Load Balancing IBM Watson Health iConnect Enterprise Archive & MergePACS

Version 1.2.0
# Table of Contents

1. About this Guide ................................................................. 3
2. Loadbalancer.org Appliances Supported ........................................... 3
3. Loadbalancer.org Software Versions Supported ................................. 3
4. IBM Watson Health iConnect Enterprise Archive & MergePACS Software Versions Supported ............... 3
5. Load Balancing iConnect Enterprise Archive & MergePACS ................................. 3
   Port Requirements .......................................................... 3
   Deployment Concept ......................................................... 4
   Virtual Service (VIP) Requirements ...................................... 5
   Deployment Mode ............................................................ 6
6. Loadbalancer.org Appliance – the Basics .......................................... 6
   Virtual Appliance .......................................................... 6
   Initial Network Configuration ............................................. 6
   Accessing the WebUI ....................................................... 7
      Main Menu Options ...................................................... 8
      HA Clustered Pair Configuration ..................................... 9
7. Appliance, iConnect Enterprise Archive & MergePACS Configuration ......................... 9
   Appliance Configuration ................................................... 9
      Network Configuration .................................................... 9
      Floating IP Configuration (For The iConnect Enterprise Archive’s Default Gateway) .................. 9
      Configuring VIP1 – All VNA Services ................................ 10
      Configuring VIP2 – All PACS Services .............................. 12
   iConnect Enterprise Archive Server Configuration .......................... 14
   MergePACS Server Configuration ....................................... 14
8. Testing & Verification ......................................................... 19
   Automatic Failover .......................................................... 19
   Manual Failover ............................................................ 19
   Client Connection Tests .................................................... 20
9. Technical Support .............................................................. 20
10. Additional Documentation ..................................................... 20
11. Conclusion ........................................................................... 20
12. Appendix ............................................................................. 21
    Configuring HA - Adding a Secondary Appliance ......................... 21
13. Document Revision History ..................................................... 24
1. About this Guide

This guide details the steps required to configure a highly available IBM Watson Health iConnect Enterprise Archive & MergePACS environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any iConnect Enterprise Archive & MergePACS configuration changes that are required.

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 for load balancing IBM Watson Health iConnect Enterprise Archive & MergePACS. For full specifications of available models please refer to https://www.loadbalancer.org/products. Some features may not be supported in all cloud platforms due to platform specific limitations, please check with Loadbalancer.org support for further details.

3. Loadbalancer.org Software Versions Supported

• v8.3.8 and later

4. IBM Watson Health iConnect Enterprise Archive & MergePACS Software Versions Supported

• IBM Watson Health iConnect Enterprise Archive – all versions
• IBM Watson Health MergePACS – all versions

5. Load Balancing iConnect Enterprise Archive & MergePACS

For high availability, IBM Watson Health recommend that a load balancer is used to enable rapid failover to the secondary iConnect Enterprise Cluster / MergePACS Cluster should the Primary Cluster become unavailable.

Port Requirements

The following table shows the ports used by iConnect Enterprise Archive. The load balancer must be configured to listen on the same ports.

<table>
<thead>
<tr>
<th>Port</th>
<th>Protocols</th>
<th>System</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>12000</td>
<td>TCP</td>
<td>VNA</td>
<td>DICOM</td>
</tr>
<tr>
<td>12100</td>
<td>TCP</td>
<td>VNA</td>
<td>DICOM Proxy</td>
</tr>
<tr>
<td>12200</td>
<td>TCP</td>
<td>VNA</td>
<td>DICOM Work List</td>
</tr>
<tr>
<td>12300 &amp; 12301</td>
<td>TCP</td>
<td>VNA</td>
<td>VNA Admin</td>
</tr>
<tr>
<td>12950</td>
<td>TCP</td>
<td>VNA</td>
<td>VNA Stream</td>
</tr>
<tr>
<td>12800</td>
<td>TCP</td>
<td>VNA</td>
<td>VNA HL7</td>
</tr>
<tr>
<td>104</td>
<td>TCP</td>
<td>PACS</td>
<td>DICOM</td>
</tr>
<tr>
<td>80,8080,443,8443</td>
<td>TCP</td>
<td>PACS</td>
<td>HTTP &amp; HTTPS</td>
</tr>
<tr>
<td>5222</td>
<td>TCP</td>
<td>PACS</td>
<td>Instant Messenger</td>
</tr>
<tr>
<td>Port</td>
<td>Protocols</td>
<td>System</td>
<td>Use</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>--------</td>
<td>--------------</td>
</tr>
<tr>
<td>1001</td>
<td>TCP</td>
<td>PACS</td>
<td>PACS HL7</td>
</tr>
</tbody>
</table>

