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1. About this Guide

This guide details the steps required to configure a load balanced Qumulo Hybrid File System environment utilizing Loadbalancer.org appliances. It covers the configuration of the load balancers and also any Qumulo 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 Administration Manual.

2. Loadbalancer.org Appliances Supported

All our products can be used for load balancing Qumulo Hybrid File System. 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. Software Versions Supported

3.1. Loadbalancer.org Appliance
   - V8.4.1 or later

   Note: The screenshots used throughout this document aim to track the latest Loadbalancer.org software version. If using an older software version, note that the screenshots presented here may not match the WebUI exactly.

3.2. Qumulo Hybrid File System
   - V3.0.0 or later

4. Qumulo Hybrid File System

Qumulo’s advanced hybrid file software allows you to symmetrically scale capacity and performance. Work in real-time, without the need for tree walks. Qumulo offers the most efficient file system in the industry, with the best raw-to-useable capacity that leverages 100 percent of useable storage.

Qumulo’s file system is built for the hybrid cloud, providing a single file solution whether your data is in the cloud or on-prem or scaling across both. Users can burst compute in AWS or GCP and shift primary workloads to the cloud without application changes.

5. Load Balancing Qumulo Hybrid File System

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

5.1. Load Balancing & HA Requirements
The function of the load balancer is to ensure that connections to a Qumulo Hybrid file System cluster are distributed across healthy Qumulo nodes. This is done to provide a highly available and scalable service. To provide HA for the load balancer, Loadbalancer.org recommends that 2 appliances are deployed as an HA clustered pair.

5.2. Load Balancer Configuration
Load balancing a Qumulo deployment requires no Virtual Services (VIPs). Instead, both load balancers are configured as smart DNS name servers for the FQDN of the Qumulo cluster address in question (qumulo.company.com in this guide). This is achieved using the load balancer’s built-in GSLB service and by using DNS delegation.

5.3. Connection Distribution
The GSLB service uses weighted round-robin load balancing to distribute inbound client connections across the healthy Qumulo nodes. The weights for the nodes can be set as required depending on relative node performance.

5.4. Health Checks
Each Qumulo node is regularly health-checked by each load balancer and this information is used when providing the smart DNS response to inbound DNS queries.

| Note | For more details on configuring DNS delegation please refer to DNS Server Configuration for Qumulo Hybrid File System. |

6. Deployment Concept
The diagram below illustrates how the load balancer is deployed.
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 an HA clustered pair.

### 6.1. Explanation

1. The client sends a DNS query for the service FQDN, e.g. `qumulo.company.com` to the local DNS server.
2. The local DNS server has the sub domain delegated to both load balancers (both load balancers are configured as name servers for the sub domain).
3. One of the load balancers receives the delegated DNS query.
4. The load balancer selects a healthy Qumulo node based on the GSLB health checks and the round robin algorithm used.
5. The load balancer returns the IP address of the selected Qumulo node to the DNS server.
6. The DNS server returns the IP address of the selected Qumulo node to the client.
7. The client connects directly to the Qumulo node.
7. Loadbalancer.org Appliance – the Basics

7.1. 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.

7.2. Initial Network Configuration
After boot up, follow the instructions on the appliance console to configure the management IP address, subnet mask, default gateway, DNS Server and other network settings.

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

7.3. 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.

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

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


Note
You’ll receive a warning about the WebUI’s certificate. This is due to the default self signed certificate that is used. If preferred, you can upload your own certificate - for more
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. Click **Dismiss** if you're following a guide or want to configure the appliance manually. Click **Accept** to start the Setup Wizard.
Main Menu Options

System Overview - Displays a graphical summary of all VIPs, RIPv 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 & RIPv
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

7.4. 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

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:

   Information: Version v8.9.0 is the current release. No updates are available

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

```
Information: Update completed successfully.
```

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.

- 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:

```
Software Update
```

```
Offline Update

The following steps will lead you through offline update.

1. Contact Loadbalancer.org support to obtain the offline update archive and checksum.
2. Save the archive and checksum to your local machine.
3. Select the archive and checksum files in the upload form below.
4. Click Upload and Install to begin the update process.

Archive: Choose File | No file chosen
Checksum: Choose File | No file chosen

Upload and Install
```

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.

