LOADBALANCER

DEPLOYMENT GUIDE

Load Balancing Insignia Medical Systems

Version 1.2.0

Table of Contents

1. About this Guide

This guide details the steps required to configure a load balanced Insignia Medical System environment utilizing Loadbalancer.org appliances. It includes details on load balancing DICOM & HL7.

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 Medical Imaging and Information Systems. For full specifications of available models please refer to https://www.loadbalancer.org/products.

Some features may not be available or fully supported in all cloud platforms due to platform specific limitations. For more details, please refer to the "Main Differences to our Standard (Non-Cloud) Product" section in the appropriate cloud platform Quick Start Guide or check with Loadbalancer.org support.

3. Software Versions Supported

3.1. Loadbalancer.org Appliance

- V8.9.1 and later

Note	The screenshots used throughout this document aim to track the latest Loadbalancer.org software version. If you're using an older version, or the very latest, the screenshots presented here may not match your WebUI exactly.

3.2. Medical Systems Supported

- Any systems that utilize medical system standards and protocols such as DICOM and HL7.

4. Medical Information System Standards & Protocols

4.1. DICOM

The Digital Imaging and Communications in Medicine (DICOM) Standard describes the means of formatting, storing and exchanging medical images and image related information to facilitate the connectivity of medical devices and systems. The DICOM Standard endorsed by the National Electrical Manufacturers Association (NEMA) is a result of joint efforts of users and manufacturers of medical imaging and health-care information technology.

Today, virtually all imaging devices (Modalities) that are used in radiology, such as CT, MRI, Ultrasound, RF, and other digital rooms, supports the DICOM standard for the exchange of images and related information.

4.2. HL7

Health Level Seven (HL7) is an American National Standards Institute accredited Standards Developing

Organization (SDO) operating in the health-care arena. Since its inception, HL7 has specified standards for a large number of application areas. HL7 standards cover generic application fields such as patient administration, patient care, order entry, results reporting, document and financial management. In addition to that, HL7 addresses the departmental information system communication needs of clinical specialties like laboratory medicine and diagnostic imaging. HL7 is the language used for communication between health-care IT systems.

5. Load Balancing Overview

5.1. Basic Concepts

To provide resilience and high availability, multiple Virtual Services (VIPs) are configured for the various protocols and systems. Clients and systems then connect to these VIPs rather than directly to the application servers. Each VIP can be configured in one of the following ways:

- **Load balanced mode**

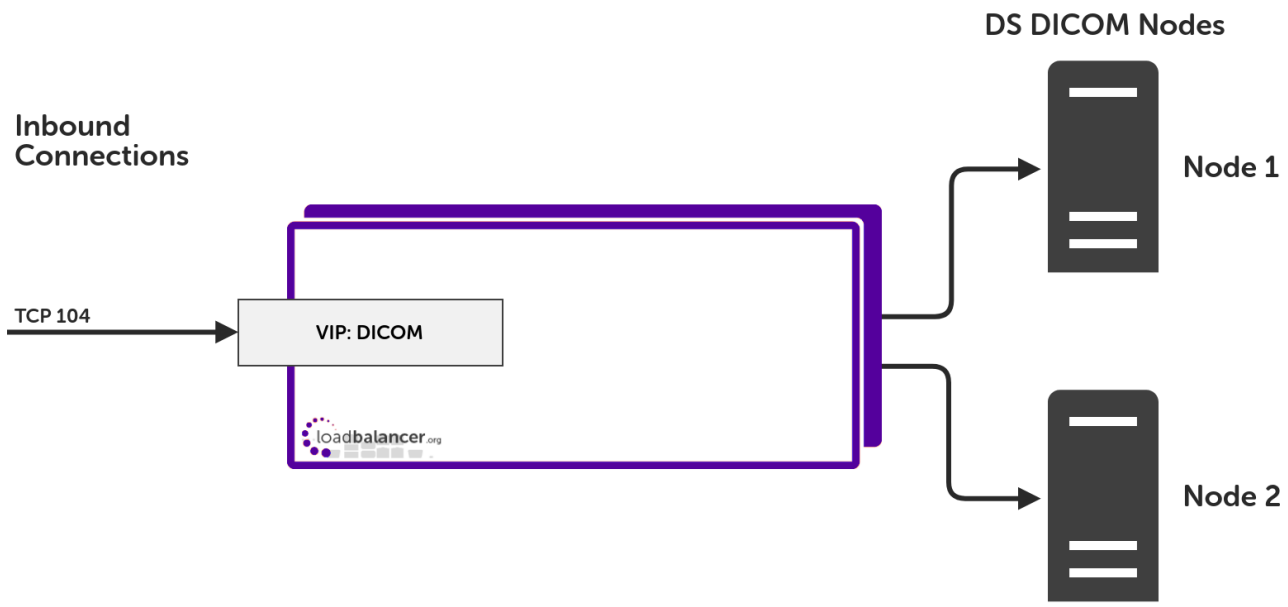
  Load is distributed across all configured servers/endpoints