**Deployment Concept**

**Connect Enterprise Archive**

When iConnect Enterprise Archive is deployed with the load balancer, clients connect to the Virtual Service (VIP) on the load balancer rather than connecting directly to one of the iConnect Enterprise Archive Clusters. Under normal conditions, these connections are then forwarded to the Primary Cluster.

![Inbound Connections Diagram](image1)

**MergePACS**

When MergePACS is deployed with the load balancer, clients connect to the Virtual Service (VIP) on the load balancer rather than connecting directly to one of the MergePACS Clusters. Under normal conditions, these connections are then forwarded to the Primary Cluster.

![Inbound Connections Diagram](image2)

**Note**  
VIP1 (VNA) and VIP2 (PACS) are configured on a single clustered par of load balancers.
The load balancer can be deployed as a single unit, although Loadbalancer.org recommends a clustered pair for resilience & high availability. Please refer to Configuring HA - Adding a Secondary Appliance for more details on configuring a clustered pair.

Should the Primary Cluster become unavailable, failover to the Secondary Cluster can be handled in either of the following ways:

- **Automatically** – In this case, health checks are configured at 30 second intervals. Should there be 10 consecutive health check failures, failover to the Secondary Cluster occurs.

- **Manually** – In this case, failover to the Secondary Cluster must be triggered manually using the ‘Halt’ feature in the load balancer’s WebUI. Please refer to Manual Failover for more details.

The way the Virtual Service’s health check is configured determines which of these failover methods is used.

### Virtual Service (VIP) Requirements

To provide load balancing and HA for iConnect Enterprise Archive & MergePACS, 2 VIPs are required as depicted in the diagrams above, 1 multiport VIP for iConnect Enterprise Archive and 1 multiport VIP for MergePACS:

**iConnect Enterprise Archive**

A single multi-port VIP is used that listens on all required ports. The VIP is configured as follows:

- Deployment mode: Layer 4 NAT (Network Address Translation) mode
- Listens on a total of 7 ports as described on the table and diagram in Port Requirements
- The health-check configuration depends on whether automatic or manual failover is required:
  - for automatic failover an external script is used, the script checks that all 7 ports are available and runs every 30 seconds, if connection to one or more of the ports fails, the health check is deemed to have failed, if there are 10 consecutive health check failures, cluster failover occurs
  - for manual failover the health check is set to: No checks, always On
- The associated Real Server is configured to be the cluster IP address of the Primary Cluster
- The fallback server is configured to be the cluster IP address of the Secondary Cluster

**MergePACS**

A single multi-port VIP is used that listens on all required ports. The VIP is configured as follows:

- Deployment mode: Layer 4 DR (Direct Return) mode
- Listens on a total of 7 ports as described on the table and diagram in Port Requirements
- The health-check configuration depends on whether automatic or manual failover is required:
  - for automatic failover an external script is used, the script checks that all 7 ports are available and runs every 30 seconds, if connection to one or more of the ports fails, the health check is deemed to have failed, if there are 10 consecutive health check failures, cluster failover occurs
for manual failover the health check is set to: **No checks, always On**  
- The associated Real Server is configured to be the cluster IP address of the Primary Cluster  
- The fallback server is configured to be the cluster IP address of the Secondary Cluster

**Deployment Mode**  
iConnect Enterprise Archive

As mentioned above, the VIP for iConnect Enterprise Archive is configured using Layer 4 NAT mode. With this mode, return traffic must pass via the load balancer. To achieve this, the default gateway of each cluster must be set to be the load balancer. For a clustered pair (our recommended configuration), an additional floating IP address must be used for this purpose. This allows the same IP address to be brought up on the Secondary appliance should an appliance failover occur.