**7.5. Ports Used by the Appliance**

By default, the appliance uses the following TCP & UDP ports:
<table>
<thead>
<tr>
<th>Protocol</th>
<th>Port</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP</td>
<td>22</td>
<td>SSH</td>
</tr>
<tr>
<td>TCP &amp; UDP</td>
<td>53</td>
<td>DNS</td>
</tr>
<tr>
<td>TCP &amp; UDP</td>
<td>123</td>
<td>NTP</td>
</tr>
<tr>
<td>TCP &amp; UDP</td>
<td>161</td>
<td>SNMP</td>
</tr>
<tr>
<td>UDP</td>
<td>6694</td>
<td>Heartbeat between Primary &amp; Secondary appliances in HA mode</td>
</tr>
<tr>
<td>TCP</td>
<td>7778</td>
<td>HAProxy persistence table replication</td>
</tr>
<tr>
<td>TCP</td>
<td>9080</td>
<td>WebUI - HTTP (disabled by default)</td>
</tr>
<tr>
<td>TCP</td>
<td>9081</td>
<td>Nginx fallback page</td>
</tr>
<tr>
<td>TCP</td>
<td>9443</td>
<td>WebUI - HTTPS</td>
</tr>
</tbody>
</table>

8. Appliance Configuration for Qumulo Hybrid File System

8.1. Step 1 – Configure the HA Pair

If you intend to deploy 2 load balancers in order to configure an HA clustered pair (our recommended configuration) then the HA pair should be configured first before the GSLB configuration takes place. This simplifies the process since GSLB settings will then be automatically replicated to the paired appliance. This helps ensure that both appliances are correctly configured and ready for sub domain delegation (please refer to [DNS Server Configuration for Qumulo Hybrid File System]).

Once the HA pair is configured, the remaining configuration should take place on the Primary unit, the Secondary unit will then be kept in sync automatically. For details on configuring an HA pair, please refer to Configuring HA - Adding a Secondary Appliance.

8.2. Step 2 – Configure GSLB

Handling Multiple Subdomains, Including Wildcard Subdomains

Scenario

Object storage-related DNS configurations may use various DNS subdomains, for example:

- `s3-<region/location>.domain.tld` (e.g. `s3-region1.domain.tld`)

Some scenarios also require the use of wildcard DNS entries, for example to cover bucket specific subdomains like `app-instance-f57ac0.s3-region1.domain.tld`.

Solution

Configuring DNS delegation can be complex. As such, the supported solution is to:

- Delegate a single subdomain to the load balancer, e.g. `gslb`.
- Use CNAME records to point everything else at the delegated subdomain
For example, the subdomain `gslb.domain.tld` would be delegated and everything else would point to it. This would look like so:

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>DNS Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>gslb.</code></td>
<td>Delegate to the load balancer</td>
</tr>
<tr>
<td><code>s3-&lt;region&gt;.,</code></td>
<td>CNAME to <code>gslb.domain.tld</code></td>
</tr>
<tr>
<td><code>*.s3-&lt;region&gt;.,</code></td>
<td>CNAME to <code>gslb.domain.tld</code></td>
</tr>
<tr>
<td><code>s3-admin-console.</code></td>
<td>CNAME to <code>gslb.domain.tld</code></td>
</tr>
</tbody>
</table>

This approach simplifies DNS entry configuration, particularly when wildcard entries are involved.

**Appliance Configuration**

The GSLB service should be configured on the *primary* load balancer appliance and should be configured at each site if a multi-site deployment is being configured.