- **Failover mode**

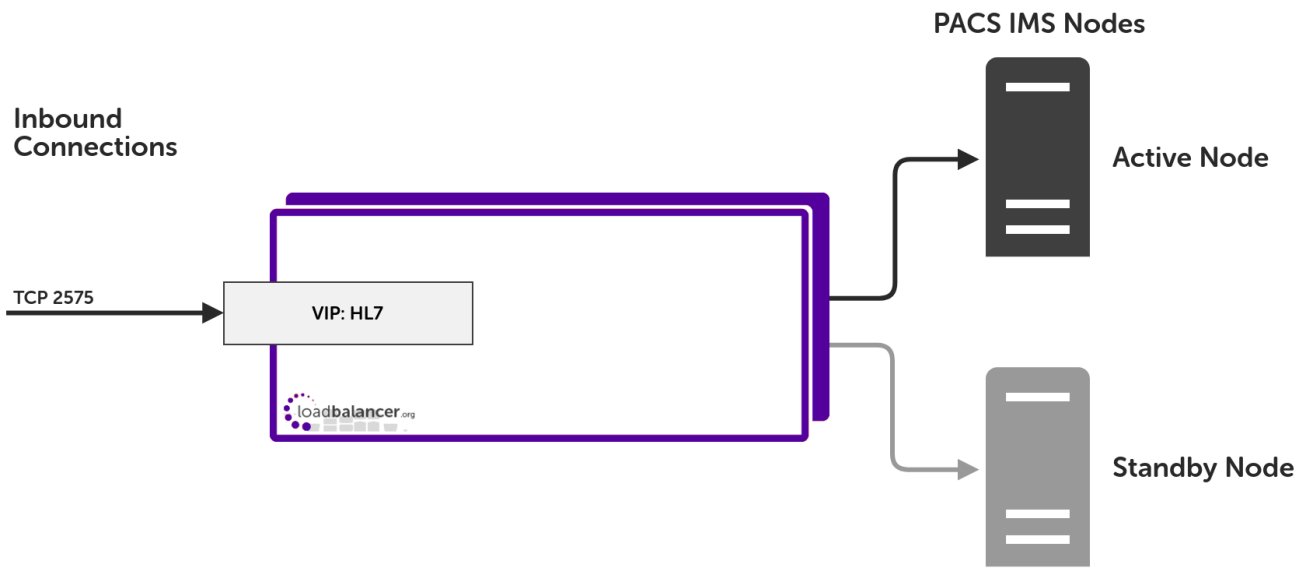
  The second server is used only when the first server/endpoint fails

Load Balancer Deployment

The following diagram shows a simplified view of Insignia Medical System in load balancing mode:



The following diagram shows a simplified view of Insignia Medical System in failover mode:



Notes

1. **VIP** (**V**irtual **IP**) – This is the IP address presented by the load balancer. Clients and other systems connect to this rather than directly to the back end servers/endpoints.
2. A single load balancer appliance can be used to load balance all services. More that one load balancer appliance may be required depending on throughput and physical network topology.

5.2. Load Balancing Deployment Modes

The load balancer supports the following deployment modes:

Layer 4 DR Mode – This mode offers the best performance and requires limited physical Real Server changes. The load balanced application must be able to bind to the Real Server's own IP address and the VIP at the same time. This mode requires the ***ARP Problem*** to be solved as described here. Layer 4 DR mode is transparent, i.e. the Real Servers will see the source IP address of the client.

Layer 4 NAT Mode – This mode is also a high performance solution but not as fast as DR mode. It requires the default gateway of each Real Server to be the load balancer and supports both one-arm and two-arm configurations. Layer 4 NAT mode is transparent, i.e. the Real Servers will see the source IP address of the client.

Layer 4 SNAT Mode – This mode is also a high performance solution but not as fast as the other layer 4 modes. It does not require any changes to the Real Servers and can be deployed in one-arm or two-arm mode. This mode is ideal for example when you want to load balance both TCP and UDP but you're unable to use DR mode or NAT mode due to network topology or Real Server related reasons. Layer 4 SNAT mode is non-transparent, i.e. the Real Servers will see the source IP address of the load balancer.

Layer 7 SNAT Mode – This mode offers greater flexibility but at lower performance levels. It supports HTTP cookie insertion, RDP cookies, Connection Broker integration and works very well with either Pound or STunnel when SSL termination is required. It also enables content switching and header manipulation rules to be implemented. It does not require any changes to the Real Servers and can be deployed in one-arm or two-arm mode. HAProxy is a high performance solution, but since it operates as a full proxy it cannot perform as fast as the layer 4 solutions. Layer 7 SNAT mode is non-transparent by default, i.e. the Real Servers will see the source IP address of the load balancer. This mode can be made transparent through the use of TProxy.

In this guide, Layer 4 DR mode is used for the DICOM VIP and Layer 7 SNAT mode is used for the HL7 VIP.

5.3. Load Balanced Ports & Services

The following tables shows the typical ports/services that are load balanced.

Port	Protocols	Use
104	TCP/DICOM	Exchange of images and related information
2575	TCP/HL7	Communication between health-care IT systems

5.4. Persistence (Server Affinity)

Source IP address persistence is used for all protocols. This ensures that a particular client will connect to the same load balanced server/endpoint for the duration of the session.

5.5. Server Health Checking

The default health-check used for new VIPs is a TCP port connect. This verifies that the port is open and accepting connections. However, it does not necessarily guarantee that the associated service is fully operational. Also, repeated ongoing connections to the service port may cause multiple log entries reporting incomplete connections or other issues.

In this guide a DICOM C-ECHO check is used for the DICOM VIP and a ping check is used for the HL7 VIP.

6. Loadbalancer.org Appliance – the Basics

6.1. 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 Virtual Appliance Installation and the ReadMe.txt text file included in the VA download for additional information on deploying the VA using the various Hypervisors.

> **Note** The VA has 4 network adapters. For VMware only the first adapter (**eth0**) is connected by default. For HyperV, KVM, XEN and Nutanix AHV all adapters are disconnected by default. Use the network configuration screen within the Hypervisor to connect the required adapters.

6.2. Initial Network Configuration

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

> **Important** Be sure to set a secure password for the load balancer, when prompted during the setup routine.

6.3. Accessing the Appliance WebUI

The WebUI is accessed using a web browser. By default, users are authenticated using Apache authentication. Users can also be authenticated against LDAP, LDAPS, Active Directory or Radius - for more information, please refer to External Authentication.

> **Note** There are certain differences when accessing the WebUI for the cloud appliances. For details, please refer to the relevant Quick Start / Configuration Guide.

1. Using a browser, navigate to the following URL:

   https://<IP-address-configured-during-the-network-setup-wizard>:9443/lbadmin/

   > **Note** You'll receive a warning about the WebUI's SSL certificate. This is due to the default self signed certificate that is used. If preferred, you can upload your own certificate - for more information, please refer to Appliance Security Features.

