



# Load Balancing OKI DICOM-Embedded Printers

v1.1.1

*Deployment Guide*

**NOTE:** This guide has been archived and is no longer being maintained. While the content is still valid for the particular software versions mentioned, it may refer to outdated software that has now reached end-of-life. For more information please contact [support@loadbalancer.org](mailto:support@loadbalancer.org).



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## 1. About this Guide

This guide details the steps required to configure a load balanced OKI DICOM-embedded printer environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any OKI DICOM-embedded printer 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 for load balancing OKI DICOM-embedded printers. The complete list of models is shown below:

Discontinued Models	Current Models *
Enterprise R16	Enterprise R20
Enterprise VA R16	Enterprise MAX
Enterprise VA	Enterprise 10G
Enterprise R320	Enterprise 40G
	Enterprise Ultra
	Enterprise VA R20
	Enterprise VA MAX
	Enterprise AWS **
	Enterprise AZURE **
	Enterprise GCP **

\* 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. OKI DICOM-Embedded Printer Software Versions Supported

- OKI DICOM-Embedded Printer – version 4.01 and later

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## 5. OKI DICOM-Embedded Printer

OKI's range of DICOM-embedded printers allow for medical images to be printed directly from medical equipment. Printing directly from DICOM modalities eliminates the need to use conversion software or costly external hardware as part of the medical printing workflow. OKI's printers can also be used for day-to-day printing tasks.

Having a highly available print service allows printing to continue even when some printers are out of service, for example for maintenance. The load balancer will select a printer that is still online and ready to accept jobs and will send traffic there. Having a load balanced printing service also helps in a high volume printing environment, where multiple printers can share the printing load and increase the total pages per minute printing capacity. Overall, having a highly available print service improves the experience for physicians, medical professionals, and patients.

Loadbalancer.org appliances also support load balancing print servers, offering additional flexibility and possibilities for load balancing a full printing environment.

## 6. Load Balancing OKI DICOM-Embedded Printers

Note: It's highly recommended that you have a working OKI DICOM-embedded printer environment first before implementing the load balancer.

### Persistence (aka Server Affinity)

OKI DICOM-embedded printers do not require session affinity at the load balancing layer.

### Port Requirements

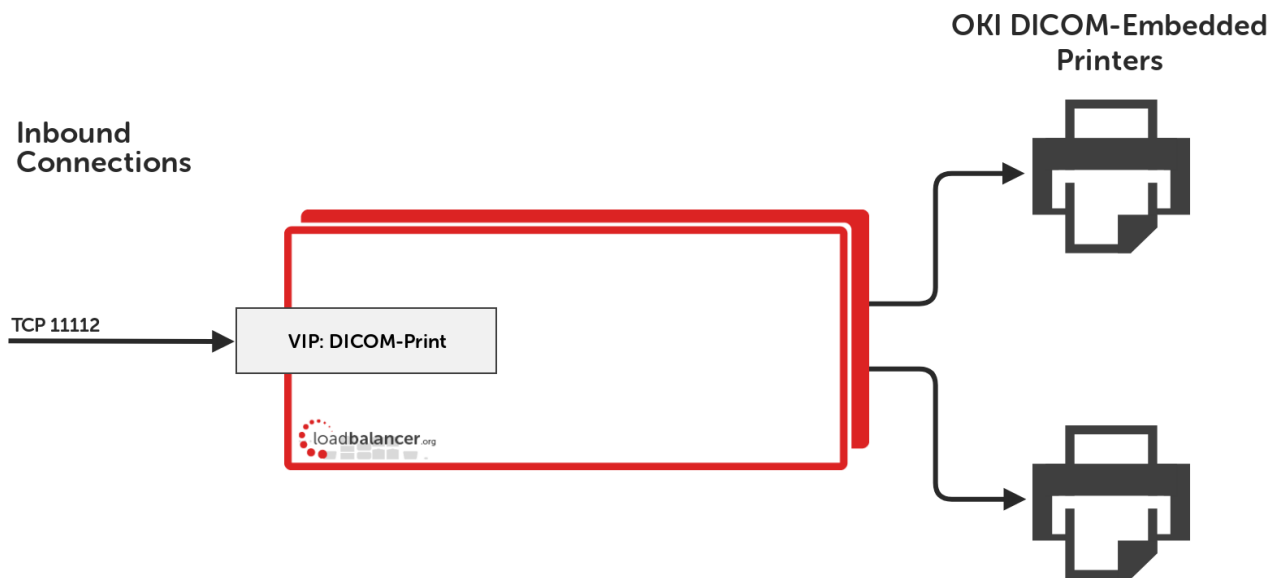
One port needs to be load balanced:

Port	Protocols	Use
11112	TCP/DICOM	DICOM print service

### Health Checks

It is recommended to use the DICOM specific health check when load balancing DICOM printers. This can be found on the load balancer by setting *Health Checks* to **External script** and then setting *Check Script* to the **DICOM-C-ECHO** health check.

