Load Balancing
Microsoft IIS

Deployment Guide
v1.6.4
# Table of Contents

1. About this Guide.........................................................................................................................4
2. Loadbalancer.org Appliances Supported..................................................................................4
3. Loadbalancer.org Software Versions Supported.................................................................4
4. Microsoft IIS Software Versions Supported........................................................................4
5. Microsoft Internet Information Services (IIS).......................................................................5
6. Load Balancing IIS.....................................................................................................................5
   The Basics.................................................................................................................................5
   Ports & Protocols.....................................................................................................................5
   IIS Server Health-checks..........................................................................................................5
   SSL Termination & Certificates...............................................................................................5
   Persistence (aka Server Affinity)..............................................................................................5
   Load Balancer Deployment.......................................................................................................6
   Load Balancer Deployment Modes..........................................................................................7
   Layer 4 DR Mode.....................................................................................................................7
   Layer 4 NAT Mode...................................................................................................................8
   Layer 7 SNAT Mode.................................................................................................................9
   Loadbalancer.org Recommended Mode....................................................................................10
7. Loadbalancer.org Appliance – the Basics...............................................................................12
   Virtual Appliance Download & Deployment..........................................................................12
   Initial Network Configuration..................................................................................................12
   Accessing the Web User Interface (WebUI)............................................................................13
   HA Clustered Pair Configuration............................................................................................14
8. Appliance & IIS Server Configuration – Using Layer 4 DR Mode.........................................15
   Overview..................................................................................................................................15
   Load Balancer Configuration..................................................................................................15
   Configure the Network Interface............................................................................................15
   Configure the Virtual Service (VIP). .......................................................................................15
   Configure the Real Servers (RIPs)..........................................................................................16
   IIS Server Configuration.........................................................................................................16
   Solve the ‘ARP Problem’.........................................................................................................16
   Configure IIS Bindings.............................................................................................................17
   DR Mode – Key Points.............................................................................................................17
   Overview..................................................................................................................................18
   Load Balancer Configuration..................................................................................................18
   Configure the Network Interfaces...........................................................................................18
   Configure the Virtual Service (VIP). .......................................................................................19
   Configure the Real Servers (RIPs)..........................................................................................20
   Create a Floating IP to use for the IIS server’s Default Gateway............................................21
   IIS Server Configuration.........................................................................................................21
   Default Gateway.....................................................................................................................22
   NAT Mode – Key Points..........................................................................................................22
10. Appliance & IIS Server Configuration – Using Layer 7 SNAT Mode....................................22
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>22</td>
</tr>
<tr>
<td>Load Balancer Configuration</td>
<td>22</td>
</tr>
<tr>
<td>Configure the Network Interface</td>
<td>22</td>
</tr>
<tr>
<td>Configure the Virtual Service (VIP)</td>
<td>22</td>
</tr>
<tr>
<td>Configure the Real Servers (RIPs)</td>
<td>23</td>
</tr>
<tr>
<td>IIS Server Configuration</td>
<td>24</td>
</tr>
<tr>
<td>SNAT Mode – Key Points</td>
<td>24</td>
</tr>
<tr>
<td>11. Additional Configuration Options &amp; Settings</td>
<td>24</td>
</tr>
<tr>
<td>SSL Termination</td>
<td>24</td>
</tr>
<tr>
<td>SSL Termination on the IIS servers (SSL Pass-through)</td>
<td>25</td>
</tr>
<tr>
<td>SSL Termination on the Load Balancer (SSL Offloading)</td>
<td>25</td>
</tr>
<tr>
<td>SSL Termination on the Load Balancer with Re-encryption (SSL Bridging)</td>
<td>30</td>
</tr>
<tr>
<td>Real Server (IIS) Health Checks</td>
<td>31</td>
</tr>
<tr>
<td>Layer 4</td>
<td>31</td>
</tr>
<tr>
<td>Layer 7</td>
<td>32</td>
</tr>
<tr>
<td>External Health-Check Scripts</td>
<td>32</td>
</tr>
<tr>
<td>URL Rewriting / Content Switching (ACL's)</td>
<td>32</td>
</tr>
<tr>
<td>HTTP Header Manipulation</td>
<td>35</td>
</tr>
<tr>
<td>Web Application Firewall (WAF)</td>
<td>35</td>
</tr>
<tr>
<td>Server Feedback Agent</td>
<td>36</td>
</tr>
<tr>
<td>Windows Agent</td>
<td>37</td>
</tr>
<tr>
<td>Load Balancer Transparency</td>
<td>39</td>
</tr>
<tr>
<td>Layer 4</td>
<td>39</td>
</tr>
<tr>
<td>Layer 7</td>
<td>39</td>
</tr>
<tr>
<td>12. Testing &amp; Validation</td>
<td>39</td>
</tr>
<tr>
<td>Testing Load Balanced Services</td>
<td>40</td>
</tr>
<tr>
<td>Diagnosing VIP Connection Problems</td>
<td>40</td>
</tr>
<tr>
<td>Taking IIS servers Offline</td>
<td>41</td>
</tr>
<tr>
<td>Using Reports &amp; Log Files</td>
<td>42</td>
</tr>
<tr>
<td>13. Technical Support</td>
<td>42</td>
</tr>
<tr>
<td>14. Further Documentation</td>
<td>42</td>
</tr>
<tr>
<td>15. Conclusion</td>
<td>42</td>
</tr>
<tr>
<td>16. Appendix</td>
<td>43</td>
</tr>
<tr>
<td>1 - Solving the ARP Problem</td>
<td>43</td>
</tr>
<tr>
<td>2 – Clustered Pair Configuration – Adding a Slave Unit</td>
<td>48</td>
</tr>
<tr>
<td>3 - Company Contact Information</td>
<td>50</td>
</tr>
</tbody>
</table>
1. About this Guide

This guide details the steps required to configure a load balanced Microsoft IIS environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any Microsoft IIS configuration changes that are required to enable load balancing.

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

- v7.Administration Manual
- v8.Administration Manual

2. Loadbalancer.org Appliances Supported

All our products can be used with IIS. The complete list of models is shown below:

<table>
<thead>
<tr>
<th>Discontinued Models</th>
<th>Current Models *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise R16</td>
<td>Enterprise R20</td>
</tr>
<tr>
<td>Enterprise VA R16</td>
<td>Enterprise MAX</td>
</tr>
<tr>
<td>Enterprise VA</td>
<td>Enterprise 10G</td>
</tr>
<tr>
<td>Enterprise R320</td>
<td>Enterprise Ultra</td>
</tr>
<tr>
<td></td>
<td>Enterprise VA R20</td>
</tr>
<tr>
<td></td>
<td>Enterprise VA MAX</td>
</tr>
<tr>
<td></td>
<td>Enterprise AWS **</td>
</tr>
<tr>
<td></td>
<td>Enterprise AZURE **</td>
</tr>
</tbody>
</table>

* For full specifications of these models please refer to: http://www.loadbalancer.org/products/hardware
** Some features may not be supported, please check with Loadbalancer.org support

3. Loadbalancer.org Software Versions Supported

- v7.6.4 and later

4. Microsoft IIS Software Versions Supported

- Microsoft IIS – all versions
5. Microsoft Internet Information Services (IIS)

IIS is one of the components of Microsoft Windows and is Microsoft’s implementation of a web server. The protocols supported include HTTP, HTTPS, FTP, FTPS, SMTP & NNTP. The latest versions of IIS are built on an open and modular architecture that allows users to customize and add new features through various IIS Extensions. It’s estimated that around 25% of all websites utilize IIS.

6. Load Balancing IIS

Note:
It’s highly recommended that you have a working IIS environment first before implementing the load balancer.

THE BASICS

The primary function of the load balancer is to distribute inbound requests across multiple IIS servers. This allows administrators to configure multiple servers and easily share the load between them. Adding additional capacity as demand grows then becomes straight forward and can be achieved by simply adding additional IIS servers to the load balanced cluster.

PORTS & PROTOCOLS

The following table shows the ports that are normally used with IIS for web based applications:

<table>
<thead>
<tr>
<th>Port</th>
<th>Protocol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>TCP/HTTP</td>
<td>HTTP web traffic</td>
</tr>
<tr>
<td>443</td>
<td>TCP/HTTPS</td>
<td>HTTPS web traffic</td>
</tr>
</tbody>
</table>

IIS SERVER HEALTH-CHECKS

Regular IIS server monitoring ensures that failed servers are marked as down and client requests are only directed to functional servers. Health checks can range from a simple ICMP PING to a full negotiate check where content on a certain page is read and verified. Please refer to page 31 for more details.

