Load Balancing
Cloudian HyperFile

Deployment Guide
v1.0.1
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1. About this Guide
This guide details the steps required to configure a load balanced Cloudian HyperFile environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any Cloudian HyperFile 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 Cloudian HyperFile. 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 40G</td>
</tr>
<tr>
<td></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>
<tr>
<td></td>
<td>Enterprise GCP **</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

- V76.4 and later

4. Cloudian HyperFile Software Versions Supported

- Cloudian HyperFile – version 3.6.1 and later
5. Cloudian HyperFile

Cloudian HyperFile is a scale-out NAS platform that provides file system protocols for clients and transparent data tiering to object storage (Cloudian HyperStore). Client applications write data to HyperFile and then HyperFile manages the underlying storage tiers, leveraging its native information lifecycle management (ILM) capabilities.

HyperFile provides capabilities including:

- Local data caching and tiering to Cloudian HyperStore object storage
- Bi-modal access to data (data tiered from HyperFile to object storage can be read through HyperFile's file protocols or directly through HyperStore's S3 interface)
- Integrated data protection via snapshots
- Active Directory / LDAP integration and user quotas
- Multi-controller configurations
- High availability (HA) configurations
- Write Once Read Many (WORM) support, together with compliance features such as auditing and so on

6. Load Balancing Cloudian HyperFile

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

Load Balancing & HA Requirements

To allow a Cloudian HyperFile deployment to be load balanced, the HyperFile nodes must be deployed in a multi-controller configuration sharing an NFS volume.

Persistence (aka Server Affinity)

Source IP address persistence is required to successfully load balance Cloudian HyperFile. This is true for both the layer 4 DR mode and layer 7 load balancing scenarios described in this document.

Virtual Service (VIP) Requirements

To provide load balancing and HA for Cloudian HyperFile, a single VIP is used which covers all of the ports needed.

Port Requirements

The following table shows the ports that are load balanced:
<table>
<thead>
<tr>
<th>Port</th>
<th>Protocols</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>TCP/RPC</td>
<td>Remote Procedure Call / portmap traffic (RPC)</td>
</tr>
<tr>
<td>1110</td>
<td>TCP/NFS</td>
<td>Cluster status service</td>
</tr>
<tr>
<td>2049</td>
<td>TCP/NFS</td>
<td>NFS daemon process (nfsd)</td>
</tr>
<tr>
<td>4045</td>
<td>TCP/NFS</td>
<td>Network lock manager process (nlockmgr)</td>
</tr>
</tbody>
</table>

Note: Additional high ports, as well as the above mentioned ports using UDP, are used for NFS version 3 and below. As described later in this document, using * to cover all ports in a layer 4 setup is recommended for NFS version 3 and below.

7. Deployment Concept

Cloudian HyperFile Nodes

Inbound Connections

TCP/UDP 111, 1110, 2049, 4045

VIP: HyperFile-NFS

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.

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 Cloudian HyperFile, using either layer 4 DR mode or layer 7 SNAT mode is recommended. If using NFS version 3 and below, layer 4 DR mode should be used due to the wide range of ports that are used in these older versions of the NFS protocol.
These modes are described below and are used for the configurations presented in this guide. For configuring using DR mode please refer to the section starting on page 12, and for configuring using layer 7 SNAT mode refer to the section starting on page 13.

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 Real Server on the fly which is very fast
- When the packet reaches the Real Server it expects the Real Server to own the Virtual Services IP address (VIP). This means that you need to ensure that the Real Server (and the load balanced application) respond to both the Real Servers own IP address and the VIP
- The Real Server should not respond to ARP requests for the VIP. Only the load balancer should do this. Configuring the Real Servers in this way is referred to as Solving the ARP Problem. Please refer to the instructions in section Configuring for Layer 4 DR Mode on page 8 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 Real Servers to ensure layer 2 connectivity required for DR mode to work
- The VIP can be brought up on the same subnet as the Real 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 Real Server will see the source IP address of the client
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.

- 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 balancer's own IP address by default, or any other local appliance IP address if preferred (eg. 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

Our Recommendation

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 Real 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.

If DR mode cannot be used, for example if the real servers are located in remote routed networks, then SNAT mode is recommended.

If the load balancer is deployed in AWS or Azure, layer 7 SNAT mode must be used as layer 4 direct routing is not currently possible on these platforms.

9. Configuring Cloudian HyperFile for Load Balancing

Configuring for Layer 4 DR Mode

**Important:** Layer 4 DR mode should be used if NFS version 3 and below is used.

For layer 4 DR mode to work, every HyperFile node must be configured so that its loopback adaptor owns the VIP address.