## 7. Deployment Concept



VIPs = Virtual IP Addresses

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 1 in the appendix on page [17](#) for more details on configuring a clustered pair.

### Virtual Service (VIP) Requirements

One virtual service is needed in this deployment, which load balances the DICOM printer traffic.

## 8. Load Balancer Deployment Methods

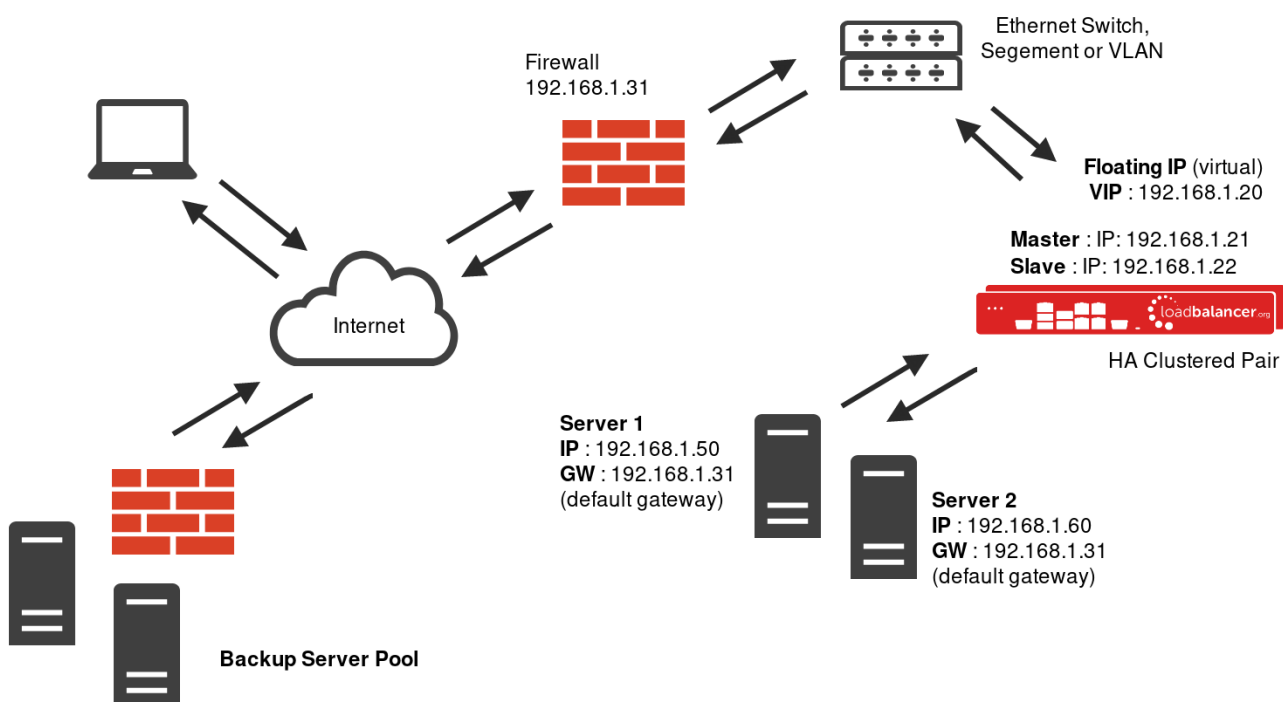
The load balancer can be deployed in 4 fundamental ways: *Layer 4 DR mode*, *Layer 4 NAT mode*, *Layer 4 SNAT mode*, and *Layer 7 SNAT mode*.

For OKI DICOM-embedded printers, using layer 7 SNAT mode is recommended. It is also possible to use layer 4 SNAT mode.