SSL TERMINATION & CERTIFICATES

SSL can be terminated on the IIS servers (SSL pass-through) or on the load balancer (SSL offloading). When terminated on the load balancer, it’s also possible to enable re-encryption so that the connection from the load balancer to the IIS servers is also protected (SSL bridging). Please refer to the section “SSL Termination” starting on page 24 for more details of each option.

Note:
SSL termination on the load balancer can be very CPU intensive. In most cases, for a scalable solution, terminating SSL on the IIS servers is usually the best option.

PERSISTENCE (AKA SERVER AFFINITY)

Ideally, persistence should be considered at the start of any IIS project. A database is typically used to maintain session information. This information is then available to all IIS servers so that whenever a user
connects, any previous session details can be accessed. If this structure is not in place, persistence can be implemented on the load balancer. This ensures that requests from a particular user will be handled by the same IIS server during their session. For web based applications, persistence can be based on:

1. Source IP address
2. HTTP Cookie (inserted by the load balancer)
3. Application Cookie (inserted by the application)
4. SSL Session ID
5. HTTP Cookie / failing back to Source IP address if the cookie is missing
6. X-Forwarded-For / failing back to Source IP address if the header is missing

Note:
For persistence options 2 to 6, a layer 7 SNAT mode VIP is required – please refer to page 9 and the section starting on page 22 for more details.

For HTTPS traffic, when SSL is terminated on the IIS Servers, only source IP address persistence can be used. To use the other persistence methods, SSL must be terminated on the load balancer so that the traffic is readable – please refer to the section starting on page 24 for more details on SSL termination.

LOAD BALANCER DEPLOYMENT
The following diagram illustrates how the load balancer is deployed with multiple IIS servers.

Note:
The load balancer can be deployed as a single unit, although Loadbalancer.org recommends a clustered pair for resilience & high availability. Please refer to section 2 in the appendix on page 48 for more details on configuring a clustered pair.
WAF
As illustrated in the diagram above, a WAF is included with the appliance at no extra cost and can be deployed if required. Please refer to page 35 for more details.

SSL Decryption / Re-Encryption
As illustrated in the diagram above and as mentioned on page 5, the load balancer can be configured to terminate SSL and also re-encrypt to the backend servers if required. Please refer to the section “SSL Termination” starting on page 24 for more details.

LOAD BALANCER DEPLOYMENT MODES
The load balancer can be deployed in 4 fundamental ways: Layer 4 DR mode, Layer 4 NAT mode, Layer 4 SNAT mode and Layer 7 SNAT mode.

For IIS, Layer 4 DR mode, Layer 4 NAT mode or Layer 7 SNAT is recommended. These modes are described below and are used for the configurations presented in this guide. For configuring using DR mode, please refer to page 15, for configuring using NAT mode, refer to page 18 and for layer 7 SNAT mode, refer to page 22.

LAYER 4 DR MODE
One-arm direct routing (DR) mode is a very high performance solution that requires little change to your existing infrastructure.

Note:
Kemp, Brocade, Barracuda & A10 Networks call this Direct Server Return and F5 call it N-Path.

- DR mode works by changing the destination MAC address of the incoming packet to match the selected IIS server on the fly which is very fast
- When the packet reaches the IIS server it expects the IIS server to own the Virtual Services IP address (VIP). This means that you need to ensure that the IIS server (and the load balanced application) respond to both the IIS servers own IP address and the VIP
- The IIS server should not respond to ARP requests for the VIP. Only the load balancer should do this. Configuring the IIS servers in this way is referred to as Solving the ARP Problem. please refer
to chapter 6 in the Administration Manual for more information
- On average, DR mode is 8 times quicker than NAT for HTTP, 50 times quicker for Terminal Services and much, much faster for streaming media or FTP
- The load balancer must have an Interface in the same subnet as the IIS servers to ensure layer 2 connectivity required for DR mode to work
- The VIP can be brought up on the same subnet as the IIS servers, or on a different subnet provided that the load balancer has an interface in that subnet
- Port translation is not possible in DR mode i.e. having a different RIP port than the VIP port
- DR mode is transparent, i.e. the IIS server will see the source IP address of the client

Note:
For details of configuring the appliance and IIS servers using layer 4 DR mode, please refer to page 15.

LAYER 4 NAT MODE
Layer 4 NAT mode is also a high performance solution, although not as fast as layer 4 DR mode. This is because IIS server responses must flow back to the client via the load balancer rather than directly as with DR mode.

- The load balancer translates all requests from the external Virtual Service to the internal IIS servers
- Normally eth0 is used for the internal network and eth1 is used for the external network although this is not mandatory. If the IIS servers require Internet access, Autonat should be enabled using the WebUI option: Cluster Configuration > Layer 4 – Advanced Configuration, the external interface should be selected
- NAT mode can be deployed in the following ways:
  2-arm (using 2 Interfaces), 2 subnets (as shown above) - One interface on the load balancer is connected to subnet1 and the second interface and IIS servers are connected to subnet2. The VIP
Load Balancing IIS

is brought up in subnet1. The default gateway on the IIS servers is set to be an IP address in subnet2 on the load balancer. Clients can be located in subnet1 or any remote subnet provided they can route to the VIP

2-arm (using 1 Interface, 2 subnets) - same as above except that a single interface on the load balancer is allocated 2 IP addresses, one in each subnet

1-arm (using 1 Interface, 1 subnet) - Here, the VIP is brought up in the same subnet as the IIS servers. For clients located in remote networks the default gateway on the IIS servers must be set to be an IP address on the load balancer. For clients located on the same subnet, return traffic would normally be sent directly to the client bypassing the load balancer which would break NAT mode. To address this, the routing table on the IIS servers must be modified to force return traffic to go via the load balancer - for more details on 'One-Arm NAT Mode' please refer to chapter 6 in the Administration Manual

• If you want IIS servers to be accessible on their own IP address for non-load balanced services, e.g. SMTP or RDP, you will need to setup individual SNAT and DNAT firewall script rules for each IIS server or add additional VIPs for this - please refer to chapter 6 in the Administration Manual
• NAT mode is transparent, i.e. the IIS server will see the source IP address of the client
• Port translation is possible in NAT mode, i.e. VIP:80 --> RIP8080 is possible

Note:
For details of configuring the appliance and IIS servers using layer 4 NAT mode, please refer to page 18.

LAYER 7 SNAT MODE
Layer 7 SNAT mode uses a proxy (HAProxy) at the application layer. Inbound requests are terminated on the load balancer, and HAProxy generates a new request to the chosen IIS server. As a result, Layer 7 is a slower technique than DR or NAT mode at Layer 4. Layer 7 is typically chosen when either enhanced options such as SSL termination, cookie based persistence, URL rewriting, header insertion/deletion etc. are required, or when the network topology prohibits the use of the layer 4 methods.

This mode can be deployed in a one-arm or two-arm configuration and does not require any changes to the IIS servers. However, since the load balancer is acting as a full proxy it doesn’t have the same raw throughput as the layer 4 methods. The load balancer proxies the application traffic to the servers so that
the source of all traffic becomes the load balancer.

- SNAT mode is a full proxy and therefore load balanced IIS servers do not need to be changed in any way
- Because SNAT mode is a full proxy any server in the cluster can be on any accessible subnet including across the Internet or WAN
- Layer 7 SNAT mode is not transparent by default, i.e. the IIS servers will not see the source IP address of the client, they will see the load balancer’s own IP address by default, or any other local appliance IP address if preferred (e.g. the VIP address). This can be configured per layer 7 VIP. If required, the load balancer can be configured to provide the actual client IP address to the IIS servers in 2 ways. Either by inserting a header that contains the client’s source IP address, or by modifying the Source Address field of the IP packets and replacing the IP address of the load balancer with the IP address of the client. For more information about these methods, please refer to the Administration Manual and search for “Transparency at Layer 7”.
- SNAT mode can be deployed using either a 1-arm or 2-arm configuration

Note:
For details of configuring the appliance and IIS servers using layer 7 SNAT mode, please refer to page 22.

