Change the Real Server IP Address field to the required IP address, e.g. 10.200.251.10.

5. Leave the Real Server Port field blank.

6. Click Update.

7. Repeat the above steps to add your other UAG(s).

Step 2 - Add a Floating IP Address to the Load Balancer to be used as the UAGs Default Gateway
Using the WebUI option: Cluster Configuration > Floating IP’s add a Floating IP that can be used as the default gateway for the UAGs. Using a floating IP will ensure that the IP address is available when a clustered pair is used, and a failover to the Secondary has occurred. This floating IP should be an additional IP address that is dedicated to this purpose.

Step 3 - Configure the Default Gateway on the Load Balancer
Using the WebUI option: Local Configuration > Routing set the default gateway to be the internal interface of the external firewall, e.g. 10.200.251.254.

Step 4 - Configure HTTP to HTTPS Redirection
If required, the load balancer can be configured to automatically redirect clients who attempt to connect to http://<Horizon URL> to https://<Horizon URL>.

When SSL is terminated on the real servers, a separate VIP is required to handle this. For details on setting this up, please refer to Configuring an HTTP to HTTPS redirect.

Option 2
The configuration presented in this section relates to the topology described in External Clients – Option 2.

Connection Server Configuration
Follow the Connection Server configuration steps in Option 1 - Connection Server Configuration.

UAG Configuration
Step 1 – Configure URLs
The various URLs must be configured on each UAG as shown above. To access the UAG Web Interface use: https://<uag-ip>:9443/admin.

1. Configure the Connection Server URL to be the VIP address of the load balanced Connection Servers on the internal load balancer, in this guide https://192.168.112.206.

2. Configure the PCoIP External URL to be the public IP address of the UAG, in this guide 10.200.251.10:4172.

3. Configure the Blast External URL to be the FQDN of the UAG, in this guide https://uag1.lbtestdom.com:8443, this should resolve to the public IP address of the UAG.

4. Configure the Tunnel External URL to be the FQDN of the UAG, in this guide https://uag1.lbtestdom.com:443, this should resolve to the public IP address of the UAG.

Note: Steps 2 – 4 above illustrate that clients connect directly to the UAGs for all secondary protocols, bypassing the load balancer. Using FQDNs for steps 3 & 4 rather than IP addresses avoids certificate related errors. For a SAN certificate, make sure you include the FQDN of each UAG.

Step 2 - Configure the default gateway on the UAGs
1. Set the default gateway on each UAG to be the external firewall.

Note: The default gateway can be set at UAG deployment, or later by using the UAG’s Admin UI as mentioned here.
Load Balancer Configuration

The load balancer is used for the primary protocol only, secondary protocols pass directly from client to the UAGs. Source IP address persistence is recommended if there are no inline NAT devices between the clients and the VIP – see the section below for configuration steps. If there are inline NAT devices, cookie based persistence can be used – please see Configuring the VIP & RIPs for the Primary Protocol (using cookie persistence).

Port Requirements

The following table shows the ports that are load balanced:

<table>
<thead>
<tr>
<th>Port</th>
<th>Transport Protocol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>443</td>
<td>TCP</td>
<td>Various HTTPS traffic</td>
</tr>
</tbody>
</table>

Configuring the VIP & RIPs for the Primary Protocol (using source IP persistence)

a) Setting up the Virtual Service

1. Using the WebUI, navigate to: Cluster Configuration > Layer 7 – Virtual Services and click Add a New Virtual Service.
2. Enter the following details:

   - Set Virtual Service IP address to required IP address, e.g. 10.200.251.206.
   - Set Virtual Service Ports to 443.
   - Set Layer 7 Protocol to TCP Mode.
   - Click Update.
3. Now click Modify next to the newly created VIP.
4. Set Health Checks to Negotiate HTTPS.
5. Set Check Port to 443.
6. Set Request to send to favicon.ico.
7. Leave Response expected blank.
8. Click Update.

b) Setting up the Real Servers
1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Real Servers* and click **Add a New Real Server** next to the newly created VIP.

2. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>UAG1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Server IP Address</td>
<td>10.200.251.10</td>
</tr>
<tr>
<td>Real Server Port</td>
<td>443</td>
</tr>
<tr>
<td>Re-Encrypt to Backend</td>
<td>☐</td>
</tr>
<tr>
<td>Weight</td>
<td>100</td>
</tr>
</tbody>
</table>

3. Enter an appropriate label for the RIP, e.g. **UAG1**.

4. Change the *Real Server IP Address* field to the required IP address, e.g. **10.200.251.10**.

5. Change the *Real Server Port* field to **443**.

6. Click **Update**.

7. Repeat the above steps to add your other UAG(s).

Configuring the VIP & RIPs for the Primary Protocol (using cookie persistence)

a) Setting up the Virtual Service

1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Virtual Services* and click **Add a New Virtual Service**.

2. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>HorizonExternal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Service IP Address</td>
<td>10.200.251.206</td>
</tr>
<tr>
<td>Ports</td>
<td>80</td>
</tr>
</tbody>
</table>

3. Enter an appropriate label for the VIP, e.g. **HorizonExternal**.

4. Set the *Virtual Service IP address* field to the required IP address, e.g. **10.200.251.206**.

5. Set the *Virtual Service Ports* field to **80**.

6. Leave *Layer 7 Protocol* set to **HTTP Mode**.

7. Click **Update**.
8. Now click Modify next to the newly created VIP.
9. Set Health Checks to Negotiate HTTP.
10. Set Check Port to 80.
11. Set Request to send to favicon.ico.
12. Leave Response expected blank.
13. Click Update.

b) Setting up the Real Servers

1. Using the WebUI, navigate to: Cluster Configuration > Layer 7 – Real Servers and click Add a New Real Server next to the newly created VIP.
2. Enter the following details:

   ![Real Server Details](image)

   3. Enter an appropriate label for the RIP, e.g. UAG1.
   4. Set the Real Server IP Address field to the required IP address, e.g. 10.200.251.10.
   5. Set the Real Server Port field to 443.
   7. Click Update.
   8. Repeat the above steps to add your other UAG(s).

c) Configure SSL Termination – Upload the SSL certificate

1. Using the WebUI, navigate to: Cluster Configuration > SSL Certificate.
2. Click Add a new SSL Certificate.
4. Enter a suitable label (name) for the certificate, e.g. Horizon.
5. Browse to the relevant Horizon PFX certificate file.

   **Note** When SSL re-encryption (SSL bridging) is used, the UAG & load balancer **must** have the same SSL certificate as mentioned here.
6. Enter the relevant **PFX File Password**.
7. Click **Add Certificate**.

**d) Configure SSL Termination – Create the SSL Virtual Service**

1. Navigate to: **Cluster Configuration > SSL Termination**.
2. Click **Add a new Virtual Service**.
3. Enter the following details:

   ![SSL Virtual Service Configuration Table]

4. Enter a suitable Label (name) for the VIP, e.g. **SSL**.
5. Set **Associated Virtual Service** to the Layer 7 VIP created earlier, e.g. **HorizonExternal**.
6. Leave **Virtual Service Port** set to **443**.
7. Leave **SSL Operation Mode** set to **High Security**.
8. Select the SSL certificate uploaded previously using the **SSL Certificate** drop-down.
9. Click **Update**.

**Configure Remaining Load Balancer Settings & Reload Services**

**Step 1 - Configure HTTP to HTTPS Redirection**

If required, the load balancer can be configured to automatically redirect clients who attempt to connect to http://<Horizon URL> to https://<Horizon URL>.

- When using cookie based persistence (SSL is terminated on the load balancer), this can be configured by modifying the **HorizonExternal** VIP and enabling the **Force to HTTPS** option.
- When using source IP persistence (SSL is terminated on the real servers), a separate VIP is required to handle this. For details on setting this up, please refer to **Configuring an HTTP to HTTPS redirect**.

**Step 2 - Configure the Default Gateway on the Load Balancer**

Using the WebUI option: **Local Configuration > Routing** set the default gateway to be the internal interface of the external firewall, e.g. **10.200.251.254**.

**Step 3 – Reload Services**

To apply the new settings, reload HAProxy and STunnel (if using SSL offload) using the **Reload** buttons in the blue...
commit changes box at the top of the screen.