These modes are described below and are used for the configurations presented in this guide. For configuring using layer 7 SNAT mode please refer to the section starting on page [12](#), and for configuring using layer 4 SNAT mode please refer to the section starting on page [13](#).

### 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 Real 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 Real 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.

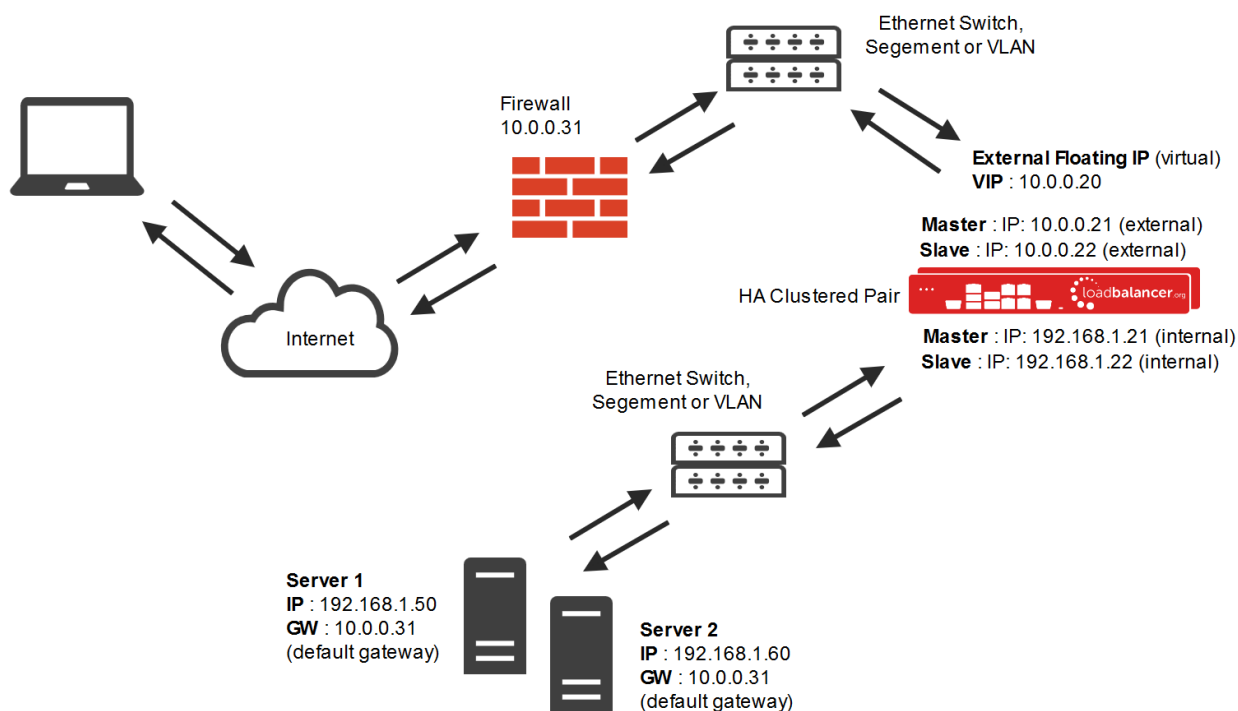
- SNAT mode is a full proxy and therefore load balanced Real Servers do not need to be changed in any way
- Because SNAT mode is a full proxy any server in the cluster can be on any accessible subnet including across the Internet or WAN
- SNAT mode is not transparent by default, i.e. the Real Servers will not see the source IP address of the client,

they will see the load balancers 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 clients IP address can be passed through either by enabling TProxy on the load balancer, or for HTTP, using X-forwarded-For headers. Please refer to chapter 6 in the [administration manual](#) for more details

- SNAT mode can be deployed using either a 1-arm or 2-arm configuration
- You should not use the same RIP:PORT combination for layer 7 SNAT mode VIPs and layer 4 SNAT mode VIPs because the required firewall rules conflict.

## Layer 4 SNAT Mode

Layer 4 SNAT mode is a high performance solution, although not as fast as the other layer 4 modes.