LOADBALANCER.ORG RECOMMENDED MODE
Where possible we recommend that Layer 4 Direct Routing (DR) mode is used. This mode offers the best possible performance since replies go directly from the IIS servers to the client, not via the load balancer. It’s also relatively simple to implement. Ultimately, the final choice does depend on your specific requirements and infrastructure.
Helping you Choose

The flow chart below is intended as a simple guide to help determine which deployment mode is most appropriate. Please also refer to the previous section which describes each deployment mode.

START

Do you require enhanced options such as SSL termination, cookie based persistence, HTTP mode URL rewriting, header insertion/deletion, etc.? Yes No

Can the load balanced application bind to the real servers own IP address And the VIP at the same time? AND are the load balancer and the real servers part of the same Layer 2 network? Yes No

Do you want to retain the clients source IP address when packets reach the real servers (transparent)? Yes No

Use layer 4 DR Mode

Use layer 4 NAT Mode

Use layer 7 SNAT Mode
7. Loadbalancer.org Appliance – the Basics

VIRTUAL APPLIANCE DOWNLOAD & DEPLOYMENT
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 and XEN and has been optimized for each Hypervisor. By default, the VA is allocated 1 CPU, 2GB of RAM and has an 8GB 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 Administration Manual and the ReadMe.txt text file included in the VA download for more detailed information on deploying the VA using various Hypervisors.

INITIAL NETWORK CONFIGURATION
The IP address, subnet mask, default gateway and DNS settings can be configured in several ways as detailed below:

Method 1 - Using the Network Setup Wizard at the console
After boot up, follow the instructions on the console to configure the IP address, subnet mask, default gateway and DNS settings.

Method 2 - Using the WebUI
Using a browser, connect to the WebUI on the default IP address/port: http://192.168.2.21:9080
To set the IP address & subnet mask, use: Local Configuration > Network Interface Configuration
To set the default gateway, use: Local Configuration > Routing
To configure DNS settings, use: Local Configuration > Hostname & DNS

Method 3 - Using Linux commands
At the console, set the initial IP address using the following command:
```
ip addr add <IP address>/<mask> dev eth0
```

At the console, set the initial default gateway using the following command:
```
route add default gw <IP address> <interface>
```

At the console, set the DNS server using the following command:
```
echo nameserver <IP address> >> /etc/resolv.conf
```

Note:
If method 3 is used, you must also configure these settings using the WebUI, otherwise the settings will be lost after a reboot.
ACCESSING THE WEB USER INTERFACE (WEBUI)

The WebUI can be accessed via HTTP at the following URL: http://192.168.2.21:9080/lbadmin
* Note the port number → 9080

The WebUI can be accessed via HTTPS at the following URL: https://192.168.2.21:9443/lbadmin
* Note the port number → 9443

(replace 192.168.2.21 with the IP address of your load balancer if it’s been changed from the default)

Login using the following credentials:

**Username:** loadbalancer

**Password:** loadbalancer

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

Once logged in, the WebUI will be displayed as shown on the following page:
HA CLUSTERED PAIR CONFIGURATION

Loadbalancer.org recommend that load balancer appliances are deployed in pairs for high availability. In this guide a single unit is deployed first, adding a secondary slave unit is covered in section 2 of the Appendix on page 48.
8. Appliance & IIS Server Configuration – Using Layer 4 DR Mode

Note:
It’s highly recommended that you have a working IIS environment first before implementing the load balancer.

OVERVIEW
This is our recommended deployment mode for IIS. It’s ideal when you want the fastest possible deployment and don’t need layer 7 techniques such as advanced persistence methods, SSL termination, URL rewriting, header insertion/manipulation etc. If you do need to use these features, you should use layer SNAT mode instead – please refer to page 22 for more details.

LOAD BALANCER CONFIGURATION

CONFIGURE THE NETWORK INTERFACE

1. One interface is required. Page 12 covers the various methods available to configure network settings.

CONFIGURE THE VIRTUAL SERVICE (VIP)

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

<table>
<thead>
<tr>
<th>Label</th>
<th>IIS-Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Service</td>
<td>192.168.2.180</td>
</tr>
<tr>
<td>Ports</td>
<td>80,443</td>
</tr>
<tr>
<td>Protocol</td>
<td>TCP</td>
</tr>
<tr>
<td>Forwarding Method</td>
<td>Direct Routing</td>
</tr>
</tbody>
</table>

3. Enter an appropriate name (Label) for the VIP, e.g. IIS-Cluster
4. Set the Virtual Service IP address field to the required IP address, e.g. 192.168.2.180
5. Set the Virtual Service Ports field to 80,443

Note:
Including port 443 here means that SSL is terminated on the IIS servers. HTTP and HTTPS traffic will be forwarded to the same IIS server – provided that persistence is enabled (see step 11 below).
If you want to terminate SSL on the load balancer, you’ll have to use one of the other modes (layer 4 NAT mode or Layer 7 SNAT mode) because DR mode cannot be used as explained on page 26.

6. Leave Protocol set to TCP
7. Ensure that Forwarding Method is set to Direct Routing
8. Click Update
9. Now click Modify next to the newly created Virtual Service
10. Set Balance Mode (the load balancing algorithm) according to your requirements. Weighted least connection is the default and recommended method.
11. Persistence is enabled by default for new layer 4 VIPs and is based on source IP address. The persistence timeout can be set using the Persistence Timeout field, the default is 5 minutes which is normally fine for HTTP/HTTPS traffic.

Note:
For more information about persistence, please refer to page 5.

12. Click Update

CONFIGURE THE REAL SERVERS (RIPS)

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 – Real Servers and click Add a new Real Server next to the newly created Virtual Service
2. Enter the following details:

3. Enter an appropriate name (Label) for the first IIS server, e.g. IIS-1
4. Change the Real Server IP Address field to the required IP address, e.g. 192.168.2.190
5. Leave other settings at their default values
6. Click Update
7. Repeat the above steps for your other IIS server(s)

IIS SERVER CONFIGURATION

SOLVE THE ‘ARP PROBLEM’
As mentioned previously, DR mode works by changing the destination MAC address of the incoming packet to match the selected IIS server on the fly which is very fast. When the packet reaches the IIS server
it expects the IIS server to own the Virtual Services IP address (VIP). This means that you need to ensure that the IIS server (and the load balanced application) respond to both the IIS servers own IP address and the VIP. The IIS server should not respond to ARP requests for the VIP. Only the load balancer should do this.

To achieve this, a loopback adapter is added to the IIS servers. The IP address is set to be the same as the Virtual Service and the loopback adapter is configured so that it does not respond to ARP requests. Please refer to section 1 in the appendix on page 43 for full details of solving the ARP problem for Windows 2012 / 2016.

CONFIGURE IIS BINDINGS
By default, IIS listens on all configured IP addresses as shown below:

![Site Bindings](image)

If the default configuration is left, no further IIS configuration is required. If you do change the IP address in the bindings from “All Unassigned” to a specific IP address, then you need to make sure that you also add a binding for the Virtual Service IP address (VIP) as shown below:

![Site Bindings](image)

In this example, 192.168.2.180 is the main NIC interface for the IIS server and 192.168.2.190 is the Virtual Service’s IP address (assigned to the loopback Interface). This ensures that IIS responds to both the RIP and the VIP.

DR MODE – KEY POINTS

- You must solve the ‘ARP Problem’ on all IIS servers in the cluster (please refer to page 43 in the appendix for more information)
Appliance & IIS Server Configuration – Using Layer 4 DR Mode

• Virtual Services & Real Servers (i.e. the IIS servers) must be within the same switch fabric. They can be on different subnets but this cannot be across a router – this is due to the way DR mode works, i.e. by changing MAC addresses to match the destination server

• Port translation is not possible, e.g. VIP:80 → IIS:82 is not allowed. The port used for the VIP & RIP must be the same

• IIS bindings must include the Virtual Service IP (VIP) address – this is the default for IIS when 'All Unassigned' is selected


Note:
It’s highly recommended that you have a working IIS environment first before implementing the load balancer.