1. The change to the loopback adaptor should be set from the command line by writing a script to ensure that the change is persistent across reboots.
   
   a. The script should be put in the directory `/etc/rc2.d` and its filename must begin with a capital letter S. For example: `/etc/rc2.d/Sloopbackscript`
   
   b. An example script that can be used is presented below. The example VIP address of 192.168.88.69 should be changed to match the VIP address being used

   ```
   #!/bin/sh
   #
   # This is to redirect ARP requests to the HyperFile VIP
   #
   ifconfig lo0:1 plumb
   ifconfig lo0:1 192.168.88.69 netmask 255.255.255.255 up
   ```

Configuring for Layer 7 SNAT Mode

No changes are required on the HyperFile nodes for layer 7 SNAT mode.
10. 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://192.168.221:9443
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:

  **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 1 of the appendix on page 17.
11. Appliance Configuration for Cloudian HyperFile – Using Layer 4 DR Mode

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. HyperFile.
3. Set the Virtual Service IP Address field to the required IP address, e.g. 192.168.85.140.
4. Set the Ports field to * (this wildcard sets the VIP to use all ports).
5. Set the Protocol to TCP/UDP.
7. Click Update to create the virtual service.

8. Click Modify next to the newly created VIP.
9. Ensure that the Persistence Enable checkbox is checked and that the Timeout is set to 300 (this should already be configured by default).
10. Set the Health Checks Check Type to Connect to port.
11. Set the Check Port to 2049.
12. Click Update.

Defining the Real Servers (RIPs)
1. 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.
2. Define the Label for the real server as required, e.g. hyperfile-node1.
3. Set the Real Server IP Address field to the required IP address, e.g. 192.168.85.200
4. Click Update
5. Repeat these steps to add additional HyperFile servers as required

<table>
<thead>
<tr>
<th>Label</th>
<th>hyperfile-node1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Server IP Address</td>
<td>192.168.85.200</td>
</tr>
<tr>
<td>Weight</td>
<td>100</td>
</tr>
<tr>
<td>Minimum Connections</td>
<td>0</td>
</tr>
<tr>
<td>Maximum Connections</td>
<td>0</td>
</tr>
</tbody>
</table>


**Important:** This load balancing method should not be used if NFS version 3 and below is to be used with HyperFile. Layer 4 DR mode should be used instead (see the previous section on how to set this up). This is because NFS versions 3 and below use additional high ports, as well as the standard ports but using UDP.

**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. HyperFile
3. Set the Virtual Service IP Address field to the required IP address, e.g. 192.168.85.150
4. Set the Ports field to 111,1110,2049,4045
5. Set the Layer 7 Protocol to TCP Mode
6. Click Update to create the virtual service
7. Click **Modify** next to the newly created VIP
8. Set **Persistence Mode** to **Source IP**
9. In the **Persistence** section click **Advanced** to expand the menu
10. Set **Persistence Timeout** to 5 (the default units are minutes)
11. Set **Health Checks** to **Connect to port**
12. In the **Health Checks** section click **Advanced** to expand the menu
13. Set **Check Port** to 2049
14. In the **Other** section click **Advanced** to expand the menu
15. Check the **Timeout** checkbox
16. Set **Client Timeout** to 5m (the m is for minutes)
17. Set **Real Server Timeout** to 5m
18. Click **Update**

**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. **hyperfile-node1**
3. Set the **Real Server IP Address** field to the required IP address, e.g. **192.168.85.200**
4. Click **Update**
5. Repeat these steps to add additional HyperStore nodes as real servers as required
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

13. Testing & Verification

Using System Overview
The System Overview can be viewed in the WebUI. It shows a graphical view of all VIPs & RIPS (i.e. the Cloudian HyperFile nodes) 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 HyperFile nodes are healthy and available to accept connections:

Layer 4 DR mode specific test
If the layer 4 DR mode load balancing method has been used then an additional check can be performed to confirm that the load balanced HyperFile deployment as a whole is functioning correctly.
After sending some test traffic to the virtual service, from the WebUI, navigate to Reports > Layer 4 Current Connections. Ensure that the test connections are not shown to be in the SYN_RECV state under the third column, ‘state’. Successful connections are shown as ESTABLISHED like so:

If any of the connections are in the SYN_RECV state then it is very likely that the HyperFile nodes have not been correctly configured for layer 4 DR mode. Identify which nodes are affected, by looking at their IP address in the ‘destination’ column, and then refer to section Configuring for Layer 4 DR Mode and ensure that all steps have been followed correctly.

14. 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

15. Further Documentation

16. Conclusion
Loadbalancer.org appliances provide a very cost effective solution for highly available load balanced Cloudian HyperFile environments.
17. 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
• 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:

• Once complete, the following will be displayed:

• 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.
18. Document Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
<th>Reason for Change</th>
<th>Changed By</th>
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</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>8 November 2019</td>
<td>Initial version</td>
<td></td>
<td>IG, AH</td>
</tr>
<tr>
<td>1.0.1</td>
<td>18 November 2019</td>
<td>Removed the instruction to change each node's default gateway to the VIP address in section 'Configuring Cloudian HyperFile for Load Balancing'</td>
<td>The step in question was not required and was removed for simplicity</td>
<td>AH</td>
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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.