**MergePACS**

As mentioned above, the VIP for MergePACS is configured using Layer 4 DR (Direct Return) mode. This mode offers the best possible performance since replies go directly from the MergePACS Cluster to the client, and not via the load balancer. To use this mode, the "ARP Problem" must be solved on each MergePACS server as explained in [iConnect Enterprise Archive Server Configuration](#).

### 6. Loadbalancer.org Appliance – the Basics

**Virtual Appliance**

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

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

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

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

**Initial Network Configuration**

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

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

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

**Note**

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

**Note**

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

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


2. Log in to the WebUI:

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

   **Note**

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

Once logged in, the WebUI will be displayed as shown below:
The WebUI for the VA is shown, the hardware and cloud appliances are very similar. The yellow licensing related message is platform & model dependent.

3. You'll be asked if you want to run the Setup Wizard. If you click Accept the Layer 7 Virtual Service configuration wizard will start. If you want to configure the appliance manually, simple click Dismiss.

**Main Menu Options**

**System Overview** - Displays a graphical summary of all VIPs, 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
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 unit is covered in Configuring HA - Adding a Secondary Appliance.

7. Appliance, iConnect Enterprise Archive & MergePACS Configuration

Appliance Configuration

Network Configuration

When using Layer 4 NAT mode (for load balancing iConnect Enterprise Archive), two Interfaces are required, this can be achieved by using two network adapters, or by creating VLAN’s on a single adapter. The following configuration uses 2 separate network adapters, one for each subnet.

To Configure network settings using eth0 & eth1:

1. Using the WebUI, navigate to: Local Configuration > Network Interface Configuration.

2. Enter an IP address/mask in the subnet where the iConnect Enterprise Archive’s are located, e.g. 192.168.100.1/24.

3. Enter an IP address/mask in the subnet where the VIP & clients are located, e.g. 192.168.200.1/24.

4. Click Configure Interfaces.

Note  There are no restrictions on which interface is used for each requirement.

Floating IP Configuration (For The iConnect Enterprise Archive’s Default Gateway)

As mentioned in Deployment Mode, when using Layer 4 NAT mode and a clustered pair of load balancers, a floating IP address must be configured on the load balancer for use as the iConnect Enterprise Archive Server’s default gateway.
1. Using the WebUI, navigate to: *Cluster Configuration > Floating IP’s.*

   ![Add Floating IP](image)

2. Enter the IP address you’d like to use as the default gateway. e.g. **192.168.100.254**.
3. Click **Add Floating IP**.

**Configuring VIP1 – All VNA Services**

*a) 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:

   - **Label**: VNA
   - **Virtual Service IP**: 192.168.200.100
   - **Virtual Service_ports**: 12000,12100,12200,12300,12301,12950,12800
   - **Protocol**: TCP
   - **Forwarding Method**: NAT

3. Leave **Protocol** set to **TCP**.
4. Set the **Virtual Service IP** address field to the required IP address, e.g. **192.168.200.100**.
5. Set the **Virtual Service Ports** field to **12000,12100,12200,12300,12301,12950,12800**.
6. Leave **Protocol** set to **TCP**.
7. Set the **Forwarding Method** to **NAT**.
8. Click **Update**.
9. Now click **Modify** next to the newly created VIP.
10. Configure health check settings:

   For *automatic* failover:

   * Create the following file: `/var/lib/loadbalancer.org/check/IBM-WHI-iConnect-Enterprise-Archive`.
Set file permissions to 755.