OVERVIEW
If you have a custom application that is installed on IIS that is unable to bind to the IIS servers own address and the VIP address at the same time, or the load balancer and the IIS servers are not part of the same layer 2 network, then DR mode cannot be used. If you require a high performance solution that is transparent by default (i.e. the client IP address is maintained through the load balancer) and you do not require layer 7 functionality such as advanced persistence methods, URL rewriting, header insertion/manipulation etc then layer 4 NAT mode can be used. Layer 4 NAT mode is also a high performance solution, although not as fast as layer 4 DR mode. This is because IIS server responses must flow back to the client via the load balancer rather than directly as with DR mode.

LOAD BALANCER CONFIGURATION

CONFIGURE THE NETWORK INTERFACES

1. Set the first IP address using one of the methods listed on Page 12
2. Using the WebUI, navigate to: Local Configuration > Network Interface Configuration
3. Define an additional IP address in a different subnet – either by using 2 separate interfaces or a single interface with an additional alias (secondary) address as shown below:

Using separate interfaces:
Note:
Eth0 is typically used as the internal interface and eth1 is used as the external interface. However, you can use any interface for any purpose.

Adding a VLAN to the interface:

**CONFIGURE THE VIRTUAL SERVICE (VIP)**

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 – Virtual Services and click Add a New Virtual Service
2. Enter the following details:
3. Enter an appropriate name (Label) for the VIP, e.g. **IIS-Cluster**
4. Set the **Virtual Service IP address** field to the required IP address, e.g. **192.168.2.180**
5. Set the **Virtual Service Ports** field to **80,443**

   **Note:**
   Including port 443 here means that SSL is terminated on the IIS servers. HTTP and HTTPS traffic will be forwarded to the same IIS server during a particular client session – provided that persistence is enabled (see step 11 below).

   If you want to terminate SSL on the load balancer, you'll need to setup an additional Pound or STunnel (default) SSL VIP to handle the offloading - please refer to the section “SSL Termination” starting on page 24 for more information.

6. Leave **Protocol** set to **TCP**
7. Set the **Forwarding Method** is to **NAT**
8. Click **Update**
9. Now click **Modify** next to the newly created Virtual Service
10. Set **Balance Mode** (the load balancing algorithm) according to your requirements. Weighted least connection is the default and recommended method.
11. Persistence is enabled by default for new layer 4 VIPs and is based on source IP address. The persistence timeout can be set using the **Persistence Timeout** field, the default is 5 minutes which is normally fine for HTTP/HTTPS traffic.

   **Note:**
   For more information about persistence, please refer to page 5.

12. Click **Update**

**CONFIGURE THE REAL SERVERS (RIPS)**

1. Using the WebUI, navigate to: **Cluster Configuration > Layer 4 – Real Servers** and click **Add a new Real Server** next to the newly created Virtual Service
2. Enter the following details:
3. Enter an appropriate name (Label) for the first IIS server, e.g. **IIS1**
4. Change the **Real Server IP Address** field to the required IP address, e.g. **192.168.4.190**
5. Leave the **Real Server Port** field blank
6. Leave other settings at their default values
7. Click **Update**
8. Repeat the above steps for your other IIS server(s)

**CREATE A FLOATING IP TO USE FOR THE IIS SERVER’S DEFAULT GATEWAY**

The default gateway on each IIS server must be configured to be an IP address on the load balancer. It’s possible to use the IP address assigned to the internal facing interface (eth0 in this example) for the default gateway, although it’s recommended that an additional floating IP is created for this purpose. This is required if two load balancers (our recommended configuration) are used. In this scenario if the master unit fails, the floating IP will be brought up on the slave.

*To create a floating IP address on the load balancer:*

1. Using the WebUI, navigate to: **Cluster Configuration > Floating IPs**
2. Enter the required IP address to be used for the default gateway, e.g. **192.168.4.254**
3. Click **Update**.

Once added, there will be two floating IP’s, one for the Virtual Service (**192.168.2.180**) and one for the default gateway (e.g. **192.168.4.254**) as shown below:

**IIS SERVER CONFIGURATION**
DEFAULT GATEWAY
To ensure return traffic passes back to the client via the load balancer, set the default gateway of each IIS server to be the floating IP address added in the previous step, in this example **192.168.4.254**.

NAT MODE – KEY POINTS

- Virtual Services & Real Servers (i.e. the IIS servers) must be on different subnets
- The default gateway on the IIS servers should be an IP address on the load balancer (for an HA pair this must be a floating IP address)
- Port translation is possible, e.g. VIP:80 → RIP:8080 is allowed

10. Appliance & IIS Server Configuration – Using Layer 7 SNAT Mode

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

**OVERVIEW**
If you require enhanced options such as SSL termination, cookie based persistence, HTTP mode URL rewriting, header insertion/deletion, etc. then you must use a layer 7 SNAT mode VIP.

**LOAD BALANCER CONFIGURATION**

**CONFIGURE THE NETWORK INTERFACE**

1. In this example one interface is required. Page 12 covers the various methods available to configure network settings.

**CONFIGURE THE VIRTUAL SERVICE (VIP)**

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 name (Label) for the Virtual Service, e.g. **IIS-Cluster**
4. Set the **Virtual Service IP address** field to the required IP address, e.g. **192.168.2.180**
5. Set the **Virtual Service Ports** field to **80,443**

**Note:**
Including port 443 here means that SSL is terminated on the IIS servers. HTTP and HTTPS traffic will be forwarded to the same IIS server during a particular client session – provided that persistence is enabled (see step 10 below).

If you want to terminate SSL on the load balancer, you’ll need to setup an additional Pound or STunnel (default) SSL VIP to handle the offloading - please refer to the section “SSL Termination” starting on page 24 for more information.

6. Set **Layer 7 Protocol** to **TCP Mode**
7. Click **Update**
8. Now click **Modify** next to the newly created Virtual Service
9. Set **Balance Mode** (the load balancing algorithm) according to your requirements. Weighted least connection is the default and recommended method.
10. Persistence is enabled by default for new layer 7 VIPs. For TCP Mode (which is required when the VIP handles both HTTP and HTTPS) it’s based on source IP address. The persistence timeout can be set using the **Persistence Timeout** field, the default is 30 minutes which is normally fine for HTTP/HTTPS traffic.

**Note:**
If SSL is terminated on the IIS servers (as in this example) only Source IP address persistence can be used. Other methods such as HTTP Cookie persistence require the traffic to be unencrypted and therefore require SSL to be terminated on the load balancer - please refer to the section “SSL Termination” starting on page 24 for more information.

**Note:**
For more information about persistence, please refer to page 5.

11. Click **Update**

**CONFIGURE THE REAL SERVERS (RIPS)**

1. Using the WebUI, navigate to: **Cluster Configuration > Layer 7 – Real Servers** and click **Add a new**
Appliance & IIS Server Configuration – Using Layer 7 SNAT Mode

**Real Server** next to the newly created Virtual Service

2. Enter the following details:

<table>
<thead>
<tr>
<th>Label</th>
<th>IIS1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Server IP Address</td>
<td>192.168.2.190</td>
</tr>
<tr>
<td>Real Server Port</td>
<td></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 name (Label) for the first IIS server, e.g. IIS1
4. Change the **Real Server IP Address** field to the required IP address (e.g. 192.168.2.190)
5. Leave the **Real Server Port** field blank
6. Click **Update**
7. Repeat the above steps for your other IIS server(s)

**IIS SERVER CONFIGURATION**

In layer 7 SNAT mode, no IIS server configuration changes are required.

**SNAT MODE – KEY POINTS**

- Virtual Services & Real Servers (the IIS servers) can be on the same or different subnets
- Port translation is possible, e.g. VIP:80 → RIP:8080 is allowed
- No configuration changes are required to the IIS servers
- Enables enhanced options such as SSL termination / re-encryption, cookie based persistence, HTTP mode URL rewriting, header insertion/deletion, etc.
- Not as fast as Layer 4 DR mode or NAT mode

**11. Additional Configuration Options & Settings**

**SSL TERMINATION**

SSL termination can be handled in the following ways:

1. On the IIS Servers (recommended) – aka **SSL Pass-through**
2. On the load balancer – aka **SSL Offloading**
3. On the load balancer with re-encryption to the IIS Servers – aka **SSL Bridging**
SSL TERMINATION ON THE IIS SERVERS (SSL PASS-THROUGH)

In this case, SSL certificates are installed on each IIS Server in the normal way. Data is encrypted from client to server. This provides full end-to-end data encryption as shown in the diagram above.