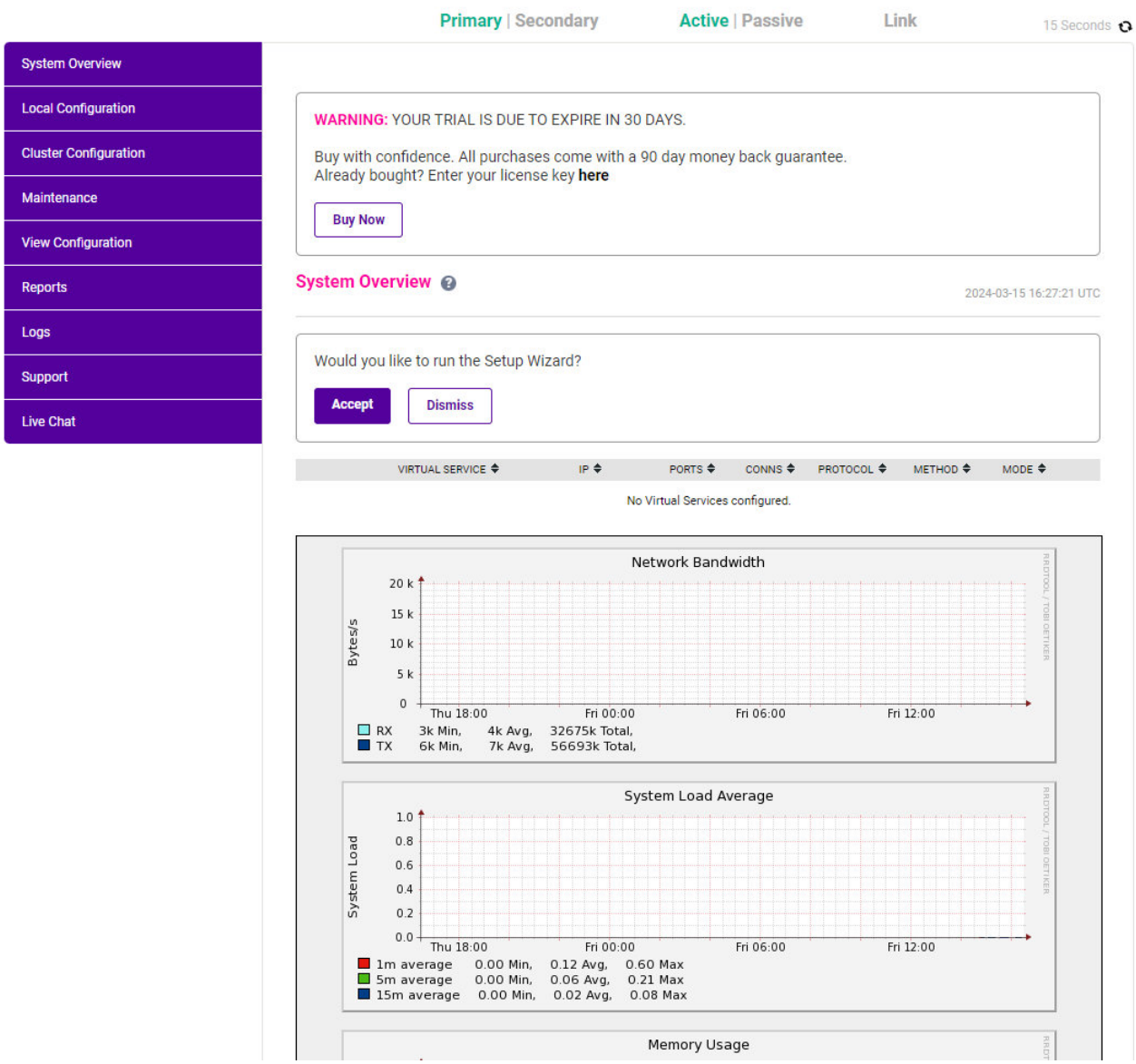
   > **Note** If you need to change the port, IP address or protocol that the WebUI listens on, please refer to Service Socket Addresses.

2. Log in to the WebUI using the following credentials:

   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 which can be used to configure layer 7 services. Click **Dismiss** if you're following a guide or want to configure the appliance manually or click **Accept** to start the wizard.

Main Menu Options

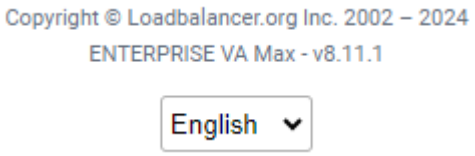
System Overview - Displays a graphical summary of all VIPs, RIPs and key appliance statistics
Local Configuration - Configure local host settings such as IP address, DNS, system time etc.
Cluster Configuration - Configure load balanced services such as VIPs & RIPs
Maintenance - Perform maintenance tasks such as service restarts and taking backups
View Configuration - Display the saved appliance configuration settings
Reports - View various appliance reports & graphs
Logs - View various appliance logs
Support - Create a support download, contact the support team & access useful links
Live Chat - Start a live chat session with one of our Support Engineers

6.4. Appliance Software Update

To ensure that the appliance(s) are running the latest software version, we recommend a software update check is performed.

Determining the Current Software Version

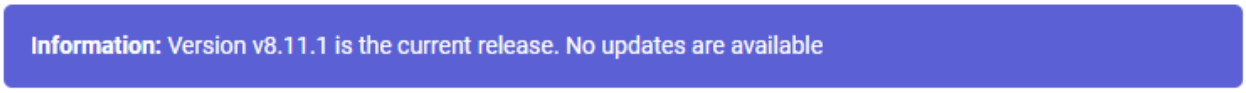
The software version is displayed at the bottom of the WebUI as shown in the example below:



Checking for Updates using Online Update

> **Note** By default, the appliance periodically contacts the Loadbalancer.org update server and checks for updates. An update check can also be manually triggered as detailed below.