Edit the file and copy / paste the following script:

```bash
#!/bin/bash
##########################################################
# # IBM Watson Health Imaging - iConnect Enterprise Archive #
# # (c) Loadbalancer.org 2019 #
# # 2019-07-31 - Initial write - Aaron West <support@loadbalancer.org> #
# # ##########################################################################
## Variables
# Space separated port list to check using a TCP half open check (SYN Scan)
HALF_OPEN_RPT="12800"
# Space separated port list to check using a full 3 way handshake (Connect to port)
FULL_3WAY_RPT="12000 12100 12200 12300 12301 12950"
# $3 represents the real server address as passed by the load balancer
RIP="$\{3}\"
# Timeout for checking each port
TIMEOUT="3"
### Shouldn't need to edit below here
PATH=/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin
for i in $\{HALF_OPEN_RPT\}; do
    timeout $\{TIMEOUT\} nmap -sS -p $i $\{RIP\} 2>&1 | grep -q 'open'
    ec=$?
    if [ $ec -ne "0" ]; then
        exit $ec
    fi
done
for i in $\{FULL_3WAY_RPT\}; do
    nc -w $\{TIMEOUT\} -zvn $\{RIP\} $i &>/dev/null
    ec=$?
    if [ $ec -ne "0" ]; then
        exit $ec
    fi
done
```

Save the file.

In the Health Checks section set the Check Type to External Script.

Set the External Script drop-down to IBM-WHI-iConnect-Enterprise-Archive (the script just created).

Click Update.

For manual failover:

Set the Check Type to No checks, Always On.

Click Update.

11. Set the Fallback Server IP Address field to the IP address of the Secondary iConnect Enterprise Archive Cluster.

12. Set the Fallback Server Port field to 0 (numerical zero), this ensures that the fallback server (i.e. the Secondary Cluster) can receive connections on all required ports.

13. Enable (check) the MASQ Fallback checkbox.

14. Click Update.

b) Setting up the Real Server (RIP)
1. Using the WebUI, navigate to: *Cluster Configuration > Layer 4 – Real Servers* and click **Add a new Real Server** next to the newly created VNA VIP.

2. Enter the following details:

   ![Real Server Configuration](image1)

   - **Label**: PrimaryCluster
   - **Real Server IP Address**: 192.168.100.110
   - **Weight**: 100
   - **Minimum Connections**: 0
   - **Maximum Connections**: 0

   ![Real Server Details](image2)

3. Enter an appropriate label (name) for the RIP, e.g. **PrimaryCluster**.

4. Set the **Real Server IP Address** field to the IP address of the Primary iConnect Enterprise Archive Cluster.

5. Leave the **Real Server Port** field blank.

6. Click Update.

**Configuring VIP2 – All PACS Services**

**a) 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:

   ![Virtual Service Configuration](image3)

   - **Label**: PACS
   - **IP Address**: 192.168.100.100
   - **Ports**: 104.80.8080.4443.8443.6222
   - **Protocol**: TCP
   - **Forwarding Method**: Direct Routing

   ![Virtual Service Details](image4)

3. Enter an appropriate label (name) for the VIP, e.g. **PACS**.
4. Set the Virtual Service IP address field to the required IP address, e.g. 192.168.100.100.

5. Set the Virtual Service Ports field to 104,80,8080,443,8443,5222,1001.

6. Leave Protocol set to TCP.

7. Leave Forwarding Method set to Direct Routing.

8. Click Update.

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

10. Configure health check settings:

For **automatic** failover:

- Create the following file: /var/lib/loadbalancer.org/check/IBM-WHI-MergePACS.
- Set file permissions to 755.
- Edit the file and copy / paste the following script:

```bash
#!/bin/bash

# IBM Watson Health Imaging - Merge PACS healthcheck
#
# (c) Loadbalancer.org 2019
#
# 2019-07-31 - Initial write - Aaron West <support@loadbalancer.org>
#
### Variables
# Space separated port list to check using a TCP half open check (SYN Scan)
HALF_OPEN_RPT="1000"
# Space separated port list to check using a full 3 way handshake (Connect to port)
FULL_3WAY_RPT="104 80 8080 443 8443 5222"
# $3 represents the real server address as passed by the load balancer
RIP="$\{3\}"
# Timeout for checking each port
TIMEOUT="3"
### Shouldn't need to edit below here
PATH=/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin
for i in $\{HALF_OPEN_RPT\}; do
    timeout $\{TIMEOUT\} nmap -sS -p $\{i\} $\{RIP\} 2>&1 | grep -q 'open'
    ec=$?
    if [ $ec -ne "0" ]; then
        exit $ec
    fi
done
for i in $\{FULL_3WAY_RPT\}; do
    nc -w $\{TIMEOUT\} -zvn $\{RIP\} $i &>/dev/null
    ec=$?
    if [ $ec -ne "0" ]; then
        exit $ec
    fi
done
```

- Save the file.
- In the Health Checks section set the Check Type to External Script.
- Set the External Script drop-down to IBM-WHI-MergePACS (the script just created).
- Click Update.