Notes:

- The VIP on the load balancer is configured to listen on port 80 & 443.
- This is our recommended solution. SSL termination on the load balancer (SSL Offload) can be very CPU intensive and in most cases, for a scalable solution, terminating SSL on the IIS servers is the best option.
- It’s not possible to use HTTP cookie persistence as well as other layer 7 techniques that control how traffic is sent to the IIS servers because all data is encrypted as it passes through the load balancer.

SSL TERMINATION ON THE LOAD BALANCER (SSL OFFLOADING)

Note:
SSL termination on the load balancer can be very CPU intensive. In most cases, for a scalable solution, terminating SSL on the IIS servers is the best option.

In this case, an SSL VIP utilizing either STunnel (default & recommended) or Pound is configured on the appliance and an SSL certificate is uploaded and associated to the Virtual Service. Data is encrypted from the client to the load balancer, but is unencrypted from the load balancer to the backend servers as shown.
above. If you require SSL bridging where the data is re-encrypted to the backend IIS servers, please refer to page 30.

Notes:

• By default, a self-signed certificate is used for the new SSL VIP. Certificates can be requested on the load balancer or uploaded as described in the section below. The default self-signed certificate can be regenerated if needed using the WebUI menu option: SSL Certificate and clicking the Regenerate Local SSL Certificate button.

• The backend for the SSL VIP can be either a Layer 7 SNAT mode VIP or a Layer 4 NAT or SNAT mode VIP. Layer 4 DR mode cannot be used since Pound & STunnel act as a proxy, and the IIS servers see requests with a source IP address of the VIP. However, since the IIS servers believe that they own the VIP (due to the loopback adapter configured to handle to ARP problem) they are unable to reply to Pound/STunnel.

• If a layer 7 VIP is used as the backend for the SSL VIP, it’s possible to use cookie based persistence as well as other layer 7 techniques to control traffic flow to the IIS servers.

Certificates
To enable the load balancer to perform SSL termination, an SSL certificate is required. If you already have an SSL certificate in either PFX or PEM file format, this can be uploaded to the Load balancer using the certificate upload option. Alternatively, you can create a Certificate Signing Request (CSR) and send this to your chosen CA to create a new certificate.

Generating a CSR on the Load Balancer
CSR’s can be generated on the load balancer to apply for a certificate from your CA.

To generate a CSR:

1. Using the WebUI, navigate to: Cluster Configuration > SSL Certificates
2. Click Add a new SSL Certificate & select Create a New SSL Certificate (CSR)
3. Enter a suitable label (name) for the certificate, e.g. **Cert1**
4. Populate the remaining fields according to your requirements
5. Once all fields are complete click **Create CSR**
6. To view the CSR click **Modify** next to the new certificate, then expand the Certificate Signing Request (CSR) section
7. Copy the CSR and send this to your chosen CA
8. Once received, copy/paste your signed certificate into the **Your Certificate** section
9. Intermediate and root certificates can be copied/pasted into the **Intermediate Certificate** and **Root Certificate** sections as required
10. Click **Update** to complete the process

**Uploading Certificates**

If you already have a certificate in either PEM or PFX format, this can be uploaded to the load balancer.

To upload a Certificate:

1. Using the WebUI, navigate to: **Cluster Configuration > SSL Certificates**
2. Click **Add a new SSL Certificate** & select **Upload prepared PEM/PFX file**

![Image](image-url)

3. Enter a suitable **Label** (name) for the certificate, e.g. **Cert1**
4. Browse to and select the certificate file to upload (PEM or PFX format)
5. Enter the password , if applicable
6. Click **Upload Certificate**, if successful, a message similar to the following will be displayed:

![Information](information-url)

**Note:**

It’s important to backup all your certificates. This can be done via the WebUI from **Maintenance > Backup & Restore > Download SSL Certificates**.

**Exporting PFX Certificates from Windows Servers**

When exporting certificates from Windows servers, make sure that **Yes, export the private key** is selected, this will enable the output format to be PFX. Also make sure that **Include all certificates in the certification path if possible** is selected.

**Creating a PEM file**

Using a text editor such as vi or vim under Linux or Notepad under Windows, create an empty file (e.g. pem.txt) then copy/paste the entire contents of each of the following items into this file in the order listed:

- Private Key
• SSL Certificate
• Intermediate Certificate
• Root CA Certificate

Make sure you include the beginning and end tags. The resulting file should look like this:

-----BEGIN PRIVATE KEY-----
(the contents of your Private Key goes here)
-----END PRIVATE KEY-----
-----BEGIN CERTIFICATE-----
(the contents of your SSL Certificate goes here)
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
(the contents of your Intermediate Certificate goes here)
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
(the contents of your Root Certificate goes here)
-----END CERTIFICATE-----

**Configuring SSL Termination on the Load Balancer**

_To configure an SSL VIP:_

For v8.3.3 and later:

1. Using the WebUI, navigate to: _Cluster Configuration > SSL Termination_ and click _Add a new Virtual Service_

   ![Screenshot of configuration page](image)

2. Enter a suitable Label (name) for the VIP, e.g. _SSL_
3. Set _Associated Virtual Service_ to the appropriate VIP, e.g. _IIS-Cluster_

   **Note:**
   The _Associated Virtual Service_ drop-down is populated with all single port, standard (i.e. non manual) Layer 7 VIPs available on the load balancer. Using a Layer 7 VIP for the backend is the recommended method although as mentioned earlier, Layer 4 NAT mode and layer 4 SNAT.
mode VIPs can also be used if required. To forward traffic from the SSL VIP to these type of VIPs, you’ll need to set Associated Virtual Service to Custom, then configure the IP address & port of the required VIP.

**Note:**

If you are following on from the example on page 22, the IIS-Cluster VIP would need to be modified to make it a valid candidate for the Associated Virtual Service drop-down. Port 443 would need to be removed (i.e. set the port field to 80 not 80,443). This is because HTTPS traffic would no longer be handled by the Layer 7 SNAT mode VIP, the SSL VIP would be used instead.

4. Leave Virtual Service Port set to **443**
5. Leave SSL operation Mode set to **High Security**
6. Select the required certificate from the SSL Certificate drop-down.
7. Click **Update**
8. Reload STunnel to apply the new settings using the link provided in the blue box for v8.3.2 and earlier:

1. Enter the following details:

   ![Virtual Service Configuration Table]

2. Enter the required Label (name) for the Virtual Service, e.g. **SSL**
3. Select the certificate uploaded previously in the SSL Certificate drop-down
4. Set the Virtual Service IP address to be the same as the VIP created previously, e.g. **192.168.2.180**
5. Set the Virtual Service Port field to **443**
6. Set the Backend Virtual Service IP address to be the same as the VIP created previously, e.g. **192.168.2.180**
7. Set the Backend Virtual Service Port field to **80**
8. The other settings can be left at their default values
9. Click **Update**

Once configured, HTTP traffic will be load balanced by the Layer 7 SNAT mode VIP and HTTPS traffic will be terminated by the SSL VIP, then passed on to the Layer 7 SNAT mode VIP as unencrypted HTTP for load balancing.
SSL TERMINATION ON THE LOAD BALANCER WITH RE-ENCRYPTION (SSL BRIDGING)

Note:
SSL termination on the load balancer can be very CPU intensive. In most cases, for a scalable solution, terminating SSL on the IIS servers is the best option.

In this case, an SSL VIP utilizing either STunnel (default & recommended) or Pound is configured on the appliance and an SSL certificate is uploaded and associated to the Virtual Service. Data is encrypted from the client to the load balancer and is also encrypted from the load balancer to the backend servers as shown above.

Notes:

• This is similar to SSL Offload, the only difference is that the connection from the load balancer to the IIS servers is encrypted using the certificate located on the IIS server, this could be a self-signed certificate since no client connections are terminated here, only at the STunnel or Pound VIP.

• This mode can be enabled for the entire VIP and all associated IIS servers using the VIP option Enable Backend encryption or per IIS server using the Re-Encrypt to Backend option as detailed below.

Note:
SSL termination on the load balancer can be very CPU intensive. In most cases, for a scalable solution, terminating SSL on the IIS servers is the best option.