- The load balancer translates all requests from the external Virtual Service to the internal Real Servers in the same way as NAT mode (please refer to the previous page for details).
- Layer 4 SNAT mode is not transparent, an iptables SNAT rule translates the source IP address to be the load balancer rather than the original client IP address.
- Layer 4 SNAT mode can be deployed using either a one-arm or two-arm configuration.
- For two-arm deployments, eth0 is normally used for the internal network and eth1 is used for the external network although this is not mandatory. If the Real Servers require Internet access, Autonat should be enabled using the WebUI option: *Cluster Configuration > Layer 4 – Advanced Configuration*, the external interface should be selected.
- Port translation is not possible in layer 4 SNAT mode i.e. having a different RIP port than the VIP port.

- 
- You should not use the same RIP:PORT combination for layer 7 SNAT mode VIPs and layer 4 SNAT mode VIPs because the required firewall rules conflict.

## Our Recommendation

Where possible, we recommend that layer 7 SNAT mode is used. This mode is simple to implement, and requires no changes to be made to any network architecture or servers. Ultimately, the final choice does depend on your specific requirements and infrastructure.

Layer 4 SNAT mode can also be used as an alternative to layer 7 SNAT mode.



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## 9. 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: **https://192.168.2.21:9443**

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*

### Accessing the Web User Interface (WebUI)

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:

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**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:

- System Overview
- Local Configuration
- Cluster Configuration
- Maintenance
- View Configuration
- Reports
- Logs
- Support

**SYSTEM OVERVIEW**

2015-06-18 14:21:20 UTC

Would you like to run the Setup Wizard?

Accept

Dismiss

VIRTUAL SERVICE

IP

PORTS

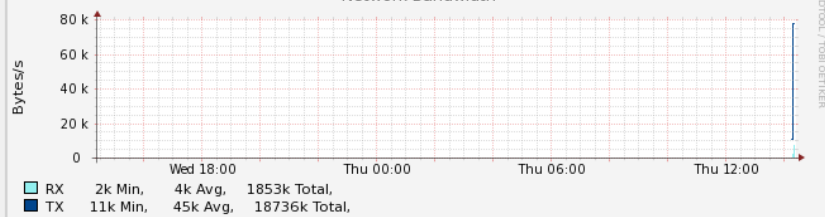
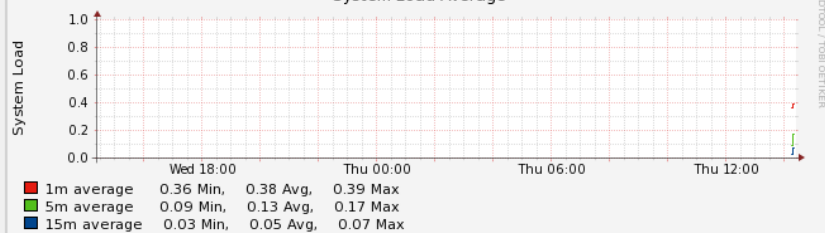
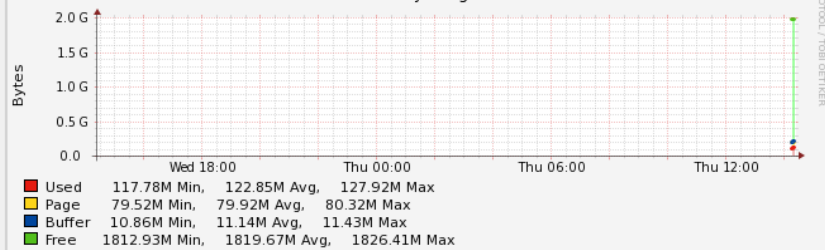
CONN

PROTOCOL

METHOD

MODE

No Virtual Services configured.

**Network Bandwidth**

**System Load Average**

**Memory Usage**


(shows v8.2.x)

## 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 1 of the appendix on page [17](#).

## 10. Appliance Configuration for OKI DICOM-Embedded Printers – Using Layer 7 SNAT Mode

Note: You should not use the same RIP:PORT combination for layer 7 SNAT mode VIPs and layer 4 SNAT mode VIPs because the required firewall rules conflict. In the context of load balancing OKI DICOM-embedded printers, one load balancing method should be chosen and stuck to. Mixing layer 7 and layer 4 SNAT modes is not advisable.