Option 3
The configuration presented in this section relates to the topology described in External Clients – Option 3.

Connection Server Configuration
Follow the Connection Server configuration steps in Option 1 - Connection Server Configuration.

UAG Configuration
Step 1 - Decide on the External Ports for the VIPs

The table below shows one possible option for the external ports for the VIPs used for the secondary protocols.

<table>
<thead>
<tr>
<th>VIP/External Port</th>
<th>Primary/Secondary</th>
<th>Protocol</th>
<th>VIP Name</th>
<th>Real Server IP/Port</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UAG 1 &amp; 2 – Primary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UAG1 – Secondary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocols</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UAG2 – Secondary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocols</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Horizon Settings

Enable Horizon YES
Connection Server URL https://192.168.112.206
Connection Server URL Thumbprint-34456387144563
Enable PCoIP YES
PCoIP External URL 10.200.251.206:14172
Enable Blast YES
Blast External URL https://horizon.lbtestdom.com:18443
BSG UDP Tunnel Server YES
Enable Tunnel YES
Tunnel External URL https://horizon.lbtestdom.com:1443
More

Step 2 – Configure URLs

The various URLs must be configured on each UAG as shown above. To access the UAG Web Interface use: https://<uag-ip>:9443/admin.

1. Configure the Connection Server URL to be the VIP address of the load balanced Connection Servers on the internal load balancer, in this guide https://192.168.112.206.
2. Configure the PCoIP External URL to be the public IP address of the VIP on the load balancer, in this guide 10.200.251.206:14172.
3. Configure the Blast External URL to be the FQDN that external clients use to connect, in this guide https://horizon.lbtestdom.com:18443, this should resolve to the public IP address of the VIP on the load balancer.
4. Configure the Tunnel External URL to be the FQDN that external clients use to connect, in this guide https://horizon.lbtestdom.com:1443, this should resolve to the public IP address of the VIP on the load balancer.

Note
Steps 2 – 4 above illustrate that clients connect to the VIP on the load balancer for all secondary protocols.

Step 3 - Configure the default gateway on the UAGs

Note
Return traffic MUST pass back via the load balancer for layer 4 NAT mode to operate.

1. Set the default gateway on each UAG to be an address on the load balancer. This address should be a floating IP address to enable failover when using a clustered pair as described in Configure Remaining Load.
Balancer Settings & Reload Services.

Note: The default gateway can be set at UAG deployment, or later by using the UAG’s admin UI as mentioned here.

Load Balancer Configuration
The load balancer is used for both the primary & secondary protocols.

Configuring the VIP & RIPs for the Primary Protocol
Source IP address persistence is recommended if there are no inline NAT devices between the clients and the VIP – please follow the steps in Configuring the VIP & RIPs for the Primary Protocol (using source IP persistence).

If there are inline NAT devices, cookie based persistence can be used – please follow the steps in Configuring the VIP & RIPs for the Primary Protocol (using cookie persistence).

Once complete, configure the VIPs for the secondary protocols.

Configuring the VIPs & RIPs for the Secondary Protocols
The 6 secondary protocol VIPs (3 for UAG1, 3 for UAG2) listed in Option 3: UAG Configuration.

The configuration for the first VIP, UAG1-HTTPS is shown below:

a) Setup the Virtual Service

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 – Virtual Service and click Add a New Virtual Service.
2. Enter the following details:
   - Label: UAG1-443
   - IP Address: 10.200.251.206
   - Ports: 1443
   - Protocol: TCP/UDP
   - Forwarding Method: NAT
3. Enter an appropriate label (name) for the VIP, e.g. UAG1-443.
4. Set the Virtual Service IP address field to the required IP address, e.g. 10.200.251.206.
5. Set the Virtual Service Ports field to 1443.
6. Set the Protocol to TCP/UDP.
7. Set the Forwarding Method to NAT.
8. Click Update.
9. Now click **Modify** next to the newly created VIP.

10. Set **Check Type** to **Negotiate**.

11. Set **Check Port** to **443**.

12. Set **Protocol** to **HTTPS**.

13. Set **Request to send** to **favicon.ico**.

14. Leave **Response expected** blank.

15. Click **Update**.

b) Setup the Real Servers

1. Using the WebUI, navigate to: **Cluster Configuration > Layer 4 – Real Servers** and click **Add a New Real Server** next to the newly created VIP.

2. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>UAG1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Server IP Address</td>
<td>10.200.251.10</td>
</tr>
<tr>
<td>Real Server Port</td>
<td>443</td>
</tr>
<tr>
<td>Weight</td>
<td>100</td>
</tr>
<tr>
<td>Minimum Connections</td>
<td>0</td>
</tr>
</tbody>
</table>

3. Enter an appropriate label for the RIP, e.g. **UAG1**.

4. Change the **Real Server IP Address** field to the required IP address, e.g. **10.200.251.10**.

5. Set the port to the **443**.

6. Click **Update**.

7. Repeat the above steps to add your other UAG(s).

Now continue and create the 5 remaining secondary protocol VIPs (UAG1-PCoIP, UAG1-Blast, UAG2-443, UAG2-PCoIP & UAG2-Blast) & associated RIPS listed in the table. Make sure that you:

- Configure all VIPs using layer 4 NAT mode.
- Set the **Virtual Service Port** and the **Real Server Port** according to column 1 & 5 respectively in the table.
- Set the **Protocol** according to column 3 in the table.
- Configure the same health check settings:
  - Set **Check Type** to **Negotiate**.
  - Set **Check Port** to **443**.
Configure Remaining Load Balancer Settings & Reload Services

Step 1 - Add a Floating IP Address to the Load Balancer to be used as the UAG's Default Gateway

Using the WebUI option: *Cluster Configuration > Floating IP's* add a Floating IP that can be used as the default gateway for the UAGs. Using a floating IP will ensure that the IP address is available when a clustered pair is used, and a failover to the Secondary has occurred. This floating IP should be an additional IP address that is dedicated to this purpose.

Step 2 - Configure the Default Gateway on the Load Balancer

Using the WebUI option: *Local Configuration > Routing* set the default gateway to be the internal interface of the external firewall, e.g. 10.200.251.254.

Step 3 - Configure HTTP to HTTPS Redirection

If required, the load balancer can be configured to automatically redirect clients who attempt to connect to http://<Horizon URL> to https://<Horizon URL>.

- When using cookie based persistence (SSL is terminated on the load balancer), this can be configured by modifying the HorizonExternal VIP and enabling the Force to HTTPS option.
- When using source IP persistence (SSL is terminated on the real servers), a separate VIP is required to handle this. For details on setting this up, please refer to Configuring an HTTP to HTTPS redirect.

Step 4 – Reload Services

To apply the new settings, reload HAProxy and STunnel (if using SSL offload) using the Reload buttons in the blue commit changes box at the top of the screen.

13. Configuring for Internal Clients

The configuration presented in this section relates to the topology described in Internal Clients.

**Note**

Internal clients connect directly to the virtual desktop rather than going via the Connection Servers. For HTML Access, this can result in a Blast certificate error. Please refer to the following URLs for dealing with this: Blast Certificate Issue, DNS Names for Horizon Servers

Connection Server Configuration

Follow the Connection Server configuration steps Option 1 - Connection Server Configuration.

Load Balancer Configuration

The load balancer is used for the primary protocol only, secondary protocols pass directly from client to virtual desktop. Source IP address persistence is recommended if there are no inline NAT devices between the clients and the VIP – see the section below for configuration steps. If there are inline NAT devices, cookie based persistence can be used – please see Configuring the VIP & RIPv3s for the Primary Protocol (Cookie persistence).
If you want the actual client IP addresses to be represented in X-Forwarded-For (XFF) headers which the Connection Servers can use, please follow Configuring the VIP & RIPv for the Primary Protocol (Cookie persistence). In addition to the configuration steps mentioned there, you'll also need to enable (check) the option Set X-Forward-For header when configuring the layer 7 VIP "HorizonInternal".

For more information on enabling layer 7 transparency using inserted headers, please refer to the Administration Manual and search for "Using Proxy Protocol & X-Forwarded-For Headers".