For **manual** failover:
• Set the **Check Type** to **No checks, Always On**.

• Click **Update**.

11. Set the **Fallback Server IP Address** field to the IP address of the Secondary MergePACS Cluster.

12. Set the **Fallback Server Port** field to **0** (numerical zero) - this ensures that the fallback server (i.e. the Secondary Cluster) can receive connections on all required ports.

13. Enable (check) the **MASQ Fallback** checkbox.

14. Click **Update**.

b) 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 PACS VIP.

2. Enter the following details:

   - **Label**: Enter an appropriate label (name) for the RIP, e.g. **PrimaryCluster**.
   - **Real Server IP Address**: Set to the IP address of the Primary MergePACS Cluster.
   - **Weight**: Set to **100**.
   - **Minimum Connections**: Set to **0**.
   - **Maximum Connections**: Set to **0**.

3. Enter an appropriate label (name) for the RIP, e.g. **PrimaryCluster**.

4. Set the **Real Server IP Address** field to the IP address of the Primary MergePACS Cluster.

5. Click **Update**.

**iConnect Enterprise Archive Server Configuration**

As mentioned in **Deployment Mode**, when using Layer 4 NAT mode and a clustered pair of load balancers, a floating IP address must be configured for use as the default gateway. Set the default gateway of each iConnect Enterprise Archive to be this IP address.

**MergePACS Server Configuration**

As mentioned in **Deployment Mode**, when using Layer 4 DR mode, the ARP problem must be solved. This involves configuring each MergePACS 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.

**Note**

The steps below are for IPv4 addresses on Windows 2012 & later. For other versions of Windows & IPv6 configuration steps, please refer to **DR Mode Considerations**.
Note: The following steps must be performed on all MergePACS Servers.

Windows Server 2012, 2016 & 2019
The basic concept is the same as for Windows 2000/2003. However, additional steps are required to set the strong/weak host behavior. This is used to either block or allow interfaces receiving packets destined for a different interface on the same server. As with Windows 2000/2003/2008, if the Real Server is included in multiple VIPs, you can add additional IP addresses to the Loopback Adapter that correspond to each VIP.

Step 1 of 3: 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.

![Add Hardware](image)

6. Click Next to start the installation, when complete click Finish.

Step 2 of 3: 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.

**Note**
For Windows 2012/2016/2019, it’s not necessary to modify the interface metric on the advanced tab and should be left set to Automatic.

**Step 3 of 3: Configure the strong/weak host behavior**

To configure the correct strong/weak host behavior for Windows 2012/2016/2019, the following commands must be run on each Real Server:

For IPv4 addresses:

```
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:

```
netsh interface ipv4 set interface "LAN" weakhostreceive=enabled
netsh interface ipv4 set interface "LOOBACK" weakhostreceive=enabled
netsh interface ipv4 set interface "LOOBACK" weakhostsend=enabled
```

For IPv6 addresses:
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:

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.

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

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

Repeat steps 1 - 3 on all remaining Windows 2012/2016/2019 Real Server(s).

For Windows 2012/2016/2019 you can also use the following PowerShell Cmdlets:

The following example configures both IPv4 and IPv6 at the same time:

Set-NetIpInterface -InterfaceAlias loopback -WeakHostReceive enabled -WeakHostSend enabled -DadTransmits 0
Set-NetIpInterface -InterfaceAlias net -WeakHostReceive enabled

To configure just IPv4:

Set-NetIpInterface -InterfaceAlias loopback -WeakHostReceive enabled -WeakHostSend enabled -DadTransmits 0 -AddressFamily IPv4

Set-NetIpInterface -InterfaceAlias net -WeakHostReceive enabled -AddressFamily IPv4

To configure just IPv6:

Set-NetIpInterface -InterfaceAlias loopback -WeakHostReceive enabled -WeakHostSend enabled -DadTransmits 0 -AddressFamily IPv6

Set-NetIpInterface -InterfaceAlias net -WeakHostReceive enabled -AddressFamily IPv6

8. Testing & Verification

Note For additional general guidance please also refer to Testing Load Balanced Services.

Under normal circumstances the Primary Cluster handles all connections. Failover to the Secondary Cluster is handled automatically or manually depending on how the VIP is configured (see Deployment Mode).

Automatic Failover
Automatic failover occurs after 5 minutes. To trigger a failover, the Primary Cluster must be continuously unavailable for this time.

Manual Failover
To trigger a failover to the Secondary Cluster, the ‘Halt’ option in the System Overview is used:

(Screen shots for the VNA VIP are shown, the same concept applies to the PACS VIP)

<table>
<thead>
<tr>
<th>REAL SERVER</th>
<th>IP</th>
<th>PORTS</th>
<th>WEIGHT</th>
<th>CONNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PrimaryCluster</td>
<td>192.168.100.110</td>
<td>5.12000.12</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Once Halted, the VIP & RIP will be shown colored blue, connections will then be forwarded to the fallback server, i.e the Secondary Cluster:
To return to the Primary Cluster, the 'Online' option is used:

Client Connection Tests
Ensure that clients can connect via the load balancer to the iConnect Enterprise Archive Cluster / MergePACS cluster. You’ll probably need to create new DNS records or modify your existing DNS records, replacing the IP addresses of individual servers or the cluster with the IP address of the Virtual Service on the load balancer.

9. 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.

10. Additional Documentation

11. Conclusion
Loadbalancer.org appliances provide a very cost effective solution for highly available load balanced IBM Watson Health iConnect Enterprise Archive & MergePACS environments.
12. Appendix

Configuring HA - Adding a Secondary Appliance

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

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

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

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

Note
A number of settings are not replicated as part of the Primary/Secondary pairing process and therefore must be manually configured on the Secondary appliance. These are listed by WebUI menu option in the table below:

<table>
<thead>
<tr>
<th>WebUI Main Menu Option</th>
<th>Sub Menu Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Configuration</td>
<td>Hostname &amp; DNS</td>
<td>Hostname and DNS settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Network Interface Configuration</td>
<td>All network settings including IP address(es), bonding configuration and VLANs</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Routing</td>
<td>Routing configuration including default gateways and static routes</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>System Date &amp; time</td>
<td>All time and date related settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Physical – Advanced Configuration</td>
<td>Various settings including Internet Proxy, Management Gateway, Firewall connection tracking table size, NIC offloading, SMTP relay, logging and Syslog Server</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Security</td>
<td>Appliance security settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>SNMP Configuration</td>
<td>Appliance SNMP settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>Graphing</td>
<td>Appliance graphing settings</td>
</tr>
<tr>
<td>Local Configuration</td>
<td>License Key</td>
<td>Appliance licensing</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Software Updates</td>
<td>Appliance software update management</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Firewall Script</td>
<td>Appliance firewall (iptables) configuration</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Firewall Lockdown Wizard</td>
<td>Appliance management lockdown settings</td>
</tr>
</tbody>
</table>

To add a Secondary node - i.e. create a highly available clustered pair:
1. Deploy a second appliance that will be the Secondary and configure initial network settings.

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

**Note**

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

**Note**

For more details on configuring HA with 2 appliances, please refer to [Appliance Clustering for HA](https://example.com).
## 13. Document Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
<th>Reason for Change</th>
<th>Changed By</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.0</td>
<td>2 August 2019</td>
<td>Styling and layout</td>
<td>General styling updates</td>
<td>RJC</td>
</tr>
<tr>
<td>1.1.1</td>
<td>24 August 2020</td>
<td>New title page</td>
<td>Branding update</td>
<td>AH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Updated Canadian contact details</td>
<td>Change to Canadian contact details</td>
<td></td>
</tr>
<tr>
<td>1.2.0</td>
<td>1 October 2021</td>
<td>Converted the document to AsciiDoc</td>
<td>Move to new documentation system</td>
<td>AH,RJC,ZAC</td>
</tr>
</tbody>
</table>
About Loadbalancer.org

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