### Configuring the Virtual Service (VIP)

1. Using the web user interface, navigate to *Cluster Configuration > Layer 7 – Virtual Services* and click on **Add a new Virtual Service**
2. Define the *Label* for the virtual service as required, e.g. **DICOM-Print**
3. Set the *Virtual Service IP Address* field to the required IP address, e.g. **192.168.85.190**
4. Set the *Ports* field to **11112**
5. Set the *Layer 7 Protocol* to **TCP Mode**
6. Click **Update** to create the virtual service

The screenshot shows a web form titled "LAYER 7 - ADD A NEW VIRTUAL SERVICE". The form contains the following fields and controls:

- Label:** A text input field containing "DICOM-Print".
- Virtual Service:** A section containing two sub-fields:
  - IP Address:** A text input field containing "192.168.85.190".
  - Ports:** A text input field containing "11112".
- Layer 7 Protocol:** A dropdown menu currently set to "TCP Mode".
- Manual Configuration:** A checkbox that is currently unchecked.

At the bottom right of the form, there are two buttons: a red "Cancel" button and a green "Update" button. Each input field has a small blue question mark icon to its right.

7. Click **Modfiy** next to the newly created VIP
8. Set *Persistence Mode* to **None**
9. From the *Health Checks* drop-down list select **External script**
10. From the *Check Script* drop-down list that appears, select **DICOM-C-ECHO**
11. Click **Update** to apply the changes

### Defining The Real Servers (RIPs)

1. Using the web user interface, navigate to *Cluster Configuration > Layer 7 – Real Servers* and click on **Add a new Real Server** next to the newly created VIP
2. Define the *Label* for the real server as required, e.g. **OKI-DICOM-Printer-1**

3. Set the *Real Server IP Address* field to the required IP address, e.g. **192.168.85.200**
4. Set the *Real Server Port* to **11112**
5. Click **Update**
6. Repeat these steps to add additional real servers as required

### LAYER 7 ADD A NEW REAL SERVER - DICOM-PRINT

Label	OKI-DICOM-Printer-1	?
Real Server IP Address	192.168.85.200	?
Real Server Port	11112	?
Re-Encrypt to Backend	<input type="checkbox"/>	?
Weight	100	?

Cancel
Update

## Finalizing the Configuration

To apply the new settings, HAProxy must be reloaded as follows:

1. Using the WebUI, navigate to: *Maintenance > Restart Services* and click **Reload HAProxy**

## 11. Appliance Configuration for OKI DICOM-Embedded Printers – Using Layer 4 SNAT Mode

Note: You should not use the same RIP:PORT combination for layer 4 SNAT mode VIPs and layer 7 SNAT mode VIPs because the required firewall rules conflict. In the context of load balancing OKI DICOM-embedded printers, one load balancing method should be chosen and stuck to. Mixing layer 4 and layer 7 SNAT modes is not advisable.

## Configuring the Virtual Service (VIP)

1. Using the web user interface, navigate to *Cluster Configuration > Layer 4 – Virtual Services* and click on **Add a new Virtual Service**
2. Define the *Label* for the virtual service as required, e.g. **DICOM-Print**
3. Set the *Virtual Service IP Address* field to the required IP address, e.g. **192.168.85.170**
4. Set the *Ports* field to **11112**
5. Set the *Protocol* set to **TCP**
6. Set the *Forwarding Method* set to **SNAT**

- Click **Update** to create the virtual service

**LAYER 4 - ADD A NEW VIRTUAL SERVICE**

Label	<input type="text" value="DICOM-Print"/>		?
Virtual Service	IP Address	<input type="text" value="192.168.85.170"/>	?
	Ports	<input type="text" value="11112"/>	?
Protocol	<input type="text" value="TCP"/>		?
Forwarding Method	<input type="text" value="SNAT"/>		?

- Click **Modfiy** next to the newly created VIP
- Make sure that the *Persistent* checkbox is not checked
- From the *Health Checks Check Type* drop-down list select **External script**
- From the *External script* drop-down list that appears, select **DICOM-C-ECHO**
- Click **Update** to apply the changes

## Defining the Real Servers (RIPs)

- Using the web user interface, navigate to *Cluster Configuration > Layer 4 – Real Servers* and click on **Add a new Real Server** next to the newly created VIP
- Define the *Label* for the real server as required, e.g. **OKI-DICOM-Printer-1**
- Set the *Real Server IP Address* field to the required IP address, e.g. **192.168.85.200**
- Set the *Real Server Port* to **11112**
- Click **Update**
- Repeat these steps to add additional real servers as required

LAYER 4 ADD A NEW REAL SERVER - DICOM-PRINT

Label	<input type="text" value="OKI-DICOM-Printer-1"/>	?
Real Server IP Address	<input type="text" value="192.168.85.200"/>	?
Real Server Port	<input type="text" value="11112"/>	?
Weight	<input type="text" value="100"/>	?
Minimum Connections	<input type="text" value="0"/>	?
Maximum Connections	<input type="text" value="0"/>	?