1. Using the WebUI, navigate to: *Maintenance > Software Update*.
2. Select **Online Update**.
3. If the latest version is already installed, a message similar to the following will be displayed:



4. If an update is available, you'll be presented with a list of new features, improvements, bug fixes and security related updates.
5. Click **Online Update** to start the update process.

> **Note** Do not navigate away whilst the update is ongoing, this may cause the update to fail.

6. Once complete (the update can take several minutes depending on download speed and upgrade version) the following message will be displayed:

7. If services need to be reloaded/restarted or the appliance needs a full restart, you'll be prompted accordingly.

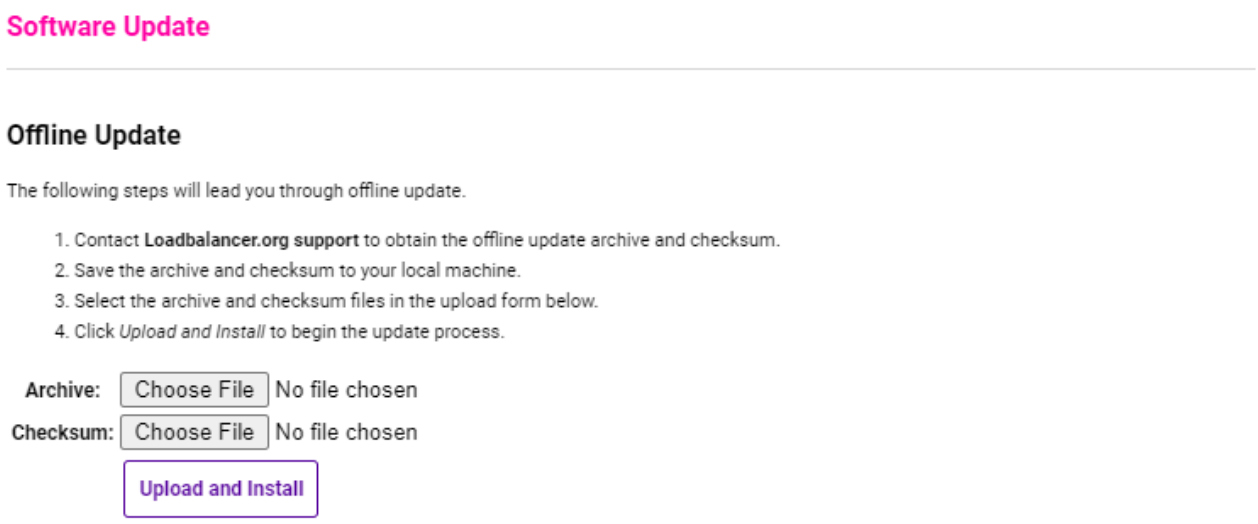
Using Offline Update

If the load balancer does not have access to the Internet, offline update can be used.

> **Note** Please contact support@loadbalancer.org to check if an update is available and obtain the latest offline update files.

To perform an offline update:

1. Using the WebUI, navigate to: *Maintenance > Software Update*.
2. Select **Offline Update**.
3. The following screen will be displayed:



4. Select the *Archive* and *Checksum* files.
5. Click **Upload and Install**.
6. If services need to be reloaded/restarted or the appliance needs a full restart, you'll be prompted accordingly.

6.5. Ports Used by the Appliance

By default, the appliance uses the following TCP & UDP ports:

Protocol	Port	Purpose
TCP	22 *	SSH
TCP & UDP	53 *	DNS / GSLB
TCP & UDP	123	NTP
TCP & UDP	161 *	SNMP
UDP	6694	Heartbeat between Primary & Secondary appliances in HA mode
TCP	7778	HAProxy persistence table replication
TCP	9000 *	Gateway service (Centralized/Portal Management)
TCP	9080 *	WebUI - HTTP (disabled by default)
TCP	9081 *	Nginx fallback page

Protocol	Port	Purpose
TCP	9443 *	WebUI - HTTPS
TCP	25565 *	Shuttle service (Centralized/Portal Management)

> **Note** The ports used for SSH, GSLB, SNMP, the WebUI, the fallback page, the gateway service and the shuttle service can be changed if required. For more information, please refer to Service Socket Addresses.

6.6. 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 unit is covered in Configuring HA - Adding a Secondary Appliance.

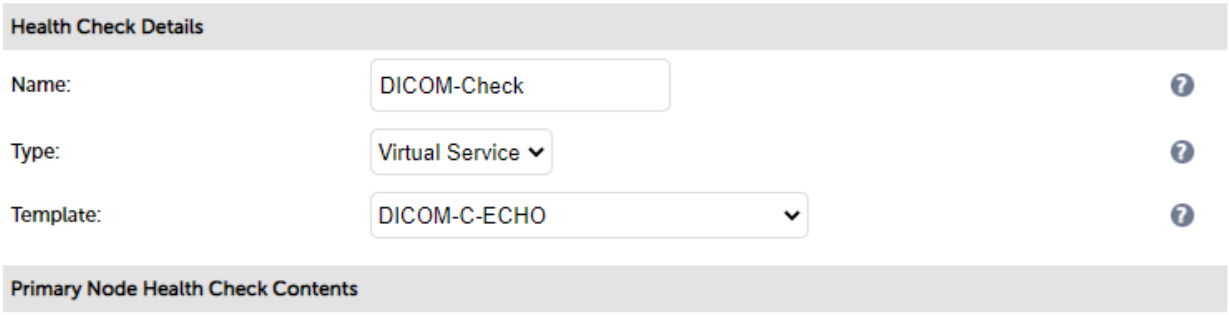
7. Appliance and Server Configuration

7.1. Load Balancing DICOM

(Using Layer 4 DR Mode)