To enable re-encryption at the Virtual Server level:

1. Use the WebUI menu option: Cluster Configuration > Layer 7 – Virtual Servers > Modify

Enable Backend Encryption

2. Enable the option Re-Encrypt to Backend
3. Click **Update**
4. Now add the IIS servers ensuring that you specify the correct HTTPS port – typically 443

**Note:**
This setting only applies to IIS servers added after setting this option, it auto enables the Re-Encrypt to Backend option (see below) for all new IIS servers.

To enable re-encryption at the Real Server level:

1. For each Real Server use the WebUI menu option: **Cluster Configuration > Layer 7 – Real Servers > Modify**

![Real Server Configuration](image)

2. Set **Real Server Port** to **443**
3. Enable the option **Re-Encrypt to Backend**
4. Click **Update**
5. Repeat for your other IIS server(s)

### REAL SERVER (IIS) HEALTH CHECKS

The load balancer performs regular health checks to ensure that each server in the cluster is healthy and able to accept client connections. The health check options depend on whether the VIP is defined at layer 4 or layer 7 as outlined below.

#### LAYER 4

By default, a TCP connect health check is used for newly created layer 4 Virtual Services. The following table lists all options available:

<table>
<thead>
<tr>
<th>Check Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiate</td>
<td>Sends a request and looks for a specific response. This option enables the load balancer to perform a more robust check. For example, an HTTP check can be configured that requests a certain page and then looks for a specific word on that page.</td>
</tr>
<tr>
<td>Connect to port</td>
<td>Just do a simple connect to the specified port/service &amp; verify that it's able to accept a connection.</td>
</tr>
<tr>
<td>Ping server</td>
<td>Sends an ICMP echo request packet to the Real Server.</td>
</tr>
<tr>
<td>External check</td>
<td>Use a custom script for the health check.</td>
</tr>
<tr>
<td>No checks, always Off</td>
<td>All Real Servers are off.</td>
</tr>
<tr>
<td>No checks, always On</td>
<td>All Real Servers are on (no checking).</td>
</tr>
</tbody>
</table>
### Additional Configuration Options & Settings

<table>
<thead>
<tr>
<th>5 Connects, 1 Negotiate</th>
<th>Do 5 connect checks and then 1 negotiate check.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Connects, 1 Negotiate</td>
<td>Do 10 connect checks and then 1 negotiate check.</td>
</tr>
</tbody>
</table>

**LAYER 7**

By default, a TCP connect health check is used for newly created layer 7 Virtual Services. The following tables lists all options available:

<table>
<thead>
<tr>
<th>Check Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiate HTTP/HTTPS (GET)</td>
<td>Sends a request and looks for a specific response. This option enables the load balancer to perform a more robust check. For example, an HTTP or HTTPS check can be configured that requests a certain page and then looks for a specific word on that page.</td>
</tr>
<tr>
<td>Negotiate HTTP/HTTPS (HEAD)</td>
<td>Scan the returned page headers defined as the <em>Request to Send</em>, and check the returned data in the <em>Response Expected</em> string. HEAD would return the page headers that would usually be returned by a GET.</td>
</tr>
<tr>
<td>Connect to port</td>
<td>Just do a simple TCP connect to the specified port/service &amp; verify that it’s able to accept a connection.</td>
</tr>
<tr>
<td>External Script</td>
<td>Use a custom script for the health check.</td>
</tr>
<tr>
<td>MySQL</td>
<td>The check consists of sending two MySQL packets, one Client Authentication packet, and one QUIT packet, to correctly close the MySQL session. It then parses the MySQL Handshake Initialization packet and/or Error packet.</td>
</tr>
<tr>
<td>No checks, always On</td>
<td>All Real Servers are assumed on (i.e. no checking)</td>
</tr>
</tbody>
</table>

**Note:**
If a Negotiate check is selected and *Response Expected* is left blank, the appliance will check the location specified in *Request to Send* (if blank the root will be checked) and look for a **HTTP 200 OK** response from the Real Server.

**Note:**
For full details on the options available, please refer to Chapter 8 – *Real Server Health Monitoring & Control* in the *Administration Manual*.

**EXTERNAL HEALTH-CHECK SCRIPTS**

Writing an external health check script enables the way the IIS servers are monitored to be customized. The example presented in *this.loadbalancer.org* blog provides an example script that performs an HTTP GET, checks that the Application Pool specified is running and writes the status to a text file on the IIS server which the load balancer then reads.

**URL REWRITING / CONTENT SWITCHING (ACL’S)**

The WebUI supports the ability to create ACL’s which can be used to control and direct HTTP traffic based on the rules defined. This option can be accessed by clicking the *Edit ACL Rules* button when modifying a VIP.
Multiple rules can be defined using the Add button.

Once all rules have been defined, click Save to save the rules, then click Update to update the VIP, then click Reload HAProxy at the top of the page to apply the new settings.

In the example above, requests are redirected to the URL location http://www.example.com if the path begins with /example.

e.g. if the requested URL is: http://www.domain.com/example
the request is redirected to: http://www.example.com

Other Examples:

In the example above, requests are redirected to the URL prefix http://www.domain3.com if the host header value is www.domain1.com.

e.g. if the requested URL is: http://www.domain1.com/contract
the request is redirected to: http://www.domain3.com/contract
In the example above, requests are forwarded to the backend called Blog if the path begins with /blog.

For example, if the requested URL is: **http://www.domain1.com/blog**

the request is forwarded to the backend called Blog.

Requests to **http://www.domain1.com/other locations** are forwarded to the IIS servers that were defined using the WebUI menu option: Cluster Configuration > Layer 7 – Real Servers

The Backend can be defined in the following 2 ways:

1. **As a Manually defined Backend**

   Using the WebUI menu option: Cluster Configuration > Layer 7 – Manual Configuration, the backend 'Blog' can be defined as shown below:

   ```
   backend Blog
   mode http
   balance roundrobin
   option forwardfor
   server rip3 192.168.110.242:80 weight 1 check
   server rip4 192.168.110.243:80 weight 1 check
   ```

2. **As a VIP with the required backend (Real) Servers**

   Here, 'Blog' has been defined as an additional VIP with 2 Real Servers:

<table>
<thead>
<tr>
<th>REAL SERVER</th>
<th>IP</th>
<th>PORTS</th>
<th>WEIGHT</th>
<th>CONNS</th>
<th>HTTP</th>
<th>Layer 7</th>
<th>Proxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blog</td>
<td>192.168.110.116</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td>HTTP</td>
<td></td>
</tr>
<tr>
<td>BlogRIP1</td>
<td>192.168.110.240</td>
<td>80</td>
<td>100</td>
<td></td>
<td>0</td>
<td>Drain</td>
<td>Halt</td>
</tr>
<tr>
<td>BlogRIP2</td>
<td>192.168.110.243</td>
<td>80</td>
<td>100</td>
<td></td>
<td>0</td>
<td>Drain</td>
<td>Halt</td>
</tr>
</tbody>
</table>

   **Note:**
   When defining ACL's that have their Rule Action Type set to Backend or Use Server, the relevant Backend/VIP or Real Server must exist before HAProxy can be successfully restarted. Note also that names used are case sensitive.
HTTP HEADER MANIPULATION

The appliance enables HTTP headers to be added, set and deleted as described below. This option can be accessed by clicking the Edit HTTP Headers button when modifying a VIP.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add</td>
<td>Allows you to append a HTTP header who’s name is controlled by the ‘Header Name’ input box. The value of the header is controlled by the ‘Header Value’ Box.</td>
</tr>
<tr>
<td>set</td>
<td>Does the same as add but the header is removed/replaced if it already exists.</td>
</tr>
<tr>
<td>Delete</td>
<td>Removes all HTTP header fields that match the header name specified in the Header Name Box.</td>
</tr>
</tbody>
</table>

- Multiple headers can be defined using the Add button
- Once all headers have been defined, click Save to save the headers, then click Update to update the VIP, then click Reload HAProxy at the top of the page to apply the new settings

In the example above, the 3 header configuration rows result in the following headers being added to the requests sent from the appliance to the web servers:

- [HTTP_X_CLIENT_DEST_PORT], i.e. the port that the client connected to
- [HTTP_X_CLIENT_DEST], i.e. the IP address that the client connected to
- [HTTP_X_SOURCE], i.e. the clients source IP address

WEB APPLICATION FIREWALL (WAF)

The load balancer includes a built in WAF that can be deployed if required. The WAF is based on the ModSecurity Open Source Project and includes a default vulnerability rule-set based on the “OWASP top 10”. This defines the top 10 areas of vulnerability that can effect Web Applications.