Port Requirements

The following table shows the ports that are load balanced:

<table>
<thead>
<tr>
<th>Port</th>
<th>Transport Protocol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>443</td>
<td>TCP</td>
<td>Various HTTPS traffic</td>
</tr>
</tbody>
</table>

Configuring The VIP & RIPv for the Primary Protocol (source IP persistence)

a) Setting up the Virtual Service

1. Using the WebUI, navigate to: Cluster Configuration > Layer 7 – Virtual Services and click Add a New Virtual Service.

2. Enter the following details:

3. Enter an appropriate label for the VIP, e.g. HorizonInternal.

4. Set the Virtual Service IP address field to the required IP address, e.g. 192.168.112.206.

5. Set the Virtual Service Ports field to 443.


7. Click Update.

8. Now click Modify next to the newly created VIP.

9. Set Health Checks to Negotiate HTTPS.

10. Set Check Port to 443.

11. Set Request to send to favicon.ico.
12. Leave *Response expected* blank.

13. Click **Update**.

b) Setting up the Real Servers

1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Real Servers* and click **Add a New Real Server** next to the newly created VIP.

2. Enter the following details:

   - **Label**: CS1
   - **Real Server IP Address**: 192.168.112.200
   - **Real Server Port**: 443
   - **Re-Encrypt to Backend**: 
   - **Weight**: 100

3. Enter an appropriate label for the RIP, e.g. **CS1**.

4. Change the *Real Server IP Address* field to the required IP address, e.g. **192.168.112.200**.

5. Change the *Real Server Port* field to **443**.

6. Click **Update**.

7. Repeat the above steps to add your other Connection Server(s).

Configuring the VIP & RIPS for the Primary Protocol (Cookie persistence)

a) Setting up the Virtual Service

1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Virtual Services* and click **Add a New Virtual Service**.

2. Enter the following details:

   - **Label**: HorizonInternal
   - **Virtual Service IP Address**: 192.168.112.206
   - **Ports**: 80
   - **Layer 7 Protocol**: HTTP Mode
   - **Manual Configuration**: 

3. Enter an appropriate label for the VIP, e.g. **HorizonInternal**.
4. Set the Virtual Service IP address field to the required IP address, e.g. 192.168.112.206.

5. Set the Virtual Service Ports field to 80.


7. Click Update.

8. Now click Modify next to the newly created VIP.

9. Set Health Checks to Negotiate HTTP.

10. Set Check Port to 80.

11. Set Request to send to favicon.ico.

12. Leave Response expected blank.

13. Click Update.

b) Setting up the Real Servers

1. Using the WebUI, navigate to: Cluster Configuration > Layer 7 – Real Servers and click Add a New Real Server next to the newly created VIP.

2. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>CS1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Server IP Address</td>
<td>192.168.112.200</td>
</tr>
<tr>
<td>Real Server Port</td>
<td>443</td>
</tr>
<tr>
<td>Re-Encrypt to Backend</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>100</td>
</tr>
</tbody>
</table>

3. Enter an appropriate label for the RIP, e.g. CS1.

4. Change the Real Server IP Address field to the required IP address, e.g. 192.168.112.200.

5. Change the Real Server Port field to 443.

6. Click Update.

7. Repeat the above steps to add your other Connection Server(s).

c) Configure SSL Termination – Upload the SSL certificate

1. Using the WebUI, navigate to: Cluster Configuration > SSL Certificate.

2. Click Add a new SSL Certificate.


4. Enter a suitable label (name) for the certificate, e.g. Horizon.

5. Browse to the relevant Horizon PFX certificate file.
6. Enter the relevant PFX File Password.

7. Click Add Certificate.

d) Configure SSL Termination – Create the SSL Virtual Service

1. Navigate to: Cluster Configuration > SSL Termination.

2. Click Add a new Virtual Service.

3. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>SSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated Virtual Service</td>
<td>HorizonInternal</td>
</tr>
<tr>
<td>Virtual Service Port</td>
<td>443</td>
</tr>
<tr>
<td>SSL Operation Mode</td>
<td>High Security</td>
</tr>
<tr>
<td>SSL Certificate</td>
<td>Horizon</td>
</tr>
</tbody>
</table>

4. Enter a suitable Label (name) for the VIP, e.g. SSL.

5. Set Associated Virtual Service to the Layer 7 VIP created earlier, e.g. HorizonInternal.

6. Leave Virtual Service Port set to 443.


8. Select the SSL certificate uploaded previously using the SSL Certificate drop-down.

9. Click Update.

Configure Remaining Load Balancer Settings & Reload Services

Step 1 - Configure HTTP to HTTPS Redirection

If required, the load balancer can be configured to automatically redirect clients who attempt to connect to http://<Horizon URL> to https://<Horizon URL>.