Configuring the External Health Check Script

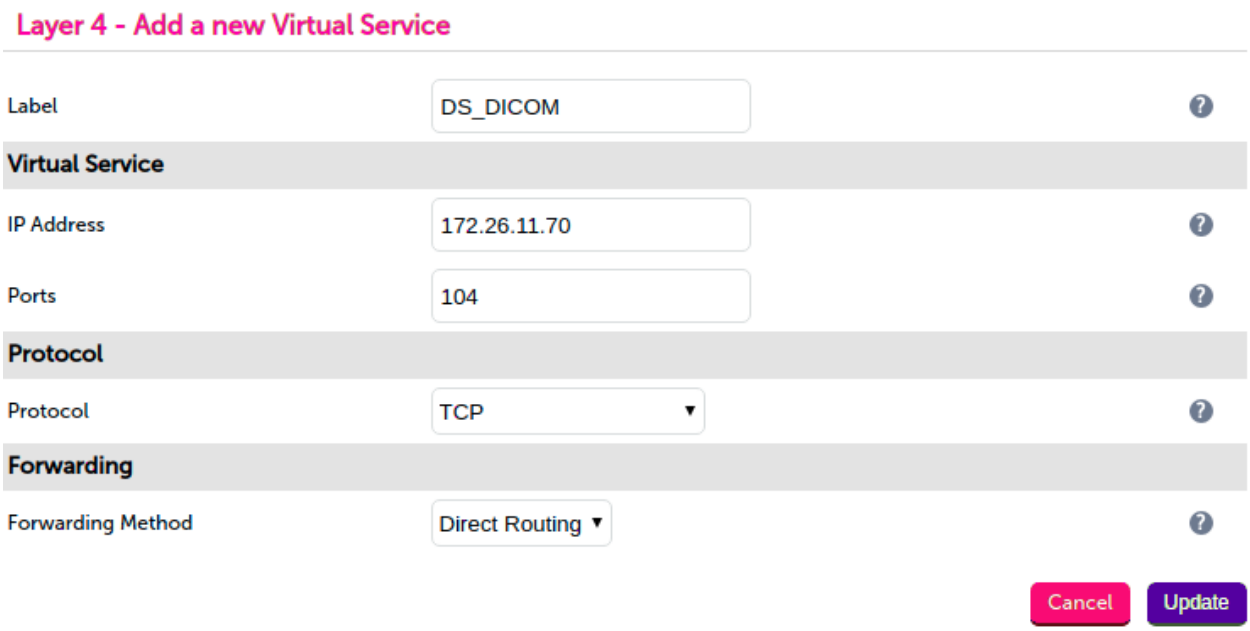
1. Using the WebUI, navigate to *Cluster Configuration > Health Check Scripts* and click **Add New Health Check**.



2. Specify an appropriate *Name* for the health check, e.g. **DICOM-Check**.
3. Set *Type* to **Virtual Service**.
4. Set *Template* to **DICOM-C-ECHO**.
5. Click **Update**.

Setting up the Virtual Service (VIP)

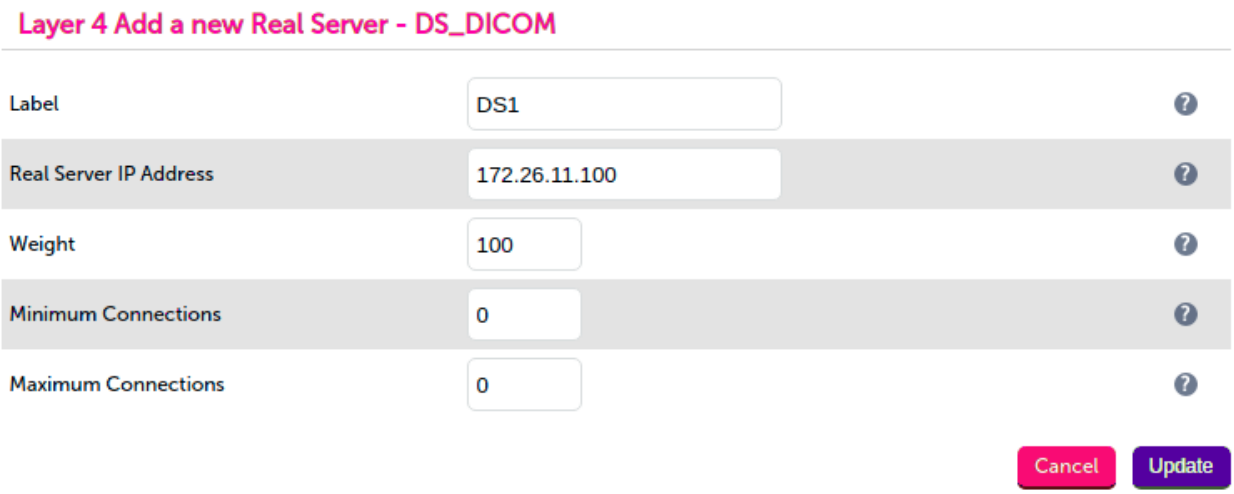
1. Using the WebUI, navigate to: *Cluster Configuration > Layer 4 – Virtual Services* and click **Add a New Virtual Service**.
2. Enter the following details:



3. Enter an appropriate name (Label) for the Virtual Service, e.g. **DS_DICOM**.
4. Set the *Virtual Service IP address* field to the required IP address, e.g. **172.26.11.70**.
5. Set the *Virtual Service Ports* field to the required port(s), e.g. **104**.
6. Set *Protocol* to **TCP**.
7. Set *Forwarding Method* to **Direct Routing**.
8. Click **Update**.
9. Now click **Modify** next to the newly created Virtual Service.
10. Scroll to the *Persistence* section.
    a. Ensure the *Persistent Timeout* is set to **300** , i.e. 5 minutes.
11. Scroll to the *Health Checks* section.
    a. Set *Check Type* to **External Script**.
    b. Set *External Script* to **DICOM-Check**.
12. Click **Update**.

Setting up 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 VIP.
2. Enter the following details:



3. Enter an appropriate name (Label) for the first DICOM server, e.g. **DS1**.
4. Change the *Real Server IP Address* field to the required IP address, e.g. **172.26.11.100**.
5. Click **Update**.
6. Repeat these steps to add additional server(s).