Configuration takes place in the WebUI under *Cluster Configuration > GSLB Configuration*:

**Step 1 – Configuring the Global Name**

1. Using the WebUI on the primary appliance, navigate to *Cluster Configuration > GSLB Configuration*.
2. Select the *Global Names* tab.
3. Click the *New Global Name* button.
4. Define a friendly *Name* for the new hostname, which can just be the subdomain itself, e.g. `gslb.domain.tld` If only working with a *single* subdomain then it’s perfectly acceptable to directly delegate the specific subdomain in question, e.g. `s3-region1.domain.tld`, rather than delegating a generic subdomain like `gslb.domain.tld`.
5. Define the *Hostname* of what will be the delegated subdomain, e.g. `gslb.domain.tld`.
6. Click *Submit*.
Step 2 – Configure the Members

Each member is a single Qumulo node.

1. Select the Members tab.
2. Click the New Member button.
3. Enter a friendly Name for the member, e.g. `qumulo-node1`.
4. Specify an IP address for the member: in this context, this should be the IP address of the Qumulo node in question, e.g. `10.0.0.11`.
5. Ignore the example value in the Monitor IP field.
6. Click Submit.
7. Repeat these steps to add additional Qumulo nodes as members as required.

Step 3 – Configure the Pool

A pool must be created to link together a global name with the members that should serve traffic for that global
Continuing with the example presented in this section, a pool would be created linking the global name `gslb.domain.tld` with the members (Qumulo nodes), all of which should serve Qumulo traffic.

1. Select the **Pools** tab.
2. Click the **New Pool** button.
3. Enter a friendly **Name** for the pool, e.g. `qumulo-nodes`.
4. Set the **Monitor** to **TCP**.
5. Set **Monitor Port** to **443**.
6. Set **LB Method** to **wrr**.
7. From the **Global Names** list box, select the global name in question, e.g. `gslb.domain.tld`
8. In the **Members** section, drag the appropriate members (Qumulo nodes) from the **Available Members** box into the **Members In Use** box.
9. Click **Submit**.

**Step 4 – Finalising the Configuration**
To apply the new settings, the GSLB service must be restarted as follows:

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

**DNS Server Configuration**

Once the GSLB service has been configured on the primary load balancer at every site, the DNS server at each site must then be configured for GSLB.

The DNS server at each site must be configured to delegate DNS requests for the subdomain in question to the load balancers; the load balancers' GSLB services will serve the appropriate IP addresses to the DNS servers. Using the example presented throughout this section, the DNS server at each site would be configured with a delegation for the domain `gslb.domain.tld`. The domain would be delegated to every load balancer across every site, which provides multi-site redundancy.

Steps walking through creating a DNS delegation on a Microsoft DNS server in the context of setting up GSLB on our appliance can be found in the appendix, in the section **Microsoft DNS Server Configuration**.

**Testing the Configuration**

The configuration can be tested to make sure it's working as expected.

From the command line on a Microsoft Windows machine, the `nslookup` program can be used to send test DNS queries to the load balancer(s). The primary load balancer is located at IP address 10.0.0.1 in the example presented here.

For the test, use the `-norecurse` option to instruct the load balancer **not** to attempt to query another server for the answer. A successful test would see the load balancer respond with the IP address of one of the online Qumulo nodes, like so:

```
C:\Users\me>nslookup -norecurse gslb.domain.tld 10.0.0.1
Server: UnKnown
Address: 10.0.0.1

Name: gslb.domain.tld
Address: 10.0.0.11
```

**9. Microsoft DNS Server Configuration**

Once the GSLB service has been fully configured on the primary load balancer at every site, as described in the previous sections, the DNS server at each site must be configured for GSLB.

The DNS server at each site must be configured to delegate DNS requests for the subdomain in question to the load balancers; the load balancers' GSLB services will serve the appropriate IP addresses to the DNS servers. Using the example presented throughout this document, the DNS server at each site would be configured with a delegation for the domain `gslb.domain.tld`. The domain would be delegated to every load balancer across every site, which provides multi-site redundancy.

The exact steps for creating a DNS delegation vary between different DNS servers. Presented below are steps...
that walk through creating a DNS delegation on a Microsoft DNS server in the context of setting up GSLB on our appliance.

9.1. Microsoft DNS Server

Delegating a subdomain in Microsoft DNS Manager is a short process.