- When using cookie based persistence (SSL is terminated on the load balancer), this can be configured by modifying the HorizonInternal VIP and enabling the Force to HTTPS option.

- When using source IP persistence (SSL is terminated on the real servers), a separate VIP is required to handle this. For details on setting this up, please refer to Configuring an HTTP to HTTPS redirect.

Step 2 – Reload Services

To apply the new settings, reload HAProxy and STunnel (if using SSL offload) using the Reload buttons in the blue commit changes box at the top of the screen.
14. Testing & Verification

Client Protocol Testing
To ensure that all required client protocols are configured correctly, the Horizon client should be configured to each of the configured protocols using the right-click menu as shown below for both internal and external clients.

![Horizon Client Menu](image)

HTML Access should also be verified for internal and external clients using a browser.

Using System Overview
The System Overview shows a graphical view of all VIPs & RIPs (i.e. the Horizon Servers) and shows the state/health of each server as well as the state of the cluster as a whole. The example below shows that both UAGs are healthy and available to accept connections.

![System Overview Example](image)

Layer 4 Current Connections Report
The Layer 4 Current Connections report shows all current layer 4 connects and their status. This can be accessed in the WebUI using the option: Reports > Layer 4 Current Connections. The example below shows the report whilst an External Horizon Client is connected via a layer 4 VIP.

![Layer 4 Current Connections](image)
Layer 4 Current Connections

Layer 4 Status Report
The Layer 4 Status report gives a summary of layer 4 configuration and running stats as shown below. This can be accessed in the WebUI using the option: Reports > Layer 4 Status.

Layer 4 Status

Layer 7 Statistics Report
The Layer 7 Statistics report gives a summary of all layer 7 configuration and running stats as shown below. This can be accessed in the WebUI using the option: Reports > Layer 7 Status.
Appliance Logs

Logs are available for both layer 4 and layer 7 services and can be very useful when trying to diagnose issues. Layer 4 logs are active by default and can be accessed using the WebUI option: Logs > Layer 4. Layer 7 logging is not enabled by default (because it’s extremely verbose) and can be enabled using the WebUI option: Cluster Configuration > Layer 7 – Advanced Configuration, and then viewed using the option: Logs > Layer 7.

15. Technical Support

If you have any questions regarding the appliance or would like assistance designing your deployment, please don’t hesitate to contact our support team: support@loadbalancer.org.

16. Further Documentation


17. Conclusion

Loadbalancer.org appliances provide a very cost effective solution for highly available load balanced VMware Horizon environments.
18. Appendix

Configuring an HTTP to HTTPS redirect

An additional layer 7 VIP is required that listens on HTTP port 80 on the same IP address. The VIP is then configured to redirect connections to HTTPS port 443.

e.g. http://horizon.lbtestdom.com should be redirected to https://horizon.lbtestdom.com.

The steps:

1) Create another Layer 7 VIP with the following settings:

- Label: HTTP-redirect.
- Virtual Service IP Address: <same as the VIP that's listening on port 443>.
- Virtual Service Ports: 80.
- Persistence Mode: None.
- Force to HTTPS: Yes.

Note
This additional VIP will be shown purple/green to indicate that it's being used for HTTP to HTTPS redirection.

2) Apply the new settings – to apply the new settings, HAProxy must be restarted:

- Using the WebUI, navigate to: Maintenance > Restart Services and click Restart HAProxy.

Configuring HA - Adding a Secondary Appliance

Our recommended configuration is to use a clustered HA pair of load balancers to provide a highly available and resilient load balancing solution.

We recommend that the Primary appliance should be configured first, then the Secondary should be added. Once the Primary and Secondary are paired, all load balanced services configured on the Primary are automatically replicated to the Secondary over the network using SSH/SCP.