Configuring the load balanced DICOM servers

As mentioned in Load Balancing Deployment Modes, when using Layer 4 DR mode, the ARP problem must be solved. This involves configuring each load balanced server to be able to receive traffic destined for the VIP and ensuring that each Server does not respond to ARP requests for the VIP address – only the load balancer should do this.

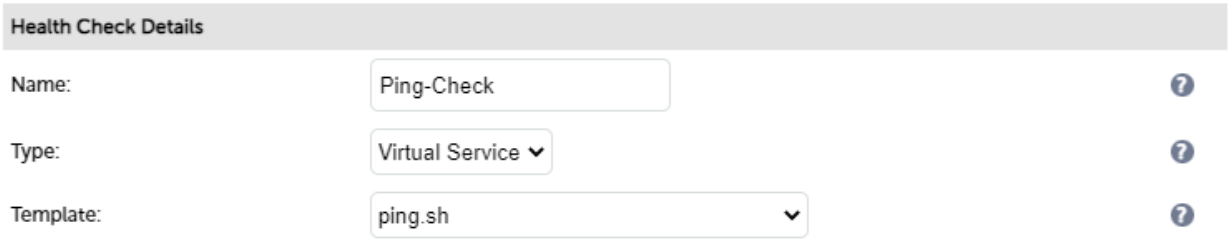
For detailed steps on solving the ARP problem for Linux, Windows and various other operating systems, please refer to DR Mode Considerations.

7.2. Load Balancing HL7

(Using Layer 7 SNAT Mode)

Configuring the External Health Check Script

1. Using the WebUI, navigate to *Cluster Configuration > Health Check Scripts* and click **Add New Health Check**.

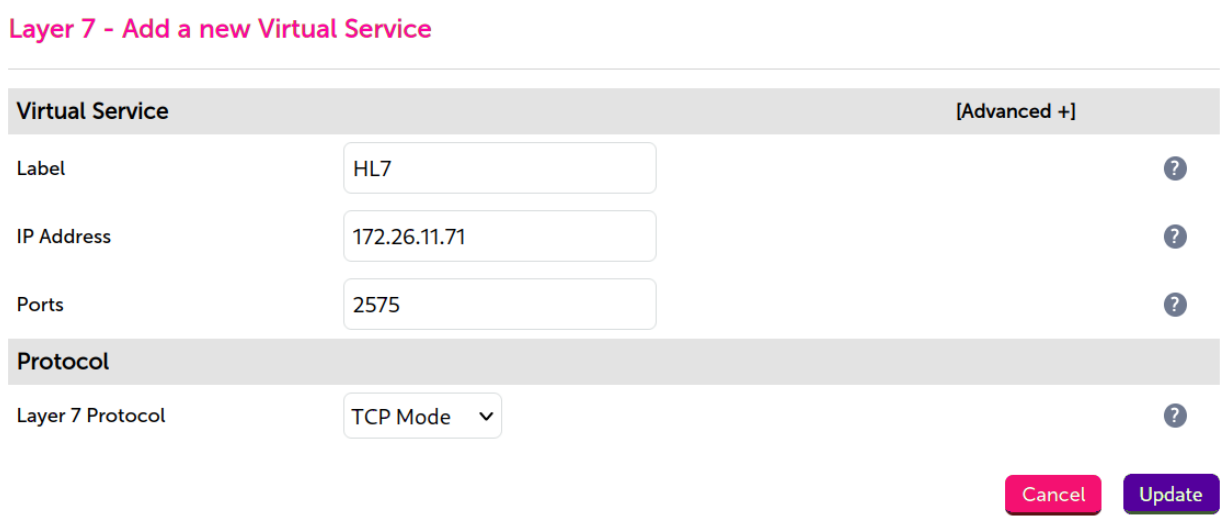


2. Specify an appropriate *Name* for the health check, e.g. **Ping-Check**.
3. Set *Type* to **Virtual Service**.

4. Set *Template* to **ping.sh**.
5. Click **Update**.

Setting up the Virtual Service (VIP)

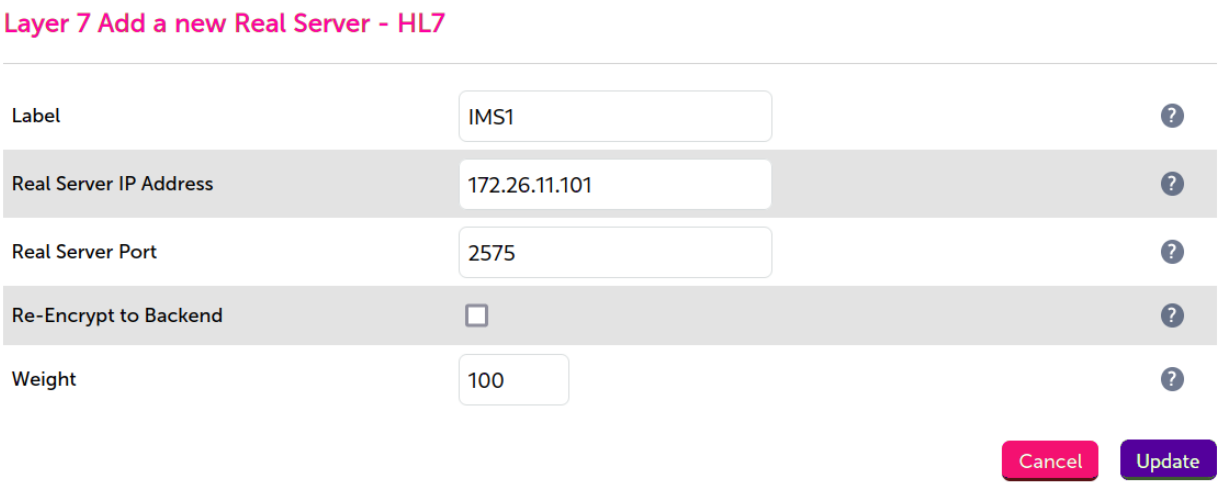
1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Virtual Services* and click **Add a New Virtual Service**.
2. Enter the following details:



3. Enter an appropriate name (Label) for the Virtual Service, e.g. **HL7**.
4. Set the *Virtual Service IP address* field to the required IP address, e.g. **172.26.11.71**.
5. Set the *Virtual Service Ports* field to the required port, e.g. **2575**.
6. Set the *Layer 7 Protocol* to **TCP Mode**.
7. Click **Update**.
8. Now click **Modify** next to the newly created Virtual Service.
9. Scroll to the *Persistence* section.
    a. Set *Persistence Mode* to **None**.
10. Scroll to the *Health Checks* section.
    a. Set the *Health Checks* to **External Script**.
    b. Set the *Check Script* to **Ping-Check**.
11. Scroll to the *Fallback Server* section.
    a. Set the *Fallback Server IP address* field to that of the *Standby node* e.g. **172.26.11.103**.
    b. Set the *Port* field to **2575**.
12. Click **Update**.

Setting up the Real Servers (RIPs)

1. Using the WebUI, navigate to: *Cluster Configuration > Layer 7 – Real Servers* and click **Add a new Real Server** next to the **HL7** Virtual Service.
2. Enter the following details:



3. Enter an appropriate name (Label) for the first HL7 server, e.g. **IMS1**.
4. Change the *Real Server IP Address* field to the required IP address, e.g. **172.26.11.101**.
5. Set the *Real Server Port* field to **2575**.
6. Click **Update**.
7. Repeat these steps to add additional server(s).

Restart HAProxy

1. To apply the new settings, restart HAProxy using the WebUI option *Maintenance > Restart Services* and clicking **Restart HAProxy**.

> **Note** If you will be configuring additional layer 7 services, you can restart HAProxy at the end once all layer 7 Virtual Services and Real Servers have been defined.

8. Testing & Verification

> **Note** For additional guidance on diagnosing and resolving any issues you may have, please also refer to Diagnostics & Troubleshooting.

8.1. Using the System Overview

Verify that all VIPs & associated RIPs are reported as up (green) as shown below:

System Overview

2020-01-14 14:39:18 UTC

VIRTUAL SERVICE	IP	PORTS	CONNS	PROTOCOL	METHOD	MODE
DS_DICOM	172.26.11.70	104	0	TCP	Layer 4	DR
REAL SERVER	IP	PORTS	WEIGHT	CONNS		
DS1	172.26.11.100	104	100	0	Drain	Halt
DS2	172.26.11.103	104	100	0	Drain	Halt
HL7	172.26.11.71	2575	0	TCP	Layer 7	Proxy
REAL SERVER	IP	PORTS	WEIGHT	CONNS		
IMS1	172.26.11.101	2575	100	0	Drain	Halt

If certain servers are down, i.e. failing their health check, they will be highlighted red as shown below:

HL7	172.26.11.71	2575	0	TCP	Layer 7	Proxy
REAL SERVER	IP	PORTS	WEIGHT	CONNS		
IMS1	172.26.11.101	2575	100	0	Drain	Halt

8.2. System Logs & Reports

Various system logs & reports can be used to help diagnose problems and help solve appliance issues. Logs can be accessed using the WebUI options: *Logs & Reports*.

9. 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.

10. Further Documentation

For additional information, please refer to the Administration Manual.

11. Appendix

11.1. 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 is fully configured first, then the Secondary appliance can be added to create an HA pair. Once the HA pair is configured, load balanced services must be configured and modified on the Primary appliance. The Secondary appliance will be automatically kept in sync.

> **Note** For Enterprise Azure, the HA pair should be configured first. For more information, please refer to the Azure Quick Start/Configuration Guide available in the documentation library

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.

Non-Replicated Settings

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:

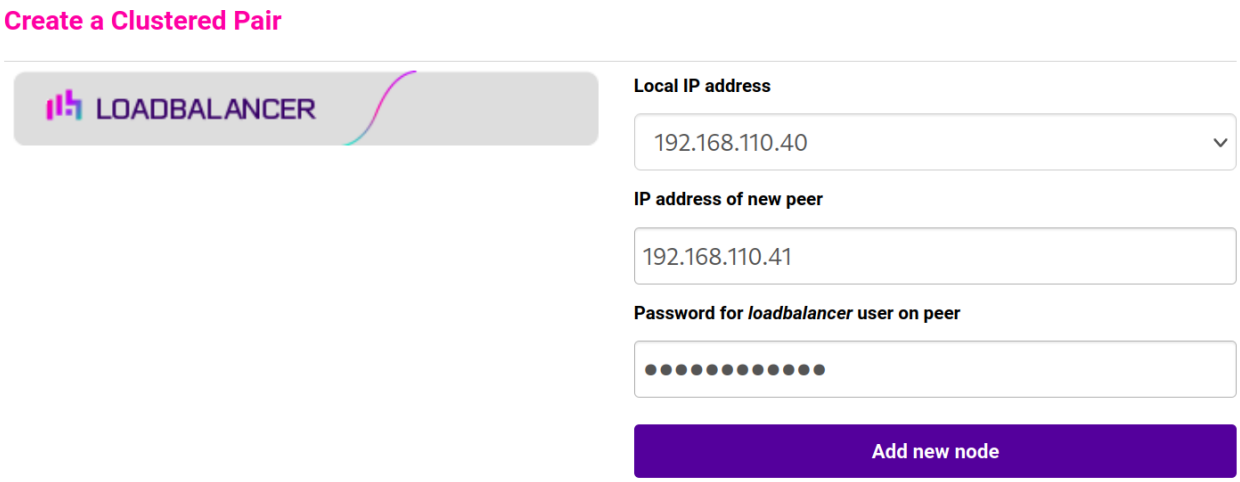
WebUI Main Menu Option	Sub Menu Option	Description
Local Configuration	Hostname & DNS	Hostname and DNS settings
Local Configuration	Network Interface Configuration	Interface IP addresses, bonding configuration and VLANs
Local Configuration	Routing	Default gateways and static routes
Local Configuration	System Date & time	Time and date related settings
Local Configuration	Physical – Advanced Configuration	Various appliance settings
Local Configuration	Portal Management	Portal management settings
Local Configuration	Security	Security settings
Local Configuration	SNMP Configuration	SNMP settings
Local Configuration	Graphing	Graphing settings
Local Configuration	License Key	Appliance licensing
Maintenance	Backup & Restore	Local XML backups
Maintenance	Software Updates	Appliance software updates
Maintenance	Fallback Page	Fallback page configuration
Maintenance	Firewall Script	Firewall (iptables) configuration
Maintenance	Firewall Lockdown Wizard	Appliance management lockdown settings