1. Open **DNS Manager** and create A records for every load balancer at every site, using **Action > New Host** (e.g. `dc1-lbprimary.domain.tld`, `dc1-lbsecondary.domain.tld`, `dc2-lbprimary.domain.tld`, and `dc2-lbsecondary`).

![DNS Manager](image)

2. Provided that the load balancer part of the GSLB configuration has been completed and is working, the **New Delegation** wizard should now be used to delegate the subdomain to the load balancers. The delegation will use the new FQDNs for the load balancers, as defined in the previous step. The delegation wizard is located at **Action > New Delegation**.
3. Test the delegation to make sure it is working as expected.

From the Windows command line, the `nslookup` program can be used to send test DNS queries to the DNS server. The DNS server is located at IP address 10.0.0.50 in the example presented here.

For the first test, use the `-norecurse` option to instruct the DNS server **not** to query another server for the answer. A successful test would see the DNS server respond and indicate that the subdomain in question is served by another server(s), giving the other server’s details, like so:

```
C:\Users\me>nslookup -norecurse gslb.domain.tld 10.0.0.50
Server: UnKnown
Address: 10.0.0.50

Name:  gslb.domain.tld
Address: 10.0.0.50
Served by:
- dc1-lbprimary.domain.tld 10.0.0.100
gslb.domain.tld
```

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For the second test, execute the same command **without** the `-norecurse` option. This should see the DNS server fetch the answer from the load balancer and then serve up the 'fetched' answer in its response. A successful test would see the server reply with the IP address of one of the online sites/services, like so:

```
C:\Users\me>nslookup gslb.domain.tld 10.0.0.50
Server: UnKnown
Address: 10.0.0.50

Non-authoritative answer:
Name:   gslb.domain.tld
Address: 10.0.0.2
```

### 10. Testing & Verification

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

Since the load balancers have no Virtual Services, there is no graphical overview of 'healthy' services to check and verify on the System Overview page of the WebUI. Instead, the GSLB configuration should be checked, ensuring that the client is able to resolve the FQDN of the Qumulo deployment via delegation and connect to a healthy Qumulo node.

See the earlier section **Testing the Configuration** for instructions on how to test the GSLB setup.

### 10.1. Accessing the Service

A successful test will see the test connection passed directly from the test client to one of the online Qumulo nodes.

### 11. 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.

### 12. Further Documentation

For additional information, please refer to the **Administration Manual**.
13. Appendix

13.1. 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 configured first and 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.

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.

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:

<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>
Adding a Secondary Appliance - Create an HA Clustered Pair

Important: Make sure that if these settings/updates have been configured on the Primary appliance, they're also configured on the Secondary appliance.

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:
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**.
<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>1.0.0</td>
<td>23 April 2020</td>
<td>First draft</td>
<td></td>
<td>RJC</td>
</tr>
<tr>
<td>1.0.1</td>
<td>29 April 2020</td>
<td>Various minor updates</td>
<td>Improved readability</td>
<td>RJC</td>
</tr>
<tr>
<td>1.0.2</td>
<td>3 September 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>1.1.0</td>
<td>1 December 2021</td>
<td>Converted the document to AsciiDoc</td>
<td>Move to new documentation system</td>
<td>AH, RJC, ZAC</td>
</tr>
<tr>
<td>1.2.0</td>
<td>6 April 2022</td>
<td>Updated GSLB set up instructions to use GUI-driven GSLB configuration</td>
<td>GSLB updates across all documentation</td>
<td>AH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Updated DNS server configuration instructions</td>
<td>Changed to use new, consistent common component</td>
<td></td>
</tr>
<tr>
<td>1.2.1</td>
<td>5 January 2023</td>
<td>Combined software version information into one section</td>
<td>Housekeeping across all documentation</td>
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<td>Added one level of section numbering</td>
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<td>Added software update instructions</td>
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<td>Added table of ports used by the appliance</td>
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<td>Reworded ‘Further Documentation’ section</td>
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<td>7 March 2023</td>
<td>Removed conclusion section</td>
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<td>Modified diagram colours</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.