Note
For Enterprise Azure, the HA pair should be configured first. In Azure, when creating a VIP using an HA pair, 2 private IPs must be specified – one for the VIP when it’s active on the Primary and one for the VIP when it’s active on the Secondary. Configuring the HA pair first, enables both IPs to be specified when the VIP is created.

The clustered HA pair uses Heartbeat to determine the state of the other appliance. Should the active device (normally the Primary) suffer a failure, the passive device (normally the Secondary) will take over.

Note
A number of settings are not replicated as part of the Primary/Secondary pairing process and therefore must be manually configured on the Secondary appliance. These are listed by WebUI menu option in the table below:
<table>
<thead>
<tr>
<th>WebUI Main Menu Option</th>
<th>Sub Menu Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Configuration</td>
<td>Hostname &amp; DNS</td>
<td>Hostname and DNS settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Network Interface Configuration</td>
<td>All network settings including IP address(es), bonding configuration and VLANs</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Routing</td>
<td>Routing configuration including default gateways and static routes</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>System Date &amp; time</td>
<td>All time and date related settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Physical – Advanced Configuration</td>
<td>Various settings including Internet Proxy, Management Gateway, Firewall connection tracking table size, NIC offloading, SMTP relay, logging and Syslog Server</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Security</td>
<td>Appliance security settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>SNMP Configuration</td>
<td>Appliance SNMP settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Graphing</td>
<td>Appliance graphing settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>License Key</td>
<td>Appliance licensing</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Software Updates</td>
<td>Appliance software update management</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Firewall Script</td>
<td>Appliance firewall (iptables) configuration</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Firewall Lockdown Wizard</td>
<td>Appliance management lockdown settings</td>
</tr>
</tbody>
</table>

To add a Secondary node - i.e. create a highly available clustered pair:

1. Deploy a second appliance that will be the Secondary and configure initial network settings.
2. Using the WebUI, navigate to: Cluster Configuration > High-Availability Configuration.

3. Specify the IP address and the loadbalancer user’s password for the Secondary (peer) appliance as shown above.
4. Click Add new node.
5. The pairing process now commences as shown below:

![Create a Clustered Pair](image)

6. Once complete, the following will be displayed:

![High Availability Configuration - Master](image)

7. To finalize the configuration, restart heartbeat and any other services as prompted in the blue message box at the top of the screen.

**Note**

Clicking the **Restart Heartbeat** button on the Primary appliance will also automatically restart heartbeat on the Secondary appliance.

**Note**

For more details on configuring HA with 2 appliances, please refer to [Appliance Clustering for HA](#).
## 19. Document Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
<th>Reason for Change</th>
<th>Changed By</th>
</tr>
</thead>
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<tr>
<td>1.1.0</td>
<td>13 August 2019</td>
<td>Styling and layout</td>
<td>General styling updates</td>
<td>RJC</td>
</tr>
<tr>
<td>1.1.1</td>
<td>7 January 2020</td>
<td>Updated method to change default gateway on UAGs.</td>
<td>Changes in later versions of the UAG’s Admin UI.</td>
<td>RJC</td>
</tr>
<tr>
<td>1.1.2</td>
<td>21 July 2020</td>
<td>New title page</td>
<td>Branding update</td>
<td>AH</td>
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<td></td>
<td></td>
<td>Updated Canadian contact details</td>
<td>Change to Canadian contact details</td>
<td></td>
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<tr>
<td>1.1.3</td>
<td>16th October 2020</td>
<td>Corrected steps to configure Connection Servers for External Client (Option 1)</td>
<td>Steps listed referred to UAGs rather than Connection Servers</td>
<td>RJC</td>
</tr>
<tr>
<td>1.2.0</td>
<td>1 December 2021</td>
<td>Converted the document to AsciiDoc</td>
<td>Move to new documentation system</td>
<td>AH, RJC, ZAC</td>
</tr>
</tbody>
</table>
About Loadbalancer.org

Loadbalancer.org's mission is to ensure that its clients' businesses are never interrupted. The load balancer experts ask the right questions to get to the heart of what matters, bringing a depth of understanding to each deployment. Experience enables Loadbalancer.org engineers to design less complex, unbreakable solutions - and to provide exceptional personalized support.