Cancel

Update

## 12. Testing & Verification

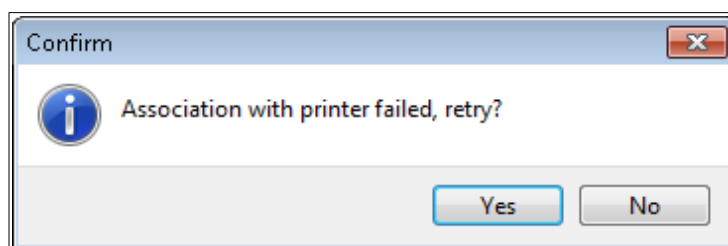
### Running a Test Print

An easy way to test if a load balanced OKI DICOM-embedded printer service is working is to send a test print to the VIP address.

If the test print works as intended then the virtual service is working correctly.

### Test Print Failure

If the test print fails, the following error message may be displayed:











### Troubleshooting

1. Confirm that the load balancer can route to the real servers, i.e. the printers. An easy way to check this is to confirm that the real servers are showing as 'green' and online on the *System Overview* page. If the servers are showing as 'red' then the load balancer cannot communicate with them, which may indicate a networking issue
2. If the real servers are showing as online, the next thing to check is that the same RIP:PORT combination is not being used for a layer 7 SNAT mode VIP and a layer 4 SNAT mode VIP. The required firewall rules conflict in such a scenario

## Using System Overview

The System Overview can be viewed in the WebUI. It shows a graphical view of all VIPs & RIPs (i.e. the OKI DICOM-embedded printers) and shows the state/health of each server as well as the state of the cluster as a whole. The example below shows that all three OKI DICOM-embedded printers are healthy and available to accept connections.

SYSTEM OVERVIEW ?							
2018-10-09 15:12:09 UTC							
VIRTUAL SERVICE	IP	PORTS	CONNS	PROTOCOL	METHOD	MODE	
 <b>DICOM-Print</b>	<b>192.168.85.190</b>	<b>11112</b>	<b>0</b>	<b>TCP</b>	<b>Layer 7</b>	<b>Proxy</b>	
REAL SERVER	IP	PORTS	WEIGHT	CONNS			
 OKI-DICOM-Printer-..	192.168.85.200	11112	100	0	Drain	Halt	
 OKI-DICOM-Printer-..	192.168.85.201	11112	100	0	Drain	Halt	
 OKI-DICOM-Printer-..	192.168.85.202	11112	100	0	Drain	Halt	

## 13. Technical Support

For more details about configuring the appliance and assistance with designing your deployment please don't hesitate to contact the support team using the following email address: [support@loadbalancer.org](mailto:support@loadbalancer.org)

## 14. Further Documentation

The Administration Manual contains much more information about configuring and deploying the appliance. It's available here: <http://pdfs.loadbalancer.org/loadbalanceradministrationv8.pdf>

## 15. Conclusion

Loadbalancer.org appliances provide a very cost effective solution for highly available load balanced OKI DICOM-embedded printer environments.



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## 16. Appendix

### 1 – 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*



loadbalancer.org

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

M

192.168.1.20

loadbalancer.org

Attempting to pair..

S

192.168.1.21

loadbalancer.org

Local IP address

192.168.1.20

IP address of new peer

192.168.1.21

Password for *loadbalancer* user on peer

.....

configuring

- Once complete, the following will be displayed:

**HIGH AVAILABILITY CONFIGURATION - MASTER**

Node	IP Address	Host
M	192.168.1.20	loadbalancer.org
S	192.168.1.21	loadbalancer.org

**Break Clustered Pair**

- 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.

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## 17. Document Revision History

Version	Date	Change	Reason for Change	Changed By
1.0.0	10 October 2018	Initial version		AH
1.0.1	6 December 2018	Added the new "Company Contact Information" page	Required updates	AH
1.1.0	9 December 2019	Styling and layout	General styling updates	AH
1.1.1	18 May 2020	New title page Updated Canadian contact details	Branding update Change to Canadian contact details	AH

## 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.



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