The load balancer supports the ability to define multiple WAF gateways. Each gateway is associated with a layer 7 VIP when created. On creation, the data path is automatically modified so that the WAF becomes the initial connection point for inbound client connections as illustrated below:
**Additional Configuration Options & Settings**

**Data flow before WAF is deployed**

- Load Balancer
  - Layer 7 VIP
  - Web Server 1
  - Web Server 2

**Modified data flow once WAF is deployed**

- Load Balancer
  - WAF Gateway
  - Layer 7 VIP
  - Web Server 1
  - Web Server 2

**Notes:**

- When defining a WAF Gateway on the load balancer, the associated layer 7 VIP must be selected from a drop-down list. This enables the WAF to be automatically configured to listen on the same TCP socket as the original layer 7 VIP. The WAF gateway is then automatically configured to forward packets to the original layer 7 VIP.

- Each WAF gateway is associated with one layer 7 VIP.

- Once the WAF gateway is defined, the **Label**, **IP Address**, **Port** and **Protocol** of the associated layer 7 VIP cannot be edited to ensure the association remains intact. If changes to these settings are required, remove the WAF, make the changes, then recreate the WAF.

- Each WAF gateway is comprised of an additional layer 7 VIP which acts as the WAF frontend and an Apache/ModSecurity config. Both are auto-created when the WAF Gateway is configured.

**Note:**
For full details on creating and configuring a WAF, please refer to Chapter 7 – *Web Application Firewall (WAF)* in the *Administration Manual*.

**SERVER FEEDBACK AGENT**

The load balancer can modify the weight (amount of traffic) of each server by gathering data from either a custom agent or an HTTP server. For layer 4 VIPs the feedback method can be set to either agent or HTTP, for Layer 7 VIPs, only the agent method is supported.

A telnet to port 3333 on a IIS server with the agent installed will return the current idle stats as an integer value in the range 0 – 100. The figure returned can be related to CPU utilization, RAM usage or a combination of both. This can be configured using the XML configuration file located in the agents.
installation folder (by default C:\ProgramData\LoadBalancer.org\LoadBalancer).
The load balancer typically expects a 0-99 integer response from the agent which by default relates to the
current CPU idle state, e.g. a response of 92 would imply that the IIS servers CPU is 92% idle. The load
balancer will then use the formula (92/100*requested_weight) to find the new optimized weight.

Note:
The ‘Requested Weight’ is the weight set in the WebUI for each IIS server. For more information
please also refer to this blog.

WINDOWS AGENT

The latest Windows feedback agent can be downloaded from here. To install the agent, run
loadbalanceragent.msi on each IIS server:

Click Next

Select Installation Folder

The installer will install LoadBalancer CPU monitor to the following folder.
To install in this folder, click ‘Next’. To install to a different folder, enter it below or click ‘Browse’.

Folder: C:\Program Files (x86)\LoadBalancer.org\LoadBalancer CPU monitor
Browse ...

Install LoadBalancer CPU monitor for yourself, or for anyone who uses this computer:

- Everyone
- Just me

Microsoft IIS Deployment Guide v1.6.4
Page 37
Select the installation folder and click **Next**

![Confirm Installation](image)

Click **Next** to start the installation

---

**Note:**
The agent should be installed on all IIS servers in the cluster.

---

**Starting the Agent**

Once the installation has completed, you’ll need to start the service on the IIS servers. The service is controlled by the Feedback Agent Monitor program that is also installed along with the Agent. The monitor can be accessed on the Windows server using: *All Programs > Loadbalancer.org > Monitor*. It’s also possible to start the service using the services snap-in – the service is called ‘Loadbalancer CPU monitor’.

![LoadBalancer.org Feedback Agent 4.2.6](image)

- To start the service, click the **Start** button
- To stop the service, click the **Stop** button
To Configure the Virtual Service to use the Agent
As mentioned, both layer 4 and layer 7 VIPs can be configured to use the feedback agent. To Configure Virtual Services to use Agent/HTTP Feedback follow the steps below:

1. Using the WebUI, navigate to: Cluster Configuration > Layer 4 - Virtual Services or Layer 7 - Virtual Services
2. Click Modify next to the Virtual Service
3. Set the Feedback Method to Agent
4. Click Update
5. Reload/restart services as prompted

LOAD BALANCER TRANSPARENCY

LAYER 4
Both Layer 4 DR mode and layer 4 NAT mode are transparent by default. This means that IIS will log the actual IP address of the client rather than the IP address of the load balancer.

LAYER 7
Because layer 7 is based on a proxy (HAProxy) it is not transparent by default, therefore IIS logs will show the load balancer’s IP address rather than the client’s IP. However, the load balancer can be configured to provide the actual client IP address to the IIS servers in 2 ways:

1. By inserting a header that contains the client IP source address. For HTTP traffic the X-Forwarded-For (XFF) header is used, for TCP traffic the Proxy Protocol Header is used.

   **Note:**
   For more details of XFF headers please refer to [this link](#), for more details of Proxy Protocol Headers please refer to [this link](#).

2. By modifying the Source Address field of the IP packets and replacing the IP address of the load balancer with the IP address of the client. The load balancer uses TProxy for this purpose.

These methods can be used independently or in combination to achieve a range of objectives. For more information and details of how to use these methods, please refer to the Administration Manual and search for “Transparency at Layer 7”.

12. Testing & Validation
TESTING LOAD BALANCED SERVICES

To test a web server based configuration, add a page to each web servers root directory e.g. test.html and put the server name on this page for easy identification during the tests.

Use two or more clients to do the testing. Open up a web browser on each test clients and enter the URL for the VIP e.g. http://192.168.110.10

Each client should see a different server name because of the load balancing algorithm in use i.e. they are being load balanced across the cluster.

**Why test using two clients?** If you use a single client it will most likely keep on hitting the same server for multiple requests. This is to do with the way that the load balancing algorithms are optimized.

DIAGNOSING VIP CONNECTION PROBLEMS

1. **Make sure that the device is active** - this can be checked in the WebUI. For a single appliance, the status bar should report **Master & Active** as shown below:

<table>
<thead>
<tr>
<th>Master</th>
<th>Slave</th>
<th>Active</th>
<th>Passive</th>
<th>Link</th>
</tr>
</thead>
</table>

2. **Check that the VIP/ floating IP is up** - Using View Configuration > Network Configuration verify that the VIP is active on the load balancer, if not check Logs > Heartbeat for errors.

   2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
   link/ether 00:6c:29:cf:18:03 brd ff:ff:ff:ff:ff
   inet 192.168.110.85/18 brd 192.168.110.255 scope global eth0
   valid_lft forever preferred_lft forever
   inet 192.168.110.90/18 brd 192.168.110.255 scope global secondary eth0
   valid_lft forever preferred_lft forever

   The above example shows that the interface address (192.168.110.85) and the VIP address (192.168.110.90) are both up.

3. **Check that the IIS Servers are up** - Using System Overview make sure that none of your VIPs are colored red. If they are, the entire cluster is down (i.e. all IIS Servers). Green indicates a healthy cluster, yellow indicates that your cluster may need attention (one or more of the IIS Servers may be down), and blue indicates all IIS Server have been deliberately taken offline (by using either Halt or Drain).

4. **Check the connection state** -

   For Layer 4 DR mode VIPs check Reports > Layer 4 Current Connections to view the current traffic in detail. Any packets with state **SYN_RECV** imply that the ‘ARP Problem’ has not been correctly solved on the IIS Servers. Please refer to page 43 for more details on solving the ARP problem.

   For layer 4 NAT mode VIPs check Reports > Layer 4 Current Connections to view the current traffic in
detail. Any packets with state SYN_RECV often imply that the default gateway on the IIS Servers has not been set to be an IP address on the load balancer.

For Layer 7 VIPs check Reports > Layer 7 Status. The default credentials required are:

- **Username**: loadbalancer
- **Password**: loadbalancer

This will open a second tab in the browser and display a statistics/status report as shown in the example below:

![Statistics Report for pid 3261](image)

**Taking IIS Servers Offline**

1) Using the System Overview check that when you Halt one of the IIS Servers the connections are redirected to the other server in the cluster.