Important	Make sure that where any of the above have been configured on the Primary appliance, they're also configured on the Secondary.

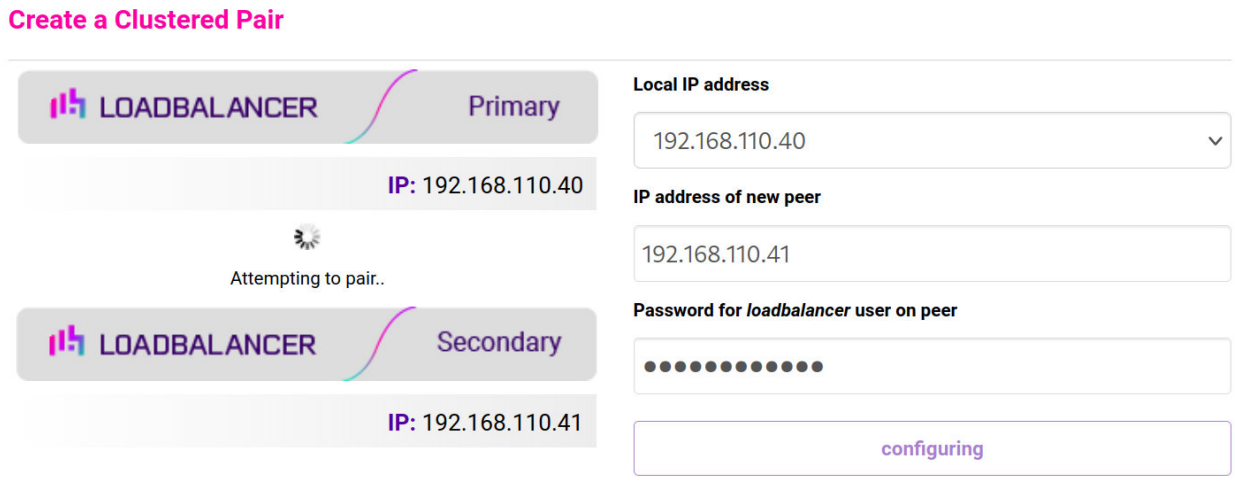
Configuring the HA Clustered Pair

Note	If you have already run the firewall lockdown wizard on either appliance, you'll need to ensure that it is temporarily disabled on both appliances whilst performing the pairing process.

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

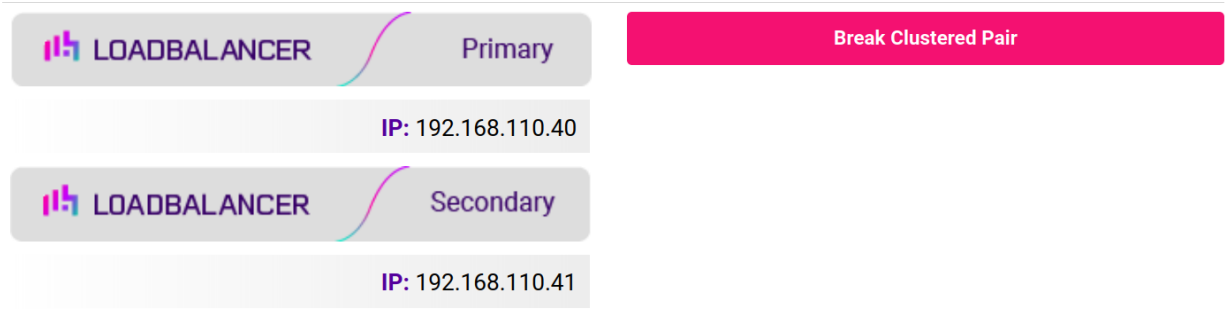


3. Specify the IP address and the *loadbalancer* user's password for the Secondary (peer) appliance as shown in the example above.
4. Click **Add new node**.
5. The pairing process now commences as shown below:



6. Once complete, the following will be displayed on the Primary appliance:

High Availability Configuration - primary



7. To finalize the configuration, restart heartbeat and any other services as prompted in the "Commit changes" 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.

> **Note** For details on testing and verifying HA, please refer to Clustered Pair Diagnostics.

12. Document Revision History

Version	Date	Change	Reason for Change	Changed By
1.0.0	14 January 2020	Initial document creation		IBG
1.0.1	1 September 2020	New title page Updated Canadian contact details	Branding update Change to Canadian contact details	AH
1.1.0	1 December 2021	Converted the document to AsciiDoc	Move to new documentation system	AH, RJC, ZAC
1.1.1	12 May 2022	Updated external health check related content to reflect latest software version	New software release	RJC
1.1.2	28 September 2022	Updated layer 7 VIP and RIP creation screenshots	Reflect changes in the web user interface	AH
1.1.3	5 January 2023	Combined software version information into one section Added one level of section numbering Added software update instructions Added table of ports used by the appliance Reworded 'Further Documentation' section	Housekeeping across all documentation	AH
1.1.4	2 February 2023	Updated screenshots	Branding update	AH
1.1.5	7 March 2023	Removed conclusion section	Updates across all documentation	AH
1.2.0	24 March 2023	New document theme Modified diagram colours	Branding update	AH

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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.