2) Remove the network cable from one of the IIS servers or stop the web service/process, wait a few seconds (for the load balancer to detect the change) and then refresh the browsers on both clients. They should now both switch to the same server (since one has been removed from the load balancing list). Also check that the server is shown red (down) in the system overview.

3) Replace the network cable, wait a few seconds and then refresh the browsers again. After a few refreshes they should again show different web servers. Also check that the server is shown green (up) in the system overview.

The System Overview will also show the updated status as these tests are performed:

![System Overview](image)

In this example:
**RIP1** is green, this indicates that it’s operating normally.

**RIP2** is blue, this indicates that it has been either Halted or Drained. In this example Halt has been used as indicated by *Online (Halt)* being displayed. If it had been drained it would show as *Online (Drain)*.

**RIP3** is red, this indicates that it has failed a health check.

**USING REPORTS & LOG FILES**
The appliance includes several logs and reports that are very useful when diagnosing issues. Both are available as main menu options in the WebUI. Details of both can be found in chapter 13 in the *Administration Manual*.

### 13. 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.

### 14. Further Documentation

### 15. Conclusion
Loadbalancer.org appliances provide a very cost effective and flexible solution for highly available load balanced Microsoft IIS environments.
16. Appendix

1 - SOLVING THE ARP PROBLEM
When using Layer 4 DR mode, the ARP problem must be solved. This involves configuring each IIS server to be able to receive traffic destined for the VIP, and ensuring that each IIS server does not respond to ARP requests for the VIP address – only the load balancer should do this.

The steps below are for Windows 2012 / 2016, for other versions of Windows please refer to chapter 6 in the Administration Manual.

Step 1: Install the Microsoft Loopback Adapter

1. Click Start, then run hdwwiz to start the Hardware Installation Wizard
2. When the Wizard has started, click Next
3. Select Install the hardware that I manually select from a list (Advanced), click Next
4. Select Network adapters, click Next
5. Select Microsoft & Microsoft KM-Test Loopback Adapter, click Next

Step 2: Configure the Loopback Adapter

1. Open Control Panel and click Network and Sharing Center
2. Click Change adapter settings
3. Right-click the new Loopback Adapter and select Properties
4. Uncheck all items except Internet Protocol Version 4 (TCP/IPv4) and Internet Protocol Version 6 (TCP/IPv6) as shown below:
Note:
Leaving both checked ensures that both IPv4 and IPv6 are supported. Select one if preferred.

5. If configuring IPv4 addresses select Internet Protocol Version (TCP/IPv4), click Properties and configure the IP address to be the same as the Virtual Service (VIP) with a subnet mask of 255.255.255.255, e.g. 192.168.2.20/255.255.255.255 as shown below:
6. If configuring IPv6 addresses select **Internet Protocol Version (TCP/IPv6)**, click **Properties** and configure the IP address to be the same as the Virtual Service (VIP) and set the **Subnet Prefix Length** to be the same as your network setting, e.g. 2001:470:1f09:e72::15/64 as shown below:

7. Click **OK** on TCP/IP Properties, then click **Close** on Ethernet Properties to save and apply the new settings.

8. Now repeat the above process on the other Windows 2012/2016 IIS servers.

### Step 3: Configure the strong/weak host behavior

Windows Server 2000 and Windows Server 2003 use the weak host model for sending and receiving for all IPv4 interfaces and the strong host model for sending and receiving for all IPv6 interfaces. You cannot configure this behavior. The Next Generation TCP/IP stack in Windows 2008 and later supports strong host sends and receives for both IPv4 and IPv6 by default. To ensure that Windows 2012/2016 is running in the correct mode to be able to respond to the VIP, the following commands must be run on each IIS server:

For IPv4 addresses:

```bash
netsh interface ipv4 set interface "net" weakhostreceive=enabled
netsh interface ipv4 set interface "loopback" weakhostreceive=enabled
netsh interface ipv4 set interface "loopback" weakhostsend=enabled
```

For these commands to work, the LAN connection NIC must be named "net" and the loopback NIC must be named “loopback" as shown below. If you prefer to leave your current NIC names, then the commands above must be modified accordingly. For example, if your network adapters are named "LAN" and "LOOPBACK", the commands required would be:

```bash
netsh interface ipv4 set interface "LAN" weakhostreceive=enabled
netsh interface ipv4 set interface "LOOPBACK" weakhostreceive=enabled
netsh interface ipv4 set interface "LOOPBACK" weakhostsend=enabled
```
For IPv6 addresses:

```bash
netsh interface ipv6 set interface "net" weakhostreceive=enabled
netsh interface ipv6 set interface "loopback" weakhostreceive=enabled
netsh interface ipv6 set interface "loopback" weakhostsend=enabled
netsh interface ipv6 set interface "loopback" dadtransmits=0
```

For these commands to work, the LAN connection NIC must be named "net" and the loopback NIC must be named "loopback" as shown below. If you prefer to leave your current NIC names, then the commands above must be modified accordingly. For example, if your network adapters are named "LAN" and "LOOPBACK", the commands required would be:

```bash
netsh interface ipv6 set interface "LAN" weakhostreceive=enabled
netsh interface ipv6 set interface "LOOPBACK" weakhostreceive=enabled
netsh interface ipv6 set interface "LOOPBACK" weakhostsend=enabled
netsh interface ipv6 set interface "LOOPBACK" dadtransmits=0
```

**Note:**
The names for the NICs are case sensitive, so make sure that the name used for the interface and the name used in the commands match exactly.

1. Start PowerShell or use a command window to run the appropriate netsh commands as shown in the example below:

```bash
netsh interface ipv6 set interface "net" weakhostreceive=enabled
netsh interface ipv6 set interface "loopback" weakhostreceive=enabled
netsh interface ipv6 set interface "loopback" weakhostsend=enabled
netsh interface ipv6 set interface "loopback" dadtransmits=0
```

**Note:**
This shows an IPv6 example, use the IPv4 commands if you’re using IPv4 addresses.

2. Now repeat these 4 commands on the other Windows 2012 / 2016 IIS servers
Configuring IIS to Respond to both the RIP and VIP

For DR mode, it’s also important to make sure that IIS responds to both the VIP and RIP. By default, IIS listens on all configured IP addresses, this is shown in the example below (shows Windows 2008 example). As can be seen the IP address field is set to “All Unassigned”.

If the default configuration is left, no further IIS configuration is required. If you do change the IP address in the bindings from “All Unassigned” to a specific IP address, then you need to make sure that you also add a binding for the Virtual Service IP address (VIP).

Note:
Solving the ARP problem for other version of Windows is similar. For full details, please refer to the Administration Manual.
Appendix

2 – CLUSTERED PAIR CONFIGURATION – ADDING A SLAVE UNIT

If you initially configured just the master unit and now need to add a slave - our recommended procedure, please refer to the relevant section below for more details:

Note:
A number of settings are not replicated as part of the master/slave pairing process and therefore must be manually configured on the slave appliance. These are listed below:

• Hostname & DNS settings
• Network settings including IP addresses, bonding configuration and VLANs
• Routing configuration including default gateways and static routes
• Date & time settings
• Physical – Advanced Configuration settings including Internet Proxy IP address & port, Firewall table size, SMTP relay and Syslog server
• SNMP settings
• Graphing settings
• Firewall Script & Firewall Lockdown Script settings
• Software updates

Version 7:

Please refer to Chapter 8 – Appliance Clustering for HA in the v7 Administration Manual.

Version 8:

To add a slave node – i.e. create a highly available clustered pair:

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

CREATE A CLUSTERED PAIR

Local IP address
192.168.1.20

IP address of new peer
192.168.1.21

Password for loadbalancer user on peer
**********

Add new node
• Specify the IP address and the loadbalancer users password (the default is 'loadbalancer') for the slave (peer) appliance as shown above
• Click Add new node
• The pairing process now commences as shown below:

![Create a Clustered Pair](image)

- Once complete, the following will be displayed:

![High Availability Configuration - Master](image)

- 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 master appliance will also automatically restart heartbeat on the slave appliance.

**Note:**
Please refer to chapter 9 – Appliance Clustering for HA in the Administration Manual for more detailed information on configuring HA with 2 appliances.
## 3 - COMPANY CONTACT INFORMATION

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</table>
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